Annex III: Summary of BREF

A. **Comparison of the processes at the Installation with the BREF for Waste Treatments Industries (published August 2006);**
B. **Comparison of the processes at the Installation with the BREF for Emissions from storage (published July 2006); and**
C. **Comparison of the processes at Facility with the BREF for Energy efficiency (published February 2009).**

Section A: Waste Treatment Industries

Part 1: Generic BAT

Aspect of BAT	BAT	Status at Installation
Environmental management system (EMS)	BAT is to implement and adhere to an Environmental Management System (EMS) that incorporates, as appropriate to individual circumstances, the following features: (see Chapter 4.1.2.8 of BREF) • definition of an environmental policy for the installation by top management (commitment of the top management is regarded as a precondition for a successful application of other features of the EMS) • planning and establishing the necessary procedures • implementation of the procedures, paying particular attention to - structure and responsibility - training, awareness and competence - communication - employee involvement - documentation - efficient process control - maintenance programme - emergency preparedness and response	Ground work for the implementation of an Environmental Management System (EMS) at the Sant' Antnin Waste Treatment Plant (SAWTP) has started. An environmental policy was drawn up and endorsed by top management. Roles and responsibilities were mapped and defined in the Quality Manual, Environmental Manual and the operational procedures. The EMS incorporates the following elements: • Organizational Chart which captures the structure and hierarchy at the SAWTP • Job Description Register which defines all roles and responsibilities of key personnel at SAWTP • Training Identification, Approval, Execution and Verification (refer to Clause B 2.9) • Communication procedure (internally and externally to third parties) • Records management including approval, retention and backup • Reference to the control checks during operations;

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	- safeguarding compliance with environmental legislation. • checking performance and taking corrective action, paying particular attention to - monitoring and measurement (see also the Reference document on General Principles of Monitoring) - corrective and preventive action - maintenance of records - independent (where practicable) internal auditing in order to determine whether or not the environmental management system conforms to planned arrangements and has been properly implemented and maintained. • review by top management. Three further features, which can complement the above stepwise, are considered as supporting measures. However, their absence is generally not inconsistent with BAT. These three additional steps are: • having the management system and audit procedure examined and validated by an accredited certification body or an external EMS verifier • preparation and publication (and possibly external validation) of a regular environmental statement describing all the significant environmental aspects of the installation, allowing for year-by-year comparison against environmental objectives and targets as well as with sector benchmarks as appropriate	necessary to ensure compliancy with environmental legislation • Maintenance Programme and necessary records • Emergency Preparedness and Response document which captures various emergency scenarios and the planned response to each scenario • Objectives (Quality and Environmental) • A system which enables users and/or individuals to register non-conforming service and/or practices. The system also specifies how such occurrences are to be recorded (Corrective Action Request), acted upon and verified for effective resolution or closure. • Auditing Schedule (internal; but will include plan for third party auditing in the near future) • Schedule of Management Review Meeting

Aspect of BAT	BAT	Status at Installation
	• implementation and adherence to an internationally accepted voluntary system such as EMAS and EN ISO 14001:1996. This voluntary step could give higher credibility to the EMS. In particular EMAS, which embodies all the above-mentioned features, gives higher credibility. However, non-standardised systems can in principle be equally effective provided that they are properly designed and implemented. Specifically for this industry sector, it is also important to consider the following potential features of the EMS: • giving consideration to the environmental impact from the eventual decommissioning of the unit at the stage of designing a new plant • giving consideration to the development of cleaner technologies • where practicable, sectoral benchmarking on a regular basis, including energy efficiency and energy conservation activities, choice of input materials, emissions to air, discharges to water, consumption of water and generation of waste	
Activities carried out	Ensure the provision of full details of the activities carried out on-site. A good detail of that is contained in the following documentation (see Section 4.1.2.7 and related to the previous aspect (preparation and publication). • descriptions of the waste treatment methods and procedures in place in the installation • diagrams of the main plant items where they have	Refer to IPPC Application Form B Annex 3 (in particular sub-clause B 2.2).

Aspect of BAT	BAT	Status at Installation
	some environmental relevance, together with process flow diagrams (schematics)	
	• details of the chemical reactions and their reaction kinetics/energy balance	
	• details on the control system philosophy and how the control system incorporates the environmental monitoring information	Parameters of interest (both plant parameters and emissions readings) are monitored through the SCADA system.
	• details on how protection is provided during abnormal operating conditions such as momentary stoppages, start-ups, and shutdowns	During normal operating conditions, biogas produced is used in the CHP as fuel. If for some reason, the CHPs fail to start, the Flare kicks-in automatically and burns the biogas. If the Flare fails to operate, it is standard procedure for the operator on duty to inform the Plant Engineer and/or Facility Manager of such instance. The Plant Engineer and/or the Facility Manager investigate the occurrence and take measures to stop biogas emissions. Rectification measures are recorded and documented.
	• an instruction manual	
	• an operational diary (related to the next aspect)	Operational diary is kept at the plant.
	• an annual survey of the activities carried out and the waste treated. The annual survey should also contain a quarterly balance sheet of the waste and residue streams, including the auxiliary materials used for each site (related to the EMS aspect).	Annual survey is compiled and submitted to the regulating authority.
Housekeeping procedure	Have a good housekeeping procedure in place, which will also cover the maintenance procedure, and an adequate training programme, covering the preventive actions that workers need to take on health and safety issues and environmental risks (see Sections 4.1.1.4, 4.1.1.5, 4.1.2.5, 4.1.2.10, 4.1.4.8 and 4.1.4.3).	(i) *MRF Maintenance Plan* and (ii) *MTP-AD Maintenance Schedule* drafted. A generic training is given to all new employees as part of the induction process (refer to form WS013). 'Health and Safety Training' is listed down as one of the modules in the

Aspect of BAT	BAT	Status at Installation
		induction. Furthermore, a basic training (covering customer focus, environmental protection awareness, environment and quality objectives, etc) is given to all employees (both current and new employees).
Relationship with waste producer/holder	Try to have a close relationship with the waste producer/holder in order that the customers sites implement measures to produce the required quality of waste necessary for the waste treatment process to be carried out (see Section 4.1.2.9).	N/A
Staff	Have sufficient staff available and on duty with the requisite qualifications at all times. All personnel should undergo specific job training and further education (see Section 4.1.2.10. This is also related to the Housekeeping procedure aspect).	Positions (or roles) for the uninterrupted operations of the plant are identified. Vacant positions are re-filled either by internal calls or externally. System for training identification and implementation is in place. Training implementation falls within the HR remit under the direction of the Chief of Corporate Services.
Waste IN **Knowledge**	Have a concrete knowledge of the waste IN. Such knowledge needs to take into account the waste OUT, the treatment to be carried out, the type of waste, the procedure under consideration (see next aspects) and the risk (related to waste OUT and the treatment) (see Section 4.1.1.1). Guidance on some of these issues is provided in Sections 4.2.3, 4.3.2.2 and 4.4.1.2.	All waste collection vehicles reporting at SAWTP are requested to enter the site through the weighbridge. With the system in place, the following detail is captured: • client name / organization • registration plate of vehicle disposing waste • waste type • source / destination and recorded on a weighbridge ticket.

Aspect of BAT	BAT	Status at Installation
		Depending on the type of waste, driver of waste collection vehicle is asked to dispose waste in predefined areas within the plant. Through random inspections, an Inspector confirms that the waste disposed is as declared by the driver and that it is in fact acceptable. Waste is rejected if Inspector finds out that the waste type is not authorised at the plant.
Waste IN **Pre-acceptance procedure**	Implement a pre-acceptance procedure containing at least the following items (see Section 4.1.1.2): • tests for the incoming waste with respect to the planned treatment • making sure that all necessary information is received on the nature of the process(es) producing the waste, including the variability of the process. The personnel having to deal with the pre-acceptance procedure need to be able due to his profession and/or experience to deal with all necessary questions relevant for the treatment of the wastes in the WT facility • a system for providing and analysing a representative sample(s) of the waste from the production process producing such waste from the current holder. • a system for carefully verifying, if not dealing directly with the waste producer, the information received at the pre-acceptance stage, including the contact details for the waste producer and an appropriate description of the waste regarding its	A pre-acceptance procedure is in place specifying the method to follow when an enquiry for 'out-of-the-ordinary' waste disposal is put forward by a waste producer. In such case, the Waste Acceptance Officer (enquires about the tonnage and type of waste (including its EWC code) to be disposed of. After that, the Waste Acceptance Officer liaises with the Facility Manager to determine if waste can be used in the Anaerobic Digester. Note that if waste is classified as animal by product (ABP), it is not accepted at the SAWTP but it is instead directed to the Thermal Treatment Facility for incineration. 'Ordinary' waste like *Municipal Solid Waste* (*Black Bag*) and *Recyclable Waste* (*Grey Bag*) are accepted at the plant without going through the pre-acceptance procedure. This does not imply that verification inspections are not carried out.

Aspect of BAT	BAT	Status at Installation
	composition and hazardousness • making sure that the waste code according to the European Waste List (EWL) is provided • identifying the appropriate treatment for each waste to be received at the installation (see Section 4.1.2.1) by identifying a suitable treatment method for each new waste enquiry and having a clear methodology in place to assess the treatment of waste, that considers the physico-chemical properties of the individual waste and the specifications for the treated waste.	
Waste IN **Acceptance procedure**	Implement an acceptance procedure containing at least the following items (see Section 4.1.1.3): • a clear and specified system allowing the operator to accept wastes at the receiving plant only if a defined treatment method and disposal/recovery route for the output of the treatment is determined (see pre-acceptance in the previous aspect). Regarding the planning for the acceptance, it needs to be guaranteed that the necessary storage (see Section 4.1.4.1), treatment capacity and dispatch conditions (e.g. acceptance criteria of the output by the other installation) are also respected • measures in place to fully document and deal with acceptable wastes arriving at the site, such as a pre-booking system, to ensure e.g. that sufficient capacity is available • clear and unambiguous criteria for the rejection of wastes and the reporting of all non conformances	Waste acceptance procedures are in place both for MRF and MTP-AD. Waste is accepted at the plant only if it falls within a predefined category of acceptable waste (example: *black bag*, *grey bag* or waste fit for the anaerobic digestion process) as per permit. The Weighbridge Officer checks that incoming vehicles have the necessary MEPA permit and that the driver is wearing the appropriate PPE. Depending on the type of waste, the driver is directed towards the reception area (adequately sized and contained) of either the MRF, or the MTP. The weighbridge ticket is finalized when the vehicle returns back to the weighbridge and weighed empty. All info of interest is captured on the weighbridge ticket. Furthermore, the (weighbridge system) is backed-up. In the eventuality that a waste carrier is rejected, details pertaining to the incidence are logged in the *Rejection Sheet*.

Aspect of BAT	BAT	Status at Installation
	• a system for identifying the maximum capacity limit of waste that can be stored at the facility • visually inspect the waste IN to check compliance with the description received during the pre-acceptance procedure. *For some liquid and hazardous waste, this BAT is not applicable* (see Section 4.1.1.3).	Waste capacity, for MRF and MTP-AD combined, is 71,000 tonnes per annum. Random inspections are carried out on (i) vehicles carrying *black bag* waste and on (ii) vehicles carrying *grey bag* waste
Waste IN **Sampling procedures**	Implement different sampling procedures for all different incoming waste vessels delivered in bulk and/or containers. These sample procedures may contain the following items (see Section 4.1.1.4): • sampling procedures based on a risk approach. Some elements to consider are the type of waste (e.g. *hazardous* or non-hazardous) and the knowledge of the customer (e.g. waste producer) • check on the relevant physico-chemical parameters. The relevant parameters are related to the knowledge of the waste needed in each case • registration of all waste materials • have different sampling procedures for bulk (liquid and solids), large and small containers and laboratory smalls. The number of samples taken should increase with the number of containers. In extreme situations, small containers must all be checked against the accompanying paperwork. The procedure should contain a system for recording the number of samples and degree of consolidation • details of the sampling of wastes in drums within designated storage, e.g. the time-scale after receipt	N/A

Aspect of BAT	BAT	Status at Installation
	• sample prior to acceptance • maintenance of a record at the installation of the sampling regime for each load, together with a record of the justification for the selection of each option • a system for determining and recording: - a suitable location for the sampling points - the capacity of the vessel sampled (for samples from drums, an additional parameter would be the total number of drums) - the number of samples and degree of consolidation - the operating conditions at the time of sampling • a system to ensure that the waste samples are analysed (see Section 4.1.1.5) • in the case of cold ambient temperatures, a temporary storage may be needed in order to allow sampling after defrosting. This may affect the applicability of some of the above items in this BAT (see Section 4.1.1.5).	
Waste IN **Reception facility**	Have a reception facility covering at least the following issues (see Section 4.1.1.5): • have a laboratory to analyse all the samples at the speed required by BAT. Typically this requires having a robust quality assurance system, quality control methods and maintaining suitable records for storing the analyses results. *Particularly for hazardous wastes, this often means that the*	Depending on the waste being disposed of, the waste collection vehicle proceeds to either the MRF reception hall or the MTP-AD reception hall.

Aspect of BAT	BAT	Status at Installation
	laboratory needs to be on-site • have a dedicated quarantine waste storage area as well as written procedures to manage non-accepted waste. If the inspection or analysis indicates that the wastes fail to meet the acceptance criteria (including, e.g. damaged, corroded or unlabelled drums) then the wastes can be temporarily stored there safely. Such storage and procedures should be designed and managed to promote the rapid management (typically a matter of days or less) to find a solution for that waste • have a clear procedure dealing with wastes where inspection and/or analysis prove that they do not fulfil the acceptance criteria of the plant or do not fit with the waste description received during the pre-acceptance procedure. The procedure should include all measures as required by the permit or national/international legislation to inform competent authorities, to safely store the delivery for any transition period or to reject the waste and send it back to the waste producer or to any other authorised destination • move waste to the storage area only after acceptance of the waste • mark the inspection, unloading and sampling areas on a site plan • have a sealed drainage system • a system to ensure that the installation personnel who are involved in the sampling, checking and analysis procedures are suitably qualified and	In the eventuality that the inspections reveals that waste is not as declared in the weighbridge ticket and thus does not fall within the list of acceptable waste (as per permit), the waste is rejected. Such occurrence is recorded in the *Rejection Sheet* and the regulating authority is informed accordingly. Waste is not stored on-site. Waste water is channelled to the second class water reservoir.

Aspect of BAT	BAT	Status at Installation
	adequately trained, and that the training is updated on a regular basis • the application of a waste tracking system unique identifier (label/code) to each container at this stage. The identifier will contain at least the date of arrival on-site and the waste code.	
Waste OUT **Analysing**	Analyse the waste OUT according to the relevant parameters important for the receiving facility (e.g. landfill, incinerator) (see Section 4.1.1.1).	Baled fractions (plastics, paper, cardboard, metal, etc) are retailed and exported accordingly. RDF (which is considered a reject) is exported to an approved treatment facility. Destruction certificates and/or Waste Movement Document (Annex 7) are collected and stored. Compost-like waste (which is a by-product of the anaerobic digestion process) is disposed of at the Ghallis engineered landfill. Other by-product waste from the MTP (example: rejects from MTP, waste captured in sand-trap, etc) is also sent to Ghallis engineered landfill.
Management systems **Traceability**	Have a system in place to guarantee the traceability of waste treatment. Different procedures may be needed to take into account the physico-chemical properties of the waste (e.g. liquid, solid), type of WT process (e.g. continuous, batch) as well as the changes that may occur to the physico-chemical properties of the wastes when the WT is carried out. A good traceability system contains the following items (see Section 4.1.2.3): • documenting the treatments by flow charts and mass	As previously indicated, waste fractions (such as plastics, paper, cardboard, metal, etc) are baled at the MRF. As soon as a bale is created, a bale ID is attached to the bale for traceability purposes. The bale ID contains the following detail: - ID number - Date and Shift (Morning / Afternoon) - Material Fraction

Aspect of BAT	BAT	Status at Installation
	balances (see Section 4.1.2.4) • carrying out data traceability through several operational steps (e.g pre-acceptance/acceptance/ storage/treatment/dispatch). Records can be made and kept up-to-date on an ongoing basis to reflect deliveries, on-site treatment and dispatches. Records are typically held for a minimum of six months after the waste has been dispatched • recording and referencing the information on waste characteristics and the source of the waste stream, so that it is available at all times. A reference number needs to be given to the waste and needs to be obtainable at any time in the process to enable the • operator to identify where a specific waste is in the installation, the length of time it has been there and the proposed or actual treatment route • having a computer database/series of databases, which are regularly backed up. The tracking system operates as a waste inventory/stock control system and includes: date of arrival on-site, waste producer details, details on all previous holders, an unique identifier, pre-acceptance and acceptance analysis results, package type and size, intended treatment/ disposal route, an accurate record of the nature and quantity of wastes held on-site including all hazards details on where the waste is physically located in relation to a site plan, at which point in the designated disposal route the waste is currently positioned • only moving drums and other mobile containers	- Weight of Bale - Operator - Status (Produced, Rejected, Warehoused, Dispatched) An electronic system (database) is in place which makes it possible to record this data and also to compile reports (both real time and also at a later day). The inspector in the yard (at SAWTP) is responsible of scanning (using hand-held scanners) the bales which are loaded into the containers for shipping. This data, which is then transmitted into the electronic system, can be used to determine to which end facility each bale goes. Because of the nature of the waste (black or grey bags from different households), traceability related to the source of the waste is not possible.

Aspect of BAT	BAT	Status at Installation
	between different locations (or loaded for removal off site) under instructions from the appropriate manager, ensuring that the waste tracking system is amended to record these changes (see Section 4.1.4.8).	
Management systems **Mixing and blending rules**	Have and apply mixing/blending rules oriented to restrict the types of wastes that can be mixed/blended together in order to avoid increasing pollution emission of down-stream waste treatments. These rules need to consider the type of waste (e.g. *hazardous*, non-hazardous), waste treatment to be applied as well as the following steps that will be carried out to the waste OUT (see Section 4.1.5).	Waste fractions (example: plastic, paper, cardboard, metal, etc) which are separated at source are run on the conveyor as individual fractions. Such waste fractions are not mixed.
Management systems **Segregation and compatibility procedure**	Have a segregation and compatibility procedure in place (see Section 4.1.5), including: • keeping records of the testing, including any reaction giving rise to safety parameters (increase in temperature, generation of gases or raising of pressure); a record of the operating parameters (viscosity change and separation or precipitation of solids) and any other relevant parameters, such as generation of odours (see Sections 4.1.4.13 and 4.1.4.14) • packing containers of chemicals into separate drums based on their hazard classification. Chemicals which are incompatible (e.g. oxidisers and flammable liquids should not be stored in the same drum (see Section 4.1.4.6).	Waste fractions (example: plastic, paper, cardboard, metal, etc) which are separated at source are kept segregated and not mixed with other waste fractions.

Aspect of BAT	BAT	Status at Installation
Management systems **Efficiency**	Have an approach for improving waste treatment efficiency. This typically includes the finding of suitable indicators to report WT efficiency and a monitoring programme (see Section 4.1.2.4).	The manual sorting process in the sorting room is inherently limited. It is inevitable that a small portion of waste ends up mixed together. A portion of the waste which is undesirable is mixed paper-plastic. This fraction of the waste, which amounts to lost recycling potential, is not directed for local treatment and thus it is exported for treatment abroad. In order to minimise this fraction as much as possible, the mixed paper-plastic is passed through the sorting process multi times in order to achieve a higher separation level of the individual fractions.
Management systems **Accident Management Plan**	Produce a structured accident management plan (see Section 4.1.7).	A procedure is in place specifying how environment accidents are to be addressed and mitigated. The procedure also defines the notification escalation order to be followed such that top management (typically: Chief Operations Officer, EMS Manager and Chief Officer Compliance and Communication) is informed of the accident. The Chief Officer Compliance and Communication is responsible of informing the regulating authority of the environmental accident.
Management systems	Have and properly using an incident diary (see Section 4.1.7).	*Environment Accident Register* is available on the company server (with read/write rights given to Facility Managers,

Aspect of BAT	BAT	Status at Installation
Incident diary		Plant Engineers, etc) .
Management systems **Noise and vibration management plant**	Have a noise and vibration management plant in place as part of the EMS (see Section 4.1.8). For some WT installations, noise and vibration may not be an environmental problem.	Noise and vibrations monitoring in place. Method as per BS 4142:1997 and ISO 1996. Detection Limits as per 2002/49/EC.
Management systems **Decommissioning**	Consider any future decommissioning at the design stage. For existing installations and where decommissioning problems are identified, put a programme to minimise these problems in place (see Section 4.1.9).	Refer to *Section B 2.10 Cessation* of the IPPC Application.
Utilities and raw material management **Raw material consumption and generation**	Provide a breakdown of the energy consumption and generation (including exporting) by the type of source (i.e. electricity, gas, liquid conventional fuels, solid conventional fuels and waste) (see Section 4.1.3.1). This involves: • reporting the energy consumption information in terms of delivered energy • reporting the energy exported from the installation • providing energy flow information (for example, diagrams or energy balances) showing how the energy is used throughout the process.	Per year, average values:

Consumption		
	Facility / Area	Energy (kWh)
	MRF	360,000
	MTP	433,000
	AD	2,254,000
	Total	3,047,000

Generation		
	Facility / Area	Energy (GWh)
		~ 2.5 – 3.0

Aspect of BAT	BAT	Status at Installation
Utilities and raw material management **Energy efficiency**	Continuously increase the energy efficiency of the installation, by (see Section 4.1.3.4): • developing an energy efficiency plan • using techniques that reduce energy consumption and thereby reduce both direct (heat and emissions from on-site generation) and indirect (emissions from a remote power station) emissions • defining and calculating the specific energy consumption of the activity (or activities), setting key performance indicators on an annual basis (e.g. MWh/tonne of waste processed).	Energy efficiency at the plant has been improved through the installation of a power factor correction unit. Excess heat from the CHPs is channel in a system in place which makes it possible to heat the swimming pool of a neighbouring institution.
Utilities and raw material management **Internal benchmarking**	Carry out an internal benchmarking (e.g. on an annual basis) of raw materials consumption. Some applicability limitations have been identified and these are mentioned in Section 4.1.3.5.	N/A
Utilities and raw material management **Waste as a raw material**	Explore the options for the use of waste as a raw material for the treatment of other wastes (see Section 4.1.3.5). If waste is used to treat other wastes, then to have a system in place to guarantee that the waste supply is available. If this cannot be guaranteed, a secondary treatment or other raw materials should be in place in order to avoid any unnecessary waiting treatment time (see Section 4.1.2.2).	In the case of MTP-AD, waste is used as raw material, that is, waste from households is transformed (using a series of mechanical and biological treatments) into biogas, and the biogas is in turn used to fuel the CHPs. Units produced are fed into the national grid.
Storage and handling **Storage**	Apply the following techniques related to storage (see Section 4.1.4.1): • locating storage areas: - away from watercourses and sensitive perimeters, and	Waste is unloaded and stored in predefined areas created specifically for this purpose. The distance between the waste storage area and the bag opener (first step of the process) is minimal, thus double

Aspect of BAT	BAT	Status at Installation
	- in such a way so as to eliminate or minimise the double handling of wastes within the installation	handling is negligible.
	• ensuring that the storage area drainage infrastructure can contain all possible contaminated run-off and that drainage from incompatible wastes cannot come into contact with each other • using a dedicated area/store which is equipped with all necessary measures related to the specific risk of the wastes for sorting and repackaging laboratory smalls or similar waste. These wastes are sorted according to their hazard classification, with due consideration for any potential incompatibility problems and then repackaged. After that, they are removed to the appropriate storage area	Water from asphalted areas (which is possibly in contact with waste) is directed into the second class water reservoir (capacity 1,800m^3). Reference to the second class water reservoir, an application with Water Service Corporation was submitted for the water discharge permit.
	• handling odorous materials in fully enclosed or suitably abated vessels and storing them in enclosed buildings connected to abatement • ensuring that all connections between the vessels are capable of being closed via valves. Overflow pipes need to be directed to a contained drainage system (i.e. the relevant bunded area or another vessel) • having measures available to prevent the building up of sludges higher than a certain level and the emergence of foams that may affect such measures in liquid tanks, e.g. by regularly controlling the tanks, sucking out the sludges for appropriate further treatment and using anti-foaming agents • equipping tanks and vessels with suitable abatement systems when volatile emissions may be generated,	All waste is unloaded in an enclosed shed. A number of doors in the MTP shed are fast roller shutters.

Aspect of BAT	BAT	Status at Installation
	together with level meters and alarms. These systems need to be sufficiently robust (able to work if sludge and foam is present) and regularly maintained • storing organic waste liquid with a low flashpoint under a nitrogen atmosphere to keep it inertised. Each storage tank is put in a waterproof retention area. Gas effluents are collected and treated.	
Storage and handling **Bunding**	Separately bund the liquid decanting and storage areas using bunds which are impermeable and resistant to the stored materials (see Section 4.1.4.4).	The digesters are located in a recessed concrete pit of size approximately 39.5m x 39.5m x 4.70m (deep).
Storage and handling **Tank and process pipework**	Apply the following techniques concerning tank and process pipework labelling (see Section 4.1.4.12): • clearly labelling all vessels with regard to their contents and capacity, and applying an unique identifier. Tanks need to have an appropriately labelled system depending on their use and contents • ensuring that the label differentiates between waste water and process water, combustible liquid and combustible vapour and the direction of flow (i.e. in or outflow) • keeping records for all tanks, detailing the unique identifier; capacity; its construction, including materials; maintenance schedules and inspection results; fittings; and the waste types which may be stored/treated in the vessel, including flashpoint limits.	Tanks are clearly labelled. Tanks details (such as contents, capacity and P&ID) are documented. Pipework in the plant is labelled and colour coded.

Aspect of BAT	BAT	Status at Installation
Storage and handling **Accumulation**	Take measures to avoid problems that may be generated from the storage/accumulation of waste. This may conflict with BAT on "Utilities and raw material management: Waste as a raw material" when waste is used as a reactant (see Section 4.1.4.10).	The processes at the plant are such that the waste is being continuously processed (and thus waste in storage area is not accumulating). In case of machinery sudden breakdown, a certain level of storage does not represent any particular problem. In the eventuality of abnormal circumstances, alternative disposal methods (in an approved facility) will be sought.
Storage and handling **Handling**	Apply the following techniques when handling waste (see Section 4.1.4.6): • having systems and procedures in place to ensure that wastes are transferred to the appropriate storage safely • having in place a management system for the loading and unloading of waste in the installation, which also takes into consideration any risks that these activities may incur. Some options for this include ticketing systems, supervision by site staff, keys or colour-coded points/hoses or fittings of a specific size • ensuring that a qualified person attends the waste holder site to check the laboratory smalls, the old original waste, waste from an unclear origin or undefined waste (especially if drummed), to classify the substances accordingly and to package into specific containers. In some cases, the individual packages may need to be protected from mechanical damage in the drum with fillers adapted to the packaged waste properties • ensuring that damaged hoses, valves and connections are not used	Drivers of waste collection vehicles are directed towards the appropriate unloading areas; these are marked such on the shed walls and also on the (internal) traffic signs/directions. Inspector on duty randomly checks unloading of black/grey bag. The inspector rejects the waste if during an inspection he/she notices that unpermitted waste was brought in the plant with the delivery/unloading.

Aspect of BAT	BAT	Status at Installation
	• collecting the exhaust gas from vessels and tanks when handling liquid waste • unloading solids and sludge in closed areas which are fitted with extractive vent systems linked to abatement equipment when the handled waste can potentially generate emission to air (e.g. odours, dust, VOCs) (see Section 4.1.4.7) • using a system to ensure the bulking of different batches only takes place with compatibility testing (see Section 4.1.4.7 and 4.1.5).	
Storage and handling **Bulking and mixing**	Ensure that the bulking/mixing to or from packaged waste only takes place under instruction and supervision and is carried out by trained personnel. For certain types of wastes, such a bulking/mixing needs to be carried out under local exhaust ventilation (see Section 4.1.4.8).	N/A
Storage and handling **Chemical incompatibilities**	Ensure that chemical incompatibilities guide the segregation required during storage (see Section 4.1.4.13 and 4.1.4.14).	N/A
Storage and handling **Containerised wastes**	Apply the following techniques when containerised wastes are handled (see Section 4.1.4.2): • storing of containerised wastes under cover. This can also be applied to any container that is held in storage pending sampling and emptying. Some exceptions on the applicability of this technique related to containers or waste not affected by ambient conditions (e.g. sunlight, temperature, water) have been identified (see Section 4.1.4.2).	Generally waste is not delivered in containers. Waste is unloaded and stored in enclosed sheds. No direct sunlight impinges on the waste. No rain falls on the waste.

Aspect of BAT	BAT	Status at Installation
	Covered areas need to have adequate provision for ventilation • maintaining the availability and access to storage areas for containers holding substances that are known to be sensitive to heat, light and water, under cover and protected from heat and direct sunlight.	
Extractive vent systems	Perform crushing, shredding and sieving operations in areas fitted with extractive vent systems linked to abatement equipment (see Section 4.1.6.1) when handling materials that can generate emission to air (e.g. odours, dust, VOCs).	N/A
Full encapsulation / Inert atmosphere	Perform crushing/shredding operations (see Sections 4.1.6.1 and 4.6) under full encapsulation and under an inert atmosphere for drums/containers containing flammable or highly volatile substances. This will avoid ignition. The inert atmosphere is to be abated.	N/A
Washing processes	Perform washing processes considering (see Section 4.1.6.2): • identifying the washed components that may be present in the items to be washed (e.g. solvents) • transferring washings to appropriate storage and then treating them in the same way as the waste from which they were derived • using treated waste water from the WT plant for washing instead of fresh water. The resultant waste water can then be treated in the WWTP or re-used in the installation.	N/A

Aspect of BAT	BAT	Status at Installation
Air emission treatments	Restrict the use of open topped tanks, vessels and pits by: • not allowing direct venting or discharges to air by linking all the vents to suitable abatement systems when storing materials that can generate emissions to the air (e.g. odours, dust, VOCs) (see Section 4.1.4.5) • keeping the waste or raw materials under cover or in waterproof packaging (see Section 4.1.4.5) • connecting the head space above the settlement tanks (e.g. where oil treatment is a pre-treatment process within a chemical treatment plant) to the overall site exhaust and scrubber units (see Section 4.1.4.1).	N/A
	The use of an enclosed system with extraction, or under depression, to a suitable abatement plant. This technique is especially relevant to processes which involve the transfer of volatile liquids, including during tanker charging/discharging (see Section 4.6.1).	Waste receiving shed is equipped with an air extraction system; the air collected is treated and thereafter dispersed.
	Apply a suitably sized extraction system which can cover the holding tanks, pre-treatment areas, storage tanks, mixing/reaction tanks and the filter press areas, or to have in place a separate system to treat the vent gases from specific tanks (for example, activated carbon filters from tanks holding waste contaminated with solvents) (see Section 4.6.1).	N/A
	Correctly operate and maintain the abatement equipment, including the handling and treatment/disposal of spent	N/A

<table>
<tr><th>Aspect of BAT</th><th>BAT</th><th>Status at Installation</th></tr>
<tr><td></td><td>scrubber media (see Section 4.6.11).</td><td></td></tr>
<tr><td></td><td>Have a scrubber system in place for the major inorganic gaseous releases from those unit operations which have a point discharge for process emissions. Install a secondary scrubber unit to certain pre-treatment systems if the discharge is incompatible or too concentrated for the main scrubbers (see Section 4.6.11).</td><td>N/A</td></tr>
<tr><td></td><td>Have leak detection and repair procedures in place in installations
• handling a large number of piping components and storage and
• compounds that may leak easily and create an environmental problem (e.g. fugitive emissions, soil contamination) (see Section 4.6.2).
This may be seen as an element of the EMS.</td><td>Refer to maintenance plan.</td></tr>
<tr><td>Air emission levels</td><td>Reduce air emission to the following levels
<table><tr><th>Air parameter</th><th>Emission levels associated to the use of BAT (mg/Nm^3)</th></tr><tr><td>VOC</td><td>7 – 20[1]</td></tr><tr><td>PM</td><td>5 – 20</td></tr><tr><td colspan="2">[1] For low VOC loads, the higher end of the range can be extended to 50</td></tr></table>by using a suitable combination of preventive and/or abatement techniques (see Section 4.6). The techniques mentioned above in the BAT ‘Air emission treatments’ section also contribute to achieve these values.</td><td>The MTP is equipped with an extraction/venting system which filters the air prior to releasing it into the atmosphere. The receiving area and the wet MTP are equipped with active carbon filters to neutralize the odours while the sorting area (where the sorting equipment is installed including bag opener, conveyors, sieve and ballistic separator) of the MTP includes a bag house filter to capture the dust.

All waste is delivered into the receiving area which is enclosed (thus waterproof) and is equipped with a dedicated air handling system.</td></tr>
</table>

Aspect of BAT	BAT	Status at Installation
		The AD treatment process takes place in enclosed tanks. All gas generated, which contains H2S and VOCs, is used for energy recovery through the CHPs or is flared (depending on the quality of the gas). In addition to regular cleaning of the facility, a misting system on the conveyors of both the MRF and the MTP is installed. This serves to reduce the diffusion of dust from wastes moving along the conveyors. For monitoring information refer to Section B3.10 of the IPPC application.
Waste water management	Reduce the water use and the contamination of water by (see Sections 4.1.3.6 and 4.7.1):	
	• applying site waterproofing and storage retention methods	3 reservoirs can be found at SAWTP. Rain water from roof tops is stored in Reservoir ***A*** (refer to site plan attached). Process water and water from asphalted surfaces is directed in Reservoir ***B***. A small reservoir (Reservoir ***C***) is used for the storage of water used specifically for fire fighting.
	• carrying out regular checks of the tanks and pits especially when they are underground	
	• applying separated water drainage according to the pollution load (roof water, road water, process water)	Foul water drainage (from toilets & showers) is directed to the public sewer. A permit application is filled with Water Services Corporation for the discharge of process water and water from asphalted surfaces (from Reservoir ***B***) to the sewer.
	• applying a security collection basin	
	• performing regular water audits, with the aim of	

Aspect of BAT	BAT	Status at Installation
	reducing water consumption and preventing water contamination • segregating process water from rainwater (see Section 4.7.2).	Reservoir ***A*** and Reservoir ***B*** are not connected to each other but in case of surplus rainwater (which cannot be stored), the rainwater collected is channelled to (i) either to Reservoir ***B*** or (ii) directly to the main rainwater culvert passing through the site.
	Have procedures in place to ensure that the effluent specification is suitable for the on-site effluent treatment system or discharge (see Section 4.7.1).	Process water and reservoir water (second class water) are currently monitored on a quarterly basis. Water Services Corporation requires a basis line of waste water from SAWTP. Once this is established, a way forward (in relation to treatment needed) will be determined.
	Avoid the effluent by-passing the treatment plant systems (see Section 4.7.1).	N/A
	Have in place and operate an enclosure system whereby rainwater falling on the processing areas is collected along with tanker washings, occasional spillages, drum washings, etc. and returned to the processing plant or collected in a combined interceptor (see Section 4.7.1).	Surface water from asphalted areas (and thus in possible contact with waste) is directed in the reservoir for process water storage (Reservoir ***B***).
	Segregate the water collecting systems for potentially more contaminated waters from less contaminated water (see Section 4.7.2).	Rain water from roof tops is collected in a separate reservoir (Reservoir ***A***).

Aspect of BAT	BAT	Status at Installation
	Have a full concrete base in the whole treatment area that falls to internal site drainage systems which lead to storage tanks or to interceptors that can collect rainwater and any spillage. Interceptors with an overflow to sewer usually need automatic monitoring systems, such as pH checks, which can shut down the overflow (see Section 4.1.3.6).	Surface water from asphalted areas (and thus in possible contact with waste) is directed in the reservoir for process water storage (Reservoir ***B***).
Rainwater collecting	Collect the rainwater in a special basin for checking, treatment if contaminated and further use (see Section 4.7.1).	Rain water from roof tops is collected in a separate reservoir (Reservoir ***A***).
Re-use	Maximise the re-use of treated waste waters and use of rainwater in the installation (see Section 4.7.1).	Water from the rain water reservoir (Reservoir ***A***) is used for irrigation of the soft landscaping areas on site. In order to avoid overly high water consumption of the process, an internal circulation inside the AD-plant was established by means of a dedicated process water steel tank. This process water is reused in the digestion process.
Daily checks	Conduct daily checks on the effluent management system and to maintain a log of all checks carried out, by having a system for monitoring the effluent discharge and sludge quality in place (see Section 4.7.1).	N/A
	Firstly identify waste waters that may contain hazardous compounds (e.g. adsorbable organically bound halogens (AOX); cyanides; sulphides; aromatic compounds; benzene or hydrocarbons (dissolved, emulsified or undissolved); and metals, such as mercury, cadmium, lead, copper, nickel, chromium, arsenic and zinc) (see Section 4.7.2). Secondly,	N/A

Aspect of BAT	BAT	Status at Installation
	segregate the previously identified waste water streams on-site and thirdly, specifically treat waste water on-site or off-site.	
	Ultimately after the application of “the water use and the contamination of water reduction”, select and carry out the appropriate treatment technique for each type of waste water (see Section 4.7.1).	Water Services Corporation requires a basis line of waste water from SAWTP. Once this is established, a way forward (in relation to treatment needed) will be determined.
	Implement measures to increase the reliability with which the required control and abatement performance can be carried out (for example, optimising the precipitation of metals) (see Section 4.7.1).	N/A
	Identify the main chemical constituents of the treated effluent (including the make-up of the COD) and to then make an informed assessment of the fate of these chemicals in the environment (see Section 4.7.1 and their applicability restrictions identified).	N/A
	Only discharge the waste water from its storage after the conclusion of all the treatment measures and a subsequent final inspection (see Section 4.7.1).	N/A
Water emission levels	Achieve the following water emission values before discharge:	Water Services Corporation requires a basis line of waste water from SAWTP. Once this is established, a way

<table>
<tr><th>Aspect of BAT</th><th>BAT</th><th>Status at Installation</th></tr>
<tr><td></td><td><table>
<tr><th>Water parameter</th><th>Emission values associated with the use of BAT (ppm)</th></tr>
<tr><td>COD</td><td>20 – 120</td></tr>
<tr><td>BOD</td><td>2 – 20</td></tr>
<tr><td>Heavy metals (Cr, Cu, Ni, Pb, Zn)</td><td>0.1 – 1</td></tr>
<tr><td>Highly toxic heavy metals:
As
Hg
Cd
Cr(VI)</td><td>
<0.1
0.01 – 0.05
<0.1 – 0.2
<0.1 – 0.4</td></tr>
</table>
by applying a suitable combination of techniques mentioned in Sections 4.4.2.3 and 4.7. The techniques mentioned above in this section on ‘waste water management’ (also contribute to reach these values.</td><td>forward (in relation to treatment needed) will be determined.</td></tr>
<tr><td>Management of the process generated residues</td><td>BAT is to have a residue management plan (see Section 4.8.1) as part of the EMS including:
basic housekeeping techniques
internal benchmarking techniques (see Section 4.1.2.8).</td><td>Sorting residues (from MRF and MTP) are either exported, thermal treated or landfilled.
Digestion residues from MSW are landfilled.</td></tr>
<tr><td></td><td>Maximise the use of re-usable packaging (drums, containers, IBCs, palettes, etc.) (see Section 4.8.1).</td><td>Waste does not come in drums, pallets, IBCs or containers.</td></tr>
<tr><td></td><td>Re-use drums when they are in a good working state. In other cases, they are to be sent for appropriate treatment (see Section 4.8.1).</td><td>N/A</td></tr>
<tr><td></td><td>Keep a monitoring inventory of the waste on-site by using records of the amount of wastes received on-site and records of the wastes processed (see Section 4.8.3).</td><td>Should it be necessary, weighbridge transactions (which are recorded and backed-up) can be accessed and waste received on site verified. SCADA software records the plant parameters of interest (including waste processed – is true for AD plant).</td></tr>
</table>

Aspect of BAT	BAT	Status at Installation
	Re-use the waste from one activity/treatment possibly as a feedstock for another (see Section 4.1.2.6).	Bales of fractioned waste (plastic, paper, cardboard, etc) are retailed and exported.
Soil contamination	BAT is to provide and then maintain the surfaces of operational areas, including applying measures to prevent or quickly clear away leaks and spillages, and ensuring that maintenance of drainage systems and other subsurface structures is carried out (see Section 4.8.2).	Surface water from asphalted areas (thus possibly in contact with waste) is channelled to a dedicated reservoir (Reservoir ***B***). Bunds and spill kits are available around the plant. Basic spill kit training was provided to the operators.
	Utilise impermeable base and internal site drainage (see Section 4.1.4.6, 4.7.1 and 4.8.2).	All working area is either asphalted or concreted. Surface water from asphalted areas (thus possibly in contact with waste) is channelled to a dedicated reservoir (Reservoir ***B***).
	Reduce the installation site and minimise the use of underground vessels and pipework (see Section 4.8.2).	N/A

Part 2: BAT for specific types of waste treatments

Aspect of BAT	BAT	Status at Installation
Biological treatments	BAT is to use the following techniques for storage and handling in biological systems (see Section 4.2.2): • for less odour-intensive wastes, use automated and rapid action doors (opening times of the doors being kept to a minimum) in combination with an appropriate exhaust air collection device resulting in an under pressure in the hall • for highly odour-intensive wastes, use closed feed bunkers constructed with a vehicle sluice • house and equip the bunker area with an exhaust air collection device.	• A number of doors in the MTP shed are fast roller shutters. • All waste is unloaded in an enclosed shed. • Waste receiving shed is equipped with an air extraction system; the air collected is directed for dispersion following the relevant treatment.
	Adjust the admissible waste types and separation processes according to the type of process carried out and the abatement technique applicable (e.g. depending on the content of non-biodegradable components) (see Section 4.2.3).	Wastes accepted at the plant are governed by the prevailing environmental permit. In general, grey bag waste is directed to the MRF while black bag waste is directed to the MTP. All processes are conducted in enclosed sheds/tanks.
	Use the following techniques when applying anaerobic digestion (see Sections 4.2.4 and 4.2.5): • application of a close integration between the process with the water management • a recycling of the maximum amount of waste water to the reactor. See some operational issues that may appear when applying this technique in Section 4.2.4 • operate the system under thermophilic digestion conditions. For certain types of wastes, thermophilic conditions cannot to be reached (see Section 4.2.4)	• The use of water in the process is monitored by flow meters and controlled by a SCADA system. • Most of the process water is re-circulated and used several times before being discarded. • The plant was designed for mesophillic conditions.

	• measure TOC, COD, N, P and Cl levels in the inlet and outlet flows. When a better control of the process is required, or a better quality of the waste OUT, more parameters are necessary for measuring and controlling • maximise the production of biogas. This technique needs to consider the effect on the digestate and biogas quality.	• In order to monitor the process, the followings tests are carried out: - pH - Organic Acids (FOS) to Total inorganic Carbonate (TAC) • Total biogas generation and the quality of the biogas is monitored.
	Reduce the air emissions of the exhaust gas when using biogas as a fuel by restricting the emissions of dust, NOx, SOx, CO, H_2S and VOC by using an appropriate combination of the following techniques (see Section 4.2.6): • scrubbing the biogas with iron salts • using de-NOx techniques such as SCR • using a thermal oxidation unit • using activated carbon filtration.	Ferric (II) chloride ($FeCl_2$) is added to the substrate in the hydrolysis to reduce as much as possible hydrogen sulphide in the biogas required for the operation of the CHP units. The CHPs are not equipped with a scrubbing system.
	Improve the mechanical biological treatments (MBT) by (see Sections 4.2.2, 4.2.3, 4.2.8, 4.2.10, 4.6.23): • using fully enclosed bioreactors • avoiding anaerobic conditions during aerobic treatment by controlling the digestion and the air supply (by using a stabilised air circuit) and by adapting the aeration to the actual biodegradation activity • using water efficiently • thermally insulating the ceiling of the biological degradation hall in aerobic processes • minimising the exhaust gas production to levels of	• All bioreactors are enclosed systems. • Blowers are used to input air in the aerobic stage of the plant. The process is controlled by a SCADA system. • At the dewatering stage, the collected water is again used in the process recirculation. • Not applicable. • This information is currently not available.

<table>
<tr>
<td></td>
<td>2500 to 8000 Nm3 per tonne. Levels below 2500 Nm3 per tonne do not have been reported

guaranteeing a uniform feed
recycling process waters or muddy residues within the aerobic treatment process to completely avoid water emissions. If waste water is generated, then this should be treated to reach the water emissions values mentioned previously
continuously learning of the connection between the controlled variables of biological degradation and the measured (gaseous) emissions
reducing emissions of nitrogen compounds by optimising the C:N ratio
</td>
<td>
The feeding system is controlled by Scada systems
At the dewatering stage, the collected water is again used in the process recirculation.
</td>
</tr>
<tr>
<td>Emission levels for mechanical biological treatments</td>
<td>Reduce the emissions from mechanical biological treatments to the following levels (see Section 4.2.12):
<table>
<tr><th>Parameter</th><th>Treated exhaust gas</th></tr>
<tr><td>Odour (ouE/m^3)</td><td><500 – 6000</td></tr>
<tr><td>NH_3 (mg/Nm^3)</td><td><1 – 20</td></tr>
<tr><td colspan="2">For VOC and PM, see the generic BAT 41
The TWG recognised that N_2O (see Section 4.6.10) and Hg also needed to be added to this table, however not enough data were provided to validate values on these issues.</td></tr>
</table>
by using an appropriate combination of the following techniques (see Section 4.6):

maintaining good housekeeping (related to BAT number 3)
regenerative thermal oxidiser
dust removal.
</td>
<td>
A regular cleaning programme is in place.
Contaminated air collected through the air handling system is treated before dispersed.
In addition to regular cleaning of the facility, a misting system on the conveyors of both the MRF and the MTP has been installed. This serves to reduce the diffusion of dust from wastes moving along the conveyor systems.
Emission levels for mechanical biological treatment shall fall within the prescribed limits.
</td>
</tr>
<tr>
<td></td>
<td>Reduce the emissions to water to the levels mentioned in “the water emissions values”. In addition, restrict the</td>
<td>There are no direct emissions to water.</td>
</tr>
</table>

	emissions to water of total nitrogen, ammonia, nitrate and nitrite as well (see Section 4.7.7 and the concluding remarks Chapter 7).	
Physico-chemical treatments	BAT is to apply the following techniques in physico-chemical reactors (see Section 4.3.1.2): • clearly defining the objectives and the expected reaction chemistry for each treatment process • assessing each new set of reactions and proposed mixes of wastes and reagents in a laboratory-scale test prior to waste treatment • specifically designing and operating the reactor vessel so that it is fit for its intended purpose • enclosing all treatment/reaction vessels and ensuring that they are vented to the air via an appropriate scrubbing and abatement system • monitoring the reaction to ensure that it is under control and proceeding towards the anticipated result • preventing the mixing of wastes or other streams that contain metals and complexing agents at the same time (see Section 4.3.1.3).	N/A
	In addition to the generic parameters identified previously for waste water, additional parameters need to be identified for the physico-chemical treatment of waste waters. Some reference is given on this issue in the concluding remark Chapter 7.	N/A
	Apply the following techniques for the neutralisation process (see Section 4.3.1.3) • ensuring that the customary measurement methods	N/A

	are used • separately storing the neutralised waste water • performing a final inspection of the neutralised waste water after a sufficient storage time has elapsed.	
	Apply the following techniques to aid precipitation of the metals in treatment processes (see Section 4.3.1.4): • adjusting the pH to the point of minimum solubility where the metals will precipitate • avoiding the input of complexing agents, chromates and cyanides • avoiding organic materials that may interfere with precipitation from entering the process • allowing the resulting treated waste to clarify by decantation when possible, and/or by the addition of other dewatering equipment • using sulphidic precipitation if complex agents are present. This technique may increase the sulphide concentration in the treated waste water.	N/A
	Apply the following techniques to break-up emulsions (see Section 4.3.1.5): • testing for the presence of cyanides in the emulsions to be treated. If cyanides are present, the emulsions need a special pre-treatment first • setting up simulated laboratory tests.	N/A
	Apply the following techniques to oxidation/reduction (see Section 4.3.1.6): • abating the air emissions generated during the	N/A

	oxidation/reduction • having safety measures and gas detectors in place (e.g. suitable for detecting HCN, H2S, NOx).		
	Apply the following techniques to waste waters containing cyanides (see Section 4.3.1.7): • destroying the cyanides by oxidation • adding caustic soda in excess to prevent a decrease in pH • avoiding the mixing of cyanide wastes with acidic compounds • monitoring the progress of the reaction using electropotentials.	N/A	
	Apply the following techniques to waste waters containing chromium (VI) compounds (see Section 4.3.1.8): • avoiding the mixing of Cr(VI) wastes with other wastes • reducing Cr(VI) to Cr(III) • precipitating the trivalent metal.	N/A	
	Apply the following techniques to waste waters containing nitrites (see Section 4.3.1.9): • avoiding mixing nitrite wastes with other wastes • checking and avoiding nitrous fumes during the oxidation/acidification treatment of nitrites.	N/A	
	Apply the following techniques to waste waters containing ammonia (see Section 4.3.1.11): • using a dual column air stripping system with an acidic scrubber for waste with ammonia solutions up	N/A	

	to 20 w/w-% • recovering the ammonia in the scrubbers and returning it to the process prior to the settlement stage • removing the ammonia removed in the gas phase by scrubbing the waste with sulphuric acid to produce ammonium sulphate • extending any air sampling for ammonia in exhaust stacks or filter press areas to cover the VOCs in filtration and dewatering (see Section 4.3.1.12).		
	Link the air space above filtration and dewatering processes to the main abatement system of the plant (see Section 4.3.1.12).	N/A	
	Add flocculation agents to the sludge and waste water to be treated, to accelerate the sedimentation process and to facilitate the further separation of solids (see Section 4.3.1.16 for some applicability restrictions identified). To avoid use of flocculation agents, evaporation is better in those cases where it is economically viable (see Section 4.7.6.1).	N/A	
	Apply rapid cleaning and steam- or high pressure water jet cleaning of the filter apertures of the sieving processes (see Section 4.3.1.17).	N/A	
Physico-chemical treatment of solid wastes	BAT is to promote the insolubilisation of amphoteric metals, and to reduce the leaching of toxic soluble salts by a suitable combination of water washing, evaporation, recrystallisation and acid extraction (see Section 4.3.2.1,	N/A	

	4.3.2.8, 4.3.2.9) when inmobilisation is used to treat solid waste containing hazardous compounds for land filling.		
	Test the leachability of inorganic compounds, by using the standardised CEN leaching procedures and by applying the appropriate testing level: basic characterisation, compliance testing or on-site verification (see Section 4.3.2.2).	N/A	
	Restrict the acceptance of wastes to be treated by solidification/immobilisation treatment to those not containing high levels of VOCs, odorous components, solid cyanides, oxidising agents, chelating agents, high TOC wastes and gas cylinders (see Section 4.3.2.3).	N/A	
	Apply control and enclosure techniques for loading/unloading and enclosed conveyor systems (see Section 4.3.2.3).	N/A	
	Have an abatement system(s) in place to handle the flow of air, as well as the peak loadings associated with charging and unloading (see Section 4.3.2.3).	N/A	
	Use at least a solidification, vitrification, melting or fusion process before landfilling solid waste according to techniques in Sections from 4.3.2.4 to 4.3.2.7.	N/A	
Re-refining of waste oils	BAT is to operate a careful control of the incoming materials supported by analytical equipment (viscometry, infrared, chromatography and mass spectrometry as appropriate), laboratories and resources (see Section 4.1.1.1).	N/A	

	Check at least for chlorinated solvents and PCBs (see Sections 4.1.1.1 and 4.4.1.2).	N/A
	Use condensation as a treatment for the gas phase of the flash distillation unit (see Section 4.6.8).	N/A
	Have vapour return lines for loading and unloading vehicles, routing all vents to a thermal oxidiser/incinerator or an activated carbon adsorption installation (see Sections 4.1.4.6, 4.6.7 and 4.6.14).	N/A
	Direct vent streams to a thermal oxidiser with waste gas treatment if chlorinated species are present in the vent stream. If high levels of chlorinated species are present then condensation followed by caustic scrubbing and an activated carbon guard bed is the preferred treatment path (see Section 4.6).	N/A
	Utilise a thermal oxidation at 850 °C with a two seconds residence time for the vacuum distillation vent of vacuum generators or for the air from process heaters (see Section 4.6).	N/A
	Use a highly efficient vacuum system (see Section 4.4.1.1).	N/A
	Use the residues from vacuum distillation or thin film evaporators as asphalt products (see Section 4.4.1.15).	N/A
	Use a re-refining process of waste oil which can achieve a yield higher than 65 % on a dry basis (see Sections from 4.4.1.1 to 4.4.1.12).	N/A

<table>
<tr><td>Emission levels for re-refining of waste oils</td><td>Achieve the following values in the discharged waste water from the re-refining unit (see Section 4.4.1.14):
<table>
<tr><th>Waste water parameter</th><th>Concentration (ppm)</th></tr>
<tr><td>Hydrocarbons</td><td><0.01 – 5</td></tr>
<tr><td>Phenols</td><td>0.15 – 0.45</td></tr>
<tr><td colspan="2">For other water parameters, refer to BAT number 56 in the Generic BAT section</td></tr>
</table>
by using a suitable combination of process-integrated techniques and/or primary, secondary, biological and finishing treatments (see Sections 4.4.1.14 and 4.7).</td><td>N/A</td></tr>
<tr><td>Treatment of waste solvent</td><td>BAT is to operate a careful control of the incoming materials as supported by analytical equipment, laboratories and resources (see Section 4.1.1.1).</td><td>N/A</td></tr>
<tr><td></td><td>Evaporate the residue from the distillation columns and to recuperate the solvents (see Section 4.4.2.4).</td><td>N/A</td></tr>
<tr><td>Regeneration of waste catalyst</td><td>BAT is to use bag filters to abate particulates from the fumes generated during the regeneration process (see Sections 4.4.3 and 4.6.5).</td><td>N/A</td></tr>
<tr><td></td><td>Use a SOx abatement system (see Section 4.4.3.3).</td><td>N/A</td></tr>
<tr><td>Regeneration of waste activated carbon</td><td>BAT is to have an effective quality control procedure in place to ensure that the operator can differentiate between the carbon used for potable water or food grade carbon and the rest of spent carbons (the so-called ‘industrial carbons’) (see Section 4.4.4.2).</td><td>N/A</td></tr>
<tr><td></td><td>Require a written undertaking from customers indicating</td><td>N/A</td></tr>
</table>

	what the activated carbon has been used for (see Section 4.1.2.3).		
	Utilise an indirect fired kiln for industrial carbons –it may be argued that this could equally be applied to potable water carbons. However, limits on capacity and corrosion may deem that only multiple hearth or direct fired rotary kilns may be used (see Section 4.4.4.1).	N/A	
	Utilise an afterburner with a minimum of 1100 °C, two seconds residence time and 6 % excess oxygen for the regeneration of industrial carbons where refractory halogenated or other thermally resistant substances are likely to be present. In other cases, less stringent thermal conditions are sufficient (see Section 4.4.4.2).	N/A	
	Utilise an afterburner with a minimum heating temperature of 850 °C, two seconds residence time and 6 % excess oxygen for potable water and food grade active carbons (see Section 4.4.4.2).	N/A	
	Apply a flue-gas treatment train consisting of quench and/or venturi and aqueous scrubbing sections, followed by an induced draft fan (see Section 4.4.4.2).	N/A	
	Utilise a caustic or soda ash scrubbing solutions to neutralise acid gases for industrial carbon plants (see Section 4.4.4.2).	N/A	
	Have a WWTP containing an appropriate combination of	N/A	

	flocculation, settlement, filtration and pH adjustment for the treatment of potable water carbons. For effluents of industrial carbons, applying additional treatments (e.g. metal hydroxide precipitation, sulphide precipitation) are also considered BAT (see Section 4.4.4.3).	
Preparation of waste to be used as fuel	BAT is to try to have a close relationship with the waste fuel user in order that a proper transfer of the knowledge of the waste fuel composition is carried out (see Section 4.5.1).	N/A
	Have a quality assurance system to guarantee the characteristics of the waste fuel produced (see Section 4.5.1).	N/A
	Manufacture different type of waste fuels according to the type of user (e.g. cement kilns, different power plants), to the type of furnace (e.g. grate firing, blow feeding) and to the type of waste used to manufacture the waste (e.g. hazardous waste, municipal solid waste) (see Section 4.5.2).	N/A
	When producing waste fuel from hazardous waste, use activated carbon treatment for low contaminated water and thermal treatment for highly polluted water (see Sections 4.5.6 and 4.7). In this context, thermal treatment relates to any thermal treatment in Section 4.7.6 or incineration which is not covered in this document.	N/A
	When producing waste fuel from hazardous waste, ensure correct follow-up of the rules concerning electrostatic and flammability hazards for safety reasons (see Sections 4.1.2.7 and 4.1.7).	N/A

Preparation of solid waste fuels from non-hazardous waste	BAT is to visually inspect the incoming waste to sort out the bulky metallic or non-metallic parts. The purpose is to protect the plant against mechanical destruction (see Section 4.1.1.3 and this is also related to BAT 8.e).	Ferrous and non-ferrous separators are in place to collect such waste fractions.
	Use magnetic ferrous and non-ferrous metal separators. The purpose is to protect the pelletisers as well as fulfill the requirements of the final users (see Sections 4.5.3.3 and 4.5.3.4).	Ferrous and non-ferrous separators are in place to collect such waste fractions.
	Make use of the NIR technique for the sorting out of plastics. The purpose is the reduction of organic chlorine and some metals which are part of the plastics (see Section 4.5.3.10).	N/A
	Use a combination of shredder systems and pelletisers suitable for the preparation of the specified size waste fuel (see Sections 4.5.3.1 and 4.5.3.12).	N/A
	For some installations preparing solid waste fuels from source-separated waste streams, the use of some or all of the above-mentioned techniques may not be necessary to comply with BAT (see Section 4.5.3.1).	N/A

B. Emissions from storage

Part 1: Storage of liquids and liquefied gases

1.1 Tanks

Aspect of BAT	BAT	Status at Installation
General principles to prevent and reduce emissions **Tank design**	BAT for a proper design is to take into account at least the following: • the physico-chemical properties of the substance being stored • how the storage is operated, what level of instrumentation is needed, how many operators are required, and what their workload will be • how the operators are informed of deviations from normal process conditions (alarms) • how the storage is protected against deviations from normal process conditions (safety instructions, interlock systems, pressure relief devices, leak detection and containment, etc.) • what equipment has to be installed, largely taking account of past experiences of the product (construction materials, valve quality, etc.) • which maintenance and inspection plan needs to be implemented and how to ease the maintenance and inspection work (access, layout, etc.) • how to deal with emergency situations (distances to other tanks, facilities and to the boundary, fire protection, access for emergency services such as the fire brigade, etc.).	The digester tanks are set up on a concrete foundation. The cylindrical tank wall is made of screwed enamelled steel plates. The roof is made of stainless steel plates. The choice of this material prevents corrosion. The tank is gas tight (except for safety relief valve) thus there is no diffuse emission into the surrounding area. The tank wall is insulated with glass wool and cladded using trapezoidal profiles. Visual inspection of the digester can be carried out via an inspection glass on the digester roof using lighting. The digesters have a footbridge for inspection and maintenance work. It can be reached via a staircase. The steel construction is made from galvanised steel.

Aspect of BAT	BAT	Status at Installation
	See Annex 8.19 for a typical checklist.	
General principles to prevent and reduce emissions **Inspection and maintenance**	BAT is to apply a tool to determine proactive maintenance plans and to develop risk-based inspection plans such as the risk and reliability based maintenance approach; see Section 4.1.2.2.1. Inspection work can be divided into routine inspections, in-service external inspections and out-of-service internal inspections and are described in detail in Section 4.1.2.2.2.	Refer to Maintenance Plan.
General principles to prevent and reduce emissions **Location and lay-out**	For building new tanks it is important to select the location and the layout with care, e.g. water protection areas and water catchment areas should be avoided whenever possible. See Section 4.1.2.3.	Location of tanks to compliment design of plant.
	BAT is to locate a tank operating at, or close to, atmospheric pressure aboveground. However, for storing flammable liquids on a site with restricted space, underground tanks can also be considered. For liquefied gases, underground, mounded storage or spheres can be considered, depending on the storage volume.	Tanks are situated on the outside where pressure is atmospheric.
General principles to prevent and reduce emissions **Tank colour**	BAT is to apply either a tank colour with a reflectivity of thermal or light radiation of at least 70 %, or a solar shield on aboveground tanks which contain volatile substances, see Section 4.1.3.6 and 4.1.3.7 respectively.	N/A

Aspect of BAT	BAT	Status at Installation
General principles to prevent and reduce emissions **Emissions minimization principle in tank storage**	BAT is to abate emissions from tank storage, transfer and handling that have a significant negative environmental effect, as described in Section 4.1.3.1. This is applicable to large storage facilities allowing a certain time frame for implementation.	The tank is gas tight (except for safety relief valve) thus there is no diffuse emission into the surrounding area.
General principles to prevent and reduce emissions **Monitoring of VOC**	On sites where significant VOC emissions are to be expected, BAT includes calculating the VOC emissions regularly. The calculation model may occasionally need to be validated by applying a measurement method. See Section 4.1.2.2.3. [i]	VOC monitored as part of the monitoring programme at SAWTP, both *off-site* and *on-site* (refer to Annex 3 of IPPC Application).
General principles to prevent and reduce emissions **Dedicating systems**	BAT is to apply dedicated systems; see Section 4.1.4.4. Dedicated systems are generally not applicable on sites where tanks are used for short to medium-term storage of different products.	N/A
Tank specific considerations **Open top tanks**	Open top tanks are used for the storage of, e.g. manure slurry in agricultural premises and water and other non-flammable or non-volatile liquids in industrial facilities, see Section 3.1.1. If emissions to air occur, BAT is to cover the tank by applying: • a floating cover, see Section 4.1.3.2 • a flexible or tent cover, see Section 4.1.3.3, or	N/A

Aspect of BAT	BAT	Status at Installation
	• a rigid cover, see Section 4.1.3.4. Additionally, with an open top tank covered with a flexible, tent or a rigid cover, a vapour treatment installation can be applied to achieve an additional emission reduction, see Section 4.1.3.15. The type of cover and the necessity for applying the vapour treatment system depend on the substances stored and must be decided on a case-by-case basis. To prevent deposition that would call for an additional cleaning step, BAT is to mix the stored substance (e.g. slurry), see Section 4.1.5.1.	
Tank specific considerations **External floating roof tank**	External floating roof tanks are used for the storage of, e.g. crude oil; see Section 3.1.2. The BAT associated emission reduction level for a large tank is at least 97 % (compared to a fixed roof tank without measures), which can be achieved when over at least 95 % of the circumference the gap between the roof and the wall is less than 3.2 mm and the seals are liquid mounted, mechanical shoe seals. By installing liquid mounted primary seals and rim mounted secondary seals, a reduction in air emissions of up to 99.5 % (compared to a fixed roof tank without measures) can be achieved. However, the choice of seal is related to reliability, e.g. shoe seals are preferred for longevity and, therefore, for high turnovers. See Section 4.1.3.9.	N/A

Aspect of BAT	BAT	Status at Installation
	BAT is to apply direct contact floating roofs (double-deck), however, existing non-contact floating roofs (pontoon) are also BAT. See Section 3.1.2. Additional measures to reduce emissions are (see Section 4.1.3.9.2): • applying a float in the slotted guide pole • applying a sleeve over the slotted guide pole, and/or • applying 'socks' over the roof legs. A dome can be BAT for adverse weather conditions, such as high winds, rain or snowfall. See Section 4.1.3.5. For liquids containing a high level of particles (e.g. crude oil), BAT is to mix the stored substance to prevent deposition that would call for an additional cleaning step, see Section 4.1.5.1.	
Tank specific considerations **Fixed roof tanks**	Fixed roof tanks are used for the storage of flammable and other liquids, such as oil products and chemicals with all levels of toxicity, see Section 3.1.3. For the storage of volatile substances which are toxic (T), very toxic (T+), or carcinogenic, mutagenic and reproductive toxic (CMR) categories 1 and 2 in a fixed roof tank, BAT is to apply a vapour treatment installation. [ii] For other substances, BAT is to apply a vapour treatment installation, or to install an internal floating roof (see Sections 4.1.3.15 and 4.1.3.10 respectively). Direct contact floating roofs and non-contact floating roofs are BAT. In	N/A

Aspect of BAT	BAT	Status at Installation
	the Netherlands, the condition for when to apply these BAT is when the substance has a vapour pressure (at 20 ºC) of 1 kPa and the tank has a volume of $\geq 50\ m^3$. In Germany, the condition for when to apply these BAT is when the substance has a vapour pressure (at 20 ºC) of 1.3 kPa and the tank has a volume of $\geq 300\ m^3$. For tanks < $50\ m^3$, BAT is to apply a pressure relief valve set at the highest possible value consistent with the tank design criteria. The selection of the vapour treatment technology is based on criteria such as cost, toxicity of the product, abatement efficiency, quantities of rest-emissions and possibilities for product or energy recovery, and has to be decided case-by-case. The BAT associated emission reduction is at least 98 % (compared to a fixed roof tank without measures). See Section 4.1.3.15. The achievable emission reduction for a large tank using an internal floating roof is at least 97 % (compared to a fixed roof tank without measures), which can be achieved when over at least 95 % of the circumference of the gap between the roof and wall is less than 3.2 mm and the seals are liquid mounted, mechanical shoe seals. By applying liquid mounted primary seals and rim mounted secondary seals, even higher emission reductions can be achieved. However, the smaller the tank and the smaller the number of turnovers the less effective the floating roof is, see Annex 8.22 and Annex 8.23 respectively.	

Aspect of BAT	BAT	Status at Installation
	Also the case studies in Annex 8.13 show that achievable emission reductions depend on several issues such as the substance that is actually stored, meteorological circumstances, number of turnovers and diameter of the tank. The calculations show that with an internal floating roof an emission reduction in the range 62.9 – 97.6 % can be achieved (compared to a fixed roof tank without measures); where 62.9 % refers to a tank of 100 m^3 equipped with only primary seals and 97.6 % refers to a tank of 10263 m^3 equipped with primary and secondary seals. For liquids containing a high level of particles (e.g. crude oil) BAT is to mix the stored substance to prevent deposition that would call for an additional cleaning step, see Section 4.1.5.1.	
Tank specific considerations **Atmospheric horizontal tanks**	Atmospheric horizontal tanks are used for the storage of flammable and other liquids, such as oil products and chemicals in all levels of flammability and toxicity, see Section 3.1.4. Horizontal tanks are different to vertical tanks, e.g. since they can inherently operate under higher pressures. For the storage of volatile substances which are toxic (T), very toxic (T+), or CMR categories 1 and 2 in an atmospheric horizontal tank, BAT is to apply a vapour treatment installation. [iii]	N/A

Aspect of BAT	BAT	Status at Installation
	For other substances, BAT is to do all, or a combination, of the following techniques, depending on the substances stored: • apply pressure vacuum relief valves; see Section 4.1.3.11 • up rate to 56 mbar; see Section 4.1.3.11 • apply vapour balancing; see Section 4.1.3.13 • apply a vapour holding tank, see Section 4.1.3.14, or • apply vapour treatment; see Section 4.1.3.15. The selection of the vapour treatment technology has to be decided on a case-by-case basis.	
Tank specific considerations **Pressurised storage**	Pressurised storage is used for storing all categories of liquefied gases, from non-flammable up to flammable and highly toxic. The only significant emissions to air from normal operation are from draining. BAT for draining depends on the tank type, but may be the application of a closed drain system connected to a vapour treatment installation, see Section 4.1.4. The selection of the vapour treatment technology has to be decided on a case-by-case basis.	N/A
Tank specific considerations **Lifter roof tanks**	For emissions to air, BAT is to (see Sections 3.1.9 and 4.1.3.14): • apply a flexible diaphragm tank equipped with pressure/vacuum relief valves, or • apply a lifter roof tank equipped with pressure/vacuum relief valves and connected to a vapour treatment	N/A

Aspect of BAT	BAT	Status at Installation
	installation. The selection of the vapour treatment technology has to be decided on a case-by-case basis.	
Tank specific considerations **Refrigerated tanks**	There are no significant emissions from normal operation, see Section 3.1.10.	N/A
Tank specific considerations **Underground and mounded tanks**	Underground and mounded tanks are used especially for flammable products, see Sections 3.1.11 and 3.1.8 respectively. For the storage of volatile substances which are toxic (T), very toxic (T+), or CMR categories 1 and 2 in an underground or mounded tank, BAT is to apply a vapour treatment installation.[iv] For other substances, BAT is to do all, or a combination, of the following techniques, depending on the substances stored: • apply pressure vacuum relief valves; see Section 4.1.3.11 • apply vapour balancing; see Section 4.1.3.13 • apply a vapour holding tank, see Section 4.1.3.14, or • apply vapour treatment; see Section 4.1.3.15. The selection of the vapour treatment technology has to be decided on a case-by-case basis.	N/A
Preventing incidents and (major) accidents	Corrosion is one of the main causes of equipment failure and can occur both internally and externally on any metal surface, see Section 4.1.6.1.4. BAT is to prevent corrosion	The digester tanks are set up on a concrete foundation. The cylindrical tank wall is made of screwed enamelled steel plates. The roof is made of stainless steel plates. The choice

Aspect of BAT	BAT	Status at Installation
Leakage due to corrosion and/or erosion	by: • selecting construction material that is resistant to the product stored • applying proper construction methods • preventing rainwater or groundwater entering the tank and if necessary, removing water that has accumulated in the tank • applying rainwater management to bund drainage • applying preventive maintenance, and • where applicable, adding corrosion inhibitors, or applying cathodic protection on the inside of the tank. Additionally for an underground tank, BAT is to apply to the outside of the tank: • a corrosion-resistant coating • plating, and/or • a cathodic protection system. Stress corrosion cracking (SCC) is a specific problem for spheres, semi-refrigerated tanks and some fully refrigerated tanks containing ammonia. BAT is to prevent SCC by: • stress relieving by post-weld heat treatment, see Section 4.1.6.1.4, and • applying a risk based inspection as described in Section 4.1.2.2.1.	of this material prevents corrosion. The tank is gas tight (except for safety relief valve) thus there is no diffuse emission into the surrounding area. The tank wall is insulated with glass wool and cladded using trapezoidal profiles. Visual inspection of the digester can be carried out via an inspection glass on the digester roof using lighting. The digesters have a footbridge for inspection and maintenance work. It can be reached via a staircase. The steel construction is made from galvanised steel.
Preventing incidents and (major) accidents **Operational**	BAT is to implement and maintain operational procedures – e.g. by means of a management system – as described in Section 4.1.6.1.5, to ensure that: • high level or high pressure instrumentation with alarm	Parameters of interest are monitored via SCADA.

Aspect of BAT	BAT	Status at Installation
procedures and instrumentation to prevent overfill	settings and/or auto closing of valves is installed • proper operating instructions are applied to prevent overfill during a tank filling operation, and • sufficient ullage is available to receive a batch filling. A standalone alarm requires manual intervention and appropriate procedures, and automatic valves need to be integrated into the upstream process design to ensure no consequential effects of closure. The type of alarm to be applied has to be decided for every single tank. See Section 4.1.6.1.6.	
Preventing incidents and (major) accidents **Instrumentation and automation to detect leakage**	The four different basic techniques that can be used to detect leaks are: • release prevention barrier system • inventory checks • acoustic emission method • soil vapour monitoring. BAT is to apply leak detection on storage tanks containing liquids that can potentially cause soil pollution. The applicability of the different techniques depends on the tank type and is discussed in detail in Section 4.1.6.1.7.	As a safety measure, employees have a hand-held portable instrument (gas detector). Confined ATEX zones are equipped with auto-detection gas leak detection systems. In non-confined ATEX zones, leaks are detected manually. Gas production is monitored and recorded by the SCADA system; any gas leaks and/or fluctuations in gas production are investigated by the technical staff on the plant.
Preventing incidents and (major) accidents **Risk-based approach to emissions to soil below tanks**	The risk-based approach to emissions to soil from an aboveground flat-bottom and vertical, storage tank containing liquids with a potency to pollute soil, is that soil protection measures are applied at such a level that there is a 'negligible risk' for soil pollution because of leakage from the tank bottom or from the seal where the bottom and the	The waste treatment process flows do not include any regular flow to soil. All working area is either asphalted or concreted. The digesters are located in a recessed concrete pit.

Aspect of BAT	BAT	Status at Installation
	wall are connected. See Section 4.1.6.1.8 where the approach and the risk levels are explained. BAT is to achieve a 'negligible risk level' of soil pollution from bottom and bottom-wall connections of aboveground storage tanks. However, on a case-by-case basis, situations might be identified where an 'acceptable risk level' is sufficient.	
Preventing incidents and (major) accidents **Soil protection around tanks - containment**	BAT for aboveground tanks containing flammable liquids or liquids that pose a risk for significant soil pollution or a significant pollution of adjacent watercourses is to provide secondary containment, such as: • tank bunds around single wall tanks; see Section 4.1.6.1.11 • double wall tanks; see Section 4.1.6.1.13 • cup-tanks; see Section 4.1.6.1.14 • double wall tanks with monitored bottom discharge; see Section 4.1.6.1.15. For building new single walled tanks containing liquids that pose a risk for significant soil pollution or a significant pollution of adjacent watercourses, BAT is to apply a full, impervious, barrier in the bund, see Section 4.1.6.1.10. For existing tanks within a bund, BAT is to apply a risk-based approach, considering the significance of risk from product spillage to the soil, to determine if and which barrier is best applicable. This risk-based approach can also be applied to determine if a partial impervious barrier in a tank bund is sufficient or if the whole bund needs to be	The digesters are located in a recessed concrete pit. The process water tank is located adjacent to the pit. In case of rapture, liquid waste will flow in this same pit and thus containment is achieved.

Aspect of BAT	BAT	Status at Installation
	equipped with an impervious barrier. See Section 4.1.6.1.11. Impervious barriers include: • a flexible membrane, such as HDPE • a clay mat • an asphalt surface • a concrete surface. For chlorinated hydrocarbon solvents (CHC) in single walled tanks, BAT is to apply CHC-proof laminates to concrete barriers (and containments), based on phenolic or furan resins. One form of epoxy resin is also CHC-proof. See Section 4.1.6.1.12. BAT for underground and mounded tanks containing products that can potentially cause soil pollution is to: • apply a double walled tank with leak detection, see Section 4.1.6.1.16, or • to apply a single walled tank with secondary containment and leak detection, see Section 4.1.6.1.17.	
Preventing incidents and (major) accidents **Flammable areas and ignition sources**	See Section 4.1.6.2.1 together with ATEX Directive 1999/92/EC.	N/A
Preventing incidents and (major) accidents **Fire protection**	The necessity for implementing fire protection measures has to be decided on a case-by-case basis. Fire protection measures can be provided by applying, e.g. (see Section 4.1.6.2.2):	The following are available in the plant: • Fire extinguishers • Fire fighting equipment • Water reservoir dedicated for fire fighting

Aspect of BAT	BAT	Status at Installation
	• fire resistant claddings or coatings • firewalls (only for smaller tanks), and/or • water cooling systems	
Preventing incidents and (major) accidents **Fire-fighting equipment**	The necessity for implementing fire-fighting equipment and the decision on which equipment to apply has to be taken on a case-by-case basis in agreement with the local fire brigade. Some examples are given in Section 4.1.6.2.3.	N/A
Preventing incidents and (major) accidents **Containment of contaminated extinguishant**	The capacity for containing contaminated extinguishant depends on the local circumstances, such as which substances are stored and whether the storage is close to watercourses and/or situated in a water catchment area. The applied containment therefore has to be decided on a case-by-case basis, see Section 4.1.6.2.4. For toxic, carcinogenic or other hazardous substances, BAT is to apply full containment.	N/A

1.2 Storage of packaged dangerous substances

Aspect of BAT	BAT	Status at Installation
Safety and risk management	Operational losses do not occur in storing packaged dangerous materials. The only possible emissions are from incidents and (major) accidents. Companies that fall under the scope of the Seveso II Directive are required to take all measures necessary to prevent and limit the consequences of major accidents. They must, in any, case have a major accident prevention policy (MAPP) and a safety management system to implement the MAPP. Companies in the high risk category (Annex I of the Directive) must also draw up a safety report and an on-site emergency plan and maintain an up-to-date list of substances. However, companies storing dangerous substances not falling under the scope of the Seveso II Directive can also cause emissions from incidents and accidents. Applying a similar, maybe less detailed, safety management system is the first step in preventing and limiting these. BAT in preventing incidents and accidents is to apply a safety management system as described in Sections 4.1.6.1. The degree of detail of the system is clearly dependent on various factors such as: the quantities of substances stored, specific hazards of the substances and the location of the storage. However, the minimum level of BAT is to assess the risks of accidents and incidents on the site using the five steps described in Section 4.1.6.1	N/A
Training and responsibility	BAT is to appoint a person or persons who is or are responsible for the operation of the store. BAT is to provide the responsible person(s) with specific	An officer is designated as Store Keeper. A program is in place for training and/or refreshers on storage and handling of dangerous substances.

Aspect of BAT	BAT	Status at Installation
	training and retraining in emergency procedures as described in Section 4.1.7.1 and to inform other staff on the site of the risks of storing packaged dangerous substances and the precautions necessary to safely store substances that have different hazards.	
Storage area	BAT is to apply a storage building and/or an outdoor storage area covered with a roof, as described in Section 4.1.7.2. For storing quantities of less than 2500 litres or kilograms dangerous substances, applying a storage cell as described in Section 4.1.7.2 is also BAT.	Stores on the plant are situated in enclosed buildings. Spill kits are available in the stores.
Separation and segregation	BAT is to separate the storage area or building of packaged dangerous substances from other storage, from ignition sources and from other buildings on- and off-site by applying a sufficient distance, sometimes in combination with fire-resistant walls. Member States apply different distances between the (outdoor) storage of packaged dangerous substances and other objects on- and off-site; see Section 4.1.7.3 for some examples. BAT is to separate and/or segregate incompatible substances. For the compatible and incompatible combinations see Annex 8.3 of the BREF. Member States apply different distances and/or physical partitioning between the storage of incompatible substances; see Section 4.1.7.4 for some examples.	Material Safety Data Sheets are stored in a file in the store/s. As applicable, MSDS are printed and attached with the tank/container. Spill kits are available in the stores.
Containment of leakage and	BAT is to install a liquid-tight reservoir according to Section 4.1.7.5, that can contain all or a part of the	N/A

Aspect of BAT	BAT	Status at Installation
contaminated extinguishant	dangerous liquids stored above such a reservoir. The choice whether all or only a part of the leakage needs to be contained depends on the substances stored and on the location of the storage (e.g. in a water catchment area) and can only be decided on a case-by-case basis. BAT is to install a liquid-tight extinguishant collecting provision in storage buildings and storage areas according to Section 4.1.7.5. The collecting capacity depends on the substances stored, the amount of substances stored, the type of package used and the applied fire-fighting system and can only be decided on a case-by-case basis.	
Fire-fighting equipment	BAT is to apply a suitable protection level of fire prevention and fire-fighting measures as described in Section 4.1.7.6. The appropriate protection level has to be decided on a case-by-case basis in agreement with the local fire brigade.	The following are available in the plant: • Fire extinguishers • Fire fighting equipment • Water reservoir dedicated for fire fighting
Preventing ignition	BAT is to prevent ignition at source as described in Section 4.1.7.6.1.	The area in the AD, including all the tanks and steel structures, are earthed. As a safety measure, employees have a hand-held portable instrument (gas detector). Confined ATEX zones are equipped with auto-detection gas leak detection systems. In non-confined ATEX zones, leaks are detected manually. Gas production is monitored and recorded by the SCADA system; any gas leaks and/or fluctuations in gas production

Aspect of BAT	BAT	Status at Installation
		are investigated by the technical staff on the plant As part of the continuous development of personnel, each worker undergoes training. Smoking within the AD plant and the MTP / MRF sheds is not permitted. The gas route is fitted with the necessary safety fittings for safety reasons.

Part 2: Transfer and handling of liquids and liquefied gases

2.1 General principles to prevent and reduce emissions

Aspect of BAT	BAT	Status at Installation
Inspection and maintenance	BAT is to apply a tool to determine proactive maintenance plans and to develop risk-based inspection plans such as, the risk and reliability based maintenance approach; see Section 4.1.2.2.1.	N/A
Leak detection and repair programme	For large storage facilities, according to the properties of the products stored, BAT is to apply a leak detection and repair programme. Focus needs to be on those situations most likely to cause emissions (such as gas/light liquid, under high pressure and/or temperature duties). See Section 4.2.1.3.	Refer to maintenance plan.
Emissions	BAT is to abate emissions from tank storage, transfer and	N/A

Aspect of BAT	BAT	Status at Installation
minimisation principle in tank storage	handling that have a significant negative environmental effect, as described in Section 4.1.3.1. This is applicable to large storage facilities, allowing a certain time frame for implementation.	
Safety and risk management	BAT in preventing incidents and accidents is to apply a safety management system as described in Section 4.1.6.1.	An emergency response plan exists for the site.
Operational procedures and training	BAT is to implement and follow adequate organisational measures and to enable the training and instruction of employees for safe and responsible operation of the installation as described in Section 4.1.6.1.1.	Further training to be coordinated.

2.2 Considerations on transfer and handling techniques

Aspect of BAT	BAT	Status at Installation
Piping	BAT is to apply aboveground closed piping in new situations, see Section 4.2.4.1. For existing underground piping it is BAT to apply a risk and reliability based maintenance approach as described in Section 4.1.2.2.1. Bolted flanges and gasket-sealed joints are an important source of fugitive emissions. BAT is to minimise the number of flanges by replacing them with welded connections, within the limitation of operational requirements for equipment maintenance or transfer system flexibility, see Section 4.2.2.1.	The plant is equipped with above-ground closed piping. Material chosen for piping is such to match product passing through it.

Aspect of BAT	BAT	Status at Installation
	BAT for bolted flange connections (see Section 4.2.2.2.) include: • fitting blind flanges to infrequently used fittings to prevent accidental opening • using end caps or plugs on open-ended lines and not valves • ensuring gaskets are selected appropriate to the process application • ensuring the gasket is installed correctly • ensuring the flange joint is assembled and loaded correctly • where toxic, carcinogenic or other hazardous substances are transferred, fitting high integrity gaskets, such as spiral wound, kammprofile or ring joints. Internal corrosion may be caused by the corrosive nature of the product being transferred, see Section 4.2.3.1. BAT is to prevent corrosion by: • selecting construction material that is resistant to the product • applying proper construction methods • applying preventive maintenance, and • where applicable, applying an internal coating or adding corrosion inhibitors. To prevent the piping from external corrosion, BAT is to apply a one, two, or three layer coating system depending on the site-specific conditions (e.g. close to sea). Coating is normally not applied to plastic or stainless steel pipelines. See Section 4.2.3.2.	
Vapour treatment	BAT is to apply vapour balancing or treatment on	N/A

Aspect of BAT	BAT	Status at Installation
	significant emissions from the loading and unloading of volatile substances to (or from) trucks, barges and ships. The significance of the emission depends on the substance and the volume that is emitted, and has to be decided on a case-by-case basis. For more detail see Section 4.2.8. For example, according to Dutch regulations, the emission of methanol is significant when over 500 kg/yr is emitted.	
Valves	BAT for valves include: • correct selection of the packing material and construction for the process application • with monitoring, focus on those valves most at risk (such as rising stem control valves in continual operation) • applying rotating control valves or variable speed pumps instead of rising stem control valves • where toxic, carcinogenic or other hazardous substances are involved, fit diaphragm, bellows, or double walled valves • route relief valves back into the transfer or storage system or to a vapour treatment system. See Sections 3.2.2.6 and 4.2.9.	Manual valves are fitted in front of and behind the units for easy maintenance and assembly of the built-in pumps, blowers and other equipment. Pneumatic automatic values are equipped with end of travel switch which are controlled via PLC.
Pumps and compressors **Installation and maintenance of pumps and compressors**	The design, installation and operation of the pump or compressor heavily influence the life potential and reliability of the sealing system. The following are some of the main factors which constitute BAT: • proper fixing of the pump or compressor unit to its base-plate or frame	N/A

Aspect of BAT	BAT	Status at Installation
	• having connecting pipe forces within producers' recommendations • proper design of suction pipework to minimise hydraulic imbalance • alignment of shaft and casing within producers' recommendations • alignment of driver/pump or compressor coupling within producers' recommendations when fitted • correct level of balance of rotating parts • effective priming of pumps and compressors prior to start-up • operation of the pump and compressor within producers' recommended performance range (The optimum performance is achieved at its best efficiency point.) • the level of net positive suction head available should always be in excess of the pump or compressor • regular monitoring and maintenance of both rotating equipment and seal systems, combined with a repair or replacement programme.	
Pumps and compressors **Sealing system in pumps**	BAT is to use the correct selection of pump and seal types for the process application, preferably pumps that are technologically designed to be tight such as canned motor pumps, magnetically coupled pumps, pumps with multiple mechanical seals and a quench or buffer system, pumps with multiple mechanical seals and seals dry to the atmosphere, diaphragm pumps or bellow pumps. For more details see Sections 3.2.2.2, 3.2.4.1 and 4.2.9.	N/A
Pumps and	BAT for compressors transferring non-toxic gases is to	N/A

Aspect of BAT	BAT	Status at Installation
compressors **Sealing systems in compressors**	apply gas lubricated mechanical seals. BAT for compressors, transferring toxic gases is to apply double seals with a liquid or gas barrier and to purge the process side of the containment seal with an inert buffer gas. In very high pressure services, BAT is to apply a triple tandem seal system. For more detail see Sections 3.2.3 and 4.2.9.13.	
Sampling connections	BAT, for sample points for volatile products, is to apply a ram type sampling valve or a needle valve and a block valve. Where sampling lines require purging, BAT is to apply closed-loop sampling lines. See Section 4.2.9.14.	N/A

Part 3: Storage of solids

Aspect of BAT	BAT	Status at Installation
Open storage	BAT is to apply enclosed storage by using, for example, silos, bunkers, hoppers and containers, to eliminate the influence of wind and to prevent the formation of dust by wind as far as possible by primary measures. See Table 4.12 for these primary measures with cross-references to the relevant sections. However, although large volume silos and sheds are available, for (very) large quantities of not or only moderately drift sensitive and wettable material, open	All plant operations take place closed halls, all vehicle and staff doors have to be kept closed and only be opened for a minimum period necessary to enter / leave. In order to maximise the area of the plant, bales of a certain material fraction (example: plastics) are stored outside in the yard. Bale quotas shall be set for different waste streams so as to limit their effect on the surrounding area.

Aspect of BAT	BAT	Status at Installation
	storage might be the only option. Examples are the long-term strategic storage of coal and the storage of ores and gypsum. BAT for open storage is to carry out regular or continuous visual inspections to see if dust emissions occur and to check if preventive measures are in good working order. Following the weather forecast by, e.g, using meteorological instruments on site, will help to identify when the moistening of heaps is necessary and will prevent unnecessary use of resources for moistening the open storage. See Section 4.3.3.1. BAT for long-term open storage are one, or a proper combination, of the following techniques: • moistening the surface using durable dust-binding substances, see Section 4.3.6.1 • covering the surface, e.g. with tarpaulins, see Section 4.3.4.4 • solidification of the surface, see Table 4.13 • grassing-over of the surface, see Table 4.13. BAT for short-term open storage are one, or a proper combination, of the following techniques: • moistening the surface using durable dust-binding substances, see Section 4.3.6.1 • moistening the surface with water, see Sections 4.3.6.1 • covering the surface, e.g. with tarpaulins, see Section 4.3.4.4.	The compost storage hall is designed as an open hall with pushwalls on three sides. The fourth side is open to allow vehicles to enter the hall. Due to the process involved, the digestate is typically (partial) wet; thus no dust emissions are expected from the digestate. During periods of heavy wind, digestate turning (or loading) is kept to the absolute minimal requirement – this is so to further minimise the possibility of dust emissions.

Aspect of BAT	BAT	Status at Installation
	Additional measures to reduce dust emissions from both long and short-term open storage are: • placing longitudinal axis of the heap parallel with the prevailing wind • applying protective plantings, windbreak fences or upwind mounds to lower the wind velocity • applying only one heap instead of several heaps as far as possible; with two heaps storing the same amount as one, the free surface increases with 26 % • applying storage with retaining walls reduces the free surface, leading to a reduction of diffuse dust emissions; this reduction is maximised if the wall is placed upwind of the heap • placing retaining walls close together. See Table 4.13 for more details.	
Enclosed storage	BAT is to apply enclosed storage by using, for example, silos, bunkers, hoppers and containers. Where silos are not applicable, storage in sheds can be an alternative. This is, e.g. the case if apart from storage, the mixing of batches is needed. BAT for silos is to apply a proper design to provide stability and prevent the silo from collapsing. See Sections 4.3.4.1 and 4.3.4.5. BAT for sheds is to apply proper designed ventilation and filtering systems and to keep the doors closed. See Section 4.3.4.2.	All plant operations take place closed halls, all vehicle and staff doors have to be kept closed and only be opened for a minimum period necessary to enter / leave. A misting system on the conveyors of both the MRF and the MTP has been installed in order to reduce the diffusion of dust from wastes moving along the conveyor systems.

Aspect of BAT	BAT	Status at Installation
	BAT is to apply dust abatement and a BAT associated emission level of 1 – 10 mg/m3, depending on the nature/type of substance stored. The type of abatement technique has to be decided on a case-by-case basis. See Section 4.3.7. For a silo containing organic solids, BAT is to apply an explosion resistant silo (see Section 4.3.8.3), equipped with a relief valve that closes rapidly after the explosion to prevent oxygen entering the silo, as described in Section 4.3.8.4.	
Storage of packaged dangerous solids	For details regarding BAT for the storage of packaged dangerous solids, see Section 5.1.2.	N/A
Preventing incidents and (major) accidents **Safety and risk management**	The Seveso II Directive (Council Directive 96/82/EC of 9 December 1996 on the control of major accident hazards involving dangerous substances) requires companies to take all measures necessary to prevent and limit the consequences of major accidents. They must in any case have a major accident prevention policy (MAPP) and a safety management system to implement the MAPP. Companies holding large quantities of dangerous substances, so-called upper tiered establishments, must also draw up a safety report and an on-site emergency plan and maintain an up-to-date list of substances. However, plants that do not fall under the scope of the Seveso II Directive can also cause emissions from incidents and accidents. Applying a similar, maybe less detailed, safety management	An emergency response plan for the site. The following are available in the plant: • Fire extinguishers • Fire fighting equipment • Water reservoir dedicated for fire fighting

Aspect of BAT	BAT	Status at Installation
	system is the first step in preventing and limiting these. BAT in preventing incidents and accidents is applying a safety management system as described in Section 4.1.7.1.	

Part 4: Transfer and handling of solids

Aspect of BAT	BAT	Status at Installation
General approaches to minimise dust from transfer and handling	BAT is to prevent dust dispersion due to loading and unloading activities in the open air, by scheduling the transfer as much as possible when the wind speed is low. However, and taking into account the local situation, this type of measure cannot be generalised to the whole EU and to any situation irrespective of the possible high costs. See Section 4.4.3.1. Discontinuous transport (e.g. shovel or truck) generally	All plant operations take place closed halls, all vehicle and staff doors have to be kept closed and only be opened for a minimum period necessary to enter / leave. A misting system on the conveyors of both the MRF and the MTP has been installed in order to reduce the diffusion of dust from wastes moving along the conveyor systems.

Aspect of BAT	BAT	Status at Installation
	generates more dust emissions than continuous transport such as conveyors. BAT is to make transport distances as short as possible and to apply, wherever possible, continuous transport modes. For existing plants, this might be a very expensive measure. See Section 4.4.3.5.1.	
	When applying a mechanical shovel, BAT is to reduce the drop height and to choose the best position during discharging into a truck; see Section 4.4.3.4.	
	While driving, vehicles might swirl up dust from solids spread on the ground. BAT then is to adjust the speed of vehicles on-site to avoid or minimise dust being swirled up; see Section 4.4.3.5.2.	A speed limit of 10km/h is set for the whole plant; this will improve safety and reduce exhaust emissions and swirling up of dust.
	BAT for roads that are used by trucks and cars only, is applying hard surfaces to the roads of, for example, concrete or asphalt, because these can be cleaned easily to avoid dust being swirled up by vehicles, see Section 4.4.3.5.3. However, applying hard surfaces to the roads is not justified when the roads are used just for big shovel vehicles or when a road is temporary.	All plant area where vehicles operate is asphalted.
	BAT is to clean roads that are fitted with hard surfaces according to Section 4.4.6.12.	
	Cleaning of vehicle tyres is BAT. The frequency of cleaning and type of cleaning facility applied (see Section 4.4.6.13) has to be decided on a case-by-case basis.	

Aspect of BAT	BAT	Status at Installation
	Where it neither compromises product quality, plant safety, nor water resources, BAT for loading/unloading drift sensitive, wettable products is to moisten the product as described in Sections 4.4.6.8, 4.4.6.9 and 4.3.6.1. Risk of freezing of the product, risk of slippery situations because of ice forming or wet product on the road and shortage of water are examples when this BAT might not be applicable. For loading/unloading activities, BAT is to minimise the speed of descent and the free fall height of the product; see Sections 4.4.5.6 and 4.4.5.7 respectively. Minimising the speed of descent can be achieved by the following techniques that are BAT: • installing baffles inside fill pipes • applying a loading head at the end of the pipe or tube to regulate the output speed • applying a cascade (e.g. cascade tube or hopper) • applying a minimum slope angle with, e.g. chutes. To minimise the free fall height of the product, the outlet of the discharger should reach down onto the bottom of the cargo space or onto the material already piled up. Loading techniques that can achieve this, and that are BAT, are: • height adjustable fill pipes • height adjustable fill tubes, and • height adjustable cascade tubes. These techniques are BAT, except when loading/unloading non drift sensitive products, for which the free fall height is not that critical.	

Aspect of BAT	BAT	Status at Installation
	Optimised discharged hoppers are available and described in Section 4.4.6.7	
Considerations on transfer techniques **Grabs**	For applying a grab, BAT is to follow the decision diagram as shown in Section 4.4.3.2 and to leave the grab in the hopper for a sufficient time after the material discharge. BAT for new grabs, is to apply grabs with the following properties (see Section 4.4.5.1): • geometric shape and optimal load capacity • the grab volume is always higher than the volume that is given by the grab curve • the surface is smooth to avoid material adhering, and • a good closure capacity during permanent operation.	N/A

Aspect of BAT	BAT	Status at Installation
Considerations on transfer techniques **Conveyors and transfer chutes**	For all types of substances, BAT is to design conveyor to conveyor transfer chutes in such a way that spillage is reduced to a minimum. A modelling process is available to generate detail designs for new and existing transfer points. For more details see Section 4.4.5.5. For non or very slightly drift sensitive products (S5) and moderately drift sensitive, wettable products (S4), BAT is to apply an open belt conveyor and additionally, depending on the local circumstances, one or a proper combination of the following techniques: • lateral wind protection, see Section 4.4.6.1 • spraying water and jet spraying at the transfer points, see Sections 4.4.6.8 and 4.4.6.9, and/or • belt cleaning, see Section 4.4.6.10. For highly drift sensitive products (S1 and S2) and moderately drift sensitive, not wettable products (S3) BAT for new situations, is to: o apply closed conveyors, or types where the belt itself or a second belt locks the material (see Section 4.4.5.2), such as: • pneumatic conveyors • trough chain conveyors • screw conveyors • tube belt conveyor • loop belt conveyor • double belt conveyor o or to apply enclosed conveyor belts without support pulleys (see Section 4.4.5.3), such as:	Outdoor transfer systems are equipped with rubber chutes. Indoor transfer systems are not affected by wind; thus no material dispersion takes place. Conveyors are subject to regular cleaning. A misting system on the conveyors of both the MRF and the MTP has been installed in order to reduce the diffusion of dust from wastes moving along the conveyor systems.

Aspect of BAT	BAT	Status at Installation
	• aerobelt conveyor • low friction conveyor • conveyor with diabolos. The type of conveyor depends on the substance to be transported and on the location and has to be decided on a case-by-case basis. For existing conventional conveyors, transporting highly drift sensitive products (S1 and S2) and moderately drift sensitive, not wettable products (S3), BAT is to apply housing; see Section 4.4.6.2. When applying an extraction system, BAT is to filter the outgoing air stream; see Section 4.4.6.4. To reduce energy consumption for conveyor belts (see Section 4.4.5.2), BAT is to apply: • a good conveyor design, including idlers and idler spacing • an accurate installation tolerance, and • a belt with low rolling resistance. See Annex 8.4 for the disperseveness classes (S1 – S4) of solid bulk materials.	

C: Comparison of the processes at Facility with the BREF for Energy efficiency (published February 2009).

Part 1. Best Available Techniques for achieving energy efficiency at an installation level

Aspect of BAT	BAT	Status at Installation
Energy efficiency management	A number of energy efficiency management techniques are determined as BAT. The scope (e.g. level of detail) and nature of the energy efficiency management system (ENEMS) (e.g. standardised or non-standardised) will generally be related to the nature, scale and complexity of the installation, as well as the energy requirements of the component processes and systems (see Section 2.1): BAT is to implement and adhere to an energy efficiency management system (ENEMS) that incorporates, as appropriate to the local circumstances, all of the following features (see Section 2.1. The letters (a), (b), etc. below, correspond those in Section 2.1): a. commitment of top management (commitment of the top management is regarded as a precondition for the successful application of energy efficiency management) b. definition of an energy efficiency policy for the installation by top management c. planning and establishing objectives and targets (see BAT “Continuous environmental improvement”, BAT “Identification of energy efficiency aspects of an installation and opportunities for energy savings” and BAT “Establishing and reviewing energy efficiency objectives	Energy efficiency management shall be captured via EMS objectives and targets.

Aspect of BAT	BAT	Status at Installation
	and indicators”) d. implementation and operation of procedures paying particular attention to: ▪ structure and responsibility ▪ training, awareness and competence (see BAT “Maintaining expertise”) ▪ communication ▪ employee involvement ▪ documentation ▪ effective control of processes (see BAT “Effective control of processes”) ▪ maintenance (see BAT “Maintenance”) ▪ emergency preparedness and response ▪ safeguarding compliance with energy efficiency-related legislation and agreements (where such agreements exist). e. benchmarking: the identification and assessment of energy efficiency indicators over time (see BAT “Establishing and reviewing energy efficiency objectives and indicators”), and the systematic and regular comparisons with sector, national or regional benchmarks for energy efficiency, where verified data are available (see Sections 2.1(e), 2.16 and BAT “Benchmarking”) f. checking performance and taking corrective action paying particular attention to: ▪ monitoring and measurement (see BAT “Monitoring and measurement”)	

Aspect of BAT	BAT	Status at Installation
	▪ corrective and preventive action ▪ maintenance of records ▪ independent (where practicable) internal auditing in order to determine whether or not the energy efficiency management system conforms to planned arrangements and has been properly implemented and maintained (see BAT Identification of energy efficiency aspects of an installation and opportunities for energy savings") g. review of the ENEMS and its continuing suitability, adequacy and effectiveness by top management. For (h) and (i), see further features on an energy efficiency statement and external verification, below o when de signing a new unit, taking into account the environmental impact from the eventual decommissioning of the unit o development of energy efficient technologies, and to follow developments in energy efficiency techniques. The ENEMS may be achieved by ensuring these elements form part of existing management systems (such as an EMS) or by implementing a separate energy efficiency management system. Three further features are considered as supporting	

Aspect of BAT	BAT	Status at Installation
	measures. Although these features have advantages, systems without them can be BAT. These three additional steps are: • (see Section 2.1(h)) preparation and publication (and possibly external validation) of a regular energy efficiency statement describing all the significant environmental aspects of the installation, allowing for year-by-year comparison against environmental objectives and targets as well as with sector benchmarks as appropriate • (see Section 2.1(i)) having the management system and audit procedure examined and validated by an accredited certification body or an external ENEMS verifier • (see Section 2.1, Applicability, 2) implementation and adherence to a nationally or internationally accepted voluntary system such as: o DS2403, IS 393, SS627750, VDI Richtlinie No. 46, etc. o (when including energy efficiency management in an EMS) EMAS and EN ISO 14001:1996. This voluntary step could give higher credibility to the ENEMS. However, non -standardised systems can be equally effective provided that they are properly designed and implemented. *Applicability:* *All installations. The scope and nature (e.g. level of detail) of applying this ENEMS will depend on the nature, scale and complexity of the installation, and the energy*	

Aspect of BAT	BAT	Status at Installation
	requirements of the component processes and systems.	
Planning and establishing objectives and targets **Continuous environmental improvement**	An important aspect of environmental management systems is continuing environmental improvement. This requires maintaining a balance for an installation between consumption of energy, raw materials and water, and the emissions (see Sections 1.1.6 and 2.2.1). Planned continuous improvement can also achieve the best cost-benefit for achieving energy savings (and other environmental benefits). BAT is to continuously minimise the environmental impact of an installation by planning actions and investments on an integrated basis and for the short, medium and long term, considering the cost-benefits and cross-media effects. *Applicability:* *All installations.* *'Continuously' means the actions are repeated over time, i.e. all planning and investment decisions should consider the overall long term aim to reduce the environmental impacts of the operation. This may mean avoiding short term actions to better use available investments over a longer term, e.g. changes to the core process may require more investment and take longer to implement, but may bring bigger reductions in energy use and emissions (see examples in Section 2.2.1).* *The environmental benefits may not be linear, e.g. 2 % energy savings every year for 10 years. They may be*	One important objective at SAWTP (which is related to energy) is the generation of electricity units. Under normal operations, the objective is to reach an electricity generation of 7,000kWh per day.

Aspect of BAT	BAT	Status at Installation
	stepwise, reflecting investment in ENE projects, etc. (see Section 2.2.1). Equally, there may be cross-media effects: for example it may be necessary to increase energy consumption to abate an air pollutant. *Environmental impacts can never be reduced to zero, and there will be points in time where there is little or no cost-benefit to further actions. However, over a longer period, with changing technology and costs (e.g. energy prices), the viability may also change.*	
Planning and establishing objectives and targets **Identification of energy efficiency aspects of an installation and opportunities for energy savings**	In order to optimise energy efficiency, the aspects of an installation that influence energy efficiency need to be identified and quantified (see Section 2.11). Energy savings can then be identified, evaluated, prioritised and implemented according to the previous BAT, above (see Section 2.1(c)). BAT is to identify the aspects of an installation that influence energy efficiency by carrying out an audit. It is important that an audit is coherent with a systems approach (see BAT "A systems approach to energy management"). *Applicability:* *All existing installations and prior to planning upgrades or rebuilds. An audit may be internal or external.* *The scope of the audit and nature (e.g. level of detail, the time between audits) will depend on the nature, scale and complexity of the installation and the energy consumption of the component processes and systems (see Section 2.8.),*	Energy efficiency at the plant has been improved through the installation of a power factor correction unit. The Digesters 1 and 2 are heated to a reaction temperature of approximately 37 °C using double tube heat exchangers. The engine cooling water from the block heat and power stations is used as a heating medium. Another initiative to use surplus energy is the installation of a system which uses excess heat from the CHPs to heat the swimming pool of a neighbouring institution (Inspire).

Aspect of BAT	BAT	Status at Installation
	e.g.: o *in large installations with many systems and individual energy-using components such as motors, it will be necessary to prioritise data collection to necessary information and significant uses* o *in smaller installations, a walk-through type audit may be sufficient.* *The first energy audit for an installation may be called an energy diagnosis.* When carrying out an audit, BAT is to ensure that the audit identifies the following aspects (see Section 2.11): a. energy use and type in the installation and its component systems and processes b. energy-using equipment, and the type and quantity of energy used in the installation c. possibilities to minimise energy use, such as: o controlling/reducing operating times, e .g. switching off when not in use (e.g. see Sections 3.6, 3.7, 3.8, 3.9, 3.11) o ensuring insulation is optimised, e.g. see Sections 3.1.7, 3.2.11 and 3.11.3.7 o optimising utilities, associated systems, processes and equipment (see Chapter 3)	

Aspect of BAT	BAT	Status at Installation
	d. possibilities to use alternative sources or use of e. energy that is more efficient, in particular energy surplus from other processes and/or systems, see Section 3.3 e. possibilities to apply energy surplus to other processes and/or systems, see Section 3.3 f. possibilities to upgrade heat quality (see Section 3.3.2). *Applicability:* *All installations. The scope of the audit and the nature (e.g. level of detail) will depend on the nature, scale and complexity of the installation, and the energy consumption of the component processes and systems.* *Examples of some techniques for optimising systems and processes are given in the relevant sections in Chapter 3.* BAT is to use appropriate tools or methodologies to assist with identifying and quantifying energy optimisation, such as: o energy models, databases and balances (see Section 2.15) o a technique such as pinch methodology (see Section 2.12) exergy or enthalpy analysis (see Section 2.13), or thermoeconomics (see Section 2.14) o estimates and calculations (see Sections 1.5 and 2.10.2).	

Aspect of BAT	BAT	Status at Installation
	Applicability: *Applicable to every sector. The choice of appropriate tool or tools will depend on the sector, and the size, complexity and energy usage of the site. This will be site-specific, and is discussed in the relevant sections.* BAT is to identify opportunities to optimise energy recovery within the installation, between systems within the installation (see BAT "A systems approach to energy management") and/or with a third party (or parties), such as those described in Sections 3.2, 3.3 and 3.4. *Applicability:* *The scope for energy recovery depends on the existence of a suitable use for the heat at the type and quantity recovered (see Sections 3.3 and 3.4, and Annexes 7.10.2 and 7.10.3). A systems approach is set out in Section 2.2.2 and BAT "A systems approach to energy management"). Opportunities may be identified at various times, such as a result of audits or other investigations, when considering upgrades or new plants, or when the local situation changes (such as a use for surplus heat is identified in a nearby activity).* *The cooperation and agreement of a third party may not be within the control of the operator, and therefore may not be within the scope of an IPPC permit. In many cases, public authorities have facilitated such arrangements or are the third party.*	

Aspect of BAT	BAT	Status at Installation
Planning and establishing objectives and targets **A systems approach to energy management**	The major energy efficiency gains are achieved by viewing the installation as a whole and assessing the needs and uses of the various systems, their associated energies and their interactions (see Sections 1.3.5, 1.4.2 and 2.2.2). BAT is to optimise energy efficiency by taking a systems approach to energy management in the installation. Systems to be considered for optimising as a whole are, for example: ➢ process units (see sector BREFs) ➢ heating systems such as: • steam (see Section 3.2) • hot water ➢ cooling and vacuum (see the ICS BREF) ➢ motor driven systems such as: • compressed air (see Section 3.7) • pumping (see Section 3.8) ➢ lighting (see Section 3.10) ➢ drying, separation and concentration (see Section 3.11). *Applicability:* *All installations. The scope and nature (e.g. level of detail, frequency of optimisation, systems to be considered at any one time) of applying this technique will depend on factors such as the nature, scale and complexity of the installation, the energy requirements of the component processes and systems and the techniques considered for application.*	N/A
Planning and establishing	Quantifiable, recorded energy efficiency objectives are crucial for achieving and maintaining energy efficiency.	As stated earlier, one objective at SAWTP is the generation of electricity units. Under normal operations, the objective

Aspect of BAT	BAT	Status at Installation
objectives and targets **Establishing and reviewing energy efficiency objectives and indicators**	Areas for improvement are identified from an audit (see BAT "Identification of energy efficiency aspects of an installation and opportunities for energy savings"). Indicators need to be established to assess the effectiveness of energy efficiency measures. For process industries, these are preferably indicators related to production or service throughput (e.g. GJ/t product, see Section 1.3), termed specific energy consumption (SEC). Where a single energy objective (such as SEC) cannot be set, or where it is helpful, the efficiency of individual processes, units or systems may be assessed. Indicators for processes are often given in the relevant sector BREFS (for an overview, see [283, EIPPCB]). Production parameters (such as production rate, product type) vary and these may affect the measured energy efficiency and should be recorded to explain variations and to ensure that energy efficiency is realised by the techniques applied (see Sections 1.4 and 1.5). Energy use and transfers may be complicated and the boundary of the installation or system being assessed should be carefully defined on the basis of entire systems (see Sections 1.3.5 and 1.4.2 and previous BAT "A systems approach to energy management"). Energy should be calculated on the basis of primary energy, or the energy uses shown as secondary energy for the different utilities (e.g. process heat as steam use in GJ/t, see Section 1.3.6.1). BAT is to establish energy efficiency indicators by carrying out all of the following:	is to reach an electricity generation of 7,000kWh per day. To monitor this figure throughout the year.

Aspect of BAT	BAT	Status at Installation
	a. identifying suitable energy efficiency indicators for the installation, and where necessary, individual processes, systems and/or units, and measure their change over time or after the implementation of energy efficiency measures (see Sections 1.3 and 1.3.4) b. identifying and recording appropriate bound aries associated with the indicators (see Sections 1.3.5 and 1.5.1) c. identifying and recording factors that can cause variation in the energy efficiency of the relevant process, systems and/or units (see Sections 1.3.6 and 1.5.2). *Applicability:* *All installations. The scope and nature (e.g. level of detail) of applying these techniques will depend on the nature, scale and complexity of the installation, and the energy consumption of the component processes and systems.* *Secondary or final energies are usually used for monitoring ongoing situations. In some cases, it may be most convenient to use more than one secondary or final energy indicator, for example, in the pulp and paper industry, where both electricity and steam are given as joint energy efficiency indicators. When deciding on the use (or change) of energy vectors and utilities, the energy indicator used may also be the secondary or final energy. However, other indicators such as primary energy or carbon balance may be used, to take account of the production of any secondary*	

Aspect of BAT	BAT	Status at Installation
	energy vector and the cross-media effects, depending on local circumstances (see Section 1.3.6.1).	
Planning and establishing objectives and targets **Benchmarking**	Benchmarking is a powerful tool for assessing the performance of a plant and the effectiveness of energy efficiency measures, as well as overcoming paradigm blindness.[1] Data may be found in sector BREFs, trade association information, national guidance documents, theoretical energy calculations for processes, etc. Data should be comparable and may need to be corrected, e.g. for type of feedstock. Data confidentiality may be important, such as where energy consumption is a significant part of the cost of production, although it may be possible to protect data (see Section 2.16). See also the establishment of energy indicators in the previous BAT "Establishing and reviewing energy efficiency objectives and indicators". Benchmarking can also be applied to processes and working methods (see Sections 2.5 and 2.16). BAT is to carry out systematic and regular comparisons with sector, national or regional benchmarks, where validated data are available. *Applicability:* *All installations. The level of detail will depend on the*	The introduction of the power factor correction unit measure shall be monitored and compared to previous years.

[1] Paradigm blindness is a term used to describe the phenomenon that occurs when the dominant paradigm prevents one from seeing viable alternatives, i.e. 'the way we do it is best, because we've always done it this way'

Aspect of BAT	BAT	Status at Installation
	nature, scale and complexity of the installation, and the energy consumption of the component processes and systems. Confidentiality issues may need to be addressed (see Section 2.16): for instance, the results of benchmarking may remain confidential. Validated data include those in BREFs, or those verified by a third party. The period between benchmarkings is sector-specific and usually long (i.e. years), as benchmark data rarely change rapidly or significantly in a short time period.	
Energy efficient design (EED)	The planning phase of a new installation, unit or system (or one undergoing major refurbishment) offers the opportunity to consider the lifetime energy costs of processes, equipment and utility systems, and to select the most energy efficient options, with the best lifetime costs (see Section 2.1(c)). BAT is to optimise energy efficiency when planning a new installation, unit or system or a significant upgrade (see Section 2.3) by considering all of the following: a. the energy efficient design (EED) should be initiated at the early stages of the conceptual design/basic design phase, even though the planned investments may not be well-defined. The EED should also be taken into account in the tendering process b. the development and/or selection of energy efficient technologies (see Sections 2.1(k) and 2.3.1)	N/A

Aspect of BAT	BAT	Status at Installation
	c. additional data collection may need to be carried out as part of the design project or separately to supplement existing data or fill gaps in knowledge d. the EED work should be carried out by an energy expert e. the initial mapping of energy consumption should also address which parties in the project organisations influence the future energy consumption, and should optimise the energy efficiency design of the future plant with them. For example, the staff in the (existing) installation who may be responsible for specifying design parameters. *Applicability:* *All new and significantly refurbished installations, major processes and systems.* *Where relevant in-house expertise on ENE is not available (e.g. non-energy intensive industries), external ENE expertise should be sought (see Section 2.3).*	
Increased process integration	There are additional benefits to seeking process integration, such as optimising raw material usage. BAT is to seek to optimise the use of energy between more than one process or system (see Section 2.4), within the installation or with a third party.	The Digesters 1 and 2 are heated to a reaction temperature of approximately 37 °C using double tube heat exchangers. The engine cooling water from the block heat and power stations is used as a heating medium. Another initiative to use surplus energy is the installation of a system which uses excess heat from the CHPs to heat the swimming pool of a neighbouring institution (Inspire).

Aspect of BAT	BAT	Status at Installation
	Applicability: *All installations. The scope and nature (e.g. level of detail) of applying this technique will depend on the nature, scale and complexity of the installation, and the energy requirements of the component processes and systems.* *The cooperation and agreement of a third party may not be within the control of the operator, and therefore may not be within the scope of an IPPC permit. In many cases, public authorities have facilitated such arrangements or are the third party.*	
Maintaining the impetus of energy efficiency initiatives	To successfully achieve ongoing energy efficiency improvement over time, it is necessary to maintain the impetus of energy efficiency programmes (see Section 2.5). BAT is to maintain the impetus of the energy efficiency programme by using a variety of techniques, such as: a. implementing a specific energy efficiency management system (see Section 2.1 and first BAT "Energy efficiency management") b. accounting for energy usage based on real (metered) values, which places both the obligation and credit for energy efficiency on the user/bill payer (see Sections 2.5, 2.10.3 and 2.15.2) c. the creation of financial profit centres for energy efficiency (see Section 2.5)	N/A

Aspect of BAT	BAT	Status at Installation
	d. benchmarking (see Section 2.16 and BAT "Benchmarking") e. a fresh look at existing management systems, such as using operational excellence (see Section 2.5) f. using change management techniques (also a feature of operational excellence, see Section 2.5). *Applicability:* *All installations. It may be appropriate to use one technique or several techniques together. The scope and nature (e.g. level of detail) of applying these techniques will depend on the nature, scale and complexity of the installation, and the energy consumption of the component processes and systems. Techniques (a), (b) and (c) are applied and maintained according to the relevant sections referred to. The frequency of application of techniques such as (d), (e) and (f) should be far enough apart to enable the progress of the ENE programme to be assessed, and is therefore likely to be several years.*	
Maintaining expertise	Human resources are required for the implementation and control of energy efficiency management, and staff whose work may affect energy should receive training (see Section 2.1(d)(i) and (ii), and Section 2.6). BAT is to maintain expertise in energy efficiency and energy-using systems by using techniques such as: a. recruitment of skilled staff and/or training of staff. Training can be delivered by in-house staff, by external experts, by formal courses or by self-study/development	N/A

Aspect of BAT	BAT	Status at Installation
	(see Section 2.6) b. taking staff off-line periodically to perform fixed term/specific investigations (in their original installation or in others, see Section 2.5) c. sharing in-house resources between sites (see Section 2.5) d. use of appropriately skilled consultants for fixed term investigations (e.g. see Section 2.11) e. outsourcing specialist systems and/or functions (e.g. see Annex 7.12) *Applicability:* *All installations. The scope and nature (e.g. level of detail) of applying these techniques will depend on the nature, scale and complexity of the installation, and the energy requirements of the component processes and systems.*	
Effective control of processes	BAT is to ensure that the effective control of processes is implemented by techniques such as: a. having systems in place to ensure that procedures are known, understood and complied with (see Sections 2.1(d)(vi) and 2.5) b. ensuring that the key performance parameters are identified, optimised for energy efficiency and monitored	N/A

Aspect of BAT	BAT	Status at Installation
	(see Sections 2.8 and 2.10) c. documenting or recording these parameters (see Sections 2.1(d)(vi), 2.5, 2.10 and 2.15). *Applicability:* *All installations. The scope and nature (e.g. level of detail) of applying these techniques will depend on the sector, nature, scale and complexity of the installation, and the energy requirements of the component processes and systems.*	
Maintenance	Structured maintenance and the repair of equipment that uses energy and/or controls energy use at the earliest opportunity are essential for achieving and maintaining efficiency (see Sections 2.1(d)(vii), 2.9 and first BAT “Energy efficiency management”). BAT is to carry out maintenance at installations to optimise energy efficiency by applying all of the following: a. clearly allocating responsibility for the planning and execution of maintenance b. establishing a structured programme for maintenance based on technical descriptions of the equipment, norms, etc. as well as any equipment failures and consequences. Some maintenance activities may be best scheduled for plant shutdown periods	N/A

Aspect of BAT	BAT	Status at Installation
	c. supporting the maintenance programme by appropriate record keeping systems and diagnostic testing d. identifying from routine maintenance, breakdowns and/or abnormalities possible losses in energy efficiency, or where energy efficiency could be improved e. identifying leaks, broken equipment, worn bearings, etc. that affect or control energy usage, and rectifying them at the earliest opportunity. *Applicability:* *All installations. The scope and nature (e.g. level of detail) of applying these techniques will depend on the nature, scale and complexity of the installation, and the energy requirements of the component processes and systems. Carrying out repairs promptly has to be balanced (where applicable) with maintaining the product quality and process stability and the health and safety issues of carrying out repairs on the operating plant (e.g. it may contain moving and/or hot equipment, etc.).*	
Monitoring and measurement	Monitoring and measurement are an essential part of checking in a 'plan-do-check-act' system, such as in energy management (Section 2.1). It is also a part of the effective control of processes (see BAT "Effective control of processes"). BAT is to establish and maintain documented procedures to monitor and measure, on a regular basis, the key	N/A

Aspect of BAT	BAT	Status at Installation
	characteristics of operations and activities that can have a significant impact on energy efficiency. Some suitable techniques are given in Section 2.10. *Applicability:* *All installations. The scope and nature (e.g. level of detail) of applying this technique will depend on the nature, scale and complexity of the installation, and the energy requirements of the component processes and systems.*	

Part 2. Best available techniques for achieving energy efficiency in energy-using systems, processes, activities or equipment

Aspect of BAT	BAT	Status at Installation
Introduction	Section 4.2.2.3 identifies the importance of seeing the installation as a whole, and assessing the needs and purposes of the various systems, their associated energies and their interactions. BAT "A systems approach to energy management" gives examples of systems commonly found in installations. In the previous Section "Best available techniques for achieving energy efficiency at an installation level", there are BAT that are generally applicable to all systems, processes and associated activities. These include: • analysing and benchmarking the system and its performance (BAT "Energy efficiency management", BAT "Identification of energy efficiency aspects of an installation and opportunities for energy savings", BAT "Establishing and reviewing energy efficiency objectives and Indicators" and BAT "Benchmarking") • planning actions and investments to optimise energy efficiency considering the cost-benefits and cross-media effects (BAT "Continuous environmental improvement") • for new systems, optimising energy efficiency in the design of the installation, unit or system and in the selection of processes (BAT "Energy efficient design (EED") • for existing systems, optimising the energy efficiency of the system through its operation and management, including regular monitoring and maintenance (see BAT "Effective control of processes", BAT "Maintenance" and BAT	N/A

Aspect of BAT	BAT	Status at Installation
	“Monitoring and measurement”). The BAT presented in this section therefore assume that these general BAT in the previous Section “Best available techniques for achieving energy efficiency at an installation level” are also applied to the systems described below, as part of their optimisation.	
Combustion	Combustion is a widely used process for both direct heating (such as in cement and lime manufacture, steel making) and indirect heating (such as firing steam boiler systems and electricity generation). Techniques for energy efficiency in combustion are therefore addressed in the appropriate sector BREFs. For other cases, such as combustion in associated activities, the Scope of the LCP BREF states: '…smaller units can potentially be added to a plant to build one larger installation exceeding 50 MW. This means that all kinds of conventional power plants (e.g. utility boiler, combined heat and power plants, district heating plants.) used for mechanical power and heat generation are covered by this (LCP BREF) work.' BAT is to optimise the energy efficiency of combustion by relevant techniques such as: o those specific to sectors given in vertical BREFs o those given in Figure 1.	N/A
Steam systems	Steam is a widely used heat transport medium because of its non-toxic nature, stability, low cost and high heat capacity, and flexibility in use. Steam utilisation efficiency is	N/A

Aspect of BAT	BAT	Status at Installation
	frequently neglected, as it is as not as easily measured as the thermal efficiency of a boiler. It may be determined using tools such as those in BAT "Identification of energy efficiency aspects of an installation and opportunities for energy savings" in conjunction with appropriate monitoring (see Section 2.10). BAT for steam systems is to optimise the energy efficiency by using techniques such as: o those specific to sectors given in vertical BREFs o those given in Figure 2.	
Heat recovery	The main types of heat recovery systems are described in Section 3.3: • heat exchangers (see Section 3.3.1) • heat pumps (see Section 3.3.2). Heat exchange systems are widely used with good results in many industrial sectors and systems, and are widely used for implementing BAT "Identification of energy efficiency aspects of an installation and opportunities for energy savings" and BAT "Increased process integration". Heat pumps are being increasingly used. The use of 'wasted' or surplus heat may be more sustainable than using primary fuels, even if the energy efficiency in use is lower.	The Digesters 1 and 2 are heated to a reaction temperature of approximately 37 °C using double tube heat exchangers. The engine cooling water from the block heat and power stations is used as a heating medium. Another initiative to use surplus energy is the installation of a system which uses excess heat from the CHPs to heat the swimming pool of a neighbouring institution (Inspire).

Aspect of BAT	BAT	Status at Installation
	Heat recovery is not applicable where there is no demand that matches the production curve. However, it is being applied in an increasing number of cases, and many of these can be found outside of the installation, see Section 3.4 and Annex 7.10. Techniques for cooling and the associated BAT are described in the ICS BREF, including techniques for the maintenance of heat exchangers. BAT is to maintain the efficiency of heat exchangers by both: a. monitoring the efficiency periodically, and b. preventing or removing fouling See Section 3.3.1.1.	
Cogeneration	There is significant interest in cogeneration, supported at European Community level by the adoption of Directive 2004/8/EC on the promotion of cogeneration, and Directive 2003/96/EC on energy taxation, as well as by various national level policies and incentives. Relatively small scale plants may now be economically feasible, and incentives may also be available. In many cases, cogeneration has been successfully installed due to the assistance of local authorities. See Section 3.4 and Annex 7.10.3 and 7.10.4. Utilities modelling, described in Section 2.15.2, can assist the optimisation of generation and heat recovery systems, as	N/A

Aspect of BAT	BAT	Status at Installation
	well as managing the selling and buying of surplus energy. BAT is to seek possibilities for cogeneration, inside and/or outside the installation (with a third party). *Applicability:* *The cooperation and agreement of a third party may not be within the control of the operator, and therefore may not be within the scope of an IPPC permit.* *Cogeneration is as likely to depend as much on economic conditions as ENE optimisation.* *Cogeneration opportunities should be sought on the identification of possibilities, on investment either on the generator's side or potential customer's side, identification of potential partners or by changes in economic circumstances (heat, fuel prices, etc.).* *In general, cogeneration can be considered when:* • *the demands for heat and power are concurrent* • *the heat demand (on-site and/or off-site), in terms of quantity (operating times during year), temperature, etc. can be met using heat from the CHP plant, and no significant heat demand reductions can be expected.* *Section 3.4 discusses the application of cogeneration, the different types of cogeneration (CHP) plants and their applicability in individual cases.*	

Aspect of BAT	BAT	Status at Installation
	Successful implementation may depend on a suitable fuel and/or heat price in relation to the price of electricity. In many cases, public authorities (at local, regional or national level) have facilitated such arrangements or are the third party.	
Electrical power supply	Quality of the electrical power supply and the manner in which the power is used can affect energy efficiency, see Section 3.5. This may be difficult to understand and is often overlooked. There are often energy losses as unproductive power inside the installation and in the external supply grid. There can also be loss of capacity in the installation's electrical distribution system, leading to voltage drops, causing overheating and premature failure of motors and other equipment. It may also lead to increased charges when buying in electricity. BAT is to increase the power factor according to the requirements of the local electricity distributor by using techniques such as those in Table 4.3, according to applicability (see Section 3.5.1).	Power factor correction unit is installed at the plant.

Aspect of BAT	BAT	Status at Installation

Technique	Applicability
Installing capacitors in the AC circuits to decrease the magnitude of reactive power	All cases. Low cost and long lasting, but requires skilled application
Minimising the operation of idling or lightly loaded motors	All cases
Avoiding the operation of equipment above its rated voltage	All cases
When replacing motors, using energy efficient motors (see Section 3.6.1)	At time of replacement

Table 4.3: Electrical power factor correction techniques to improve energy efficiency

BAT is to check the power supply for harmonics and apply filters if required (see Section 3.5.2).

BAT is to optimise the power supply efficiency by using techniques such as those in Table 4.4, according to applicability:

Technique	Applicability	Section in this document
Ensure power cables have the correct dimensions for the power demand	When the equipment is not in use, e.g. at shutdown or when locating or relocating equipment	3.5.3
Keep online transformer(s) operating at a load above 40 – 50 % of the rated power	∞ for existing plants: when the present load factor is below 40 %, and there is more than one transformer ∞ on replacement, use a low loss transformer and with a loading of 40 – 75 %	3.5.4
Use high efficiency/low loss transformers	At time of replacement, or where there is a lifetime cost benefit	3.5.4
Place equipment with a high current demand as close as possible to the power source (e.g. transformer)	When locating or relocating equipment	3.5.4

Table 4.4: Electrical power supply techniques to improve energy efficiency

Aspect of BAT	BAT	Status at Installation
Electric motor driven sub-	Electric motors are widely used in industry. Replacement by electrically efficient motors (EEMs) and variable speed	At the MRF, all feeder conveyors are driven by gear motors at variable speed (VFD - Variable Frequency Drives).

Aspect of BAT	BAT	Status at Installation
systems[2]	drives (VSDs) is one of the easiest measures when considering energy efficiency. However, this should be done in the context of considering the whole system the motor sits in, otherwise there are risks of: • losing the potential benefits of optimising the use and size of the systems, and subsequently optimising the motor drive requirements • losing energy if a VSD is applied in the wrong context. The key systems using electric motors are: o compressed air (CAS, see Section 3.7) o pumping (see Section 3.8) o heating, ventilation and air conditioning (see Section 3.9) o cooling (see the ICS BREF). BAT is to optimise electric motors in the following order (see Section 3.6): 1. optimise the entire system the motor(s) is part of (e.g. cooling system, see Section 1.5.1) 2. then optimise the motor(s) in the system according to the newly-determined load requirements, by applying one or more of the techniques in Figure 3, according to applicability 3. when the energy-using systems have been optimised, then optimise the remaining (non-optimised) motors	

[2] In this document 'system' is used to refer to a set of connected items or devices which operate together for a specific purpose, e.g. ventilation, CAS. See the discussion on system boundaries in Sections 1.3.5 and 1.5.1. These systems usually include motor sub-systems (or component systems).

Aspect of BAT	BAT	Status at Installation
	according to Table 4.5 and criteria such as: ▪ prioritising the remaining motors running more than 2000 hrs per year for replacement with EEMs ▪ electric motors driving a variable load operating at less than 50 % of capacity more than 20 % of their operating time, and operating for more than 2000 hours a year should be considered for equipping with variable speed drives.	
Compressed air systems (CAS)	Compressed air is widely used as either part of a process or to provide mechanical energy. It is widely used where there is risk of explosion, ignition, etc. In many cases, it is used as an integral part of the process (such as providing low quality nitrogen as an inert atmosphere, and for blowing, moulding or mixing), and it is difficult to assess its mechanical efficiency. In some cases, e.g. where driving small turbines such as assembly tools, it has a low overall efficiency, and where there are no health and safety constraints, replacement with other drives may be considered (see Section 3.7). BAT is to optimise compressed air systems (CAS) using the techniques such as those in Figure 4, according to applicability.	N/A
Pumping systems	Some 30 to 50 % of the energy consumed by pumping systems may be saved through equipment or control system changes (see Section 3.8). For electric motors used for driving pumps, see BAT	N/A

Aspect of BAT	BAT	Status at Installation
	"Electric motor driven sub-systems". However, the use of VSDs (a key technique) is also mentioned in Figure 5. BAT is to optimise pumping systems by using the techniques in Figure 5, according to applicability (see Section 3.8). Note that throttle control is less energy wasteful than bypass control or no control. However, all are wasteful of energy and should be considered for replacement according to size of the pump and how frequently it is used.	
Heating, ventilation and air conditioning (HVAC) systems	A typical HVAC system comprises the equipment providing some or all of the following functions: • system heating (boilers, see Section 3.2; heat pumps, see Section 3.3.2, etc.) • cooling (see Section 3.3) • pumps (see Section 3.8) • heat exchangers (see Section 3.3.1) transferring or absorbing heat from a space or a process • space heating and cooling (Section 3.9.1) • ventilation by fans extracting or providing air through ducts, to or from heat exchangers and/or the external air (see Section 3.9.2). Studies have shown that about 60 % of the energy in an HVAC system is consumed by the chiller/heat pump and the remaining 40 % by peripheral machinery. Air conditioning is increasingly used across Europe, particularly in the south.	N/A

Aspect of BAT	BAT	Status at Installation
	Ventilation is essential for many industrial installations to function. It: • protects staff from pollutant and heat emissions within premises • maintains a clean working atmosphere to protect product quality. Requirements may be dictated by health, safety and process considerations (see Section 3.9). BAT is to optimise heating, ventilation and air conditioning systems by using techniques such as: • for ventilation, space heating and cooling, techniques in Figure 6 according to applicability • for heating, see Sections 3.2 and 3.3.1, and BAT "Steam systems" and BAT "Heat recovery" • for pumping, see Section 3.8 and previous BAT "Pumping systems" • for cooling, chilling and heat exchangers, see the ICS BREF, as well as Section 3.3 and BAT "Heat recovery".	
Lighting	Health and safety at work is the priority criterion for lighting systems requirements. The energy of lighting systems can be optimised according to the specific use requirements, see Section 3.10. BAT is to optimise artificial lighting systems by using the techniques such as those in Figure 7 according to	Street lighting is provided throughout the site according to the legal requirements. Street lighting is such to minimize light emission from the site.

Aspect of BAT	BAT	Status at Installation
	applicability (see Section 3.10).	
Drying, separation and concentration processes	The separation of (usually) a solid from a liquid may be carried out by one or more stages. By optimising the process steps necessary to achieve the required product, substantial energy savings can be achieved. Energy efficiency may be optimised by using two or more techniques in combination (see Section 3.11). BAT is to optimise drying, separation and concentration processes by using techniques such as those in Figure 8 according to applicability, and to seek opportunities to use mechanical separation in conjunction with thermal processes.	N/A

Figure 1:

	Techniques for sectors and associated activities where combustion is not covered by a vertical BREF				
	Techniques in the LCP BREF July 2006 by fuel type and section				**Techniques in this document (the ENE BREF) by section**
	Coal and lignite	**Biomass and peat**	**Liquid fuels**	**Gaseous fuels**	
Lignite pre-drying	4.4.2				
Coal gasification	4.1.9.1 4.4.2 7.1.2				
Fuel drying		5.1.2, 5.4.2 5.4.4			
Biomass gasification		5.4.2 7.1.2			
Bark pressing		5.4.2 5.4.4			
Expansion turbine to recover the energy content of pressurised gases				7.1.1 7.1.2 7.4.1 7.5.1	
Cogeneration 4.	5.5 6.1.8	5.3.3 5.5.4	4.5.5 6.1.8	7.1.6 7.5.2	3.4 Cogeneration
Advanced computerised control of combustion conditions for emission reduction and boiler performance	4.2.1 4.2.1.9 4.4.3 4.5.4	5.5.3 6	.2.1 6.2.1.1 6.4.2 6.5.3.1	7.4.2 7.5.2	
Use of the heat content of the flue-gas for district heating	4.4.3				
Low excess air	4.4.3 4.4.6	5.4.7	6.4.2 6.4.5	7.4.3	3.1.3 Reducing the mass flow of the flue-gases by reducing the excess air

	Techniques for sectors and associated activities where combustion is not covered by a vertical BREF				
	Techniques in the LCP BREF July 2006 by fuel type and section				Techniques in this document (the ENE BREF) by section
	Coal and lignite	Biomass and peat	Liquid fuels	Gaseous fuels	
Lowering of exhaust gas temperatures	4.4.3		6.4.2		3.1.1 Reduction of the flue-gas temperature by: ∞ dimensioning for the maximum performance plus a calculated safety factor for surcharges ∞ increasing heat transfer to the process by increasing either the heat transfer rate, or increasing or improving the heat transfer surfaces ∞ heat recovery by combining an additional process (for example, steam generation by using economisers,) to recover the waste heat in the flue-gases ∞ installing an air or water preheater or preheating the fuel by exchanging heat with flue-gases (see 3.1.1 and 3.1.1.1). Note that the process can require air preheating when a high flame temperature is needed (glass, cement, etc.)

					∞ cleaning of heat transfer surfaces that are progressively covered by ashes or carbonaceous particulates, in order to maintain high heat transfer efficiency. Soot blowers operating periodically may keep the convection zones clean. Cleaning of the heat transfer surfaces in the combustion zone is generally made during inspection and maintenance shutdown, but online cleaning can be applied in some cases (e.g. refinery heaters)
Low CO concentration in the flue-gas	4.4.3		6.4.2		
Heat accumulation			6.4.2	7.4.2	
Cooling tower discharge	4.4.3		6.4.2		
Different techniques for the cooling system (see the ICS BREF)	4.4.3		6.4.2		

	Techniques for sectors and associated activities where combustion is not covered by a vertical BREF				
	Techniques in the LCP BREF July 2006 by fuel type and section				**Techniques in this document (the ENE BREF) by section**
	Coal and lignite	**Biomass and peat**	**Liquid fuels**	**Gaseous fuels**	
Preheating of fuel gas by using waste heat				7.4.2	3.1.1 Reduction of the flue-gas temperature: ∞ preheating the fuel by exchanging heat with flue-gases (see 3.1.1). Note that the process can require air preheating when a high flame temperature is needed (glass, cement, etc.)
Preheating of combustion air				7.4.2	3.1.1 Reduction of the flue-gas temperature: ∞ installing an air preheater by exchanging heat with flue-gases (see 3.1.1.1). Note that the process can require air preheating when a high flame temperature is needed (glass, cement, etc.)
Recuperative and regenerative burners					3.1.2
Burner regulation and control					3.1.4
Fuel choice					Note that the use of non-fossil fuels may be more sustainable, even if the ENE in use is lower
Oxy-firing (oxyfuel)					3.1.6
Reducing heat losses by insulation					3.1.7
Reducing losses through furnace doors					3.1.8
Fluidised bed combustion	4.1.4.2 5	.2.3			

Table 4.1: Combustion system techniques to improve energy efficiency

Figure 2:

Techniques for sectors and associated activities where steam systems are not covered by a vertical BREF		
Techniques in the ENE BREF		
	Benefits	***Section in this document***
DESIGN		
Energy efficient design and installation of steam distribution pipework	Optimises energy savings	2.3
Throttling devices and the use of backpressure turbines: utilise backpressure turbines instead of PRVs	Provides a more efficient method of reducing steam pressure for low pressure services. Applicable when size and economics justify the use of a turbine	
OPERATING AND CONTROL		
Improve operating procedures and boiler controls	Optimises energy savings	3.2.4
Use sequential boiler controls (apply only to sites with more than one boiler)	Optimises energy savings	3.2.4
Install flue-gas isolation dampers (applicable only to sites with more than one boiler)	Optimises energy savings	3.2.4

GENERATION		
Preheat feed-water by using: ∞ waste heat, e.g. from a process ∞ economisers using combustion air ∞ deaerated f eed-water t o h eat condensate ∞ condensing t he s team us ed f or stripping a nd heating t he f eed water t o t he deaerator v ia a h eat exchanger	Recovers available heat from exhaust gases and transfers it back into the system by preheating feed-water	3.2.5 3.1.1
Prevention and removal of scale deposits on heat transfer surfaces. (Clean boiler heat transfer surfaces)	Promotes effective heat transfer from the combustion gases to the steam	3.2.6
Minimise boiler blowdown by improving water treatment. Install automatic total dissolved solids control	Reduces the amount of total dissolved solids in the boiler water, which allows less blowdown and therefore less energy loss	3.2.7
Add/restore boiler refractory	Reduces heat loss from the boiler and restores boiler efficiency	3.1.7 2.9
Optimise deaerator vent rate	Minimises avoidable loss of steam	3.2.8
Minimise boiler short cycling losses	Optimises energy savings	3.2.9
Carrying out boiler maintenance		2.9

DISTRIBUTION		
Optimise steam distribution systems (especially to cover the issues below)		2.9 and 3.2.10
Isolate steam from unused lines	Minimises avoidable loss of steam and reduces energy loss from piping and equipment surfaces	3.2.10
Insulation on steam pipes and condensate return pipes. (Ensure that steam system piping, valves, fittings and vessels are well insulated)	Reduces energy loss from piping and equipment surfaces	3.2.11 and 3.2.11.1
Implement a control and repair programme for steam traps	Reduces passage of live steam into the condensate system and promotes efficient operation of end-use heat transfer equipment. Minimises avoidable loss of steam	3.2.12
RECOVERY		
Collect and return condensate to the boiler for re-use. (Optimise condensate recovery)	Recovers the thermal energy in the condensate and reduces the amount of makeup water added to the system, saving energy and chemicals treatment	3.2.13
Re-use of flash-steam. (Use high pressure condensate to make low pressure steam)	Exploits the available energy in the returning condensate	3.2.14
Recover energy from boiler blowdown	Transfers the available energy in a blowdown stream back into the system, thereby reducing energy loss	3.2.15

Techniques in the LCP BREF July 2006 by fuel type and by section				
	Coal and lignite	***Biomass and peat***	***Liquid fuels***	***Gaseous fuels***
Expansion turbine to recover the energy content of pressurised gases				7.4.1 and 7.5.1
Change turbine blades	4.4.3	5.4.4	6.4.2	
Use advanced materials to reach high steam parameters	4.4.3		6.4.2	7.4.2
Supercritical steam parameters	4.4.3, 4.5.5		6.4.2	7.1.4
Double reheat	4.4.3, 4.5.5		6.4.2, 6.5.3.1	7.1.4, 7.4.2, 7.5.2
Regenerative feed-water	4.2.3, 4.4.3	5.4.4	6.4.2	7.4.2
Use of heat content of the flue-gas for district heating	4.4.3			
Heat accumulation			6.4.2	7.4.2
Advanced computerised control of the gas turbine and subsequent recovery boilers				7.4.2

Table 4.2: Steam system techniques to improve energy efficiency

Figure 3:

Driven system energy savings measure	Applicability	Section in this document[1]
SYSTEM INSTALLATION or REFURBISHMENT		
Using energy efficient motors (EEM)	Lifetime cost benefit	3.6.1
Proper motor sizing	Lifetime cost benefit	3.6.2
Installing variable speed drives (VSD)	Use of VSDs may be limited by security and safety requirements. According to load. Note in multi-machine systems with variable load systems (e.g. CAS) it may be optimal to use only one VSD motor	3.6.3
Installing high efficiency transmission/reducers	Lifetime cost benefit	3.6.4
Use: ∞ direct coupling where possible ∞ synchronous belts or cogged V-belts in place of V belts ∞ helical gears in place of worm gears	All	3.6.4
Energy efficient motor repair (EEMR) or replacement with an EEM	At time of repair	3.6.5
Rewinding: avoid rewinding and replace with an EEM, or use a certified rewinding contractor (EEMR)	At time of repair	3.6.6
Power quality control	Lifetime cost benefit	3.5
SYSTEM OPERATION and MAINTENANCE		
Lubrication, adjustments, tuning	All cases	2.9
Note[1]: Cross-media effects, Applicability and Economics are given in Section 3.6.7		

Table 4.5: Electric motor techniques to improve energy efficiency

Figure 4:

Technique	Applicability	Section in this document
SYSTEM DESIGN, INSTALLATION or REFURBISHMENT		
Overall system design, including multi-pressure systems	New or significant upgrade	3.7.1
Upgrade compressor	New or significant upgrade	3.7.1
Improve cooling, drying and filtering	This does not include more frequent filter replacement (see below)	3.7.1
Reduce frictional pressure losses (for example by increasing pipe diameter)	New or significant upgrade	3.7.1
Improvement of drives (high efficiency motors)	Most cost effective in small (<10 kW) systems	3.7.2, 3.7.3, 3.6.4
Improvement of drives (speed control)	Applicable to variable load systems. In multi-machine installations, only one machine should be fitted with a variable speed drive	3.7.2
Use of sophisticated control systems		3.7.4
Recover waste heat for use in other functions	Note that the gain is in terms of energy, not of electricity consumption, since electricity is converted to useful heat	3.7.5
Use external cool air as intake	Where access exists	3.7.8
Storage of compressed air near highly-fluctuating uses	All cases	3.7.10
SYSTEM OPERATION and MAINTENANCE		
Optimise certain end use devices	All cases	3.7.1
Reduce air leaks	All cases. Largest potential gain	3.7.6
More frequent filter replacement	Review in all cases	3.7.7
Optimise working pressure	All cases	3.7.9

Table 4.6: Compressed air system techniques to improve energy efficiency

Figure 5:

Technique	Applicability	Section in this document	Additional information
DESIGN			
Avoid oversizing when selecting pumps and replace oversized pumps	For new pumps: all cases For existing pumps: lifetime cost benefit	3.8.1 3.8.2	Largest single source of pump energy wastage
Match the correct choice of pump to the correct motor for the duty	For new pumps: all cases For existing pumps: lifetime cost benefit	3.8.2 3.8.6	
Design of pipework system (see Distribution system, below)		3.8.3	
CONTROL and MAINTENANCE			
Control and regulation system	All cases	3.8.5	
Shut down unnecessary pumps	All cases	3.8.5	
Use of variable speed drives (VSDs)	Lifetime cost benefit. Not applicable where flows are constant	3.8.5	See BAT 24, in Section 4.3.6
Use of multiple pumps (staged cut in)	When the pumping flow is less than half the maximum single capacity	3.8.5	
Regular maintenance. Where unplanned maintenance becomes excessive, check for: ∞ cavitation ∞ wear ∞ wrong type of pump	All cases. Repair or replace as necessary	3.8.4	

DISTRIBUTION SYSTEM			
Minimise the number of valves and bends commensurate with keeping ease of operation and maintenance	All cases at design and installation (including changes). May need qualified technical advice	3.8.3	
Avoiding using too many bends (especially tight bends)	All cases at design and installation (including changes). May need qualified technical advice	3.8.3	
Ensuring the pipework diameter is not too small (correct pipework diameter)	All cases at design and installation (including changes). May need qualified technical advice	3.8.3	

Table 4.7: Pumping system techniques to improve energy efficiency

Figure 6:

Energy savings measure	Applicability	Section in this document
DESIGN and CONTROL		
Overall system design. Identify and equip areas separately for: ∞ general ventilation ∞ specific ventilation ∞ process ventilation	New or significant upgrade. Consider for retrofit on lifetime cost benefit	3.9.1 3.9.2.1
Optimise the number, shape and size of intakes	New or upgrade	3.9.2.1
Use fans: ∞ of high efficiency ∞ designed to operate at optimal rate	Cost effective in all cases	3.9.2.1 3.9.2.2
Manage airflow, including considering dual flow ventilation	New or significant upgrade	3.9.2.1
Air system design: ∞ ducts are of a sufficient size ∞ circular ducts ∞ avoid long runs and obstacles such as bends, narrow sections	New or significant upgrade	3.9.2.1
Optimise electric motors, and consider installing a VSD	All cases. Cost effective retrofit	3.9.2.1, 3.9.2.2, 3.6, 3.6.3, 3.6.7 and BAT 24
Use automatic control systems. Integrate with centralised technical management systems	All new and significant upgrades. Cost effective and easy upgrade in all cases	3.9.2.1 3.9.2.2
Integration of air filters into air duct system and heat recovery from exhaust air (heat exchangers)	New or significant upgrade. Consider for retrofit on lifetime cost benefit. The following issues need to be taken into account: the thermal efficiency, the pressure loss, and the need for regular cleaning	3.9.2.1 3.9.2.2

Reduce heating/cooling needs by: ∞ building insulation ∞ efficient glazing ∞ air infiltration reduction ∞ automatic closure of doors ∞ destratification ∞ lowering of temperature set point during non-production period (programmable regulation) ∞ reduction of the set point for heating and raising it for cooling	Consider in all cases and implement according to cost benefit	3.9.1
Improve the efficiency of heating systems through: ∞ recovery or use of wasted heat (Section 3.3.1) ∞ heat pumps ∞ radiative and local heating systems coupled with reduced temperature set points in the non occupied areas of the buildings	Consider in all cases and implement according to cost benefit	3.9.1
Improve the efficiency of cooling systems through the use of free cooling	Applicable in specific circumstances	3.9.3
MAINTENANCE		
Stop or reduce ventilation where possible	All cases	3.9.2.2
Ensure system is airtight, check joints	All cases	3.9.2.2
Check system is balanced	All cases	3.9.2.2
Manage airflow: optimise	All cases	3.9.2.2
Air filtering, optimise: ∞ recycling efficiency ∞ pressure loss ∞ regular filter cleaning/replacement ∞ regular cleaning of system	All cases	3.9.2.2

Table 4.8: Heating, ventilation and air conditioning system techniques to improve energy efficiency

Figure 7:

Technique	Applicability
ANALYSIS and DESIGN OF LIGHTING REQUIREMENTS	
Identify illumination requirements in terms of both intensity and spectral content required for the intended task	All cases
Plan space and activities in order to optimise the use of natural light	Where this can be achieved by normal operational or maintenance rearrangements, consider in all cases. If structural changes, e.g. building work, is required, new or upgraded installations
Selection of fixtures and lamps according to specific requirements for the intended use	Cost benefit on lifetime basis
OPERATION, CONTROL, and MAINTENANCE	
Use of lighting management control systems including occupancy sensors, timers, etc.	All cases
Train building occupants to utilise lighting equipment in the most efficient manner	All cases

Table 4.9: Lighting system techniques to improve energy efficiency

Figure 8:

Technique	Applicability	Additional information	Section in this document
DESIGN			
Select the optimum separation technology or combination of techniques (below) to meet the specific process equipments	All cases		3.11.1
OPERATION			
Use of surplus heat from other processes	Depends on the availability of surplus heat in the installation (or from third party)	Drying is a good use for surplus heat	3.11.1
Use a combination of techniques	Consider in all cases	May have production benefits, e.g. improved product quality, increased throughput	3.11.1
Mechanical processes, e.g. filtration, membrane filtration	Process dependent. To achieve high dryness at lowest energy consumption, consider these in combination with other techniques	Energy consumption can be several orders of magnitude lower, but will not achieve high % dryness	3.11.2
Thermal processes, e.g. ∞ directly heated dryers ∞ indirectly heated dryers ∞ multiple effect	Widely used, but efficiency can be improved by considering other options in this table	Convective (direct) heat dryers may be the option with the lowest energy efficiency	3.11.3 3.11.3.1 3.11.3.2 3.11.3.3 3.11.3.6
Direct drying	See thermal and radiant techniques, and superheated steam	Convective (direct) heat dryers may be the option with the lowest energy efficiency	3.11.3.2

Superheated steam	Any direct dryers can be retrofitted with superheated steam. High cost, needs lifetime cost benefit assessment. High temperature may damage product	Heat can be recovered from this process	3.11.3.4
Heat recovery (including MVR and heat pumps)	Consider for almost any continuous hot air convective dryers	3.	11.1 3.11.3.5 3.11.3.6
Optimise insulation of the drying system	Consider for all systems. Can be retrofitted		3.11.3.7
Radiation processes e.g. ∞ infrared (IR) ∞ high frequency (HF) ∞ microwave (MW)	Can be easily retrofitted. Direct application of energy to component to be dried. They are compact and Reduce the need for air extraction. IR limited by substrate dimensions. High cost, needs lifetime cost benefit assessment	More efficient heating. Can boost production throughput coupled with convection or conduction	3.11.4
CONTROL			
Process automation in thermal drying processes	All cases	Savings of between 5 and 10 % can be achieved compared with using traditional empirical controllers	3.11.5

Table 4.10: Drying, separation and concentration system techniques to improve energy efficiency

[i] There is a split view from three Member States, because in their view, on sites where significant VOC emissions are to be expected (e.g. refineries, petrochemical plants and oil terminals), BAT is to calculate the VOC emissions regularly with validated calculation methods, and because of uncertainties in the calculation methods, emissions from the plants should be monitored occasionally in order to quantify the emissions and to give basic data for refining calculation methods. This can be carried out by using DIAL techniques. The necessity and frequency of emission monitoring needs to be decided on a case-by-case basis.

[ii] There is a split view from industry, that this technique is not BAT because in their view:
a) there is no definition of ‘ volatile’ in this BREF
b) there is no test of environmental significance
c) products which may be dangerous to the environment, but not classed as toxic, are not captured
d) it can be demonstrated that other emission control measures may provide a higher level of environmental protection taking into account the costs and advantages of the various techniques
e) there are no commonly understood performance criteria for a vapour treatment installation
f) this does not take into account the cost, or advantages of other techniques
g) this does not provide the flexibility to take into account the technical characteristics of the installation concerned, its geographical location and the local environmental conditions
h) there is no proportionality in this conclusion.

[iii] There is a split view from industry, that this technique is not BAT because in their view:
a) there is no definition of ‘volatile’ in this BREF
b) there is no test of environmental significance
c) products which may be dangerous to the environment, but not classed as toxic, are not captured
d) it can be demonstrated that other emission control measures may provide a higher level of environmental protection taking into account the costs and advantages of the various techniques
e) there are no commonly understood performance criteria for a vapour treatment installation
f) this does not take into account the costs or advantages of other techniques
g) this does not provide the flexibility to take into account the technical characteristics of the installation concerned, its geographical location and the local environmental conditions
h) there is no proportionality in this conclusion.

[iv] There is a split view from industry, that this technique is not BAT because in their view:
a) there is no definition of ‘volatile’ in this BREF

b) there is no test of environmental significance

c) products which may be dangerous to the environment, but not classed as toxic, are not captured

d) it can be demonstrated that other emission control measures may provide a higher level of environmental protection taking into account the costs and advantages of the various techniques

e) there are no commonly understood performance criteria for a vapour treatment installation

f) this does not take into account the costs or advantages of other techniques

g) this does not provide the flexibility to take into account the technical characteristics of the installation concerned, its geographical location and the local environmental conditions

h) there is no proportionality in this conclusion.