

Connahs Quay Power Station

Environment Agency initiated variation to incorporate Eel Regulations Improvement Condition (IC22)



E.ON UK

Connahs Quay Power Station
EPR/MP3337SH

Environment Agency initiated
variation to incorporate Eel
Regulations Improvement
Condition (IC22).

January 2014

Drafted by

Andy Black - SHE Team

*James Elliott - Senior Environment
Advisor*

Date: 30th September 2013

Page 1 of 15

	INITIALS	DATE
CN FOR PUBLIC REGISTER	SR	03.02.14
COPIED TO PUBLIC REGISTER	JB	EP em

CONTENTS

1.0 INTRODUCTION	3
1.1 Background to Connahs Quay Power Station.....	3
1.2 Eel Regulations.....	3
1.3 Summary of discussions with Environment Agency and Natural Resources Wales	4
2.0 CONNAHS QUAY INTAKES AND OUTFALLS	5
2.1 Abstraction Details.....	5
2.2 Description of Cooling System.....	6
2.3 Aquatic life within cooling water system.....	8
2.4 Offshore Arrangements.....	9
2.4.1 Cooling Water System Intakes	9
2.4.2 Cooling Water System Outfalls	10
3.0 SCREENING IMPROVEMENTS	11
3.1 Plant shut down.....	11
3.2 Cost of new purpose designed intake mesh screens.....	12
3.3 Work within an environmentally protected area.....	12
3.4 Potential for Extension to cooling water extraction period....	12
3.5 Silt entrapment within system.....	13
4.0 CONCLUSIONS	13

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 Eel Regulations

The Improvement Condition (IC22) detailed in the variation notice EPR/MP3337SH/V006 (dated 11th March 2013) requires E.ON to review Connahs Quay Power Station's existing screening measures at both cooling water intakes and outfalls to assess compliance with the "Eels (England and Wales) Regulations 2009 (SI2009/3344) and the Environment Agency's "Safe Passage of Eel" Regulatory Position Statement (version 1 dated July 2012).

The power station abstracts water for cooling from the Dee Estuary which is able to support eel populations. The estuarine location of the installation means that all life stages of eel have the potential to be present including elvers/glass eels as detailed in table 3.4 of the Environment Agency's 'Eel Manual'.

Table S1 of the 'Eel Manual' states that the mesh spacing on screening required to protect elvers and glass eels should be 1-2mm.

1.3 Summary of discussions with Environment Agency and Natural Resources Wales

In October 2012, E.ON held a workshop with the Environment Agency to assess the current status of its sites with regard to compliance with Eel Regulations and to identify any actions needed to achieve compliance. Following the workshop, the Environment Agency provided an update summarising the compliance status of each of E.ON's affected power stations. For Connahs Quay, the Environment Agency stated that they considered the site to be compliant with the Eel Regulations.

In April 2013, following the creation of Natural Resources Wales (NRW), Connahs Quay received a request to re-submit screening and intake information to NRW for assessment against Eel Regulations requirements. Following a review of this information, NRW considered Connahs Quay to be non-compliant with the Eels Regulations as the existing intake screening mesh of 3mm is just outside the 1-2mm mesh size required by the 'Eel Manual' guidance. However, because the screening mesh is only just outside the size needed and because the cost of a refit would be disproportionately high, NRW plan to issue Connahs Quay with an exemption from the Eel Regulations requirements.

E.ON welcomes the risk based approach outlined in the Eel Regulatory Position Statement Feb 2013 which states that the Environment Agency/NRW will not seek measures for screening where the risks of damaging eels in intakes is low. E.ON believes that Connahs Quay Power Station poses a negligible risk to eel populations due to the following reasons:

- Use of a hybrid cooling system as opposed to direct cooling;
- Presence of Passive Wedge Wire Cylinder (PWWC) Screens of 3mm mesh size with significant biofilm accumulation;

- Abstraction limited to between one hour before and two hours after high tide; and,
- Low intake velocity (maximum permitted velocity of 0.15m/sec).
- No known history of eel existence in cooling system

2.0 CONNAHS QUAY INTAKES AND OUTFALLS

2.1 Abstraction Details

For the purposes of evaporative cooling, Connahs Quay is authorised by the Environment Agency/NRW to abstract and return water to the River Dee. The abstraction license details the volume and flow rate of the water to be abstracted.

License Serial Number: 24/67/10/124E;

Date of issue: 03 August 2004;

Date effective: 07 July 2004;

Maximum quantity of water to be abstracted during the specified period.

- 11.0 megalitres per hour;
- 33.0 megalitres per high tide;
- 24,090 megalitres per year;
- At an instantaneous rate not exceeding 3.04 cubic metres per second.

Abstraction shall only take place during a period between one hour prior to and two hours after each high tide but only when the water level at the Agency's summer jetty level recorder is higher than 0.8meters above Ordnance Datum during the specified period.

The abstraction licence also states that the intake velocity should not exceed of 0.15m/sec. This is just outside the advisable screen approach velocity of 0.1m/sec outlined in table s2 of the 'Eel Manual'.

2.2 Description of Cooling System

At Connahs Quay, each of the four generating units has a dedicated cooling system in which the condenser and cooling system, including cooling water pumps and cooling towers, are arranged in a split configuration to form two independent cooling streams per generating unit. The cooling system for each unit incorporates 2 x 50% cooling water pumps, where each pump circulates cooling water from the tower pond to one half of the condenser and, in turn, to one half of the cooling tower before returning to the pond. The auxiliary cooling system provides an indirect connection between the two streams as it has a single header fed from each stream upstream of the condensers and returning downstream.

Each generating unit has a dedicated cooling tower of hybrid type with wet and dry. The cooling tower for each unit comprises a total of ten cells arranged in two independent banks of five - termed Tower A and Tower B - each section servicing each side of the one condenser. The towers are of induced draft type with top horizontally mounted fans. The lower section of the tower acts as a conventional flow evaporative tower with plastic film packing. The top section has finned tube dry cooling heat exchangers supplied with air. The dry sections provide alternative cooling for plume control during cold winter periods.

Estuarine water is abstracted from the River Dee as cooling system make-up. Due to environmental constraints, abstraction is limited to no more than three hours per tide around high water and purge discharge to no more than three hours commencing on the ebb tide immediately after high water. This periodic abstraction and discharge

requires storage capacity for make-up and purge via large holding ponds on site. The make-up water contains significant quantities of suspended solids and so the storage pond also provides settlement. Make-up water is pumped from the storage pond to unit cooling water systems on a continuous basis. Additional cooling of the purge water can be provided by a purge cooling tower before the water enters the purge storage pond for discharge back to the river.

The unit condensers are titanium tubed and each condenser nest is provided with an automatic recirculating ball on-line mechanical cleaning system.

Key design parameters for the cooling circuits are:

- Make-up water storage pond capacity: 31,000 m³ nominal
- Purge water storage pond capacity: 20,000 m³ nominal
- Recirculating water flow: 14,000 m³/hr - 18,000 m³/hr per unit
7,200 m³/hr - 9000 m³/hr per half tower

- Make-up water flow: 400 m³/hr per generating unit
200 m³/hr per half tower

- Purge water flow: 230 - 260 m³/hr per generating unit
115 - 130 m³/hr per condenser

- Circuit concentration factor: 1.8 (average)
- Maximum permitted salinity 55 ppt

The estuary neighbouring the Connahs Quay site is designated as a Site of Special Scientific Interest, notified under the Wildlife and Countryside Act 1981, a Wetland of International Importance under the Ramsar Convention and a Special Protection Area under the EC Conservation of Wild Birds Directive. These designations stem from the international importance of this estuary for migratory wildfowl and wading birds. These large bird populations use the productive mudflat and saltmarsh areas for feeding and roosting sites. The estuary also acts as a nursery area for several species of fish and has been designated as a bass nursery area. Any adverse effects on

the invertebrate populations living in the mudflat areas would be of considerable significance for these bird and fish populations.

Condenser cooling water is circulated through low level hybrid cooling towers, where the heat is rejected to atmosphere via conduction, convection and primarily evaporation. Evaporative loss of water is made up by water from the make-up storage/settling pond. To prevent the build-up of dissolved solids and control scaling in the circulating water system, a small percentage of the flow is purged to a storage pond. Twice each day, for a period from one hour before to two hours after high tide, water is abstracted from the River Dee to fill the make-up storage and settling pond. The contents of the purge storage pond are discharged to the River over a period of up to three hours commencing one hour after each high tide. The CW system is protected against biological fouling of heat exchange surfaces by the controlled injection of chlorine dioxide throughout the cooling water system (at the CW intake and directly into each of the cooling towers via the discharge of each CW pump). Chlorine Dioxide is dosed at residual levels to satisfy the reactive demand within the system, and minimise potential scaling thus consequently yielding only very low levels of residual chlorine in the purge storage pond.

The use of the low level hybrid cooling towers dramatically reduces the amount of water which has to be abstracted for cooling purposes. If the station was directly cooled where water is abstracted and passed directly to the condenser and returned to the river the amount of water required to be abstracted would be much larger. It can therefore be assumed that a hybrid cooled site is less likely to impact on eels than a direct cooled site.

2.3 Aquatic life within cooling water system

Due to the Chlorine Dioxide dosing system (and previous to that the Sodium Hypochlorite dosing system), the presence of biological life within cooling waters is kept to a minimum at all times to maximise efficiency of cooling and prevent blockage issues. Additionally the

biocide is used to prevent the potential formation / distribution of legionella bacteria. Each of the cooling towers is drained periodically in line with routine maintenance plans. Every four years a month long Station Outage is completed to allow for routine maintenance upon the entire cooling water system. There have been no known discoveries of eel populations within the power station cooling water systems (specifically during drainage programs) since commissioning in 1996. Additionally, the purge pond tanks are drained daily following complete discharge of purge waters during the three hour purge discharge window and no eels have ever been sighted within the drained tanks following cooling water discharge.

2.4 Offshore Arrangements

2.4.1 Cooling Water System Intakes

Water is abstracted from the river Dee by a DN900mm GRP pipe which extends approximately 5 meters out in to the river. At the point of abstraction the water passes through a series of 3mm Passive Wedge Wire Cylinder (PWWC) screens to prevent any contaminants entering into the power station cooling water system.

PWWC screens such as those used at Connahs Quay are considered BAT for estuarine locations and are the most widely used screening method for juvenile and larval fish protection. The Eel Manual states that the mesh spacing on screening required to protect elvers and glass eels should be 1-2mm, therefore the 3mm PWWC screens at Connahs Quay which are just outside this range could be considered as not meeting BAT requirements. However, E.ON believes that due to 17 years of biofilm accumulation and oxidation, the gaps in the mesh screens are now significantly less than 3mm and provide acceptable protection against eel entrainment and impingement.



Figure 1. PWWC screening at Connahs Quay. Significant biofilm accumulation is clearly visible on the mesh screens.

2.4.2 Cooling Water System Outfalls

The discharge from the purge storage pond is restricted by the sites environment permit, and may only take place between one hour after the predicted time of high water and four hours after the predicted time of high water.

Purge water is released from the purge storage ponds over a weir and subsequently returned to the river by a DN1000mm GRP pipe which extends approximately 5 meters out into the river. Water is discharged via gravity up to a maximum flow of 2.5 m³/second and this

is monitored via MCERT accredited equipment. There is no screening on the end of the purge outfall and water is discharged directly into the lower level river body.

The purge outfall is located downstream of the abstraction intakes, and whilst some of the purge outfall pipework is within the tidal range, it would not be possible for aquatic life to pass all the way up the purge pipework and enter the cooling water system due to the limited tidal reach and purge water weir.

3.0 SCREENING IMPROVEMENTS

An initial engineering study to assess the feasibility of replacing the existing PWWC screens with 'BAT' 1-2mm mesh screens has been undertaken. This has allowed E.ON to identify a number of technical challenges / modifications which must be completed if deemed required for continued Eel Regulation compliance at Connahs Quay.

3.1 Plant shut down

Successful operation of the cooling water system is vital to enable the power station to operate and generate electricity. Historically the installation has operated on a 24/7 basis, moving to a two

shifting environment to meet changing demands in electricity generation. Neither of these scenarios allow maintenance periods of more than a few hours upon the cooling water system. Therefore a total plant shut down will be required to entail any works upon the cooling water system. Total station outages are only scheduled and budgeted with a frequency of a one month outage every four calendar years.

3.2 Cost of new purpose designed intake mesh screens.

E.ON estimate that the purchase of a new, larger number purpose built cooling water intake mesh screens (with 2mm spacing) would be required. Additionally, once purchased, installation will involve considerable engineering works within an area of high environmental sensitivity (the River Dee and its river bed. In order to minimise sediment intake into the power station, these intakes would be placed upon articulated floating heads. These heads would rise and fall with tidal levels to allow water extraction from those areas of river water with the least volumes of sediment loading. This may provide an additional obstacle for local river traffic to avoid. Initial estimates lay the potential cost of modelling, design and manufacture of new floating head intake screens with a 2mm spacing is anticipated to cost at least £560,000 (excluding installation costs). The resulting temporary plant closure and associated installation works will increase this value to a potential floating head intake screen upgrade at a minimum cost of £1.5-2 million (excluding lost generation revenue).

3.3 Work within an environmentally protected area

The Dee Estuary has numerous statutory designations including SAC, SPA, RAMSAR and SSSI. To undertake construction work within or near to such sites would require various environmental assessments with consent likely to be needed from Natural Resources Wales. This may result in an protracted installation process, taking into account requirements for additional environmental compliance during any associated works in the river bed.

3.4 Potential for Extension to cooling water extraction period

E.ON is limited to a restricted time period within which water may be extracted from the River Dee. Currently the relevant abstraction licence for the installation (License 24/67/10/124/E/Variation

No.2). A reduction in intake mesh size (from 3mm to 2mm) will place an increased restriction upon the volumes of water which may be extracted within the permissible time window. A reduction in mesh size may result in the requirement to review the permissible extraction window length.

3.5 Silt entrapment within system

Installation of a finer mesh is likely to exacerbate the current problems experienced with silt entrainment within the cooling system. This may require additional computer modelling to ensure that the replacement floating heads are installed within the best level of the river to ensure minimising sediment intake into the installation. Additionally, the surface area of the screen would need to be increased in order to supply enough water and to avoid head losses. Such work would involve significant civil operations and technical challenges associated with working within an estuary with a large tidal range which should not be underestimated.

4.0 CONCLUSIONS

E.ON has operated Connahs Quay Power Station with the previously detailed 3mm intake mesh screens since initial commissioning and operation in of the plant in 1996 / 1997. Since that time, the following factors highlight why E.ON believe replacement of these screens with a smaller mesh size to be unnecessary;

- Throughout the seventeen year operational period (1997 to 2013), there have been no known reported incidents of the known presence of eels within the site cooling systems. Previous station outages have involved maintenance across the entire cooling water system (whilst drained) and no eels were found. Additionally there are no known incidents of eel

discovery during unit outage and / or subsequent cooling tower and / or purge pond drainage. This highlights E.ON's belief that the current 3mm intake screen provides adequate cooling water filtration.

- The power station suffers from substantial issues due to silt build up within the cooling systems. This is predominantly due to the high concentrations of suspended solids within the waters of the River Dee. Reduction of the screen intake size further may lead to additional problems with regard to silt build up upon the filter screen reducing potential water intake and possibly restricting generational capabilities (due to the already extant restricted abstraction time period).
- The existing 3mm intake screens are only marginally in exceedance of legislative requirements, and show significant bio fouling. Therefore it can be concluded that the potential difference in filtration between the existing mesh intake screens and proposed replacement 2mm screens would be negligible.
- The installation of a new, 2mm mesh screen will involve significant financial expenditure and temporary cessation of generation by the power station. The cost of modelling, design and manufacture of new floating head intake screens with a 2mm spacing is anticipated to cost at least £560,000 (excluding installation & generational losses).

Given the points made above, E.ON considers that any benefits of installing replacement 2mm spaced mesh screens are negligible and disproportionate to the significant financial costs of installation. Installing 2mm mesh screening would also require unnecessary disturbance to an important protected habitat. E.ON therefore requests that the NRW grant Connahs Quay Power Station an exemption from any further screening requirements.

Connahs Quay Power Station

Environment Agency initiated variation to incorporate Eel Regulations Improvement Condition 1022



