3 Site and Scheme Description

3.1 Introduction

This chapter presents a description of the proposed waste management facility at Ringaskiddy. The existing site and the neighbouring land uses are also described.

3.2 Current Site Layout

The site for the Ringaskiddy waste management facility is situated at the north eastern corner of the Ringaskiddy peninsula (refer to Figures 3.1a and 3.1b), and occupies an area of approximately 12 hectares. The main road from Ringaskiddy village forms the northern boundary of the site. Cliffs along the shore and the West Channel form most of the eastern boundary. On the southern and western boundaries there is agricultural land (refer to Figure 3.2). The site is flat for some distance from the northern boundary but rises steeply as one approaches the southern boundary.

3.3 Neighbouring Land Uses

3.3.1 Immediate Vicinity

The site encircles the premises of the Hammond Lane Metal Company, which processes scrap steel. Immediately to the south and west of the site, there is agricultural land. From the northern side of the N28, to the northern shore of the peninsula, there is an area of reclaimed land (refer to Figure 3.2).

3.3.2 The Wider Area

The centre of Ringaskiddy village is located approximately 1km to the west of the proposed site. The Cork Harbour area is a mixture of urban developments (such as Cobh and Monkstown), and pockets of industry near the foreshore. Spike Island is located approximately 500m to the east of the site, with Fort Mitchell prison being situated there. There is an Irish Naval Base situated on Haulbowline Island (refer to Figure 3.1a).

The Ringaskiddy peninsula is industrial in character, with a number of pharmaceutical companies having large manufacturing plants in the area. In addition, the Irish ISPAT steel mill is located to the north of the site on Haulbowline Island. The location of a number of these industries is shown in Figures 3.1a and 3.1b.

3.4 Scheme Description

3.4.1 General

The waste management facility will consist of three elements:

- community recycling park
- *waste transfer station*
- a waste-to-energy plant for the treatment of hazardous and non-hazardous waste.

The proposed layout of the site and a section of the waste to energy building can be seen in Figures 3.3 and 3.4 respectively. The elements of the facility, and the activities which will occur within them are described in the following sections.

3.4.2 Community Recycling Park

The Irish Government's Policy Statement 'Waste Management: Changing Our Ways' was published in October 1998. It advocated that local authorities should work closely with local communities to use a proportion of the income from waste charges and gate fees to mitigate the impact of waste management facilities on the communities, in which they are located. This could be done through appropriate community environmental projects.

Indaver will include a Community Recycling Park in the waste management facility at Ringaskiddy. The park will accept a wide range of recyclable materials and is designed to allow members of the public free access to deposit their waste items into designated containers. In order to optimise the recovery and recycling options available, there will be approximately twelve different categories of waste accepted in the park. A photograph of a similar facility is shown in Figure 3.5.

Categories of recyclable waste, which will be accepted at the community recycling park, include the following.

- cardboard
- newspaper and magazines
- glass
- aluminium drink cans
- textiles such as clothes and blankets
- footwear
- batteries
- waste oils
- fluorescent tubes
- garden green waste.

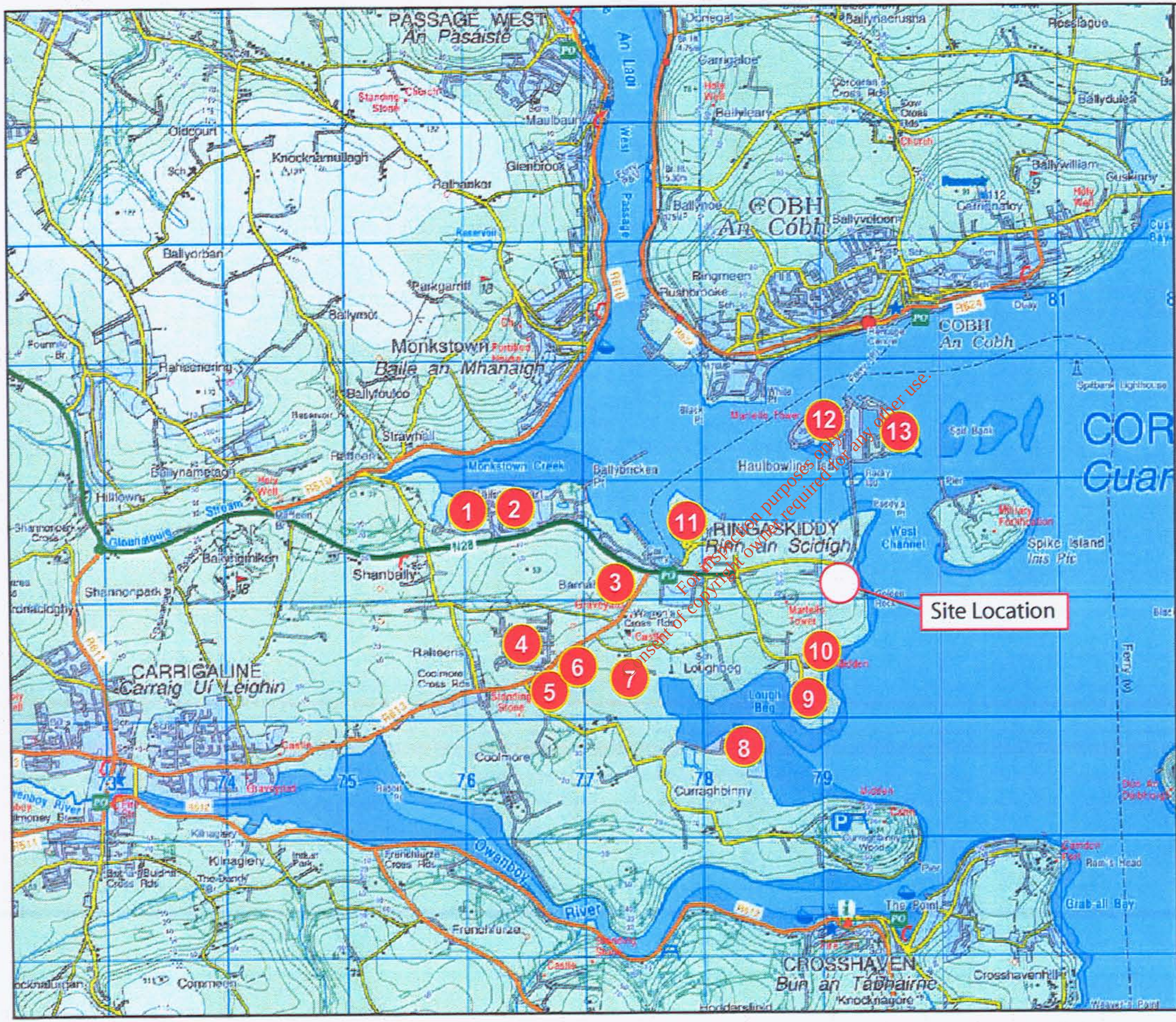
The proposed layout of the park is illustrated in Figure 3.6:

The park will be supervised during opening hours, 10:00-19:00hrs Monday to Friday and 10:00-14:00hrs on Saturday. Assistance in the disposal of materials will be available to the public. The full time supervision will also ensure that a high standard of housekeeping is maintained. Hand-washing facilities and car vacuum cleaners will be provided in the park for use by members of the public. Containers will be emptied once they become full.

It is intended that the Park will help to increase environmental awareness in the community as well as assisting in diverting recyclable material from landfill. Environmental information in brochure form will be available from the Park staff. The leaflets will provide information to householders on issues relating to composting and household waste management.

In addition, Indaver propose to implement the following measures:

- formation of an environmental liaison committee
- provision of an area within the facility's administration block for public environmental awareness education
- utilisation of a portion of income from waste charges for appropriate environmental improvement projects.



Industrial Neighbours

1. ADM
2. Pfizer
3. Buckeye
4. Novartis
5. Carbon Chemicals
6. Elisa
7. Moog
8. Glaxo Smithkline
9. Pfizer Loughbeg
10. DePuy
11. Port of Cork
12. Naval Base
13. Irish ISPAT

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Figure Title : Site in Context

Figure No : 3.1a

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Ordnance Map :

Figure Title : Site in Context (Aerial)

Figure No : 3.1b

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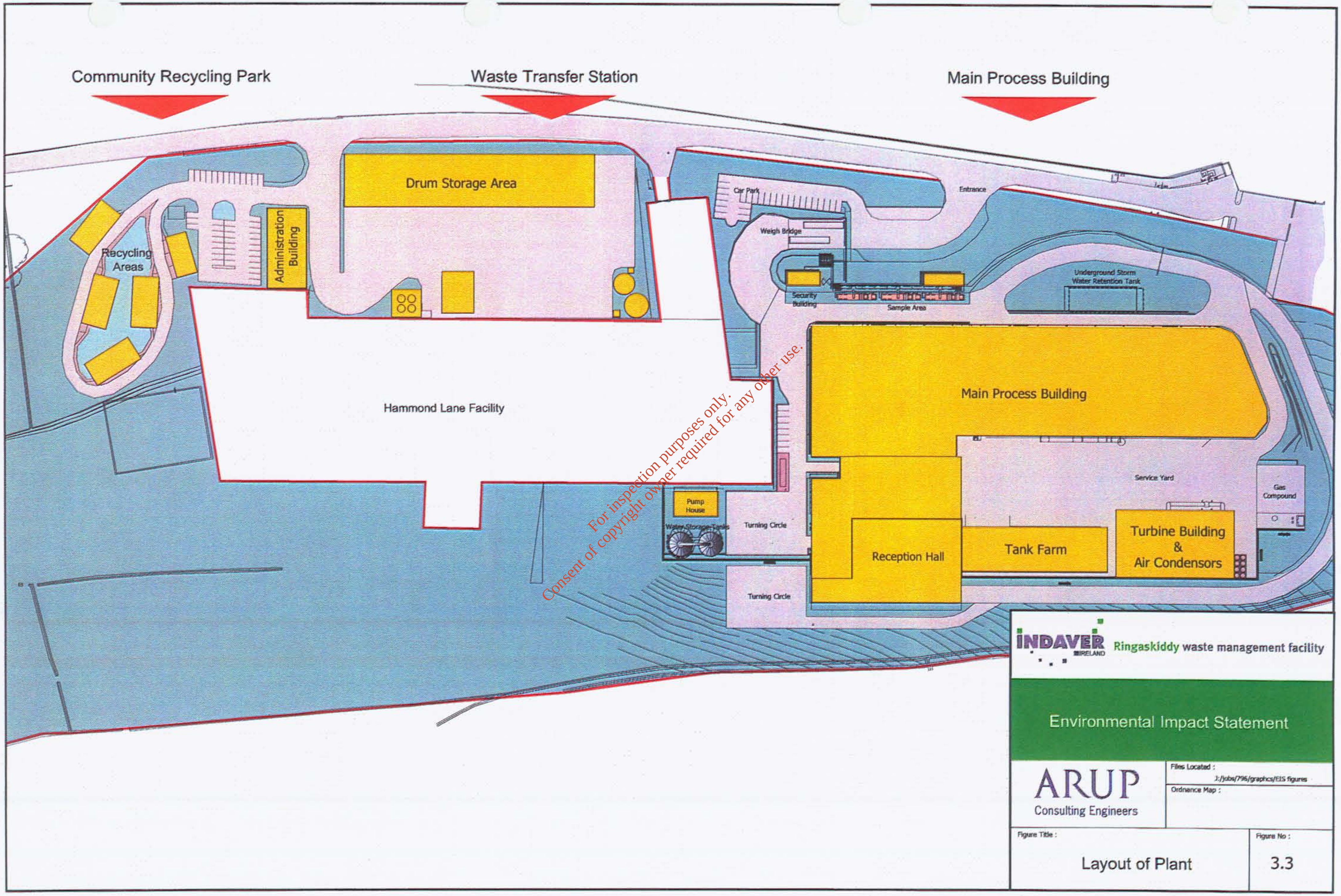
Ordnance Map : Ordnance Survey Ireland Licence No. EN 0002801 © Government of Ireland

Figure Title : Current Site Layout

Figure No : 3.2


Community Recycling Park
Waste Transfer Station
Main Process Building
Drum Storage Area
Recycling Areas
Administration Building
Hammond Lane Facility
Car Park
Entrance
Weigh Bridge
Security Building
Sample Area
Underground Storm Water Retention Tank
Main Process Building
Service Yard
Gas Compound
Pump House
Water Storage Tanks
Turning Circle
Turning Circle
Reception Hall
Tank Farm
Turbine Building & Air Condensors
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Ordnance Map :
Figure Title :
Layout of Plant
Figure No :
3.3

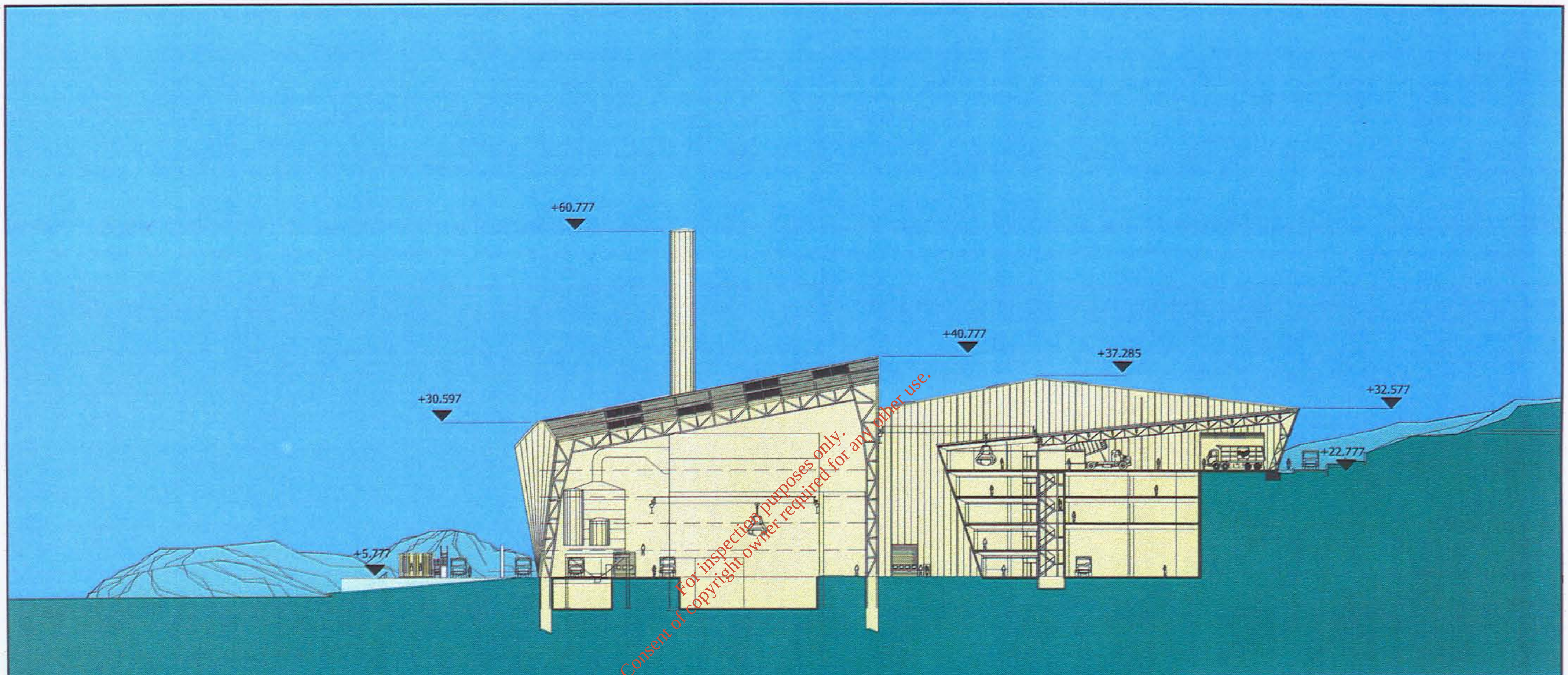

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Figure Title : Waste to Energy Facility Typical Section

Figure No : 3.4

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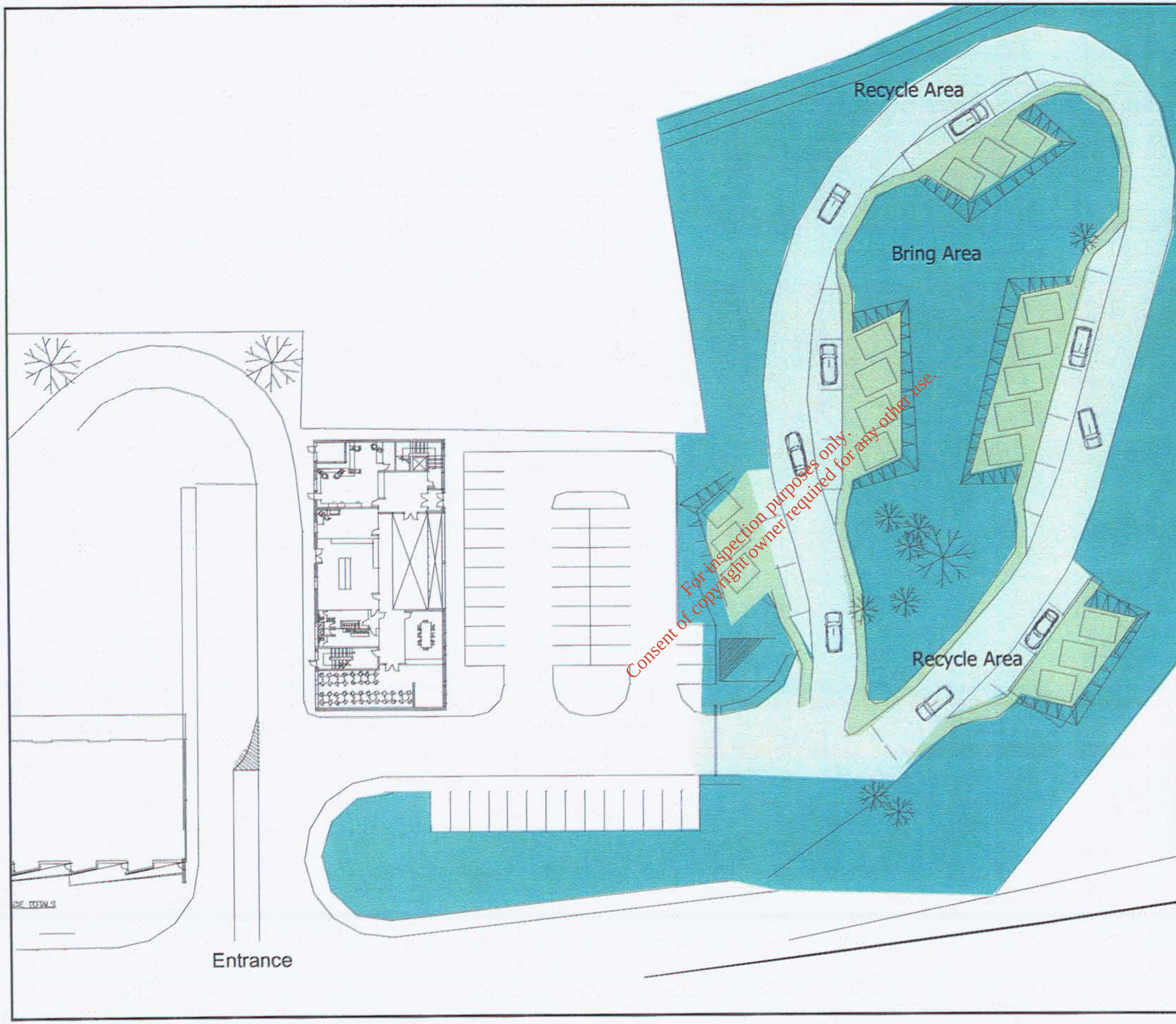
Ordnance Map :

Figure Title : Photograph of Similar Recycling Park

Figure No : 3.5



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Ordnance Map : Ordnance Survey Ireland Licence No. EN 0002801 @ Government of Ireland

Figure Title : Layout of Community Recycling Park

Figure No : 3.6

3.4.3 Environmental Education

Indaver Ireland is an integrated waste management company, which advocates the use of a range of technologies to manage waste most effectively. Indaver Ireland is aware that the continued education of members of the public in areas such as waste segregation, recycling and composting is vital in order to achieve the levels of diversion of waste from landfill required by both EU and Irish legislation, and achieved elsewhere in the EU.

In addition to the provision of information in the Community Recycling Park, public education on waste management can be provided through publications and direct teaching methods. Indaver Ireland has published several guides aimed at creating awareness of the opportunities which exist for public participation in waste minimisation and recycling. Guides on the composting of household organic waste and household waste management have already been produced and distributed (see Volume 2, Attachment 2). It is envisaged that additional publications will be provided on relevant topics such as, for example, integrated waste management. The leaflets are circulated by Indaver, by large employers, through some local authorities and may be requested from the Indaver Ireland website, www.indaver.ie.

Indaver Ireland employs a Waste Education Officer (WEO), who is available to members of the public. The WEO is educated to degree level in environmental science. It is intended that the WEO will also serve the Ringaskiddy facility, and will help promote waste management awareness through lectures, discussion groups and projects within the communities of South Cork. The public awareness programme will include local schools and youth groups. A meeting area will be provided within the administration building of the Ringaskiddy facility for the use of the public awareness programme. However, the Waste Education Officer will also travel to groups further afield.

The estimated cost of constructing the Community Recycling Park is approx. £600,000 while annual operating costs for the park will amount to approximately £150,000. Indaver Ireland will fund the construction and the operation of the park throughout its working life.

3.5 Waste Transfer Station

This facility will be utilised for the sorting, and repacking if necessary, of industrial hazardous and non-hazardous waste. There will be a warehouse on site, and waste will be stored in segregated, bunded areas in the warehouse. There will also be offices for administrative staff and a packaged sewerage treatment plant will be provided for treatment of sanitary effluent.

The following facilities will be provided:

- warehouse for drum storage of 1800 drums
- unloading area
- repacking area
- emptying drums into bulk tanks
- drum washing area
- storage tanks
- container parking area

The layout of the waste transfer station is shown in Figure 3.7 and some computer generated images of the activities are shown in Figure 3.8.

All waste entering the transfer station will be checked, categorised and recorded after acceptance, in a computerised tracking system. When the drums are unloaded from the trucks, they are physically checked to ensure that there has been no damage to the drums in transit. If damage has occurred, or the drum is thought to be in poor condition it is sent to the repacking area where the entire drum is placed in a larger sealed container, repacked or cross-pumped. The identification and location of drums in the storage areas is recorded.

Liquid drummed material that is suitable for treatment onsite will be analysed and transferred into storage tanks. The drums or containers will then be cleaned. These will either be returned to the customer for re-use or sent for recycling. The material that has been bulked up in storage tanks, will be transported to the waste to energy facility by road tanker. Solids may be repacked prior to going for incineration onsite. Material for recovery will be repacked where necessary and exported to licensed facilities. Material that is not suitable for recovery, or for incineration on site, will be prepared in lots for shipment to the appropriate disposal facilities abroad.

In the areas where the drums are bulked up and cleaned, there will be localised extraction of any fumes and vapours that may be emitted which will be ducted to a treatment system such as, for example, a carbon bed filtration unit or HEPA filters.

The bulk storage tanks incorporate a number of safety systems to minimise the risk of an accident occurring and also, to confine any damage to the immediate area should an accident happen. Among the standard design features for these types of storage tanks are the following:

- weak seal on the roof
- all tanks will have a Nitrogen 'blanket'. Nitrogen is an inert gas, which is used to fill the headspace of the tank thereby ensuring that flammable or explosive vapours will be suppressed.
- tanks will be earthed and there will be an interlock on the tank mixers to avoid the build up of static electricity if the tank is empty
- in the event of a fire occurring, the tanks will have foam injection
- water curtain on the outside of the tank
- the tanks will have high and low level alarms as well as overfill protection
- the tanks will be located within a containment bund, which will collect the tank contents in the event of a spillage.

3.6 Waste-to-Energy Facility

3.6.1 Phasing of Waste to Energy Facility

The waste to energy facility will be developed in two phases. The first phase will consist of a fluidised bed furnace, a post combustion chamber or afterburner, and flue gas cleaning systems. The fluidised bed furnace and post combustion chamber will be used for the thermal treatment of solid and liquid hazardous and non-hazardous industrial waste. The second phase will be a moving grate furnace with flue gas cleaning systems. Phase 2 will treat non-hazardous waste.

The waste to energy building will include a control room and offices for operating staff, maintenance workshops etc. a packaged sewerage treatment plant will be provided to treat sanitary effluent.

It is anticipated that the waste to energy facility will operate 24hrs/day, seven days per week. There will be planned shutdowns for maintenance purposes. Waste acceptance will be limited to the hours 09.00 to 19.00 on week days and 09.00 to 14.00 on Saturdays.

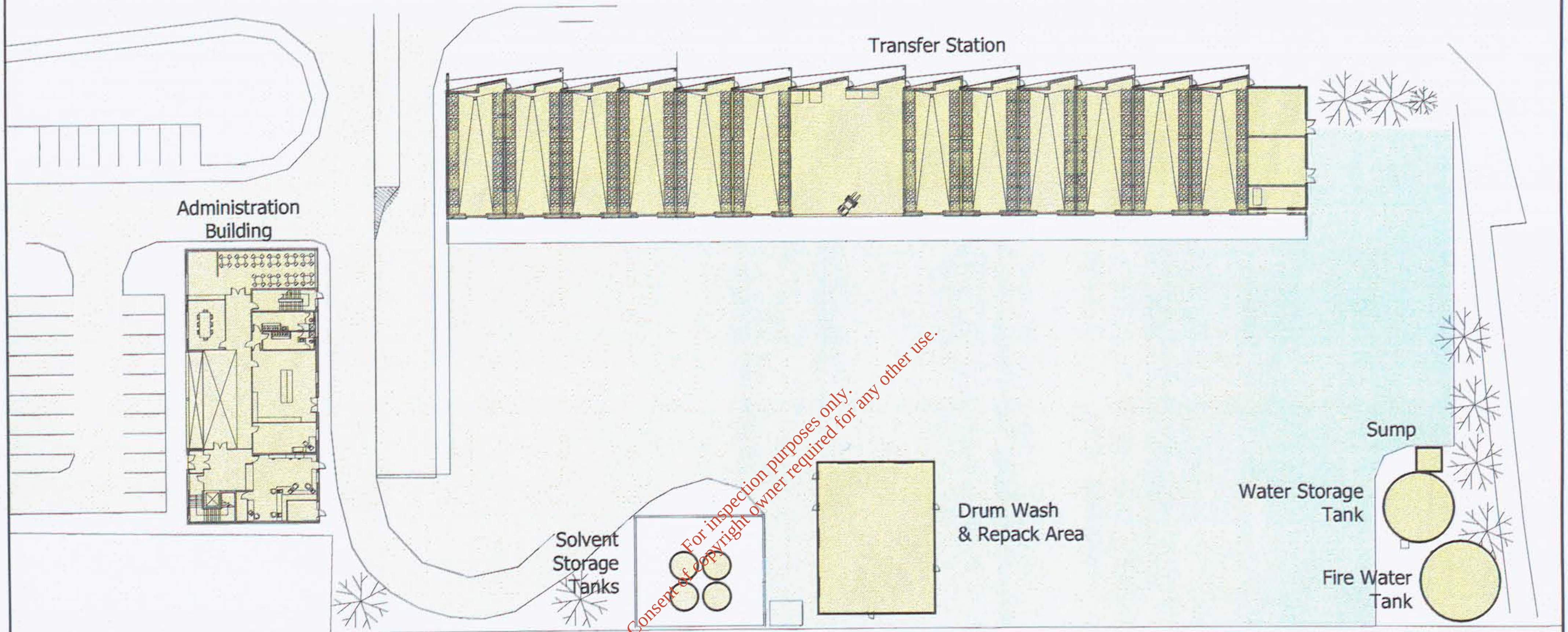

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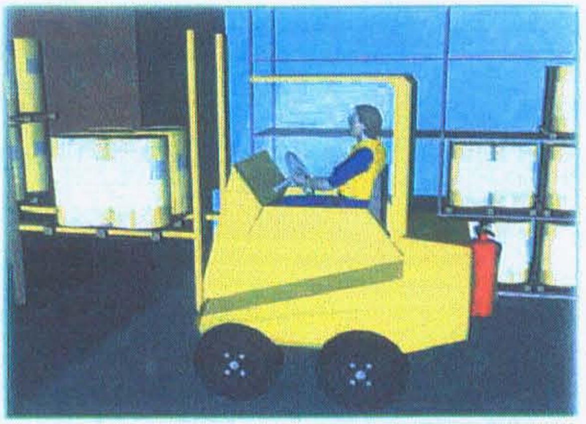
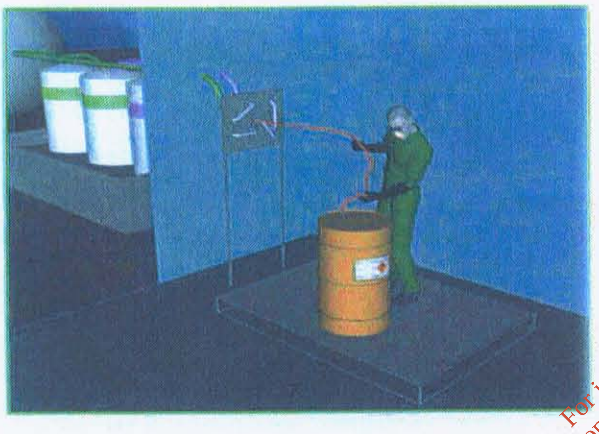
Figure Title : Layout of Waste Transfer Station

Figure No : 3.7



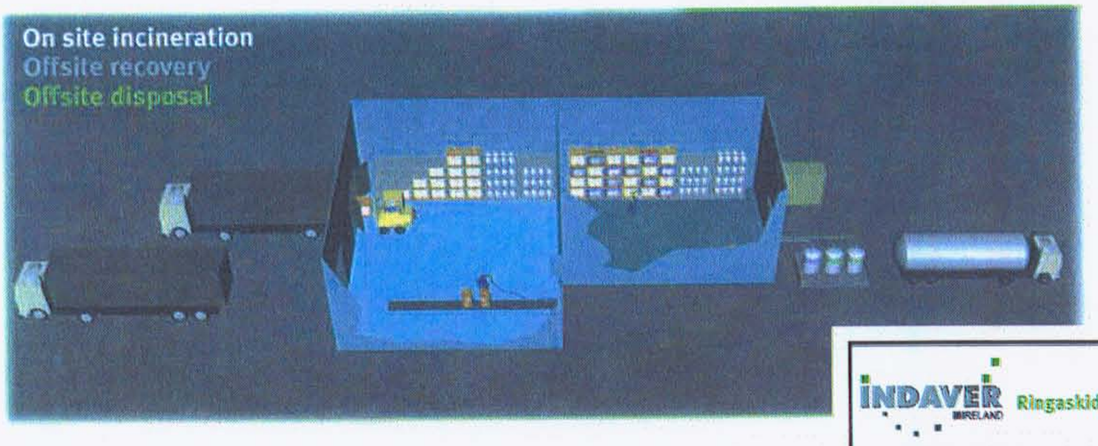
Computerised tracking system used to check in waste

Computerised tracking system for identification and location of drums in storage area and transportation offsite



Pumping of drummed waste into storage tanks

Drum cleaning prior to re-use, recycling or disposal



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Ordnance Map :

Figure Title : Schemematic of Activities of Waste Transfer Station

Figure No : 3.8

The design of the proposed facility has been optimised to include the most up to date emissions control and flue gas cleaning technology, which will be the same for both phases. The waste-to-energy process (or incineration with energy recovery) will consist of a number of main process elements as follows:

- waste acceptance/laboratory testing
- waste intake and storage
- combustion process
- energy recovery process
- flue gas cleaning
- dioxin and furan removal

The waste intake and combustion processes for phase 1 and phase 2 are described separately.

Schematic diagrams of both phase 1 and phase 2 of the Waste to Energy process, are shown in Figures 3.9 and 3.10 respectively.

3.6.2 Phase 1 – Waste Acceptance

Waste Reception

All waste trucks entering the waste to energy plant will pass through a scanner to detect the presence of any radioactive elements. Radioactive waste will not be accepted at the Ringaskiddy waste management facility. All trucks entering and leaving the plant will also be weighed.

Waste is received in different ways at the waste to energy plant, depending on the nature of the waste stream.

Solid waste will be deposited in a bunker in an enclosed reception hall. There will be separate compartments in the bunker for hazardous and non-hazardous waste. Liquid wastes will be unloaded from tankers, and the different categories of liquids will be stored in separate tanks prior to combustion, or injected directly into the post combustion chamber.

Laboratory Analysis of Incoming Wastes

Laboratory analysis will be carried out on every bulk liquid hazardous waste load. The main objectives of the waste analysis procedures are:

- to check whether the properties of the waste delivered correspond to the characteristics described in the specification agreed with the customer
- to identify any potential safety issues

The following analysis will be performed to satisfy the above objectives:

- visual check of conformity
- analytical check of specific parameters on a representative fraction of the waste
- mixture tests – these are important in establishing the compatibility of different liquids that are to be stored together.

Approval and Rejection of Incoming Waste

Indaver Ireland will implement procedures, similar to those which are currently in operation at other Indaver facilities, to regulate the acceptance, approval and if necessary, the rejection of incoming wastes.

3.6.3 Phase 1 Waste Handling and Storage

The waste handling and storage facility consists of:

- a waste reception hall
- one or two shredders, with accompanying shredder feeding pits
- a waste bunker which is compartmentalised for various waste streams, with grab cranes which can be operated manually or automatically
- storage tanks for liquid wastes
- facilities for the direct injection of liquid wastes from road tankers to the post combustion chamber.

Figure 3.11 shows some photographs of incoming wastes at a similar facility. Figure 3.12 shows a layout plan of the waste to energy facility.

Waste Reception Hall

Solid waste will be discharged from trucks, under cover, in a large room called the waste reception hall. The trucks will discharge the waste into the shredder feeding pits through chutes in the wall of the waste reception hall. To reduce the risk of nuisance odours, the waste reception hall will be maintained under negative pressure, i.e. air will be drawn into the hall through any openings rather than escaping outwards.

Waste Shredders

The purpose of the waste shredders is to ensure that there is uniformity in the waste entering the fluidised bed furnace. The reduction in size of the waste material will ensure a more homogenous waste mixture with a consistent calorific value. Not all waste destined for the fluidised bed furnace will require shredding.

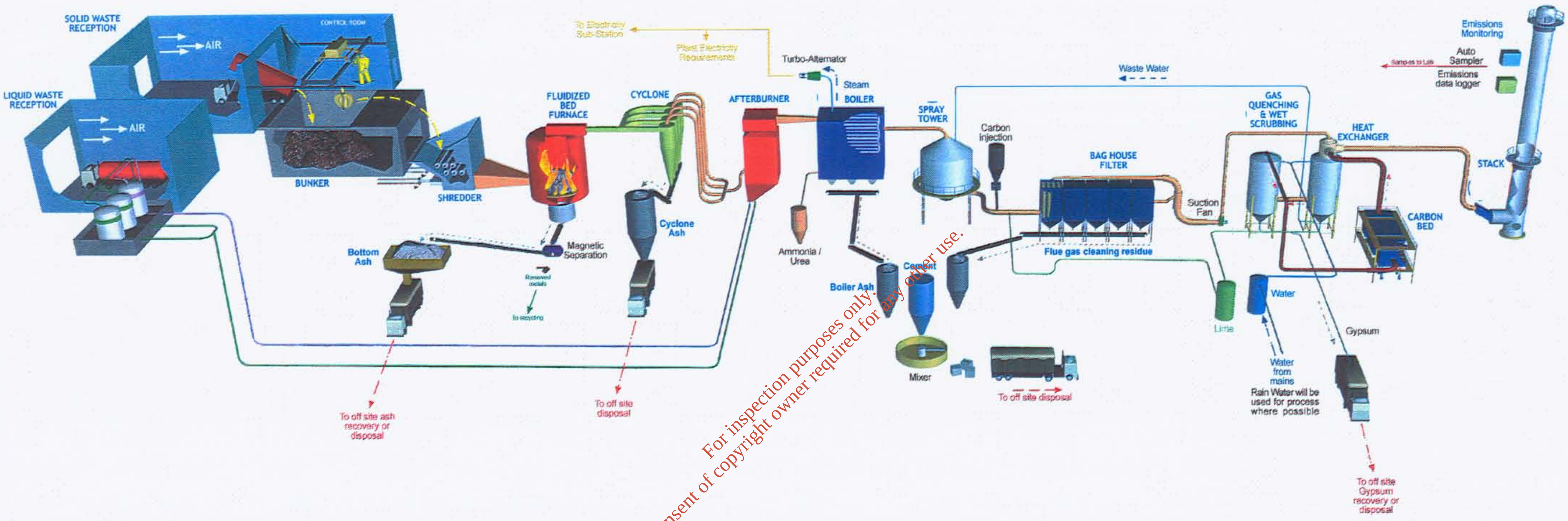
Waste Bunker

The waste material will be stored in a compartmentalised bunker, which will provide separate storage areas for the different waste streams. The bunker will have a total capacity of 12,500m^3. This will be sufficient capacity to allow the plant to accept waste during periods when the incinerator will be shut down for maintenance and to allow operations to continue over prolonged periods (e.g. long weekends), without deliveries.

Operators will use travelling grab cranes positioned over the bunker to blend the waste, so even if there is variety within the waste loads delivered, the feed to the furnace will be relatively uniform.

Potential emissions from the waste bunker include odours and windblown waste. However, as stated earlier, the use of negative pressure conditions in the waste storage area will minimise the risk of any nuisance odours and litter occurring.

The grab cranes will feed the blended waste material into a hopper. The waste will be discharged to the furnace from the hopper, via a dosing screw mechanism.



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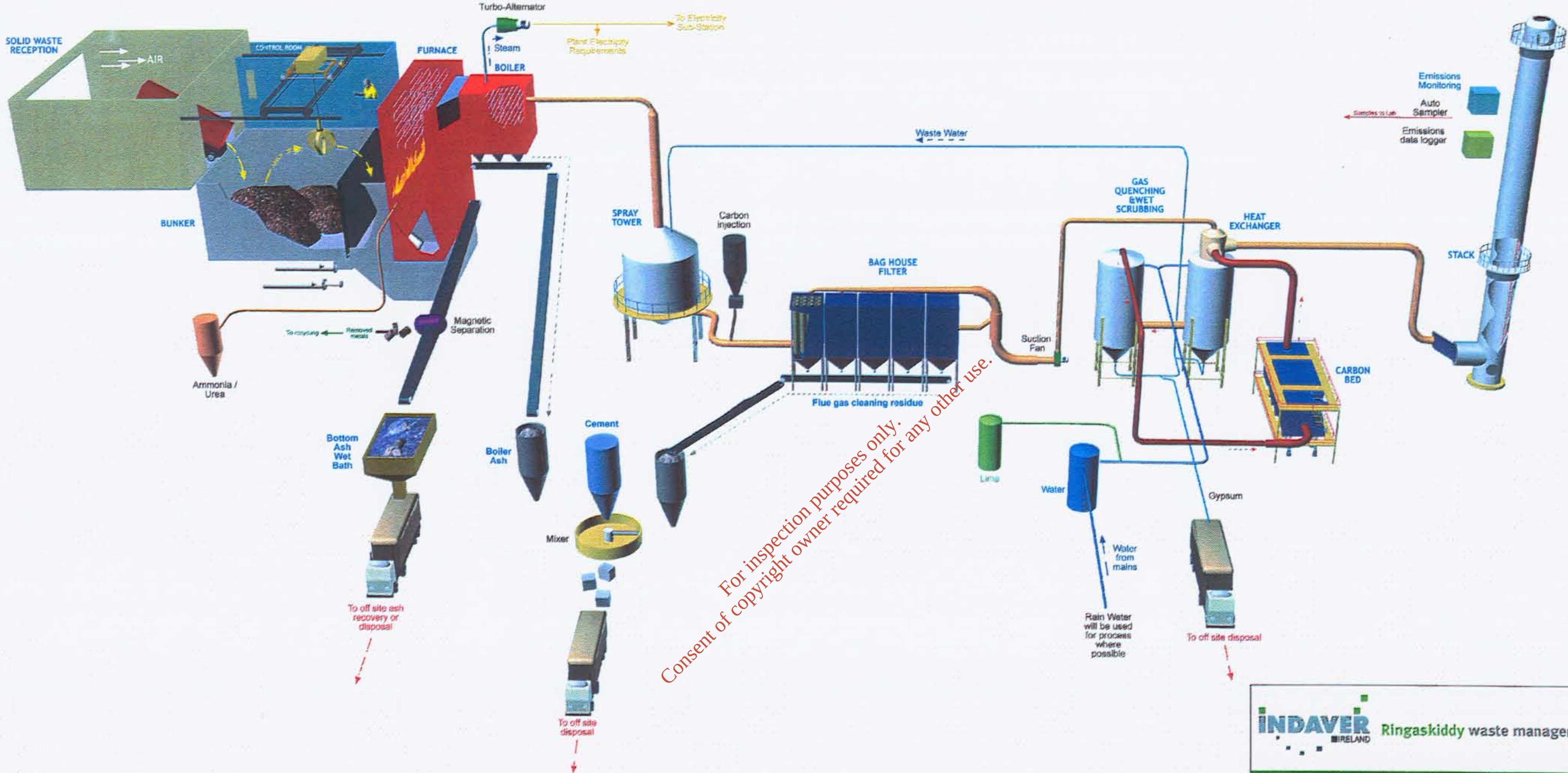
Ordnance Map :

Figure Title : Schematic Diagram of the Process - Phase 1

Figure No : 3.9



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Ordnance Map :

Figure Title : Schematic Diagram of the Process - Phase 2

Figure No : 3.10

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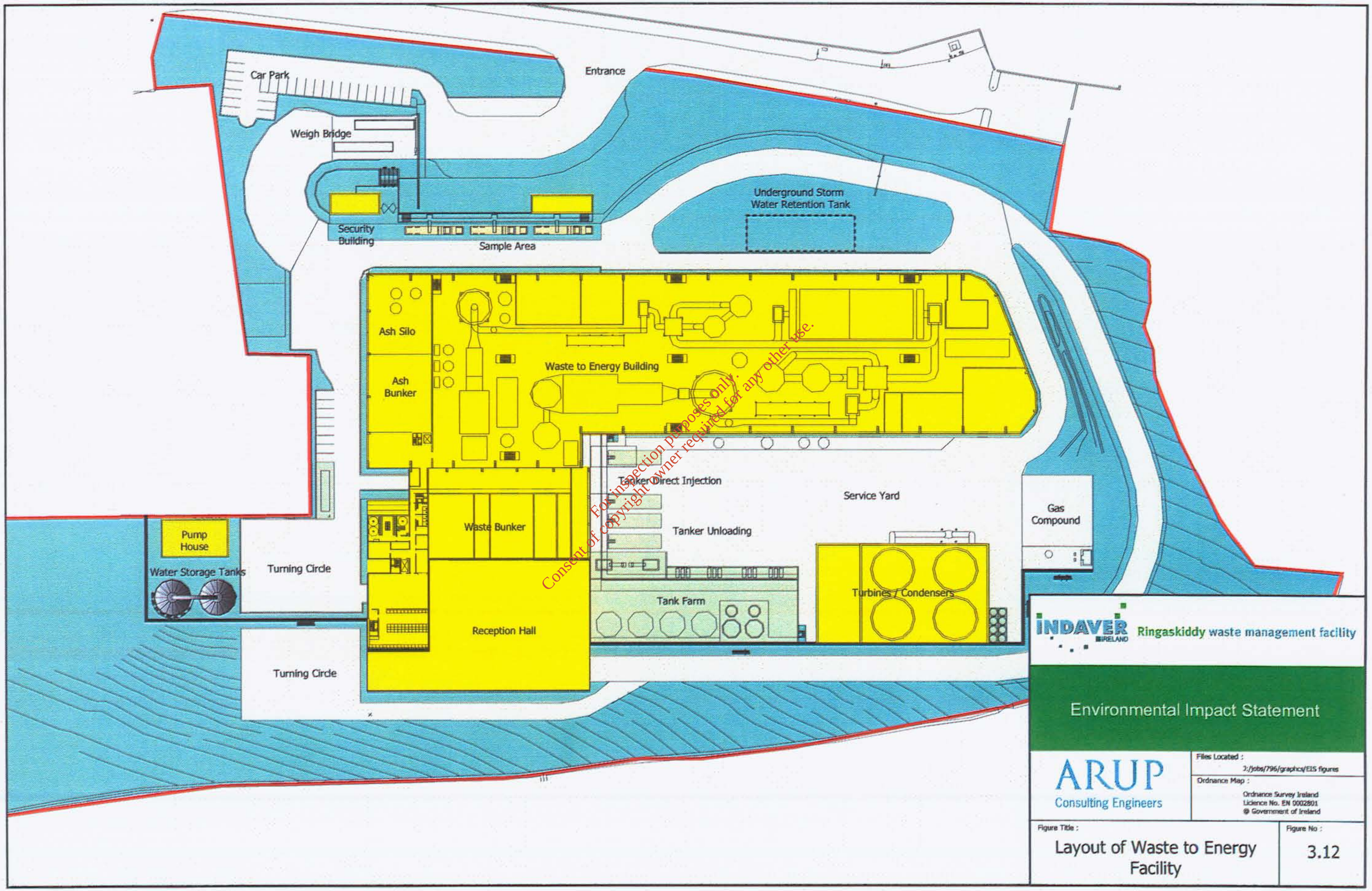
Ordnance Map :

Figure Title : Waste Acceptance at a Similar Facility

Figure No : 3.11



Car Park
Entrance
Weigh Bridge
Security Building
Sample Area
Underground Storm Water Retention Tank
Ash Silo
Ash Bunker
Waste to Energy Building
Tanker Direct Injection
Service Yard
Gas Compound
Pump House
Water Storage Tanks
Turning Circle
Waste Bunker
Tanker Unloading
Tank Farm
Turbines / Condensers
Reception Hall
Turning Circle
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Figure Title :
Layout of Waste to Energy Facility
Figure No :
3.12

The discharge, mixing and feeding of waste into the hoppers will be all controlled manually. The bunker will be continuously monitored by the operator of the grab crane, who will ensure that the correct mix and volume of waste will be fed into the hopper. The rate of feedstock entering the furnace will be controlled by adjusting the dosing screw mechanism of the hopper.

Storage Tanks for Liquid Wastes

Incoming liquid wastes will be transferred from road tankers to storage tanks via a sieve, which removes any solid debris that may be present in the liquid. The solids will be retained in a separate storage pit and transferred to the furnace. The liquids will be directed to specific storage tanks, depending on the characteristics of the waste stream. The safety systems, which will be incorporated into the storage tanks in the waste to energy plant, will be similar to the safety systems used in the tanks in the waste transfer station, which are described in Section 3.5.

The tank farm will have 14 days storage for incoming waste and will have a total capacity of approximately 2000m^3. There will also be tanks for the storage of Urea, Sodium Hydroxide and Hydrochloric Acid, raw materials which will be used in the process.

Direct Injection of Liquid Wastes to the Post Combustion Chamber

Some waste liquids will be injected directly into the post combustion chamber from the road tankers. The tankers will park in a bunded area during the unloading procedure.

3.6.4 Phase 1 - Fluidised Bed Incinerator

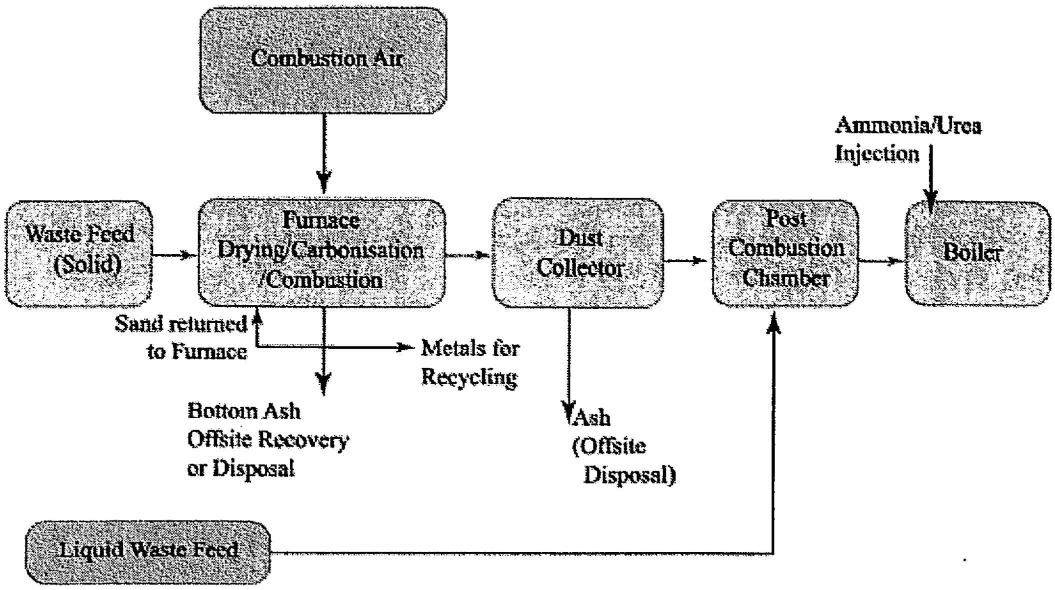
Phase 1 will use a fluidised bed incinerator to burn solid hazardous and non-hazardous waste. In the fluidised bed furnace solid or sludge-like waste is introduced onto a bed of sand or similar inert material which is agitated or 'fluidised' by an upward movement of air through a porous plate below it. The waste only accounts for a small percentage of the bed material. The heat of the sand (600-900°C) initialises drying, carbonisation and partial combustion of the waste material.

The primary combustion air required for the fluidised bed furnace and post combustion chamber is taken from the bunker, while the secondary air is drawn from the area under the roof space of the building. The secondary air is drawn from this area to remove excess heat that radiates from the equipment. Secondary air is blown over the top of the sand-bed to ensure complete combustion and to maintain an excess of oxygen. This also helps with destruction of organic micro-pollutants.

Residence time of the waste in the fluidised bed furnace will be up to one hour, depending on the waste stream.

Refer to figure 3.13 for the process flow diagram for the fluidised bed furnace.

Figure 3.13 Fluidised Bed Incinerator Process Flow Diagram



Bottom ash and sand are removed from the furnace at a temperature of approximately 600°C. The material passes through an air/water cooled screw, which serves to cool down the bottom ash/sand mixture. This mixture is then sieved in order to separate the sand from the bottom ash. The sand is then returned to the furnace. Metals will be removed from the bottom ash and sent for recycling.

The low fuel-to-air ratio of the fluidised bed is very efficient in suppressing nitrogen oxides (NO_x) formation. (Refer to section 3.8.2). The coarse ash produced is suitable for reuse in, for example, the construction industry. Although capable of treating some lightly chlorinated (<1% chlorine) hazardous waste, the maximum operating temperature of the fluidised bed is 950°C. This makes the fluidised bed, on its own, unsuitable for the combustion of highly chlorinated liquid wastes and therefore the post combustion chamber is used.

The percentage levels of Oxygen (O_2) and Carbon Monoxide (CO) and the temperature in the furnace are all interrelated to an extent, and are dependant on the rate at which combustion air is supplied to the furnace. The CO levels are used as an indicator of the degree of combustion in the furnace. By monitoring these parameters, the combustion air input is optimised to ensure efficient and effective combustion.

3.6.5 Phase 1 - Post Combustion Chamber (PCC)

All liquid wastes will be directed to the post combustion chamber which will be installed after the fluidised bed. Higher and lower calorific value waste streams will be blended prior to pumping to the PCC. The PCC will operate at a temperature of 850°C or 1100°C, depending on the chlorine content of the waste stream being treated. The waste residence time for the wastes in the PCC will be a minimum of two seconds.

There will be a dust collector, either between the furnace and the PCC, or between the boiler and evaporating spray towers. The dust collector will be either a cyclone or an electrofilter. In Figures 3.9 and 3.13, the dust collector is illustrated between the furnace and the post combustion chamber. The cyclone/electrofilter ash is collected for offsite disposal. Refer to Section 3.12 for a description of the ash handling.

3.6.6 Waste Treatment Capacity of Phase 1

The operating capacity of the fluidised bed furnace will be determined by the calorific value of the waste, rather than a set tonnage. The capacity will be equivalent to a throughput of approximately 60,000 tonnes per annum of hazardous and non hazardous waste, from industrial sources. Solid waste and high moisture content wastes such as sludge will be handled in the furnace. The operating capacity of the PCC will also be determined by the calorific value of the waste. The PCC capacity will be equivalent to a throughput of approximately 40,000 tonnes per annum of hazardous liquid wastes.

3.6.7 Phase 2 – Waste Acceptance Procedures (Non-Hazardous Municipal Solid Waste)

All vehicles carrying waste which enter the site will be required to have the waste covered. In addition to weighing the trucks and scanning them for radioactivity, a certain number of trucks carrying non hazardous waste will be required to discharge their waste onto the floor of the waste reception hall to allow visual inspection of their contents, prior to transfer to the bunker.

The handling of waste in the reception hall and bunker for phase 2 will be similar to that described above for phase 1. As described for phase 1, the grab crane will feed waste from the bunker to a hopper which will feed the moving grate furnace.

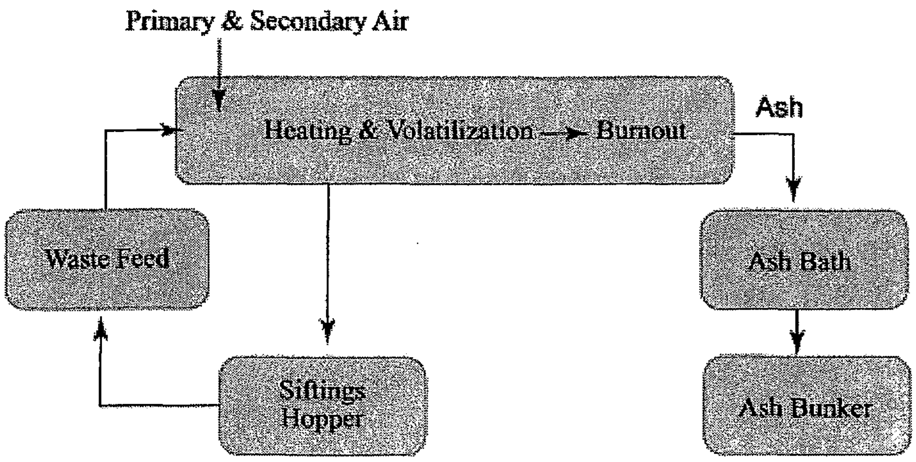
3.6.8 Phase 2 - Moving Grate Incinerator

The waste will be moved forward from the hopper into the furnace using a ram mechanism. The volume of waste will be controlled by adjusting the ram. Should the level of waste in the hopper drop to a low level an alarm will sound in the control room to alert the crane operator.

The moving grate mechanism will transport the waste slowly from the feed point to the ash discharge. The rate at which the waste will travel through the furnace will be controlled to optimise the combustion. The residence time for waste in the furnace will be approximately one hour.

As the waste enters the hot furnace the material will be heated due to contact with the hot combustion gases and radiated heat from the walls of the incinerator. The initial heat (temperature range of 50 to 100°C), will drive off the moisture from the waste. Figure 3.14 below gives a schematic representation of the Moving Grate furnace.

Figure 3.14 Moving Grate Incinerator Process Flow Diagram



The next stage in the combustion process will be volatilisation, where the combustible gases and vapours will be driven off. The volatilisation stage will take place in the temperature range of 200 to 750°C. The volatile components of the organic material of MSW typically account for 70 to 90%, and are produced in the form of hydrogen, carbon monoxide, methane and ethane. The combustion of volatiles will take place immediately above the surface of the waste and in the combustion chamber above the grate.

The volatile gases and vapours released will immediately ignite in the furnace due to the furnace gas temperature of between 750 and 1000°C. Typical mean residence times of the gases and vapours in the combustion chamber will be 2 to 4 seconds. The final section of the grate will be the burnout section where the char will be held for sufficient time to ensure sufficient burnout. The grate will discharge the resultant bottom ash into a water bath, and then via a conveyor to a bunker. Refer to Section 3.12, for further information on the ash handling. Metals will be removed from the bottom ash and sent for recycling.

The addition of combustion air to the furnace will be controlled to ensure optimum conditions. As with the fluidised bed furnace, combustion air will be drawn from the reception hall and bunker. Both primary air, fed from below the grate, and secondary air, fed over the grate, will be supplied from this source. The secondary air will be provided to assist in burning and to provide some mixing of the flue gases. This will ensure combustion of the volatile gases. Sufficient combustion air will be added to ensure effective combustion of the waste. The induced air movement through the furnace will prevent the possibility of "fire-back" in the hopper. Air will also be used as a cooling source for the grate.

The burnout of waste in the furnace will be controlled by visual inspection of the flame front via cameras and monitors, and by automatic monitoring of the temperature in the last section of the furnace. The temperature will be controlled by the air supply rate and the waste feed rate.

As with the fluidised bed furnace, the levels of O_2 and CO and the temperature in the furnace will be monitored and the combustion air input optimised to ensure efficient and effective combustion.

3.6.9 Waste Treatment Capacity of Phase 2

The operating capacity of the moving grate furnace will be determined by the calorific value of the waste. The capacity of the furnace will be equivalent to a throughput of approximately 100,000 tonnes per annum of solid non hazardous waste. The waste will be from industrial and municipal sources.

3.6.10 Process Control of the Furnaces and Post Combustion Chamber

As mentioned previously when discussing the individual furnaces, there will be a number of control parameters monitored to optimise the conditions in the furnaces as follows:

- Waste feed
- Burnout of waste in the furnace
- Temperature
- % O_2 in the combustion gases
- % CO in the combustion gases
- NO_x in the combustion gases
- Steam flow and pressure

The rate of waste feed will be controlled to maintain constant steam production at the desired temperature and pressure.

3.6.11 Inputs and Outputs

The main inputs into the furnaces will be waste and combustion air. One of the consumables of the fluidised bed furnace will be sand. The sand capacity of the furnace will be approximately 15 tonnes and the volume of sand consumed during the combustion of waste will be dependent on the waste stream. As the waste combusts, some of the sand will be ground down and some will be entrained in the flue gases. Typically 1-2% of the total volume of sand will need to be replenished each year. Sand will be replenished as needed, with typical volumes added to the furnace being in the order of 0-25kg/hr. On start up both furnaces will use natural gas to heat up to operating temperature.

The outputs from the furnaces will be bottom ash and combustion gases. Refer to Section 3.12 for details of bottom ash production.

3.7 Energy Recovery

3.7.1 Boilers and Turbine

Boilers

The thermal energy generated by burning the waste will be transformed into useful motive power and electricity using a conventional steam cycle. This will consist of a boiler on each flue gas line to generate steam, a steam turbine across which the steam will be expanded to produce motive power and a condenser to condense the steam and dissipate the low grade waste heat.

The boiler will consist of a number of empty passes and a final pass with tube bundles. The empty flue gas passes will be constructed from membrane walls without obstructions such as tube banks. The empty passes will allow heat transfer from the flue gas to the evaporating water in the membrane walls mainly by radiation. There will be no heat exchange surfaces in this section of the boiler as the fly ash will be sticky at temperatures above 650°C, and would quickly deposit on and foul the surfaces.

The large empty first pass will allow sufficient time at high temperature to complete combustion. The lower part of the first pass will be refractory lined to avoid corrosion and to provide thermal insulation close to the furnace.

The refractory lined part of the first pass of the boiler will be designed to ensure that the specified minimum residence time, temperature and oxygen content, after the last air/fuel injection, will be maintained, to ensure compliance with the EU Directive 2000/76/EC on incineration of waste.

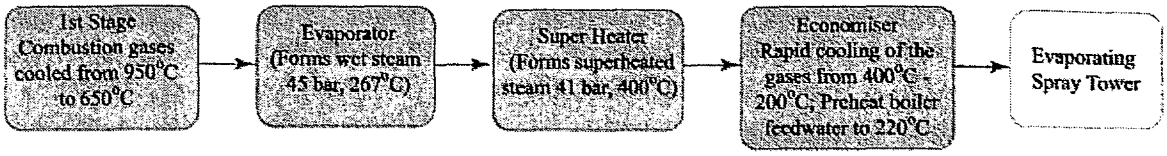
Either ammonia or urea will be injected into the first section of the boiler (urea breaks down to form ammonia and water). The ammonia will react with the Nitrogen Oxides (NO_x) to form nitrogen and water, thus reducing the NO_x emissions from the plant. This is explained in more detail in Section 3.8.2. The concentration of NO_x in the combustion gases will be continuously monitored and the rate of ammonia or urea injection will be set to ensure that the NO_x concentration will be well below the concentration limits, without the injection of excess ammonia.

The combustion gases will then pass through three further stages containing heat exchangers (refer to Figure 3.15 below):

- Evaporator – The evaporator will evaporate the boiler water to form wet steam at 45 bar gauge, 267°C.

- Superheater – This will heat the wet steam to form superheated steam at about 41 bar gauge, 400°C.
- Economiser – This will preheat the boiler feedwater to about 220°C, increasing the efficiency of the boiler.

Figure 3.15 Boiler Process Flow Diagram



The primary purpose of the steam boiler/economiser will be to exchange heat between the flue gas and the water/steam circuit, which will produce steam for power generation.

Some 75% of the energy produced by the combustion of waste will be recovered as steam in the boilers. While this will be somewhat lower than with a normal power plant, the flue gases from the incineration process will contain corrosive elements, which would attack the boiler components if steam was recovered over a wider temperature range, either at higher temperatures or at lower temperatures.

During the cooling in the latter stages of the boiler, dioxins may be partially reformed particularly over the temperature range 400°C to 200°C. In order to minimise the formation of dioxins the following design measures will be implemented:

- Regular cleaning of heat transfer surfaces. The formation of dioxins is catalysed (speeded up) by the presence of metals, and copper in particular. Regular cleaning of surfaces will reduce the amount of copper present to act as a catalyst.

- Rapid cooling over the range 400°C to 200°C. This will be effected by increasing the velocity of the combustion gases through the section of the boiler where cooling through this temperature range occurs. This increase in velocity will accelerate heat transfer and cool the gases more rapidly. The total residence time of the gases in the boiler will be approximately 30 seconds.

Steam Turbine

In the proposed plant, the steam from the two boilers will be expanded in a single steam turbine down to a pressure of 0.15 bar gauge. This low pressure will maximise the energy recovery from the turbine, which will be used to drive the generator set (refer to Figure 3.16). It is estimated that the approximate electrical outputs will be as follows:

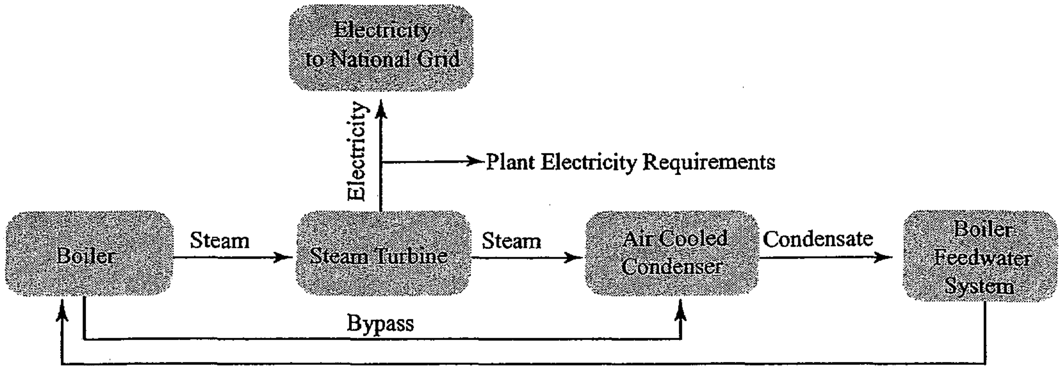
- *Phase 1*

Total	10MW
Plant Requirements	2MW
Net Available for Export	8MW

- *Phase 2*

Total	8MW
Plant Requirements	2MW
Net Available for Export	6MW

Figure 3.16 Steam Turbine Process Flow Diagram



The steam from the turbine will exit at a temperature of approximately 50°C and will be condensed in an air-cooled condenser. This will maintain the low pressure at the turbine exhaust and dissipate the waste heat into the air via banks of heat exchangers similar to a car radiator. It was decided to use an air-cooled condenser as this will reduce the water requirement of the plant and will also reduce the amount of effluent produced.

There will be a steam bypass to the condenser, which will be used during start up and in the event of a failure of the steam turbine. The steam pipes will be provided with pressure relief valves, which will automatically activate in the unlikely event of the steam pressure exceeding a set level.

The condensate will be collected in a tank, from where it will be pumped to the boiler feedwater tank for reuse in the boilers.

The electrical generator will be cooled using a smaller air cooler, with oil as the heat transport fluid.

Process Control for the Steam Turbine

The steam flow will be controlled by valves, which will control the flow of the steam to the turbine according to a specified load or other operating conditions. The system will be equipped with stop valves, which will interrupt the steam flow if the operating conditions fall outside preset levels.

Alarms, controls and measurements from the steam turbine control and protection system will be relayed to the main plant control system, so that the operation of the turbine can be monitored and controlled from the central control room.

Emissions from the Boiler, Condenser and Turbine

As with all boiler plant it will be necessary to treat the feed water to the boiler to achieve a high level of purity. A demineralisation plant will be provided for this purpose. In order to maintain the high level of purity required in the boiler water, a small quantity of water will be purged constantly from the system and replaced with fresh make up water. This purge is often referred to as boiler blowdown. This blowdown will be recycled for use in the evaporating spray towers.

Inputs and Outputs

The inputs into the boiler will be hot combustion gases and cold boiler feedwater and the outputs will be cooler combustion gases and superheated steam. In addition, some small amounts of boiler treatment chemicals will be added to the boiler feed to prevent corrosion and scale build up in the steam circuit.

Refer to Section 3.12 for details of the boiler ash.

3.7.2 Evaporating Spray Towers

On the fluidised bed line, if the dust collector is not installed between the furnace and the post combustion chamber (refer to section 3.6.5 above), it will be installed between the boiler and the spray towers. The dust collector will be a cyclone or electrofilter. The former option is shown in Figures 3.9 and 3.12.

The flue gas leaving the boiler will still be relatively hot at approximately 230°C and will be further cooled in the evaporative spray towers to a temperature of about 170°C. The evaporating spray towers will serve the dual function of cooling the flue gases, prior to the activated carbon injection and the dust filter stages, and of utilising all process waters from the plant.

The evaporating spray towers will be essentially large, empty vessels. Water will be sprayed at the flue gases as they pass through the towers. Process effluents from the plant, e.g. scrubber effluent, boiler blow down and boiler water treatment plant effluent, and wash waters will be collected for use in the evaporative spray towers. The balance will be made up from rainwater or potable water. By using process waters and rainwater, the plant's consumption of potable water will be minimised and there is no liquid process effluent to be disposed of off-site. The combustion gases will come into the top of the tower by forced draft and will travel downwards, through the water spray. The salts contained in the water will be dried by evaporation in the spray tower and collected in the baghouse filter as solid wastes for off site disposal (refer to Section 3.12).

Process Control for the Evaporating Spray Towers

The temperature of the combustion gases leaving the evaporating spray towers will be monitored and will be maintained at the required temperature of about 170°C by controlling the rate at which the water is sprayed.

Emissions from the Evaporating Spray Towers

There will be no emissions from the evaporating spray tower.

Inputs and Outputs

The inputs and outputs from the evaporating spray towers will be combustion gases and water. The quantity of solid residues collected at the bottom of the spray tower will be negligible.

3.8 Flue Gas Cleaning

3.8.1 Substances Treated in the Flue Gas Cleaning Systems

The combustion of waste produces the following substances, the emission of which is regulated by the EU Directive on Waste Incineration (2000/76/EC):

- Oxides of Nitrogen (NO_x)
- Carbon Monoxide (CO)
- Particulates (Dust)
- Poly-Chlorinated Dibenzo Dioxins (PCDD)
- Poly-Chlorinated Dibenzo Furans (PCDF)
- Hydrocarbons (expressed as Total Organic Carbon (TOC))
- Sulphur Dioxide (SO_2)
- Hydrogen Chloride (HCL)
- Hydrogen Fluoride (HF)
- Heavy Metals

The abatement of the emissions of these substances is addressed below in the relevant sub-section dealing with the stage at which they arise.

There are a number of different technologies available for the treatment of flue gases. A combination of treatment systems has been chosen for the Ringaskiddy waste to energy plant to ensure that the emission limit values, in the EU Directive (2000/76/EC), will be met. With this equipment it is expected that, similar to the Indaver plants in Belgium, the emission concentrations will be significantly below the limits.

The combustion gases from the furnaces will be treated as separate waste streams, with each line having its own dedicated flue gas cleaning equipment. This will ensure that, should one of the lines be out of operation for any reason (e.g., planned maintenance), the other line can remain operational. A set of valves and fans will regulate the flow of gases and the pressure in each line.

3.8.2 NO_x - Urea/Ammonia Solution Injection

All combustion processes lead to the formation of nitrogen oxides (NO_x). These substances are formed partly from combustion of the nitrogen fraction in the waste feed and partly from the oxidation of nitrogen in the combustion air. The optimised combustion conditions in the furnace will minimise the oxidation of nitrogen in the combustion air. However, to meet the strict NO_x emission values set by the EU, 'DeNOx' technology will be used.

This technology uses the reaction of ammonia and nitrogen oxides at high temperature to convert the nitrogen oxides to nitrogen and water vapour. This reaction will be achieved by the injection of either an ammonia solution or urea into the first section of the boiler. The urea will break down to form water and ammonia. The ammonia will then react with NO_x to produce nitrogen and water. Throughout this process the NO_x levels will be monitored to optimise the quantity of ammonia solution/urea injected and ensure that emission limits will not be exceeded.

This technology of ammonia solution/urea injection is known as Selective Non Catalytic Reduction (SNCR). The alternative to this technology is Selective Catalytic Reduction (SCR), where the flue gases are heated to about 280°C and react with ammonia over a catalyst.

Process Control for the Urea/Ammonia Injection

The ammonia solution or urea will be injected into the first section of the boiler at a controlled rate, which will be based on the NO_x concentration measured continuously in the stack.

Emissions from the Urea/Ammonia Injection

There will be no emissions from the Urea/Ammonia injection system.

Inputs and Outputs

The inputs to the system will be combustion gases and ammonia solution or urea. The output will be water vapour and nitrogen.

3.8.3 Dioxin and Furan Removal

Dioxins and furans are complex chlorinated hydrocarbon molecules which occur as trace elements in a range of organic chemicals and in the ash and emissions from most combustion processes. Chapter 14 (Impact on Human Beings), contains an explanation of dioxins, the various mechanisms for their formation in incineration of waste and an overview of dioxins and related compounds. Some of the various sources (both natural and man-made) from which dioxins may arise are outlined and a number of the studies of dioxins in the environment, which have been carried out at national and local level, are summarised.

As described previously, the plant has been designed to minimise the formation of dioxins. The combustion gases will be maintained at a high temperature (a minimum 850°C for waste with less than 1% chlorine, and 1100°C for wastes with more than 1% chlorine) for over 2 seconds, and the flue gases will be cooled rapidly through the critical temperature range from 400°C to 200°C. These measures will reduce the dioxin concentration in the combustion gases to a low level.

While a single stage of dioxin and furan removal would be sufficient to meet the standards proposed by the EU, the plant will be equipped with a second stage to reduce dioxin emissions to approximately 0.01 ng/m^3 (0.000 000 001 g/m^3), that is one tenth of the EU emission limit.

The first stage of the removal will involve the injection of a mixture of activated carbon and lime into the combustion gas directly after the evaporative spray towers. This is described below in Section 3.8.4.

In the second stage, the exhaust gas from the wet scrubbers will undergo a final gas-cleaning step. The technology for the final gas-cleaning step will be either a second stage of activated carbon and lime mixture injection and a second baghouse filter or a wet lignite coke filter. A brief description of these technologies is included in the section 3.9.2 and 3.9.3.

3.8.4 Dust – Activated Carbon and Lime Injection/Baghouse Filter

A small amount of a mixture of activated carbon and lime will be injected into the flue gas as it is leaving the evaporative spray tower. Activated carbon consists of small, porous carbon particles, which due to their porosity have a very large surface area. The large surface area will adsorb any dioxins, furans, hydrocarbons and heavy metals present in the flue gases. These carbon granules and other particulates will then be removed by filtration as the flue gases pass through the baghouse filter.

The particulates in the flue gas will consist primarily of fly ash carried over from the boiler and also of dry residues from the evaporation of the process effluents in the evaporative spray towers. This material will be removed by the baghouse filters.

Process Control

The activated carbon and lime mixture will be injected at a fixed rate controlled by a volumetric dosing screw. This fixed rate will be based on operating experience of the incineration plants in Belgium. The rate of dosing will allow for the maximum reduction in emissions.

The weight of the activated carbon and lime mixture feed container will be monitored continuously to ensure that dosing is continual. Should the weight of the feed container remain steady, which would mean that the feed to the process has stopped, an alarm will be activated in the process control room.

Each line will be equipped with a bagfilter, containing multiple filter sleeves in separate compartments. The separate compartments will allow the cake that accumulates on the filter sleeves to be removed while the filter is on-line. As dust accumulates on the sleeves, an individual compartment will be isolated and the dust cake will be blown off using compressed air. The cake will then fall into hoppers at the bottom of the filter.

Emissions

There will be no emissions to the atmosphere from the activated carbon and lime mixture injection or baghouse filter stages.

Inputs and Outputs

The inputs and outputs from this stage of the process will be the activated carbon and lime mixture and flue gas cleaning residues.

3.8.5 Acid Gases – Wet Scrubbers

The flue gas streams leaving the baghouse filters will be cooled via a heat exchanger prior to further gas cleaning in a system of scrubbers. The wet scrubbers will remove Sulphur Dioxide (SO_2), Hydrogen Fluoride (HF) and Hydrogen Chloride (HCL), which will be formed if sulphur, fluorine and chlorine are present in the waste stream. The scrubbers will cool the flue gases to approximately 60°C and saturate them with water.

The wet scrubbers will use a calcium based neutralisation agent, either lime or limestone, to remove acidic compounds and residues of heavy metals. The solution strength will be monitored continuously and replenished to ensure the effectiveness of the chemical based gas cleaning.

The scrubbers will not contain packing material. Instead, the scrubbers will be equipped with nozzles, which form water curtains through which the combustion gases will be forced to pass. The acid gases and heavy metals will be absorbed into the circulating water. The lime or limestone will react with the acid gases captured in the water. The flue gases will enter through the bottom of the scrubbers, and leave through the top after a residence time of about 2 seconds.

The first scrubber will normally operate at a low pH, and will absorb mainly HCL, HF and heavy metals to produce calcium salts. The second scrubber will be operated at a pH of about 6 and will absorb SO_2 to produce $CaSO_4$ (gypsum).

A predetermined purge of the solution will be maintained to prevent the concentration of reaction salts rising. This purge will contain gypsum ($CaSO_4$) in suspension, which will be removed using a vacuum belt filter. The purge water will then be recycled for use in the evaporating spray towers. The flue gases will pass through a mist eliminator after the scrubber, where droplets of water will be removed. The droplets will fall back into the scrubber.

Process Controls

The circulating water in the scrubbers will be constantly monitored for:

- Density or conductivity
- pH.

The rate of purge will be controlled by the measurement of the density or the conductivity (either of which is an indicator of the level of dissolved salts). The rate of addition of lime (or limestone) will be controlled by the pH measurement. Each scrubber will be equipped with a flow detector on the circulation water system and will be provided with a backup circulating pump.

Emissions

The purge from the scrubbers will be recycled back into the process for use in the evaporating spray towers and will not be emitted to the environment. There will be no emissions from the scrubbers.

Inputs and Outputs

The main input into the wet flue gas cleaning will be lime or limestone. The fluidised bed/PCC line scrubbers will need a higher lime input due to the higher chlorine content of the waste being treated. The chlorine content of hazardous waste liquids is expected to be in the order of 3-4%. The typical chlorine level for MSW is 0.5%.

Refer to Section 3.12 for details on the quantities of gypsum produced in the process.

3.9 Tail End Flue Gas-Cleaning Filter

As stated above the wet flue gases from the wet scrubbers will go through a final flue gas cleaning step prior to discharge.

3.9.1 Induced Draught Fan

The induced draught fan will draw the combustion gases through the flue gas cleaning equipment and maintain the plant at negative pressure. This will ensure that no combustion gases escape from the process without going through the flue gas cleaning plant.

If the activated carbon and lime mixture injection/baghouse filter is used as the final gas cleaning step, the induced draught fan will be situated after this, as this filter works best at under pressure. If a lignite coke filter is used, the induced draught fan will be located between the wet scrubbers and the tail end flue gas cleaning section, as the lignite coke filter operates more effectively at over pressure.

3.9.2 Activated Carbon and Lime Mixture Injection/Baghouse Filter

This will be the same technology as will be used in the first stage of dioxin/furan removal. This has been described in Section 3.8.4 above. The input/outputs and process controls will also be similar.

3.9.3 Lignite Coke Filter

This will consist of a fixed bed of activated wet lignite coke pellets, through which the flue gases will pass upwards from the bottom. Lignite is derived from brown coal and can, in activated pellet form, be used to achieve final reductions in dioxin and furan levels. This filter will also remove acids, hydrocarbons and heavy metals.

The system will be based on a modular design, containing separate filter modules, allowing one or more modules to be shut down with the remaining modules still on line.

Figures 3.9 and 3.10 illustrate the wet lignite coke bed option.

Process Control

Approximately once a week a small amount of the coke will be extracted from the bottom of the filter. This will remove the coke most exposed to the flue gases. The removal will be effected by adding water into the coke bed and opening a valve at the bottom through which the coke and water mixture will be extracted. The rate of extraction of the coke will be fixed.

Emissions

The lignite coke and water removed will be incinerated in the waste to energy plant. Thus, the filter will not produce any emissions to the environment.

3.10 Plume Abatement and Discharge

The relatively low temperature and high water content of the gases would lead to the formation of a visible plume from the stack if discharged directly and so the gases will be reheated prior to discharge, via a heat exchanger. The gases from each line will be discharged through individual flues via the tack. The stack height of 55m has been determined by computer modelling of the dispersion of the emissions to atmosphere. A stack of this height will ensure that the discharge will not lead to any adverse impact on air quality. The dispersion modelling of the emissions from the stack are addressed in Chapter 9 of this EIS.

Process Control

The controls on the plume discharge will be part of the emissions monitoring system.

Emissions

The emissions from this element of the process will be the treated flue gases. Refer to Chapter 9 for a full description of emissions to atmosphere.

3.11 Emissions Monitoring and Stack Discharge

As mentioned previously, the waste reception hall, the bunkers, the furnaces and gas cleaning plant will be operated under negative pressure generated by the induced draught fan. This will ensure that the only emissions from the plant will be those fully treated and discharged through the stack.

Flue gas monitoring equipment will be installed to monitor emissions. The equipment will consist of continuous monitors and regular grab sampling according to the specifications laid down in EU and Irish legislation for incineration plants.

The following parameters will be continuously measured in the stack: total dust, TOC, HCL, SO_2, NO_x, CO, temperature and O_2.

There will also be regular monitoring for HF and the heavy metals Cadmium, Thallium, Mercury, Antimony, Arsenic, Lead, Chromium, Cobalt, Copper, Manganese, Nickel, Vanadium and Tin.

Although it is not a requirement of EU or Irish legislation, the monitoring equipment will include a state of the art continuous dioxin sampler. This instrument will allow the dioxin emissions to be sampled continuously. Laboratory testing of the samples will give dioxin emission concentrations and mass emission rates over a two week period. This equipment is in use on existing Indaver plants.

An external and independent calibration and maintenance programme will be implemented for the upkeep of the monitoring equipment. Sample points will be accessible to EPA personnel for their independent inspection and monitoring programme.

The facility will be licensed by the EPA, which will specify the environmental monitoring that must be performed. The regulatory controls under which the facility will operate are described in more detail in Section 3.16.

3.12 Ash and Solid Residues

3.12.1 General

There will be five solid residues from the waste to energy plant:

- Bottom Ash
- Cyclone/Electrofilter Ash
- Boiler Ash
- Gypsum
- Flue Gas Cleaning Residues

The types and approximate quantities (dry weight) of ash and residues which are expected to be produced when the Ringaskiddy waste to energy facility is in operation are detailed in the following tables.

Table 3.1 Estimated Residue Quantity and Type (Phase 1)

Ash Type	Tonnes/annum	Hazardous/Non-Hazardous
Bottom	2,000	Non-Hazardous
Cyclone or Electrofilter	5,000	Non-Hazardous
Boiler	2,600	Non-Hazardous
Gypsum	1,600	Non-Hazardous
Flue Gas Cleaning Residue	4,400	Hazardous
Total	**15,600**	

Table 3.2 Estimated Residue Quantity and Type (Phase 1 and 2)

Ash Type	Tonnes/annum	Hazardous/Non-Hazardous
Bottom	23,000	Non-Hazardous
Cyclone or Electrofilter	5,000	Non-Hazardous
Boiler	3,200	Non-Hazardous
Gypsum	2,600	Non-Hazardous
Flue Gas Cleaning Residue	6,900	Hazardous
Total	**40,700**	

3.12.2 Use and Disposal of the Residues

Classification of the Residues

The classification of the residues as hazardous or not is made by reference to the classification set out in the European Waste Catalogue (EWC). If the residue does not contain the properties listed in H1 to H14 of the 'Waste Catalogue and Hazardous Waste List', and Annex III of the Hazardous Waste Directive 91/689/EEC, it is non-hazardous.

A leachate test on the residue will be carried out and the results will be compared with the requirements of the Directive. This will ultimately determine if the residue is suitable for disposal to a non-hazardous landfill in accordance with the Landfill Directive (99/31/EC) and the Hazardous Waste Directive 91/689/EEC.

Bottom Ash

The bulk of the ash, at about 11% of waste input by weight, will be bottom ash. The bottom ash, which will be at high temperature when it exits the furnace, will be quenched with air or water prior to transfer to the ash bunker, which will be contained within a closed building. Ash from the bunker is transferred into special covered trucks within the building. This will prevent any ash escaping from the plant.

The bottom ash will consist of silicates, minerals, metal pieces and glass compounds. Metals will be recovered from the bottom ash and sent for recycling. The bottom ash will be non-hazardous. Bottom ash from waste incineration in EU countries, including Belgium, is used in road construction or as railway ballast, following treatment in an ash recycling plant. This option for the recovery of bottom ash is discussed in Chapter 12, Material Assets.

Cyclone/Electrofilter Ash

The ash from this element of the process will amount to approximately 2.5% of the total waste input. Leachate tests will be carried out to determine the classification of the ash. It is expected, based on experience elsewhere in Europe, that the cyclone/electrofilter ash will be non-hazardous, and therefore suitable for non-hazardous landfill.

Boiler Ash

About 1.6% by weight of the waste input will be collected as boiler ash. The boiler ash will consist of compounds that will be carried over in vapour or particulate form from the combustion chamber. It will contain a higher concentration of heavy metals than the bottom ash. It may be solidified with cement prior to disposal. Leachate tests will be carried out to determine the classification of the boiler ash. It is expected, based on experience elsewhere in Europe, that the boiler ash will be non-hazardous, and therefore suitable for non-hazardous landfill.

Flue Gas Cleaning Residue

The flue gas cleaning residues will be approximately 3.5% by weight of the waste input. This material will be collected in the baghouse filter and will contain the particulates not collected as boiler ash. It will also contain salts from the spray towers (essentially solid residues from the flue gas cleaning process) and activated carbon. This residue will be classified as hazardous waste and must be disposed of in a hazardous waste landfill. Prior to its disposal to the landfill, this residue will be solidified with cement to ensure there will be no dust or other emissions.

Although it is an objective of the EPA's National Hazardous Waste Management Plan to develop hazardous waste landfill capacity in Ireland, there is currently no such facility. If, at the time of commissioning of the waste to energy plant, there is no hazardous waste landfill in Ireland, the flue gas cleaning residues will be exported for final disposal. The flue gas cleaning residues will be exported in closed containers to ensure there are no emissions. Indaver Ireland's associated company, MinChem, has over 20 years experience of collecting hazardous waste in Ireland and exporting it for disposal.

Gypsum

Gypsum, at about 1% of waste input by waste, will be removed from the purge from the wet scrubbers prior to injecting the purge into the evaporative spray tower. The recovered gypsum will be non-hazardous and can be recycled for beneficial use or disposed of to non-hazardous waste landfill. This is discussed in Chapter 12, Material Assets.

Process Control

The residue collection and handling systems will be controlled locally and will be monitored from the central control room via the plant's main control system.

Emissions

The only potential emission from the solid residue storage and handling process will be fugitive windblown ash emissions. The bottom ash bunker and bottom ash loading area will be enclosed within the main building, eliminating the potential for windblown ash. All trucks carrying bottom ash from the plant will be provided with covers to remove any potential for windblown ash.

The boiler ash and flue gas cleaning residue handling systems will be fully enclosed, with enclosed conveyors transporting the ash to silos. The silos will be equipped with High Efficiency Particulate Abatement (HEPA) filters to prevent fugitive emissions of ash. The ash will transported off site in closed containers.

3.13 Utility Requirements

The utility requirements of the waste management facility are dealt with in the chapter on Material Assets, Chapter 12.

3.14 Construction Activities

Construction activities are dealt with in detail in Chapter 7.

3.15 Health And Safety Aspects

3.15.1 General

Construction Safety

Construction safety is addressed in Chapter 7.

Operational Safety

The operation of the waste to energy plant will involve hazards associated with the handling of combustible materials, chemicals and high-pressure steam. During the design phase of the plant, hazard and operability studies will be carried out. These studies are a systematic method of identifying hazards and assessing mitigation measures. These studies have already commenced as part of the determination of the plant's status relative to the Seveso Directive (refer to Section 3.17). Prior to start-up a comprehensive set of standard operating procedures will be drawn up for operation of the plant, which, in addition to the staff training, will minimise risk. In compliance with the 1989 Safety, Health and Welfare at Work Act, Indaver Ireland will draw up a safety statement covering the operation of the plant and appoint safety representatives from the plant workforce. In addition the plant will operate to OHSAS 18001.

The following measures (based on the experience of the successful operation of Indaver's plants in Flanders) will be implemented to ensure safety and minimise the risk of emergency situations.

- The plant design will be carried out by skilled people according to internationally recognised standards, design codes, legislation, good practice and experience.
- The design will be reviewed to check for safety hazards in steady and non-steady state conditions and for ease of operability.
- Backup systems for pumps, control systems, power supply, monitoring equipment, instruments etc. will be provided for critical situations.
- Fire detection and fire fighting systems will be installed.
- The design will comply with Irish Building Regulations Part B Fire Safety and Indaver's insurance company's requirements.
- A thorough interlock system will automatically shut down the plant in a safe manner in the event of failure of key equipment.
- The installations will be commissioned according to a schedule that will provide for the testing of safety systems.
- The installations will be inspected by safety officers before start up.

- The installations will be well maintained and cleaned.
- Indaver will apply strict rules on safety such as a working permit system, training of operators and staff, and provision and use of personal protection equipment where appropriate.

In the unlikely event of a failure of the plant, and a simultaneous failure of the supply from the electrical distribution system, the plant's un-interruptible power supply (UPS) will supply electricity to the critical systems, such as the computer systems. The UPS will be designed to maintain a power supply to the control systems for 15 to 30 minutes.

The emergency generator will come on line at the same time as the UPS and will supply electricity to motors, pumps and fans until the plant is safely shut down.

3.15.2 Safety and Tracking during the Transport of Hazardous Waste

The handling and transport of hazardous wastes (and hazardous materials in general), is strictly regulated so as to minimise the risk of any negative health and safety or environmental effects. The following sections briefly outline the regulatory framework and the labelling and transport requirements to which Indaver adheres.

Tracking of Waste Shipments

The transport of hazardous waste is strictly controlled within Ireland and in the EU, so as to ensure, as far as possible, that there are no negative environmental or health and safety effects.

Most environmental hazardous waste legislation derives from the Waste Management Act 1996 and was brought into law by a number of Statutory Instruments. Hazardous waste movements within Ireland are controlled under SI No. 47 of 1998 - Waste Management (Movement of Hazardous Waste) Regulations, 1998. In order to move waste a consignment note (known as a C1 form) system, is required. The C1 form enables Local Authorities to 'track' the waste. The C1 form (obtained from the Local Authority where the waste originates), is uniquely numbered and comes in three separate parts (with five different coloured pages). Completed C1 forms are returned to the Local Authority.

The consignment note system is a comprehensive of way of tracking the movement of waste shipments from the producer to the consignee (disposer/recoverer).

A producer or consignee who wishes to ship hazardous waste material for recovery, treatment or disposal to another member state of the EU must do so under a licence known as a trans frontier shipment (TFS) licence.

Safe Transport of Hazardous Waste

The transport regulations cover areas such as classification, description, packaging, labelling, and training. The regulations apply equally to dangerous goods and wastes classified as hazardous for transport.

There are a number of sets of regulations which apply, depending on the mode of transport. Most hazardous waste is transported by road within Ireland, while sea transport is used for the export of wastes for recovery or disposal. In the case of road transport the ADR (European Agreement concerning the international carriage of dangerous goods by road) regulations apply. For sea transport the IMDG (International Maritime Dangerous Goods) code applies.

Where a waste shipment involves both modes of transport (e.g. Limerick to Ringaskiddy waste transfer station by road and onwards by ship), then the IMDG code is applied to all sections of the journey in addition to the ADR regulations.

Prior to transport from the consignor's premises, the waste shipment must be assessed and classified to establish the hazard class to which the waste must be assigned. Within a class, both the IMDG and ADR codes have particular 'Packing Groups', which assign a level of hazard to the material.

Following the classification of the material, it has to be labelled and packaged in the correct UN approved containers. The material is labelled with the UN number, proper shipping name and the correct 'hazard diamond', which shows the correct hazard symbol associated with the material, e.g., flammable.

All road tankers and trucks are labelled clearly to show what they are carrying. For package waste, a load plan is also carried on the truck, so that in the event of an accident the emergency services will be aware of the location of all items being transported.

Finally, the drivers of vehicles transporting hazardous waste receive specialist training in the handling and transporting of hazardous substances.

3.15.3 Fire Safety Strategy

Design for Fire Safety

The fire safety objectives adopted in the design of the Ringaskiddy facility are:

- to achieve compliance with the Building Regulations with particular reference to Part B (Fire), so that a Fire Safety Certificate will be obtained prior to the commencement of construction
- to follow as far as practicable the recommendations in the Code of Practice for Fire Safety in Buildings – BS5588 which is referred to in Technical Guidance Document B (Fire) to the Building Regulations.

Fire Systems

The entire plant will be designed and provided with adequate fire protection and detection systems consistent with the requirements of the Building Regulations. The fire protection system will be based on tried and tested systems which are provided in Indaver's existing waste to energy plants. The systems for detection and fire fighting will include:

- smoke detectors
- fire alarm system
- on site storage of water for fire fighting purposes
- manual call points
- smoke ventilation
- hydrants and hose reels
- dry rising mains
- fire extinguishing devices.

The fire alarm system will cover the entire facility, with local detectors, manual call points, local alarm bells, and a remote alarm and fire alarm/control panel. The main buildings will be fitted with dry rising mains. Outdoor hydrants will be installed at strategic locations around the plant.

3.15.4 Potential Operating Hazards

Waste Bunker

The greatest potential for a fire on site will be in the waste bunker, where a localised rise in temperature could occur due to the decomposition of organic material or as a result of hot ashes in the waste leading to isolated fires. Decomposition of organic waste can raise the temperature to 75°C, drying the waste and causing it to smoulder. Incoming ashes from domestic fires, wrapped in other waste, can retain their heat. When waste in the bunker is moved these ashes could be exposed to air and could start to smoulder.

Proposed Operational Safety Measures

The waste bunker will be continuously monitored by the crane operator to ensure that any fire can be detected at an early stage. Should the crane operator fail to detect a fire, automatic fire detection systems will activate an alarm in the control room. However, a localised fire is usually more quickly detected by the human eye, than by the fire detection systems.

In the event of a fire, it will be quite simple for the grab crane to lift the pieces of waste that are on fire into the hoppers, and from there it will go into the furnace. The waste in the hopper will then be covered over with another layer of waste.

Should the fire increase in size, it can be put out using one of the water cannons, which will be located around the top of the bunker. The crane operators will be trained in fire fighting techniques. Firewater generated in dealing with any fire event will collect in the bunker, from where it can be pumped out for treatment.

A number of design measures will prevent flames flowing back from the furnaces through the hopper into the bunker. These are as follows:

- the furnace will be at negative pressure relative to the bunker
- the waste hopper will always be filled to at least a pre-set minimum level, thereby ensuring a waste 'plug' between the furnace and bunker. This level will be monitored and safeguarded by interlocking.
- a valve in, or on the hopper will close automatically in case of fire or other warning signals.

Solvent Storage Tanks

The safety systems for the solvent storage tanks are described in section 3.5.

3.15.5 Fluidised Bed and Moving Grate Furnaces

Proposed Operational Safety Measures

The waste to energy plant will be provided with detailed control and safety systems. Interlocks will shut down the installation automatically as soon as a fire risk is detected. In an emergency shut down, all air and waste supply will be stopped to extinguish the fire. In this event all gases will continue to be discharged through the stack via the flue gas cleaning plant.

In the event of failure of the main control computer or of the supply of utilities such as air or electricity the plant will be automatically shut down in a safe manner.

3.15.6 Steam Production

Proposed Operational Safety Measures

The design of the steam circuit will be carried out to the best industry standards to minimise hazards. The standby generator will keep one boiler feedwater pump in operation to keep the water level in the boiler above a minimum. This will prevent overheating of the boiler.

3.15.7 Flue Gas Cleaning System

The main hazard in the system would be the flue gas temperature at the outlet of the boiler being too high. This could cause damage to the baghouse filters and ignite the activated carbon and lime mixture.

Proposed Operational Safety Measures

The flue gas temperature will be monitored and, in the event of a temperature threshold being exceeded, the plant will automatically shut down.

3.15.8 Emergency Response Planning

A Site Emergency Plan will be prepared prior to operational start-up, which will set out the response measures to be taken by personnel in the event of an emergency. These measures will be designed to ensure maximum protection for the site employees, site visitors and people in other premises near the site, to limit property damage and to minimise the impact on site operations and on the environment. The Site Emergency Plan will have four basic components:

Prevention

Prevention involves identifying potential hazards and then taking measures to remove the hazard, or reduce the potential for the hazard and its adverse effects.

Preparedness

Emergency planning, training programmes, emergency drill and exercise programmes are integral components of an effective preparedness programme. The site will have a dedicated 'emergency response team', which will be given specific training. Evacuation routes will be defined and all personnel will be aware of them.

Response

The site will be manned on a continuous basis except during shut-down periods when there will be a maintenance and security presence. Response activities address the immediate and short-term effects of an emergency.

Recovery

Recovery activities and programmes involve restoration of site services and systems to normal status.

3.16 Regulatory Control of the Waste Management Facility

3.16.1 General

In order to operate the waste management facility, Indaver will require a licence from the EPA. Under the 1996 Waste Management Act, as amended, facilities such as that proposed for Ringaskiddy will require a waste licence.

3.16.2 Waste Licence

Waste disposal in Ireland is controlled primarily through the Waste Management Act of 1996. Under the act, the EPA has the responsibility for the licensing of all significant waste recovery and disposal activities.

The table of contents for a typical waste licence, in this case the licence for the MinChem Waste Transfer Station located in Dublin Port, is given below. The licensee must adhere to a wide range of conditions to ensure the satisfactory management of the facility during its operation. The waste licence also addresses any restoration and aftercare provisions that may be required, once the facility ceases operations.

- Activities Licensed
- Interpretation
- Condition 1 - Scope
- Condition 2 - Management of the Activity
- Condition 3 - Notification and Record Keeping
- Condition 4 - Site Infrastructure
- Condition 5 - Waste Acceptance and Handling
- Condition 6 - Environmental Nuisances
- Condition 7 - Emissions and Environmental Impacts
- Condition 8 - Decommissioning and Aftercare
- Condition 9 - Environmental Monitoring
- Condition 10 - Contingency Arrangements
- Condition 11 - Charges and Financial Provisions
- Schedule A - Waste Activities
- Schedule B - Content of the Environmental Management Programme
- Schedule C - Content of the Annual Environmental Report
- Schedule D - Recording and Reporting to the Agency
- Schedule E - Monitoring
- Schedule F - Specified Engineering Works
- Schedule G - Emission Limits

3.17 Site Status in Relation to the EU Control of Major Accidents Hazards Involving Dangerous Substances Directive

3.17.1 Background to the 'Seveso' Directive

The European Union Council Directive 96/82/EC on the Control of Major Accident Hazards Involving Dangerous Substances ('Seveso 2' Directive) came into force in February 1997 and has been implemented in Ireland under SI 476 of 2000.

The new directive required the repeal of the original 'Seveso' Directive (82/501/EC) which was adopted following a series of accidents involving dangerous substances, such as the accident which occurred at Seveso, Italy in 1976.

The Directive defines a major accident as:

'an occurrence such as a major emission, fire, or explosion resulting from uncontrolled developments in the course of the operation of any establishment covered by this directive, and leading to serious danger to human health and/or the environment, immediate or delayed, inside or outside the establishment, and involving one or more dangerous substances.'

Hazard is defined as:

'the intrinsic property of a dangerous substance or physical situation, with a potential for creating damage to human health and/or the environment.'

This second Seveso directive revises the previous directive on the basis of experience acquired during its implementation with the aim of preventing major accidents, limiting their consequences and ensuring a high level of protection throughout the European Union in a consistent and effective manner. The directive covers all establishments having quantities of dangerous substance equal to or in excess of the thresholds.

Some of the requirements, which the directive places on the operators of establishment, are briefly outlined below.

General Obligations (Article 5)

The Directive obliges every operator to take all measures necessary to prevent major accidents and limit their consequences for man and the environment, with an obligation to prove at any time to the regulatory authorities that such measures have been taken.

Notification (Article 6)

Operators of establishments covered by the directive are required to notify nominated competent authorities of their existence and give clearly specified details in relation to the operator, relevant dangerous substances, inventories, type of activity and the immediate environment of the establishment. Any significant changes in the quantity, nature or physical form of dangerous substances or in their processing, or the permanent closure of an installation must also be immediately notified.

The central competent authority for Ireland is the National Authority for Occupational Safety & Health (NAOSH), also known as the Health & Safety Authority (HSA).

The notification requirement is to enable the regulatory authorities to manage their inspection programmes more effectively, identify possible domino effects, monitor implementation by operators and advise local authorities in respect of land-use or planning considerations.

Major Accident Prevention Plan (Article 7)

All operators of establishments subject to the directive are required to prepare a major accident prevention plan (MAPP) and ensure it is properly implemented. The major accident prevention plan established by the operator must be designed to guarantee a high level of protection for human beings and the environment by appropriate means, structures and safety management systems.

In planning for emergencies the operator is required to adopt and implement procedures to identify foreseeable emergencies by systematic analysis and to prepare, test and review emergency plans to respond to such emergencies.

Article 18

Article 18 deals with the requirement of competent authorities to organise a system of inspections, or other measures of control appropriate to the type of establishment concerned.

3.17.2 Status of the Ringaskiddy Waste Management Facility

Indaver Ireland commissioned Byrne Ó Cléirigh to undertake a study to determine if the proposed waste management facility would come under the European Communities (Control of Major Accident Hazards Involving Dangerous Substances) regulations, S.I. 476 of 2000, due to the quantity and nature of the materials that will be stored on the site.

Based on the maximum expected inventory levels of hazardous materials the study concluded that articles 6 and 7 of the Seveso II Directive (lower tier requirements) will be applicable to the Ringaskiddy facility. Thus the provisions of S.I. 476 of 2000 will apply to the facility.

A detailed study of the hazards associated with the operation of the site has been completed.

3.18 Site Management

When phase 1 is operational, the plant will employ approximately 50 permanent staff, some of whom will work on shift as the plant will be operational 24 hours per day. With phase 2 operational, it is expected that the total workforce will be approximately 57 people. Personnel will be split between the following functions:

- management and administration
- operations
- maintenance
- quality control and assessment
- shift operators for the waste to energy plant

Senior managerial staff will be experienced personnel from either Belgium or Ireland. All other staff will be recruited locally prior to start-up. Key staff will be recruited prior to commissioning of the Ringaskiddy plant and will be trained at a similar plant in Belgium. Training will also be carried out in co-operation with equipment designers and suppliers. By doing this, the operators will become familiar with the equipment and learn first hand from the equipment's design engineers.

The plant's staff will be responsible for routine maintenance and inspections of the plant, maintenance budget planning, procurement of services and materials, managing and supervising repairs and overhauls, the upkeep of the management information system (MIS) and updating and renewing environmental and operating permits.

Major machinery repairs and plant overhauls, which cannot be done by the facility staff will be subcontracted out to either local contractors or to the equipment suppliers. On such occasions the hiring of special expertise or specialised equipment may be required. Through careful preparation and training, Indaver Ireland's staff will be prepared for every stage of construction, commissioning and operation of the waste management facility.

3.19 Provisions for Site Decommissioning

The Ringaskiddy waste management facility has a projected life span of 20-30 years, though this may be extended thorough maintenance or the replacement of equipment. Should circumstances arise whereby it becomes necessary to shut down the facility, then Indaver Ireland will implement a decommissioning programme to ensure that any negative environmental impact is minimised. This programme will include:

- Removal of any chemicals or wastes stored on site. Any oils, lubricants or fuels that are on site at the time of closure will be recycled/disposed of through appropriate registered contractors.
- Plant, equipment and machinery. will be emptied on ceasing operations, dismantled and stored under suitable conditions until sold, or if a suitable buyer cannot be located, recycled/disposed of through appropriate licensed waste disposal contractors.
- The plant buildings will be subject to thorough house cleaning procedures prior to final departure.
- The site and buildings will be left in a secure manner and appropriate security maintained on site in the event of the site potentially being vacant for an extended period of time.
- If the site is being permanently vacated it will be returned to its current agricultural use.
- There will be no asbestos used in the construction of the facility so its removal during decommissioning will not arise.

A detailed decommissioning plan will be submitted to the Environmental Protection Agency as part of the application for an operating licence.

3.20 References

World Health Organisation Regional Office for Europe (1996) Waste Incineration (Environmental Health Planning Pamphlet Series; 6) WHO, Copenhagen, Denmark.

Forbairt (1996) Environmental Licensing and Control in Ireland: A Guide for Industrialists

SI 476 of 2000 (Control of Major Accident Hazards Involving Dangerous Substances) Regulations

Royal Commission on Environmental Pollution (1993) Seventeenth Report: Incineration of Waste, HMSO, London

EU Directive 96/82/EC Control of Major Accident Hazards Involving Dangerous Substances