



Building Ventilation and Odour Abatement

Revision D01

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1. Building Ventilation and Odour Abatement

The proposed Drehid MBT Facility will include a building ventilation system and an odour abatement system.

The function of the building ventilation system will be to provide a number of air changes per hour and to maintain a negative air pressure environment within each building. The maintaining of a negative pressure environment within each building will prevent the emission of untreated air thereby minimising nuisance odour emissions. The provision of air changes within each building will also provide appropriate working conditions for MBT plant operators.

The odour abatement system will treat the air extracted by the building ventilation system and the process air exhausted by the biological treatment process. The core components of the odour abatement system include acid scrubbers, humidifiers and biofilters. As is commonplace in modern MBT facilities, the volumes of extracted building air requiring treatment in the odour abatement system will be optimised by the integration and cascading of air flows between buildings and operational areas.

On the basis that each facility building at the proposed MBT facility will facilitate a specific element of the MBT process, the ventilation and odour abatement system will take account of the differing process activities in each facility building. This approach will ensure the efficient and focused treatment of odours generated by the MBT process.

The layout of the building ventilation system and an odour abatement system is presented in Figure 1 (Configuration A (MBT with Composting)) and Figure 2 (Configuration B (MBT with Dry Anaerobic Digestion and Composting)), attached.

1.1. Building Ventilation System

It is envisaged that the building ventilation system will comprise of aluminium ducting suspended from the underside of the roofs and located within the headspace of buildings. The arrangement of the ducting will be such to facilitate uniform extraction of air and to facilitate movement of air in all areas within buildings. To this end, a network of ducting is likely to traverse the inside of buildings. Automatically controlled dampers strategically located within ductwork will further facilitate the control and optimisation of air flows.

The facility buildings will be constructed such that the potential for air leakages is minimised. To this end, interfaces between doorways, concrete walls and proprietary cladding will be fully sealed with materials that can withstand a high humidity environment.

Electrically powered variable speed extraction fans, in the form of axial fans, will propel the movement of air within the ductwork. Pressure and flow measuring instrumentation located within the ductwork will regulate the speed of the extraction fans.

As outlined in Figure 1 and Figure 2, extracted air from buildings with lower levels of odour will be re-circulated within buildings with higher levels of odour (i.e. integration and cascading of air flows). For example, extracted air from the Mechanical Treatment Building will be re-circulated in the Biological Treatment Buildings. In this way, the volumes of extracted air requiring treatment in the odour abatement system will be optimised.

Air extracted from facility buildings, where there is a likelihood of dust generation, will be processed through a dust filter prior to being re-circulated within other facility buildings thereby preventing dust emissions and maintaining appropriate working conditions. It is envisaged that a pulse jet bag filters will be used for this purpose.

In a pulse jet bag filter, the dust laden air is sucked into a chamber where the heavier dust particles fall off upon entry, while the lighter dusts get carried upwards to filter bags where the dust gets deposited on the outer surface of the bags and the clean air moves upwards from the centre of the bags through the outlet plenum to the top air outlet. The dust collected on the outer surface of the bags is removed in a pre-determined cycle by a momentary pulse of high-pressure compressed air.

When extracted air is re-circulated in facility buildings, a significant proportion of fresh air is also drawn in through inlet openings fixed to external walls. The control of the volume of fresh air entering the buildings ensures the creation of a negative pressure environment within.

The building ventilation system will provide the following air changes within the MBT facility buildings:

- **Mechanical Treatment Building** - A minimum of three air changes per hour will be provided in the waste reception bunker. A minimum of two air changes per hour will be provided in remaining areas of this building.
- **Biological Treatment Buildings:**
 - A minimum of three air changes per hour will be provided in the section of the building containing the dry AD/composting tunnels
 - A minimum of three air changes per hour will be provided in the section of the building containing the maturation process
- **Refining Building** - A minimum of two air changes per hour will be provided in this building.
- **SRF Building** - A minimum of two air changes per hour shall be provided in this building.

The ventilation of the Biological Treatment Buildings will be further facilitated by the composting tunnel process and the maturation process. Fresh air to the composting tunnels will be taken from within the Biological Treatment Buildings. Similarly, the maturation process will be sustained by pulling building air through the trapezoidal windrows (by means of negative aeration). Negative aeration, by virtue of the pulling of air into the windrows, greatly eliminates the potential for nuisance odour emissions.

The ventilation of the SRF Building will be facilitated by the air requirements of the SRF dryer. Air from within the SRF building will be heated in a water to air heat exchanger prior to entering the SRF dryer. The air exhausted from the SRF thermal dryer will be processed through cyclones (to remove dust and particulates) prior to treatment in a humidifier and biofilter.

1.2. Odour Abatement System

The proposed MBT facility will include 3 No. odour abatement systems. The odour abatement systems will comprise of acid scrubbers, humidifiers and biofilters.

While all odourous airstreams will be processed through biofilters, only specific airstreams with a potential for high ammonia levels will be processed through acid scrubbers. Air streams with a potential for high ammonia levels include:

- Process air exhausted from the composting tunnels
- Process air exhausted from the dry AD tunnels (during the aerobic stage)
- Air pulled through the trapezoidal windrows (by means of negative aeration)

Essentially, exhausted process air from the biological treatment process as opposed to building ventilation air will be processed through acid scrubbers.

The function and workings of acid scrubbers, humidifiers and biofilters is described in further detail herein.

Acid Scrubber

Chemical scrubbing of an air stream is a technique widely used in many industries to remove both solid and gaseous contaminants. The technique is essentially one of mass transfer by absorption when the air contaminants are brought into intimate contact with a liquid solvent in which they have a high solubility.

An acid scrubber (acid solvent used) consisting of a pH monitoring/dosing system is commonly used for biological treatment applications. The acid scrubber treats ammonia/amine gases and operates at a typical pH of 3.5. This process captures the vast majority of the particulate and the ammoniacal gases. The pH is controlled by the addition of phosphoric / sulphuric acid.

The input side of the scrubber will be equipped with guide plates for laminar flow (rectifier) which will provide a smooth airflow through the air humidifier. Guide plates for the droplet discharger will be mounted on the output side to prevent too much water being transported to the biofilter.

Electronic pressure recording instruments will be mounted before and after the scrubber and will continuously send measurement signals to the SCADA control system.

When the pressure across the scrubber reaches a predetermined point, the scrubber will need to be cleaned. When the pressure across the scrubber reaches a value set below the threshold value for cleaning, a 'first warning' will be issued on the alarm visualisation system such that scrubber cleaning can be scheduled.

The conductivity of the water in the scrubber will be measured and when high levels are reached, the water in the unit will be automatically refreshed. The used water will be collected in the facility waste water tanks, along with other waste waters.

The by-product generated by the scrubbing process will be ammonium sulphate in solution. This by-product will be added to the feedstock entering the biological treatment process.

The scrubber will also be equipped with a bunded acid storage tank and an ammonium sulphate tank.



Typical Acid Scrubber

Humidifier

Before the odourous air flows through the biofilters, it will be moistened with water using air humidifiers. A high air humidity level is essential for the correct operation of the biofilters. The air humidifier will also serve to reduce the dust content of the process airstream, as the presence of dust has an adverse affect on the operation of biofilters. The air humidifier will essentially consist of a chamber provided with spray nozzles. The exhaust air will flow through this chamber horizontally while the spray nozzles sprinkle process water. The water will be absorbed by the odourous air because of the close contact and of the temperature difference between the process water and the odourous air. After the air humidifying process, the exhaust air will flow to the biofilters. The input side of the air humidifier will be equipped with guide plates for laminar flow (rectifier) which will provide a smooth airflow through the air humidifier. Guide plates for the droplet discharger will be mounted on the output side to prevent too much water being transported to the biofilter.

Electronic pressure recording instruments will be mounted before and after the air humidifier and will continuously send measurement signals to the SCADA control system.

When the pressure across the humidifier reaches a predetermined point, the air humidifier will need to be cleaned. When the pressure across the humidifier reaches a value set below the threshold value for cleaning, a 'first warning' will be issued on the alarm visualisation system such that humidifier cleaning can be scheduled.

The conductivity of the water in the humidifier will be measured and when high levels are reached, the water in the unit will be automatically refreshed. The used water will be collected in the facility waste water tanks, along with other waste waters.

Biofilter

Biofiltration technology can be used to treat a variety of biodegradable, water soluble contaminants. In a biofilter, the odour contaminants are solubilised from the vapour phase into an aqueous phase on the surface of an organic medium. The compounds are then degraded by the bacteriological population on this media. Biofilters are very effective at removing sulphur based odour compounds such as hydrogen sulphide, organic sulphides and mercaptans. Biofilters are generally not as effective at removing nitrogen based compounds such as ammonia and amines, hence the use of an acid scrubber to process air streams containing high levels of ammonia prior to biofiltration.

The air discharged from the acid scrubbers and air humidifiers will be forced through the biofilters to reduce odour concentrations before it is discharged to the atmosphere. Each biofilter will consist of a concrete basin. The biofilter floor will consist of perforated concrete slabs supported by walls which will allow the air to flow evenly under the complete biofilter field. The air discharged from the acid scrubbers and air humidifiers will be blown into air plenums before being forced through the biofilter material. It is envisaged that the biofilter media will consist of woodchips, Mónafil or Mónashell (the latter two being proprietary biofilter media). The biofilter material selected will have a high odour removal efficiency and life, while providing low pressure losses combined with a good moisture holding capacity. The organic pollutants in the odourous air will be initially adsorbed by the biofilter material and then used by the microorganisms as food. The waste products of the microorganisms are environmentally friendly and include carbon dioxide, water and heat. The microorganisms are only active in a humid environment. The target value for the humidity level of the biofilter material is between 50% and 70%. The biofilter material will be sprinkled regularly with water to achieve adequate humidity levels.

Biogas Engines

In the case of Configuration B (MBT with Dry Anaerobic Digestion and Composting), the CHP plants will form part of the odour abatement system.

Biogas produced in the dry anaerobic digestion process will be processed (gas cleaning, removal of contaminants and moisture) before it is combusted in the CHP plants. It is envisaged that two CHP plants will be provided to process the biogas thereby producing renewable electricity and heat.

A standby gas flare will be provided to facilitate the thermal destruction of the biogas in the event of unavailability of the CHP plants and insufficient volume in the biogas storage units.

1.3. Measures to minimise Nuisance Odour Emissions

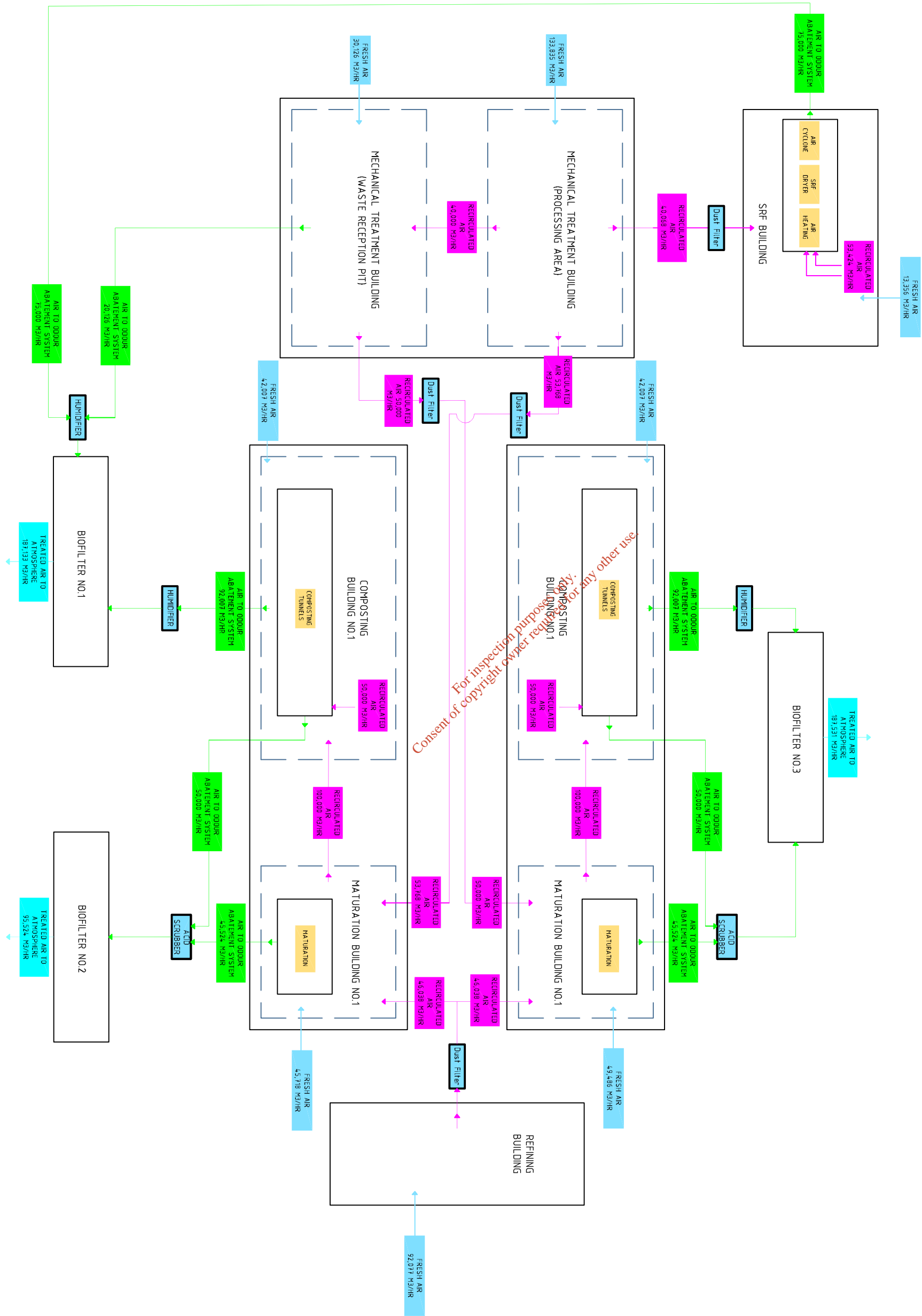
Measures will be implemented during the design, construction and operation of the proposed MBT facility in order to eliminate or minimise nuisance odour emissions. These measures include:

- All aspects of the MBT process will be undertaken in fully enclosed buildings
- All waste delivered to the MBT facility will be in covered/enclosed vehicles. Similarly, all waste residues being removed from the MBT facility will be in covered/enclosed vehicles
- Doors at the waste reception area of the Mechanical Treatment Building will be rapid closing doors, with an opening or closing time of approximately 20 seconds
- Doors at the waste reception area of the Mechanical Treatment Building will be fitted with air curtains to minimise the escape of odourous emissions when a door is opened for the acceptance of waste
- The first stage of the biological treatment process is the most critical with respect to odour emissions, since easily biodegradable components (e.g. sugars, proteins and fats) are degraded at a high rate, thus causing gaseous by-products. This intensive phase of the biological treatment process will be undertaken in fully enclosed concrete composting/dry AD tunnels located within an enclosed building - thereby providing double containment features
- The maturation process will be undertaken by means of negative aeration. Negative aeration draws air from within the building through the trapezoidal windrows and into the aeration ductwork. This arrangement will greatly reduce emissions from the trapezoidal windrows within the building, thereby minimising the potential for nuisance odour emissions.
- Air streams with a potential for high ammonia levels will be treated in an acid scrubbers prior to biofiltration
- An odour management plan will be developed prior to the detailed design and construction of the facility. This plan will include management strategies for the prevention of emissions and a strict preventative maintenance and management program for ensuring that all odour mitigation techniques remain operational at optimal capacity throughout all operational scenarios
- Critical and key odour abatement system performance parameters will be continually monitored on the SCADA control system. Should any parameter deviate outside of its accepted range, an alarm will be immediately generated. Critical alarms will be texted to selected mobile phone numbers thereby ensuring the communication of critical alarms to responsible individuals on a 24 hour basis
- Good housekeeping practices (internally and externally) and a closed-door management strategy will be maintained at all times
- Biofilters will be compartmentalised to facilitate maintenance and replacement of media. Each biofilter will comprise of two sections such that treatment is provided by one of the sections while the other section is being maintained
- Biofilters will be covered and hence isolated from extreme weather conditions (e.g. intensive rainfall or intensive heat) thereby providing optimum control of biofilter efficacy
- Normal operational practices will be such that the organic fines fraction (putrescible fraction with the highest potential for odour) generated in any day by the mechanical treatment process will be loaded into the composting/dry AD tunnels on the same day
- Treated air from the biofilters will be emitted through 20m high stacks to facilitate appropriate residual odour dispersion

- The organic fines fraction will be conveyed from the Mechanical Treatment Building to the biological treatment buildings in fully covered and enclosed galleys
- If composting temperatures exceed approximately 65°C, odour emissions increase significantly, due to the changes in process biochemistry. Excessive increases in composting temperatures are especially relevant in the first stage of composting when, due to the fast degradation, a lot of energy will be released. Temperature sensors will be used to measure the temperature in the composting tunnels and subsequently in the maturation area. The SCADA control system will ensure that the composting temperature does not exceed 65°C by adding more fresh process air to the composting mass. This will reduce the odour load in the process air being transported to the odour abatement systems
- In the case of Configuration B (MBT with Dry Anaerobic Digestion and Composting), a standby gas flare will be provided to facilitate the thermal destruction of the biogas in the event of unavailability of the CHP plants.

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CONFIGURATION A (MBT WITH COMPOSTING)



CONFIGURATION B (MBT WITH DRY ANAEROBIC DIGESTION & COMPOSTING)

