KRIGER 2.0 MW_{th} BIOMASS BOILER INSTALLATION MCP/SG ENVIRONMENTAL PERMIT APPLICATION JCG HALE LIMITED JUNE 2019

Energy Efficiency

Energy represents a significant proportion of process costs associated with the operation of the Kriger 2.0 MW_{th} biomass boiler, and therefore, JCG Hale Limited considers it important to minimise the actual use of energy and to employ energy efficient techniques wherever practicable throughout the Installation.

It is recognised that there are both environmental and financial benefits associated with the reduction and minimisation of energy usage. Even small percentage savings in energy consumption can represent considerable financial savings and environmental benefits through emission reductions.

Energy Recovery

The Kriger 2.0 MW_{th} biomass boiler is intended specifically to recover energy, via combustion, from virgin timber wood chip fuel arising from on-site timber processing activities. Energy is recovered from the hot combustion flue gas in a boiler that generates 125ºC hot water for use in an associated ORC electrical generator and on-site space and process heating applications. The boiler will use the clean off-cuts, creating local energy for on-site use rather than being shipped off site for other recovery, recycling or disposal.

The Kriger 2.0 MW_{th} biomass boiler will generate up to approximately 19,000 MWhr of renewable thermal energy that will be utilised by on-site space heating and process operations on an annual basis, depending on the variability of the moisture content and calorific value of the wood chip fuel. The Kriger 2.0 MW_{th} biomass boiler will provide a dedicated heat supply to on-site space and process heating operations, which use all of the available heat that the boiler can generate.

The installation also incorporates an Organic Rankine Cycle (ORC) power generation unit that generates approximately 110 KW of renewable electricity for use predominantly within the site.

Energy Consumption

The main activities associated with the operation of the Kriger 2.0 MW_{th} biomass boiler are summarised in Appendix 2 of this Environmental Permit application.

The annual energy balance relating to the Kriger 2.0 MW_{th} biomass boiler is summarised in the following table and is based upon the utilisation of approximately 525 kg/hour (4,200 T/annum) of virgin timber wood chip fuel, depending upon the moisture content and calorific value of the fuel.

Energy Associated with Biomass Combustion	
Wood chip fuel feedrate (kg/hr)	525
CV of Wood Chip (MJ/kg)	16.32
Total Energy (J/hr)	8,566,740,000
Total Energy per hour (MWhr)	2.38
Number of Operational Hours	8,000
Total Energy input per year (MWhr)	19,037
Total Energy output per year (MWhr)	16,000
ORC Output	
Rating (kWe)	
Electrical Output (kWhr)	110
Number of Operational Hours	8,000
Total Energy per year (MWhr)	880

The ORC unit will generate up to 880 MWhr of renewable electricity per year for use predominantly within the JCG Hale Ltd site, assuming 8,000 operational hours per year, and will offset the requirement to import the equivalent amount of electricity from the mains.

Basic Energy Efficient Physical Measures

The basic, low cost physical techniques that are incorporated into the biomass boiler include the following:

- Insulation on all hot water pipe-work, boiler, combustion plant (high efficiency refractory insulation);
- High-efficiency electric motors for all drives;
- An automated system (setting) of the biomass boiler minimises the actual energy consumption;
- Provision of both forced draught (FD) and induced draught (ID) fans to ensure stable, efficient combustion conditions.

As a combustion process, it is important to ensure that all connecting joints and flanges within the Kriger 2.0 MW_{th} biomass boiler are sealed effectively to prevent the egress of combustion gases that may pose a risk to the health of the workforce. In so doing, the gas-tight containment of the process equipment minimises the escape of hot flue gas that would otherwise reduce the overall thermal efficiency of the boiler, which could require additional supplementary fuel firing to maintain operating temperatures.

Building Services Energy Efficiency Measures

The Kriger 2.0 MW_{th} biomass boiler and the associated space heating activities are considered to be energy-intensive, therefore the energy use directly associated with the building services is of minor impact when compared with the process use. Building services are expected to account for less than 1% of the total energy use.

Further Energy Efficiency Requirements

Energy management techniques will be incorporated into the Environmental Management System (EMS) that will direct the operation of the Kriger 2.0 MW_{th} biomass boiler, however, the following provides a concise overview of the techniques and measures that JCG Hale Ltd may employ in the operation of the boiler and their other site processes:

On a Continuous basis: Use of a centralised PLC control panel to manage the operation of the boiler, all of the feed mechanisms and ash extraction in addition to primary and secondary air and boiler pumps. The use of this Critical Control System and of Standard Operating Procedures will ensure operators are able to identify, monitor and maintain optimum process operating conditions;

Each Shift: Hourly recording of key process conditions. The Kriger 2.0 MW_{th} biomass boiler will have a computerised system to record trends and data. Although this over-writes every 48-hours, any important condition or variation in performance will be manually recorded from the log;

Daily: review of key energy production figures and environmental performance;

Monthly: tracking of energy efficiencies within the system and delivery of heat and power to the industrial estate for use.

Combustion efficiency within the Kriger 2.0 MW_{th} biomass boiler will be optimised by employing the following measures:

- Moving grate combustion system to ensure even combustion throughout the system for improved efficiency;
- Computer control to ensure stable combustion at low and high output levels, and to facilitate automatic turndown to as little as 30% of design capacity;

- Self-cleaning heat exchanger to ensure that the biomass boiler works at optimum efficiency at all times;
- Flue gas recirculation system to control combustion temperatures and minimise the formation of Oxides of Nitrogen.

The Kriger 2.0 MW_{th} biomass boiler has been designed to comply with the principles of Best Available Techniques (BAT) for the combustion of biomass fuels and incorporates a range of monitoring and control features to optimise combustion and the associated recovery of thermal energy from the wood chip fuel, while at the same time minimising pollutant emissions and the generation of solid residues. It is recognised that even with the above factors incorporated into the design of the biomass boiler, the energy recovery efficiency of the facility may vary throughout the year. The principal reason for this may be due to seasonal variability in the moisture content of the seasoned virgin timber supplied to the on-site manufacturing processes.

The parasitic electrical load used by the Kriger 2.0 MW_{th} biomass boiler will be minimised by employing variable speed drives for all fans, motors and pumps operating at less than full load for significant periods, including the combustion forced draft and induced draft fans. This is an automated system managed through the control panel. The design of the Kriger 2.0 MW_{th} biomass boiler will ensure that the efficiency of energy utilisation is optimised at all times.

The supply of electrical and thermal energy generated by the biomass boiler will be used predominantly to provide heat and power to the JCG Hale Ltd site.

CO_2 Emissions Reductions via the Combustion of Virgin Timber Wood Chip Fuel

The Kriger 2.0 MW_{th} biomass boiler will produce approximately 2.0 MW_{th} of 125 ºC hot water for supply to the associated ORC and on-site space and process heating operations, which equates to approximately 16,000 MWhr $annum^{-1}$ of useable, renewable thermal energy generated by the boiler. It is estimated that if all of the thermal energy supplied to on-site space and process heating applications was instead generated by an electrical heating system, then approximately 4,500 tonnes of CO_2 would be released to the atmosphere each year. Over the twenty-year operational lifetime of the boiler, this would equate to emissions of about 90,000 tonnes of CO_2 from the burning of non-renewable fossil fuels in UK power stations, which are eliminated by the use of the biomass boiler. This estimate is based upon a CO_2 emission factor of 283 kg per MWhr provided by DEFRA for total UK electricity generation and total UK Carbon Dioxide emissions from electricity generation[1].

The associated ORC system is capable of generating up to approximately 880 MWhr of renewable electricity per year, with additional associated savings in CO_2 emissions of approximately 250 tonnes per year for each system. Accordingly, the aforementioned CO_2 tonnage increases to approximately 4,750 tonnes per annum offset in emissions of CO_2 due to the operation of the Kriger 2.0 MW_{th} biomass boiler burning virgin timber wood chip fuel sourced from on-site manufacturing processes. This represents a small but significant contribution towards the national CO_2 emissions reductions targets.

[1] https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2018