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3. ALTERNATIVES

Alternatives are described at four levels as follows in accordance with the requirements of the EIA Regulations:

- Alternative Locations
- Alternative Thermal Treatment Technologies
- Alternative Waste Management Strategies
- Alternative Energy Recovery and Gas Cleaning Systems

Where appropriate, the Integrated Pollution Prevention Control Reference Document on the Best Available Techniques for Waste Incineration (also known as BREF Note on waste incineration) has been consulted in relation to alternative technologies and processes.

The BREF document is an aid to determining whether such technologies and processes are considered as Best Available Technology (BAT). (See Appendix 3.1 for further information)

3.1 ALTERNATIVE LOCATIONS

An assessment of the alternative location suitable for the waste-to-energy facility was undertaken by Kiaran O'Malley & Co. Ltd. Town Planning Consultants. The site selection process involved the consideration of both technical and environmental criteria over an extended period of time to determine whether the application site is a suitable site for the development of the proposed waste management facility and indeed the suitability of other sites.

The site selection process involved an assessment including the following steps:

- Step 1: The use of the 'centre of gravity' model, which relates the volume of waste arisings and the distances of these waste centres to each other centre within the catchment area. This exercise ranks the settlements in accordance with the total number of tonne-kilometres associated with each location.
- Step 2: Examination of the highest ranked locations from Step 1 against the recognised site selection criteria from published documents including the Feasibility Study of Thermal Options for Waste Treatment/Recovery in the North East Region (prepared by M. C. O'Sullivan Consulting Engineers on behalf of the local authorities of the NE Region and published in 1999) and the Waste Management Plan for the North East Region 1999. Step 2 concludes by identifying a suitable site from the list of potential sites for more detailed consideration at Step 3.
- Step 3: The candidate site from Step 2 was considered having regard to the criteria for siting waste-to-energy (WTE) Facilities in the following documents including the World Health Organisation-Site Selection Criteria for the siting of a New Hazardous Waste Management Facility (1993), the Waste

Management Plan for the North East Region 1999 and the Proposed Replacement Waste Management Plan 2005-2010.

The findings from the site selection assessment noted that the site at Carranstown was a suitable site for the proposed waste-to-energy facility. The detailed site selection study is contained in Section 2.5.

3.2 ALTERNATIVE THERMAL TREATMENT TECHNOLOGIES

Thermal treatment technologies are reviewed, outlining advantages and disadvantages, under the following headings:

- Pyrolysis and Gasification
- Waste combustion with energy recovery
- Combustion of refuse derived fuel (RDF)

It should be noted that only technologies that are in accordance with the requirements of EU Directive 2000/76/EC on the incineration of waste are discussed.

Pyrolysis and Gasification

By far the most promising technologies as an alternative to grate incineration are the advanced thermal conversion technologies of pyrolysis and gasification for energy from solid waste.

Gasification is the conversion of a solid or liquid feedstock into gas by partial oxidation under the application of heat and sometimes water. The gas can then be used as fuel in boilers, combustion engines or gas turbines.

Pyrolysis is the thermal degradation of a material in the complete absence of an oxidising agent (typically air). The by-products can then be used as a fuel for energy production.

Pyrolysis and gasification technology is at the point of transition between research and development and commercial phases. Indications are that advanced thermal conversion technologies will have similar costs, may have lower environmental emissions and there are prospects for higher levels of energy recovery.

These advanced technologies are proven for homogeneous waste streams but are still being commercially proven for mixed waste streams. In the last 5 years a couple of full scale plants have failed to operate correctly (e.g. Thermoselect plant in Karlsruhe - Germany; Schwell-brenn in Fürth – Germany). The Brightstar Environment demonstration pyrolysis/gasification plant in Wollongong (Australia) has ceased operation due to technical delays and funding issues.

To achieve the full potential for energy recovery from these advanced thermal technologies combustion of the char residue produced is required in a downstream waste-to-energy or similar facility. The carbon content of the char is also too high to meet future EU limits for landfilling, and unless payment can be received for use of this char as a fuel substitute the operating cost of the facility is higher than with conventional waste incineration.

Furthermore, pyrolysis and gasification both produce toxic, flammable gas that can cause intoxication and explosive conditions in the case of leaks. This increases the hazard associated with the plant and also the capital investment costs. Given that these advanced thermal conversion technologies do not as of yet have a sufficient track record in full-scale commercial operation, they were not considered suitable for the multi-purpose requirements of the proposed project.

Technology	Advantages	Disadvantages
Pyrolysis	Better retention of heavy metals in char than ash from combustion	Pyrolytic oils/tars contain toxic and carcinogenic compounds
	CO_2 neutral energy production	No long term operating experience from large scale plants. More useful for single waste streams rather than mixed MSW.
	Less flue gas (quantity) than mass burn	Requires back up fuel supply
	No formation of dioxins or furans	Char has high content of heavy metals
	HCl can be distilled from or retained in the solid residue	Char does not meet EU requirements for landfilling due to carbon content
	Low leaching of Chromium from solid fraction deposition. Reduction to 20% for Cadmium and Nickel	Waste requires shredding prior to entering pyrolysis unit
		The solid residue requires final combustion in a solid fuel boiler and gasifier.
	Production of gas with lower calorific value which may be combusted with short retention time and low emissions. Requires pre-scrubbing of extensive flue gas cleaning.	Further treatment of the char is required for the production of sterile clinker and other associated residues

Technology	Advantages	Disadvantages
Gasification	CO_2 neutral energy production	No long term operating experience. Very small number of non-prototype plants operating within market. More useful for single waste streams rather than mixed MSW.
	Energy (in the form of gas) can be stored for later use	The gas contains traces of tars containing toxic and carcinogenic compounds
	Better retention of heavy metals within ash	Energy recovery efficiency is low
	If solid fraction is vitrified, low leaching of heavy metals from ash	Waste requires shredding prior to entering gasifier unit
	Produces sterile clinker and other residues	Complicated gas cleaning for engine uses
	Less flue gas (quantity) than mass burn	Combustion of production gas produces NOx
	Gas cleaning system can result in low emissions	Complexity may reduce long term reliability
	Production of gas with lower calorific value which may be combusted with short retention time and low emissions. Requires pre-scrubbing of extensive flue gas cleaning.	Solid residues may contain unprocessed carbon in ash

Waste Combustion with Energy Recovery

The principal technologies of waste combustion are grate combustion or fluidised bed systems. Waste combustion involves the reduction of municipal waste to approximately 5-10% of its original volume. The thermal energy generated can be recovered as electricity, heat or a combination of heat and power (CHP). The process leads to the production of flue gas cleaning residues which either requires further treatment or deposition in a controlled landfill.

Fluidised Bed

With regard to the design of the combustion section of the incineration plant fluidised beds do exist as an alternative to conventional grate furnaces.

In a fluidised bed system the waste is pre-treated, usually by shredding, with the resulting particulates and fluidised sand bed suspended in an upward airflow in the combustion chamber. This ensures uniform combustion conditions and is particularly suitable for efficient combustion of low grade fuels. An example being peat or sewage sludge combustion, where it is now the industry standard. Fluidised bed systems for waste combustion are common in Japan, and there are a number of examples in operation in Europe. In 2005 Indaver commissioned a 466,000 tonnes per annum fluidised bed incinerator in Flanders, Belgium which treats industrial waste and sludges. Planning permission and EPA waste licence has also been received for a 100,000 tonnes per annum facility for hazardous and non-hazardous waste, which includes a fluidised bed incinerator, in Ringaskiddy, County Cork.

Fluidised bed is particularly suited for the combustion of wet sludges and material of a low calorific value, which are not planned for the proposed plant. Furthermore, a fluidised bed furnace requires a pre-treatment of the waste, which is easier with dry wastes than with the typically wet waste (c. 40% moisture) expected to be received by the proposed plant. The technology also has a less extensive reference list than grate furnaces. It was on the basis of these considerations that the more established grate furnace technology was chosen for the proposed plant.

Grate Combustion

As grate combustion is the chosen technology this is discussed in detail in Section 5.

Technology	Advantages	Disadvantages
Waste Combustion (Fluidized Bed & Grate Incineration)	Proven reliable process	High Capital Cost
	Total volume of waste reduced to approximately 5-10%	Generation of NOx, other gases and dust. These require an extensive flue gas cleaning system. Fly ash requires disposal at a controlled landfill or further treatment
	CO_2 neutral energy production	
	Residues are sterile	
	Energy recovery efficiency of up to 80% (steam from boiler)	
	Ferrous metals within the ash can be re-used	
	The process can handle all municipal waste	

Combustion of RDF

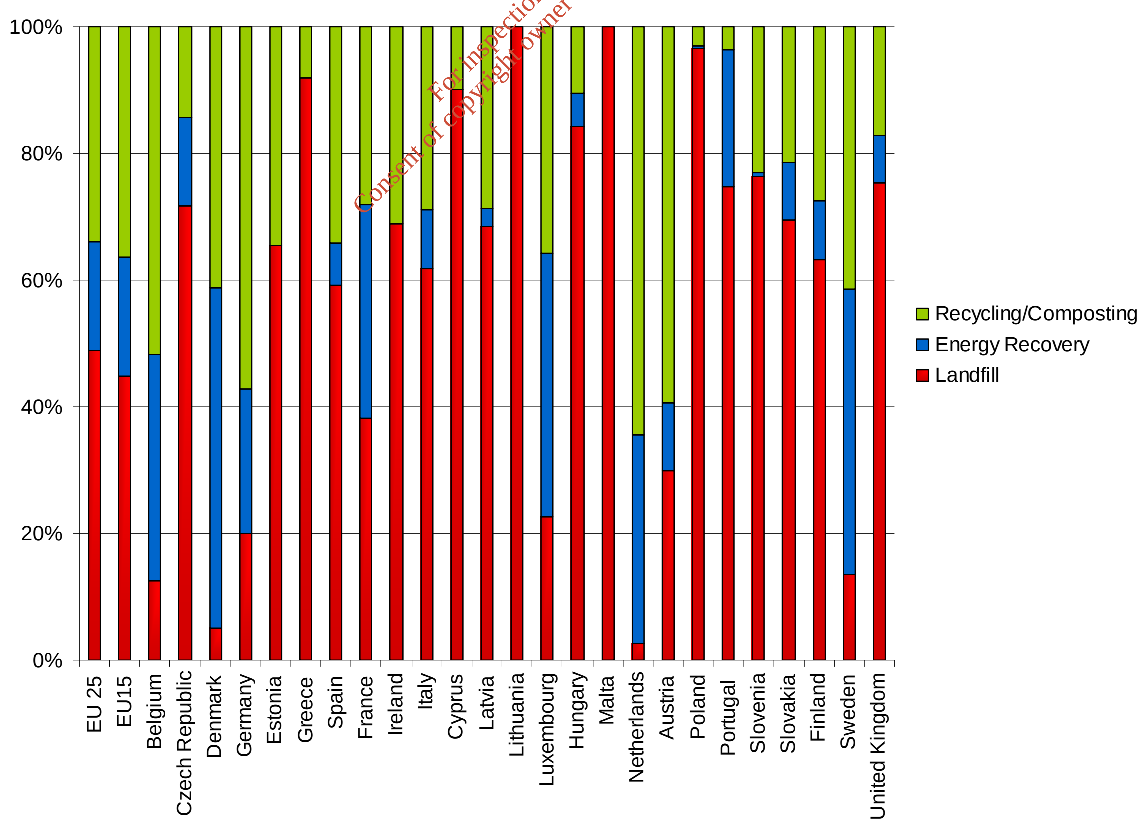
This process is to produce fuel suitable for use as a fuel in cement kilns or power stations. Refuse Derived Fuel (RDF) requires sorting of the household waste to remove recyclable materials and putrescible wastes, therefore the process generally takes place in conjunction with material recycling. The sorting will generally remove the wastes comprising low calorific value (i.e. wet organics) in order to achieve a high content of high calorific waste streams. Experience from Europe to date has shown that reaching consistent RDF which meets the end users quality control requirements has proved difficult and therefore has resulted in RDF material being sent to incineration plants for disposal. RDF plants tend to be smaller scale than that of moving grate and more suitable to single waste streams, or more homogenous waste streams to that expected to be treated at the proposed facility. In order for a facility to use RDF it must be designed to meet the requirements of 2000/76/EC.

Technology	Advantages	Disadvantages
RDF	Recycling of materials and diversion from landfill	End product markets (including RDF) are limited
	Flue gas pollutants reduced as metals are separated prior to combustion	No market for dry stabilitie. Cannot be burned in incinerators or solid fuel boilers without these meeting the requirements of 2000/76/EC
	Produces a storable RDF with a high calorific value and reduced pollutant level	The recycling value is minimal where effective source separation systems are in place.
	Achieves energy recovery from waste using existing facilities (where these can be designed to meet requirements under 2000/76/EC only)	Storage problems may arise (to include waste and a total of three end products for distribution)

3.3 ALTERNATIVE WASTE MANAGEMENT STRATEGIES

The technical solution proposed for the plant is the combustion of waste using conventional grate furnaces with energy recovery in the form of electrical generation. While there are no examples of this technology in Ireland as of yet, it is widely practiced in European countries as a disposal option. Figure 3.1 shows the waste management strategies for municipal waste in a number of European countries.

Figure 3.1 Waste Management strategies in European Countries (2003)



Source: Eurostat, the Statistical Office of the European Communities, http://epp.eurostat.cec.eu.int

There are, however, alternatives to conventional grate incineration for waste management. These are best addressed within the European Union's policy on waste, given in the 6th Action Plan on the Environment (93/C 138/56). The strategy includes a hierarchy of waste management options in which primary emphasis is laid on waste prevention, followed by promotion of recycling and reuse, and then by optimisation of final disposal methods for waste which is not reused. EU waste policy promotes the development of an integrated system which includes all the elements of the waste hierarchy and requires that these elements be developed simultaneously, rather than consecutively and in the same order as the waste hierarchy. The objectives for municipal waste are:

- Prevention of waste (closing of cycles)
- Maximal recycling and reuse of material
- Safe disposal of any waste which cannot be recycled or reused in the following ranking order:
    - Combustion as fuel
    - Incineration
    - Landfill

These objectives will be addressed in detail in the following Sections.

3.3.1 Prevention of Waste

Prevention of waste is the cornerstone of all waste policies. The proposed development is a commercial operation with commercially appropriate charges for waste disposal. Therefore the 'Polluter Pays' principle applies. This principle allocates the cost of pollution to producers and consumers rather than to society at large. The charges applied will therefore act as an incentive for the minimisation of waste at source.

A frequent charge levied against the incineration of municipal waste is that they require large quantities of waste, in particular waste of high heating value, and that this leads to disincentive for the prevention and recycling of waste.

Practical experience in European Countries, such as Germany, Denmark, Austria and Switzerland, and Scandinavia indicate that the extent of recycling is more intensive in regions with waste-to-energy plants. In part this is due to a higher level of environmental awareness, which regulate against excessive production of waste, and high diversion targets in line with the landfill directive are also a factor.

Indaver has a successful history of promoting waste prevention initiatives and Indaver Ireland provides a public information service on the means of preventing waste. A range of publications have been produced, such a Total Waste Management guide for businesses, a home composting and hazardous waste guide for households and these can be ordered or downloaded from www.indaver.ie.

The construction and operation of the proposed waste-to-energy facility will not impact negatively on waste prevention because of the capacity restraint placed on the facility by the Regional Waste Management Plan.

3.3.2 Maximal Recycling and Reuse of Material

The implementation of taxes for incineration and landfill (see Table 3.1 below) in a number of European Countries has promoted effective reuse and recycling practices. Such taxes in effect encourage more sustainable waste management.

Table 3.1 Waste Management and associated taxes in selected European Countries

Country	Recycled (,000)T	Composted (,000)T	Incinerated (,000)T	Landfilled (,000)T	Landfill Tax (€/T)	Incineration Tax (€/T)
Belgium	1,442	1,088	1,627	594	58.6 (35) (Note 1)	10 (Double for hazardous waste)
Czech Republic	175	122	401	2,097	10 (2005-2006) (Note 2)	-
Denmark	796	555	2,008	215	50.49	44.43
Germany	17,250	7,844	11,826	11,266	None	-
Spain	3,811	3,914	1,567	14,723	None (Note 3)	-
France	4,715	4,208	11,110	12,991	7.32-9.15	-
Italy	3,897	7,335	2,698	18,500	1-10 (Inert) 5-10 (other excl MSW) 10-25 (MSW)	Incineration without energy recovery = 20% of landfill tax
Netherlands	2,213	2,365	3,125	810	84	-
Austria	116	-	490*	1,500*	44	7
Portugal	252	135	944	3,388	None	-
Finland	659	-	201	1,512	30 MSW	-
Sweden	1,295	354	1675	825	41	-
United Kingdom	3,733	1,423	2,681	27,545	25.64	-
Ireland	463	34	-	1,967	15	-

Source: Eurostat (2002) and CEWEP (2005)

Note 1 – 58.6 for Belgium -Flanders and 35 for Belgium – Wallonie (municipal and industrial waste)

Note 2 – Municipal Waste Landfill taxes: 10€/t (2005-2006); 13€/t (2007-2008); 17€/t after 2009

Note 3 – Madrid: 10€/t dangerous waste; 7 €/t domestic waste; 3 €/t C&D

Note 4 – 9.66 €/t residual landfill; 12.88 €/t for reactor landfill (eg slag); 32.19 €/t export to disused salt mines (eg untreated residues from flue gas cleaning)

The charges applied for the disposal of waste at the facility will act as an incentive for recycling and reuse. Recycling and reuse includes segregation and recycling of the usable fraction of waste and the composting of organic material fractions. The European Union itself has set the target of recycling/reuse of paper, glass and plastics of at least 50%. The level of segregation and recycling currently practised in Ireland is 50.8% for commercial waste and 19.5% for household waste (EPA Waste Report 2004). Collectively, the recovery rate for municipal waste has increased from 28.4% in 2003 to 33.6% in 2004 which shows considerable progress towards achieving the national target of 35% recycling by 2013.

Flanders achieves one of the highest recycling rates of all western countries with a recycling rate of 70% in 2004. This grew from a rate of 18.3% in 1991 through a combination of regulations, agreements and taxes. A successful system of selective collection of recyclables, based on door to door collection and Community Recycling Parks, has facilitated this decrease. However, despite this very successful increase in recycling rates, the Flemish authorities recognise that there is a need for both incineration and landfill in their overall waste management strategy. Flanders has a planned incineration capacity of 1.6 million tonnes per annum from 2005.

Germany has one of the most developed waste management infrastructures in Europe. As far back as 1990 the German Department of the Environment addressed the issue of recycling in its publication on the importance of municipal incineration within waste disposal policy. The German government found that a responsible minded public, and a consequent recycling of material, led under optimum conditions to a weight reduction in private household waste (ca. 250 kg/capita per year) of 20 – 25%.

These figures, while actually achieved in some areas, relied on exceptional collection systems. Additional reductions in weight could be achieved through the intensification of home composting and the collection of biowaste (organic kitchen and garden wastes) with municipal composting. The resultant total weight reduction in private household waste with collection of biowaste lies at 38 – 49 % when 80 % of the citizens are connected to the system. That is, with maximum recycling rates and a separate collection for organic waste, less than a 40% reduction in waste for final disposal is considered attainable. Landfill bans and taxes are also a prerequisite for reaching and maintaining high recycling rates. In Germany all waste must be pretreated (at recycling, mechanical biological treatment and waste-to-energy facilities) prior to landfill. By 2020 they will be a complete ban on the landfilling of waste.

Disregarding agricultural, 954,746 tonnes of waste was produced in the four north east counties in 2003.

An estimated 454,198 tonnes of household, commercial and industrial waste was generated within the North East Region in 2003. The proposed Waste-to-Energy plant will have an annual average capacity equivalent to 37% of the total waste generated within the region in 2003. The proposed replacement waste management plan also predicts an annual growth rate of 2-2.58% in waste generated between 2005 and 2020.

The Proposed Replacement Waste Management Plan (2005) outlines an integrated waste management system for the North East Region. Waste infrastructure in the North East Region has also grown significantly however; progress is still required to meet the targets of the original Plan set for 2015 as follows.

- 43% recycling
- 39% thermal treatment
- 18% landfill

Indaver promotes the recycling of waste through the operation of the community recycling centres in Navan and Trim on behalf of Meath County Council and the provision of a paper and waste electrical recycling collection service in the North East. As the proposed waste-to-energy facility is in line with the capacity restraint outlined in the Proposed Replacement Waste Plan it will impact negatively on recycling.

3.3.3 Zero Waste

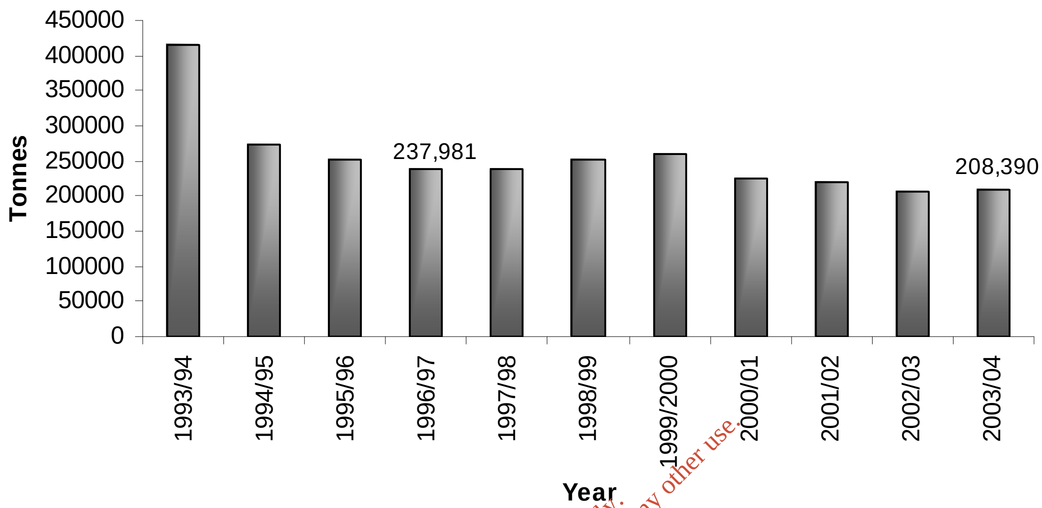
Zero waste as a waste policy has been proposed as an alternative strategy that Ireland should adopt. Zero waste is a noble concept. It holds the highest position in the waste hierarchy as the elimination of waste is the ultimate target.

However such a policy would require the redesign of all products and a dramatic change in lifestyle. It does not solve today's waste problem and, to date, no community has achieved a zero, or near zero, waste position.

Canberra, Australia (population 300,000 urban dwellers), one of the founders of the zero waste concept, has implemented an 'Australian Capital Territory (ACT) – No Waste by 2010' programme which is based on a 'zero waste to landfill' concept and has been actively promoting minimisation, recycling and zero waste to landfill. The ACT was the first government in the world to set a goal of achieving NO WASTE going to landfill. Launched in 1996, the Waste Management Strategy for Canberra has been developed to set the vision and future directions for waste management in the Australian Capital Territory.

The aim of the strategy was to achieve a no waste society within about 14 years of its launch in December 1996. Canberra's initiatives have included provision of separate recycling bins with compartments, promotion of composting and public information programmes. Although the programme achieved an initial significant reduction in waste going to landfill, in latter years the rate of reduction has levelled off. Between the period 1996 and 2004 while there has been a 12% reduction in the quantity of waste landfilled, there has, in fact, been a 51% increase in the total quantity of waste generated (www.nowaste.act.gov.au). There has also been a 17% increase in the quantity of domestic waste going to landfill.

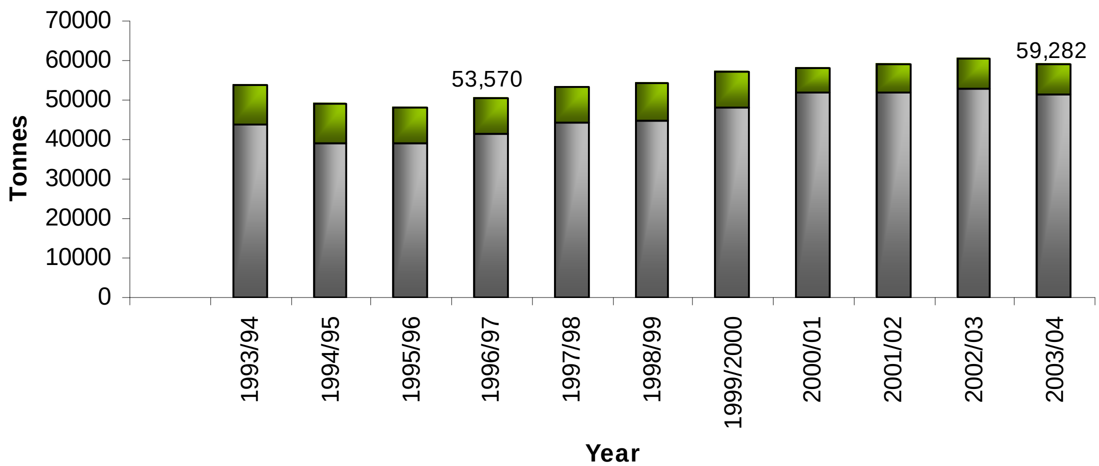
Figure 3.2: Total Waste to Landfill in Canberra, Australia



Source: www.nowaste.act.gov.au

This shows that such a 'zero waste to landfill' target is difficult to achieve.

Figure 3.3: Domestic Waste to Landfill in Canberra, Australia



Source: www.nowaste.act.gov.au

Experience overseas has shown that a 100% waste recycling target, the so-called 'zero waste' target, with no residual waste to be disposed of, is not feasible. Consequently, even with a highly optimised waste management strategy, for the foreseeable future a considerable proportion of the waste will remain for final disposal. Flanders has the highest percentage of recycling in the world yet has 1.6 M tonnes of incineration capacity.

3.3.4 Landfill

Landfill of waste represents the lowest level of the waste hierarchy given by the EU. The Landfill Directive sets down targets for the reduction of biodegradable waste to landfill. Many Member states have banned recyclable and combustible waste to landfill – only pre-treated material (e.g. residues from composting facility or Waste-to-Energy facility) can be disposed to landfill.

Methane, which is a potent greenhouse gas, is produced with odorous by-products through the decomposition of biodegradable matter in a landfill. While landfill gas collection systems can capture between 50 and 70% of this gas for energy generation, significant quantities of gas are dissipated to the environment. Additional problems arise from degradation by-products in the aqueous run-off from the landfill (leachate), which presents a pollution threat to ground water and surface water, while litter and vermin will have an impact unless well managed.

The proposed development will minimise the need for landfill by providing an alternative solution which is higher up the waste hierarchy.

3.4 ALTERNATIVE ENERGY RECOVERY & GAS CLEANING SYSTEMS

3.4.1 Heat Recovery

The following heat recovery alternatives are discussed below:

- no heat recovery
- hot water generation
- steam boiler

Incineration without heat recovery has not been deemed an alternative, as it is not considered BAT nor in line with EU Regulations.

Hot water generation, as opposed to steam generation, while considered BAT, has not been considered an alternative option as it requires connection to a heat consumer which typically comprises district heating systems. While this is popular in much colder countries, such as Scandinavian countries, no such system exists in the North East Region in Ireland.

Hot water systems have the advantage of a higher energy use. Such a system has very high efficiency rates, typically 90%, compared to an efficiency rate of 30% for generation of electricity within a steam turbine. However, due to seasonal fluctuations the demand for hot water does not achieve 100%. There will only be a constant requirement for heat generated from a hot water system (even during the summer period) where the hot water generator feeds into a network which has a constant requirement for heat in excess to that generated by the incinerator. While reasonable efficiencies are achieved in colder climates such as Scandinavia, this is not the case in warmer climates. Such a network is not available in Ireland and therefore it is not considered as an option for the proposed development.

A steam boiler is an alternative option and has been chosen for the Meath waste-to-energy facility. Steam parameters of a pressure of 40 bar and a temperature of 400℃ are standard parameters used in the waste incineration industry and are considered BAT. This is the maximum pressure and temperature technically possible for electricity generation as anything greater than this will result in excessive corrosion of the boiler and lower efficiency.

The boiler outlet temperature for the proposed development will be a minimum of 250℃ and is considered BAT. Such a temperature is required for the evaporation of excess water from the process and the prevention of liquid effluent. Temperatures lower than 250℃ would impact on the evaporation process and result in the generation of effluent from the facility.

3.4.2 Dust Removal System

Dust removal can be achieved using a variety of technologies in order to meet the requirements of EC 2000/76 waste incineration directive, such as:

- cyclone
- electrofilter
- baghouse filter

The most suitable option is dependant on process conditions and emission limits standards.

Cyclones can be used at temperatures up to 900℃. T he efficiency is dependant on the particle size and density. Efficiencies of over 90% can be achieved for sand, however for fly ash it is unlikely to have a separation efficiency of more than 60%.

Electrofilters can be used at temperatures up to 400℃. The efficiency is dependant on the number of "electrical fields" installed. An efficiency of 95 % is common. However, achieving dust emissions below 5 mg/Nm3 has proven difficult.

Baghouse filters can be used at temperatures up to 200℃ with high efficiency. Such filters achieve typical dust emissions of 2 mg/Nm^3 which compares favorably with the waste incineration directive which sets the limit at 10 mg/Nm^3. Due to the creation of a cake on the filter cloth it is possible to consider a baghouse filter as a reactor also for the removal of acid gases and further removal of dioxins and heavy metals. The outlet temperature from the evaporating spray reactor is between 160 and 180°C, therefore this is an optimal location for a baghouse filter in the process.

For the reasons outlined above it is therefore proposed to use a baghouse filter for the removal of dust after the evaporating spray reactor as the outlet temperature is optimal. This is considered BAT.

Fly ash separation (dust removal prior to gas cleaning) has not been considered due to the very low volume generated. The advantage of separation would be the landfilling of fly ash without solidification with cement, however, this would be dependent on prior knowledge of the concentration of metals in the waste.

3.4.3 DeNOx

DeNOx can be achieved by either Selective Catalytic Reduction (SCR) or Selective Non Catalytic Reduction (SNCR). Both technologies are considered BAT.

SCR is more complicated to operate than SNCR. Ammonia is used as a reagent in the process. As it requires fossil fuel (gas) it has a negative effect on the overall energy balance of the plant. It also has an extensive fire safety prerequisite. As a result an SCR system is more prone to technical difficulties and frequent, unscheduled, shutdown time. Advantages include an option to combine DeNOx with dioxin removal, efficient NOx removal and less effluent and residues.

SNCR is a less complicated system and is therefore more reliable and not as prone to technical difficulties and frequent, unscheduled, shutdown time. However, it does require a higher consumption of ammonia. Modern SNCR systems can achieve very low NOx emission limits which are comparable with SCR. SNCR does not require any additional energy input.

Two reagents can be used in such a DeNOx system: ammonia or urea. Urea is a chemical that decomposes to ammonia and carbon monoxide at temperatures greater than 200°C. It is safer to handle than ammonia. In an SNCR system, the carbon monoxide will be further oxidised to carbon dioxide because it is applied at temperatures of approximately 900°C. Urea allows a larger temperature range in which to react with NOx.

It is proposed to use SNCR with urea or ammonia injection as it is safer, more flexible and consumes less energy and therefore does not have a negative effect on the overall energy balance of the plant. This system is considered BAT.

3.4.4 Dry or Semi Wet Flue Gas Cleaning

The Evaporating Spray Reactor can use a semi-dry or semi-wet absorber. Both are considered BAT.

Flue gases are cooled to some 160℃ by the evaporat ion of injected water and lime. Lime is added either as a suspension of lime in water (semi-wet system) or dry lime (semi-dry system).

The lime reacts with the acids in the flue gas. The spray reactor, with a significant over-stoichiometric use of lime, will ensure acid emissions are within EU emission limits. The spray reactor alone can abate the hydrochloric acid and sulphur dioxide to some 70 % of the EU emission limits, however it is not as efficient in the abatement of peaks of these acids. Therefore, it is proposed that the spray reactor for the proposed facility be operated together with a wet scrubbing system to ensure that emissions are well within EU limits. The BREF Notes on waste incineration recommend a recirculation of the partly reacted lime from the baghouse filter, located after the reactor, back to the reactor.

Alternatively the evaporating spray reactor can be used as a dryer in combination with a wet scrubbing system. In this system water is used instead of water with lime. For an effluent free plant, water can be purged from the wet flue gas cleaning system after the evaporating spray reactor.

An alternative to semi-wet or semi-dry flue gas cleaning is dry flue gas cleaning (with lime or sodium bicarbonate). Dry systems generally require an over consumption of the reactants (lime, sodium bicarbonate) and hence create more residues. BAT guidelines suggest that very high stoichiometric rates of lime should be avoided.

Use of bicarbonate has not been considered for the proposed facility due to the quantity of residue produced. The residue can be recycled and used in the manufacture of salt, however no such recycling market is available in Ireland. Dry systems are not as efficient and do not achieve as low emission limits as semi-wet systems.

Dry systems are favourable for smaller waste-to-energy facilities.

3.4.5 First stage removal of dioxins, trace organics and heavy metals

Options for dioxin removal are the injection of a premix of activated carbon or activated lignite cokes and lime before the baghouse filter.

Activated carbon or activated lignite cokes injection before the baghouse filter is an efficient dioxin removal system and is considered BAT. It is the most favourable option due to its operational simplicity and the fact that a baghouse filter has also been proposed for dust removal from the proposed facility.

Alternatively activated carbon or activated lignite cokes can be injected as a premixed blend with hydrated lime. However, it is not possible to alter the activated carbon or activated lignite cokes /lime ratio when they are dosed together. The benefits of this system are less relevant due to the injection of lime in the evaporating spray tower and the re-use of effluent from the process in the evaporating spray reactor.

An SCR system is another alternative option. A catalyst bed would be required and the risk of catalyst poisoning/fouling is too high to consider it as an alternative in the earlier stages of the flue gas cleaning system.

3.4.6 Wet flue gas cleaning

Although not required to meet the EU Waste Incineration Directive, a wet flue gas cleaning system has been selected to ensure emissions are well within limits set in the Directive. Wet systems are more efficient than semi wet or dry systems in the abatement of peaks of acids in flue gases.

A number of options are available, depending on the neutralising agent and the number of wet scrubbers used.

The neutralising agents include lime, limestone, caustic or a combination of these.

Limestone is more cost-efficient than the others but also less reactive for peak loads of sulphur dioxide. Caustic is the least cost effective but has the highest reactivity for peaks of sulphur dioxide. Lime is somewhere between limestone and caustic. Unlike caustic, lime and limestone require scrubbers which can handle suspensions instead of clear liquid and consume more electricity. They produce insoluble gypsum from sulphur dioxide from the flue gases. This is advantageous for the discharge of the residue from an effluent free facility. As caustic is more efficient it has been chosen as the best option.

The wet scrubbing system can use one or two scrubbers. If two scrubbers are used, the first is commonly an acid scrubber to eliminate hydrochloric acid mainly and the second is a neutral scrubber for the removal of sulphur dioxide mainly. The first scrubber includes a "quench part" to cool the flue gas temperature from approximately 160 °C (spray reacto r temperature) to saturation (about 60 °C).

However, when the pollutant load is moderate to low, both acids can be neutralised in one neutral scrubber.

As the pollutant load will be low when it reaches the wet flue gas cleaning system (as acids have already been removed by evaporating spray reactor), the use of one neutral scrubber is the most efficient option for the proposed facility and is considered BAT.

3.4.7 Second stage removal of dioxins, trace organics and heavy metals

Alternatives for dioxin removal are as follows:

- wet fixed bed coal filter
- dry fixed bed coal filter
- coal injection before baghouse filter
- wet scrubber with a coal suspension
- wet scrubber packing which includes coal
- catalytic destruction (mostly in combination with DeNOx)

(coal means “activated carbon” or “activated lignite cokes”):
The wet fixed bed coal filter results in very efficient dioxin removal, however, such a system is delicate and prone to breakdown resulting in unscheduled shutdown time.

The dry fixed bed coal filter has not been considered due to its high content of combustible dry coal and issues relating to fire safety.

Coal injection before the baghouse filter is an efficient option for the removal of dust and dioxins. It has not been chosen for the 2nd stage of dioxin removal because, as dust has already been removed in the 1st stage removal system, this 2nd stage is a polishing stage for the removal of minute traces of dioxins. This system would also require an additional baghouse filter to that proposed for the 1st stage removal system, however, this is not considered BAT because of the additional energy required to operate the filter.

Coal injection before an (wet) electrofilter has not been selected as it is not a proven technology in the waste incineration industry. Also, dust and dioxin removal efficiency is less than that of a baghouse filter.

A wet scrubber system using a pre-packed coal system or a coal suspension is an efficient system for the removal of minute traces of dioxins and has been chosen for the 2nd stage dioxin removal system. The combination of this system with the injected carbon/baghouse filter is considered BAT and will ensure that the facility will operate not only to the EU emission limit value for dioxins but well below it.

3.5 CONCLUSIONS

Over 85% of municipal waste in Ireland currently goes to landfill. This situation is not environmentally sustainable and must be changed to comply with the requirements of the EU landfill Directive. The Government's waste policy is firmly based on the waste management hierarchy and an integrated approach to waste management. Its targets are to reduce the amount of household waste going to landfill by 50% and to reduce by 65% the amount of biodegradable waste going to landfill.

Attaining these targets will require a seismic shift in waste management practices on a national, regional and personal level and will require a balanced, integrated waste management strategy rather than one simple solution. The optimum strategy will necessarily include all elements of the waste management hierarchy – from prevention to final disposal.

Claims that all waste can be recovered and recycled have not been borne out by the experience of countries with a much more developed waste management strategy (and higher levels of public awareness) than Ireland such as Germany, Flanders and Australia. Even in a highly optimised waste management strategy, a proportion of the waste remains for final disposal.

Waste-to-Energy plants (or thermal treatment plants) are higher up on the waste hierarchy than landfilling and mainly produce inert residue with only 10% of the volume of the original waste. Diversion from landfill is part of the Government's policy on waste, a policy which has been echoed in all the regional Waste Management Plans – most notably that for the North East Region.

The proposed facility will allow the North East Region achieve its policy target of 39% for energy recovery identified in the proposed replacement plan for the region.

Waste-to-Energy plants also provide a renewable source of energy and the construction of such a plant is in line with EU and national policy to promote renewable energy sources.

The technology chosen is BAT in line with the BREF Notes on Waste Incineration and will ensure the proposed facility operates well within stringent EU standards for the incineration of waste.

Appendix 3.1

IPPC Reference Document on the Best Available Techniques for Waste Incineration. July 2005

Executive Summary

&

Chapter 5: Best Available Techniques

EUROPEAN COMMISSION
DIRECTORATE-GENERAL JRC
JOINT RESEARCH CENTRE
Institute for Prospective Technological Studies (Seville)
Sustainability in Industry, Energy and Transport
European IPPC Bureau

Integrated Pollution Prevention and Control

Reference Document on the Best Available Techniques for Waste Incineration

Dated July 2005

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This document is one of a series of foreseen documents as below (at the time of writing, not all documents have been drafted):

Full title	BREF code
Reference Document on Best Available Techniques for Intensive Rearing of Poultry and Pigs	ILF
Reference Document on the General Principles of Monitoring	MON
Reference Document on Best Available Techniques for the Tanning of Hides and Skins	TAN
Reference Document on Best Available Techniques in the Glass Manufacturing Industry	GLS
Reference Document on Best Available Techniques in the Pulp and Paper Industry	PP
Reference Document on Best Available Techniques on the Production of Iron and Steel	IandS
Reference Document on Best Available Techniques in the Cement and Lime Manufacturing Industries	CL
Reference Document on the Application of Best Available Techniques to Industrial Cooling Systems	CV
Reference Document on Best Available Techniques in the Chlor - Alkali Manufacturing Industry	CAK
Reference Document on Best Available Techniques in the Ferrous Metals Processing Industry	FMP
Reference Document on Best Available Techniques in the Non Ferrous Metals Industries	NFM
Reference Document on Best Available Techniques for the Textiles Industry	TXT
Reference Document on Best Available Techniques for Mineral Oil and Gas Refineries	REF
Reference Document on Best Available Techniques in the Large Volume Organic Chemical Industry	LVOC
Reference Document on Best Available Techniques in the Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector	CWW
Reference Document on Best Available Techniques in the Food, Drink and Milk Industry	FM
Reference Document on Best Available Techniques in the Smitheries and Foundries Industry	SF
Reference Document on Best Available Techniques on Emissions from Storage	ESB
Reference Document on Best Available Techniques on Economics and Cross-Media Effects	ECM
Reference Document on Best Available Techniques for Large Combustion Plants	LCP
Reference Document on Best Available Techniques in the Slaughterhouses and Animal By-products Industries	SA
Reference Document on Best Available Techniques for Management of Tailings and Waste-Rock in Mining Activities	MTWR
Reference Document on Best Available Techniques for the Surface Treatment of Metals	STM
Reference Document on Best Available Techniques for the Waste Treatments Industries	WT
Reference Document on Best Available Techniques for the Manufacture of Large Volume Inorganic Chemicals (Ammonia, Acids and Fertilisers)	LVIC-AAF
Reference Document on Best Available Techniques for Waste Incineration	WI
Reference Document on Best Available Techniques for Manufacture of Polymers	POL
Reference Document on Energy Efficiency Techniques	ENE
Reference Document on Best Available Techniques for the Manufacture of Organic Fine Chemicals	OFC
Reference Document on Best Available Techniques for the Manufacture of Speciality Inorganic Chemicals	SIC
Reference Document on Best Available Techniques for Surface Treatment Using Solvents	STS
Reference Document on Best Available Techniques for the Manufacture of Large Volume Inorganic Chemicals (Solids and Others)	LVIC-S
Reference Document on Best Available Techniques in Ceramic Manufacturing Industry	CER

EXECUTIVE SUMMARY

The BAT (Best Available Techniques) Reference Document (BREF) entitled Waste Incineration (WI) reflects an information exchange carried out under Article 16(2) of Council Directive 96/61/EC (IPPC Directive). This executive summary describes the main findings, a summary of the principal BAT conclusions and the associated consumption and emission levels. It should be read in conjunction with the preface, which explains this document's objectives; how it is intended to be used and legal terms. It can be read and understood as a standalone document but, as a summary, it does not present all the complexities of this full document. It is therefore not intended as a substitute for this full document as a tool in BAT decision making.

Scope of this document

The scope of this document is based on Sections 5.1 and 5.2 of Annex 1 of the IPPC Directive 96/61/EC, in so far as they deal with incineration of waste. The scope chosen for the work was not restricted by the installation size limitations in the IPPC Directive, nor by the definitions of waste, recovery or disposal included therein. The selected scope therefore intended to provide a pragmatic view across the incineration sector as a whole, with a particular focus upon those installation and waste types that are most common. The scope of the Waste Incineration Directive was also a factor taken into account when deciding on the scope of the BREF document. The final contents of the BREF reflect the information that was submitted during the information exchange by the TWG.

The document deals only with the dedicated incineration of waste and not with other situations where waste is thermally treated, e.g. co-incineration processes such as cement kilns and large combustion plants.

Although incineration provides the main focus of the document, it also includes some information on waste pyrolysis and gasification systems.

This BREF document does not:

- deal with decisions concerning the selection of incineration as a waste treatment option
- compare waste incineration with other waste treatment options.

Waste Incineration (WI)

Incineration is used as a treatment for a very wide range of wastes. Incineration itself is commonly only one part of a complex waste treatment system that altogether, provides for the overall management of the broad range of wastes that arise in society.

The incineration sector has undergone rapid technological development over the last 10 to 15 years. Much of this change has been driven by legislation specific to the industry and this has, in particular, reduced emissions to air from individual installations. Continual process development is ongoing, with the sector now developing techniques which limit costs, whilst maintaining or improving environmental performance.

The objective of waste incineration, in common with most waste treatments, is to treat waste so as to reduce its volume and hazard, whilst capturing (and thus concentrating) or destroying potentially harmful substances. Incineration processes can also provide a means to enable recovery of the energy, mineral and/or chemical content from waste.

Basically, waste incineration is the oxidation of the combustible materials contained in the waste. Waste is generally a highly heterogeneous material, consisting essentially of organic substances, minerals, metals and water. During incineration, flue-gases are created that will contain the majority of the available fuel energy as heat. The organic substances in the waste will burn when they have reached the necessary ignition temperature and come into contact with oxygen. The actual combustion process takes place in the gas phase in fractions of seconds and simultaneously releases energy. Where the calorific value of the waste and oxygen supply is sufficient, this can lead to a thermal chain reaction and self-supporting combustion, i.e. there is no need for the addition of other fuels.

Although approaches vary greatly, the incineration sector may approximately be divided into the following main sub-sectors:

i. Mixed municipal waste incineration – treating typically mixed and largely untreated household and domestic wastes but may sometimes including certain industrial and commercial wastes (industrial and commercial wastes are also separately incinerated in dedicated industrial or commercial non-hazardous waste incinerators).

ii. Pretreated municipal or other pretreated waste incineration – installations that treat wastes that have been selectively collected, pretreated, or prepared in some way, such that the characteristics of the waste differ from mixed waste. Specifically prepared refuse derived fuel incinerators fall in this sub-sector

iii. Hazardous waste incineration - this includes incineration on industrial sites and incineration at merchant plants (that usually receive a very wide variety of wastes)

iv. Sewage sludge incineration – in some locations sewage sludges are incinerated separately from other wastes in dedicated installations, in others such waste is combined with other wastes (e.g. municipal wastes) for its incineration

v. Clinical waste incineration – dedicated installations for the treatment of clinical wastes, typically those arising at hospitals and other healthcare institutions, exist as centralised facilities or on the site of individual hospital etc. In some cases certain clinical wastes are treated in other installations, for example with mixed municipal or hazardous wastes.

Data in this document shows that, at the time of its compilation:

- Around 20 - 25 % of the municipal solid waste (MSW) produced in the EU-15 is treated by incineration (total MSW production is close to 200 million tonnes per year)
- The percentage of MSW treated by incineration in individual Member States of the EU-15 varies from 0 % to 62 %
- The total number of MSW installations in the EU-15 is over 400
- Annual MSW incineration capacity in individual European countries varies from 0 kg to over 550 kg per capita
- In Europe the average MSW incinerator capacity is just under 200000 tonnes per year.
- The average throughput capacity of the MSWI installations in each MS also varies. The smallest plant size average seen is 60000 tonnes per year and the largest close to 500000 tonnes per year
- Around 12 % of the hazardous waste produced in EU-15 is incinerated (total production close to 22 million tonnes per year).

Expansion of the MSW incineration sector is anticipated in Europe over the next 10 – 15 years as alternatives are sought for the management of wastes diverted from landfill by the Landfill Directive and both existing and new Member States examine and implement their waste management strategies in the light of this legislation.

Key environmental issues

Waste and its management are a significant environmental issue. The thermal treatment of waste may therefore be seen as a response to the environmental threats posed by poorly or unmanaged waste streams. The target of thermal treatment is to provide for an overall reduction in the environmental impact that might otherwise arise from the waste. However, in the course of the operation of incineration installations, emissions and consumptions arise, whose existence or magnitude is influenced by the installation design and operation.

The potential impacts of waste incineration installations themselves fall into the following main categories:

- overall process emissions to air and water (including odour)
- overall process residue production
- process noise and vibration
- energy consumption and production
- raw material (reagent) consumption
- fugitive emissions – mainly from waste storage
- reduction of the storage/handling/processing risks of hazardous wastes.

Other impacts beyond the scope of this BREF document (but which can significantly impact upon the overall environmental impact of the whole chain of waste management) arise from the following operations:

- transport of incoming waste and outgoing residues
- extensive waste pretreatment (e.g. preparation of waste derived fuels).

The application and enforcement of modern emission standards, and the use of modern pollution control technologies, has reduced emissions to air to levels at which pollution risks from waste incinerators are now generally considered to be very low. The continued and effective use of such techniques to control emissions to air represents a key environmental issue.

Other than its role in ensuring effective treatment of otherwise potentially polluting unmanaged wastes, many waste incineration installations have a particular role as an energy-from-waste recovery process. Where policies have been implemented to increase the ability of, (most commonly municipal) waste incineration installations to recover the energy value of the waste, this increases the exploitation of this positive environmental contribution. A significant environmental opportunity for the industry is therefore to increase its potential as an energy supplier.

Applied processes and techniques

Chapter 2 of this document provides a description of the processes and techniques that are applied in the waste incineration industry. It focuses upon the most commonly applied thermal treatment of incineration, but also includes information on gasification and pyrolysis. The following main activities and areas are described to varying degrees of detail:

- incoming waste reception
- storage of waste and raw materials
- pretreatment of waste (mainly on-site treatments and blending operations)
- loading of waste into the furnace
- techniques applied at the thermal treatment stage (furnace design etc.)
- the energy recovery stage (e.g. boiler and energy supply options)
- flue-gas cleaning techniques (grouped by substance)
- flue-gas cleaning residue management
- emissions monitoring and control
- waste water control and treatment (e.g. from site drainage, flue-gas treatment, storage)
- ash/bottom ash management and treatment (arising from the combustion stage).

Where techniques are specific to certain types of wastes, relevant sections are subdivided according to waste type.

Consumptions and emissions

The emissions, and material and energy consumptions, that arise from waste incineration installations are described in Chapter 3. Available data are presented on installation emissions to air and water, noise, and residues. Information on raw material consumptions is also provided, along with a section that focuses upon energy consumption and output. Most of the data are whole installation data arising from industrial surveys. Some information about the techniques applied in order to achieve these emission levels is also included.

Although some European installations have yet to be upgraded, the industry is generally achieving operational levels that meet or improve upon the air emission limit values set in Directive 2000/76/EC.

In circumstances where CHP or heat (as heat or steam) can be supplied, it is possible for very large percentages of the energy value of the waste (approx. 80 % in some cases) to be recovered.

Techniques to consider in the determination of BAT

Each technique described in Chapter 4 includes the available relevant information, on: the consumption and emission levels achievable using the technique; some idea of the costs and the cross-media issues associated with the technique, and; information on the extent to which the technique is applicable to the range of installations requiring IPPC permits - for example new, existing, large or small installations, and to various waste types. Management systems, process-integrated techniques and end-of-pipe measures are included.

The techniques that are included are those that are considered to have the potential to achieve, or contribute to, a high level of environmental protection in the waste incineration industry. The final BAT, as agreed by the TWG, is not covered in Chapter 4, but in Chapter 5. The inclusion of a technique in Chapter 4, but not in Chapter 5 should not be taken as an indication that the technique is not and cannot be BAT - the rationale for excluding the technique from Chapter 5 could, for example, be that the TWG felt that the technique not sufficiently widely applicable for it to be described as *BAT in general*. Furthermore, because it is not possible to be exhaustive and because the situation is dynamic, Chapter 4 cannot be considered to be entirely comprehensive. Other techniques may also provide for levels of performance that meet or exceed the BAT criteria later established in Chapter 5, and when applied locally those techniques may provide particular advantages in the situation in which they are used.

The techniques included are grouped in approximately the order in which they would appear in the majority of waste incineration installations. The table below gives the title of the chapter subsections and indicates the grouping to which the techniques are listed.

Chapter 4 section number	Title of section
4.1	General practices applied before thermal treatment
4.2	Thermal processing
4.3	Energy recovery
4.4	Flue-gas treatment
4.5	Process water treatment and control
4.6	Treatment techniques for solid residues
4.7	Noise
4.8	Environmental management tools
4.9	Good practice for public awareness and communication

Table: Organisation chart for the information in Chapter 4

Chapter 4 concentrates on techniques that provide particular advantages at each of the main stages generally seen in waste incineration installations. Dividing the techniques in this way does however mean that, although mentioned in some cases, the important aspect of the overall integration of all of the techniques in an installation (sometimes referred to in the BREF as their "inter-process compatibility") is something which requires careful consideration when reading the individual sections of Chapter 4. The subsections on *operational data* and *applicability* are generally where such matters are given consideration. Overall compatibility was also been given further consideration when finally deriving the BAT conclusions in Chapter 5.

Chapter 4 does not generally describe in detail those techniques that, whilst they provide, or contribute to, a high level of environmental performance, are so common that their use may already be considered as standard. An example of this is that, because the applicability of the main combustor designs to the main waste streams is relatively well established, the techniques considered at this stage concentrate mainly on:

a) the general issue of ensuring the combustion system selected is properly matched to the wastes fed to it, and
b) on some aspects relating to improving combustion performance e.g. waste preparation, air supply control, etc.

BAT for the incineration of waste

The BAT chapter (Chapter 5) identifies those techniques that the TWG considered to be BAT in a general sense, based on the information in Chapter 4, taking into account the Article 2(11) definition of best available techniques and the considerations listed in Annex IV of the Directive.

The BAT chapter does not set or propose emission limit values but suggests the operational consumption and emission values that are associated with the use of BAT. The introduction to Chapter 5 included in this BREF is specifically extended to clarify certain issues that were considered to be of particular relevance to the waste incineration industry, including the links between the Waste Incineration Directive (WID) and IPPC. These additional specific issues include:

- the difference between WID emission limit values and BAT performance
- the relationship between BAT and site selection
- how to understand and use the BAT described in Chapter 5.

The following paragraphs summarise the key BAT conclusions but **reference must be made to the BAT chapter itself to be comprehensive**. The generic BAT are intended to apply to the whole sector (i.e. waste incineration, waste gasification and waste pyrolysis of whatever type of waste). Other BAT are given that apply to sub-sectors dealing primarily with specific waste streams. It is therefore anticipated that a specific installation would apply a combination of the generic and waste specific BAT, and that installations treating mixtures of waste, or wastes not specifically mentioned, would apply the generic BAT plus a suitable selection of the waste specific BAT. Further comment on the combining of the BAT is included in the introduction to Chapter 5.

Generic BAT

A fundamental BAT stresses the importance of the selecting an installation design that is suited to the characteristics of the waste received at the installation in terms of both its physical and chemical characteristics. This BAT is fundamental to ensuring the installation may treat the waste received with a minimum of process disturbances – which themselves may give rise to additional environmental impacts. To this end there is also a BAT about the minimisation of planned and unplanned shutdowns.

BAT includes establishing and maintaining quality controls over the waste input. This aims to ensure that the waste characteristics remain suited to the design of the receiving installation. Such quality control procedures are compatible with the application of an environmental management system, which is also considered BAT.

There are several BAT regarding the conditions and management of the storage of incoming wastes prior to their treatment, so that this does not give rise to pollution and odour releases. Some specific techniques and conditions of storage are noted. A risk based approach that takes into account the properties of the waste concerned is considered BAT.

Consideration of the demonstrated ability of some installation designs to very efficiently treat highly heterogeneous wastes (e.g. mixed MSW), and the risks and cross-media effects associated with pretreatment, results in a conclusion that it is BAT to pretreat incoming wastes to the degree required to meet the design specification for the receiving installation, noting that to treat wastes beyond this requires balanced consideration of (possibly limited) benefits, operational factors and cross-media effects.

The design and operation of the combustion stage is identified as an important primary pollution prevention aspect, and therefore of great relevance to achieving the aims of the IPPC Directive. It is noted in the BAT chapter that flow modelling at the design stage may assist in ensuring that certain key design decisions are well informed. In operation, it is considered BAT to use various techniques (e.g. control of air supply and distribution) to control combustion. The BAT regarding the selection of a design that suits the waste received is of particular relevance here.

In general the use of the combustion operating conditions specified in Article 6 of Directive 2000/76/EC (WID) are considered to be compatible with BAT. However the TWG noted, that the use of conditions in excess of these (e.g. higher temperatures) could result in an overall deterioration in environmental performance, and that there were several examples of hazardous waste installations that had demonstrated an overall improvement in environmental performance when using lower operational temperatures than the 1100 °C specified in WID for certain hazardous wastes. The general BAT conclusion was that the combustion conditions (e.g. temperature) should be sufficient to achieve the destruction of the waste but, in order to limit potential cross-media impacts, generally not significantly in excess of those conditions. The provision of auxiliary burner(s) for achieving and maintaining operational conditions is considered to be BAT when waste is being burned.

When gasification or pyrolysis is used, in order to prevent the generation of waste by disposal of the reaction products of these techniques, it is BAT either, to recover the energy value from the products using a combustion stage, or to supply them for use. The BAT associated emission levels for releases to air from the combustion stage of such installations are the same as those established for incineration installations.

The recovery of the energy value of the waste is a key environmental issue for the sector, presenting an area where the sector may make a significant positive contribution. Several BAT cover this aspect, dealing with:

- specific techniques that are considered to be BAT
- the heat transfer efficiencies expected of boilers
- the use of CHP, district heating, industrial steam supply and electricity production
- the recovery efficiencies that may be anticipated.

With CHP and steam/heat supply generally offering the greatest opportunity for increasing energy recovery rates, policies affecting the availability of suitable customers for steam/heat generally play a far greater role in determining the efficiency achievable at an installation than the detail of its design. For mainly policy and economic reasons, electricity generation and supply is often the energy recovery option selected at individual installations. Options for CHP, district heating and industrial steam supply are only well exploited in a few European Member States – generally those that have high heat prices and/or that have adopted particular policies. The supply of energy for the operation of cooling systems and desalination plants is something that is done, but is in general poorly exploited – such an option may be of particular interest in warmer climate zones, and in general expands the options for the supply of waste derived energy.

The flue-gas treatments applied at waste incineration installations have been developed over many years in order to meet stringent regulatory standards and are now highly technically advanced. Their design and operation are critical to ensure that all emissions to air are well controlled. The BAT that are included:

- cover the process of selection of FGT systems
- describe several specific techniques which are considered to be BAT
- describe the performance levels that are anticipated from the application of BAT.

The performance ranges agreed by the wider TWG resulted in some split views. These were mainly from one Member State and the Environmental NGO, who believed that lower emission values than the ranges agreed by the remainder of the TWG could also be considered to be BAT.

The BAT regarding waste water control include:

- the in-process recirculation of certain effluents
- the separation of drainage for certain effluents
- the use of on-site effluent treatment for wet scrubber effluents
- BAT associated performance levels for emissions from scrubber effluent treatment
- the use of specific techniques.

The performance ranges agreed by the wider TWG resulted in some split views from one Member State and the Environmental NGO, who believed that lower emission values than the ranges given could also be considered to be BAT.

BAT regarding residue management include:

- a bottom ash burnout TOC level of below 3 %, with typical values falling between 1 and 2 %
- a list of techniques, which when suitably combined may attain these burnout levels
- the separate management of bottom ash from fly ash and a requirement to assess each stream produced
- the extraction of ferrous and non-ferrous metals from ash for their recovery (where present in ash to sufficient degree to make this viable)
- the treatment of bottom ashes and other residues using certain techniques - to the extent required for them to meet the acceptance criteria at the receiving recovery or disposal site.

In addition to these generic BAT, more specific BAT are identified for those sub-sectors of the industry treating mainly the following wastes:

- municipal wastes
- pretreated or selected municipal wastes
- hazardous wastes
- sewage sludge
- clinical waste.

The specific BAT provide, where it has been possible, more detailed BAT conclusions. These conclusions deal with the following waste stream specific issues:

- in-coming waste management, storage and pretreatment
- combustion techniques
- energy recovery performance.

Emerging techniques

The section on emerging techniques is not comprehensive. A number of the techniques supplied by the TWG and included in earlier drafts of this document were transferred into this section. In the majority of cases the techniques included have only been demonstrated on a pilot or trial scale.

The degree of demonstration (as measured by overall throughput and operational hours) of pyrolysis and gasification on the main European waste streams is low compared with incineration and operational difficulties are reported at some installations. However, both gasification and pyrolysis are applied in the sector and therefore, according to the BREF definition, cannot be considered to be *emerging techniques*. For this reason the information concerning these techniques is included in Chapter 4.

Concluding remarks

Information exchange
This BREF is based on several hundred sources of information, and over 7000 consultation comments supplied by a very large working group. Some of the information was overlapping and therefore, not all of the documents supplied are referenced in the BREF. Both industry and Member States supplied important information. Data quality was generally good, particularly for emissions to air, allowing valid comparisons to be made in some cases. This was not however uniformly the case, and data regarding costs was difficult to compare owing to inconsistencies in data compilation and reporting. The consumption and emissions data given are predominantly for whole installations or groups of techniques, rather than individual ones. This has lead to some important BAT conclusions being expressed as quantitative overall performance targets, with certain technical options presented that when suitably combined, may give rise to that performance.

Level of consensus
There was a very good general level of consensus. There was full agreement, and no split views, in relation to the technique related BAT. There was also generally good consensus upon the quantitative BAT, although the operational emission levels associated with the use of BAT did give rise to some split views, with one Member State and the Environmental NGO recording split views in relation to many of the BAT associated emission levels for releases to both air and water.

Recommendations for future work and R&D projects

The information exchange and its result, i.e. this BREF, provide a step forward in achieving the integrated prevention and control of pollution from waste incineration. Further work could continue the process by providing:

- information regarding the techniques used to, and costs of, upgrading existing installations – such information may be derived from experience of implementing WID in Member States and might usefully be compared with the costs/performance at new installations
- the more detailed cost information that is required to undertake a more precise assessment of variations in technique affordability with plant size and waste type
- information regarding smaller installations – very little information was provided regarding small installations
- information regarding installations that treat industrial non-hazardous wastes and the impact on installations of treating mixtures of wastes e.g. sewage sludge or clinical waste with MSW
- a more detailed evaluation of the impact on pollution prevention of detailed combustion design features e.g. grate design
- further information on emerging techniques.
- ammonia consumption and emission (mainly to air and water) levels for different FGT systems (mainly wet, semi-wet and dry) and their relative NO_X reduction efficiency
- the impact of the dust removal temperature range upon PCDD/F releases to air and residues
- further experiences with continuous emissions monitoring for Hg (to air and water).

Other important recommendations for further work beyond the scope of this BREF but arising from the information exchange are:

- the need for consideration of the overall impact of competition for waste treatment, in particular competition from industries co-incinerating wastes – a study of such might usefully include consideration of: relative reliability of, and risks to, the supply of the total waste management service; overall emissions and energy recovery according to various degrees of diversion, and; consider and identify key risk factors e.g. waste fuel quality assurance.
- it may be useful to assess the impact on adopted waste strategies (i.e. the balance of technologies used on a national scale), and on achieved thermal treatment installation efficiencies, of the degree of integration of energy and waste management policy in EU Member States (and other countries). Such studies may identify how policy on energy and waste interact and give examples, both positive and negative.
- the need to understand in more detail of the impact of absolute and relative energy prices (for electricity and heat) upon the typically achieved energy efficiency of installations, and the role and impact of subsidies and taxation schemes
- the identification of the typical barriers to developing new installations and the approaches that have proved successful
- the development of suitable standards for the use of bottom ash – such standards have proved helpful in improving markets for the use of bottom ash
- the costs and benefits of further reducing emissions from the waste incineration industry when compared to reductions at other industrial and anthropogenic sources of pollution.

The EC is launching and supporting, through its RTD programmes, a series of projects dealing with clean technologies, emerging effluent treatment and recycling technologies and management strategies. Potentially these projects could provide a useful contribution to future BREF reviews. Readers are therefore invited to inform the EIPPCB of any research results which are relevant to the scope of this document (see also the preface of this document).

5 BEST AVAILABLE TECHNIQUES

General Introduction to the BAT chapter

In understanding this chapter and its contents, the attention of the reader is drawn back to the preface of this document and in particular the fifth section of the preface: "How to understand and use this document". The techniques and associated emission and/or consumption levels, or ranges of levels, presented in this chapter have been assessed through an iterative process involving the following steps:

- identification of the key environmental issues for Waste Incineration
- examination of the techniques most relevant to address those key issues
- identification of the best environmental performance levels, on the basis of the available data in the European Union and worldwide
- examination of the conditions under which these performance levels were achieved; such as costs, cross-media effects, and the main driving forces involved in implementation of these techniques
- selection of the Best Available Techniques (BAT) and the associated emission and/or consumption levels for this sector in a general sense all according to Article 2(11) and Annex IV of the Directive.

Expert judgement by the European IPPC Bureau and the relevant Technical Working Group (TWG) has played a key role in each of these steps and in the way in which the information is presented here.

On the basis of this assessment, techniques, and as far as possible emission and consumption levels associated with the use of BAT, are presented in this chapter that are considered to be appropriate to the sector as a whole and in many cases reflect current performance of some installations within the sector. Where emission or consumption levels "associated with best available techniques" are presented, this is to be understood as meaning that those levels represent the environmental performance that could be anticipated as a result of the application, in this sector, of the techniques described, bearing in mind the balance of costs and advantages inherent within the definition of BAT. However, they are neither emission nor consumption limit values and should not be understood as such. In some cases it may be technically possible to achieve better emission or consumption levels but due to the costs involved or cross-media considerations, they are not considered to be appropriate as BAT for the sector as a whole. However, such levels may be considered to be justified in more specific cases where there are special driving forces.

The emission and consumption levels associated with the use of BAT have to be seen together with any specified reference conditions (e.g. averaging periods).

The concept of "levels associated with BAT" described above is to be distinguished from the term "achievable level" used elsewhere in this document. Where a level is described as "achievable" using a particular technique or combination of techniques, this should be understood to mean that the level may be expected to be achieved over a substantial period of time in a well maintained and operated installation or process using those techniques, although the particular circumstances (e.g. technical conditions, costs, cross-media impacts) that gave rise to the achieved level may mean that these levels are not generally considered to be BAT.

Where available, data concerning costs have been given together with the description of the techniques presented in the previous chapters. These give a rough indication about the magnitude of costs involved. However, the actual cost of applying a technique will depend strongly on the specific situation regarding, for example, taxes, fees, and the technical characteristics of the installation concerned. It is not possible to evaluate such site-specific factors fully in this document. In the absence of data concerning costs, conclusions on economic viability of techniques are drawn from observations on existing installations.

It is intended that the general BAT in this chapter are a reference point against which to judge the current performance of an existing installation or to judge a proposal for a new installation. In this way they will assist in the determination of appropriate "BAT-based" conditions for the installation or in the establishment of general binding rules under Article 9(8). It is foreseen that new installations can be designed to perform at or even better than the general BAT levels presented here, and that existing installations could move towards the general BAT levels or do better, subject to the technical and economic applicability of the techniques in each case.

While the BAT reference documents do not set legally binding standards, they are meant to give information for the guidance of industry, Member States and the public on achievable emission and consumption levels when using specified techniques. The appropriate limit values for any specific case will need to be determined taking into account the objectives of the IPPC Directive and the local considerations.

Additional introductory issues specifically developed for this BREF

The relationship between Emission Limit Values and BAT performance:

Many European incineration plants have been the subject of specific regulations concerning their emissions to air – in some cases for many years. Regulations have included the application of emission limit values (ELVs) for some substances when released to air. The most recent European legislation is Directive 2000/76/EC, which includes a range of operational conditions and ELVs applicable to the majority of situations where waste is burned in industrial installations.

When interpreting the emission and performance levels associated with the use of BAT as reported in this chapter it is essential that the reader understands the following:

- emission and performance levels associated with the use of BAT are not the same as ELVs
- across the EU25, where this is a matter for national or local competence, ELVs are set and enforced in different ways
- the emission and performance levels given here are the operational performance levels that would normally be anticipated from the application of BAT
- compliance with the ELVs set in permits and legislation naturally results in operational levels below those ELVs
- it is important to note that, at a particular installation, lowering an emission level within the BAT range presented here may not represent the best overall solution considering costs and cross-media effects. Additionally, antagonism may exist between them i.e. lowering one may increase another. For these reasons, it is not anticipated that an installation would operate with all parameters at the lowest levels in the BAT ranges.

The ELVs that appear in the various regulations applicable to incineration have been used in equipment supply contracts as minimum performance guarantee levels for plant suppliers, to be achieved under the most adverse of operating conditions. This then leads to a situation where in actual operation, some incineration installations show operational emissions that are significantly below the ELVs (see in particular Section 3.2). It is, therefore, important to appreciate the difference between the operational performance levels that are given as BAT in this chapter, and the higher ELVs that have given rise to this level of performance.

In a hypothetical example, if the ELV for HCl is set at 10 mg/Nm^3, a supplier of a particular technology may, as part of their equipment supply contract, choose to provide a performance guarantee in the region of 7 - 8 mg/ Nm^3. In such a situation the plant might then typically operate at 1 - 5 mg/ Nm^3 with some transient variations above this.

An actual example of an ELV and reported emission results for dust at a MSWI in one MS is (data year 2001):

- ELV given in the permit was: 15 mg/Nm³ (½hr average)
- range of actual measured values: 0 - 12.6 mg/Nm³ (½hr average)
- monthly mean values (based on all measured ½hr average values): 0.4 - 1.8 mg/Nm³
- yearly mean value (based on all measured ½hr average values): 0.8 mg/Nm³.

It can be seen that the averaged emission values are closer to the lower level of the measured range and far below the ELV set in this example case. It should however be noted that it cannot be automatically assumed that similar relationships between ELVs and actual results will exist in other cases or other industrial sectors.

For some substances and some technologies reducing an ELV may result in difficulties in guaranteeing the lower emission level. This can then drive the adoption of a different technique for the control of that substance and require revision of the overall design of the installation.

Reducing ELVs to air on their own, without consideration of the overall integrated performance of the installation, can, whilst improving performance in one respect, give rise to an overall reduction in performance and/or significant cost impacts. This is generally supported for this sector by the results of European health impact assessment studies - which, on the basis of current evidence and modern emissions performance, suggest that the local impacts of incinerator emissions to air are either negligible or not detectable. [64, TWGComments, 2003]

The emission and performance levels associated with the use of BAT as given in this chapter are, where appropriate, given with the reference conditions under which they apply, for example the relevant monitoring and sampling periods. For emissions to air the release concentrations stated are standardised at 11 % Oxygen, dry gas, 273K and 101.3kPa.

Combining the BAT on waste incineration listed in this chapter:

When considering the BAT described here for waste incineration, it is important to consider that the optimal solution for a particular incineration installation as a whole, varies according to local conditions. A checklist for the best local solution is not what the BAT listed here provides, as this would require the consideration of local conditions to a degree that cannot be carried out in a document dealing with BAT in general. Hence, the simple combination of the individual elements described here as BAT in general, without consideration of local conditions is not likely to give the optimised local solution in relation to the environment as a whole.
[74, TWGComments, 2004]

The relationship between BAT and site selection for waste incineration installations:

This document does not itself deal with criteria for the selection of suitable sites for waste incineration plants, but it is the case that for some of the BAT to be fulfilled, special site conditions are required. However, the choice of a site itself will typically require consideration of many other important criteria e.g. site availability, waste transport to the installation etc.

For example, in a particular local circumstance it may only be possible to build either:
a) an installation with very high rates of energy recovery in a location that then requires long waste transport distances, or
b) one with reduced energy recovery that then reduces the waste transport

Such advantages and disadvantages themselves are often considered together in a balanced way when the location is being selected. The result may then be that, owing to the location selected, some of the BAT included here are simply unavailable at the installation level.

Understanding the application of the BAT described in this chapter:

This BREF deals with wastes of different types (e.g. HW, MSW, sludge) which exhibit a very wide range of characteristics between and even within the different classes e.g. particulate size, calorific value, water and ash content, type and concentration of pollutants. Therefore when considering the BAT presented in this chapter the applicability of the techniques described in Chapter 4 must always be checked for a specific plant. Article 9 (4) of the Directive takes this into account saying that permit conditions shall be based on BAT "*without prescribing the use of any technique or specific technology, but taking into account the technical characteristics of the installation concerned, its geographical location and the local environmental conditions.*"

The BAT that are listed in this chapter include generic BAT (see 5.1) and specific BAT (see 5.2, 5.3, 5.4, 5.5 and 5.6) for certain waste types. The generic BAT are those that are considered to be generally applicable to all types of waste incineration installations. The waste type specific BAT are those that are considered to be generally BAT for installations dealing mainly or wholly with certain types of waste (i.e. dedicated installations). At installations that are receiving more than one waste type a combination of the specific BAT may represent BAT, however no assessment of when and to what degree they should be applied is made here and a local judgement will be required.

Overall BAT for a specific case	
Generic BAT plus	**Specific BAT for waste type**
as described in 5.1	Municipal waste incineration – section 5.2
	Pretreated or selected municipal waste (including municipal refuse derived fuels) – section 5.3
	Hazardous waste incineration) – section 5.4
	Sewage sludge incineration) – section 5.5
	Clinical waste incineration) – section 5.6

Table 5.1: How to combine the BAT described for a specific case

Because it is not possible to be exhaustive and because of the dynamic nature of industry, and the momentary nature of this document, it is possible that there may be additional techniques not described in this chapter but which meet or exceed the BAT criteria established here.

5.1 Generic BAT for all waste incineration

The generic BAT in this section are additional to those listed later in this chapter for individual sub-sectors of the incineration industry.

It is considered that in general for each waste incineration installation, the combination of the BAT listed here (section 5.1), together with the waste type specific BAT listed in sections 5.2 to 5.6 represent a starting point for the process of determining appropriate local techniques and conditions. The practical aim is therefore the local optimisation in the circumstances of the installation, taking account of this BAT guidance, and other local factors.

For waste incineration, the local factors to be taken into account may, amongst others, generally include:

- local environmental drivers e.g. background environmental quality may influence the required local performance in respect of releases from the installation, or availability of certain resources
- the particular nature of the waste(s) that arise locally and the impact of the waste management infrastructure upon the type and nature of waste arriving at the installation
- the cost and technical possibility of implementing a particular technique in relation to its potential advantages – this is of particular relevance when considering the performance of existing installations
- the availability, degree of utilisation and price of options for the recovery/disposal of residues produced at the installation
- the availability and price received for recovered energy
- local economic/market/political factors that may influence the tolerability of the higher gate fees that may accompany the addition of certain technological options.

Therefore, in combination with the additional waste stream specific BAT listed in later sections of this chapter, in order to provide for levels of performance that are generally compatible with BAT, in general BAT for waste incineration is considered to be:

1. the selection of an installation design that is suited to the characteristics of the waste received, as described in 4.1.1 and 4.2.1 and 4.2.3

2. the maintenance of the site in a generally tidy and clean state, as described in 4.1.2

3. to maintain all equipment in good working order, and to carry out maintenance inspections and preventative maintenance in order to achieve this

4. to establish and maintain quality controls over the waste input, according to the types of waste that may be received at the installation, as described in:
4.1.3.1 Establishing installation input limitations and identifying key risks, and
4.1.3.2 Communication with waste suppliers to improve incoming waste quality control, and
4.1.3.3 Controlling waste feed quality on the incinerator site, and
4.1.3.4 Checking, sampling and testing incoming wastes, and
4.1.3.5 Detectors for radioactive materials.

5. the storage of wastes according to a risk assessment of their properties, such that the risk of potentially polluting released is minimised. In general it is BAT to store waste in areas that have sealed and resistant surfaces, with controlled and separated drainage as described in 4.1.4.1.

6. to use techniques and procedures to restrict and manage waste storage times, as described in 4.1.4.2, in order to generally reduce the risk of releases from storage of waste/container deterioration, and of processing difficulties that may arise. In general it is BAT to:

   - prevent the volumes of wastes stored from becoming too large for the storage provided
   - in so far as is practicable, control and manage deliveries by communication with waste suppliers, etc.

7. to minimise the release of odour (and other potential fugitive releases) from bulk waste storage areas (including tanks and bunkers, but excluding small volume wastes stored in containers) and waste pretreatment areas by passing the extracted atmosphere to the incinerator for combustion (see 4.1.4.4).

In addition it is also considered to be BAT to make provision for the control of odour (and other potential fugitive releases) when the incinerator is not available (e.g. during maintenance) by:

a. avoiding waste storage overload, and/or
b. extracting the relevant atmosphere via an alternative odour control system

8. the segregation of the storage of wastes according to a risk assessment of their chemical and physical characteristics to allow safe storage and processing, as described in 4.1.4.5

9. the clear labelling of wastes that are stored in containers such that they may continually be identified, as described in 4.1.4.6.

10. the development of a plan for the prevention, detection and control (described in 4.1.4.7) of fire hazards at the installation, in particular for:

- waste storage and pretreatment areas
- furnace loading areas
- electrical control systems
- bag house filters and static bed filters.

It is generally BAT for the plan implemented to include the use of:

a. automatic fire detection and warning systems, and
b. the use of either a manual or automatic fire intervention and control system as required according to the risk assessment carried out.

11. the mixing (e.g. using bunker crane mixing) or further pretreatment (e.g. the blending of some liquid and pasty wastes, or the shredding of some solid wastes) of heterogeneous wastes to the degree required to meet the design specifications of the receiving installation (4.1.5.1). When considering the degree of use of mixing/pretreatment it is of particular importance to consider the cross-media effects (e.g. energy consumption, noise, odour or other releases) of the more extensive pretreatments (e.g. shredding). Pretreatment is most likely to be a requirement where the installation has been designed for a narrow specification, homogeneous waste.

12. the use of the techniques described in 4.1.5.5 or 4.6.4 to, as far as practicably and economically viable, remove ferrous and non-ferrous recyclable metals for their recovery either:

a. after incineration from the bottom ash residues, or
b. where the waste is shredded (e.g. when used for certain combustion systems) from the shredded wastes before the incineration stage.

13. the provision of operators with a means to visually monitor, directly or using television screens or similar, waste storage and loading areas, as described in 4.1.6.1

14. the minimisation of the uncontrolled ingress of air into the combustion chamber via waste loading or other routes, as described in 4.1.6.4

15. the use of flow modelling which may assist in providing information for new plants or existing plants where concerns exist regarding the combustion or FGT performance (such as described in 4.2.2), and to provide information in order to:

a. optimise furnace and boiler geometry so as to improve combustion performance, and
b. optimise combustion air injection so as to improve combustion performance, and
c. where SNCR or SCR is used, to optimise reagent injection points so as to improve the efficiency of NO_X abatement whilst minimising the generation of

nitrous oxide, ammonia and the consumption of reagent (see general sections on SCR and SNCR at 4.4.4.1 and 4.4.4.2).

16. in order to reduce overall emissions, to adopt operational regimes and implement procedures (e.g. continuous rather than batch operation, preventative maintenance systems) in order to minimise as far as practicable planned and unplanned shutdown and start-up operations, as described in 4.2.5

17. the identification of a combustion control philosophy, and the use of key combustion criteria and a combustion control system to monitor and maintain these criteria within appropriate boundary conditions, in order to maintain effective combustion performance, as described in 4.2.6. Techniques to consider for combustion control may include the use of infrared cameras (see 4.2.7), or others such as ultra-sound measurement or differential temperature control

18. the optimisation and control of combustion conditions by a combination of:
    a. the control of air (oxygen) supply, distribution and temperature, including gas and oxidant mixing
    b. the control of combustion temperature level and distribution, and
    c. the control of raw gas residence time.

    Appropriate techniques for securing these objectives are described in:
    4.2.8 Optimisation of air supply stoichiometry
    4.2.9 Primary air supply optimisation and distribution
    4.2.11 Secondary air injection, optimisation and distribution
    4.2.19 Optimisation of time, temperature, turbulence of gases in the combustion zone, and oxygen concentrations
    4.2.4 Design to increase turbulence in the secondary combustion chamber

19. in general it is BAT to use those operating conditions (i.e. temperatures, residence times and turbulence) as specified in Article 6 of Directive 2000/76. The use of operating conditions in excess of those that are required for efficient destruction of the waste should generally be avoided. The use of other operating conditions may also be BAT – if they provide for a similar or better level of overall environmental performance. For example, where the use of operational temperatures of below the 1100 °C (as specified for certain hazardous waste in 2000/76/EC) have been demonstrated to provide for a similar or better level of overall environmental performance, the use of such lower temperatures is considered to be BAT.

20. the preheating of primary combustion air for low calorific value wastes, by using heat recovered within the installation, in conditions where this may lead to improved combustion performance (e.g. where low LCV/high moisture wastes are burned) as described in 4.2.10. In general this technique is not applicable to hazardous waste incinerators.

21. the use of auxiliary burner(s) for start-up and shut-down and for maintaining the required operational combustion temperatures (according to the waste concerned) at all times when unburned waste is in the combustion chamber, as described in 4.2.20

22. the use of a combination of heat removal close to the furnace (e.g. the use of water walls in grate furnaces and/or secondary combustion chambers) and furnace insulation (e.g. refractory areas or other lined furnace walls) that, according to the NCV and corrosiveness of the waste incinerated, provides for:
    a. adequate heat retention in the furnace (low NCV wastes require higher retention of heat in the furnace)
    b. additional heat to be transferred for energy recovery (higher NCV wastes may allow/require heat removal from earlier furnace stages)

The conditions under which the various techniques may be applicable are described in 4.2.22 and 4.3.12

23. the use of furnace (including secondary combustion chambers etc.) dimensions that are large enough to provide for an effective combination of gas residence time and temperature such that combustion reactions may approach completion and result in low and stable CO and VOC emissions, as described in 4.2.23

24. When gasification or pyrolysis is used, in order to avoid the generation of waste, it is BAT to:
   a. combine the gasification or pyrolysis stage with a subsequent combustion stage with energy recovery and flue-gas treatment that provides for operational emission levels to air within the BAT associated emission ranges specified in this BAT chapter, and/ or
   b. recover or supply for use of the substances (solid, liquid or gaseous) that are not combusted

25. in order to avoid operational problems that may be caused by higher temperature sticky fly ashes, to use a boiler design that allows gas temperatures to reduce sufficiently before the convective heat exchange bundles (e.g. the provision of sufficient empty passes within the furnace/boiler and/or water walls or other techniques that aid cooling), as described in 4.2.23 and 4.3.11. The actual temperature above which fouling is significant is waste type and boiler steam parameter dependent. In general for MSW it is usually 600 – 750 °C, lower for HW and higher for SS. Radiative heat exchangers, such as platten type super heaters, may be used at higher flue-gas temperatures than other designs (see 4.3.14).

26. the overall optimisation of installation energy efficiency and energy recovery, taking into account the techno-economic feasibility (with particular reference to the high corrosivity of the flue-gases that results from the incineration of many wastes e.g. chlorinated wastes), and the availability of users for the energy so recovered, as described in 4.3.1, and in general:
   a. to reduce energy losses with flue-gases, using a combination of the techniques described in 4.3.2 and 4.3.5
   b. the use of a boiler to transfer the flue-gas energy for the production of electricity and/or supply of steam/heat with a thermal conversion efficiency of:
      i. for mixed municipal waste at least 80 % (ref. Table 3.46)
      ii. for pretreated municipal wastes (or similar waste) treated in fluidised bed furnaces, 80 to 90 %
      iii. for hazardous wastes giving rise to increased boiler corrosion risks (typically from chlorine/sulphur content), above 60 to 70 %
      iv. for other wastes conversion efficiency should generally be increased in the range 60 to 90 %
   c. for gasification and pyrolysis processes that are combined with a subsequent combustion stage, the use of a boiler with a thermal conversion efficiency of at least 80 %, or the use of a gas engine or other electrical generation technology

27. to secure where practicable, long-term base-load heat/steam supply contracts to large heat/steam users (see 4.3.1) so that a more regular demand for the recovered energy exists and therefore a larger proportion of the energy value of the incinerated waste may be used

28. the location of new installations so that the use of the heat and/or steam generated in the boiler can be maximised through any combination of:
   a. electricity generation with heat or steam supply for use (i.e. use CHP)
   b. the supply of heat or steam for use in district heating distribution networks
   c. the supply of process steam for various, mainly industrial, uses (see examples in 4.3.18)

d. the supply of heat or steam for use as the driving force for cooling/air conditioning systems

Selection of a location for a new installation is a complex process involving many local factors (e.g. waste transport, availability of energy users, etc) which are addressed by IPPC Directive Article 9(4). The generation of electricity <u>only</u> may provide the most energy efficient option for the recovery of the energy from the waste in specific cases where local factors prevent heat/steam recovery.

29. in cases where electricity is generated, the optimisation of steam parameters (subject to user requirements for any heat and steam produced), including consideration of (see 4.3.8):
   a. the use of higher steam parameters to increase electrical generation, and
   b. the protection of boiler materials using suitably resistant materials (e.g. claddings or special boiler tube materials)

The optimal parameters for an individual installation are highly dependent upon the corrosivity of the flue-gases and hence upon the waste composition.

30. the selection of a turbine suited to:
   a. the electricity and heat supply regime, as described in 4.3.7
   b. high electrical efficiency

31. at new or upgrading installations, where electricity generation is the priority over heat supply, the minimisation of condenser pressure, as described in 4.3.9

32. the general minimisation of overall installation energy demand, including consideration of the following (see 4.3.6):
   a. for the performance level required, the selection of techniques with lower overall energy demand in preference to those with higher energy demand
   b. wherever possible, ordering flue-gas treatment systems in such a way that flue-gas reheating is avoided (i.e. those with the highest operational temperature before those with lower operational temperatures)
   c. where SCR is used;
      i. to use heat exchangers to heat the SCR inlet flue-gas with the flue-gas energy at the SCR outlet
      ii. to generally select the SCR system that, for the performance level required (including availability/fouling and reduction efficiency), has the lower operating temperature
   d. where flue-gas reheating is necessary, the use of heat exchange systems to minimise flue-gas reheating energy demand
   e. avoiding the use of primary fuels by using self produced energy in preference to imported sources

33. where cooling systems are required, the selection of the steam condenser cooling system technical option that is best suited to the local environmental conditions, taking particular account of potential cross-media impacts, as described in 4.3.10

34. the use of a combination of on-line and off-line boiler cleaning techniques to reduce dust residence and accumulation in the boiler, as described in 4.3.19

35. the use of an overall flue-gas treatment (FGT) system that, when combined with the installation as a whole, generally provides for the operational emission levels listed in Table 5.2 for releases to air associated with the use of BAT.

Table 5.2: Operational emission level ranges associated with the use of BAT (see notes below) for releases to air (in mg/Nm^3 or as stated)

Substance(s)	Non-continuous samples	½ hour average	24 hour average	Comments
Total dust		1 – 20 (see split view 2)	1 – 5	In general the use of fabric filters give the lower levels within these emission ranges. Effective maintenance of dust control systems is very important. Energy use can increase as lower emission averages are sought. Controlling dust levels generally reduces metal emissions too.
Hydrogen chloride (HCl)		1 – 50	1 – 8	Waste control, blending and mixing can reduce fluctuations in raw gas concentrations that can lead to elevated short-term emissions. Wet FGT systems generally have the highest absorption capacity and deliver the lowest emission levels for these substances, but are generally more expensive. See Table 5.3 for consideration of criteria for selection between the main FGT systems, including cross-media impacts.
Hydrogen fluoride (HF)		<2 (see split view 2)	<1	
Sulphur dioxide (SO_2)		1 – 150 (see split view 2)	1 – 40 (see split view 2)	
Nitrogen monoxide (NO) and nitrogen dioxide (NO_2), expressed as nitrogen dioxide for installations using SCR		40 – 300 (see split view 2)	40 – 100 (see split view 2)	Waste and combustion control techniques coupled with SCR generally result in operation within these emission ranges. The use of SCR imposes an additional energy demand and costs. In general at larger installations the use of SCR results in less significant additional cost per tonne of waste treated. High N waste may result in increased raw gas NO_X concentrations.
Nitrogen monoxide (NO) and nitrogen dioxide (NO_2) expressed as nitrogen dioxide for installations not using SCR		30 – 350	120 – 180	Waste and combustion control techniques with SNCR generally result in operation within these emission ranges. 24 hour averages below this range generally require SCR although levels below 70mg/Nm^3 have been achieved using SNCR e.g. where raw NO_X is low and/or at high reagent dose rates) Where high SNCR reagent dosing rates are used, the resulting NH_3 slip can be controlled using wet FGT with appropriate measures to deal with the resultant ammoniacal waste water. High N waste may result in increased raw gas NO_X concentrations. (See also note 8 below in respect of small installations).
Gaseous and vaporous organic substances, expressed as TOC		1 – 20	1 – 10	Techniques that improve combustion conditions reduce emissions of these substances. Emission concentrations are generally not influenced greatly by FGT. CO levels may be higher during start-up and shut down, and with new boilers that have not yet established their normal operational fouling level
Carbon monoxide (CO)		5 – 100	5 – 30	
Mercury and its compounds (as Hg)	<0.05 (see split view 2)	0.001 – 0.03	0.001 – 0.02	Adsorption using carbon based reagents is generally required to achieve these emission levels with many wastes - as metallic Hg is more difficult to control than ionic Hg. The precise abatement performance and technique required will depend on the levels and distribution of Hg in the waste. Some waste streams have very highly variable Hg concentrations – waste pretreatment may be required in such cases to prevent peak overloading of FGC system capacity. Continuous monitoring of Hg is <u>not</u> required by Directive 2000/76/EC but has been carried out in some MSs
Total cadmium and thallium (and their compounds expressed as the metals)	0.005 - 0.05 (see split view 2)			See comments for Hg. The lower volatility of these metals than Hg means that dust and other metal control methods are more effective at controlling these substances than Hg.
Σ other metals	0.005 - 0.5			Techniques that control dust levels generally also control these metals
Dioxins and furans (ng TEQ/Nm^3)	0.01 – 0.1 (see split view 2)			Combustion techniques destroy PCDD/F in the waste. Specific design and temperature controls reduce *de-novo* synthesis. In addition to such measures, abatement techniques using carbon based absorbents reduce final emissions to within this emission range. Increased dosing rates for carbon absorbent may give emissions to air as low as 0.001 but result in increased consumption and residues.

Substances not included in Directive 2000/76/EC on waste incineration:				
Ammonia (NH_3)	<10	1 – 10	<10 (see split view 1)	Effective control of NO_X abatement systems, including reagent dosing contributes to reducing NH_3 emissions. Wet scrubbers absorb NH_3 and transfer it to the waste water stream.
Benz(a)pyrene	For these substances there was insufficient data to draw a firm BAT conclusion on emission levels. However, the data provided in Chapter 3 indicates that their emission levels are generally low. PCBs, PAHs and benz(a)pyrene can be controlled using the techniques applied for PCDD/F. N_2O levels are determined by combustion technique and optimisation, and SNCR optimisation where urea is used.			Techniques that control PCDD/F also control Benz(a)pyrene, PCBs and PAHs
PCBs				
PAHs				
Nitrous oxide (N_2O)				Effective oxidative combustion and control of NO_X abatement systems contribute to reducing N_2O emissions. The higher levels may be seen with fluidised beds operated at lower temperatures e.g. below ~900 °C

NOTES:
1. The ranges given in this table are the levels of operational performance that may generally be expected as a result of the application of BAT – they are not legally binding emission limit values (ELVs)
2. ∑ other metals = sum of Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V and their compounds expressed as the metals
3. Non-continuous measurements are averaged over a sampling period of between 30 minutes and 8 hours. Sampling periods are generally in the order of 4 – 8 hours for such measurements.
4. Data is standardised at 11 % Oxygen, dry gas, 273K and 101.3kP
5. Dioxin and furans are calculated using the equivalence factors as in EC/2000/76
6. When comparing performance against these ranges, in all cases the following should be taken into account: the confidence value associated with determinations carried out; that the relative error of such determinations increases as measured concentrations decrease towards lower detection levels
7. The operational data supporting the above-mentioned BAT ranges were obtained according to the currently accepted codes of good monitoring practice requiring measurement equipment with instrumental scales of 0 – 3 times the WID ELV. For parameters with an emission profile of a very low baseline combined with short period peak emissions, specific attention has to be paid to the instrumental scale. For example changing the instrumental scale for the measurement of CO from 3-times the WID ELV to a 10-times higher value, has been reported in some cases, to increase the reported values of the measurement by a factor of 2 – 3. This should be taken into account when interpreting this table.
8. One MS reported that technical difficulties have been experienced in some cases when retrofitting SNCR abatement systems to existing small MSW incineration installations, and that the cost effectiveness (i.e. NO_X reduction per unit cost) of NO_X abatement (e.g. SNCR) is lower at small MSWIs (i.e. those MSWIs of capacity <6 tonnes of waste/hour).

SPLIT VIEWS:

1 BAT 35 : Based upon their knowledge of the performance of existing installations a few Member States and the Environmental NGO expressed the split view that the 24 hour NH_3 emission range associated with the use of BAT should be <5 mg/Nm^3 (in the place of <10 mg/ Nm^3)

2 BAT 35 : One Member State and the Environmental NGO expressed split views regarding the BAT ranges in table 5.2 (air). These split views were based upon their knowledge of the performance of a number of existing installations, and their interpretation of data provided by the TWG and also of that included in this BREF document (e.g. in Chapter 3). The final outcome of the TWG meeting was the ranges shown in Table 5.2, but with the following split views recorded: total dust 1/2hr average 1 - 10 mg/Nm^3; NO_X (as NO_2) using SCR 1/2hr average 30 - 200 and 24hr average 30 - 100 mg/Nm^3; Hg and its compounds (as Hg) non-continuous 0.001 - 0.03 mg/Nm^3; Total Cd + Tl non-continuous 0.005 - 0.03mg/Nm^3; Dioxins and furans non-continuous 0.01 - 0.05 ng TEQ/Nm^3. Based on the same rationale, the Environmental NGO also registered the following split views: HF 1/2hr average <1 mg/Nm^3; SO_2 1/2hr average 1 – 50 mg/Nm^3 and 24hr average 1 – 25 mg/Nm^3.

Table 5.2 Operational emission level ranges associated with the use of BAT for releases to air from waste incinerators

36. when selecting the overall FGT system, to take into account:
    a. the general factors described in 4.4.1.1 and 4.4.1.3
    b. the potential impacts on energy consumption of the installation, as described in section 4.4.1.2
    c. the additional overall-system compatibility issues that may arise when retrofitting existing installations (see 4.4.1.4)

37. when selecting between wet/ semi-wet/ and dry FGT systems, to take into account the (non-exhaustive) general selection criteria given as an example in Table 5.3:

Criteria	Wet FGT (W)	Semi-wet FGT (SW)	Dry lime FGT (DL)	Dry sodium bicarbonate FGT (DS)	Comments
Air emissions performance	+	0	-	0	• in respect of HCl, HF, NH_3 & SO_2 wet systems generally give the lowest emission levels to air • each of the systems are usually combined with additional dust and PCDD/F control equipment • DL systems may reach similar emission levels as DS & SW but only with increased reagent dosing rates and associated increased residue production.
Residue production	+	0	-	0	• residue production per tonne waste is generally higher with DL systems and lower with W systems with greater concentration of pollutants in residues from W systems • material recovery from residues is possible with W systems following treatment of scrubber effluent, and with DS systems
Water consumption	-	0	+	+	• water consumption is generally higher with W systems • Dry systems use little or no water
Effluent production	-	+	+	+	• the effluents produced (if not evaporated) by W systems require treatment and usually discharge – where a suitable receptor for the salty treated effluent can be found (e.g. marine environments) the discharge itself may not be a significant disadvantage • ammonia removal from effluent may be complex
Energy consumption	-	0	0	0	• energy consumption higher with W systems due to pump demand – and is further increased where (as is common) combined with other FGT components e.g. for dust removal
Reagent consumption	+	0	-	0	• generally lowest reagent consumption with W systems • generally highest reagent consumption with DL – but may be reduced with reagent re-circulation • SW, and DL & DS systems can benefit from use of raw gas acid monitoring (see 4.4.3.9)
Ability to cope with inlet variations of pollutant	+	0	-	0	• W systems are most capable of dealing with wide ranging and fast changing inlet concentrations of HCl, HF and SO_2. • DL systems generally offer less flexibility – although this may be improved with the use of raw gas acid monitoring (see 4.4.3.9)
Plume visibility	-	0	+	+	• plume visibility is generally higher with wet systems (unless special measures used) • dry systems generally have the lowest plume visibility
Process complexity	- (highest)	0 (medium)	+ (lowest)	+ (lowest)	• W systems themselves are quite simple but other process components are required to provide an all round FGT system including a waste water treatment plant etc.
Costs - capital	Generally higher	medium	Generally lower	Generally lower	• additional cost for wet system arises from the additional costs for complementary FGT and auxiliary components – most significant at smaller plants
Costs – operational	medium	Generally lower	medium	Generally lower	• there is an additional operational cost of ETP for W systems – most significant at smaller plants • higher residue disposal costs where more residues are produced, and more reagent consumed. W systems generally produce lowest amounts of reagents and therefore may have lower reagent disposal costs. • op. costs include consumables, disposal and maintenance costs. Op. costs depend very much on local prices for consumables and residue disposal.

Note: + means that the use of the technique generally offers an advantage in respect of the assessment criteria considered
0 means that the use of the technique generally offers no significant advantage or disadvantage in respect of the assessment criteria considered
- means that the use of the technique generally offers a disadvantage in respect of the assessment criteria considered

Table 5.3: An example assessment of some IPPC relevant criteria that may be taken into account when selecting between wet/semi-wet/dry FGT options

38. to prevent the associated increased electrical consumption, to generally (i.e. unless there is a specific local driver) avoid the use of. two bag filters in one FGT line (as described in 4.4.2.2 and 4.4.2.3)

39. the reduction of FGT reagent consumption and of FGT residue production in dry, semi-wet, and intermediate FGT systems by a suitable combination of:
   a. adjustment and control of the quantity of reagent(s) injected in order to meet the requirements for the treatment of the flue-gas such that the target final operational emission levels are met
   b. the use of the signal generated from fast response upstream and/or downstream monitors of raw HCl and/or SO_2 levels (or other parameters that may prove useful for this purpose) for the optimisation of FGT reagent dosing rates, as described in 4.4.3.9
   c. the re-circulation of a proportion of the FGT residues collected, as described in 4.4.3.7

The applicability and degree of use of the above techniques that represents BAT will vary according to, in particular: the waste characteristics and consequential flue-gas nature, the final emission level required, and technical experience from their practical use at the installation.

40. the use of primary (combustion related) NO_X reduction measures to reduce NO_X production, together with either SCR (4.4.4.1) or SNCR (4.4.4.2), according to the efficiency of flue-gas reduction required. In general SCR is considered BAT where higher NO_X reduction efficiencies are required (i.e. raw flue-gas NO_X levels are high) and where low final flue-gas emission concentrations of NO_X are desired.
One MS reported that technical difficulties have been experienced in some cases when retrofitting SNCR abatement systems to existing small MSW incineration installations, and that the cost effectiveness (i.e. NO_X reduction per unit cost) of NO_X abatement (e.g. SNCR) is lower at small MSWIs (i.e. those MSWIs of capacity <6 tonnes of waste/hour).

41. for the reduction of overall PCDD/F emissions to all environmental media, the use of:
   a. techniques for improving knowledge of and control of the waste, including in particular its combustion characteristics, using a suitable selection of techniques described in 4.1, and
   b. primary (combustion related) techniques (summarised in 4.4.5.1) to destroy PCDD/F in the waste and possible PCDD/F precursors, and
   c. the use of installation designs and operational controls that avoid those conditions (see 4.4.5.2) that may give rise to PCDD/F reformation or generation, in particular to avoid the abatement of dust in the temperature range of 250 – 400 °C. Some additional reduction of de-novo synthesis is reported where the dust abatement operational temperature has been further lowered from 250 to below 200 °C, and
   d. the use of a suitable combination of one or more of the following additional PCDD/F abatement measures:
      i. adsorption by the injection of activated carbon or other reagents at a suitable reagent dose rate, with bag filtration, as described in 4.4.5.6, or
      ii. adsorption using fixed beds with a suitable adsorbent replenishment rate, as described in 4.4.5.7, or
      iii. multi layer SCR, adequately sized to provide for PCDD/F control, as described in 4.4.5.3, or
      iv. the use of catalytic bag filters (but only where other provision is made for effective metallic and elemental Hg control), as described in 4.4.5.4

42. where wet scrubbers are used, to carry out an assessment of PCDD/F build up (memory effects) in the scrubber and adopt suitable measures to deal with this build up and prevent scrubber breakthrough releases. Particular consideration should be given to the possibility of memory effects during shut-down and start-up periods.

43. if re-burn of FGT residues is applied, then suitable measures should be taken to avoid the re-circulation and accumulation of Hg in the installation

44. for the control of Hg emissions where wet scrubbers are applied as the only or main effective means of total Hg emission control:
    a. the use of a low pH first stage with the addition of specific reagents for ionic Hg removal (as described in 4.4.6.1, 4.4.6.6 and 4.4.6.5), in combination with the following additional measures for the abatement of metallic (elemental) Hg, as required in order to reduce final air emissions to within the BAT emission ranges given for total Hg
    b. activated carbon injection, as described in 4.4.6.2, or
    c. activated carbon or coke filters, as described in 4.4.6.7

45. for the control of Hg emissions where semi-wet and dry FGT systems are applied, the use of activated carbon or other effective adsorptive reagents for the adsorption of PCDD/F and Hg, as described in 4.4.6.2, with the reagent dose rate controlled so that final air emissions are within the BAT emission ranges given for Hg

46. the general optimisation of the re-circulation and re-use of waste water arising on the site within the installation, as described in 4.5.8, including for example, if of sufficient quality, the use of boiler drain water as a water supply for the wet scrubber in order to reduce scrubber water consumption by replacing scrubber feed-water (see 4.5.6)

47. the use of separate systems for the drainage, treatment and discharge of rainwater that falls on the site, including roof water, so that it does not mix with potential or actual contaminated waste water streams, as described in 4.5.9. Some such waste water streams may require only little or no treatment prior to their discharge, depending on contamination risk and local discharge factors

48. where wet flue-gas treatment is used:
    a. the use of on-site physico/chemical treatment of the scrubber effluents prior to their discharge from the site, as described in 4.5.11, and thereby to achieve, at the point of discharge from the effluent treatment plant (ETP), emission levels generally within the operational emission level ranges associated with BAT that are identified in Table 5.4
    b. the separate treatment of the acid and alkaline waste water streams arising from the scrubber stages, as described in 4.5.13, when there are particular drivers for the additional reduction of releases to water that result, and/or where HCl and/or gypsum recovery is to be carried out
    c. the re-circulation of wet scrubber effluent within the scrubber system, and the use of the electrical conductivity (mS/cm) of the re-circulated water as a control measure, so as to reduce scrubber water consumption by replacing scrubber feed-water, as described in 4.5.4
    d. the provision of storage/buffering capacity for scrubber effluents, to provide for a more stable waste water treatment process, as described in 4.5.10
    e. the use of sulphides (e.g. M-trimercaptotriazine) or other Hg binders to reduce Hg (and other heavy metals) in the final effluent, as described in 4.5.11
    f. when SNCR is used with wet scrubbing the ammonia levels in the effluent discharge may be reduced using ammonia stripping, as described in 4.5.12, and the recovered ammonia re-circulated for use as a NO_X reduction reagent

Parameter	BAT range in mg/l (unless stated)	Sampling and data information
Total suspended solids as defined by Directive 91/271/EEC	10 – 30 (95 %) 10 – 45 (100 %)	• based on spot daily or 24 hour flow proportional sample
Chemical oxygen demand	50 – 250	• based on spot daily, or 24 hour flow proportional sample
pH	pH 6.5 – pH 11	• continuous measurement
Hg and its compounds, expressed as Hg	0.001 – 0.03 (see split view 1)	• based on monthly measurements of a flow proportional representative sample of the discharge over a period of 24 hours with one measurement per year exceeding the values given, or no more than 5 % where more than 20 samples are assessed per year • There have been some positive experiences with continuous monitoring of Hg • Total Cr levels below 0.2 mg/l provide for control of Chromium VI • Sb, Mn, V and Sn are not included in Directive 2000/76
Cd and its compounds, expressed as Cd	0.01 – 0.05 (see split view 1&2)	
Tl and its compounds, expressed as Tl	0.01 – 0.05 (see split view 2)	
As and its compounds, expressed as As	0.01 – 0.15 (see split view 1)	
Pb and its compounds, expressed as Pb	0.01 – 0.1	
Cr and its compounds, expressed as Cr	0.01 – 0.5 (see split view 2)	
Cu and its compounds, expressed as Cu	0.01 – 0.5 (see split view 2)	
Ni and its compounds, expressed as Ni	0.01 – 0.5 (see split view 2)	
Zn and its compounds, expressed as Zn	0.01 – 1.0 (see split view 2)	
Sb and its compounds, expressed as Sb	0.005 – 0.85 (see split view 1)	
Co and its compounds, expressed as Co	0.005 – 0.05	
Mn and its compounds, expressed as Mn	0.02 – 0.2	
V and its compounds, expressed as V	0.03 – 0.5 (see split view 1)	
Sn and its compounds, expressed as Sn	0.02 – 0.5	
PCDD/F (TEQ)	0.01 – 0.1 ng TEQ/l (see split view 1&2)	• average of 6 monthly measurements of a flow proportional representative sample of the discharge over a period of 24 hours

NOTE:
1. Values are expressed in mass concentrations for unfiltered samples
2. Values relate to the discharge of treated scrubber effluents without dilution
3. BAT ranges are not the same as ELVs – see comments in introduction to Chapter 5
4. pH is one important parameter for waste water treatment process control
5. Confidence levels decrease as measured concentrations decrease towards lower detection levels

SPLIT VIEWS:

1 **BAT 48:** One Member State and the Environmental NGO expressed split views regarding the BAT ranges in table 5.4 (water). These split views were based upon their knowledge of the performance of a number of existing installations, and their interpretation of data provided by the TWG and also of that included in this BREF document (e.g. in Chapter 3). The final outcome of the TWG meeting was the ranges shown in Table 5.4, but with the following split views recorded: Hg 0.001 - 0.01 mg/l; Cd 0.001 - 0.05 mg/l; As 0.003 - 0.05 mg/l; Sb 0.005 - 0.1 mg/l; V 0.01 - 0.1 mg/l; PCDD/F <0.01 - 0.1 ng TEQ/l.

2 **BAT 48:** Based on the same rationale, the Environmental NGO also registered the following split views: Cd 0.001 - 0.02 mg/l; Tl 0.001 – 0.03 mg/l; Cr 0.003 – 0.02 mg/l; Cu 0.003 – 0.3 mg/l; Ni 0.003 – 0.2 mg/l.; Zn 0.01 – 0.05 mg/l; PCDD/F <0.01 ng TEQ/l.

Table 5.4: BAT associated operational emission levels for discharges of waste water from effluent treatment plant receiving FGT scrubber effluent

49. the use of a suitable combination of the techniques and principles described in 4.6.1 for improving waste burnout to the extent that is required so as to achieve a TOC value in the ash residues of below 3 wt % and typically between 1 and 2 wt %, including in particular:
    a. the use of a combination of furnace design (see combustion technology selection in 4.2.1), furnace operation (see 4.2.17) and waste throughput rate (see 4.2.18) that provides sufficient agitation and residence time of the waste in the furnace at sufficiently high temperatures, including any ash burn-out areas
    b. the use of furnace designs that, as far as possible, physically retain the waste within the combustion chamber (e.g. narrow grate bar spacings for grates, rotary or static kilns for appreciably liquid wastes) to allow its combustion. The return of early grate riddlings to the combustion chamber for re-burn may provide a means to improve overall burn out where they contribute significantly to the deterioration of burnout (see 4.2.21)
    c. the use of techniques for mixing and pretreatment of the waste, as described in BAT 11, according to the type(s) of waste received at the installation
    d. the optimisation and control of combustion conditions, including air (oxygen) supply and distribution, as described in BAT 18

50. the separate management of bottom ash from fly ash and other FGT residues, so as to avoid contamination of the bottom ash and thereby improve the potential for bottom ash recovery, as described in 4.6.2. Boiler ash may exhibit similar or very different levels of contamination to that seen in bottom ash (according to local operational, design and waste specific factors) – it is therefore also BAT to assess the levels of contaminants in the boiler ash, and to assess whether separation or mixing with bottom ash is appropriate. It is BAT to assess each separate solid waste stream that arises for its potential for recovery either alone or in combination.

51. where a pre-dedusting stage (see 4.6.3 and 4.4.2.1) is in use, an assessment of the composition of the fly ash so collected should be carried out to assess whether it may be recovered, either directly or after treatment, rather than disposed of

52. the separation of remaining ferrous and non-ferrous metals from bottom ash (see 4.6.4), as far as practicably and economically viable, for their recovery

53. the treatment of bottom ash (either on or off-site), by a suitable combination of:
    a. dry bottom ash treatment with or without ageing, as described in 4.6.6 and 4.6.7, or
    b. wet bottom ash treatment, with or without ageing, as described in 4.6.6and 4.6.8, or
    c. thermal treatment, as described in 4.6.9 (for separate treatment) and 4.6.10 (for in-process thermal treatment) or
    d. screening and crushing (see 4.6.5)

    to the extent that is required to meet the specifications set for its use or at the receiving treatment or disposal site e.g. to achieve a leaching level for metals and salts that is in compliance with the local environmental conditions at the place of use.

54. the treatment of FGT residues (on or off-site) to the extent required to meet the acceptance requirements for the waste management option selected for them, including consideration of the use of the FGT residue treatment techniques described in 4.6.11

55. the implementation of noise reduction measures to meet local noise requirements (techniques are described in 4.7 and 3.6)

56. apply environmental management. A number of environmental management techniques are determined as BAT. The scope (e.g. level of detail) and nature of the EMS (e.g. standardised or non-standardised) will generally be related to the nature, scale and complexity of the installation, and the range of environmental impacts it may have.

BAT is to implement and adhere to an Environmental Management System (EMS) that incorporates, as appropriate to individual circumstances, the following features: (see Chapter 4.8)

- definition of an environmental policy for the installation by top management (commitment of the top management is regarded as a precondition for a successful application of other features of the EMS)
- planning and establishing the necessary procedures
- implementation of the procedures, paying particular attention to
  - structure and responsibility
  - training, awareness and competence
  - communication
  - employee involvement
  - documentation
  - efficient process control
  - maintenance programme
  - emergency preparedness and response
  - safeguarding compliance with environmental legislation.
- checking performance and taking corrective action, paying particular attention to
  - monitoring and measurement (see also the Reference document on Monitoring of Emissions)
  - corrective and preventive action
  - maintenance of records
  - independent (where practicable) internal auditing in order to determine whether or not the environmental management system conforms to planned arrangements and has been properly implemented and maintained.
- review by top management.

Three further features, which can complement the above stepwise, are considered as supporting measures. However, their absence is generally not inconsistent with BAT. These three additional steps are:

- having the management system and audit procedure examined and validated by an accredited certification body or an external EMS verifier
- preparation and publication (and possibly external validation) of a regular environmental statement describing all the significant environmental aspects of the installation, allowing for year-by-year comparison against environmental objectives and targets as well as with sector benchmarks as appropriate
- implementation and adherence to an internationally accepted voluntary system such as EMAS and EN ISO 14001:1996. This voluntary step could give higher credibility to the EMS. In particular EMAS, which embodies all the above-mentioned features, gives higher credibility. However, non-standardised systems can in principle be equally effective provided that they are properly designed and implemented.

Specifically for this industry sector*, it is also important to consider the following potential features of the EMS:

- giving consideration to the environmental impact from the eventual decommissioning of the unit at the stage of designing a new plant
- giving consideration to the development of cleaner technologies
- where practicable, sectoral benchmarking on a regular basis, including energy efficiency and energy conservation activities, choice of input materials, emissions to air, discharges to water, consumption of water and generation of waste
- the development and use of procedures for the commissioning stages of new installations, generally including:
- the prior preparation of a detailed programme of works describing the commissioning programme
- an initial gap analysis of training requirements to identify pre-commissioning training needs
- health & safety needs which meet European and local requirements
- the availability of sufficient and up to date documentation regarding the installation
- emergency and accident prevention planning, generally include procedures for:
    - serious fire
    - major explosion
    - sabotage/bomb
    - site intruders
    - major injury/death of employee/visitor/contractor
    - traffic accident
    - theft
    - environmental incident
    - power interruption
- where the plant commissioning and tuning period may give rise to emissions outside the normal regulatory controls.

All incineration installations, and in particular for those receiving hazardous wastes, personnel training programs are considered an important part of all safety management systems, especially training for:
- explosion and fire prevention
- fire extinguishing
- knowledge of chemical risks (labelling, carcinogenic substances, toxicity, corrosion, fire) and transportation

5.2 Specific BAT for municipal waste incineration

In addition to the generic measures given in Section 5.1, for municipal waste incineration BAT is in general considered to be:

57. the storage of all waste, (with the exception of wastes specifically prepared for storage or bulk items with low pollution potential e.g. furniture), on sealed surfaces with controlled drainage inside covered and walled buildings

58. when waste is stockpiled (typically for later incineration) it should generally be baled (see Section 4.1.4.3) or otherwise prepared for such storage so that it may be stored in such a manner that risks of odour, vermin, litter, fire and leaching are effectively controlled.

59. to pretreat the waste, in order to improve its homogeneity and therefore combustion characteristics and burn-out, by:
    a. mixing in the bunker (see 4.1.5.1), and
    b. the use of shredding or crushing for bulky wastes e.g. furniture (see 4.1.5.2) that are to be incinerated,

    to the extent that is beneficial according to the combustion system used. In general grates and rotary kilns (where used) require lower levels of pretreatment (e.g. waste mixing with bulky waste crushing) whereas fluidized bed systems require greater waste selection and pretreatment, usually including full shredding of the MSW.

60. the use of a grate design that incorporates sufficient cooling of the grate such that it permits the variation of the primary air supply for the main purpose of combustion control, rather than for the cooling of the grate itself. Air-cooled grates with well distributed air cooling flow are generally suitable for wastes of average NCV of up to approx 18 MJ/kg. Higher NCV wastes may require water (or other liquid) cooling in order to prevent the need for excessive primary air levels (i.e. levels that result in a greater air supply than the optimum for combustion control) to control grate temperature and length/position of fire on the grate (see section 4.2.14)

61. the location of new installations so that the use of CHP and/or the heat and/or steam utilisation can be maximised, so as to generally exceed an overall total energy export level of 1.9 MWh/tonne of MSW (ref. Table 3.42), based on an average NCV of 2.9 MWh/tonne (ref. Table 2.11)

62. in situations where less than 1.9 MWh/tonne of MSW (based on an average NCV of 2.9 MWh /tonne) can be exported, the greater of:
    a. the generation of an annual average of 0.4 – 0.65 MWh electricity/tonne of MSW (based on an average NCV of 2.9 MWh/tonne (ref. Table 2.11) processed (ref. Table 3.40), with additional heat/steam supply as far as practicable in the local circumstances, or
    b. the generation of at least the same amount of electricity from the waste as the annual average electricity demand of the entire installation, including (where used) on-site waste pretreatment and on-site residue treatment operations (ref. Table 3.48)

63. to reduce average installation electrical demand (excluding pretreatment or residue treatment) to be generally below 0.15 MWh/tonne of MSW processed (ref. Table 3.47 and section 4.3.6) based on an average NCV of 2.9 MWh/tonne of MSW (ref. Table 2.11)

5.3 Specific BAT for pretreated or selected municipal waste incineration

In addition to the generic measures given in Section 5.1, for pretreated or selected municipal waste (including municipal refuse derived fuels) incineration BAT is in general considered to be:

64. the storage of wastes:
    a. in enclosed hoppers or,
    b. on sealed surfaces with controlled drainage inside covered and walled buildings

65. when waste is stockpiled (typically for later incineration) it should generally be baled (see Section 4.1.4.3) or otherwise prepared for such storage so that it may be stored in such a manner that risks of odour, vermin, litter, fire and leaching are effectively controlled

66. at new and existing installations, the generation of the greater of:
    a. an annual average of generally at least 0.6 – 1.0 MWh electricity/tonne of waste (based on an average NCV of 4.2 MWh/tonne), or
    b. the annual average electricity demand of the entire installation, including (where used) on-site waste pretreatment and on-site residue treatment operations

67. the location of new installations so that:
    a. as well as the 0.6 – 1.0 MWhe/ tonne of electricity generated, the heat and/or steam can also be utilised for CHP, so that in general an additional thermal export level of 0.5 – 1.25 MWh/tonne of waste (ref. section 3.5.4.3) can be achieved (based on an average NCV of 4.2 MWh/tonne), or
    b. where electricity is not generated, a thermal export level of 3 MWh/tonne of waste can be achieved (based on an average NCV of 4.2 MWh/tonne)

68. to reduce installation energy demand and to achieve an average installation electrical demand (excluding pretreatment or residue treatment) to generally below 0.2 MWh/tonne of waste processed (ref. Table 3.47 and section 4.3.6) based on an average NCV of 4.2 MWh/tonne of waste

5.4 Specific BAT for hazardous waste incineration

In addition to the generic measures given in Section 5.1, for hazardous waste incineration BAT is in general considered to be:

69. in addition to the quality controls outlined in BAT4, at HWI to use specific systems and procedures, using a risk based approach according to the source of the waste, for the labelling, checking, sampling and testing of waste to be stored/treated (see 4.1.3.4). Analytical procedures should be managed by suitable qualified personnel and using appropriate procedures. In general equipment is required to test:

- the calorific value
- the flashpoint
- PCBs
- Halogens (e.g. Cl, Br, F) and sulphur
- heavy metals
- waste compatibility and reactivity
- radioactivity (if not already covered by BAT3 through fixed detectors at the plant entrance.

Knowledge of the process or origin of the waste is important as certain hazardous characteristics, (for example toxicity or infectiousness) are difficult to determine analytically.

70. the mixing, blending and pretreating of the waste in order to improve its homogeneity, combustion characteristics and burn-out to a suitable degree with due regard to safety considerations. Examples are the shredding of drummed and packaged hazardous wastes, described in 4.1.5.3 and 4.1.5.6. If shredding is carried out then blanketing with an inert atmosphere should be carried out.

71. the use of a feed equalisation system for solid hazardous wastes (e.g. as described in 4.1.5.4 or other similar feeding technology) in order to improve the combustion characteristics of the fed waste and to improve the stability of flue-gas composition including the improved control of short-term CO peak emissions.

72. the direct injection of liquid and gaseous hazardous wastes, where those wastes require specific reduction of exposure, releases or odour risk, as described in 4.1.6.3

73. the use of a combustion chamber design that provides for containment, agitation and transport of the waste, for example: rotary kilns - either with or without water cooling. Water cooling for rotary kilns (see 4.2.15), may be favourable in situations where:
    a. the LHV of the fed waste is higher (e.g. >15 – 17 GJ/tonne), or
    b. higher temperatures e.g. >1100 °C are used (e.g. for ash slagging or destruction of specific wastes)

74. to reduce installation energy demand and in general, and to achieve an average installation electrical demand (excluding pretreatment or residue treatment) of generally below 0.3 – 0.5 MWh/tonne of waste processed (see 3.5.5 and 4.3.6). Smaller installations generally result in consumption levels at the upper end of this range. Weather conditions may have a significant impact on consumption owing to heating requirements etc.

75. for merchant HWI and other hazardous waste incinerators feeding wastes of highly varying composition and sources, the use of:
    a. wet FGT, as described in 4.4.3.1, is generally BAT to provide for improved control of short-term air emissions (see concluding remarks 7.4.3 ref. other systems and BAT37 regarding FGT system selection)
    b. specific techniques for the reduction of elemental iodine and bromine emissions, as described in 4.4.7.1, where such substances exist in the waste at appreciable concentrations

5.5 Specific BAT for sewage sludge incineration

In addition to the generic measures given in Section 5.1, for sewage sludge incineration BAT is in general considered to be:

76. at installations that are mainly dedicated to the incineration of sewage sludge, the use of fluidised bed technology may generally be BAT because of the higher combustion efficiency and lower flue-gas volumes that generally result from such systems. There may be a risk of bed clogging with some sewage sludge compositions.

77. the drying of the sewage sludge, preferably by using heat recovered from the incineration, to the extent that additional combustion support fuels are not generally required for the normal operation of the installation (i.e. in this case, normal operation excludes start-up, shut-down and the occasional use of support fuels for maintaining combustion temperatures)

5.6 Specific BAT for clinical waste incineration

In addition to the generic measures given in Section 5.1, for clinical waste incineration BAT is in general considered to be:

78. the use of non-manual waste handling and loading systems

79. The receipt and storage of clinical wastes in closed containers that are suitably resistant to leaks and punctures.

80. the washing out of waste containers that are to be re-used in a specifically designed, designated washing facility, with disinfection as required, and the feeding of any accumulated solids to the waste incinerator

81. where grates are used, the use of a grate design that incorporates sufficient cooling of the grate such that it permits the variation of the primary air supply for the main purpose of combustion control, rather than for the cooling of the grate itself. Air-cooled grates with well distributed air cooling flow are generally suitable for wastes of NCV of up to approx. 18 MJ/kg. Higher NCV wastes (e.g. above approx. 18 MJ/kg) may require water (or other liquid) cooling in order to prevent the need for excessive primary air levels to control grate temperature i.e. levels that result in a greater air supply than the optimum for combustion control (see section 4.2.14)

82. the use of a combustion chamber design that provides for containment, agitation and transport of the waste, for example: rotary kilns - either with or without water cooling. Water cooling for rotary kilns, as described in 4.2.15, may be favourable in situations where:
    a. the NCV of the fed waste is higher (e.g. >15 – 17 GJ/tonne), or
    b. higher temperatures e.g. >1100 °C are used (e.g. for slagging or destruction of specific wastes)

4. PLANNING AND POLICY CONTEXT

This section outlines the statutory land use development and planning policy context of the proposed waste-to-energy facility at Carranstown, Co. Meath. The proposed development is examined in the context of the policies and objectives of the documents below, which address waste management policy guidance at European Union, national, regional and local levels.

Most of these documents relate to waste management generally rather than specifically to the management of hazardous or non-hazardous waste.

EU Directives and Policy Guidance

- The Sixth Environmental Action Programme 'Environment 2010: Our Future, Our Choice'
- Thematic Strategy on the Prevention and Recycling of Waste/Proposal for a Directive of the European Parliament and of the Council on Waste (2005).
- EU Directive 1999/31/EC – Landfill of Waste
- EU Directive 2000/76/EC – Incineration of Waste
- EU Directive 2001/77/EC – Renewable Energy
- Kyoto Protocol To The United Nations Framework Convention On Climate Change (1997)

National Policy Guidance

- Sustainable Development – A Strategy for Ireland (1997)
- National Development Plan 2000 – 2006
- National Climate Change Strategy Ireland (2000)
- Waste Management: Changing our Ways (1998)
- Waste Management: Preventing and Recycling Waste Delivering Change (2001)
- Waste Management: Taking Stock & Moving Forward (2004)
- National Strategy for Biodegradable Waste Draft Report (2004)
- Policy Guidance Circular WIR: 04/05

Regional & Local Policy Guidance

- Waste Management Plan for North East Region (1999)
- Proposed Replacement North East Region Waste Management Plan 2005-2010
- Meath County Development Plan (2001)

4.1 European Union Directives and Policy Guidance

4.1.1 EU Sixth Environmental Action Programme – 'Environment 2010: Our Future, Our Choice'

The EU sixth action programme is the successor to the EU fifth action programme (1992 – 1999), 'Towards Sustainability' and sets out the major priorities and objectives for environment policy in the European Union in the period 2001 to 2010. The document states that a strategy is needed to ensure more sustainable use of resources. It also predicts that waste volumes will continue to rise unless remedial action is taken. Waste prevention is identified as a key element and further measures are also needed to encourage the recycling and recovery of wastes.

The Programme says that it is clear that the continuance of current consumption and production trends will translate into increasing quantities of waste arisings, of which a significant proportion will continue to be hazardous. The policy document acknowledges that new waste treatment facilities meet high operating standards that significantly reduce emissions and risks. However, with waste still going to older and less well managed facilities, the impact of waste management and waste transport are still problematic in many areas of the European Union.

The European Union's approach to waste management policy is based on the established waste management hierarchy. The sixth programme considers this approach has been successful in improving standards in waste management, but that it has not halted the increase in waste volumes. The programme focuses upon waste prevention and acknowledges this is one of the most challenging aspects in the waste sector that will require the de-coupling of waste generation from economic growth.

The following objectives in relation to the generation and management of wastes are stated in the sixth programme are:

- wastes should be non-hazardous or present as little risk as possible
- preference should be given to recovery, including energy recovery, and especially recycling
- the quantity of waste for final disposal should be minimised and should be safely destroyed or disposed of
- the waste should be treated as close as possible to the place of generation.

The proposed waste-to-energy facility will promote the objectives of the EU Sixth Environmental Action Programme. The facility will operate to the highest standards and will deal with wastes that are not suitable for recycling. Energy will be recovered and the waste-to-energy plant will achieve approximately a 90% reduction in the volume of waste going for final disposal. The proposed facility is located near the centre of gravity of waste production in the North East Region, its intended catchment, so it optimises the transportation patterns associated with it in accordance with objective in this programme.

4.1.2 Thematic Strategy on the Prevention and Recycling of Waste/Proposal for a Directive of the European Parliament and of the Council on Waste (2005)

The 6th Environmental Action Programme calls for a number of inter-related measures designed to reduce the environmental impacts of resource use in line with the EU's Sustainable Development Strategy. This includes the development of a thematic strategy on the recycling of waste and initiatives in the field of waste prevention. In December 2005 the EU Commission published a Communication entitled 'Taking Sustainable Use of Resources Forward: A Thematic Strategy on the Prevention and Recycling of Waste'.

The Thematic Strategy emphasizes the objectives in current EU waste policy and considers that waste policy has the potential to contribute to reducing the overall negative environmental impact of resource use. Waste prevention and promotion of the recycling and recovery of waste will increase the resource efficiency of the European economy and reduce the negative environmental impacts of the use of natural resources. The long-term goal is for the EU to be become a recycling society that seeks to avoid waste and utilize waste as a resource. By setting high environmental reference standards, the internal market will facilitate recycling and recovery activities. To achieve these objectives, the Thematic Strategy recommends a combination of measures promoting waste prevention, recycling and reuse so as to produce the optimum reduction in the accumulated impact over the life cycle of resources including the following measures.

1. A renewed emphasis on full implementation of existing legislation.
2. Simplification and modernization of existing legislation.
3. Introduction of life-cycle thinking into waste policy.
4. Promotion of more ambitious waste prevention policies.

The proposed clarification of the definitions of recovery and disposal activities is particularly relevant to the proposed waste-to-energy facility. The Commission proposes to use energy efficiency thresholds to classify waste treatment in municipal incinerators as either recovery or disposal activities and the Thematic Strategy states as follows.

> *…Municipal incinerators with high energy efficiency are negatively discriminated against compared with co-incineration operations with similar energy efficiencies but less stringent emission controls. A definition of recovery that takes into account that energy produced by a municipal incinerator substitutes the use of resources in other power plants will better reflect the environmental benefits of incineration… At high energy efficiency incineration could be as favourable as mechanical recycling or composting of certain waste flows.*

Energy recovered from this form of incineration will also help the EU meet its targets under the Directive on the promotion of electricity produced from renewable energy resources.

This Communication on the Thematic Strategy was accompanied by a Draft Proposed Directive, which is intended to give effect to the objectives and recommendations in the Thematic Strategy. The main objective of the proposed Directive is to optimize the provisions of Directive 75/442/EEC, the Waste Framework Directive. The Thematic Strategy identified three main reasons for undertaking a revision of the Framework Directive: (1) the need to clarify key concepts such as the definition of waste, recovery and disposal to eliminate uncertainty and to strengthen measures to be taken on waste prevention having regard to the whole life-cycle of products and materials; (2) the need to introduce an environmental objective into the Framework Directive to orient the Directive towards a specific aim and to keep a sharper focus upon the environmental impacts of waste generation and waste management throughout the life-cycle of resources; and (3) the simplification of the existing legal framework by modifying or removing obsolete or unclear provisions in a number of waste Directives.

4.1.3 EU Directive 1999/31/EC – Landfill of Waste

The EU Directive (known as the Landfill Directive) is concerned with reducing the impact on the environment and on human health from the landfilling of wastes. The Directive addresses the landfilling of both hazardous and non-hazardous wastes and states that the prevention, recovery and recycling of waste, and the recovery of materials and energy, are to be encouraged so that natural resources and land are not wasted needlessly. Member states should have regard to the polluter pays principle and should also apply the principles of proximity and self-sufficiency to the management of wastes.

The Directive sets out criteria for the classification of landfills and the types of waste to be accepted at the different classes of landfill. The Directive addresses the licensing, control and monitoring, closure and after care of landfills. In Article 6, the Directive states that only waste, which has been subjected to treatment, where possible, to reduce the quantity or the hazards to human health or the environment, is to be landfilled.

Article 5 of the directive sets the following specific targets for the reduction in the landfilling of municipal biodegradable wastes. The figures are related to the 1995 baseline data.

- 25% reduction by 2006
- 50% reduction by 2009
- 65% reduction by 2016.

The Directive states that the national strategies employed to achieve the above targets should use the following means namely, recycling, composting, bio-gas production and materials and energy recovery. Many of the requirements contained in the Landfill Directive have already been introduced in Ireland. In accordance with the Draft National Strategy for Biodegradable Waste and the National Climate Change Strategy the proposed waste-to-energy facility will contribute towards diversion targets and a reduction in waste related emissions.

The proposed facility will promote the objectives of the EU directive on the landfill of waste. This facility will advance Ireland's self-sufficiency in waste management infrastructure so that waste is treated in proximity to its source of generation. The 'polluter pays principle' will apply. In the proposed waste to energy plant, the waste volume will be reduced by more than 90%. The residues from the plant will be ash, a substantial portion of which will be suitable for reuse. Some ash, representing less than 5% of the original quantity of waste (by weight), will require to be landfilled as hazardous waste.

4.1.4 EU Directive 2000/76/EC – Incineration of Waste

The aim of this Directive is to prevent, or to limit insofar as practicable, the negative effects on public health and the environment due to the incineration and co-incineration of waste. In particular this Directive addresses pollution by emissions to the air, soil, surface water and groundwater and the resulting potential risks to human health. The Directive addresses the incineration of both hazardous and non-hazardous wastes and it addresses the licensing, operations, control and monitoring of waste incinerators and sets very stringent emission limits. It also deals with the handling and fate of residues.

The proposed facility will promote the objectives of the EU incineration of waste directive. The waste to energy plant will operate significantly below the emission limit values stipulated in the Directive and there will be continuous sampling for dioxins, although this is not a requirement of the EU Directive.

4.1.5 EU Directive 2001/77/EC – Renewable Energy

The White Paper on Renewable Energy identified the promotion of electricity from renewable sources as a high priority in the European Community for reasons of security and diversification of energy supply. The purpose of the Renewable Energy Directive is to promote an increase in the contribution of renewable energy sources to electricity production in the internal market for electricity and create a basis for a future Community framework thereof (Article 1). Biomass is defined for the purposes of the Directive at Article 2 as follows.

(b) *'biomass' shall mean the biodegradable fraction of products, waste and residues from agriculture (including vegetal and animal substances), forestry and related industries, as well as the biodegradable fraction of industrial and municipal waste;*

Article 3 of the Directive requires Members States to encourage greater consumption of electricity produced from renewable sources in accordance with national indicative targets. Not later than October 2002, and every five years thereafter, Members States shall adopt and publish targets for future consumption of electricity from renewable energy expressed as a percentage of consumption for the next 10 years.

In accordance with the Directive, Ireland set a target to increase the capacity of renewable energy based electricity generation capacity to at least 1,450 megawatts (MW) installed. In this regard, the Minister for Communications, Marine and Natural Resources initiated a competition for energy from renewable source called the Draft Renewable Energy Feed in Tariff. This competition states that the Government will allocate support for the construction of 400 MWs, at least, in the period to 2010, of new electricity generation plant powered by biomass, hydropower or wind energy.

It follows that a considerable portion of the electricity generated within the proposed waste-to-energy development is based upon a biomass energy source and it therefore accords with the EU Directive and with National Policy in relation to renewable energy sources. This renewable energy source will help meet the targets set in Government Policy.

4.1.6 Kyoto Protocol To The United Nations Framework Convention On Climate Change (1997)

The goal of the Kyoto Protocol is to reduce worldwide greenhouse gas emissions to 5.2 percent below 1990 levels between 2008 and 2012. Compared to the emissions levels that would occur by 2010 without the Kyoto Protocol, however, this target actually represents a 29 percent cut. The Kyoto Protocol sets specific emissions reduction targets for each industrialized nation, but excludes developing countries.

To meet their targets, most ratifying nations would have to combine several strategies:

- place restrictions on their biggest polluters
- manage transportation to slow or reduce emissions from automobiles
- make better use of renewable energy sources—such as solar power, wind power, and biodiesel—in place of fossil fuels

The proposed waste-to-energy plant would assist in Ireland's effort towards meeting the national emissions target in the Kyoto Protocol because it would reduce emissions from biodegradable municipal waste and generate energy from a non-fossil fuel source.

4.2 Irish National Waste Management Policies

4.2.1 Sustainable Development – A Strategy for Ireland (1997)

The Department of the Environment published the Sustainable Development Strategy in 1997. The central aim of the strategy is to provide a comprehensive analysis and framework that will ensure development is undertaken in a sustainable manner in Ireland. It also supports Ireland's commitment to sustainable development at the Earth Summit in Rio de Janeiro in 1992.

Waste is identified as one of the most problematic areas of modern environmental management. It states that the issues associated with the generation and disposal of waste are inextricably linked to present-day economic activity, industrial development, lifestyle and consumption patterns. A major objective in working towards more sustainable practices is the acceptance of appropriate responsibility for waste management, on a shared basis, by all sectors of society. Other core elements of the Strategy for Ireland include the precautionary principle the adoption of an integrated approach involving environmental considerations throughout other policy initiatives and the incorporation of the polluter pays principle in all Irish environmental legislation.

In relation to waste the strategic objectives are to promote waste reduction, reuse and recycling, and higher environmental standards in waste disposal. However, the strategy concedes that even with an extensive and sophisticated clean technology programme, there will always be some residual wastes from commercial, domestic and industrial sources that will require disposal. The Strategy refers to the licensing system to be operated by the Environmental Protection Agency under the 1996 Waste Management Act.

4.2.2 National Development Plan 2000-2006

The core aim of the National Development Plan 2000-2006 is to implement public policies, which will then ensure the sustainability and consolidation of Ireland's recent economic growth. This is based on the development needs of the country and on achieving an appropriate balance between development and environmental conservation. The protection of the environment is identified as a key National and EU priority in the Development Plan and the management of waste is an important element of any environmental protection programme.

The National Development Plan states that 'appropriate waste management infrastructure is vital not only for environmental reasons, but also for industrial development reasons, as lack of suitable facilities may hamper development.' It acknowledges that 'the recent levels of economic growth have placed a significant strain on the existing waste management infrastructure and extensive investment is now required to provide the necessary infrastructure.'

The proposed Meath waste-to-energy plant will form a major part of the waste management infrastructure for the North East Region and Ireland as a whole and it therefore accords with the objectives of the National Development Plan in relation to the development of this infrastructure.

4.2.3 National Climate Change Strategy Ireland (2000)

In October 2000, the DOE published the National Climate Change Strategy, which provides a framework for achieving greenhouse gas emission reductions, and is an essential step in preparing the country for the ratification of the Kyoto Protocol. The main objectives of the strategy are twofold as follows:

- to meet Ireland's legally binding commitment under the Kyoto Protocol
- to position Ireland to be able to adhere to potentially more stringent targets in the years following 2012.

Methane emissions from the waste sector arise from the anaerobic decomposition (breakdown of organic matter in the absence of oxygen) of wastes containing carbon in landfills. The Climate Change Strategy recognises that the achievement of national waste management targets, and, particularly, substantial diversion of waste from landfill, should lead to an 80% reduction in methane emissions from landfill by 2015. This reduction in the amount of biodegradable materials sent to landfill should help meet Ireland's Kyoto obligations.

The strategy states that the energy sector contributed 32% of Irelands CO_2 emissions, and 21.6% of the combined three main greenhouse gases in 1990. The objectives for the energy sector in the strategy include 'An expansion of renewable energy', and the substitution of coal, peat and oil by natural gas and renewable fuels.

The proposed waste-to-energy facility will promote the objectives of the National Climate Change Strategy because it will have the capacity to treat biodegradable waste currently disposed of to landfill. Removing this material from landfill will reduce methane gas emissions and generate electricity, thereby meeting one of the energy sector objectives of the strategy, for the generation of electricity from a non-fossil fuel source.

4.2.4 Waste Management: Changing Our Ways (1998)

Following the EU Directives and the coming into force of the Waste Management Act in 1996, the Irish Government published this key waste management policy document in 1998. The document introduced the waste management hierarchy for the first time and is the cornerstone of Irish waste management policy. This hierarchy regards waste prevention as the most favourable option followed by minimisation, reuse, recycling and energy recovery in that order. Waste disposal is the least favoured option at the bottom of the hierarchy.

The policy document notes that waste management in Ireland is overly reliant upon landfill, which is the least developed waste management option. The EPA National Waste Database Report 1996 indicated that over 90% of household and commercial wastes were being placed in landfills. The policy recommends the need for major change in the planning, financing and operational approach to waste management by local authorities. It advocates a comprehensive integrated waste management system based upon compliance with Irish and EU legislation incorporating best practice and resource efficiency in economic sectors.

The Changing Our Ways policy statement recognizes the following key aspects in the waste management sector. It promotes the regionalisation of waste management planning because such an approach can deliver the benefits of the economies of scale, which are necessary to construct and operate new waste infrastructure. It predicts the closure of poorly managed older landfills and proposes the rationalisation of municipal landfills leading to an integrated network of some 20 state-of-the-art facilities nationwide. The scope for increased participation by the private sector in all areas of waste management is acknowledged in relation to the establishment and operation of waste recovery and disposal facilities. Ensuring waste producers pay the full cost of waste management (collection, treatment and disposal) will serve to focus public attention on the implications of waste production. The 'polluter pays' principle also provides an economic incentive to reduce waste generation and is an integral part of the policy instrument.

Waste production imposes a burden on both the waste management services and on the environment. One of the major policy objectives in "Changing our Ways" is to stabilise, and in the longer term, reverse the growth in waste generation. The policy sets a series of specific targets mainly relating to municipal waste, which are to be achieved over a fifteen years time scale.

- diversion of 50% of overall household waste away from landfill
- a minimum of 65% reduction in biodegradeable wastes consigned to landfill
- the development of waste recovery facilities employing environmentally beneficial technologies
- recycling of 35% of municipal waste
- recycling of at least 50% of construction and demolition waste within a five year period, with a progressive increase to at least 85% over fifteen years
- rationalisation of the number of landfills, with a sustained reduction in numbers
- an 80% reduction in methane emissions from landfills

With regard to thermal treatment the policy document states that waste to energy incineration can play a significant part in the management of residual waste of many EU countries and, generally, materials recycling and waste-to-energy incineration are fully compatible with an integrated approach to waste management. While the disposal to landfill of residues is still required waste-to-energy is effective in diverting a significant percentage of waste away from landfill, and with the proper control, it has a considerably lower potential environmental impact than landfill.
In addition paragraph 7.7.5 of the policy document states that

> *'the development of waste to energy is consistent with, and could make a significant contribution to, the implementation of the Government's renewable energy policy which currently aims to increase the share of renewable energy to 10% of the country's installed electricity generating capacity by the year 2000, with subsequent increases to be delivered in a programme which will be the subject of a forthcoming Green paper on sustainable energy.' (para 7.7.5)*

The proposed waste management facility accords with the objectives of the Changing Our Ways policy statement. It will form part of an integrated waste management infrastructure that is emerging in the North East Region and will embrace the 'polluter pays' principle. The facility will entail a substantial private sector capital investment, in line with the policy of increasing private sector involvement in the provision of waste management facilities and the proposed waste-to-energy facility will generate electricity from a renewable source.

In relation to the specific targets, the proposed 70MW waste-to-energy plant will have the treatment capacity to accept 150,000 to 200,000 tonnes per annum of municipal solid waste, which would otherwise be landfilled, so it will be diverting waste material away from landfill in accordance with the policy in Changing Our Ways.

4.2.5 Waste Management: Preventing and Recycling Waste - Delivering Change (2001)

The Department of the Environment and Local Government published the national waste policy statement in March 2002, entitled '*Preventing and Recycling Waste - Delivering Change'* which evolved from and is grounded in the 1998 policy statement '*Changing Our Ways.'* The 2002 waste policy statement '*Preventing and Recycling Waste - Delivering Change'* addresses the factors and practical considerations that are relevant to the achievement of Government policy objectives and for the prevention of and recovery of waste.

The 2002 Waste Policy Statement highlights the necessary disciplines that must be imposed within waste management systems to secure real progress on waste prevention, re-use, and recovery. It outlines a range of measures to be undertaken in the interests of minimising waste generation and ensuring a suitable expansion in re-use and recycling performance and the policy statement identifies issues and possible actions which require further systematic consideration.

The 2002 waste policy statement concentrates upon the three highest steps on the waste hierarchy recognising, as do the local and regional waste management plans, that emphasis must be given to the widest practicable realisation of waste prevention, minimisation, re-use, materials recycling and biological treatment before energy recovery through thermal treatment and final disposal in landfill.

Delivering Change notes the estimate in the EPA National Waste Database Report 1998 that only 9% of municipal waste is recycled compared to a reported recovery rate of 27% for industrial waste streams. While there is a strong emphasis upon recycling and other higher in hierarchy waste management options, nonetheless energy recovery, including waste-to-energy incineration is considered an essential component of the approach to divert material from landfill. It follows therefore that the proposed development can be considered to accord with the overall policy.

4.2.6 Waste Management – Taking Stock and Moving Forward (April 2004)

National waste policy is implemented through waste management plans, which were prepared for each of the 10 waste management regions in Ireland. As the first generation of the waste management plans approached the end of their plan periods, the Department of Environment Heritage and Local Government (DOEHLG) carried out a review to ensure the policy framework takes account of significant developments in the waste sector. The results of the Review were published in April 2004 in a document entitled '*Waste Management – Taking Stock and Moving Forward*'. This Review states it is necessary to consider the following factors.

- *The implications of the more up to date waste data now available,*
- *Structural changes which have taken place within the waste sector, taking particular account of the growth and consolidation of the private sector's role in waste activities and the appropriate roles for the public and private sectors, and*
- *How to ensure we achieve more intensified and consistent enforcement of the law in relation to waste.*

The Review assesses progress with the implementation of plans, considers developments since the policy framework and waste management plans were established and identifies measures to be undertaken to support progress towards stated objectives. Section 3.5.2 notes that while most Waste Plans envisaged the provision of thermal treatment as a long-term objective, the time that is required to procure such projects and to complete the necessary planning and environmental licensing processes means that those regions which have yet to show progress in this regard need to initiate action in the short term.

Section 3.5.3 confirms the move from a high number of poorly managed landfill facilities to a smaller number operated to the highest environmental standards and it estimates the number of local authority landfills reduced from 87 in 1995 to 50 by end-2001. The Review acknowledges the maximum diversion from landfill depends on achieving other aspects of the plans such as the full and timely delivery of recycling and thermal treatment.

The Review concludes with an analysis of the policy issues and identifies 21 key points for future progress. Key Point 1 of the Review reinforces the concept of integrated waste management based on the internationally recognised waste hierarchy, designed to achieve, by 2013, the targets set out in Changing Our Ways. Given the waste arisings growth trends in the most recent EPA figures the Review describes the targets as very challenging particularly the diversion of 50% of household waste from landfill and the 35% materials recycling target for municipal waste. Although Key Point 2 confirms the primacy of the waste management regions, one of the most important recommendations in the Review is Key Point 3 (KP3), which states as follows.

> *KP3: An examination of the issues arising in terms of the interrelationship between regional boundaries and waste facilities will be completed with a view to providing guidance to the relevant authorities by end-Summer 2004.*

Section 4.3 considers this aspect and states, "it is not an automatic implication of waste management plans that waste facilities provided in the region have to be used exclusively for the region/county concerned". It also states, that "facilities provided in a region must serve primarily the waste management needs of that region", which is consistent with regional waste planning whereby each region takes lead responsibility for its own waste thereby playing a part in an overall national solution. Arising from key point 3 the Department of the Environment, Heritage and Local Government (DOEHLG) published guidance to local authorities at Circular WIR 04/05 in relation to the movement of waste, which is considered below.

Section 4.5.6 considers the progress to date and identifies the issues associated with waste-to-energy and thermal treatment. It notes that health concerns and fears that such facilities would prejudice the achievement of recycling initiatives as amongst the main issues in relation to the delivery of thermal treatment with energy recovery.

> *KP10: Thermal treatment, with energy recovery, has a role to play as one element in the integrated approach to waste management; facilities will be subject to stringent controls through licenses issued by the EPA and through subsequent licence enforcement and facility monitoring. In order to provide better information in relation to thermal treatment (and other aspects of waste management), factsheets will be published in May 2004 as part of a more comprehensive information package under the Race Against Waste campaign.*

The Review of Waste Management Plans also considers the current waste management plans do not adequately reflect the scale and pace of change in the waste sector especially in regard to the balance between the public and private sectors. Waste management plans are prepared by the local authorities in that waste region, however private concerns are playing an increasing role in the delivery and operation of essential waste management services (Key Point 12).

It is considered the proposed waste-to-energy facility will form an essential part of the emerging waste management infrastructure in the North East Region and therefore accords with the principles in the most recent national waste management policy.

4.2.7 National Strategy for Biodegradable Waste Draft Report (April 2004)

This document outlines the Government policy for the diversion of biodegradable municipal waste (BMW) from landfill to meet the targets in the Landfill Directive. The policy approach builds upon the key objectives in the national policy documents “Changing Our Ways” and “Delivering Change – Preventing and Recycling Waste”. The strategy focuses upon Municipal Waste, which is mostly produced by households and commerce. Some 65% of municipal waste is biodegradable consisting of paper, cardboard, food and garden waste material.

While the Strategy promotes “higher-in-hierarchy” waste management options, thermal treatment with energy recovery is identified as an essential part of the overall policy approach because it captures the energy content of the residual waste stream. Thermal treatment is one of two broad categories, the other being Mechanical-Biological Treatment (MBT) with thermal treatment or landfill of the stabilized residue, which are required to form an effective diversion strategy.

It is estimated that 1.2 million tones of the total BMW produced will be collected as residual waste in the year 2009. Table 5.1 in the Draft Strategy Report sets a target of 27% (641,681 tonnes) of the total BMW stream for thermal treatment in 2009. Table 5.2 estimates that a target capacity of approx. 51,334 tonnes is required in the North East Region. Thus, the proposed waste-to-energy facility will provide thermal treatment capacity to meet this requirement, so it accords with the National Strategy for Biodegradable Waste.

4.2.8 Policy Guidance Circular WIR 04/05 (May 2005)

In accordance with Section 60 of the Waste Management Act, 1996 the DOEHLG published policy guidance in relation to the movement of waste. Having regard to the proximity principle and the need to develop new waste management facilities to collect, manage and treat waste in a cost-effective manner the policy recognizes the movement of waste across regional boundaries is necessary for the rational use of waste infrastructure.

Circular WIR 04/05 states that "facilities provided in a region must deal primarily with waste from that region", and the emphasis upon the waste management regions continues. However, the Circular also recognises that waste facilities can serve more than one region provided its primary function is to meet the needs of that waste region within which it is located. Here, the proposed waste-to-energy facility lies within the North East Region and it is intended to primarily serve the needs of that waste management region. In accordance with the policy in Circular WIR 04/05, it is anticipated that the facility will not be strictly restricted to waste arising within the North East Region.

4.3 Regional and Local Policy Guidance

4.3.1 Waste Management Plan for the North East Region (1999)

Meath lies within the North East Waste Management Region, which comprises Counties Cavan, Louth, Meath and Monaghan. In accordance with Section 22 of the Waste Management Act, 1996 the local authorities of the North East Region adopted a Waste Management Plan for the Region. The purpose of the Plan is to provide a framework for the management of non-hazardous wastes in the North East Region in accordance with all current national and EU waste legislation and policy. The content of the Waste Management Plan is set out in accordance with the format recommended in the Waste Management (Planning) Regulations, 1997. Waste Management Policy is articulated at Chapter 8 of the Waste Management Plan for the North East Region and embraces the policies and objectives in Changing Our Ways.

This section acknowledges the obligations set out in various EU Directives and endorses regional co-operation as favoured in Government policy at Section 8.1 as follows.

> *Government policy is also favouring regional co-operation and states that*
>
> *"Significant economy of scale is one of the main benefits accruing from this regional approach. This in turn provides a viable framework in planning and volume terms for the development of integrated and innovative waste management systems"*

Energy Recovery Facilities are addressed at Section 8.3.5, which identifies thermal treatment as an integral part of the overall solution to the management of the Region's waste (Scenario 3), which comprises elements within all tiers in the waste hierarchy.

Section 10.3 sets out specific criteria in relation to the thermal treatment for the North East Region and recommends the development of one plant with energy recovery (estimated nominal capacity of 150,000-200,000 tonnes of combustible waste per annum) to serve the Region. Section 10.3 also states that a technical assessment of thermal treatment confirms it will satisfy National Policy for diversion from landfill and will provide a cost effective treatment system in the context of the North East

Region. It is also considered that the waste-to-energy plant will greatly increase the security of the waste management system and thermal treatment with energy recovery is favoured over landfill disposal on environmental grounds.

A separate report on the Feasibility of Thermal Treatment examined the available technologies, energy usage and environmental aspects in more detail and it recommends that the procedures are put in train to ensure the provision of such a plant. This Feasibility Study lists the criteria to be considered in relation to the siting of such a facility and four possible locations within the North East Region are noted as candidates for a waste-to-energy facility. This aspect is fully addressed in the site selection section in this EIS to which you are referred.

Indaver has considerable experience in Belgium in the operation of waste-to-energy plants, utilising MSW or hazardous waste as fuel with capacities in the range 100,000 to 350,000 tonnes per annum. These facilities have proved to be economically feasible over many years with state of the art environmental controls. The proposed waste-to-energy facility will have a capacity to treat a significant proportion of the industrial and municipal non-hazardous waste (excluding construction and demolition waste) arising within the North East Region and will therefore promote the objectives of the Waste Management Plan for the Region. Energy will be recovered in the process so the proposed waste-to-energy facility will make a vital contribution towards the North East Region's energy requirements by means of a connection into the national grid.

4.3.2 Proposed Replacement North East Region Waste Management Plan (2005-2010)

The Proposed Replacement Waste Management Plan 2005- 2010 was published in September 2005. This Waste Plan identifies the current position within the Region with regard to waste management, the policy for future improvement and development, and the means to implement and monitor progress in the years to come. It restates the core objective for the Region, which is to develop a sustainable approach to managing resources by minimizing waste and managing the waste generated in a safe and environmentally sound manner.

Energy recovery is addressed at Section 1.3.3 where it notes that An Bord Pleanala has granted permission for a private sector waste-to-energy facility at Carranstown, County Meath to receive 150,000 tonnes per annum. Section 3.13.4 of the Proposed Replacement Waste Management Plan confirms the "location of a WTE Facility in the North East Region has already been approved through the planning process".

Municipal Waste Policy for the North East Region is set out at Chapter 3. Section 3.8 refers to Energy Recovery and states as follows at page 20.

Having regard to the wastes now arising in the North East Region, it is an objective of this Plan to develop a Thermal Treatment Plant with the capacity of 150,000 – 200,000 tonnes per annum. Note: a draft licence has already been obtained for the development of a facility to treat 150,000 tonnes of non-hazardous household, commercial and industrial waste.

The Proposed Plan also recognises that:

"…there should be flexibility with respect to the movement of waste across regional boundaries. In broad terms the capacity of waste facilities in the Region should satisfy the needs of the Region whilst not precluding inter-regional movement of waste and allow flexibility to cater for the development of required national infrastructure (2005-2010)."

The proposed waste-to-energy facility accords with the objectives in the Proposed Replacement Waste Management Plan and will form an essential part of an effective waste management infrastructure in the North East Region, which the Plan regards as central to the sustainable development of the Region. The proposed facility conforms to the EU principles outlined in the Plan because it will be located in close proximity to the waste producers, it will levy appropriate charges and it will employ the highest environmental standards.

The proposed waste-to-energy facility will treat waste, reducing the volume of waste arising being landfilled in the North East Region with the added benefit of energy recovery in the process and it therefore accords with the sustainable approach to managing waste generated in a safe and environmentally sound manner, which is the main objective in the Proposed Replacement Waste Management Plan for the North East Region.

4.3.3 Meath County Development Plan 2001

Applications for permission in County Meath where this site is located are considered having due regard to the policies, objectives and development controls in the Meath County Development Plan 2001. Meath's strategic location within the fastest growing region in Ireland, its proximity to the Dublin Metropolitan area and its location within the Dublin/Belfast economic corridor are cited as key factors influencing the development of County Meath. The County Plan is a framework document for the development promotion to achieve the following mission statement "to promote and implement the sustainable development of our county in partnership with local communities so as to improve the quality of life and living environment of all our citizens".

Section 2.2 of the Meath County Development Plan notes the strategic significance of Meath's location within the Greater Dublin Area. Meath is included within the Greater Dublin Area for regional planning purposes thereby confirming the strong linkages with adjoining counties. In this regard, I refer to the following extracts from the Regional Planning Guidelines for the Greater Dublin Area, which notes the increase in pressure on existing services infrastructure within the wider region and advises planning authorities in the Greater Dublin Area to;

> *Liaise and cooperate with each other and other relevant bodies to facilitate an inter-regional solution to address the critical lack of waste disposal infrastructure.*
>
> *Provide integrated waste management facilities.*

Section 8.6.3 of the Regional Guidelines emphasizes this point and states as follows.

> *While progress has been made, particularly for recycling, it is clear that the targets identified in the plans were overly ambitious and that there is a serious lack of waste management infrastructure in the GDA, both for household and commercial waste, which will become critical beyond 2008…*
>
> *…Private sector proposals to develop landfill sites in Wicklow, Kildare and Meath are likely to be developed in the medium term. Should such proposals proceed, the transferring of waste between regions could be reconsidered so as to give flexibility in dealing with waste management at a regional level. New facilities should be allowed to perform their required function in one region and also form part of the wider strategy that includes waste management in another region.*
>
> *From a strategic perspective, the waste management industry (which includes Planning Authorities and private operators) should aim to develop integrated waste management facilities infrastructure in the GDA. This infrastructure includes new landfills, waste to energy plants, biological treatment and recycling facilities. In developing this infrastructure, provision should be made to:*
>
> - *Provide for growth in the regional capacity for integrated waste management so as to mitigate the escalating costs of waste disposal.*
> - *Develop biological treatment facilities for organic waste, further recycling and waste to energy plants to serve the needs of the GDA.*
> - *Permit inter-regional transfer of waste to give appropriate economies of scale to new waste management facilities.*
> - *Consider the requirements for new infrastructure in the context of the GDA, rather than the existing waste management regions.*

Thus, the Regional Planning Guidelines acknowledge the importance of a regional wide approach and the strong functional relationship between the counties within the Greater Dublin Area, which include parts of four separate waste management regions including County Meath (which is in the North East Region). There is a clear emphasis upon the provision of integrated regional scale waste management facilities to improve cost effectiveness and reduce costs. Such regional approach is currently in place within the Greater Dublin Area. For example, strong functional relationships exist between Dublin City and County and the North East Counties for the disposal and recovery of municipal waste. Some residual waste from Dublin is disposed to landfill in the North East, while recyclable material from the North East (e.g. paper, glass and plastic) is recovered in material recycling facilities in Dublin. The Regional Planning Guidelines recommend an integrated approach to the development of new waste facilities, which is consistent with the policy guidance in Taking Stock & Moving Forward. Both the Regional Planning Guidelines and Taking Stock & Moving Forward prioritise the need for essential waste infrastructure to serve the entire region over the requirements to adhere to administrative boundaries.

It should be noted that plans are at an advanced stage to develop a waste-to-energy project at Poolbeg to serve the Dublin region. It is understood the proposed waste management facility will have a capacity in the order of 400,000 to 600,000 tonnes per annum as identified in the Dublin Waste Plan thereby providing adequate waste-to-energy capacity for waste arising within the Greater Dublin Area. It is anticipated that applications for permission and for an EPA license will be lodged in 2006.

Section 3.5.4 of the Meath County Development Plan 2001 sets out Meath County Council's solid waste policy, which emphasises the greater recovery of recyclable materials and the composting of organic waste fractions. In the longer term, it refers to the Regional Waste Management Strategy adopted by the Regional Authority, which is based upon four tenets including the development of waste handling processes including thermal treatment with energy recovery to reduce bulk and landfill requirements. Thus, the County Meath Development Plan endorses the provisions of the Waste Management Plan for the North East Region, which will be followed by the Proposed Replacement Waste Management Plan. It is already demonstrated above that the proposed facility accords with both the existing Waste Plan and the Proposed Replacement Plan from which it follows that the proposed waste-to-energy plant is compliant with the solid waste policy in the County Development Plan.

Zoning is a key land use planning consideration in every application for permission. Here, the site is located to the north of Duleek outside the nearest zoned areas at Duleek. Notwithstanding its unzoned status, the site is located within an area where there is an existing cement works and quarry, so the potential impact in planning and environmental terms can be accommodated. The site measures approx. 10 hectares, which is sufficient for the proposed facility, and the lands are currently used for agricultural purposes. While there are a small number of one-off houses in the area, the housing density is relatively low. There are no large residential areas in the vicinity of the proposed waste-to-energy facility.

The proposed development of new waste-to-energy infrastructure within County Meath can reasonably be considered to accord with the industrial development objectives and policies in the County Meath Development Plan and make a useful contribution towards the achievement of those objectives and policies.

Ease of connection to the national electricity grid is another advantage of this site. Given its R152 road frontage, site access can be provided in accordance with the Council's Roads Department requirements. This site is well served by public roads to all parts of the North East Region and adjoining waste management regions. The proposed site therefore complies with all relevant criteria for the location of a waste-to-energy facility. Site selection is considered in detail in Section 3.

Having regard to the considerations of the proper planning and sustainable development, it is considered the proposed waste management facility will promote the wider objectives in the current Meath County Development Plan. The proposed waste-to-energy facility will be a 'specialised resource', complimenting the existing infrastructure in County Meath and in the wider North East Region thereby providing a more sustainable alternative for the management of certain categories of municipal wastes that are either disposed to landfill or exported for incineration.

5 DESCRIPTION OF THE PROPOSED DEVELOPMENT

5.1 CHARACTERISTICS OF THE PROJECT

Indaver Ireland intends to apply for full planning permission for the development of a 70 MW waste-to-energy plant for the acceptance of Non Hazardous Waste on lands in the townland of Carranstown, approximately 2.5 km north east of Duleek in Co. Meath (Figure 5.1). The proposed facility will be located on an area of approximately 10 hectares (25 acres), which is currently used for agricultural purposes.

5.1.1 Description of Site Layout

The 10ha site is located at Carranstown, Duleek, Co. Meath off the R152 regional road. The site is bounded to the north, west and east by agricultural land and to the south by the R152 road.

The site is located approximately 2.5 km north east of Duleek and approximately 3km south west of Drogheda. There are approximately 40 houses within 1km of the site boundary (Figure 5.1).

Existing developments within the vicinity of the proposed facility include a cement factory and quarry located to the north of the property. A commercial freight railway is located approximately 60 metres north of the site boundary. This line is used for the transport of freight for Tara Mines, Navan and the Platin cement factory.

A 110kV power line traverses the proposed site however, due to the proposed layout of the facility and its location to the northerly end of the site, there will be no requirement for line diversion.

A natural gas pipeline runs directly under the development site. There is also a low pressure gas mains running along the R152. There will be no requirement for diversion of the gas main either.

The area of the site for development will be approximately 4 hectares, with the remaining areas of the site to be utilised for landscaping to minimise the visual impact of the proposed facility.

5.1.2 Description of Design, Size and Scale

The general site layout is illustrated on Figures 5.1, 5.2 and Drawing 1513/CD/001 attached to the planning package.

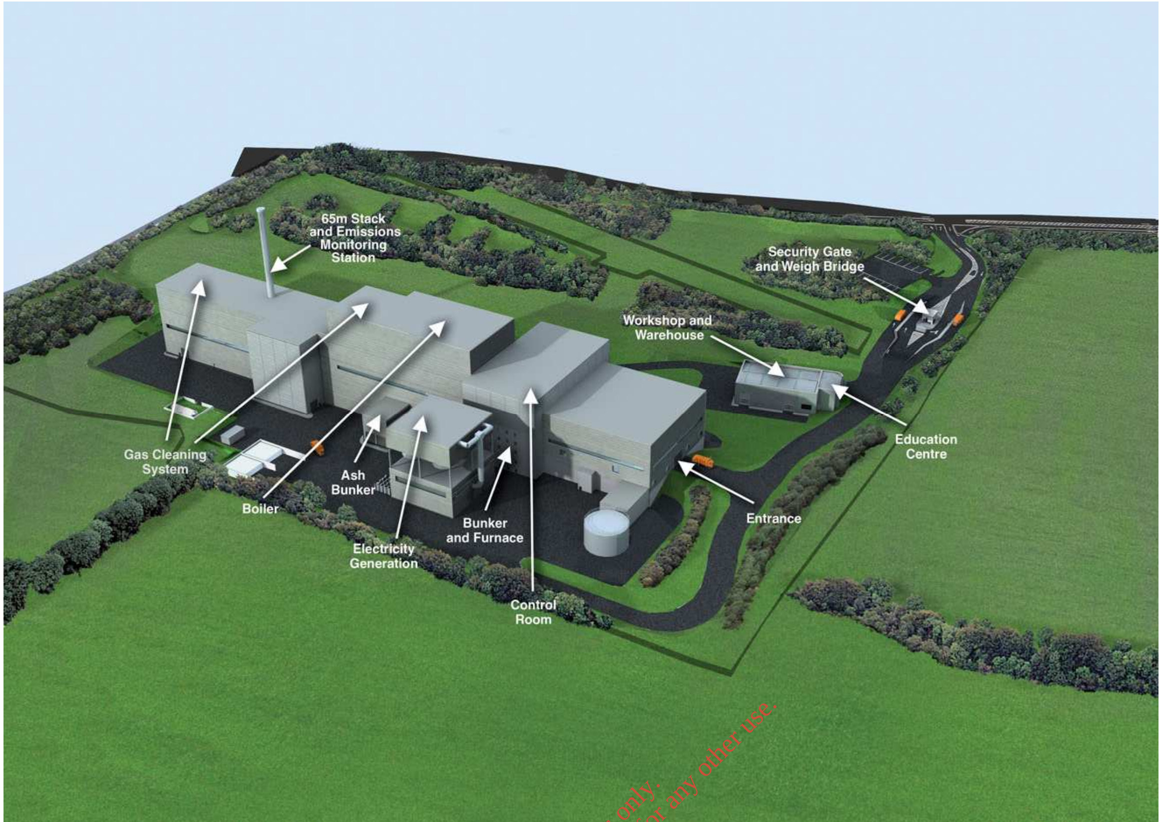


Figure 5.1 General Site Layout

The principle areas of the proposed facility are detailed below. The location and design of individual buildings as outlined in Section 5.2.3 below are presented in the engineering drawings attached to the planning package.

The proposed facility will comprise the following;

- Gatehouse and associated weighbridges
- Warehouse, workshop and education centre
- ESB substation
- Packaged domestic effluent treatment system
- Pump house and water storage
- Light fuel Storage
- Turbine Condenser building, and
- Waste reception and processing building.

The main reception/process building will house the waste reception area, waste bunker, furnace, steam boiler, evaporating spray reactor, ash bunker, baghouse filter, wet scrubber and stack. The tallest features of the development will be the stack at a level of 95.3 mOD.

As part of the company's communications programme, a waste education centre will be made available for site visitors, school tours, and the Community Liaison Committee meetings. The centre will provide information on waste management in general and on the operation of the facility specifically. Information on compliance with planning and licensing conditions, including environmental monitoring data, will be made available in this building.

The existing development site is generally flat with some minor undulations and falls by some 10m from the southeast corner to the northwestern corner of the property.

The general layout of the proposed facility is shown in Figures 5.2 and 5.3 which detail the location of proposed buildings, extent of facility development and total land holding.

5.1.3 Description of Existing Development

There is no exiting development at the proposed site.

5.2 Need for the Scheme

Under the EPA Advice Notes on Current Practice in the Preparation of Environmental Impact Statements the description of the existence of the projects defines all aspects of the proposed lifecycle of the facility under the following headings:

- Construction;
- Commissioning;
- Operation;
- Decommissioning; and
- Description of Other Developments.

Each of theses items are addressed individually in the following sections.

5.2.1 Description of Construction

Description of construction is dealt with under Section 18.

5.2.2 Description of Commissioning

The commissioning of the waste-to-energy facility will begin approximately 12 weeks prior to start up operations. The commissioning activity will involve a number of work groups certifying the various components of the facility. For the final eight weeks of commissioning approximately Indaver Ireland's operating team will join the commissioning crew and from this point continual shift works will begin (i.e. 24hrs/day; 7days/week).

5.2.3 Operation of the Project

The following sections detail the operation of the project as detailed in the EPA's Advice Notes on Current Practice in the Preparation of Environmental Impact Statements. The operation of the project is described under a number of headings including; onsite processes, staffing, natural resource requirement and emissions.

5.3 Description of Principle Process or Activities

The proposed plant is based on conventional grate incineration technology. This technology is proven and reliable and has been widely used in many countries worldwide.

The plant will consist of a 70MW furnace and a state-of-the-art flue gas cleaning system. A facility of this scale allows for a more elaborated plant design resulting in a more optimised use. A 70MW facility will allow for efficient use of raw materials and energy, and greater steam production and lower quantities of residues.

The waste is tipped into a bunker prior to being fed into the furnace. In the furnace the waste is incinerated, producing heat, ash and flue gases. The flue gases are cooled, filtered, passed through scrubbers and reheated prior to discharge via the stack. The waste liquids produced by the scrubbers are used in the cooling process and a solid waste is produced, rather than an aqueous effluent, thereby eliminating any process water discharge from the facility.

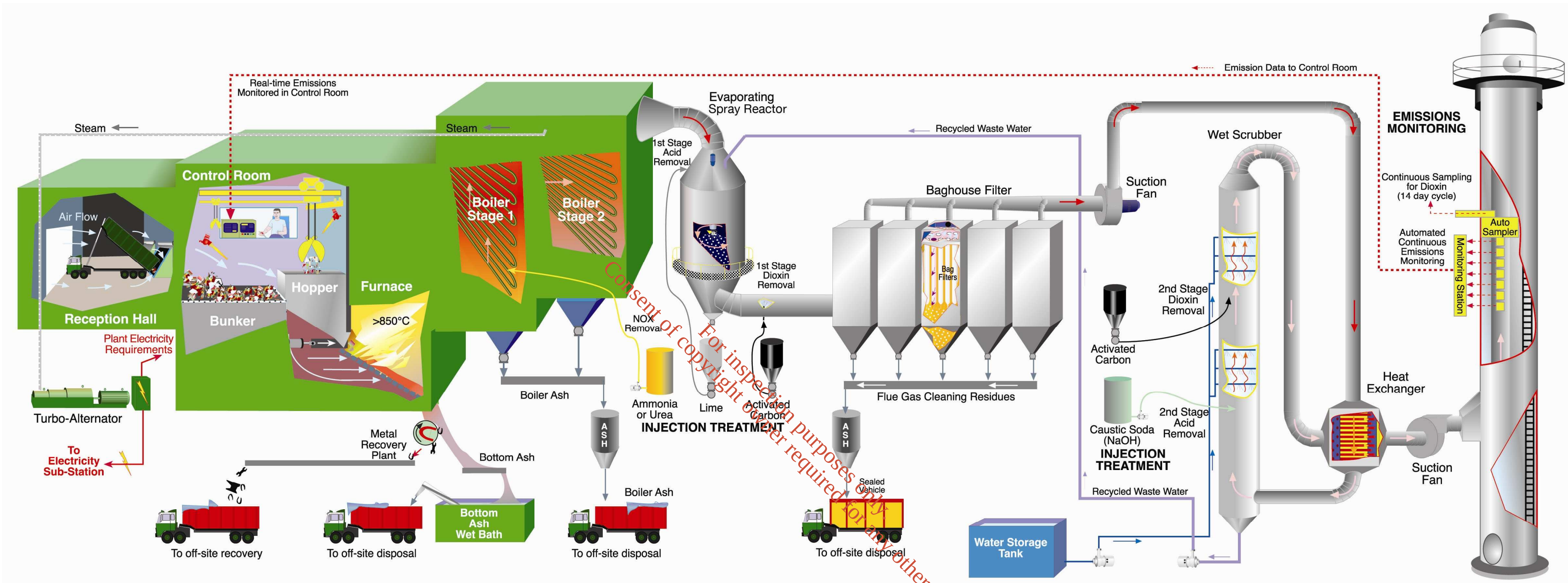
A schematic representation of the waste incineration process is shown in Figure 5.4.

The combustion of waste produces the following substances, the emission of which is regulated by the EU Directive on Waste Incineration (2000/76/EC) (see Table 5.1):

- 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 are treated.

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



Real-time Emissions Monitored in Control Room
Emission Data to Control Room
Steam
Steam
Control Room
Air Flow
Reception Hall
Bunker
Hopper
Furnace
>850°C
Boiler Stage 1
Boiler Stage 2
Plant Electricity Requirements
Turbo-Alternator
To Electricity Sub-Station
Metal Recovery Plant
Bottom Ash
Bottom Ash Wet Bath
Boiler Ash
Boiler Ash
To off-site recovery
To off-site disposal
To off-site disposal
To off-site disposal
Evaporating Spray Reactor
1st Stage Acid Removal
1st Stage Dioxin Removal
NOX Removal
Ammonia or Urea
Lime
Activated Carbon
INJECTION TREATMENT
Recycled Waste Water
Baghouse Filter
Bag Filters
Flue Gas Cleaning Residues
Sealed Vehicle
ASH
ASH
Suction Fan
Wet Scrubber
2nd Stage Dioxin Removal
Activated Carbon
Caustic Soda (NaOH)
2nd Stage Acid Removal
INJECTION TREATMENT
Recycled Waste Water
Water Storage Tank
Heat Exchanger
Suction Fan
EMISSIONS MONITORING
Continuous Sampling for Dioxin (14 day cycle)
Automated Continuous Emissions Monitoring
Auto Sampler
Monitoring Station

Table 5.1 Air Emission Limit Values (Directive 2000/76/EC)

Daily Average Values	Concentration	
Total Dust	10 mg/m^3	
Gaseous & vaporous organic substances expressed as total organic carbon (TOC)	10 mg/m^3	
Hydrogen Chloride (HCl)	10 mg/m^3	
Hydrogen Fluoride (HF)	1 mg/m^3	
Sulphur Dioxide (SO_2)	50 mg/m^3	
Nitrogen Oxides (as NO_2)$^{(1)}$	200 mg/m^3	
Half-hourly Average Values	**Concentration**	
	(100%)	**(97%)**
Total Dust$^{(2)}$	30 mg/m^3	10 mg/m^3
Gaseous & vaporous organic substances expressed as total organic carbon (TOC)	20 mg/m^3	10 mg/m^3
Hydrogen Chloride (HCl)	60 mg/m^3	10 mg/m^3
Hydrogen Fluoride (HF)	4 mg/m^3	2 mg/m^3
Sulphur Dioxide (SO_2)	200 mg/m^3	50 mg/m^3
Nitrogen Oxides (as NO_2)	400 mg/m$^{3(1)}$	200 mg/m^3
Average Value Over 30 mins to 8 Hours	**Concentration$^{(3)}$**	
Cadmium and its compounds, expressed as Cd	Total 0.05 mg/m^3	
Thallium and its compounds, expressed as Tl		
Mercury and its compounds, expressed as Hg	0.05 mg/m^3	
Antimony and its compounds, expressed as Sb	Total 0.5 mg/m^3	
Arsenic and its compounds, expressed as As		
Lead and its compounds, expressed as Pb		
Chromium and its compounds, expressed as Cr		
Cobalt and its compounds, expressed as Co		
Copper and its compounds, expressed as Cu		
Manganese and its compounds, expressed as Mn		
Nickel and its compounds, expressed as Ni		
Vanadium and its compounds, expressed as V		
Average Values Over 6 – 8 Hours	**Concentration**	
Dioxins and furans	0.1 ng/m^3	
Average Value	**Concentration$^{(4)}$**	
	Daily Average Value	**30 Min Average Value**
Carbon Monoxide	50 mg/m^3	100 mg/m^3

(1) Until 1/1/2007 the emission limit value for NO_x does not apply to plants only incinerating hazardous waste

(2) Total dust emission may not exceed 150 mg/m^3 as a half-hourly average under any circumstances

(3) These values cover also the gaseous and vapour forms of the relevant heavy metals as well as their compounds

(4) Exemptions may be authorised for incineration plants using fluidised bed technology, provided that emission limit values do not exceed 100 mg/m^3 as an hourly average value.

5.4 Scope of the Project

The waste-to-energy plant will consist of a 70MW moving grate furnace with state-of-the-art flue gas cleaning system. Assuming operating hours are fixed at 7,500 hrs per annum and the average calorific value of non-hazardous waste is 11 MJ/kg, the 'Name Plate' capacity of the plant is 170,000 tonnes of waste per annum. However, from experience of operating a similar facility in Flanders, Belgium, the average calorific value of non-hazardous waste in the bunker at any given time ranges from 6 – 16 MJ/Kg.

Table 5.2 outlines minimum and maximum operating conditions, in terms of hours of operation, waste calorific value and annual capacity, for a 70MW waste-to-energy facility. If hours of operation are fixed at 7,500 hours a calorific value greater than 11MJ/Kg will result in a lower annual capacity e.g. at a calorific value of 12.5MJ/Kg, the facility will operate at 150,000 tonnes per annum. Similarly, a calorific value less than 11MJ/Kg will result in greater annual capacity e.g. at a calorific value of 10MJ/Kg, facility will operate at 187,000 tonnes per annum.

If hours of operation are fixed at 8,000 hours, an average calorific value of 12MJ/Kg would allow the facility operate at 166,000 tonnes per annum, whereas an average calorific value of 10MJ/Kg would allow the facility operate at 199,000 tonnes per annum.

Should the annual capacity of the facility be limited to the 'Name Plate' capacity of 170,000 tonnes per annum, depending on the average calorific value of the waste, the facility could reach maximum capacity in less than 12 months. Similarly, hours of operation must be flexible to accommodate the fluctuating calorific value of the waste.

The facility can operate at 60 - 100% of its nominal capacity. The plant can operate within a range of 22.7 tonnes per hour (170,000 tonnes per annum) and 13.6 tonnes per hour (102,000 tonnes per annum, 60% of its nominal capacity), based on the assumption that the average calorific value of the incoming waste is 11MJ/Kg.

Table 5.2. Operating conditions for the 70MW Moving Grate Furnace.

		Availability (% or hours per year)							
		85.6%	**86.8%**	**87.9%**	**89.0%**	**90.2%**	**91.3%**	**92.5%**	**93.6%**
		7500	**7600**	**7700**	**7800**	**7900**	**8000**	**8100**	**8200**
Lower heating value (MJ/kg)	**8**	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000
	8.5	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000
	9	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000
	9.35	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000
	9.5	197,000	199,000	200,000	200,000	200,000	200,000	200,000	200,000
	10	187,000	189,000	192,000	194,000	197,000	199,000	200,000	200,000
	10.5	178,000	180,000	183,000	185,000	188,000	190,000	192,000	195,000
	11	170,000	172,000	175,000	177,000	179,000	181,000	184,000	186,000
	11.5	163,000	165,000	167,000	169,000	171,000	173,000	176,000	178,000
	12	156,000	158,000	160,000	162,000	164,000	166,000	168,000	170,000
	12.5	150,000	152,000	154,000	156,000	158,000	160,000	162,000	164,000
	13	144,000	146,000	148,000	150,000	152,000	153,000	155,000	157,000
	13.5	139,000	140,000	142,000	144,000	146,000	148,000	150,000	151,000
	14	134,000	135,000	137,000	139,000	141,000	142,000	144,000	146,000

As it is not possible to predict the average calorific value of residual waste in the bunker, the capacity of the facility must be flexibility to allow the plant operate at optimal conditions. Based on experience of operating a similar facility in Flanders, the optimal operating conditions for the plant lie within the following range:

- Calorific value of 12.5MW/Kg; Operating hours of 7,500hrs; Capacity of 150,000 tonnes per annum;
- Calorific value of 10MW/Kg; Operating hours of 8,000hrs Capacity of 199,000 tonnes per annum

As the thermal capacity of the plant will be limited to 70MW, the maximum capacity of the plant will be 200,000 tonnes per annum. The facility will not be capable of operating in excess of 200,000 tonnes per annum. This is in line with proposed replacement NE Waste Management Plan.

5.5 General Operation

The proposed facility will accept waste between 0800 and 1830 Monday to Friday and between 0800 and 1400 on Saturdays. The waste-to-energy plant will operate 24 hours a day for, on average, 7,500 hours/annum, depending on the average calorific value of the waste, as a greater quantity of low calorific waste would required to maintain the temperature of the furnace at a minimum of 850°C. Under such circumstances the facility may reach its maximum annual capacity in less than 12 months. The capacity of the waste bunker will allow the acceptance of waste during shut downs up to 1 week. From experience of operating similar plants in Belgium, non-scheduled events typically require a maximum shutdown of one-week.

A scheduled shutdown for maintenance takes place once a year. Such a shutdown is typically longer than 1 week, but less than 3 weeks. As these shutdowns are scheduled it is possible to organise an alternative outlet for the waste to be accepted. Alternatives would be another waste incinerator or a landfill facility, depending on their availability at the time.

The waste-to-energy plant will burn non hazardous household, commercial, industrial and other suitable waste which is currently being disposed of to landfill, thus avoiding the production of landfill gas and leachate. In doing so it will produce energy in the form of electricity, of which, that produced from the biodegradable waste fraction will be renewable energy, thereby contributing to a reduction in the consumption of fossil fuels and hence the reduction of CO_2 emissions. The incineration process will produce a mainly inert bottom ash, much of which will be suitable for use as fill for road construction or for daily cover of landfill sites. A small quantity of hazardous waste will be produced, primarily as a result of the flue gas cleaning process (see Section 5.7.2). This will be disposed of to hazardous waste landfill, either in Ireland if one is available or abroad.

5.6 Processes

The waste-to-energy plant will consist of a number of main processes and items of plant as follows:

- Waste Reception
- Moving Grate Incinerator
- NOx - Urea/Ammonia Solution Injection
- Waste Heat Boiler
- Turbine
- Evaporating Spray Reactor
- Activated carbon or lignite coke & Baghouse Filter
- Wet Scrubber
- Ash Handling
- Emissions Monitoring Station

A simplified schematic of the overall incineration process flow is shown in Figure 5.3.

The grate furnace is the predominant technology used for incineration of municipal waste with 450-500 plants in operation in Europe. This is a longstanding technology with which considerable advances have been made in recent years, particularly with regard to emissions control and flue gas cleaning. The design of the proposed plant has been optimised to include the latest technology to control emissions and to minimise environmental impacts.

Indaver currently operates a 350,000 tonnes per annum waste-to-energy plant in Beveren, Flanders based on the same technology. This facility has three incineration lines, one of which has a thermal capacity of approximately 70MW and is similar to that proposed for this planning application.

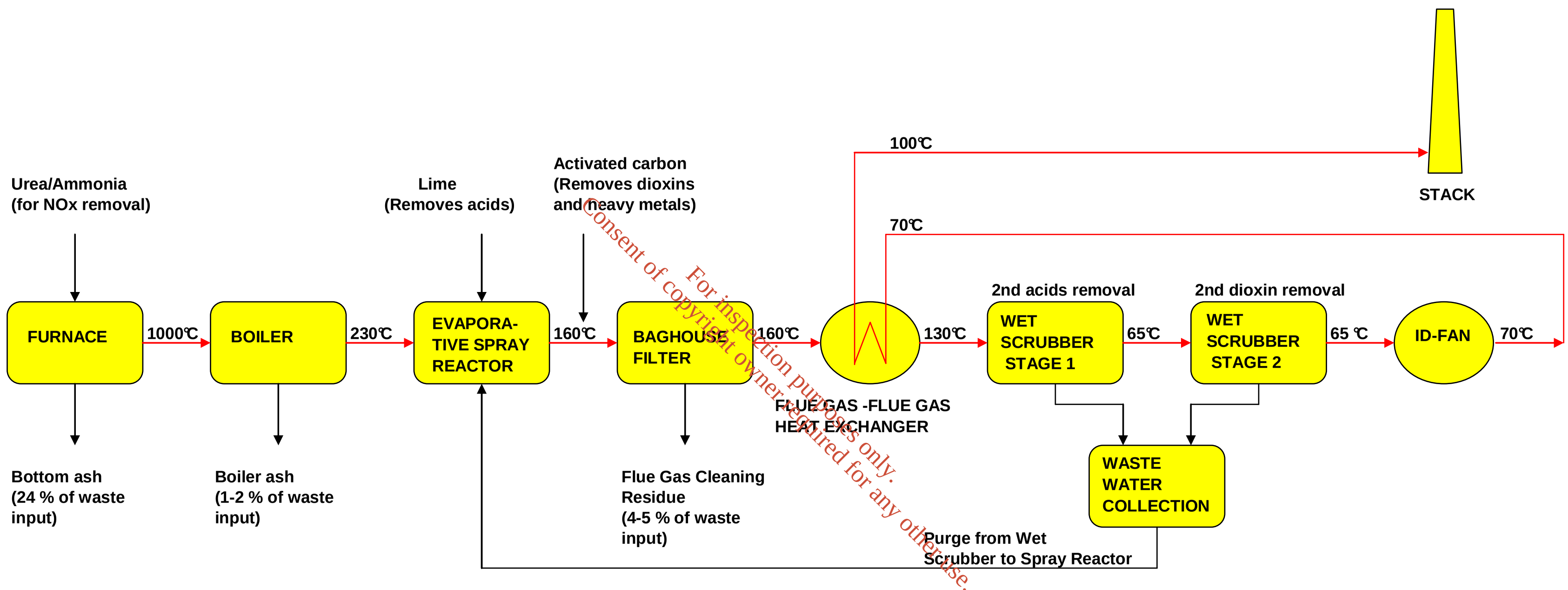


Figure 5.3 Schematic Diagram of the Incineration Process

5.6.1 Waste Reception

It will be a requirement that all waste delivery trucks arriving at the facility will be covered to prevent litter. "Litter patrols" will also be operated within the facility, around the site and on local approach roads.

Waste trucks containing residual waste check in at a security gate and pass over a weighbridge before driving into the waste acceptance hall. The majority of residual waste (e.g. waste containing putrescible material or a high proportion of water) will be discharged directly into the bunker. Any bulky residual waste will be shredded in a shredder located in the acceptance hall before being discharged to the bunker. The waste acceptance area and discharge chutes of a similar plant in Belgium are shown in Figure 5.4.

Figure 5.4 Waste Acceptance Hall of Similar Plant in Belgium

Frequent spot checks will be carried out on waste trucks arriving to the reception hall. Trucks to be checked will tip their waste onto the reception hall floor to allow visual inspection of their contents prior to transfer to the bunker.

To prevent the egress of odours from the waste acceptance hall it is maintained under negative pressure, (i.e. air will be drawn in through any opening rather than escaping out). This is affected by drawing some of the air for combustion from the waste bunker. The fact that the waste is stored in a contained area and under negative pressure ensures that there will be no windblown waste or odours emanating from the facility.

The bunker is sized at 16,000 m^3, which is sufficient to allow the plant to accept waste during periods of shut down, such as one-week scheduled shutdown for maintenance, and to continue operating over prolonged periods (e.g. long weekends) without deliveries. This waste storage area will be chemically and mechanically resistant to the waste. It will be impermeable and prevent odours.

Operators located in the control room over looking the bunker will screen the waste and remove any material unsuitable for incineration. Using travelling grab cranes positioned over the bunker the waste will be blended in the bunker pit, so that despite the variety within the waste loads delivered, the feed to the furnace will be relatively uniform. The grab cranes are also used for feeding the blended waste material to the furnace via a hopper at the highest point of the furnace. The feeding hopper and feeding ram provide the seal between the high temperature furnace and the bunker.

Figure 5.5 A) Grab in Bunker

Figure 5.5 B) Control Room

The discharge, mixing and feeding of waste into the hopper 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.

To prevent the egress of odours from the waste acceptance hall it is maintained under negative pressure (i.e. air will be drawn in to the building through any opening rather than escaping out). This air is drawn through the waste bunker and used in the combustion process. The fact that the waste is stored in a contained area and under negative pressure ensures that there will be no windblown waste or odours emanating from the facility.

When the incinerator is in shut down the combustion air fan will be kept on-line for as long as possible to maintain the bunker under negative pressure. Any odours will then be discharged via the 65m stack. During these brief periods the waste in the bunker will be sprayed with odour suppressing chemicals to minimise odours. Refer to Section 6 for more information on an Odour Management Plan.

The design of the bunker and waste acceptance and handling criteria proposed is considered BAT.

5.6.2 Moving Grate Incinerator

Process Description

A moving grate furnace has been proposed for the facility. It operates in a similar fashion to an escalator, pushing waste from the top of the furnace to the bottom to ensure complete combustion. An excess quantity of air will be drawn in through the furnace to ensure sufficient cooling of grate bars. The chosen technology is considered BAT.

The waste will be moved forward from the hopper into the furnace using a ram mechanism (see Appendix 5.1 for details on furnace start up and shut down procedures). The volume of waste will be controlled by adjusting the stroke and the frequency of 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 at the top of the furnace to the ash discharge at the bottom of the furnace. 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.

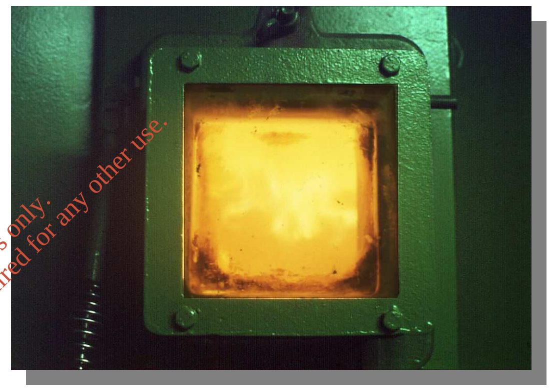


Figure 5.6 Furnace Window

As the waste enters the hot furnace the material will be heated due to contact with the hot flue gases and radiated heat from the walls of the incinerator. The initial heat (temperature range of 50 to 100^{o}C), will drive off the moisture from the waste. Figure 5.7 below gives a schematic representation of the Moving Grate furnace.

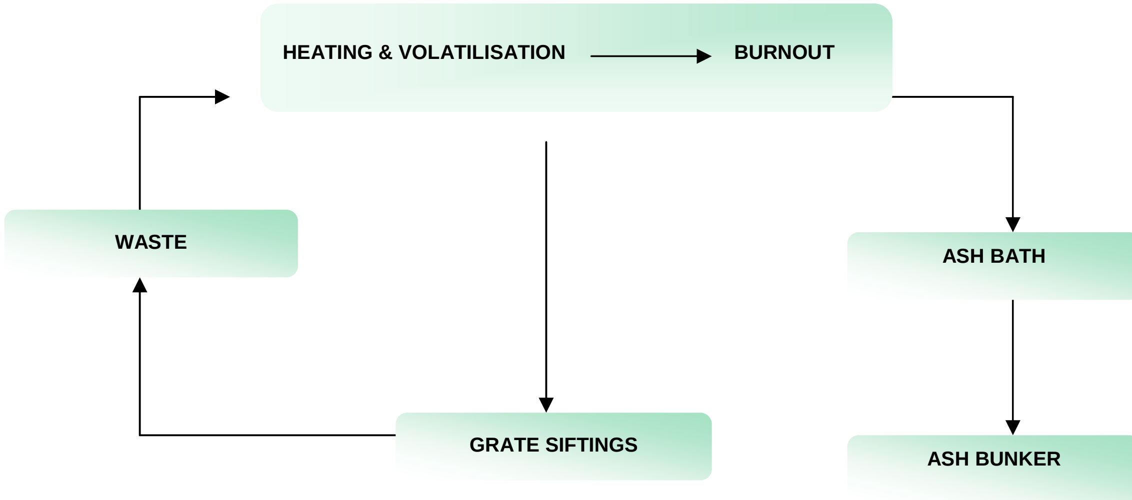


Figure 5.7 Moving Grate Incinerator Process Flow

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 within the temperature range of 200 to 750°C. The volatile components of the organic material of MSW typically account for 70 to 90% of the flue gases, and are produced in the form of hydrogen, carbon monoxide, methane and ethane. The combustion of these 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 temperature of the furnace gas, which is within the range 850 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 ash will be held for long enough to ensure sufficient burnout.

The grate will discharge the resultant bottom ash into a water bath, and then via a conveyor to an ash bunker. Refer to Sections 5.7.2 and 5.10, for further information on ash handling. Ferrous metals will be removed from the bottom ash and sent for recycling.

Finer ash to that of the bottom ash will fall through the slits and gaps between the grate bars of the furnace into hoppers located under the grate. This finer ash, known as ‘grate siftings’, is transferred from the hoppers bank to the waste bunker by conveyor belt. As these siftings are from all areas of the furnace, including areas where waste may not have been burned at a minimum of 850C, they are not of the same burnout quality as bottom ash and therefore require separate handling and secondary treatment in the furnace.

Process Control of the Moving Grate Furnace

There will be a number of control parameters monitored to optimise the conditions in the furnace as follows:

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

The addition of combustion air to the furnace will be controlled to ensure optimum operating conditions. 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 the combustion process, to safeguard a minimum 6 % vol. excess oxygen and to provide mixing of the flue gases. These conditions will ensure complete combustion of the volatile gases. The induced air movement through the furnace will prevent the possibility of "fire-back" into the hopper. Air will also be used as a cooling source for the grate itself.

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. Light fuel oil will be used to bring the furnace up to the specified temperature of 850°C prior to start up of the waste feed.

The furnace temperature will be continuously monitored and controlled to ensure that this minimum temperature is maintained and supplementary firing with natural gas or light fuel oil can be used if necessary.

The levels of O_2 and CO and the temperature in the flue gases will be monitored and the combustion air input optimised to ensure efficient and effective combustion.

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

Emissions

There will be no emissions to atmosphere from the Moving Grate Furnace.

Inputs and Outputs

The main inputs into the furnace will be waste and combustion air. On start up the furnace will use light fuel oil to heat up to the operating temperature.

The outputs from the furnaces will be bottom ash, grate siftings and flue gases. Refer to Sections 5.7.2 and 5.10 for details of bottom ash production. The grate siftings are returned to the waste bunker.

The technology chosen and the operational conditions proposed are considered BAT for the treatment of non-hazardous waste.

5.6.3 NO_x - Urea/Ammonia Solution Injection

Process Description

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. NO_x formation will be controlled in two ways. Optimal combustion conditions in the furnace will minimise the oxidation of nitrogen in the combustion air. Mixing of the waste will also prevent localised high temperatures (and therefore higher NO_x levels) in the furnace and cladding materials with suitable heat transfer properties will be used to give an optimal flue gas temperature. Secondly, in order to meet the strict NO_x emission values set by the EU waste incineration directive, 'De NO_x' 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, if used, will break down to form ammonia due to the temperature (approximately 900°C). 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 values will be well within the EU NO_x emission limits.

This technology of ammonia solution/urea injection is known as Selective Non Catalytic Reduction (SNCR). SNCR is a proven technology and experience has shown that it will attain the daily NO_x emission limit of 200 mg/Nm^3. Typical NO_x emissions from the proposed facility will be well below this EU emission limit. The impact of the NO_x emissions is addressed in Section 7.

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 and flue gas flow 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 flue gases and ammonia solution or urea. The output will be cleaned flue gases and nitrogen.

The technology proposed is considered BAT for the removal of NO_x from the flue gases.

5.6.4 Waste Heat Boiler

Process Description

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 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 steam boiler will operate to 40 bar and 400℃, the maximum steam parameters technically possible for electricity generation from waste incineration, as anything greater than this will result in excessive corrosion of the boiler and reduced efficiency.

The boiler outlet temperature for the proposed development will be a minimum of 230℃ and is considered BAT. Such a temperature is required for the evaporation of excess water from the process and the prevention of liquid effluent. Temperatures lower than 230℃ would impact on the evaporation process and result in the generation of effluent from the facility.

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 tube bundles in this section of the boiler as the fly ash will be sticky at temperatures above 650ºC, 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.

The flue gases will then pass through three further stages containing heat exchangers (refer to Figure 5.8:

- Evaporator – The evaporator will evaporate the boiler water to form wet steam at 45 bar gauge, 260°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 feed water to about 220°C, in order to avoid boiler corrosion by condensed acids.

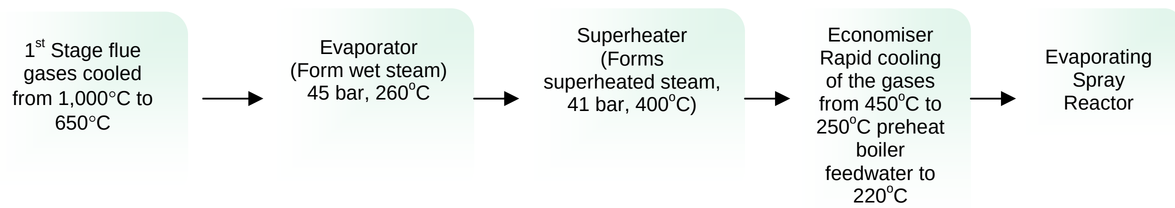


Figure 5.8 Boiler Process Flow Diagram

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 boiler. This is somewhat lower than with a power plant for following reasons:

- The flue gases from the incineration process contain corrosive elements, which would attack the boiler components if steam were to be recovered over a wider temperature range, either at higher temperatures or at lower temperatures.
- The waste incinerator does not produce any effluent. The water from the plant is evaporated before the flue gas cleaning. The outlet temperature of the flue gases from the boiler must be high to allow cooling by water evaporation. This is an environmental asset.
- The waste incinerator does not use cooling water from a river or canal. There is thus no requirement to heat such water. Air is used for the cooling process. This means a lower performance of the turbine due to a higher outlet temperature.
- The facility is less efficient due to fouling of the boiler surfaces and thus lower heat transfer. Therefore, most of the time the flue gas temperature at the outlet will be higher because of less heat transfer due to fouling.
- Waste regulation imposes a minimum of 6 % vol excess oxygen for waste incineration. As a result there is a higher amount of unused air passing through the stack and hence greater heat losses compared to that of a power plant for instance, where excess oxygen is typically 1 to 3 % vol

De Novo-synthesis has the potential to occur over the temperature range 450°C to 250°C during cooling in the latter stages of the boiler, resulting in the reformation of dioxins. In order to minimise the formation of dioxins the following design measures will be implemented:

- Regular cleaning of heat transfer surfaces to reduce the amount of metals, particularly copper present, which can act as a catalyst in the formation of dioxins.
- Rapid cooling over the range 450^{o}C to 250^{o}C by increasing the velocity of the flue gases through the section of the boiler where cooling over 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.

As with all boiler plants it is necessary to treat the feed water to the boiler to a high level of purity. A demineralisation plant is provided for this purpose to meet a demineralised water demand of the order of 25 m^3/day. An equivalent volume of water is then purged from the boiler to prevent the build up of salts in the steam circuit. This purge is often referred to as boiler blow down. This blow down is then used in the flue gas cleaning process. Small quantities of boiler treatment chemicals are added to the boiler feed- water to prevent corrosion and scale build up in the steam circuit. Such a system is considered BAT.

Process Control for the Boiler

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.

Emissions from the Boiler and Condenser

A small quantity of water will be purged constantly from the system and replaced with fresh make up water. This blow down will be recycled for use in the evaporating spray reactor.

There will be no other emissions from the boiler and condenser.

Inputs and Outputs

The inputs into the boiler will be hot flue gases and cold boiler feed water and the outputs will be cooler flue gases, boiler ash and superheated steam. Refer to Section 5.7.2 for details of the boiler ash. 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.

The technology chosen and the operational conditions proposed are considered BAT for the recovery of energy from waste.

5.6.5 Steam Turbine

Process Description

In the proposed plant, the steam from the boiler will be expanded in a single steam turbine down to a pressure of 0.15 bar absolute (see Figure 5.9). This low pressure maximises the energy recovery from the turbine, which is used to drive the generator set and give an electrical output of approximately 16 MW. As approximately 3 MW is required for electrical demand within the plant, the net electrical output will be approximately 13MW.

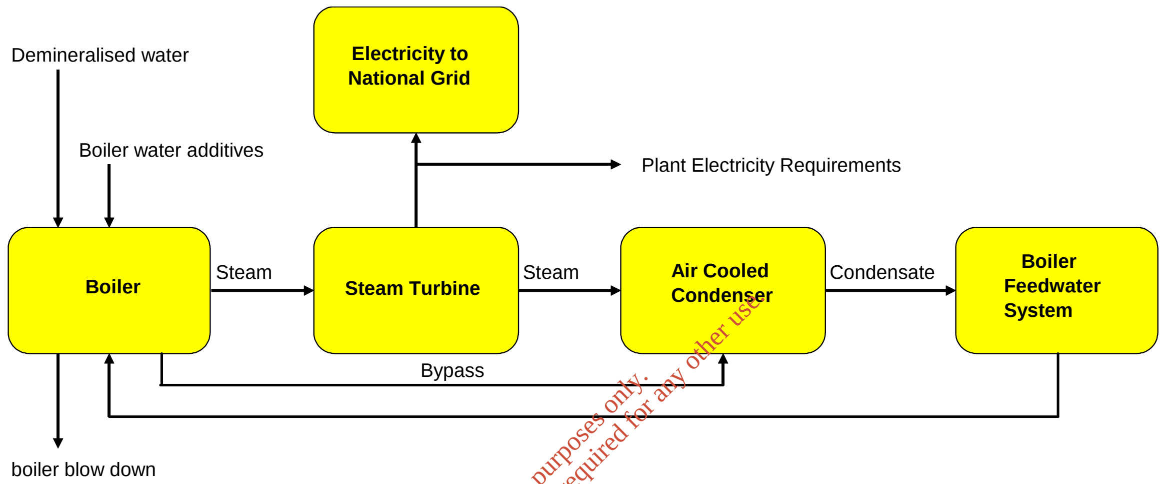


Figure 5.9 Steam Turbine Process Flow Diagram

The wet steam (about 10 % is condensed in the turbine) from the turbine will exit at a temperature of approximately 50°C and will be further 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. An air-cooled condenser is proposed as this will reduce the water requirement of the plant (no cooling water requirement) and is in keeping with an effluent free plant.

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 feed water tank for reuse in the boilers.

The electrical generator (discussed in section 5.6.6) will be cooled using a smaller air cooler, with oil as the heat transfer fluid.

Process Control for the Steam Turbine

The turbine will accept the steam coming from the boiler control by changing its rotation speed. The turbine hence 'follows' the steam production from the boiler.

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 Turbine

There are no emissions from the Turbine.

Inputs and Outputs

The inputs into the turbine will be superheated steam and the outputs will be lower grade steam taps for application in the process, low pressure steam which will go to the condenser and electricity for plant consumption and export to the national high tension grid.

The technology chosen and the operational conditions proposed are considered BAT for the generation of electricity from waste.

5.6.6 Emergency Generator

Process Description

As described elsewhere, the proposed facility will have a sophisticated control system and back-up system for protection against events which could have the potential to damage the plant, human health or the environment. In the event of a power cut or 'black-out' the facility will automatically shutdown. During automatic shutdown waste will be prevented from entering the furnace and most electrical /electronic equipment, motors and fans will cease operating except those required to cool the plant and provide emergency lighting. In the event of a black out, however, such motors and fans will require an emergency power supply. This will be provided with a backup or emergency electrical generator powered by a diesel motor.

The backup generator will be tested weekly for approximately 20 minutes but only used during automatic shutdowns or a black-out. During such events the estimated power requirement would be approximately 600 kW. This requirement can be met using a 1800 kW diesel motor. Such a motor will consume 200 l/hr of light fuel oil (diesel).

Process Control of the emergency power supply

Detection of a power supply failure to critical motors and fans will activate the automatic shutdown system and the emergency power generator simultaneously. The automatic shutdown system will then restart the critical motors and fans using the emergency generator. The emergency generator is controlled manually.

Inputs and Outputs

Input would be 200 l/hr of light fuel oil during an emergency event and weekly tests (20 minutes). Output would be flue gases.

5.6.7 Evaporating Spray Reactor (1st Stage Acid Removal System)

Process Description

The flue gas leaving the boiler will still be relatively hot at approximately 230°C and will be further cooled in the evaporating spray reactor to a temperature of about 160°C. The evaporating spray reactor will serve the triple function of

- cooling the flue gases, prior to the activated carbon or lignite coke injection
- neutralising acids with lime
- evaporating all process waters from the plant.

The evaporating spray reactor will be essentially a large, empty vessel. Water will be sprayed at the flue gases as they pass through the reactor. Lime will be injected in the reactor either as a lime suspension ('semi-wet' scrubbing) or as powder ('semi-dry' scrubbing). 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 evaporating spray reactor. The balance of the water requirement will be made up from well water. By using these process waters, the plant's consumption of potable water will be minimised and there will be no liquid process effluent to be disposed of off-site. The flue gases will enter the top (or bottom) of the reactor by forced draft and will travel downwards (or upwards), through the water/lime spray. The salts contained in the water will be dried by evaporation in the spray reactor and collected in the baghouse filter as solid wastes for off site disposal (refer to Section 5.12.4).

Process Control for the Evaporating Spray Reactor

The temperature of the flue gases leaving the evaporating spray reactor will be monitored and maintained at the required temperature of about 160°C by controlling the rate at which the water is sprayed. The rate of lime injection will be dependent on the acid concentration in the flue gases measured after the baghouse filter.

The technology chosen is considered BAT for the removal of acids from the flue gases.

Emissions from the Evaporating Spray Reactor

There will be no emissions from the evaporating spray reactor.

Inputs and Outputs

The inputs and outputs from the evaporating spray reactor will be flue gases, lime and water. The quantity of solid residues collected at the bottom of the spray reactor will be negligible.

5.6.8 Activated Carbon/Lignite Coke Injection & Baghouse Filter (1st Stage Dioxin Removal System)

Process Description

Dioxins and furans are complex chlorinated hydrocarbon molecules, which are formed as a consequence of any combustion process. As described previously the plant is designed to minimise the formation of dioxins, by maintaining the flue gases at a high temperature (over 850^{o}C) for over 2 seconds in the furnace and by rapidly cooling the gases from 450^{o}C to 250^{o}C. These measures reduce the dioxin concentration in the flue gases to a low level. The flue gas cleaning process provides for a two-stage dioxin removal process to reduce dioxin concentrations in the flue gas to levels well below the limit set in the Waste Incineration Directive (typical emissions from such a facility would be 0.01ng TEQ/m^3 (0.000,000,001 g TEQ/m^3)). Adding activated carbon, or lignite cokes, is the first step of this two-stage process.

A fixed amount of activated carbon or lignite coke will be injected into the flue gas as it is leaving the evaporating spray reactor. 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 heavy metals and trace levels of organics present in the flue gas, such as dioxins, furans, PAHs and hydrocarbons. These carbon granules and other particulates, such as dust, will then be removed by filtration as the flue gases pass through the baghouse filter.

The baghouse filter contains multiple filter bags in separate compartments. The separate compartmentsallow for maintenance and changing of filter bags whilst the filter is on-line. The dust laden flue gases are sucked from the outside (foul side) to the inside (clean side) of the filter bags leaving a dust cake on the outside of the bags. The pressure drop over the bags increases as more dust gets accumulated. A reverse pulse of clean compressed air will be blown inside the bag as soon as a preset pressure drop set-point is reached. The airwave will inflate the bag and make the carbon and particulates at the outside crack and fall into collection hoppers below.

The particulates will consist primarily of:

- fly ash carried over from the boiler
- dry residues from the evaporation of the purge of the wet scrubber
- activated carbon or lignite cokes
- un-reacted lime
- salts from reaction of lime with acids from the flue gas

Figure 5.10 Typical Baghouse Filters

Process Control

The activated carbon or lignite coke will be injected at a fixed rate controlled by a volumetric dosing screw. This fixed rate will be based on operating experience of the company's incineration plants in Belgium. The rate of dosing will allow for the maximum reduction in emissions.

The weight of the activated carbon or lignite coke feed bin will be monitored continuously to ensure that dosing is continual. Should the weight of the feed bin remain steady, which would indicate that the feed to the process has stopped, an alarm will be activated in the process control room.

The pressure drop over the bags will be monitored continuously. The removal of carbon and particulates from the bags will be controlled on defined pressure set-points.

Emissions

Activated carbon will be stored in a silo fitted with a HEPA filter. Residues will be transferred from the baghouse filter to an enclosed silo fitted with a HEPA filter by an enclosed conveyor with the process building. Both handling systems will prevent dust /carbon emissions to the atmosphere from the activated carbon/lignite coke injection or baghouse filter stages. Therefore the only emission will be filtered air and such emissions will only occur when the silos are being filled.

Inputs and Outputs

The inputs and outputs from this stage of the process will be the activated carbon/lignite coke, flue gases and flue gas cleaning residues.

The technology chosen is considered BAT for the removal of dust, dioxin and heavy metals from the flue gases.

5.6.9 Wet Scrubber (2nd Stage Acid & Dioxin Removal System)

Process Description

The wet scrubber will remove SO_2, HF and HCl, which are formed if sulphur, fluorine and chlorine are present in the incoming waste stream.

The use of the wet scrubber cools the flue gases and saturates the gas with water. The wet scrubber uses a sodium based (Sodium Hydroxide) neutralisation agent to remove acidic compounds and traces of heavy metals. It will also remove ammonia used in the SNCR de-NO_x system. The solution strength is continuously monitored and replenished to ensure the effectiveness of the chemical based gas cleaning. A predetermined purge of the solution is maintained to prevent the concentration of reaction salts rising. The wastewater purge is then recycled back to the evaporating spray reactor.

Recovery of gypsum from the flue gas cleaning residue is possible, however, it has not been considered because the quantity available for recycling would be very small. Such a small quantity of gypsum would be subject to the same quality controls as a large quantity and hence not feasible to produce. Therefore, the reuse of gypsum from a waste incinerator is not feasible as markets can be difficult to find for such small quantities.

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 further reduce emissions. As a result of this two-stage removal system, dioxin emissions will be well below the new EU limit.

As described previously, the first step of the removal system involves the injection of activated carbon or lignite cokes into the combustion gas duct, directly before the baghouse filter.

The second step of the removal system will take place in the wet scrubber by bringing the flue gases into vigorous contact with activated carbon/lignite coke. This activated carbon/lignite coke will either be in the form of a fixed bed in the scrubber or an activated carbon/lignite coke slurry circulated in the scrubber.

The technology chosen is considered BAT for the second stage removal of acids and trace quantities of dust, dioxins and heavy metals.

Process Controls

The water demand will be supplied by adding water to keep a constant level in the scrubber sump.

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 sodium hydroxide will be controlled by the pH measurement.

The scrubber will be equipped with a flow detector on the water circulation system and will be provided with a back-up circulating pump.

The activated carbon or lignite coke will be added as a continuous fixed flow (slurry circulation) or as a replacement during shut down (fixed bed).

Emissions

The purge from the scrubber will be recycled back into the process for use in the evaporating spray reactor. There will be no emissions from the scrubber.

Inputs and Outputs

The main input into the wet scrubber will be sodium hydroxide, activated carbon or lignite cokes and water.

The main output will be the controlled purge flow to the evaporating spray reactor and flue gases.

5.6.10 Plume Abatement and Discharge

Process Description

An induced draught fan keeps the flue gas system under pressure up to the wet scrubber.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. Therefore, to prevent such a visible plume, the flue gas will be reheated prior to discharge, via a flue gas heat exchanger. The hot flue gases between the baghouse filter and the wet scrubber will be cooled by reheating the cold flue gases leaving the wet scrubber.

The stack height will be 65 m. 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 8 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 8 for a full description of emissions to atmosphere.

Inputs and Outputs

Inputs will be the colder flue gas from the wet scrubber on one side and the hotter flue gas from the baghouse filter on the other side.

Outputs will be reheated flue gas coming from wet scrubber and cooler flue gas from the baghouse filter.

5.6.11 Ash Handling

See Section 5.7.2 below for details on ash handling.

5.6.12 Control System

Control Room

The control room is located above the bunker. From here crane operators visually inspect the waste and, using a grab and automated transfer system, control waste entering the furnace from the bunker.

The facility's automated computer system is controlled and monitored from here. Emissions data from the emissions monitoring station located on the stack are also monitored here.

Figure 5.11 Typical Control Room and Control System

Automated Control System

The waste-to-energy facility is controlled by an interface computer system (screens, keyboard, printers). The system monitors all the parameters and measurements required in order to have a good overview of plant performance. It executes plant control loops, reports low-level and high-level alarms and will control different levels of safety interlocking.

The control system will include the following measurement equipment:

- air flows (primary, secondary, wall cooling if any, recirculation if any) in each section of the different injection systems;
- temperatures and pressures of all flows;
- grate temperatures underneath and above the grate;
- temperature in the burn-out section
- moving grate furnace;
- flue gas temperature at two levels after the last injection of air or fuel (for verification of burning at a minimum temperature of 850 °C for 2 seconds);
- oxygen content of the flue gas after the last injection of air;
- temperature of the flue gases at the roof of the first boiler pass (triple measurement); and
- temperature outlet of the boiler

Minimum control parameters include the steam rate, temperature above the grate, temperature in the post combustion chamber, waste throughput, NO_x-content and O_2-content. The control system will use these all these parameters to control the various inputs into the furnace.

The system includes the following operating modes:

- **Full automatic control under normal operating conditions** where minimum control parameters can be set for the system, such as steam or waste flow and temperature. In this mode no intervention on the response characteristic of the control should be required or be made available to the operator.
- **Safe manual control** where different input flows can be set for the system, with system protections and interlocks operating normally. This mode is required for starting and shutdown, and when reacting to variations in operating conditions, such as extreme fuel variations. When switching from the full automatic mode to safe manual control mode due to an operational situation beyond the limits of the control loop, the operator will be guided by the control system.
- **Maintenance mode** where either the automatic or manual control mode is in operation but with control system parameters, alarm settings and interlocks available to the operator for optimisation. This mode is protected by means of keys and/or passwords.

The control system will be assisted by:

- A visual check of the combustion process by means of one or more colour cameras on the furnace;
- An on-screen indication of the position of the current waste treatment and energy production of the furance
- Operational procedures which will be in place for reaction to low-level alarms or when the facility is not running to full capacity.

Operational procedures will be in place for the following:

- Start up;
- Controlled shut down; and
- Automatic shut down.

The plant is protected by an interlock system. Interlocking is an automatic action on one or more components of the process or on the whole plant (automatic shut down).

There are four levels of interlocking

- Level 3;
- Level 2A;
- Level 2B; and
- Level 1.

Level 3 interlocks

Level-3 will be used for interlocks required by legislation. Each interlock will be preceded by a low-level alarm generated by a separated transmitter and reported by means of the central control system in the control room. The status of all consequences of a level-3 interlock will be monitored on the central control system. Each level-3 interlock will also be programmed as a level-1 and a level-2A interlock.

Level 2A interlocks

A level-2A interlock will be used under the following circumstances:

- Where a level-3 interlock is used to act as a double protection;
- Protection against human error;
- Protection against environmental damage; and
- Protection against damage of equipment.

Level 2B interlocks

A level-2B interlock will be used when an interlock is also required in manual mode and when a level-2A interlock is unnecessary.

Level-1 interlocks

A level-1 interlock will be used for the following circumstances:

- Cases where level-3 interlock is used (triple protection);
- Cases where level-2A interlock is used (double protection);
- Cases where level-2B interlock is used (double protection); and
- Protection of all non-static equipment against damage.

A level-1 interlock will act on a function group rather than a specific piece of equipment. It will be a software interlock programmed in the central control system.

An interlock which results from an abnormal operating condition will be preceded by a low-level alarm reported by means of the central automation system in the control room.

When more than one interlock-level is used for a piece of equipment or function group, the level-1 interlock will be activated before the level-2A and level-2B and the level-2A and level-2B will be activated before the level-3 interlock. Therefore, under normal operating conditions the level-2A, level-2B and level-3 interlocks will provide a backup to the level-1 interlock.

The interlock system is explained further below by way of example.

Example – Elevated levels of dust due to malfunctioning of the bag house filter

Dust emissions will be monitored from the interface computer system in the control room. The dust removal process is surveyed using a number of instruments which return measurement values to the computer system in the control room. A number of instruments will indicate a malfunctioning of process parameters before the dust emission increases and activate a low-level alarm. This would be the first level of protection from elevated emission limits. Malfunctioning process parameters would include very low pH in wet scrubber; no lime supply in the evaporating spray reactor; and low oxygen level in the furnace.

A second level of protection would be an alarm and activation of the interlocking system due to higher than normal emission values. For example if 75% of the emission limit for dust is reached a low-level alarm (acoustic signal) is given. This allows for intervention to detect and remedy the cause of the raised emission value. At the emission limit (for example if the cause cannot be detected and the emission remediated) another acoustic alarm will be given and the automatic interlock system will become active. Activation of this system will terminate waste feeding in order to reduce the emission to a value below the emission limit. Under such circumstances the temperature of the plant is automatically maintained at 850°C by the support bu rners. Such an interlock system will be of the level 2A type as it must protect against environmental damage.

The system proposed is considered BAT for the control of the incineration process.

5.6.13 Emissions Monitoring

EU Directive 2000/76/EC requires continuous monitoring of specific parameters and regular sampling of dioxins present in the flue gases prior to discharge from the stack to ensure compliance with emission limit values.

Continuous Monitoring of Flue Gases

The furnace and gas cleaning plant will be operated under negative pressure generated by the induced draft fan located adjacent to the stack. This ensures that the only emissions from the plant will be those fully treated by the flue gas cleaning system and discharged through the stack.

Figure 5.12 Continuous Monitoring Equipment and QESH Sampling

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, NOx, CO, temperature and O_2.These continuous measurements can be reviewed in 'real time' in the control room.

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.

Figure 5.14 shows the typical set up in an emissions monitoring station. This station is located at the stack. Probes positioned in the stack direct flue gas samples to the various pieces of equipment for analysis. The samples are analysed and emission values recorded. Such a station will cost in the region of €0.5 million.

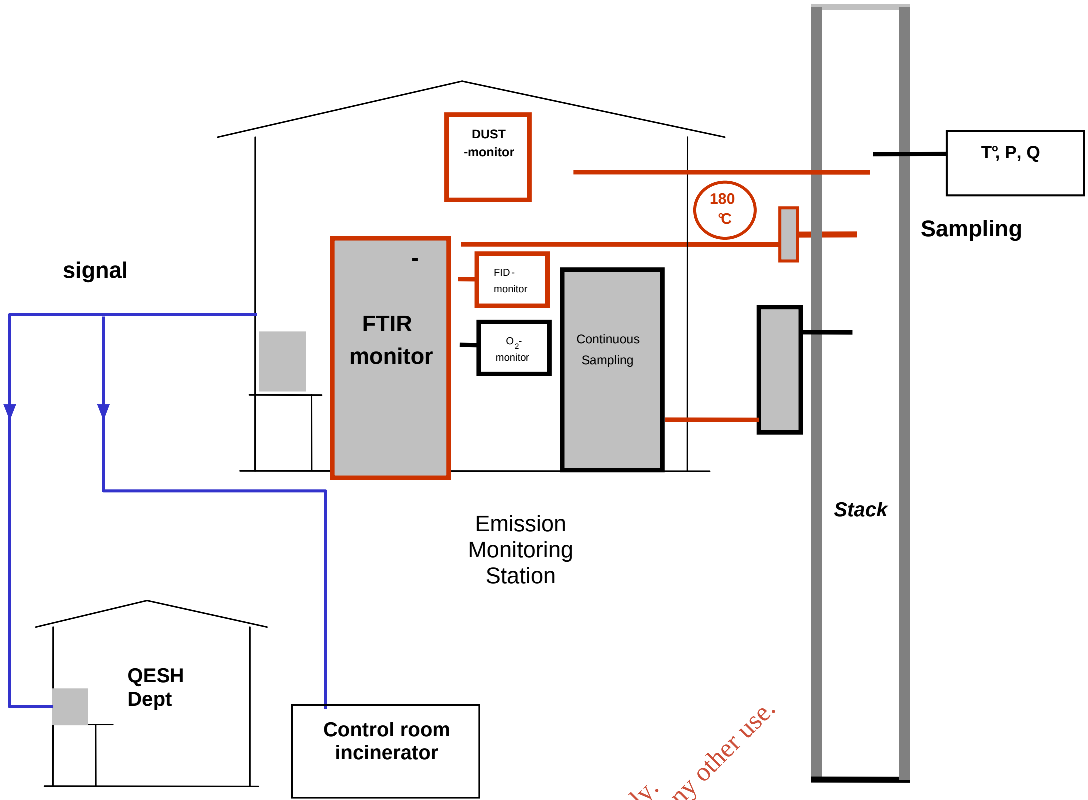


Figure 5.13 Diagram of a typical continuous monitoring station

The emission values are then relayed to both the incinerator control room, where the operators have 24 hour access to this information and can react accordingly, and to the QESH (Quality, Environmental, Health & Safety) Department where they are monitored for compliance with the relevant half-hourly, daily and monthly averages.

All equipment will be TüV certified and will adhere to the relevant standards. TüV certification is recognised throughout Europe and ensures the reliability, safety and quality of the equipment.

Preventative maintenance contracts will be put in place with the equipment suppliers who will also be able to provide a 24-hour call out service. Calibration of equipment will be carried out as per supplier recommendations. Calibration by means of parallel measurement is conducted at least annually in our facilities in Belgium and this practise will also be applied at the proposed facility. The monitoring equipment will also have auto calibration capabilities were possible.

There will also be back-up monitoring equipment available for use during maintenance and calibration.

Continuous Sampling of Dioxin Emissions

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.

Figure 5.14 shows the design of a typical continuous sampling system for dioxins.

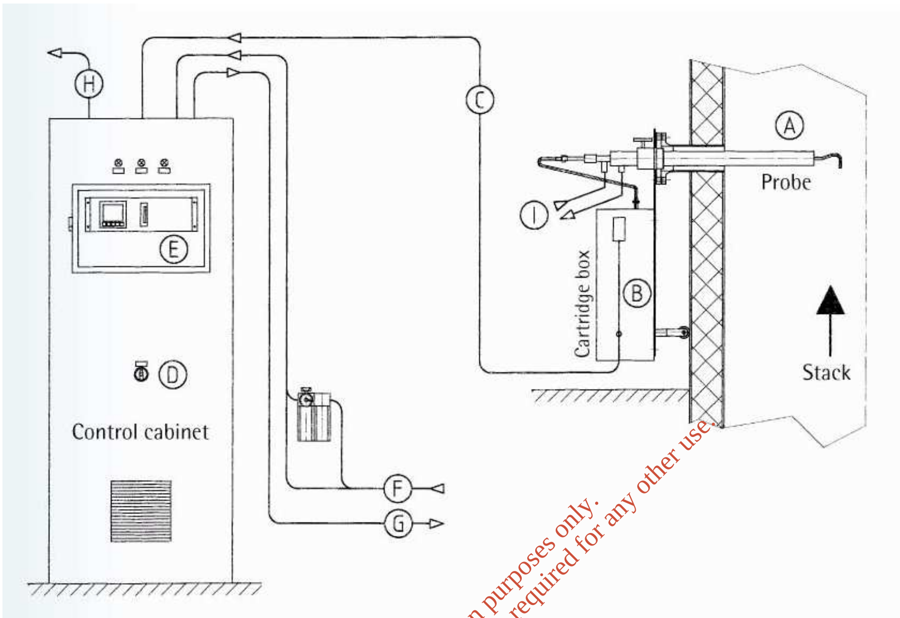


Figure 5.14 Diagram of a typical dioxin sampling station

This state-of-the-art continuous dioxin sampler will allow the dioxin emissions to be sampled continuously. A dioxin filter will be placed in the stack to measure dioxin emissions on a fortnightly basis and will then removed and analysed in an independent laboratory. Laboratory testing of the samples will give dioxin emission concentrations and mass emission rates over a two-week period. This equipment is in use in existing Indaver plants. Due to the very low levels of dioxins leaving the stack, no proven technology capable of reading continuous measurements is currently available.

The monitoring and sampling systems proposed are considered BAT for compliance with emission limit values set down in EU Directive 2000/76/EC.

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 5.14.

The stack height of 65 meters has been designed in accordance with the applicable EU design codes to ensure that the discharge will not lead to any adverse impact on air quality. The dispersion modelling of the emissions from this stack are addressed in Section 7 of this EIS.

Prior to discharge, the cleaned gas leaving the wet scrubber is then passed through the heat exchanger to increase its temperature from 60^{o}C to 100^{o}C. This increase in temperature reduces the formation of a visible plume at the stack discharge.

5.7 Description of Process Input and Output Requirements

The major input to the process is waste for incineration and the major outputs are flue gases, ash, flue gas cleaning residue and electricity. These are listed together with other inputs and outputs in the following Table which also shows the section in which they are addressed.

Table 5.3 Process Inputs and Outputs

Input (Section 5.7.1)	**Outputs** (Section 5.7.2)
Waste	Ash
Water	Electricity
Light fuel oil	Stack emissions

The plant will not produce any process effluent as any effluents will be recycled for use in the evaporating spray reactor, thus reducing the plant's overall water requirement. These effluents will consist primarily of effluent from the scrubbers, wash waters (from washing items of plant) and effluent from the boiler water treatment plant.

5.7.1 Inputs

Waste

During operation, the plant will accept residual municipal and industrial waste from a variety of sources for incineration.

The Proposed Replacement Waste Management Plan for the North East Region estimate 454,198 tonnes of household, commercial and industrial waste was generated within the North East Region in 2003. Overall 23% of municipal waste generated in the NE region was reported as recovered in 2003: 16% of household waste and 35% of commercial & industrial waste. The remaining 77% of municipal waste generated in the Region is disposed to landfill. EU, national and regional waste policy is saying that this dependence on landfill must be dramatically reduced.

The proposed waste-to-energy plant will have an annual capacity of between 150,000 and 200,000 tonnes of waste per annum in line with the Proposed Replacement Waste Management Plan for the North East Region.

The majority of this waste will be accepted from commercial and industrial enterprises and private waste collection companies. Indaver will also consider other suitable waste streams as they arise.

Water Supply and Use

As the plant uses an effluent free flue gas cleaning process and an air cooled condenser rather than cooling towers it has a significantly lower water requirement than would otherwise be the case. The major water requirement will be for flue gas cleaning. Process water (for the steam cycle), domestic potable water and water for cleaning account for the rest of the demand. The expected water requirements are listed in Table 5.4 following:

Table 5.4 Water requirement

Use	Quality	Quantity (m^3/hr)
Flue gas cleaning	Well water	7.4
Process (steam cycle)	Potable water	1.0
Domestic supplies	Potable water	2.0
Cleaning	Well water	1.0
Fire fighting	Well water	0.2
Total		**11.6**

The raw water requirement will be supplied by groundwater abstraction and a small supply of potable water from the local water main. Approximately 1m^3/hr will be supplied from Meath County Council's water main on the R152 for potable supplies.

Light Fuel Oil Consumption

The plant will use light fuel oil at start up to bring the furnaces to the required operating temperature of 850°C. Light fuel oil may also be occasionally required as a supplementary fuel to maintain the temperature if waste of an exceptionally low calorific value is received. An automatic control system will bring light fuel oil on line should the temperature approach 850°C. It will also be required for operation of the emergency power generator.

This low light fuel oil demand can be supplied from an on-site light fuel oil storage tank.

5.7.2 Outputs

Solid Waste Residues

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

- Bottom Ash
- Boiler Ash
- Flue Gas Cleaning Residues

The types and approximate quantities of ash and residues expected to be produced from the waste-to-energy process are detailed in the following tables.

Table 5.5 Estimated Residue Quantity and Type

Ash Type	Tonnes/annum (Approximate)	Hazardous/Non-Hazardous
Bottom Ash (incl. 15 % moist)	50,000	Non-Hazardous
Boiler Ash	3,000	Non-Hazardous
Flue Gas Cleaning Residue	10,000	Hazardous
Total	**63,000**	

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 will be carried out on the residue 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.

(*Leachate is the aqueous effluent produced by rainwater on landfill sites and generally contains a high concentration of dissolved solids. A leachate test involves filtering water through ash and then analysing the water properties).*

Bottom Ash

The bottom ash from the furnace, which will be at a high temperature when it exits the furnace, will be quenched with water to prevent dust emissions prior to transfer to the ash bunker. This process will take place within an enclosed building and will involve the use of a conveyor belt to transfer the ash to a water bath before final transfer to the ash bunker.

Metals will be recovered from the ash during transfer to the bunkers. A metal separator (over-band rotating magnet), located on the last conveyor before the bottom ash bunker, will remove ferrous metal and transfer it to a separate compartment of the ash bunker. An intricate and expensive recovery system is required for the removal of non-ferrous metal. As the system is of little environmental benefit due to the quantity of material recovered (less than 1% of metal in input waste) it has not been considered.

The recovery of metals from the bottom ash produced from the incineration process is a more efficient and cleaner process than removing metals from the incoming municipal waste stream. This is common practice in incineration plants throughout Europe. The recovered metal from bottom ash is free of contaminants such as organics and plastics and is therefore more acceptable at recycling facilities than those metals that would be removed directly from the municipal waste stream. Emissions from the incinerator will not be effected by the small quantity of metal in the waste stream.

The ash bunker is sized at 1,600m^3 and will have the capacity to store the equivalent of 10 days of ash. Ash will be transferred from the bunker to collection trucks using a crane and hydraulic grab. The grab will be in an enclosed structure and transfer will take place in an enclosed loading bay. All trucks leaving the facility will be securely covered to prevent any ash escaping from the facility.

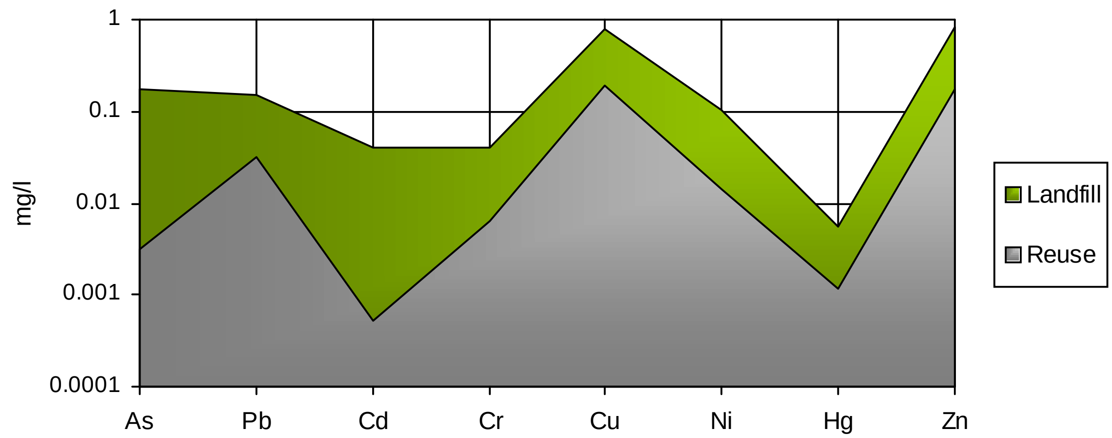
The bulk of the ash, approximately 24% of waste input by weight, will be bottom ash with a 15 % moisture content. It will consist of silicates, minerals, metal pieces and glass compounds. Ferrous metals will be recovered from the bottom ash and sent for recycling. From experience of operating similar facilities in Flanders, Belgium, it is anticipated that 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 (see Appendix 5.2 for details of typical ash treatment). This option for the recovery of bottom ash is discussed in Chapter 18, Material Assets.

If an ash recovery plant was to be constructed in Ireland it would be the intention of Indaver Ireland to proactively identify potential uses for the bottom ash. This material is suitable for use in road construction and such a use would be in accordance with Government policy on the re-use of waste. Although there is no Irish or European legislation or standard governing the quality of ash for use in roads, if the ash is to be used for road construction it must generally be of better quality than if it were to be disposed of in landfill. This improvement in quality can be achieved by treating the ash in an ash recovery plant. In Germany the quality standard of ash for use in road construction is defined by the Federal Working Group on Waste (LAGA) and is based on leachate tests.

Figure 5.16 below indicates the German quality standards required for re-use of ash in the construction industry and for disposal of ash to landfill for inert waste.

If no market can be found for the bottom ash, it will be disposed of to a suitably licensed non-hazardous landfill site.

Figure 5.15 Quality Standards for Ash Leachate



Boiler Ash

Boiler ash will be separately collected and stored as recommended in the IPPC Bureau Bref Notes. Residues will be removed from the boiler by an enclosed conveyor system and transferred to a silo located within the enclosed building. Silos will be fitted with HEPA filters to prevent dust emissions. The boiler ash will be transferred to a collection truck within the enclosed building and all trucks leaving the facility will be securely covered to prevent any ash escaping from the facility. Two boiler ash silos will be sized at approximately 100m^3 each and will have the capacity to store the equivalent of 10 days of residue.

About 1-2% 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. Leachate tests will be carried out to determine whether the boiler ash should be disposed of to hazardous or non-hazardous landfill. It is expected that, based on experience elsewhere in Europe, the boiler ash will be suitable for non-hazardous landfill. If the leachate test for direct disposal to landfill is negative it will be solidified with cement prior to disposal to landfill.

Flue Gas Cleaning Residue

Flue gas cleaning residues will be removed from the baghouse filter by an enclosed conveyor system and transferred to a silo located within the enclosed building. Silos will be fitted with HEPA filters to prevent dust emissions. These residues will be transferred to a specialised collection truck which will have an enclosed container box. The truck will reverse into the building and the silo will be connected directly to the container opening prior to discharge of the residues. This material is not classified as hazardous under transport regulations. There is no prerequisite to solidify this residue prior to transport off-site. Two flue gas cleaning residue silos will be sized at 210 m^3 and each will have the capacity to store the equivalent of 7 days of residue.

The flue gas cleaning residues will be approximately 4-5% by weight of the waste input. This material will contain particulates which were not collected in the boiler ash. It will also contain salts from the evaporating spray reactor (essentially solid residues from the flue gas cleaning process) and activated carbon or lignite cokes. Due to its leachate characteristics this residue will be classified as hazardous waste and as such must be disposed of in a hazardous waste landfill. Prior to disposal this residue will be solidified with cement to immobilise any components which have the potential to leach.

Although it is an objective of the EPA National Hazardous Waste Management Plan (2001) to develop hazardous waste landfill capacity in Ireland there is currently no such capacity. If, at the time of commissioning of the waste-to-energy plant there is no landfill capacity, hazardous ash will be exported for final disposal pending the establishment of a hazardous waste landfill in Ireland.

Indaver Ireland has over 20 years experience of sourcing suitable outlets, both in Ireland and abroad, for the disposal of hazardous waste. Indaver also operates its own hazardous waste landfill in Antwerp, Belgium.

The ash handling and treatment process proposed is considered BAT.

Electricity

The waste-to-energy plant will convert the thermal energy produced by the combustion of the waste into electricity, some of which will be used by the plant itself with the remainder (approximately 13 MW) being exported to the national grid. This will supply over 90 GWh of renewable electricity per annum, which will contribute to reducing Ireland's Greenhouse Gas emissions (see Chapter 7).

Heat Balance

The heat produced from the combustion of the waste will be used to generate steam, which will be used to drive a steam turbine and electricity generator. The plant will produce approximately 16MW of electricity, of which approximately 3MW will be used to meet on-site energy requirements (see Figure 5.16 for details of heat balance). The remaining 13 MW of electricity will be available for export to the national grid. Enough electricity will be exported to power 19,000 homes annually.

For a 69.3 MW thermal output the following heat balance is expected;

Heat loss by radiation from hot equipment (furnace, boiler, steam cycle) is approximately 1.4 MW (2%). This heat, while not recovered, heats the building. It is emitted to atmosphere through the natural draft of the building ventilation system.

56 MW of the heat generated is converted to steam. This steam is converted to 16.5 MW of electricity and 39.5 MW of hot air from the aerocondenser. Steam enters the turbine at a pressure of 40 bar and a temperature of 400^{o}C.

Steam leaves the turbine at a pressure of 0.15 bar, a temperature of 50^{o}C and only 10% condensed. The remaining 90% of the steam is condensed in the aerocondenser using an indirect cooling system. Therefore the steam is condensed in a closed loop and ambient air is heated.

The remaining 11.9 MW of heat is released from the boiler to the flue gas cleaning system and is emitted via the stack.

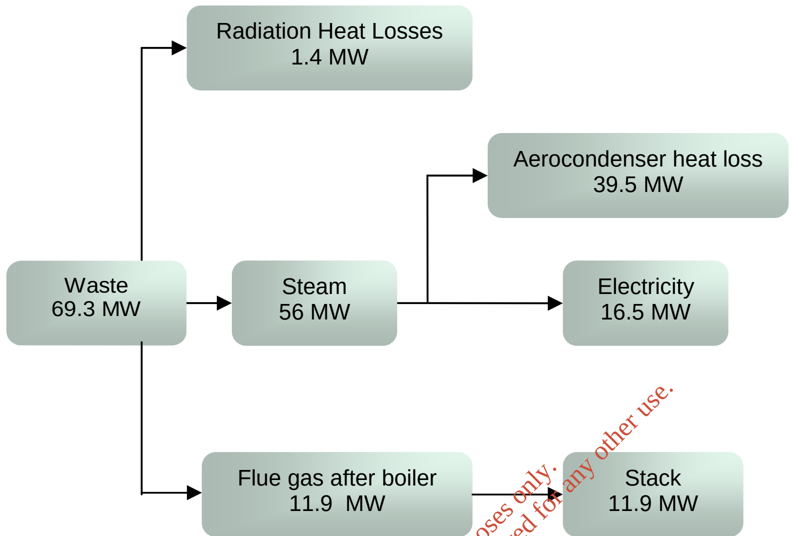


Figure 5.16 Heat Balance

Energy Efficiency

Waste that cannot be reused or recycled will be incinerated to recover as much of the energy content of the waste as possible. This is in line with EU policy. The energy content of waste is similar to that of peat or about one third that of coal. The proposed development includes energy recovery in the form of electrical production through use of a steam turbine. The combustion principle of the design, using a moving grate furnace followed by steam recovery and flue gas cleaning, is the standard for waste incineration in Europe, comprising most of the approximate 450-500 existing waste thermal treatment plants.

This state of the art technology for the low emission disposal of waste includes the production of electricity, and where possible heat for district heating. The electrical generation efficiency of this design is about 20%, which is low compared with efficiencies of about 37% that can be achieved with coal burning technology or about 57% with modern natural gas combined cycle gas turbine plants. However, the principal function of the technology is to reduce the volume of waste going to landfill rather than to generate electricity efficiently.

This relatively low efficiency is due to the fact that combustion of waste can lead to corrosive flue gases that attack boiler components. It is thus not possible to recover steam at either high temperature, or very low temperatures, as the corrosive flue gases would attack the boiler components. Therefore the steam output from the boiler is reduced leading to a reduced electrical output from the steam turbine and generator set. Furthermore, waste incinerators need to operate with a higher quantity of excess air than power plants in order to meet the more stringent EU emission limits.

A number of options are being investigated to improve the energy recovery of waste incineration. One of these options is the use of superheaters that allow steam to be generated at a higher temperature and pressure. However these technologies are not proven, and thus have not been considered for this plant.

A number of novel technologies for the use of the low-grade heat available from waste incineration are at the research stage. These include the Kalina cycle, an ammonia and water based system, and the upgrade of gas turbine fuel (synthesis gas) by chemical change. These technologies are however still in the development stage.

Ireland is required, under EU Directive 2001/77/EC, to increase electricity produced from renewable energy sources from a level of 3.6% in 1997 to greater than 13.2% by 2010. Incineration with energy recovery of the biodegradable fraction of non-hazardous waste results in production of renewable energy.

Incineration without energy recovery has not been considered for this project, since energy recovery as discussed above is considered BAT.

5.8 Occupants/Staffing

When completed and fully operational, the plant will employ approximately 50 permanent personnel, some of whom will work in shifts as the plant will be operational 24 hours per day. Employed 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

Initially, senior managerial staff will be sourced from experienced personnel either in Belgium or Ireland. All other staff will be recruited locally prior to start-up.

Key staff will be recruited prior to commissioning and will be trained by experienced personnel at a similar waste-to-energy plant in Belgium. Training will also be carried out in co-operation with the waste-to-energy plant manufacturer and equipment designers and suppliers. As part of the contractual agreement, the incinerator manufacturer will be required to remain on-site for the first twelve months of operation, or until the facility has been fully commissioned. 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's staff will be subcontracted out to either local contractors or to the plant's equipment suppliers. On such occasions the hiring of special expertise or specialised equipment will be required.

Through careful preparation and training, Indaver Ireland's staff will be prepared for every stage of construction, commissioning and operation of the proposed facility.

5.9 Description of Natural Resources Used

The requirements for natural resources are discussed under Section 17 Material Assets.

5.10 Description of Effects, Residues and Emissions

Detailed descriptions of the effects, residues and emissions associated with the facility are presented in Sections 6-18 under the following headings:

- Human Beings
- Air
- Noise
- Geology and Soils
- Groundwater and Hydrogeology
- Surface Water
- *Ecology
- Traffic
- Landscape
- Climate
- Cultural Heritage
- Material Assets
- Construction

*Flora and Fauna included under Ecology

5.11 Emissions from Residues

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 be transported off site in closed containers.

The bottom ash will be sent for reuse or to landfill (see Section 5.12.2).

The boiler ash will be sent to non-hazardous landfill and the flue gas cleaning residues will be sent to a hazardous landfill (see Section 5.12.3). The flue gas cleaning residues will be mixed with cement and water and solidified prior to landfill.

5.12 Related Developments and Indirect Impacts

5.12.1 Ash Disposal

As described in Section 5.7.2 the waste-to-energy plant will produce three distinct residues:

- Bottom Ash
- Boiler Ash
- Flue Gas Cleaning Residues.

This ash will total approximately 30% by weight (including 15 % moisture in the bottom ash) and 10% by volume of the incoming waste. Therefore, as the plant will burn waste which currently goes to landfill, it will lead to a significant immediate reduction in the volume of material going to landfill.

5.12.2 Bottom Ash

As described in Section 5.7.2 recovered bottom ash is suitable either for use in road construction or for disposal to non-hazardous landfill.

If it is possible to use the bottom ash as construction material, Indaver Ireland will ensure that any ash going for re-use complies with relevant standards. This will ensure that its re-use will not have any adverse impacts on public health or the environment. In the absence of an ash recovery plant and if a demand for the bottom ash cannot be found it will be disposed of to non-hazardous landfill.

However, in the absence of the waste-to-energy plant envisaged in the draft Plan, the requirement for new landfill capacity would be much greater. This is because the volume of ash produced by a waste-to-energy plant is only 10% of the volume of waste.

Due to the relatively inert nature of the ash it will have lesser adverse impacts than untreated waste disposed directly to landfill.

Indaver Ireland will ensure that the disposal site(s) available to the company will be appropriately licensed under Ireland's Waste Management Licensing regime.

5.12.3 Boiler Ash

The boiler ash will account for a small proportion of the plant's solid waste residues, about 3,000 tonnes per annum. This will have a slightly elevated concentration of heavy metals and dioxins than the bottom ash and is, therefore, not suitable for re-use as construction material.

If the leachate test requires it, the boiler ash will be solidified using cement. This will further reduce any potential impacts of disposal to landfill.

Indaver Ireland will ensure that this ash is disposed of to a licensed landfill with appropriate management and leachate collection practices. The final destination of the boiler ash, whether to hazardous or non hazardous landfill, will be decided on the basis of leachate tests as described in Section 5.7.2.

5.12.4 Flue Gas Cleaning Residues

The flue gas cleaning residues will contain high concentrations of salts and slightly elevated concentrations of heavy metals and dioxins. This residue will therefore be classified as hazardous waste and will have to be disposed of to a hazardous waste landfill.

The lining, leachate collection and general management requirements are much more onerous for hazardous landfill than for non-hazardous landfill. Furthermore, the residues will be solidified with cement to immobilise components with leachability properties to mitigate any potential impact. These measures will ensure that there will be no adverse impact due to the disposal of the flue gas cleaning residues.

Although it is an objective of the draft EPA Hazardous Waste Management Plan to have hazardous waste landfill capacity in Ireland there is, as yet, no hazardous waste landfill. Consequently all hazardous waste is currently exported for disposal.

If there is no change in the current situation at the time of commissioning of the facility, the flue gas cleaning residues will be exported for disposal. However, the preferred disposal route is to a hazardous waste landfill in Ireland.

5.13 Description of Secondary Process/Activities

Off Site Traffic Movements

A detailed traffic assessment is presented in Section 13.

On Site Waste/Personnel Movements

All waste material transported to the proposed facility will be directed to the waste reception and processing building for unloading into the waste bunker. Staff will be provided with parking facilities which will be located to the south east of the gatehouse and weighbridges. No unauthorised personnel will be permitted access beyond the gatehouse unless permitted to do so or accompanied by a facility employee.

Surface and Foul Water Management

Surface and foul water management is discussed in 11 Surface Water.

Monitoring

Environmental monitoring is discussed in individual Sections (6-18). The facility will have regular facility monitoring in accordance with the governing waste licence and such monitoring will be documented in the Standard Operating Procedures (SOPs) as part of Indaver's management system.

Security

Site security will be provided by a combination of suitable infrastructure and security personnel.

It is proposed that the site entrance will have a security entrance gate. There will be a security fence consisting of pallaside fencing (2.4m high) placed along the frontage to the R152. The remaining perimeter boundaries of the facility will consist of 2.4m chain link fence. There will be CCTV cameras located at suitable points around the site. Some of these will be mounted on camera towers. The exact number and location of the cameras will be reviewed on an ongoing basis.

A record will be kept of all visitors to the site. Visitors will be monitored and supervised at all times.

Wheel Wash

As the facility will have hard-surfaced roads a permanent wheel wash will not be required during the operational phase.

5.14 Regulatory Control

5.14.1 Waste Licence

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 this proposed facility require a 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 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

5.15 Description of Decommissioning

There is no site life defined for the proposed facility therefore detailed financial, administrative and technical provisions are not presented under a decommissioning plan for the site. On decommissioning of the facility it will be a condition of the waste licence for the facility to provide the EPA with a detailed decommissioning plan for their approval prior to any works proceeding. In the event of decommissioning measures will be undertaken by Indaver to ensure that there will be no environmental impacts from the closed facility. Such measures are outlined as follows:

- All wastes at the facility at time of closure will be disposed/recycled by an authorised waste contractor;

- All oils, fuels etc on site at the time of closure will be collected and disposed/recycled by an authorised waste contractor;

- It is expected that the bulk of the site infrastructure will be sold on to a prospective buyer as an asset. The will include the site buildings, offices, weighbridges, fencing, gates, lighting and drainage/sewage infrastructure. Other plant may also be acquired by the potential buyer. However, if not this will be sold to other potential buyers separately or dismantled and disposed of at a licensed facility;

- All site floor and process building walls will be power swept and washed to clear all debris and dust;

- All tanks will be de-sludged and interceptors cleaned. The waste from the cleaning operations will be disposed to relevant licensed facilities; and

- A monitoring programme of all potential emissions including surface water and dust will be conducted after the decommissioning process in order to ensure that emissions from the facility have ceased. The monitoring programme will consist of two monitoring rounds carried out within two months of decommissioning of the facility.

When operations have ceased, and assuming confirmation from the monitoring programme that all emissions have ceased, it is expected that there will be no requirement for long-term aftercare management at the site.

In accordance with waste licence requirements the company must prepare a decommissioning programme in agreement with the EPA when the facility becomes operational.

5.16 Description of Other Developments

The following subsections detail offsite and secondary developments which occur directly or indirectly from facility operations.

5.16.1 Transportation

The proposed upgrade of the R152 road is detailed in Section 13.

5.16.2 Energy

Electricity Generation & Substation

The waste-to-energy plant will export electricity to the local electrical distribution system via 20 kV overhead lines to Rathmullan Substation about 2.5km north of the site. These lines are routinely installed throughout the country and do not have the visual impact associated with high voltage lines. Planning permission is not required for 20 kV lines. The final route for the lines will be determined by the ESB.

Due to the layout of the facility and its location to the northerly end of the site, there will be no requirement to divert the existing 110 kV lines traversing the site.

5.16.3 Other

Water

The mains water supply piped along the R152 road supplies many of the residential dwellings in the area. The development will use a small quantity of mains water as a potable supply for the facility. On site water well(s) and storm water will be used as process water within the facility as detailed in Section 5.7.1.

Sanitary Service

Domestic sewage from toilets, changing and kitchen areas will discharge via the foul drainage system into an on site effluent treatment system which will then pass through a percolation area to ground as detailed in Section 9.

Telecom

Telecom network including phone lines will be ducted from the site entrance parallel to the roadway to the main process building where a main switch will be provided. The telecommunications network will extend from the process building to all areas of the site where telemetry or remote monitoring is required. All cables will be underground and ducted.

5.17 HEALTH AND SAFETY

5.17.1 Design & Construction Health and Safety

The proposed facility has been designed in accordance with the Safety Health and Welfare at Work Act, 2005, the Safety, Health and Welfare at Work (Construction) Regulations, 2001 and associated Regulations. The following principals are incorporated into the design of the proposed facility.
The plant was designed by skilled personnel according to internationally recognised standards, design codes, legislation, good practice and experience.

The design was 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 and instruments etc. are provided for critical situations.

- Fire detection and fire fighting systems are installed;
- The design complies with Irish Building Regulations Part B Fire Safety and with Indaver's insurance company's requirements;
- The installation is validated as part of commissioning procedures;
- The installation is well maintained and cleaned;
- Indaver applies 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; and
- Wherever possible Indaver strives to minimise human interaction in safety critical operations in order to eliminate the potential for 'human factors' to initiate or exacerbate major accidents at the site.

It is the policy of Indaver Ireland to attach the greatest importance to the health and safety of all persons employed on the project and indirectly affected by the works. All construction projects are carried out, so far as is reasonably practicable, in such a way that the risks to the health and safety of all persons engaged in, or affected by, its construction and maintenance are eliminated or reduced to an acceptable level under current health and safety legislation, namely the Safety, Health & Welfare at Work Act 2005 and good practice.

Relevant notifications to the HSA and planning authorities are submitted within the statutory periods prior to construction. Project supervisors for the construction and design phases are appointed in accordance with the Health, Safety and Welfare at Work (Construction Regulations) 2001, and a Preliminary Health and Safety Plan will be formulated during the design stages which will address health and safety issues from the design stages, through to the completion of the construction and maintenance phases. This Health and Safety Plan is developed further in accordance with the Safety, Health and Welfare at Work (Construction) Regulations 2001 for the construction stage of the project.

All those involved with the construction phase have a statutory duty to comply with its requirements and to provide Indaver with any relevant information needed to keep the plan up to date.

Indaver employ consultants to act as Health as Safety Co-Ordinators on larger projects. Indaver also employ a full time, fully qualified Health and Safety Officer who is responsible for ensuring that relevant legislation is adhered to and that best practice in Health and Safety is employed and enforced during construction.

5.17.2 General 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.

Indaver operates a combined Quality, Environmental, Safety & Health (QESH) Management System. The proposed facility will operate to ISO 9001:2000, ISO 14001 and OHSAS 18001, the internationally recognised quality, environmental and health and safety standards/assessment series.

The QESH policies are the top-level documents of each element of the system. They define Indaver's overall aims and objectives with respect to the provision of a quality service to customers, the provision of a quality workplace to employees and the control over the environmental and health & safety impacts of its activities respectively.

Indaver maintains a Register of Environmental Aspects, which identifies the aspects of Indaver's activities that can interact with the environment and determines where controls are required. Indaver also carries out Health & Safety Risk Assessments in order to identify the health & safety hazards associated with Indaver's activities and to determine where controls are required. Both the Register of Environmental Aspects and the Health and Safety Risk Assessments will be updated to incorporate the activities at the proposed facility.

Prior to start up a comprehensive set of operational procedures covering all aspects of the different activities will be drawn up. The purpose of these procedures is to ensure that Indaver:

- Maintains control over the environmental, quality and safety aspects of its activities;
- Meets the aims laid down in the Environmental, Quality and Health & Safety Policies; and
- Remains compliant with all relevant operating licences, permits and legislative requirements.

In compliance with the Safety, Health and Welfare at Work Act, 2005, Indaver Ireland will draw up a safety statement covering the operation of the plant and appoint safety representatives from the plant workforce. The Employees of Indaver represent the Company's greatest asset.

By providing opportunities, facilities and financial resources, the Company aims to ensure that all members of staff are in possession of the knowledge, skills and experience necessary to perform their jobs to a satisfactory standard.

The incineration process will be controlled manually and automatically by employees and a computerised control system in the control room (see section 5.6.12). Through recruitment, training, performance management, employee development and succession planning, Indaver provides employees with sufficient training, experience & knowledge for their roles and ensures that they are competent to perform them.

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 gas cleaning and 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.

5.17.3 Fire Safety

Design for Fire Safety

The fire safety objectives adopted in the design of the Meath waste-to-energy 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; and
- 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 and in consultation with Indaver's insurers. 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/heat detectors;
- fire alarm system;
- on site storage of water for fire fighting purposes; and manual call points.

5.17.4 Potential Operating Hazards

5.17.4.1 Waste Bunker

The greatest potential for fire arises in the waste bunker, where localised heating can occur due to decomposition of organic material or as a result of hot ash in the waste leading to isolated fires. Decomposition of waste can raise the temperature to 75℃, which dries the waste and causes 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

As the waste bunker is permanently monitored by the crane operator, such a fire can be detected at an early stage by the operator of the mechanical grab. 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 can usually be more quickly detected by the human eye than by the fire detection systems installed.

In the event of such a fire, the part of waste on fire is lifted into the hoppers from whence it goes into the furnace. This waste is then covered by placing another layer of waste into the hopper.

Should the fire become uncontrollable by this method, the fire can be put out using one of a number of water cannons. The crane operators will be trained in fire fighting techniques. All firewater will be contained within the bunker, eliminating the need for a firewater retention pond (see Section 11).

A number of design considerations will prevent flame back flow from the furnaces through the hopper into the bunker. Firstly, the furnace is kept under negative pressure. Secondly, the waste-feeding hopper is always filled to a minimum level generating a waste plug between furnace and bunker. This level is measured and safeguarded by an interlocking system. The feeding hopper and feeding ram also provide a seal between the high temperature furnace and the bunker. Finally, a valve in, or on, the hopper closes automatically in case of fire or other safety initialising signals.

5.17.4.2 Moving Grate Furnace

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 (see Appendix 5.3 for details), 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.

5.17.4.3 Steam Production

Proposed Operational Safety Measures

The design of the steam circuit will be carried out to the best industry standards to minimise hazards. In the event of a power failure the emergency 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.

5.17.4.4 Flue Gas Cleaning System

The main hazard is an elevated flue gas temperature at the outlet of the evaporating spray reactor. This has potential to cause damage to the baghouse filter and ignite the activated carbon/lignite coke.

Proposed Operational Safety Measures

The risk for fire from the use of activated lignite coke is minimised by the following considerations:

- A dedicated hazard assessment on the storage and dosing system will be performed;
- To prevent an elevated flue gas temperature it will be monitored and the temperature of the activated carbon/lignite coke will be maintained below 180°C;
- Activated carbon will be injected with lime to maintain the carbon content of the mixture below 40 % to reduce the risk for self-oxidation of carbon/lignite coke, hence the formation of hot spots; and
- In the event of a temperature threshold being exceeded, the plant will automatically shut down.

5.17.5 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.

5.18 SITE STATUS IN RELATION TO THE EU CONTROL OF MAJOR ACCIDENTS HAZARDS INVOLVING DANGEROUS SUBSTANCES DIRECTIVE

5.18.1 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.'

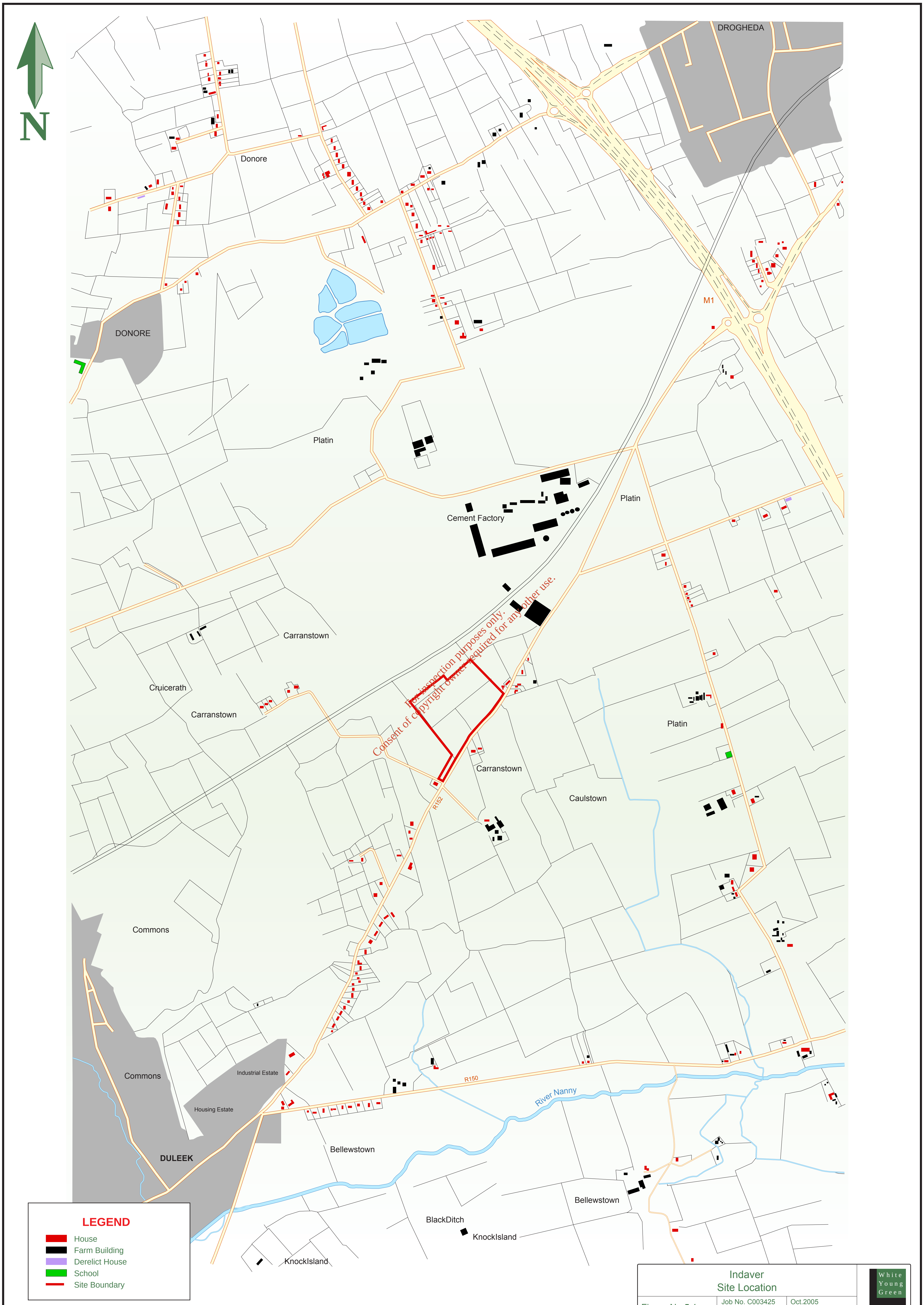
Hazard is defined as:

'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.

5.18.2 Seveso Status of the Meath Waste Management Facility

Indaver Ireland commissioned Byrne Ó Cléirigh Consulting Engineers, who specialise in safety and risk management, 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 (see Appendix 5.4 for the complete study). The conclusions of the study indicated that the proposed facility is not one to which the Seveso Regulations apply.



NOTE: Drawing is for diagrammatic purposes only. No measurements to be taken.

Indaver
Site Location

Figure No.5.1 | Job No. C003425 | Oct.2005
Finalised By -

White Young Green

JF(10)

Appendix 5.1

Furnace Start Up and Shut Down Procedures

Furnace Start Up and Shut Down Procedures

The start-up and shut down of the furnace will be carefully controlled, in accordance with standard operating procedures. The procedures will be developed in detail prior to the commissioning of the furnaces. The procedures are outlined below.

The start-up sequence for the furnace line will be as follows:

- The computerised control system for the line will be started up, which will mean that measurements and interlock systems will be in operation.
- Utilities for the line such as water, electricity, instrument air, the firewater system and safety systems will then be started up.
- Monitoring of some of these utilities will be carried out, as certain conditions such as firewater availability must be satisfied before the start-up procedure can commence.
- Peripheral equipment, such as the equipment to supply chemicals to the plant, to receive the process stream from the plant and the stack emissions monitoring equipment will then be started up.
- After verification of process parameters such as liquid levels, pressures, steam cycle etc., and adjustment as necessary, the flue gas cleaning systems will be started up.
- The ID-fan will commence running and pre-ventilation of the line for a pre-set time period of 20 minutes will occur.
- The oil-fired burners, to initiate the combustion in the furnace, will be started up and the flue gas temperature will be raised to 850℃ at a gradient o f 50℃ per hour.
- Once the temperature in the furnace has stabilised, the supply of waste will then commence and oil firing will be stopped.

The shut down sequence for a furnace line will be as follows:

- The waste supply to the furnace will be shut off
- To ensure complete combustion of the waste remaining in the furnace, the oil burners will be re-started to ensure that a temperature of 850℃, as a ppropriate, will be maintained for a period of up to 1 hour or until all the waste is incinerated.
- The ID fan of the flue gas cleaning system will remain operating to ensure that the flue gases will be treated to the emission limits during the operation.
- The furnace will then be allowed to cool down to a temperature of 200℃ at a gradient of 50℃ per hour (a period of circa 13 hours) which will be controlled by supplementary firing.

- The furnace line will have stopped incinerating waste for a number of hours, there will be no waste remaining in the furnace and consequently there will be no flue gases to be cleaned. Once the temperature at the stack is sufficiently low at approximately 60℃, the flue gas cleaning systems will be stopped.
- Some utilities to the line such as instrument air, etc. and the majority of the peripheral equipment will be shut-off.
- Other utilities such as electrical supply will continue operating as they will be required even when the line is shut down.

If the line is shut down and there is waste remaining in the bunker, one ID fan will continue operating if possible at a lower capacity to ensure that the waste reception hall and bunker will be kept under negative pressure to prevent odours.

Appendix 5.2

Typical Ash Treatment

Ash treatment

Useful application of ashes

In the ash treatment unit, ashes from the household incineration facilities are washed, sieved and purified. The end product is a valuable secondary material that can be used for several applications.

Ferrous and non-ferrous metals are carefully removed in various cut, sieve and wash units. Some of those recuperated metals will be re-used in industry. Inert ashes remaining after incineration are converted into granulates. These can be used as secondary materials in the construction industry, in accordance with the relevant VLAREA regulations.

May 2002

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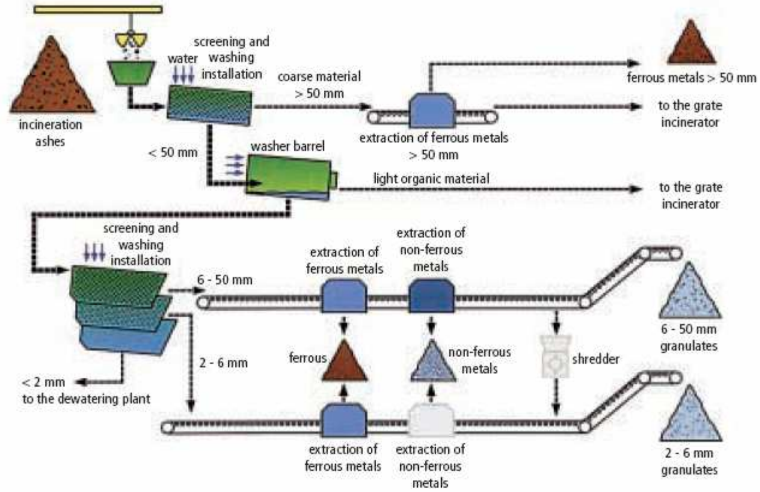

ash treatment

Delivery

Some of the ashes from the Indaver grate incinerators are transferred to the ash treatment unit. Comparable incinerator ashes from other household incineration facilities can also be treated, provided they comply with the prescribed quality requirements. Waste materials can only be supplied after contacting our planning department.

Treatment

The incineration ashes are treated in various cut, sieve and wash units.
A robust bar sieve first separates the large pieces of metal and stones. A rotary sieve then separates other large pieces, which are de-ironed and sent back to the grate incinerator. The ashes are then separated into three fractions in the wash and sieve unit. Ferrous separators retrieve the iron from the two largest fractions. A non-ferrous separator retrieves mainly aluminium. The inert fraction is converted into granulates, which are used as secondary materials in construction. The smallest fraction is dehydrated and deposited in a landfill class 1 site. The installation has been designed and constructed in such a way that Indaver can respond to the changing market demands and comply with the most recent regulations.
Three end products result from the treatment of the incineration ashes. The ferrous and non-ferrous fractions, which can be recycled and the granulate fraction, with sizes from 0 to 2 mm. The user certificate that OVAM granted to Indaver allows the company to re-use the 2-6 and 6-50 mm fractions as formless base material, for example below foundations, or as formed construction material.

Appendix 5.3

Emergency Shutdown Procedure

Emergency Shutdown Procedure

The emergency shut down will bring the incinerator line to a safe status. The main objectives of the emergency shut down procedure are as follows:

- To shut down the plant safely, avoiding injury to staff or damage to equipment
- to minimise emissions
- to prevent over pressure in the furnace
- to protect equipment from damage caused by temperatures which are too high.

The emergency shut down will be initialised by situations such as:

- An electric power failure
- Simultaneous occurrence of a flue gas temperature at the outlet of the boiler above 250℃ and a failure of the water feed to the flue gas cleaning systems or a temperature at the inlet of the bag house filter of greater than 250℃
- Some plant interlocks including over-pressure in the furnace
- Manual alarm.

The experience of the operators of Indaver's plants in Flanders is that an emergency shut down is not a frequent occurrence. Over pressure in the furnace is the most common reason for an emergency shut down.

In case of failure of electrical power supply, motors and equipment required for the emergency shut down will be powered by the emergency generator.

The emergency shut down will be automatically executed in two steps.

Step 1 is the waste burn out. As soon as the emergency shut down commences all waste (and any back-up fuel) supply will be stopped immediately. The ID-fan will be stopped. The water supply to the spray tower and scrubbers will be stopped. An emergency supply may be provided for use in the spray tower, if the temperature of the flue gases exceeds 250ºC. This option will be decided at detailed design stage. A valve will be opened to supply water from the scrubber systems' emergency supply into the scrubbers in order to avoid overheating of the resin of the scrubbers.

The injection of activated carbon/lignite coke and lime will stop and may be reactivated by the operator, manually, once the reason for the shut down is known and it is determined that there will be no risk in doing so.

The inertia of the ID-fan will ensure that the flue gases will continue to be evacuated through the flue gas cleaning systems, prior to the start-up of the ID-fan via the auxiliary motor, which will be powered by the emergency generator.

In the grate furnace, air to burn out the residual waste will be drawn into the furnace because the inertia of the ID-fan will maintain under-pressure in the furnace. During this period the flue gas flow will drop quickly to less than 20 % of the normal flow. At this stage the waste in the furnace will be almost completely burned. Only a few bigger waste parts will still be smouldering. The auxiliary motor (with gear box) of the ID-fan will then be switched on and connected to the shaft by means of a clutch. The ID-fan, running on the auxiliary motor will continue for approximately 2 hours. The power of this motor will be enough to evacuate the remaining flue gas through the flue gas cleaning system. The water supply from the emergency water will then be stopped. The temperature in the scrubber will be measured. A fire water supply will be provided through an emergency nozzle, if the temperature is too high.

Step 2 is the cooling step. Once there is no more waste in the furnace, a small heat vent after the boiler, in the line before the flue gas cleaning systems, will be opened and the ID-fan stopped. The function of the heat vent will be to evacuate heat (not combustion gases) from the furnace to the atmosphere instead of to the flue gas cleaning system. The vent release will not be pressurised. The filter cake in the bag house filter will act as a barrier between the hot and the cold part of the plant. The approximate heat emitted from the plant during this process would be subject to the detailed design of the plant but would be in the order of 3MW.

The plant will now be safely shutdown. The furnace will be cooling down slowly by the natural draft through the heat vent.

In no instance will the heat vent be opened while there is waste in the furnace. During any emergency shutdown, while there is waste in the furnace all the flue gases pass through the gas cleaning system and are emitted through the stack. As stated above, the ID Fan is kept operating during the shutdown by means of an auxiliary motor and an emergency generator. In the event of an emergency shutdown and failure of the emergency generator the inertia of the ID Fan would continue to draw the flue gases through the gas cleaning system for an initial period. The heat vent would not be opened but there may be overpressure within the furnace. It is highly unlikely that there would be both an emergency shutdown and a failure of the emergency generator at the same time.

While step 1 of the shutdown sequence is underway, the combustion gases will continue to pass through the flue gas cleaning systems and the bag house filter and particulates will be removed as efficiently as during normal operations (except in the case of catastrophic failure of the baghouse). The activated carbon/lignite coke/lime mixture present on the sleeves of the bag house filter will continue to remove heavy metals, dioxins, HCl, HF and SO_2 from the combustion gases.

The combustion gases will pass through the reheater, which will heat the flue gases but not to a particular set point as during normal operation. The flue gases will then discharge to atmosphere via the stack, possibly with a visible plume.

In the event of a loss of mains power, key pumps, fans and other equipment required to ensure the orderly shut down described above, will be supplied with power from the emergency generator.

The fixed installed emissions monitoring equipment located on the stack will continue to monitor the emissions from the stack. In the event of loss of mains power, the monitoring equipment will be supplied with electricity from the Uninterruptible Power Supply (UPS) and emergency generator for a period of at least one hour.

A risk analysis will be carried out on this procedure during the detailed design phase of the project (in the form of a Hazard and Operability Study) during which the final details of the procedure will be decided.

Appendix 5.4

Seveso Assessment

Indaver Ireland,
Haddington Terrace,
Dún Laoghaire

20th January 2006

Ref: 06P0082
FBS: 321.07.01.24

Re: Classification of Carranstown under Seveso Regulations (SI 476 of 2000)

Dear Sirs,

We have been requested by Mr. Conor Jones, Construction Manager of Indaver Ireland to provide a technical opinion as to whether, at a throughput of a maximum of 200,000 tonnes per year of municipal waste, the proposed Municipal Solid Waste Incineration Plant at Carranstown, Co. Meath would be classified as a 'Seveso' site under the relevant "Seveso" Directive and Regulations in force in Ireland.

A new development can only qualify as a "Seveso" site if it exceeds an inventory threshold for dangerous substances in which case some or all of the provisions in the "*European Communities (Control of Major Accident Hazards Involving Dangerous Substances) Regulations*", (SI 476 of 2000) would apply to the site. These Regulations, signed in December 2000, implement the EU Seveso II Directive 96/82/EC in Ireland. The original Directive 96/82/EC has been amended by Directive 2003/105/EC in December 2003[1]. Where relevant the latest rules regarding inventory thresholds for Seveso sites contained in 2003/105/EC have been applied in this assessment.

At the time of preparing this letter (January 2006), the plant at Carranstown has not been built. The provisions in SI 476 relating to new establishments would be applicable to the Carranstown project if it were found to be a Seveso site. The purpose of this letter is to establish whether the proposed development at Carranstown would be a Seveso site once operational.

[1] We understand that the Irish Regulations implementing Directive 2003/105/EC are likely to be signed during the 1st Quarter of 2006.

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SI 476 of 2000 is specifically concerned with, and limited to, **Major** Accident Hazards. It is not the function of the Regulations to address the day-to-day operation of establishments during normal operations. These "normal" activities, including the monitoring of emissions and their acceptability, are governed by other legislation, including the EPA Act and EIS legislation. SI 476 is designed to protect man and the environment from the impacts arising from Major Accidents at qualifying establishments.

For a facility to qualify as a Seveso site and be regulated under SI 476, there must be the potential for a Major Accident **involving one or more dangerous substances** at the site. Both the Directive and the Regulations only apply to those establishments at which the quantities of dangerous substances present within the boundaries of the site (or which can be formed within or emitted from the site under abnormal conditions) can exceed certain minimum thresholds.

Parts 1 and 2 of the First Schedule to the Regulations in SI 476 set out two threshold levels (generally expressed in tonnes) for 51 'named substances' and for a list of 10 'categories of substances and preparations not specifically described as named substances (in the Directive)'.

Eight revised thresholds for named substances are set out in Directive 2003/105/EC. Formulae are provided in the notes to the First Schedule which may be used to assess the qualification of a specific site under SI 476 and these formulae have been further updated in the amending Directive of 2003. These formulae are based on addition rules that aggregate the quantities of specific categories of dangerous substances on a site. In order to determine if a site qualifies under Seveso the inventory of all Seveso substances expected to be present on the site must be examined. Having applied the addition rules there are three possible outcomes.

- The site is not a Seveso site provided no material exceeds its lower tier inventory threshold AND that no aggregated inventory of dangerous substances in any of three specified categories exceeds the lower of the two threshold levels set out in the First Schedule to the Regulations as amended by Directive 2003/105/EC.

- The site is a Lower Tier Seveso site if any material exceeds its Lower Tier Threshold or if the aggregated inventories of dangerous substances in a specified category exceed the lower thresholds (set out in Column 2 of the Tables in Part 1 and Part 2 of the First Schedule) and no named substance or aggregated category inventory is above the upper thresholds (set out in Column 3 of same). Lower Tier sites are generally deemed to be less hazardous that an Upper Tier Site and only some of the Regulations in SO 476 apply.

- The site is an **Upper Tier Seveso** site if any material or any of the aggregated inventories exceed the Upper Tier threshold values for a named substance or category. All of the Regulations set out in SI 476 of 2000 apply to Upper Tier Sites.

In order to provide an opinion on whether the proposed operation at Carranstown would be a classified as a Seveso site we undertook the following actions.

- We reviewed the inventory threshold data from the First Schedule of the Regulations of SI 476 and prepared an electronic version of the First Schedule in the form of a Yes / No questionnaire. We requested Indaver Ireland to complete this questionnaire in 2001 by clearly indicating which of the 'named substances' and which of the generic categories of dangerous substances are expected to be present on their site.

- In January 2006 we sought information from Indaver in respect of any changes in substance inventories which would result from the proposed change from 150,000 tonnes per year to a maximum of 200,000 tonnes per annum of municipal waste throughput.

- In all instances where Indaver indicated that a Seveso substance would be present at the site, they provided data on the maximum inventory expected for each type of substance over a 5-year look ahead.

- Although Section 4.2 (v) of S.I. 476 states that the regulations do not apply to the transport of dangerous substances in pipelines and pumping stations, we have, following discussions with the HSA in 2001, assessed the inventory of natural gas in the pipeline which traverses the Indaver site. In the cases of natural gas the inventory assessment in the pipeline under the site was based on the pipeline diameter (200 mm), gas pressure (60 bar) and length of pipeline within the site boundary(300m).

- For dioxins, petroleum products, HCL solutions and ammonia solutions we estimated the inventories based on storage quantities and concentration data supplied by Indaver. The result of the inventory assessments are shown in the tables below.

Of the 51 named substances in the Regulations and the amended Directive of 2003 , Indaver predict that only the four named substances set out in Table 1 below are projected to be present at the proposed facility in any predictable quantities.

Table 1: Review of Inventory of 'Named Substances'

Named Substance[1]	Max Quantity on Site (tonnes)	Lower Tier Threshold (tonnes)	Upper Tier Threshold (tonnes)	Expected Inventory as % of Lower Tier Threshold	Margin of safety below Lower Tier Threshold
Natural Gas –present in a gas pipeline crossing the site.	0.62	50	200	1.24	81
Polychlorodibenzofurans and Polychlorodibenzodioxins (including TCDD) calculated in TCDD equivalent – present in incoming domestic / municipal waste and also in 3 types of waste ash. (See Annex 1 for calculation of maximum inventory)	0.00000052	N/A	0.001	0.052	1929
Automotive Petrol – present in fuel tanks of employees cars – based on 40 cars with 30 l/tank & petrol density of 0.7 kg/l plus Diesel Oil (Defined in Directive as including diesel fuels, home heating oils, and gas oil blending streams)	105.84	2500	25000	4.23	24
Hydrogen Chloride[2]	0.02	25	250	0.08	1250

Notes:

1. It can be assumed that the above are the only named substances that Indaver expect on their site in a predictable quantity. However, small quantities of other named substances could enter

the site via household waste streams e.g. minor LPG residues in aerosols, household cleaning agents in empty containers etc.

2. The material present on the site is aqueous Hydrogen Chloride as a 30% solution. The maximum quantity of solution stored is 1 tonne and the material is stored indoors. The solution is not classified as a Seveso substance in its own right. However, we have included in the inventory 20 kg of Hydrogen Chloride gas (which is a dangerous substance) because this quantity could be evolved over a 1 hour period in the event of a spill of the 30 % solution.

As can be seen from the above table, the quantities of 'named substances' that are expected to be present on the Indaver site at any one time are all well below their respective minimum thresholds at which the site would qualify for regulation under SI 476 (either as a Lower or Upper Tier site).

In the case of the aggregate of dioxins in the incoming waste and ash streams the expected maximum site inventory at any time is projected to be a factor of 1,930 (one thousand, nine hundred and thirty) times lower than the quantity which would qualify the site as a Seveso site based on the threshold for dioxins. (See Tables 3,4 and 5 for the effects of aggregation of several substances.)

The named substance with the highest percentage of the Lower Tier Threshold limit is the category of named substances entitles "Petroleum Products". The inventory of this category of named substances is 105.8 tonnes[2] and the factor by which this quantity is below the Lower Tier Threshold is 24.

In addition to checking the status by reference to the thresholds for Named Seveso substances in the Directives, it is also necessary to compute inventory levels for substances under three categories. These categories are

- substances categorised as toxic or very toxic
- substances which are Dangerous for the Environment
- Flammable substances.

[2] Assuming, conservatively that the light fuel oil proposed by Indaver falls under the new category of Gas Oils in Directive 2003/105/EC.

Table 2: Review of Categories of Substances not specifically named in SI 476 or 2003/105/EC

Category of Substance	**Max Quantity on Site (tonnes)**	**Lower Tier Threshold (tonnes)**	**Upper Tier Threshold (tonnes)**	**Expected Inventory as % of Lower Tier Threshold**
Dangerous for the environment in combination with the risk phrase R50 (very toxic to aquatic organisms): Indaver will store 50 tonnes of a 25% Ammonia Solution. This is used as chemical injected into incinerators to suppress NOx formation. A small amount is also used for water treatment. At concentration >=25% this substance has the Risk Phrase R50 and the Seveso threshold is as shown in table.	50[3]	100	200	50
Dangerous for the environment in combination with the risk phrase R53 (may cause long term adverse effects in the aquatic environment): Indaver will store 5 tonnes of diesel fuel for machinery. It will also store 100 tonnes of light fuel oil. If this oil is in the diesel range the Risk Phrase R51/53 would apply and the appropriate threshold is that of a **named substance** "Gas Oils" under EU Directive 2003/105/EC	105	2500[4]	25,000	4.2

Note: It can be assumed that the above are the only Categories of substances and preparations listed in Part 2 of the First Schedule that Indaver expect on their site. However, small quantities of other categories could enter the site via household waste streams e.g. trace quantities of flammable liquids, other materials that are dangerous to the aquatic environment in household cleaning agents etc.

[3] Revised Threshold for substances with R50 Risk Phrases in Directive 2003/105/EC of 16th December 2003
[4] Revised threshold for named "Petroleum Products" per Directive 2003/105/EC of 16th December 2003

The addition rules involve the calculation of a value, commonly referred to as the *q/Q* value, for each Seveso substance, where:

q = quantity of the substance present on the site;

Q = threshold quantity for either Lower or Upper Tier site.

In accordance with Directive 2003/105/EC the *q/Q* values are now to be aggregated separately under three different categories. These are (a) q/Q for all toxic substances (b) q/Q for substances dangerous to the aquatic environment and (c) for all flammable substances present at the site. The results of these calculations are set out in Tables 3 and 4 and 5 below.

Table 3: Addition Rule for Toxic Substances at Proposed Indaver Facility

Substance	***Q* *(tonnes)***	***$Q_{Lower\ Tier}$* *(tonnes)***	***q/Q***
Dioxins	0.00000054	0.001	0.00054
HCl gas	0.02	25	0.0008
Sum *q/Q* for toxics			**0.00134**

Table 4: Addition Rule for Substances Dangerous to Environment at Proposed Indaver Facility

Substance	***Q* *(tonnes)***	***$Q_{Lower\ Tier}$* *(tonnes)***	***q/Q***
Ammonia Solution (25%) (R50)	50	100	0.50
Petroleum Products (Named Substance – Gas Oil and automotive petrol)	105.84	2500	0.042
Sum *q/Q* for Dangerous to Environment			**0.542**

Table 5: Addition Rule for Flammable Substances at Proposed Indaver Facility

Substance	***Q* (tonnes)**	***$Q_{Lower Tier}$* (tonnes)**	***q*/*Q***
Natural Gas – in pipeline on site (Named Substance)	0.62	50	0.0124
Automotive Petrol – in employees cars (Named Substance)	0.84	2500	0.000168
Sum *q*/*Q* for Flammables			**0.0126**

Note: The oil which Indaver will use as fuel is classified as a Class 3 Petroleum liquid and does not have the risk phrases which would render it a flammable liquid as defined under the Seveso Regulations. The petrol in employee cars is flammable and is included in the q/Q computation for completeness of the inventory of flammable substances.

Since the sums of all of the three calculated *q*/*Q* values for toxic, dangerous to the environment and flammable substance groupings (based on the Lower Tier thresholds) are all less than 1.0, the proposed facility would not be classified as a Seveso Site under SI 476 of 2000 based on the inventories of dangerous substances associated with a plant of capacity of 200,000 tonnes per year.

Based on the information provided to us by Indaver Ireland, it is our view that the proposed incineration facility at Carranstown, Co. Meath is **not** one to which the Seveso Regulations apply i.e. the site is not a Seveso site. The closest substance group to the Seveso threshold is that for the ammonia solution used to reduce emissions to the atmosphere of NOx. At the maximum inventory level for this substance it will be a factor of 1.85 times lower than the minimum inventory for a Seveso II site.

Indaver may use this letter, when it is quoted in full, for the purpose of informing discussions with the HSA.

Yours sincerely

Thomas Cleary BE, C Eng, Eur Ing, FIChemE, FIEI

Partner

Annex 1

Estimation of Dioxin Inventory on Site

An estimate of the maximum dioxin inventory on the Carranstown site was conducted as set out below.

The dioxins on the site are associated with different waste streams including incoming municipal solid waste and by-product ash streams. In order to calculate the maximum combined inventory the design basis and bunker sizes for different streams were provided by Indaver. Dioxin concentrations in the individual waste streams were provided by Indaver based on operating experience with municipal waste incineration facilities in Belgium.

Table A1: Derivation of Maximum Dioxin Inventory on Carranstown site

Material Containing Dioxin	Max Bunker Capacity (m3)	Maximum Quantity[1] of waste expected to be on the site at any time (tonnes)	Dioxin Concentration (pg TEQ/g)	Maximum Dioxin Inventory (g TEQ)
Incoming Municipal Waste	16,000	6,400	50[2]	0.320
Bottom Ash	1600	1,600	5[3]	0.008
Boiler Ash	200	120	216[3]	0.026
Flue gas cleaning residue	420	252	653[3]	0.165
Total		-	-	**0.518**

Notes:

1. *Based on proposed plant design philosophy, bunker sizes, inventories etc.*
2. *Based on measurements by VITO laboratory, Belgium.*
3. *Measurements by IAWG (International Ash Working Group).*

The total expected inventory is estimated to be 1,929 (one thousand, nine hundred and twenty nine) times lower than the quantity which would qualify the site as a Seveso site based on dioxins alone.