Annex 2: Identification of Best Available Techniques Not Entailing Excessive Cost (BATNEEC) for the storage of coal blended with Petroleum Coke

Drax Power Station, Selby, North Yorkshire

February 2007

Contents

1. Executive Summary

Drax Power Ltd (Drax) has conducted extensive tests to establish the environmental impact of burning a blend of coal and petroleum coke in the boilers at Drax Power Station. Evaluation of the results obtained has enabled Drax to demonstrate that the burning of blends of coal with up to 20% petroleum coke can be regarded as Best Available Technique Not Entailing Excessive Cost (BATNEEC).

This is an application to authorise the storage of 120kt of a blend of coal and petroleum coke (at a maximum of 20% petroleum coke to coal) on the existing coal stocks at Drax. Stocking out a blend is necessary to ensure increased and efficient throughputs of petroleum coke blends and is considered in this document to be BATNEEC with regard to environmental and economic factors.

A separate BATNEEC proposal has been submitted to the Environment Agency providing the case for commercial burn of petroleum coke blends.

2. Introduction

2.1. Overview

Drax operates a dedicated blending facility to produce a consistent high quality mixture of coal and petroleum coke which has been in operation since June 2005. The plant was designed around an existing rail unloading head with very limited underground storage capacity (c. 1000Te). This arrangement has restricted the tonnage of each rail delivery and has therefore not permitted optimum effectiveness of transport arrangements.

A large amount of data has been collected on the performance of the existing blending operation throughout the extensive petroleum coke combustion trials and these data have been made available to the Environment Agency and the general public. This case is informed by that data although the information is not reproduced in this report.

Drax recognises the need to improve the efficiency of rail deliveries in order to reduce the number of train movements as the rate of use of blended material increases, as is

likely to be the case during extended trials or commercial burn of blends. Stocking out will have the added benefit of improving the consistency of blended fuel supplied to the boilers.

The increased storage capacity of blended material will facilitate more efficient programming of train movements as well as overall process efficiencies.

The stocking out process would be similar to existing short term coal stocks in that ‘turnover’ of the material would be fairly rapid, stocks would be continuously stocked out and reclaimed according to process requirements. Stocking out and reclaim operations would be conducted according to established methods which are standard across the industry.

The maximum tonnage of blended coal and petroleum coke stored will be 120 thousand tonnes (kt) at a maximum average percentage blend ratio of 20% petroleum coke in coal. This represents the blend proportion accommodating approximately 4% of the maximum coal stock capacity implying that the pure petroleum coke component would represent approximately 0.8% of stock capacity. Although the storage of blended material does not present a risk of adverse environmental impact, a period of 12 months of environmental monitoring is suggested as a precautionary measure and to identify any longer term requirements.

The proposed storage area is a discrete section of the coal stock with sections dedicated for the storage of petroleum coke / coal blend, as described in this document.

2.2. Options

Several options have been considered for the storage of petroleum coke / coal blends, these are described below;

1. The current method of internal storage. This is very restrictive and does not allow for a consistent feed of petroleum coke blends. It requires that part loaded trains are frequently despatched to the station, rather than fewer fully loaded wagons under the proposals described here. While the deficiencies of the system have been manageable for the trials to date, the requirement for a

greater rate of feed in order to expedite ongoing trials or for any future commercial burn across a range of units, renders this arrangement unworkable on economic and environmental grounds. The existing storage arrangements only allow for less than 1000 Tonnes of storage. In addition to the restrictions in operations and consistency of flow during trial and potential commercial burn scenarios. Major disruptions to delivery of the material exist at weekends when it is not possible to receive rail deliveries.

2. Build a new storage building for storing petroleum coke blends. The intention described in this document is to store a blend of petroleum coke and coal, consisting of up to 20% petroleum coke by weight. The blend will be physically very similar to the range of coals that have been stored at Drax power station for over 40 years (see section 4.3 below). The main method of stocking out and reclaim of the blend will be through the South Bucket Wheel. It would not be practical to construct a building that would accommodate this very large item of plant. An alternative might be to construct a separate internal stocking out / reclaim area. This would leave two methods of stocking out – either using mobile plant, or by investing in dedicated enclosed handling equipment. Stocking to an internal store would inevitably require 'double handling' of the material which would add to the cost, but would also increase the risk of the material becoming airborne. Investing in new dedicated enclosed handling systems to feed an internal store would be prohibitively expensive. It is noted that internal storage and handling systems exist at Drax in order to process biomass fuels because of the low density and fibrous nature of milled biomass products. However, petroleum coke has a relatively high density when compared to milled solid biomass fuels used at Drax. This makes it less likely to be entrained by the prevailing winds at the site. Currently, up to 2kt of milled biomass products can be stored internally at the power station in contrast to the requirements for 120kt of coal/petroleum coke blend. Therefore, the significant physical differences and the different operational requirements for milled biomass products and blended petroleum coke mean that internal storage is not appropriate for petroleum coke blends. The considerable investment required to construct a building with little or no environmental benefit is therefore not considered to be BATNEEC.

3. External storage of the blended product. In order for the store to be effective in its purpose of enabling consistent feed of blend material under extended trial or commercial conditions, the capacity of the stock must be 120kt In order to provide enough storage for approximately three days burn of blended material. This would alleviate the problem of weekend deliveries and ensure more consistent operation during trials and potential commercial burn. This option is considered to be the most practical and the most economically viable. This method has been demonstrated to be BATNEEC at another large UK power station. The potential environmental effects and the proposed monitoring regime are discussed further in this document.

3. Storage area description

The storage of coal at Drax, as at all large coal fired power stations, is to allow the continuous operation of the plant as required by the variable electricity market. Stocks are either strategic, that is they are long term stocks that can be called upon when required, or they are short term whereby they are stocked out and reclaimed over a relatively short period. The stocks of petroleum coke blend will be short term stocks.

A plan view of the coal stocking area is included in Appendix 1. The area designated for the external storage of coal/petroleum coke blend is in piles 1, 2, 3 and 4 adjacent to the South Bucket Wheel Machine. This area is chosen as it is possible to stock out and reclaim to this area by bucket wheel using the current blending facility (also shown in Appendix 1).

The designated area is sheltered from the prevailing south westerly winds by established vegetation to the South and West, by the main station buildings to the East and by the main coal stock to the North.

In accordance with accepted industry standards, the carpet coal base will be profiled and compacted using large mobile plant to produce an area where rainwater will run-off and subsequently be collected in the existing drainage infrastructure. As the material to be stored is a blend of coal and petroleum coke, there is no need to limit its contact with existing coal on the base of the stock.

Drainage is provided on the stocking ground by maintaining a suitable profile allowing rain water runoff to flow into the existing perimeter drainage system. A diagram of the drainage systems on the coal stocks is included in Appendix 2. The overflow from this system flows into a sump, known as the coal stock drains sump, and from there into the ash lagoons. Water from this system is re-used on site for ashing purposes. Hence any run off from the petcoke area will be well mixed in with drainage from the rest of the coal stock

The total size of the proposed stocking area is approximately 8000 square metres. This will be sufficient to provide operational flexibility in stocking out and reclaiming the material using the South Bucket Wheel machine.

4. Materials Description

The coal stock has been used continually to store a vast range of coals with varying physical characteristics since the station was built and to date there have been no public complaints of fugitive coal dust.

4.1 Petroleum coke

Petroleum coke is a product of the oil refining industry produced when residual oil is further processed by catalytic reforming to produce some lighter components, and a solid coke material.

The process is normally a continuous operation using a coking tower, but can also be carried out using batch coking plant on a smaller scale. This gives rise to some variety in physical and chemical characteristics of petroleum coke produced dependent on the crude oil source, similar in range to the variety of coals available. Globally, petroleum coke is marketed as a high grade high carbon raw material for the carbon anode industry, as a fuel in steel production, the cement industry and power production, and as a raw material for specialist chemical and metallurgical applications.

4.2 Coal

The coal with which the petroleum coke is blended will be coal with similar physical and chemical characteristics to that burnt (and therefore stored) at all large combustion plant in the UK.

4.3 Blend

The blended product will be designed to fulfil operational requirements based on volatiles content, sulphur content, ash and calorific value. In order to produce a consistent high quality blended product, the percentage of petroleum coke blended will be varied to enhance the complimentary operational and environmental characteristics of each source fuel, up to a maximum of 20% (by weight) of petroleum coke.

The physical characteristics of coal and petroleum coke which have the greatest influence on the availability to be entrained in wind are similar. Tests have been conducted to establish the specific particle densities of a range of coals and these have been compared to petroleum coke. The range of specific particle densities and moisture contents for twenty typical Drax coals and petroleum coke are described below:

	Typical	Maximum	Minimum
Drax Coal Specific Particle Density	1.47	1.6	1.31
Petroleum Coke Specific Particle Density	1.41	-	-
Drax Coal Moisture Content (%)	10	30	6
Petroleum Coke Moisture Content (%)	7	8.6	5.1

As can be seen from the figures above, the blend at 80% coal and 20% petroleum coke will have similar values to typical Drax coal.

External reports have suggested that the risk to health due to wind blown particulate matter should be carefully assessed when stocking petroleum coke externally due to

risk of exposure to Polycyclic Aromatic Hydrocarbons (PAH)[1]. Given that the material will be stored as a blend and that in this condition the predominant factors associated with entrainment will not be significantly increased, it is unlikely that the risk of exposure to PAH will be increased. In addition, analysis of petroleum coke and coal for previous trials have shown similar levels of PAH in these fuels. Provided that similar precautions are taken regarding 'dust blow' from the site, it is not considered to be a significant environmental issue. Data have been provided to the Environment Agency describing average PAH levels in coal and petroleum coke. However, due to recommendations for the risk to be carefully assessed, passive dust monitoring and analysis will be undertaken as described in Section 6.1.

5. Process Description

5.1 Transport

Petroleum coke will continue to brought to site by rail as the most effective means of transport. Experience gained during the trials have demonstrated that there have been no negative environmental issues associated with transport and handling of pure petroleum coke. Sprays have been installed at the rail unloading head dedicated to petroleum coke. In practice these are rarely required but they constitute a reliable dust management measure in case of an exceptionally dry load being delivered.

5.2 Blending Operation

The blending operation will continue as it is currently operating as this has been demonstrated to be effective throughout the extensive trial period. The blend ratios will be within the levels achieved during the trial to date at an average of no more than 20% (± 4%) petroleum coke in coal (by weight). The current controls employed to monitor blend ratio will be maintained with weekly reconciliation of the blends achieved being produced and reported.

[1] Review for the Environment Agency of 'A Proposed Test Programme for a Trial Burn of Coal / Petroleum Coke Blends at Drax Power Station' Harrison, R.M, August 2003.

5.3 Stocking out operation

Appendix 3 shows the layout and routes currently available and being used for the blending of coal and petroleum coke. Additionally, the routes used for stocking out blended material and reclaiming the blended material are shown.

Records of materials stocked out, including the source, tonnage and quality will be maintained to enable operational optimisation in accordance with established industry standards. Tonnages stocked out and reclaimed will be established using the existing beltweighers. This information is used by the control room operators to manage the overall operation. The stock of coal / petroleum coke blend will essentially be a short-term stock and will normally be reclaimed in full within a 6 week period. The short term nature of the stock will allow for the stocks to be placed by the South stocking out / reclaim machine where they will remain until reclaimed by the same machine. This will minimise double handling of the material. The stock of blended material will be restricted to a maximum working height of 30m at a typical average daily stocking out tonnage of approximately 5kt per day.

5.4 Reclaiming operation

Reclaiming will normally be carried out using the south Bucket Wheel machine. The majority of reclaiming will be carried out over the weekend, reclaiming approximately 30kt of blended material over the period. Occasionally, usually in the case of maintenance or breakdown, mobile plant may be required to reclaim material via the underground reclaim hoppers.

6. Monitoring

Monitoring will be undertaken to evaluate the significance of potential risks as described below (for fugitive dust, water quality and ambient air quality).

6.1 Dust Monitoring

Directional dust monitors are available for monitoring around the periphery of the coal stocks. Prior to stocking out, directional dust monitors will be placed at 4

locations around the area designated for the storage of coal /petroleum coke blends. A map showing the proposed locations is included in Appendix 4. Samples from these monitors will be taken regularly and analysed by station staff for dust burden and petroleum coke content.

6.2 Surface Water Monitoring

Samples of the coal stock drain will be taken at two locations. Sample point one is to the south of the coal stocking area close to the area designated for coal/petroleum coke blend storage, and sample point two is at the coal stock drain sump prior to discharge. Samples will initially be taken each month and analysed for the following; nickel, vanadium, boron, antimony, zinc, chromium, cadmium, pH and oil. If no changes in quality are detected, the sampling regime will be altered accordingly.

6.3 Ambient Air Quality Monitoring

The current off-site monitoring of the local environment for dust will continue as now, with samples from Hemingbrough Landing and Barlow School being tested for nickel and vanadium by independent experts. In addition, it is proposed that the converted Anderson pesticide monitoring shelters located in the region will continue to monitor ambient PAH levels for a 12 month period after the start of the external blend storage arrangements.

There are no long term studies regarding the effects of external storage of petroleum coke blends on ambient PAH and heavy metal levels, although opinions from health experts are available regarding potential for impacts on the health on the local community[2]. Since the material will be stocked as a blend, with characteristics very similar to coal, with a very small relative proportion of petroleum coke compared to coal and with active dust management procedures in place mean that the potential for significant changes in on-site or off-site in suspended dust concentrations is very low.

[2] A Proposed Test Programme for a Trial Burn of Coal / Petroleum Coke Blends at Drax Power Station, August 2003.

6.4 Reporting

The results of coal stock dust monitoring and coal stock drainage monitoring will be included in review meetings with the Agency.

7. Overall BATNEEC Case

Several options have been considered for the storage of petroleum coke blends at Drax. The best technique has been identified as external storage, as is the case at another large combustion plant in the UK. The storage of blended petroleum coke and coal on the existing coal stock at Drax will have a significant positive impact on the logistical and handling operations. Rail deliveries of petroleum coke have historically been relatively inefficient due to the extremely limited internal storage capacity. This has meant that individual rail freight deliveries have been nominally 50% of their design capacity. This clearly has an impact on efficient use of resources for transport, and resulting additional emissions of carbon dioxide.

It is proposed that petroleum coke is delivered using existing specifically designed facilities before being immediately blended in the existing blending plant, with a range of coals at up to 20% petroleum coke (by weight). The blend would then be either sent directly to bunkers to be used in the process, or would be stocked out. The fact that the stocked out material would be a blend and that the maximum tonnage would not exceed 120kt means that the proportion of petroleum coke on the coal stock would be less than one percent of the total coal-stock capacity. Added to this is the fact that a blend of the proportions proposed would have characteristics more akin to raw coal than to pure petroleum coke, therefore current stocking out and reclaiming operations will remain unaltered. Operating Instructions for the use of the South Bucket Wheel machine have been reviewed to ensure that they are relevant for stocking out petroleum coke blend. No further training is required for the staff, who already operate to these instructions.

External storage of the blend would have the associated advantage that feed to the boilers would be less likely to be interrupted. A more consistent feed is likely to result in process performance benefits and would provide a more controlled system on which to interpret future monitoring data.

The proposed additional monitoring regime has been designed to provide confidence that any adverse environmental impact would be detected early. At the proposed stocking capacity the material could be rapidly reclaimed if any adverse environmental impact was detected (it would take about 3 days to reclaim 120KTe)

8. Conclusions

In order to optimise the effectiveness of the transport and operational factors associated with the combustion of petroleum coke and coal blends, external storage of blend has clear advantages. The proposed cautious monitoring regime will identify adverse environmental impacts at an early stage. The extensive knowledge gained by Drax Power Ltd. has not identified any significant potential impact when handling neat petroleum coke or blends. Drax asserts that the external storage of petroleum coke / coal blends represents the Best Available Technique Not Entailing Excessive Cost (BATNEEC).