E.ON UK

Connahs Quay Power Station
EPR/MP3337SH

IC20 : Review following completion of Stage 1 of the Chlorine Dioxide Introductory Dosing Plan at Connahs Quay Power Station.

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Drafted by

Bill Smith - Chemist, Connahs Quay Power Station

Andy Black - SHE Team, Connahs Quay Power Station

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1.0 INTRODUCTION

1.1 Background to Connahs Quay Power Station

E.ON's Connahs Quay Power Station is located on the south bank of the Dee Estuary in Connahs Quay, North Wales at Grid Reference SJ 2770 7120. The installation consists of a gas treatment plant and four combined cycle gas turbines (CCGT's) providing 1426 MW of electricity exported to the National Grid. Each gas turbine exhausts directly to a heat recovery steam generator, which supplies a steam turbine comprising separate high, intermediate and low pressure cylinders. The exhaust emissions from each HRSG are dispersed to the atmosphere via 85m high chimney stacks. Exhaust steam is condensed back into water and fed back to the HRSG for re-use. Water abstracted from the River Dee is used to cool the condenser. The cooling water is circulated through low level hybrid cooling towers, where the heat is rejected to atmosphere via conduction, convection and evaporation.

1.2 Background to the Chlorine Dioxide project.

Following a successful application to vary the Environment Permit at Connahs Quay Power Station, E.ON were granted permission to install and operate a Chlorine Dioxide dosing system to the cooling water systems across the installation (Permit Variation EPR/MP3337SH/V005 - dated 6th Dec 2012). This permit allows E.ON to dose Chlorine Dioxide to the cooling water systems at Connahs Quay subject to regulatory compliance and the completion of five pre-operational conditions, and two Improvement Conditions. This document is a submission in compliance with the requirements of Improvement Clause 20.

1.3 Improvement Condition 20 (IC20)

IC20 details as follows :

Following the completion of Stage 1 of the Chlorine Dioxide Introductory Dosing Plan, the Operator shall provide a written commissioning report to the Environment Agency on its implementation. The report shall include, but not be limited to :

- Monitoring results for residual chlorine dioxide and chlorite ions at the point of entry to the purge pond (from the cooling tower tanks) and exit of the purge pond (at the point of discharge to the River Dee).

- An analysis of the monitoring data with consideration for the decay rates taking place within the purge pond under a range of operating conditions which are likely to occur, and

- An assessment of whether additional controls are required to further minimise emissions to the River Dee.

The report shall identify any required improvements together with a proposed timetable for their implementation.

The following section of this document should be considered a submission in response to the requirements of Improvement Condition 20.

2.0 IC20

2.1 Stage 1 of the Chlorine Dioxide Introductory Dosing Plan

The reasons for choice of dosing chemical and their environmental impact are not discussed since they are covered in previous reports which formed the basis of the permit variation and improvement condition.

The first stage of the cooling water dosing involved several areas of work:

- Installation and connection of Chlorine Dioxide Generator
- Completion of dosing pipework connecting Generator to Cooling Towers.
- Insulation of dosing pipework connecting Generator to Cooling Towers
- Completion of tank installation
- Commissioning of dosing systems with water testing
- Purchase of Purate chemical
- Purchase of Sulphuric Acid

Following completion of the installation, the intention was then to dose the cooling water towers with chlorine dioxide, to eight dosing locations, one on each of the individual Tower A and Tower B cooling tower sections of units 1 to 4.

Various concentration targets were proposed with dosing levels of 0.25, 0.5, and 1.0ppm chlorine dioxide for a period of seven days at each concentration.

2.2 System installation and Commissioning

Stage 1 of the dosing system (CTE dosing to Cooling Towers) has been successfully installed, and placed into operation. As detailed in

the previous variation application submissions, individual tanks of Purate and Sulphuric Acid are held on site, and the chemicals mixed in a Chlorine Dioxide generator in the CTE dosing building. From this building, Chlorine Dioxide can then be dosed to any of the main cooling towers, as and when it may be deemed necessary by the management software running the dosing system.

Dosing of Chlorine Dioxide commenced in May 2013 with an initial dosing level of 3kg/hr. This value in practice equated to a chlorine dioxide measured dose to the cooling towers of 0.25ppm.

However, intermittent operation due to minor technical issues coincided with a time of weakened demand for gas fired power stations, meant that the system was not run for sufficiently long periods to allow a significant build up of biocide in the system and hence successful assessment of the efficacy of controls.

Therefore, in February 2014 with a notable change in energy market conditions resulting in increased generation of electricity at Connahs Quay, a programme of optimisation for the cooling tower dosing system was begun.

Chlorine Dioxide was dosed continuously to the cooling towers, at various concentrations and combinations between 1kg/hr and 3 kg/hr to all eight cooling towers (Units 1-4, Towers A & B). The maximum value of 3kg/hr gave a cooling tower chlorine dioxide level of <0.25ppm.

These trials highlighted the success and efficiency of the chlorine dioxide in surpressing bacterial growth and reducing silt build up in the towers, and therefore it was quickly concluded that further dosing at levels of 0.5ppm and / or 1.0ppm was no longer required.

The chlorine dioxide and chlorite concentrations measured on the purge pond inlet and purge pond outlet points are detailed in the

below table. The Chlorite did not exceed any of the Emissions Limit Values (ELVs) as detailed in the Environment Permit Variation:

Table 1 : Discharge Concentrations

Parameter	Inlet to purge Ponds	Outlet from Pond A	Outlet form Pond B
Chlorine dioxide maximum value (mg/l)	0.12	0.16	0.10
Chlorine dioxide average value (mg/l)	<0.02	<0.02	<0.02
Chlorite maximum value (mg/l)	3.8	2.3	2.8
Average value (mg/l)	<0.1	<0.1	<0.1

Analyses of both the chlorine dioxide and chlorite showed that in general there was a decay rate between the inlet and the outlet of the pond. There are a few exceptions to this where one of the ponds had similar levels as the inlet. It is thought that this was due to a combination of continuous dosing at elevated levels to assess the effectiveness of the biocide within the cooling tower, and coupled with low salinity and or low chlorine demand. The chlorine demand may have been consumed with the elevated dosing rate.

Table 2 Decay Rates

Parameter	% Decrease from inlet to outlet Pond A and B
Chlorine dioxide decay as a % of inlet value	See note 1
Chlorite decay as a % of inlet value	Average 30 Note 2 Max 52 Min 0 Note 3

Note 1 : The inlet and outlet values are mainly below the limit of detection and thus unable to calculate a drop in chlorine dioxide.

Note 2 : It was observed that the greatest % decrease in chlorite was seen when the pond had the maximum inlet value. This coincided with testing with high dose rates on the towers.

Note 3 : It was observed that very little decay rate occurred at times when the inlet chlorite was also low. This coincided with plant testing at low dose rates

2.3 Conclusion

Continued operation with Chlorine Dioxide dosing has allowed E.ON to gain further knowledge on utilisation of the dosing of the chemical for use in Biocidal control at Connahs Quay. This monitoring exercise has shown that application of chlorine dioxide of levels <0.1ppm in the cooling towers have been effective in controlling bio fouling in the cooling water systems and therefore highly effective biocide control. The associated by-product of Chlorite ions (arising from Chlorine Dioxide dosing

The testing and analyses has been carried out during periods of continuous operation. Decay rates appeared to vary with inlet concentration. Additionally, with continued operation E.ON would plan to gather more data regarding the impact of the variance of incoming water composition (eg warmer temperatures / increased salinities) upon the efficiency of Chlorine Dioxide dosing. This additional proposal should capture a full year of data to assess any periods where increased risk to environment may alter with seasonal variations.

E.ON therefore intend to continue with their outlined plan and proceed with completion of the installation of dosing equipment to the cooling water intake. These completed works would then allow E.ON to proceed with Stage 2 of the proposed Chlorine Dioxide Introductory Dosing Plan resulting in the assessment of the application of Chlorine Dioxide all the way through the cooling water system at Connahs Quay Power Station.