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

Discharges and Air Quality

The installation of the Kriger 2.0 MW_{th} biomass boiler at the JCG Hale Ltd site will result in a number of emissions, most notably emissions to air. The potential impact of the emissions to atmosphere has been considered in a detailed air quality assessment appended to this section.

Chimney Height Considerations

The chimney of the Kriger 2.0 MW_{th} biomass boiler has been designed from the perspective of providing effective dispersion of emissions generated by the combustion of the wood chip fuel. The D1 guidance[1] was followed initially to calculate the height of the chimney required to provide effective dispersion, and was based upon the anticipated flue gas volumetric flowrate and the maximum emission limit values specified for regulation by the draft Secretary of State's Guidance Note PG 5/1(18) for the combustion of waste wood, and in line with the requirements of the MCPD. Reference was also made to estimates of background air quality data typical of the locality, provided by the DEFRA 2015 Background Maps website[2]. Discharge conditions for the chimney of the Kriger 2.0 MW_{th} biomass boiler were supplied by Novalux Energy Ltd and their technology providers, Woodtek Energy Ltd and Kriger.

The D1 guidance defines the basis of the method for calculating chimney height as follows:

> *The calculation method assumes that the discharge stack height is governed by the need to limit local ground level pollutant concentrations below a maximum level that might occur for short periods (the AQS objective values). By "local" is meant the region within a distance of about one hundred stack heights (~1.0km in the case of the Kriger 2.0 MW_{th} biomass boiler) where the occasional contribution of a single pollution source to short term pollution levels can be large.*
> *The target period is 15 to 30 minutes, but this covers acceptably a range of between about 5 minutes and an hour's duration.*

The presumption is that human health effects are the major consideration.

The results from the D1 calculation indicated that a chimney height of 16-metres was required to ensure effective dispersion of emissions from the Kriger 2.0 MW_{th} biomass boiler. The D1 calculation procedure is a screening technique, and makes the following statement with regard to accuracy:

> *It lays out a relatively simple, non-specific method of approximately determining the heights of discharge stacks for polluting emissions, which should be adequate in normal circumstances.*

Accordingly, the chimney height predicted by the D1 calculation procedure should be taken as indicative of the height required to ensure effective dispersion of pollutant emissions from the Kriger 2.0 MW_{th} biomass boiler. A copy of the D1 calculation printout is appended to this document.

To provide a more reliable estimate of the required chimney height for the Kriger 2.0 MW_{th} biomass boiler, an iterative chimney height assessment was undertaken, based upon atmospheric dispersion modelling using the ADMS Version 5.2 model. Modelling was undertaken to assess the impact of emissions of NO_X on background NO_2 concentrations, due to the operation of the Kriger 2.0 MW_{th} biomass boiler. The results are summarised in the following table and figure.

[1] Technical Guidance Note (Dispersion) D1, Her Majesty's Inspectorate of Pollution (1993)
[2] https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2015

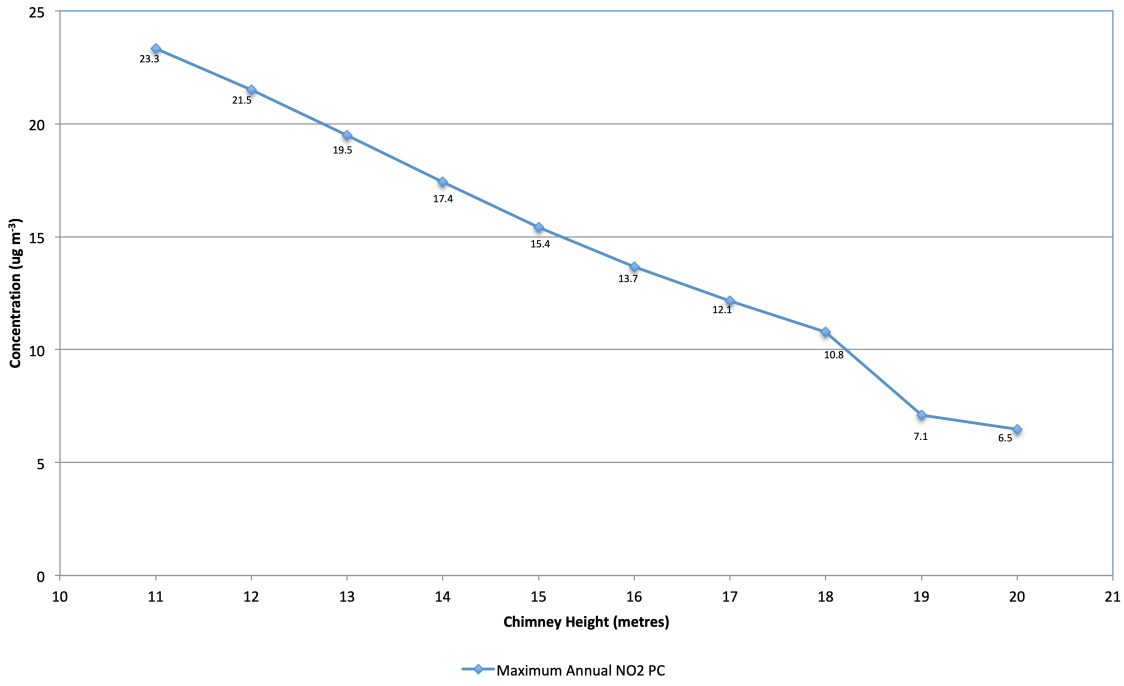
Chimney Height (m)	Maximum Annual Average NO_2 PC ($\mu g\ m^{-3}$)	Maximum Annual Average NO_2 PC as a % of AQS Objective Value	Maximum Hourly Average NO_2 PC ($\mu g\ m^{-3}$)	Maximum Hourly Average NO_2 PC as a % of AQS Objective Value
11	23.3	58%	65.5	33%
12	21.5	54%	57.7	29%
13	19.5	49%	56.6	28%
14	17.4	44%	55.4	28%
15	15.4	39%	53.1	27%
16	13.7	34%	50.8	25%
17	12.1	30%	48.4	24%
18	10.8	27%	46.0	23%
19	7.1	18%	43.7	22%
20	6.5	16%	41.3	21%

It should be noted that the location of the maximum Process Contribution is within the confines of the site boundary, close to the chimney of the biomass boiler. Process Contributions at nearby residential properties are considerably lower, in relation to their distance from the site.

The results indicate that the maximum annual average NO_2 Process Contributions are significantly above the 1% insignificance threshold specified by Environment Agency/NRW guidance. However, when considered in relation to the estimated background concentration of 11.1 µg m^{-3}, the resulting Predicted Environmental Concentrations (PECs) remain within the Welsh Air Quality Standards (AQS) objective value. The PEC for a 16-metre chimney represents a value that is 62% of the AQS objective value and can therefore be screened out at the second stage recommended by Environment Agency/NRW.

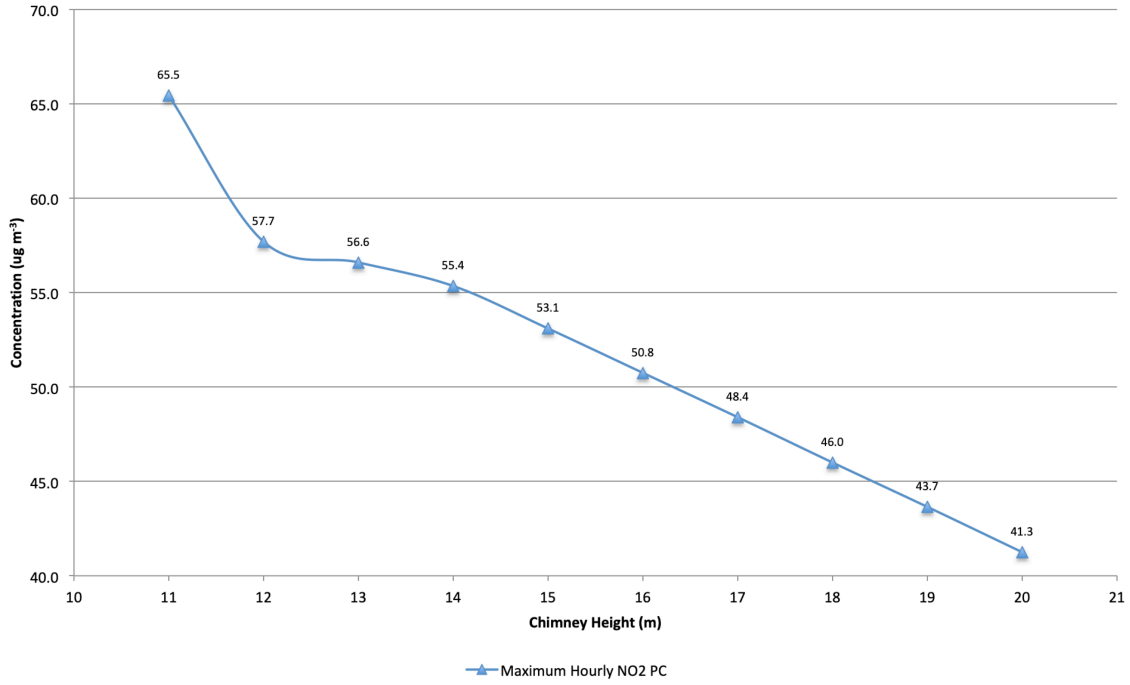
When the results are plotted on a graph, the pattern for the maximum annual average NO_2 Process Contribution is as shown in the following figure.

Figure 1 Variation in Maximum Annual Average Process Contribution of NO_2 ($\mu g\ m^{-3}$) with Different Chimney Heights



The corresponding graph for the maximum hourly average NO_2 Process Contribution is shown in the following figure.

Figure 2 Variation in Maximum Hourly Average Process Contribution of NO_2 (µg m^{-3}) with Different Chimney Heights



The results from the iterative chimney height assessment for the biomass boiler indicate that the maximum annual average and hourly average NO_2 Process Contributions would be approximately 13.7 µg m^{-3} and 51 µg m^{-3} respectively, for the D1-calculated stack height of 16-metres. There is a significant change in the gradient of the line for the hourly average Process Contribution for a chimney height of 13-metres. The change in gradient is generally considered to be indicative of the height when emissions from a chimney escape from the effects of downwash, associated with the passage of the winds over adjacent buildings and structures. However, this effect is not shown by the annual average Process Contributions which instead show a steady decline to 18 m. The break in this graph is instead due to a change in the location of the maximum value.

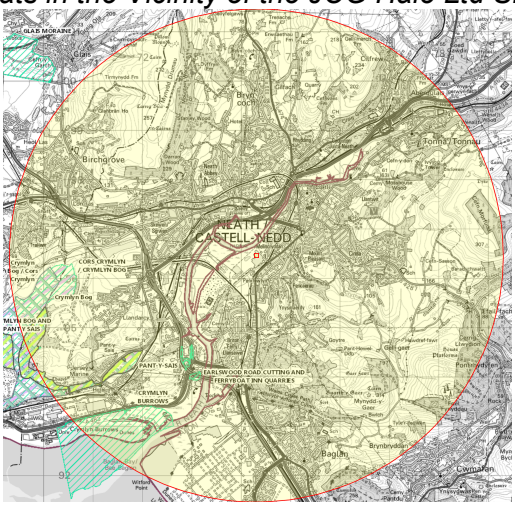
As the D1 calculation indicates that a 16-metre high chimney will provide effective dispersion of emissions from the biomass boiler, and the fact that the associated PEC value can be screened out as insignificant in relation to Environment Agency/NRW guidance, JCG Hale Ltd propose to install a 16 metre high chimney.

Detailed atmospheric dispersion modelling of emissions from the Kriger 2.0 MW_{th} biomass boiler was undertaken subsequently on the basis of a 16-metre high chimney. The objective of the study was to assess the impact on local air quality at nearby residential receptors of emissions from the Kriger 2.0 MW_{th} biomass boiler at the JCG Hale Ltd site. A copy of the detailed report is appended to this document.

Ecological Habitats in the Vicinity of the JCG Hale Ltd Site

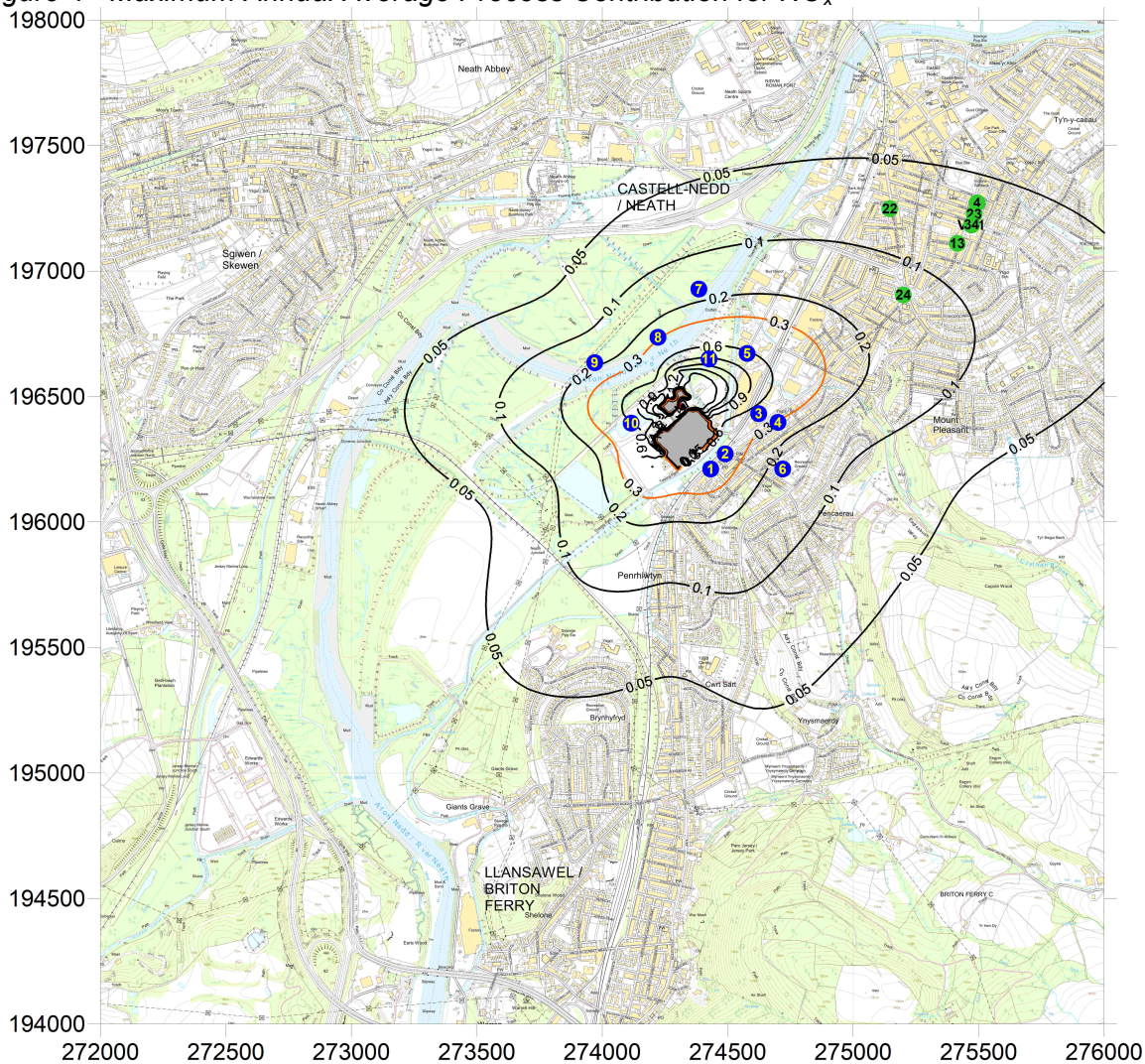
There are no statutory ecological habitat sites within 2km of the JCG Hale Ltd site, although there are six SSSIs within 5.0 km of the chimney of the Kriger boiler, predominantly located to the south-west of the site, and hence in an upwind direction. The SSSIs are designated for their ecological significance and could potentially be affected by emissions from the Kriger 2.0 MW_{th} biomass boiler, hence they were included as specific receptors in the dispersion model.

Figure 3 Ecological Habitats in the Vicinity of the JCG Hale Ltd Site



A screening assessment of the potential impact on the nearby SSSIs and woodland habitats of emissions from the Kriger 2.0 MW_{th} biomass boiler, was undertaken using the ADMS 5.2 atmospheric dispersion model. The results are presented graphically in the figure below as the annual average NO_X process contribution.

Figure 4 Maximum Annual Average Process Contribution for NO_x



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The orange contour represents an increase in the annual average NO_X concentration of 0.3 µg m^{-3}, equivalent to 1% of the 30 µg m^{-3} critical level for the protection of ecosystems, and the impact at locations outside of the contour can be screened out as insignificant in relation to Environment Agency/NRW guidance. Annual average NO_X concentrations in the vicinity of the site are estimated to be about 15.0 µg m^{-3}, with the resulting Predicted Environmental Concentration at nearby sensitive ecological receptors of up to about 16.0 µg m^{-3} or less, representing a value that is about one half of the critical level. Accordingly the impact of NO_X emissions from the Kriger 2.0 MW_{th} biomass boiler on nearby SSSI and woodland habitats can be screened out as insignificant in line with Natural Resources Wales guidance[3].

Due to the low sulphur content of the wood chip that will be utilised as fuel, similar conclusions can be drawn for emissions of sulphur dioxide and acid deposition.

Odour

The Kriger 2.0 MW_{th} biomass boiler is smokeless during operation, as it uses the latest combustion technology to ensure efficient combustion at all times. Therefore, there will be no perceptible odour associated with emissions from the chimney of the biomass boiler.

The wood chip fuel to be utilised on site will be stored undercover within a fully enclosed building. Therefore, there is little opportunity for anaerobic processes to degrade the wood chip fuel, and there will be no unpleasant odours associated with the reception, storage and handling of the biomass fuel.

Emissions to Land

Bottom ash is a by-product of the biomass combustion process, and will be stored on-site within a sealed container while awaiting collection. The bottom ash will have beneficial properties for use as a fertiliser, and may be used as a soil conditioner subject to the appropriate approval of NRW and the Food Standards Agency.

The fly ash recovered by the ceramic filter will be stored separately from the bottom ash in sealed containers while awaiting collection. The fly ash will have a similar chemical composition to the bottom ash and will probably be classified as non-hazardous waste, and may be used as a soil conditioner subject to the appropriate approval of NRW and the Food Standards Agency.

Typically total ash production from the wood chip fuel is expected to be <2% by weight and approximately 250 tonne per annum of ash is expected to be generated by the operation of the Kriger 2.0 MW_{th} biomass boiler. It is expected that bottom ash will make up the bulk of the ash recovered from the biomass boiler (approximately 90% of the total). Wood ash generally contains the inert non-toxic products of combustion, and if land spreading is considered inappropriate, then the ash can be disposed to landfill as trade waste if required.

Emissions to Water

The Kriger 2.0 MW_{th} biomass boiler utilises a bottom ash quench removal system which requires top up of the quench tank with potable water and may need periodic cleaning and disposal of the quench water. The tank is connected to the mains supply and tops up automatically as required. Should cleaning of the system be necessary, the spent quench water and wash water from the tank will be syphoned into a container and will be sent to a third-party for appropriate waste-water treatment. The biomass boiler generates hot water and as such, there is no requirement for the intermittent blow down of boiler water, which would be part of the standard boiler safety operational procedures associated with a steam boiler. As such, there is no requirement for a regular discharge of water from the system.

[3] https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit

The wood chip fuel will be relatively dry and stored undercover, eliminating the potential for leachate to form due to exposure to rainfall that may fall in the area. The fuel reception and storage containers will be located within an area laid to concrete that will provide an impermeable base, therefore eliminating any potential for ground or surface water contamination.

There is no drainage associated with the operation of the Kriger 2.0 MW_{th} biomass boiler and accordingly, the operation of the boiler will have no impact on the local sewer, surface water systems or underlying groundwater.