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ENERGY AND CLIMATE CHANGE
ENVIRONMENT AND SUSTAINABILITY
INFRASTRUCTURE AND UTILITIES
LAND AND PROPERTY
MINING AND MINERAL PROCESSING
MINERAL ESTATES
WASTE RESOURCE MANAGEMENT

ENDLESS ENERGY LIMITED

ENDLESS ENERGY FACILITY

ENERGY REPORT

SEPTEMBER 2018

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CONTENTS

TABLES

APPENDICES

1 BASIC ENERGY REQUIREMENTS

1.1 Energy Consumption

1.1.1 Guidance for the Recovery and Disposal of Hazardous and Non Hazardous Waste (Environment Agency, October 2003)[1] and Guidance for the Incineration of Waste and Fuel Manufactured from or Including Waste (Environment Agency, July 2004)[2] requires operators to provide a breakdown of energy consumption and generation by source and the associated emissions.

1.1.2 Figures provided for the operation of the Endless Energy Facility show that it will treat 148,800 tonnes of waste per annum. The facility has a flexible processing capacity in order to operate continuously with low calorific value (LCV) waste from 8,000 to 14,000 KJ/Kg, which accommodates a broad range of waste types. The site will run for approximately 8,000 hours per year.

1.1.3 Energy output in terms of electricity produced by the plant to the electrical grid will be around 11.35MWe. The plant converts waste to energy via combustion. The heat that is generated as a result of burning waste generates steam within a boiler which drives a turbine connected to a generator. The site uses a reverse-acting moving grate in the combustion chamber; a proven technology that can be adjusted to ensure complete combustion of variable waste types and therefore provides good energy recovery from the waste itself.

1.1.4 The boiler and associated equipment will be of the type and quality suitable for a Commercial and Industrial (C&I) waste incineration plant and will meet the steam requirements of the turbine generator as well as all other steam requirements of the plant. Heat is used to pre-heat boiler water and combustion air, improving the efficiency of the plant.

1.1.5 Diesel oil may be required for start-up and shut down of the site and to maintain temperature where required. Auxiliary burners within the furnace are designed to:

[1] Sector Guidance Note S5.06
[2] Sector Guidance Note IPCC S5.01

- raise the temperature in the combustion chamber prior to starting up from cold and during shutting down of the plant;
- ignite the waste at the start-up of the plant following shut down periods; and
- comply with the IED requirements for control of flue gas emissions. This requires that whenever the temperature falls below 850°C after a flue gas residence time of 2 seconds a standby burner must operate automatically to maintain the temperature whilst there is waste on the grate.

1.1.6 Annual consumption of diesel oil for the site is around 60 tonnes/year. During normal operations there is no additional energy input.

1.1.7 Table 1:1 identifies the estimated total energy consumption per annum, i.e. electricity and diesel oil use. The plant operates on a parasitic load (self-consumption) when the steam turbine is in operation.

1.1.8 Energy that is generated at the plant will be exported to the National Grid. Overall approximately 11.35MW of energy will be exported to the local electricity network by an underground cable. This is sufficient to power around 20,000 homes. The facility will produce electricity but will be CHP ready and will produce a heat supply if and when a local user becomes available.

Table 1:1 Estimated Annual Energy Consumption

Energy Source	Supply units	Energy consumption		Primary Energy Consumption MWh
		Delivered Units	Conversion Factor	
Electricity (from National Grid)	MWh	0	2.6[1]	0
Electricity (parasitic supply)	MWh	14,400	1	14,400
Diesel Oil	Kg	60,000	1	60
Total	MWh	14,460		14,460

Notes
1. Factor for conversion of delivered units to primary energy consumed in accordance with section 2.7.1 of the Environment Agency's H2 guidance Energy Efficiency)
2. The electrical consumption of the plant is produced by the plant itself.

1.2 *Specific Energy Requirements*

1.2.1 The specific energy consumption (SEC) for the site is defined as MWh per tonne of waste received. This will enable comparison of the site's SEC to industry standards.

1.2.2 The calculation of the SEC, using data from Table 1, will be made over the duration of one year and will be calculated as follows:

$$SEC = \frac{\text{total primary energy consumption (kWh)}}{\text{total amount of waste received (tonnes)}}$$

1.2.3 The calculation of SEC will be completed on an annual basis, and will be included within the annual site review. Table 1:2 shows a prediction of SEC for the first year of operation at the site. It is based on a maximum waste throughput of 148,800 tonnes per annum and a total energy consumption of 7,421 MWh per annum.

Table 1:2: Projected SEC for First Year of Operation

Year	Total Energy Consumption (kWh)	Total Waste Received (tonnes)	Projected SEC for year (kWh/ Tonne)
1	14,460.00	148,800	97.2

1.2.4 It is noted that over 95% of this energy is recovered from the waste itself and so consumption of imported energy is minimal (<5% of the total).

1.2.5 The facility will produce 90,800MWh of electricity per annum for export to the National Grid. 14,400MWh of energy may be used on site each year. Net production at the site will be 76,400MWh.

2 ELECTRICITY GENERATION BENCHMARK

2.1.1 Guidance for the Incineration of Waste and Fuel Manufactured from or Including Waste (Environment Agency, July 2004) provides a benchmark value for the amount of electricity generated from waste. The Guidance states that where electricity only is generated, 5 to 8MW of electricity should be recoverable per 100,000 tonnes of waste material treated.

2.1.2 The site will process 148,800 tonnes per annum of residual, commercial and industrial wastes of a similar nature to unsorted municipal solid waste. A rating of 11.35MWe based on this quantity of waste equates to an electricity generation value of 7.6MW per 100,000 tonnes of waste for benchmarking purposes, comfortably above the benchmark figure.

2.1.3 An R1 calculation has been completed and is included in the application. This shows that the site will achieve an R1 value of 0.74 and therefore recovers clean energy with sufficient efficiency to be classed as a recovery and not a disposal operation. The full R1 calculation is attached as Appendix 1.

2.1.4 This R1 calculation accounts for the generation of electricity only. A conservative position is provided, discounting heat supplied to third parties. A heat supply will be established at the facility, allowing for heat to be provided to a nearby data hotel. Despite discounting heat supply, the R1 calculation is shown to be above the required efficiency levels.

3 ENERGY EFFICIENCY MEASURES

3.1.1 An Energy Efficiency Plan will be prepared for the site, detailing how energy usage and consumption can be minimised. Measures that are detailed within the plan will be implemented within processes at the site. The plan will be reviewed at least every four years.

3.1.2 Energy efficiency techniques and advice are detailed to staff at inductions and training sessions. This will include simple housekeeping measures such as turning of lights when leaving a room and closing doors to retain heat.

3.1.3 Low energy bulbs will be used for lighting. Daylight and motion sensors may also be used to save energy.

3.1.4 In terms of the process, this is designed to achieve high levels of efficiency with close control over the combustion process. The waste feed is sealed to prevent the ingress of air and maintain optimal oxygen levels within the furnace to ensure complete combustion whilst maintaining efficiency.

3.1.5 The boiler incorporates on-line cleaning and all heat exchange surfaces will be kept clean to ensure optimum performance. Boiler water is conditioned using ion exchange, which uses less energy than membrane based systems.

3.1.6 Steam from the turbine bleeds is utilised to pre-heat water condensate, boiler water and combustion air, improving the efficiency of the process. Options are being explored to identify potential off-takers for the remaining heat.

3.1.7 Consistent flow of waste will be maintained during operations. Real time monitoring of waste and electricity demand will be undertaken in order to ensure that the plant is running efficiently.

3.1.8 Energy consumption at the site will be monitored in accordance with the EMS. Consumption will be reviewed annually to identify trends and any areas where energy efficiency can be improved. The electricity use will be metered to provide accurate figures.

3.1.9 Buildings will be thermally insulated to reduce heat loss and minimise heating requirements. The plant is provided with a high standard of insulation both to minimise the temperature of external surfaces, as a health and safety precaution, and also to retain heat within the system and minimise losses providing a high degree of energy efficiency.

3.1.10 Energy efficiency will be a consideration in the acquisition of new plant and equipment with low energy options being selected where possible. All plant and equipment will be serviced in accordance with manufacturers' requirements to ensure that energy efficiency is maintained.

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