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Environment Report

Aberthaw Power Station PPC Application : Point Source Emissions to Surface Waters & Sewer, Monitoring & Reporting of Emissions to Controlled Waters & Sewer, Monitoring of Process Variables (Aquatic) B2.2.2, B2.10.2, B2.10.3 &B2.10.6 (aquatic)

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Aberthaw Power Station PPC Application:
Point Source Emissions to Surface Waters & Sewer,
Monitoring & Reporting of Emissions to Controlled waters & Sewer
Monitoring of Process Variables (Aquatic)
B2.2.2, B2.10.2, B2.10.3 & B2.10.6 (aquatic)

Prepared for:

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Summary

This document deals with point source emissions to water and sewer, the monitoring and reporting of those emissions and monitoring of process variables (aquatic). This covers sections B2.2.2, B2.10.2, B2.10.3 & B2.10.6 (aquatic) of the Application Template.

It demonstrates that Aberthaw power station is compliant with BAT regarding point emissions to water.

Table of Contents

1. Introduction

This document deals with point source emissions to water and sewer, the monitoring and reporting of those emissions and monitoring of process variables (aquatic). This covers sections B2.2.2, B2.10.2, B2.10.3 & B2.10.6 (aquatic) of the Application Template.

The purpose of this document is to demonstrate BAT compliance regarding point emissions to water through providing the information required from section B2.2.2 of the Combustion Sector PPC Application Template.

Sections B2.2.2.7-9 seek descriptions of primary, secondary and tertiary treatments used on or off site and, if such treatment is not current used, the applicant must state when it will be or justify why its use is not appropriate. The use of this terminology is not common in the power sector. Moreover, it is not used in any of the BAT guidance used for the Combustion Sector, EA (2005), EC(2001), EC (2003), EC (2005). All treatments used within this sector are therefore termed ‘primary’ for the purposes of this application.

None of the BAT guidance provides definitive achievable emission levels associated with BAT for use as ‘benchmarks’. This is partly through ambiguity in what stream a particular piece of guidance is intended to refer and partly because of the variability in plant circumstances (eg abstracted water quality and variability etc). In particular the applicability in the combustion sector of the concept of ‘final effluent’ is unclear, particularly for direct-cooled plant. The aquatic discharge arrangements vary considerably between plant with most plant having multiple outfalls each receiving combinations of treated process effluents and site drains.

Thus, BAT compliance is demonstrated through descriptions of how the systems and procedures used are consistent with the BAT principles identified in the guidance.

B2.2.2 Point source emissions to surface water and sewer

2. B2.2.2.1 Process Flow Diagram

A conceptual flow diagram is provided as Appendix A.

A site plan showing the physical locations of the elements of the conceptual flow diagram is provided in Appendix B.

B2.2.2.2 Emission points to water and sewer

Discharge Point Reference	Name of receiving water	Map reference of discharge point
W1 Condenser Cooling water	The Bristol Channel.	NGR ST 0165 6588 and ST 0163 6595.
W2 Water treatment plant effluent	The Bristol Channel.	As above
W3 Storm water and surface drainage	The Bristol Channel.	As above
W4 Boiler blowdown water	The Bristol Channel.	
W5 Dirty water from drains within power plant building	The Bristol Channel.	As above
Note that all the above discharges are released via the CW outfall (W1), and therefore are grouped together for the purposes of consent authorisation.	The Bristol Channel.	As above
W6 Surface water drainage from roads, coal plant stockyard & silo areas. There are no process emissions to sewer		ST 0291 6574.

B2.2.2.3 Is your installation a large pulverised fuel power station?

Yes

B2.2.2.4 Please complete the following table for each cooling water discharge:

Water source	Volume abstracted (m^3)	Release Point	Volume discharged (m^3)	Maximum recorded temperature of discharge above receiving water temperature (ºC)
The Bristol Channel	850,084,795	NGR ST 0165 6588 and ST 0163 6595	850,084,795	12 (The FGD plant due to be commissioned in 2007 is anticipated to add up to a further 2.5°C, resulting in a maximum temperature of discharge above ambient of 14.5°C)

Note

The above data was recorded for the year 2005. The volume abstracted for cooling will depend on station load.

2.2.2.5 How much effluent do you produce?

Maximum flow m^3/day

W2 1056[1] (estimated)
W3 not routinely measured, dependant on rainfall
W4 not routinely measured
W5 not routinely measured
W6 not routinely measured, dependent on rainfall

[1] estimate based on maximum realistic operation of Water Treatment Plant (i.e regeneration of 6 streams, 1 mixed bed, 1 starvation unit, 1 Condensate Polishing Plant unit per day)

Average flow m^3/day

W2 518[1] (estimated)
W3 1381[2] (estimated)
W4 not routinely measured
W5 not routinely measured
W6 345 [2] (estimated)

[1] estimate based on typical operation of Water Treatment Plant (i.e regeneration of 3 streams, 1 starvation unit, per day)
[2] estimate based on average rainfall and area of site served by drainage system

Will the discharge be continuous?
Yes. W1
No W2, W3, W4, W5, W6
Please say why and when it will be discharged and give the identity of the effluent stream

W2 – Produced as a result of water purification process, discharged at intervals during the day.
W3 – Weather produced, discharge times weather dependent
W4 – Produced by need to maintain boiler water quality.
W5 - Produced by normal plant operation continuously
W6 - Weather produced, discharge times weather dependent

What are the average and maximum effluent temperatures?

ºC

W2 – discharged via W1, annual range of differential temperature for W1 = 8 – 10C. W3 – ambient, released via W1 W4 – ambient , released via W1 W5 – passes into plant drains, discharged via W1 above W6 – ambient

What is the maximum and minimum pH of the effluent?

pH

W1 – annual range 6 to 8, due to FGD plant operation W2 – not routinely measured, released via W1, annual range 7.5 to 8.4 W3 – not routinely measured, released via W1 W4 – not routinely measured, released via W1 W5 – not routinely measured, released via W1 W6 – annual range 7.8 to 8.1

B2.2.2.6 Please give details of your procedures for emissions to surface water and sewer

Source of wastewater	Minimisation methods	Treatment methods
Condenser cooling discharge	Plant design and siting considerations Optimised flow rate (direct-cooled) Optimised heat load	Nil
Auxiliary cooling discharge	Fed from condenser cooling system	Nil
Water treatment plant effluent	Process optimisation – occurrence of regeneration & optimisation of raw water use	Mixing with considerably larger quantities of condenser cooling water prior to discharge
Main plant blowdown & condensate rejection	Management of tube leaks, optimised start up and shut down procedures, recovery	None required – high quality water
Coal stock run off	Opportunities for re-use being investigated within Site Drainage and Water Optimisation CIGs.	Settlement of suspended solids, oil interception available if required via portable skimmer unit.
Ash disposal run off	Opportunities for re-use being investigated within Site Drainage and Water Optimisation CIGs.	Settlement of suspended solids, oil interception available if required via portable skimmer unit.
Flue Gas Desulphurisation – future case	Optimised management of FGD process	FGD Seawater Treatment Plant
Site run off uncontaminated - drains	Opportunities for re-use regularly reviewed via Site Drainage and Water Optimisation CIGs.	Settlement of suspended solids, oil skimmer available.
Plant & area drains – potentially oil contaminated	Opportunities for re-use regularly reviewed via Site Drainage and Water Optimisation CIGs.	Settlement of suspended solids, oil interception
Intermittent washings arisings	Optimisation of washing frequency, choice of cleaning agents, opportunities being investigated using sonic methods.	Settlement of suspended solids, oil interception
Fire-fighting water	Where appropriate use of deluge spray systems instead of bulk water systems.	Key area is oil storage tanks, major

		bunding in place. Closure of discharge valves can be achieved to prevent any contaminated effluent leaving site.

B2.2.2.7 Is primary treatment employed (on or off site)?

Yes

General remarks
In the following subsections the Aberthaw Power Station processes potentially leading to emissions to the aquatic environment are described and demonstrated to be compliant with installation-specific BAT.

Cooling System
In the Aberthaw Power Station, the heat energy contained in the high pressure steam produced by the steam raising plant is converted into mechanical energy in the steam turbines. This energy is then used to drive generators. The steam turbines exhaust low pressure, low temperature steam which is condensed before being returned to the steam raising plant. In order to achieve the condensation, the latent heat of vaporisation must be removed. This is achieved through use of the condenser. The heat released by the steam is transferred to the main cooling water circuit, which is fed directly from the Bristol Channel. The cooling system is a once through system, which has a series of authorised discharge limits as stipulated in site authorisation AA2682 for its release point ref Outlet No.2. The limits are –

- Differential suspended solids between incoming and outgoing water < 50mg/l
- H max = 8.5
- H min = 7.5
- Oil and grease < 5mg/l
- Maximum temperature differential between incoming and outgoing water < 12°C

Please note the once through sea water fed cooling system is referred to in many Station documents as the CW system.

In addition auxiliary cooling is required for plant such as:

- Turbine oil coolers
- Seal oil coolers
- Distilled Water coolers
- Towns Water Reserve coolers
- Generator transformer oil coolers
- Feed pump motor & speed regulator coolers
- Rotary Air pump water tanks
- Quick Start air extraction plant coolers

Cooling circuit – once through system

<table>
<tr><th>Process</th><th>Cooling circuit – once through system</th></tr>
<tr><td>Description</td><td>Aberthaw Power Station is equipped with a once-through (direct-cooled) system.

Equipment
The cooling system consists of the following principal equipment:

▪ Forebay shaft diameter 20ft
▪ 2 inlet tunnels
▪ 8 Deptford Strainers
▪ 4 cooling water pumps (rate 220Kgall/min)
▪ cupra nickel (90:10) tube condensers (20,468 tubes of length 60ft)
▪ monitoring & control systems
▪ cooling water discharge culverts
▪ two cooling water outfalls
▪ outlet tunnel floor level (seaward end) –53.5ft O.D.

Configuration
The intake caisson is a concrete tower approximately 80’ high with 12 inlet ports around the periphery at low tide level. Across each inlet is a coarse screen of bars pitched 12” apart to prevent ingress of large debris.

The annular space between the central core and the outer wall forms the water chamber and this is divided into segments by division walls radiating from the central core. There are 4 such walls, which divide the water space into 4 chambers two of the chambers feed the Aberthaw ‘B’ Station, whilst the two other chambers are redundant following decommissioning of the Aberthaw ‘A’ Station. The two ‘B’ Station chambers feed the two ‘B’ Station inlet tunnels. Anti-vortex walls are built into the tunnel shafts to reduce turbulence and loss of head.

Water passes from the intake caisson to the forebay, which is a deep concrete structure which incorporates the two inlet tunnel shafts chambers and the pump suction chambers. Surge chambers are built into the forebay structure which serves to accommodate excess surge water which will appear at the forebay should the CW pumps be stopped simultaneously at full load.

Water passes from the forebay to the CW pumps through 4 short inclined ducts, one for each pump, then on through the Deptford Strainers (designed to remove smaller sized debris), to the discharge chamber bus main before passing into the three inlet culverts. Each culvert directs water to the turbine basement and into the condenser towers of the respective unit.

Each turbine has two condensers of single pass design with the inlet water boxes at the steam end and the outlet water boxes at the alternator end of the condenser. The water boxes each have an upper and lower section with separate connections for each section to the CW riser which provides supply.

The inlet and outlet pipes are connected to the water boxes by bellows pieces to avoid interference with the turbine expansion. To minimise the risk of salt leaks at the tube expansions, double tube plates are fitted in all water boxes. The plates are 1/8’ inch apart and the intervening space is filled with condensate which is maintained at a higher pressure than that of the CW system by one of two pumps.</td></tr>
</table>

	The electrical power required to pump CW through the condensers is greatly reduced by arranging a syphonic outlet flow. The syphon is created by the fall in the level from the top of the condenser to the water level in the seal pit. On full flow this fall will be typically 33ft. The seal pit is the point in the system where the three condenser outlet culverts join the two outlet tunnel shafts. The pit consists of an open topped rectangular section concrete structure with a wier across its floor separating the culverts from the tunnel shafts. Site water drainage discharges into a chamber on the south wall of the seal pit and passes through a sluice gate into the adjacent No.3 outlet tunnel shaft. The two outlet tunnels numbered 3 and 4 direct the outgoing CW from the seal pit to the outfall structures on the foreshore. Each outlet tunnel terminates its seaward end in an outfall structure built at minus 8ft level on the foreshore. The structures are thus submerged for a large part of the tidal range and are designed to protect the tunnel shafts against any blockage and damage which might be caused by beach erosion. Each has a two feet thick concrete roof, a pebble trap shelf and eight outlet ports guarded by flat screens. **Intake/Outfall** The abstraction is operated continuously when the plant is generating electricity with the abstraction rate related to power plant load. Due to the large volumes of cooling water utilised at the Station compared to the relatively minor levels of water discharged via site drains etc, the volume of the discharge can be regarded as equal to the abstraction rate. The cooling system is also operated during the warm-up and warm-down phase of plant operation. Cooling water is pumped continuously at approximately 50.5 m^3s^{-1} at full load operation through the condensers. This leads to a temperature rise across the condenser of typically 9 °C at full load operation. This temperature rise varies marginally throughout the year as a result of the influence of ambient water temperature on the overall power plant process thermal efficiency During warm-up and warm-down operation, the temperature rise will vary as the heat load on the condenser and the cooling water flow rate is varied. In order to ensure operational reliability some abstraction may be maintained for periods when the installation is not generating electricity e.g during standard shut down or start up of plant. **Chemical Characteristics of the Cooling Water Discharge** The discharged water has chemical characteristics determined by those of the corresponding abstracted water. These characteristics can vary over tidal and seasonal timescales leading to notable variations in discharge chemical characteristics over time. The chemical composition of the discharged water is essentially that of the water abstracted several minutes earlier. A typical chemical composition of the CW inlets and outlet system is collated in Table 1 below (spot sample date Jun 28 2005). **Physical Characteristics of the Discharge** Similarly to the chemical characteristics, the physical characteristics of the discharged water are also determined by those of the corresponding abstracted water. Again these characteristics can vary significantly over tidal and seasonal timescales at tidal sites leading to significant variations in discharge physical characteristics over time. The physical composition of the discharged water is that of the water abstracted several minutes earlier but

	with increased temperature and possibly modified suspended solids as discussed below. The cooling system is designed to minimise the risk of internal settlement of abstracted suspended solids. However, in transient power plant operation, some settlement of solids abstracted previously can occur. Solids which have temporarily settled out can be re-suspended when flow rate increases leading to a temporary discharge of suspended solids at a slightly greater concentration than the corresponding abstraction concentration. The cooling water discharge temperature at each condenser outlet is equal to the temperature of the corresponding abstracted water plus the temperature rise across the condenser. This varies seasonally and can vary with fouling of the heat transfer surfaces. The temperature of the final discharge from the cooling water circuit is determined by the heat and mass balance of the streams through each condenser. **Discharge Arrangements** The seal pit is the point in the system where the three condenser outlet culverts join the two outlet tunnel shafts. The pit consists of an open topped rectangular section concrete structure with a weir across its floor separating the culverts from the tunnel shafts. Site water drainage discharges into a chamber on the south wall of the seal pit and passes through a sluice gate into the adjacent No.3 outlet tunnel shaft. Water treatment plant effluent and Boiler Blowdown water are also merged with the CW effluent stream at the seal pit.

Table 1 Example of analysis data - Comparison CW inlet / CW outlet

Parameter	CW abstraction	CW discharge
Chloride mg/l	16600	16200
Suspended solids mg/l	14	36
pH	8.00	8.02
TOC mg/l	0.53	0.50
Mercury (dissolved) µg/l	<0.002	<0.002
Antimony (dissolved) µg/l	<0.40	<0.40
Arsenic (dissolved) µg/l	<1.8	<1.8
Selenium (dissolved) µg/l	<1.8	<1.8
Absorbed Organic halide	<1.00	<1.00
Ammonia (filtered) mg/l as N	<0.01	0.04
Barium (dissolved) µg/l	<100	<100
Beryllium (dissolved) µg/l	<30	<30
Boron (dissolved) µg/l	3800	3540
Bromide (dissolved) mg/l	65.7	66.3
Cadmium (dissolved) µg/l	0.19	0.15
Chromium (dissolved) µg/l	0.31	0.56
Cobalt (dissolved) µg/l	<20	<20
Copper (dissolved) µg/l	4.18	1.93
Cyanide (dissolved) mg/l	<0.01	<0.01
Lead (dissolved) µg/l	0.08	0.07
Molybdenum (dissolved) µg/l	<30	<30
Nickel (dissolved) µg/l	1.45	0.96
Nitrate (dissolved) mg/l as N	0.00	0.00
Total Phosphate (dissolved) mg/l as P	0.05	0.05
Silver (dissolved) µg/l	<1.00	<1.00
Sulphate (dissolved) mg/l	2230	2210
Tellurium (dissolved) µg/l	<20	<20

Thallium (dissolved) mg/l	<0.01	<0.01
Tin (dissolved) μg/l	<25.00	<25.00
Titanium (dissolved) mg/l	<0.01	<0.01
Uranium (dissolved) μg/l	<20	<20
Vanadium (dissolved) μg/l	<10	<10
Zinc (dissolved) μg/l	12.7	24.3

Auxiliary Cooling system
The auxiliary cooling system serves the following principal items of plant:

- Turbine oil coolers
- Seal oil coolers
- Distilled Water coolers
- Towns Mains Reserve coolers
- Generator transformer oil coolers
- Feed pump motor & speed regulator coolers
- Rotary Air pump water tanks
- Quick Start air extraction plant coolers

The auxiliary cooling system consists of the following equipment:

- tap off from main cooling water circuit
- auxiliary cooling circuit pipework
- auxiliary cooling water circuit strainers
- auxiliary cooling circuit discharge returns to main cooling system

The main auxiliary cooling water is tapped of from the two main pipes feeding each condenser pass.

The supplies to the Towns Water Reserve coolers and the Feed pump motor & Speed Regulator coolers are each tapped off the main pipe feeding one of the condenser passes.

The auxiliary circuit has much smaller tubes than the main condenser and is vulnerable to blockage by items that pose no threat to the main circuit. Additional strainers are therefore used to reduce such blockages.

Flow through the auxiliary cooling water circuit depends on the flow through the main cooling water circuit. The warmed water, except that from the Rotary Air Pump tanks, is returned to the main condenser outlet pipes and hence passes to the seal pits. The water from the Rotary Air Pump tanks returns to the seal pit by way of the Dirty Drains System and Site Drains Sump.

On cessation of generation of electricity, the auxiliary cooling water circuits continue to operate until the residual heat has been removed from the plant items served.

BAT for the Cooling System
BAT for the cooling of the power plant was fundamental to the siting, design and operational principles of the plant. The cooling system is a significant factor in determining the overall thermal efficiency of the installation (ie MW_e generated/MW_{th} heat input) and therefore affects the specific emission (emission/MW_e generated) for the principal emissions to the environment.

A fundamental consideration in the selection of the Station as a coastal location was the availability of the sea water to act as a continuous supply of cooling water. The choice of saline water was also selected to minimise the environmental impacts of a large cooling system by minimising the use of fresh water supplies

EC(2001) contains three ‘horizontal’ issues for consideration and a number of specific BAT issues.

The ‘horizontal’ considerations are as follows.

Prevention - Optimisation of reject heat load
Opportunities for within-process and external use of heat have been considered. A principal operational goal for power plant is the optimisation of process thermal efficiency. As a result of the history of improvement over many years in the steam-cycle power generation process, including optimisation of heat flows within the process, opportunities for within-process improvements are limited for existing plant, being largely determined by the plant design and site considerations. Opportunities for external use of heat were considered at the siting stage and kept under review via the Performance Dept.

Process requirements
The ‘Level of dissipated heat’ is in the range ‘low-medium’ in EC(2001) terminology with typical turbine steam exhaust temperature of approximately 40°C. The substance being cooled is not hazardous. The primary BAT approach is therefore wet-cooling, with the objective of optimising overall energy efficiency. Thus, a wet technology would be expected to be used if water environmental considerations are permitted as is the case for the Aberthaw Power Station.

Site Characteristics
The characteristics of the site location influence installation-specific BAT. Key considerations are:

- Source water availability – saline, fresh; coastal, groundwater, surface water
- Sensitivity of receiving waters to thermal loads
- Space availability on site
- Visual amenity of cooling towers and steam plume release

The choice of cooling system is primarily based on overall plant thermal efficiency considerations, factoring in water resource availability and environmental sensitivities. This leads to the following ordering of cooling system technology:

1. Once through cooling (where water resource availability and environmental sensitivities allow)
2. Natural draught tower-cooled recirculating system (older existing plant)
2. Mechanical draught hybrid tower-cooled recirculating system (newer existing plant)
3. Dry cooling system (where water resource availability or environmental sensitivities preclude any component of wet cooling)

In the case of Aberthaw Power Station the use of a once through cooling system is in line with the above ‘horizontal’ BAT principles since water resource and water receptor sensitivity are such as to allow use of such a once through cooling.

The specific BAT considerations identified in EC (2001 section 4) are as follows.

BAT for increasing overall energy efficiency
A principal operational goal for the Aberthaw power plant is the optimisation of process thermal efficiency and hence the specific development of the Performance Dept has been established on site.

In terms of overall process energy efficiency the appropriate selection of a fundamental cooling system is recognised (see above). For the system successfully operating at Aberthaw Power Station the following examples are significant considerations contributing to optimised plant operation:

- use of energy for pumps and fans e.g. the Station operate typically with one cooling water pump per boiler unit i.e. 3 pumps for 3 units. Although a fourth cooling water pump is available the use of the fourth pump is restricted in order to conserve energy as each pump consumes approximately 4MW of energy. The fourth pump is only utilised in extreme circumstances e.g at very low tides during hottest days of Summer.
- optimised cooling water system coatings and treatment for flow resistance and heat transfer

BAT for reduction of water requirements
Heat use and re-use within the installation are regularly reviewed with the advent of plant modifications etc, however due to the somewhat remote location of the Station opportunities to support external facilities with heat recovery systems are not considered practicable.

The water requirements of the plant are governed by the power plant load. Recognised water flows are required to maintain operation. The opportunities to maintain and optimise water usage are primarily focused upon identifying and rectifying plant associated leaks. Such a focus is the remit of the Operations Team through its routine plant checks etc, the Maintenance Team with their response to identified defects and the specialist Station Teams such as the Water Optimisation CIG that regularly review means to minimise water consumption. The CIG has successfully introduced a series of plant modifications that serve to optimise water management, examples of which include:

- recapturing of motive waters from Condensate Polishing Plant transfers;
- installation of direct conductivity probes to avoid continuous loss of sample flows during conductivity sampling;
- re-direction of new boiler water sample drains to Towns Water Reserve cooling system etc.

BAT for reduction of heat emission
Environmental sensitivity to the plant thermal load was a major factor in determining the feasibility of the fundamental cooling system selection above. The through life costs and technical infeasibility render a change in fundamental cooling system technology not to be BAT, unless new and over-riding water resource or environmental sensitivity considerations different to those pertaining originally were to emerge. Since this is not the case, the current system constitutes BAT.

It should be noted that the principal design of the Aberthaw Power Station, as is typical of many power stations, includes a number of integral design features to optimise any useful heat generated in the combustion process. For example the boiler includes an economiser which functions as a heat exchanger to extract heat from the waste flue gases prior to the gases being discharged from the stack and transfers the heat to warm the incoming feedwater. Other design features incorporated into the plant design to optimise cycle efficiency include the HP turbine exhausting to the Reheater section of the boiler, this reheated steam returns to the IP turbine and some of the IP exhaust steam is tapped off to drive the main boiler feed pump which again improves cycle efficiency. The exhaust from the boiler feed pump turbine is used to heat the incoming boiler feed water in a tube type feed water heater, again improving cycle efficiency. Furthermore steam is tapped off the various stages of the LP turbine to provide heat for the d.c heaters again raising cycle efficiency.

BAT for reduction of emissions to water by design and maintenance

- The BAT principles of EC (2001, 4.6.3) have been applied during the detailed design of the plant system. This includes:
- having regard to materials and coatings choices to limit corrosion-sensitivity and solubilisation
- designing to achieve flows above the suspended solids deposition velocity throughout
- use of self-scouring concrete culverts and coated metals for cooling water culverts
- periodic physical cleaning of surfaces

BAT to reduce the risk of leakage

Since the pressure in the steam-cycle side of the condenser tubes is significantly less than that in the cooling water, should there be condenser tube leak the cooling water would contaminate the condensate in the steam-cycle, which is of operational but not directly of environmental concern. However, since the ingress of cooling water leads to impairment of steam cycle water and the increased need for blowdown or condensate rejection, operational procedures aim to reduce the incidence of leaks occurring and to take appropriate action regarding any which do occur. Salt leaks are addressed at the earliest operational opportunity.

Water Treatment Process

The main of source of water for production of boiler feed water is derived from a single source referred to as the Ely Wells. These are deep bore hole wells and provide an excellent quality of raw water. The water passes through two reservoirs, the first at St. Lythans and the second at East Aberthaw before entering the Station's water treatment plant. The reservoirs act to provide reserve supply in case of pump / pipework failure associated with the transference from the Wells to the Station.

The abstraction of the water at the Wells is permitted via abstraction license ref 21/57/31/40 and permits the abstraction of 3,737 m^3 / day. An analysis of the Ely Wells water is recorded in the table (ref Table 2) below

Under extreme circumstances, additional water can be directed to the Station from the local Towns Mains water supply. This additional make up is referred to on site as supplement water. An analysis of the supplement water is recorded in the table (ref Table 2) below. The water is purchased at additional cost via contract from Welsh Water.

The boilers require a reliable supply of high quality treated water to make up losses of steam and water from the power station's steam cycle. Losses may be incurred either through leaks of steam or water, boiler blowdown or condensate rejection. The water treatment plant produces the required quality of feed water by removal of dissolved chemical species and suspended solids present in the source water supplied to site.

The two main water treatment effluent streams relate to cation and anion regenerations. The entries below represent water qualities of the final rinses of the beds. It is noted that there is significantly higher concentration levels of mineral contaminants detected in the effluent at the beginning of the regeneration cycle than in the final rinse, e.g TDS at start of anion rinse 34800 mg/l, end of rinse 89mg/l; cation sulphate at start of rinse 25900 mg/l, end of rinse 172 mg/l. It should also be noted that the various stages of regeneration operate on differing timescales. The conclusion of an extensive investigation, prompted by the Water Optimisation CIG, identifed that at no stage during the regeneration programmes were there significant volumes of water at the appropriate quality to enable feasible re-use.

A typical comparison of source and effluent qualities are tabulated below.

Table 2 : Comparison of WTP Source Water and Final Cation and Anion Rinses

		Ely Wells	Towns Mains	Cation final rinse effluent	Anion final rinse effluent
pH-range		7.0 – 8.6	7.0	2.5	10.7
TOC	mg/l	<5	-	-	-
Alkalinity	mg/l CaCO3	248	35	<10	30
Chloride	mg/l	32.4	6.7	41.8	<20
Sulphate	mg/l	32.9	14.6	172	<5
Nitrate	mg/l	4.5	-	3.87	<0.4
Nitrite	mg/l	<0.08	-	<0.08	<0.08
Silicon	mg/l	5.13	2.0	-	-
Ortho phosphate	mg/l P	<0.1	-	-	-
Sodium	mg/l	21.9	4.1	5.06	3.2
Potassium	mg/l	2.44 / 2.34 (total / dissolved)	0.5	0.448	0.371
Calcium	mg/l	92.2 / 85.5 (total / dissolved)	17.2 (total)	0.18	0.2
Magnesium	mg/l	25.1 / 22.2 (total / dissolved)	1.8 (total)	<0.1	<0.1
Ammonia	mg/l N	<0.6	0.02	-	-
Aluminium	µg/l	-	-	-	-
Iron	µg/l	<30 / <0.1 (total / dissolved)	Trace	<0.1	<0.1
Barium	mg/l	-	-	<0.1	<0.1

Water Treatment Process – ion-exchange description

Process	Boiler make up water treatment process – ion exchange
Description	The treatment process is based on ion exchange technology. **Equipment** The plant consists of - ▪ Cation starvation units ▪ Vacuum and atmospheric degasifier towers ▪ Anion, cation and mixed ion exchange beds ▪ Regeneration chemical storage facilities (sulphuric acid and caustic) ▪ Produced water storage (referred to on site as Reserve Feed Water [RFW])

	▪ Contingency effluent holding tank ▪ Control system ***Configuration*** The water treatment plant is arranged in three independent streams, two streams being normally on-line, one being on standby. The maximum capacity of the water treatment plant is 58.2Kgall/hr, however at present the typical flow is approx 20 - 30 kgal/hr. One stream can produce a design throughput of 900m^3 of demineralised water before requiring regeneration (at a flow rate of 64m^3/h), giving a design cycle time of 14 hours. However this is highly to water dependant on the water requirements from station. ***Operation*** Because of nature of the source water i.e as the water is bore hole water and therefore essentially already finely filtered, it has been established that the traditional filtering of the water via sand filters afforded very little benefit and on consideration of the large volumes of water required to backwash the filters it was decided that it was both economically sound and environmentally appropriate to decommission the sand filters in 1991 The raw water contains a very low level of suspended solids but a considerable concentration of dissolved species in the form of positively charged ions (cations) and negatively charged ions (anions). The raw water is therefore passed through ion exchange resins to replace any cations with hydrogen ions and any anions with hydroxyl ions. After a period of operation, typically 12 -24 hours (dependant on resin type) with the current source water quality, the hydrogen and hydroxyl ions in the respective resins have been largely replaced by other cations and anions from the raw water, so that the resins become exhausted and are no longer capable of ion exchange. Regeneration must then take place and takes between two and six hours, dependant on resin type. The exhausted resins are regenerated by passing sulphuric acid (96%) over the cation resins and sodium hydroxide (46%) over the anion resins. Other than these two chemicals, no other substances are routinely added in the water treatment plant. In the year 2005 chemical usage was 690Te sulphuric acid (96%) and 598Te sodium hydroxide (46%). Occasional salt soaks (one per annum) are undertaken on the resin to enhance performance. The sodium hydroxide solution used for regeneration purposes is a well established industry grade product. The alkali contains heavy metals such as mercury and cadmium derived from the sodium hydroxide production process. The concentrations of these contaminants are strictly limited through procurement specification. The levels of these materials released from site to the aquatic environment is routinely monitored and formally reported via the Pollution Inventory Reporting Form to the Environment Agency as stipulated in the site's IPC authorisation. Effluent from the ion exchange regeneration consists predominantly of calcium, magnesium and sodium salts, primarily in their chloride, nitrate sulphate and carbonate forms. It is discharged intermittently under operator control into the cooling water purge system. The latter discharge flow is routinely monitored against the control parameters stipulated in the site's authorisation and to date an excellent level of compliance has been maintained.

Raw material inputs				

Ely Wells	Please refer to table above			
Towns water Supplement	Please refer to table above			
Chemical inputs	**Reason**	**Dosing strategy**	**Means of application**	**Comment**
Sodium hydroxide	Resin regeneration	At required frequency to regen resin bed.	Combination of manual and automatic application	Established industry method for ion exchange regeneration.
Sulphuric Acid	Resin regeneration	At required frequency to regen resin bed.	Combination of manual and automatic application	Established industry method for ion exchange regeneration.
Effluent analysis	**Typical**	**Short-term max**		
pH	Range varies with regen type i.e acid or caustic.	Range estimated as 2 - 11	N/A	Effluent streams dispersed into massive volumes of CW discharge. CW discharge pH monitored to maintain compliance with authorised limit.
Suspended solids	Not routinely monitored	Not routinely monitored	N/A	Effluent streams dispersed into massive volumes of CW discharge. CW discharge suspended solids monitored to maintain compliance with authorised limit.
Heavy metals	Trace	Not routinely monitored. Analysed twice per annum to provide data for Pollution Inventory Report	N/A	Controlled by commercial supply contracts of WTP chemicals. quality standards.
Volume flux	Not routinely measured, dependant on Power Station load factor	Nil	Not routinely measured	Not routinely measured

BAT for Water Treatment Process
BAT for the water treatment process is installation-specific depending on a variety of factors including principally:

- source water quality
- source water resource availability
- boiler feedwater requirement.

Since the existing water treatment plant is serviceable and fit for purpose, capital and through life costs associated with installation of a new plant rule out a fundamental technology change.

BAT consists therefore of:

- optimised operation of the installed technology
- consideration of the possibility of re-use of the water treatment plant effluent when opportunities arise
- appropriate discharge of the effluent

The operation of the water treatment plant at Aberthaw is in line with these BAT principles and therefore constitutes BAT.

Operation of the process is optimised by plant operational procedures and practices including:

- Appropriate selection of chemicals
- Optimising the use of chemicals
- Optimising pre-treatment
- Monitoring and optimising the process yield
- Optimising power consumption
- Exploiting cost reduction opportunities

A number of modifications to plant operation have been undertaken to enhance performance of the plant since the plant was originally commissioned. An example of such enhancements was the decommissioning of the sand filters and thereby minimisation raw water consumption previous utilised in the backwashing the beds.

The plant was designed with both a vacuum degasser unit and an atmospheric degasser unit. The degasser units act to minimise the loading of carbonate onto the anion resins and hence extend anion resin life before saturation and the requirement for regeneration i.e. volumes of sodium hydroxide as a regenerant are minimised.

Opportunities for re-use of the effluent are regularly reviewed. In particular the Station's Water Optimisation Continuous Improvement Group (CIG) actively review on a monthly basis the water consumption at the Water Treatment Plant against target consumption rates. The CIG have also recently reviewed opportunities to recycle any backwash or rinse waters from the demineralisation process. It has been found that the exaggerated levels of inorganic contaminants found in the bulk of the effluent waters preclude any realistic opportunity for re-use. The effluent was also considered for use in bowser operations for dust suppression but due to the unacceptable pH levels the proposal was deemed inappropriate.

The intermittent effluent from the water treatment plant is of relatively insignificant volume in comparison to the large volumes of sea water continually passing through the CW system. In design of the Water Treatment Plant the option of pH adjustment of the various effluent streams was incorporated but due to extensive mal-functioning of the plant, the use of the pH adjustment plant was considered a lesser benefit compared with reducing the hazard associated with the storage of additional volumes of acid and caustic. An evaluation of the impact of direct release into the cooling water system was undertaken and it was identified no significant impact would result from discharging the effluent in such a manner. The negligible effect can be demonstrated when considering the largest effluent discharge (starvation regen, approx 20K galls/ hr for 6hrs) coincident with the minimum release of CW of 133,200K galls/hr continuously. Typically with three units operational the CW release would be approximately 500,000K galls per hour.

The current mechanism of discharge is to only discharge when the CW system is in operation, which in turn means when at least one unit is operating. During the unlikely scenario of an ion exchange regeneration being required during a total Station shut down, the effluent from the regeneration is directed and stored in the contingency effluent storage tanks until such times that the CW system is returned to service. The effluent is then steadily released into the CW discharge. At no time is water treatment process effluent discharged directly into the receiving waters.

Main Plant Boiler blowdown & condensate rejection systems

Process	Main Plant –turbine, condenser
Description	In the Aberthaw Power Station, the heat energy contained in the high pressure steam produced in the steam raising plant is converted into mechanical energy in the steam turbines. This energy is then used to drive generators. The steam turbines ultimately exhaust low pressure, low temperature steam which is condensed in cupra nickel condensers before being returned to the steam raising plant. The recirculation of condensate helps to optimise the thermal efficiency of the plant as well as limiting the consumption of raw water. Steam is condensed at the lowest practicable temperature and pressure to obtain the best possible efficiency in converting the energy in the steam to electricity. Since the cooling water source is saltwater the plant is equipped with a condensate polishing plant (CPPs) in order to reduce the proportion of condensate which would otherwise need to be rejected should condenser tube leaks occur. The condensate polishing plant makes use of an ion-exchange process analogous to that for an ion-exchange water treatment plant. The CPPs utilise a mixture of cation and anion resin and are analogous to the function of a typical mixed bed demineralisation unit. **Boiler Chemistry** Boiler water is of high quality, having been supplied by direct feed from the water treatment plant. It is essential that the quality of boiler water chemistry is maintained at all times in order to avoid potentially catastrophic boiler tube failures etc or turbine blade deposits. During normal operation Aberthaw Power Station employ a low caustic / volatile treatment of boiler water using ammonia and hydrazine. The boiler water is maintained in a slightly alkaline condition (pH 9.3 - 10.0) to limit corrosion occurring on vulnerable plant surfaces. Hydrazine is dosed to the feedwater to act as an oxygen scavenger and to promote the formation of a protective magnetite layer on tube surfaces and thereby minimise the potential of corrosion. Hydrazine decomposes at boiler operating temperature to produce additional ammonia, nitrogen and water. The boiler water dosing is typically controlled to maintain a total ammonia concentration of 0.5 mgl^{-1} in boiler water. On this basis the annual release of

	ammonia in the blowdown can be considered negligible. In order to prevent wasteful loss of heat the blowdown of any unit is only operated infrequently and only to remove unwanted contaminants. The blowdown from the boiler plant is directed to the CW system. Hydrazine is a well established product utilised in a wide range of steam generating facilities, but is also subject to the COMAH Regulations. At present the management of the product is focused upon correct handling within an enclosed dosing system, however, In 2006 a plant improvement project will review the use of a non hazardous scavenger as a replacement product for hydrazine. A low level of caustic alkalinity is maintained in the boiler water via the dosing of very dilute solutions of sodium hydroxide. The alkalinity serves to prevent the development of acid conditions caused by any ingress of salinity resulting from a condenser tube leak. ***Sootblowing*** As the coal particles burn, glassy droplets of ash are produced. Those particles that impinge on the furnace tubes begin to form deposits of slag. To control accumulation and thereby prevent efficiency losses, the deposits are periodically blown off with steam (typically once per shift). The procedure is referred to as sootblowing. There is strong commercial incentive to minimise use of sootblowing because of the energy and quality costs of the water used. In typical operation, around approximately 1% of the steam raised may be used for sootblowing. The steam used in this way enters the boiler gas stream and is lost to the atmosphere. ***Blowdown*** A limited quantity of water is purged from the steam raising plant at regular intervals via blowdown to maintain the chemical quality of the water so as to avoid damage to plant equipment and maintain thermal efficiency. The blowdown rate is manually adjusted as necessary to maintain boiler water quality while minimising the loss of water. Again, there is a strong commercial incentive to minimise use of blowdown and blowdown quantity is the minimum consistent with maintaining the chemical quality of the boiler water. At Aberthaw Power Station, boiler blowdown is essentially high quality water whose quality is nonetheless insufficient for continued use within the steam generating plant due to ingress of sea water from the associated condenser cooling system. It is therefore a concentration of the feedwater supplied by the water treatment plant plus trace amounts of chloride and boiler treatment chemicals. Water blown down from the steam raising plant is discharged into the cooling water pumphouse forebay by way of the Dirty Drains System and Site Drains Sump. Routing the blowdown in this manner renders unnecessary any additional use of chemicals for pH adjustment given the minimum volume of blowdown occurring. Cooling of the blowdown takes place within the CW system. There is no direct discharge of blowdown to the cooling system purge outfall. The focus at Aberthaw Power Station is to minimise requirement for blowdown by optimising the performance of the water treatment plant as well as preventing ingress of sea water through the sea water condenser cooling system. It is also the operational procedure of choice to avoid blowdown and utilise the Condensate Polishing Plant to remove minor sea water

contamination.

Opportunities to recycle the blowdown water have been reviewed recently via the Water Optimisation Continuous Improvement Group, however, the requirement to handle steam at such high temperatures and pressures has precluded any viable recovery options.

Condensate rejection
Rejection of out of specification condensate from the steam-cycle is essential in order to maintain appropriate water quality in the steam raising plant so as to avoid damage to plant equipment and maintain efficiency.

Plant operational procedures seek to reduce the condensate rejection required eg through management of leaks which introduce contamination in order to minimise high quality water losses and through management of start-up procedures.

Possible opportunities to use rejected condensate are kept under review via the Water Optimisation CIG and via the Plant Modification Procedure which ensures best use of Station resource is utilised for any enhancements / modifications of plant.

To minimise water, heat, chemical and energy consumption, condensate is redirected to the boiler feed water via the WTP mixed beds and RFW tanks. Reject condensate i.e condensate with notable contamination may be recorded during start up of a unit. The routine procedure is then to re-circulate the condensate through the condenser polishing plant to provide the necessary quality water. All efforts are focused on re-utilising the condensate as this quality of water is well recognised, hence only when insufficient quality is noted is the condensate drained from system into the cooling water discharge.

Leaks
Any leaks from the steam-raising plant, turbine and condenser drain by gravity into one of two sumps referred to as the North End Dirty Drains Pit and the South End Dirty Drains Pit. Both these pits are equipped with oil skimmers. At time of preparation of this application new "oil in water" monitors are being installed on both pits. The monitors will relay alarm to the Main Control Room on detection of significant quantities of oil.

From these pits the water is pumped to the Site Drains Sump, which contains an oil interception facility, a skimmer and an-oil-in water detector. From here, the drains flow by gravity or are pumped, dependant on the state of the tide, to the CW Outlet Seal Pit and hence discharged from site.

Boiler blowdown characteristics and rates

Raw material inputs - Chemical inputs	Reason	Dosing strategy	Means of application	Comment
Ammonia	Boiler water chemistry corrosion control	Routine	Dosing pump to feed water	0.5 mg/l in boiler water
Hydrazine	Boiler water chemistry corrosion control	Routine	Dosing pump to feed water	Decomposes to ammonia in boiler water
Sodium hydroxide	Prevention of acid conditions	Minimal level	Dosing pump to boiler drum	Minimal level maintained as

	should saline ingress occur			determined by company technical procedure.
Effluent analysis	Typical	Short-term max	**Means of application**	**Comment**
pH	9.5 - 10	N/A	Not routinely monitored	
Ammonia (mgl^{-1})	See above	To maintain correct boiler pH	Not routinely monitored	
blowdown volume typically in a xhour event	Not routinely measured	N/A	N/A	

BAT for Blowdown & Condensate Rejection Arrangements
There is no explicit statement within Environment Agency (2005) regarding BAT for blowdown from the steam-raising plant and condensate rejection. BAT may therefore be taken to consist of operational optimisation to:

- Limit the blowdown and condensate rejection required by appropriate management of leaks which would otherwise lead to the contamination of the steam-raising plant feedwater and management of start up procedures.
- Managing blowdown and condensate rejection rates as part of the overall steam-raising plant chemical management system.
- Seek opportunities to make use of any blowdown or condensate rejection occurring
- Discharge any effluents appropriately.

The management of blowdown and condensate rejection is fully in-line with these principles. In particular the primary focus is to reduce the incidence and severity of leaks which would otherwise increase the requirement for blowdown and/or condensate rejection

The possibility of recovery of blowdown has been recently reviewed via the Water Optimisation CIG. Unfortunately due to the cost of installation and maintenance of the appropriate recovery plant required able to manage such high temperature steam / water, it was deemed not to be feasible to recover the blowdown.

The typically low volumes of blowdown are routed to the basement drains, where it combines with the CW discharge.

Contaminated condensate is routed via the WTP mixed beds back in the boiler feed system. Rejected condensate, i.e condensate of insufficient quality to re-use is discharged via the CW system.

Coal Stockpile Run-off
Coal is stored in a designated stocking area in the open as shown on site diagram in Appendix B The coal stockpiles are contoured and compacted to achieve high rates of water run-off and to minimise rainfall infiltration and leachate. Water run-off from coal stockpiles will contain fine coal particulates.

The run off water is collected in a specifically designed drain referred to as the Coal Perimeter Drain and acts as the first area for solid matter to begin to settle from the bulk waters. The water slowly passes through a series of settlement boards which holds back any solid materials, before reaching a "reception area" from whence it passes into the first of two large settlement lagoons. The water percolates slowly from the western lagoon to the eastern lagoon and then is released from site via a discharge pipe into the Bristol Channel situated at the mouth of the River Thaw approximately 20m outside of the RWE Npower's boundary fence. The discharge pipe is referred to on site as the 36" drain and is an authorised release point as stipulated in the site's authorisation. Daily analysis of the 36" drain is undertaken to ensure compliance against the discharge limits of suspended solids, oil & grease and pH.

A concrete plinth has been built aside the eastern lagoon to accommodate a mobile oil skimmer should oil be detected during routine monitoring of the lagoons by Operations / chemistry teams.

The 36" drain is served by an actuated pen-stock valve than when closed will prevent release of any material off site from this discharge location. It has been noted that the outlet screen of the 36" drain repeatedly suffers from physical bombardment from large pebbles and that smaller pebbles, grit and sand regularly interfere with the pen-stock valve guides and therefore the valve requires regular cleaning and maintenance to remain operative. An improvement that is currently being reviewed is the re-siting of the 36" drain such that the discharge point lies within RWE Npower's land and releases at a point approximately 30m upstream of the current discharge point in the River Thaw. This modification would afford far greater protection of the drainage system from physical bombardment and therefore afford greater security in times of necessity to shut the discharge valve that the valve will be in optimum condition.

The Coal Perimeter Drain also serves to collect run off from the ash conditioning area and the associated lorry wash. Water from the nearby ash mound and ash conditioning silo is collected in a series of concrete settlement pits aside the ash silo. Settled water was formerly pumped into the western settlement lagoon but a recent series of initiatives proposed by the Site Drainage CIG has prompted the re-direction of the effluent into the Coal Perimeter Drain.

The lorry wash facility immediately west of the River Thaw bridge acts to minimise the transfer of ash / dust from the vehicles onto the site roads which could then generate a potential fugitive dust issue. The lorry wash sprays fresh water (Ely Wells supply) onto the vehicles. The subsequent effluent from the lorry wash was previously directed to the western settlement lagoon but another recent initiative proposed by the Site Drainage CIG has been to direct the effluent into the coal perimeter drain and thereby significantly increasing the residence time for particulate matter to settle from the waters. This modification in combination with the re-direction of the waters collected in the ash silo settling pits into the coal perimeter drain has significantly decreased the potential loading of the settlement lagoons and thereby offers far greater efficiency to the lagoons in preventing significant levels of particulate matter being released during heavy rain periods.

Another initiative is currently being investigated via the Site Drainage CIG and Water Optimisation CIG to utilise the water within the lagoons to condition the ash before it is deposited onto the site landfill area. At present the ash is conditioned with sea water which has the distinct disadvantages of prompting corrosion on the ash vehicles as well as conferring a lower saleability to the PFA.

It is also envisaged that if the water from the lagoons is deemed feasible for re-use that the water could be utilised for dust suppression via the various bowser activities undertaken on and in the vicinity of the ash mound area.

Two further initiatives currently being considered for water optimisation in the area are the installation of two large filtration units to be fitted at the outlets of the ash silo settling pits and the lorry wash facility. The filters would allow the station to recycle water within the individual systems and thereby significantly reduce the volume of fresh water make up.

Flue Gas Desulphurisation (FGD) Wastewater Treatment

The evaluation of the available FGD technologies during the Section 36 consenting process identified that the preferred mechanism for operation at Aberthaw is via the Sea Water Process. This process utilises the sea water's natural alkalinity to neutralise the sulphur dioxide entrained in the boiler flue gases.

The process will involve diversion of up to 15% of the cooling water discharge flow from each unit post passage through the respective condenser to an absorber unit. Within the absorber the cooling water will be sprayed directly onto the flue gases to absorb the sulphur dioxide. The waters will then pass to an Seawater Treatment Plant which will introduce oxygen through aeration into the waters and thereby raise the pH to the appropriate level before effecting release to the Bristol Channel.

For a detailed explanation of the proposed FGD operation and potential environmental impact of associated activities please refer to Section B2.1.4 of this IPPC application and the supplementary report addressing the impact of significant aquatic emissions (ENV/088/2006).

Ash Handling Systems.
Furnace Bottom Ash

The furnace bottom ash handling systems operates as an intermittent system in accordance to the ashing frequency of one boiler per shift per day for the Power Station. Through many years of experience this frequency of "little and often" has shown to be the safest and most efficient to support boiler operation.

The bottom furnace ash is quenched with water and removed from the furnace hoppers with high pressure sea water. The ash is then crushed before being sluiced to the ash pits where the ash is dewatered.

The dewatered ash is then removed via the ash grab crane, placed into lorries and transported approximately 100m to the on-site grading area. The grading operation is undertaken by a contractor workforce under the direct supervision and environmental control of the Station management. All material is sold into the aggregates industry. The potential impacts associated with the FBA product are recognised by the Station and recorded as such within the Station's ISO 14001 Environmental Evaluation Effects. The principal effects associated with the operation is the potential of fugitive dust blow from the storage piles, although from evaluation of the material, the material appears of an appropriate density to avoid dust generation. However, mindful of the potential for fugitive dust blow, attention is focused on maintaining the storage piles below the surrounding bunds walls and minimising product drops onto storage piles.

In the original design of the ash handling system the importance of optimising water was recognised and therefore the water within the system is recirculated from the pits back to the hoppers. It was also recognised that it would be far more appropriate to utilise sea water than a fresh water resource.

A typical concern associated with bottom ash handling systems is the contamination of the system with fuel oil resulting from a fuel oil gun failure. The prime concern is the avoidance of the oil contamination being discharged from site. Whilst it is recognised that the principle means to avoid the contamination is to focus on appropriate maintenance of the fuel oil system, there are also contingency controls employed within the Aberthaw operation. Firstly the process is not a “once through system” and water is recirculated back through the system and secondly the arrangement of the ash pits is designed such to allow any oil to float to the surface of the pits. Significant quantities could then be removed by specialist bowser. Minor quantities would become adsorbed onto the vast quantities of ash held within the system. Should any contaminated water be released from the system, the water would be directed into the dirty drains system which is supported by both a solids interceptor and an oil skimmer to counteract any potential contamination.

Pulverised Fuel Ash (PFA) Handling System
The PFA landfill site is the subject of a separate PPC application ref DP3432SW.

All handling systems are “dry” systems and afford no direct waste water streams

Dry-conditioned Ash Storage Run-off
At no stage in the handling of PFA is the material stored in open areas. The material remains fully enclosed until deposition from the ash conditioning silo.

Drainage Systems
General System Description
Aberthaw Power Station is a 185.9 hectare site (he area within the PPC boundary is 51 hectares) located on the coast of the Bristol Channel approximately mid way between the towns of Barry and Llantwit Major. The site is predominantly level.

The nearest major water course is the Bristol Channel, whilst the site is divided east to west by the River Thaw which enters the Channel at grid ref ST 0291 6574.The site is approximately 8 metres above Ordnance Datum which represents a height of approximately 1 metre above the high water mark.

The site has two authorised discharge points referenced in the site authorisation as Outlet 2 (W1) and Outlet 3 (W6). Descriptions of the outlets and the respective discharges are referenced in sections 2.2.2.1 – 2.2.2.6 above.

Although recognised within a flood plain area, the site has no history of flooding. The southern boundary of the Station lies within a sea defence wall which was built alongside Station construction.

The site is served by a number of separated drainage systems. Distinct surface and foul water drainage systems serve the entire site. The buildings and surfaces where there is the potential for oil contamination to occur are drained separately to those areas not considered to have the potential for oil contaimination.

Surface water run-off passes to either Outlet No2 or No3 dependent on the area within the Power station site the rain has fallen. In general the east of the site drains to Outlet

3 while the west drains to Outlet 2, both Outlets have appropriate oil removal and suspended solid separators.

An overview of the site drainage system is given in Appendix B along with a smaller scale drawing showing the clean and potentially oily drainage system in the vicinity of the Turbine Hall. The manholes on the oily drainage network are colour coded red, whilst those on the clean network are coloured blue.

The drainage systems are in general below surface and make use of the site levels as far as possible to allow gravity flow. This ensures reliability of operation and minimises the energy consumption required for the pumping of effluent.

Modifications, additions and repairs to the drainage systems have been made over the years in order to improve both performance and effluent quality e.g. the incorporation of oil skimmers.

The drainage systems are subject to a variety of inspection and maintenance procedures to ensure satisfactory performance. These have been refined during the lifetime of the plant in the light of experience. These procedures include:

- Drain condition
- Drain & gully siltation and obstruction avoidance
- General staff alertness for indications of problems (such as flooding)
- Maintenance of treatment systems such as settling ponds, oil-water separators, oil booms.

Opportunities for re-use of drainage water are regularly reviewed by both the Water optimisation CIG and the Site Drainage CIG. Current proposals include the recovery and re-use of ash silo run-off water, vehicle wash water and stockyard drainage water. The possibilities to re-use these waters include PFA conditioning and as a supply for bowser operation to counteract the potential of fugitive dust arisings from site roads.

The importance of minimising water usage to both protect Station operations as well avoid unnecessary costs is well recognised and routinely re-inforced. The focus of general plant operational procedures focus toward the reduction of the potential contamination of surfaces and plant areas served by the drainage systems and the amount of water flowing to drains in enclosed areas. Together these reduce the load on the drainage systems and minimise resulting discharge loads to receiving waters.

Clean Drainage-System Description
The road drains shown in blue in the figure (B.2) drain directly, with no further treatment, by gravity to the CW Outlet Seal Pit and from there to the Bristol Channel via the twin outlet structures at NGR ST 0165 6588 and ST 0163 6595.
When tidal conditions prevent discharge to the Channel, the drains are diverted to the Surface Water System, which is supported by oil interceptors and hence to the CW Outlet Seal pit. A review of the site drainage system ahead of introduction of the IS0 14001 accredited EMS, concluded that the risk of contamination of these drains was extremely unlikely. It also concluded that as a contingency measure an oil skimmer should be installed at the CW seal pit.

The other site road drains and the drains from the Coal Stockyard are discharged by gravity via settling lagoons to the Channel at NGR ST 0291 6574. The eastern lagoon has a designated platform to support an oil separator if required. Solids are removed from the lagoons periodically by mechanical means.

The drains from the PFA silo area are retained in settling pits. The water is then pumped to the Coal Perimeter Drain and hence onto the settling lagoons referred to above. Solids are removed from both the Perimeter Drain and the lagoons periodically by mechanical means.

All flows are by gravity except when tidal conditions prevent free flow from the Surface Water Storage Tanks. In these cases the water is pumped to the CW Outlet Seal.

Water quality of both discharge points is analysed as per the requirements of IPC authorisation, site EMS and specific Local Procedure LP/ENV/1012/1.

The following points are checked daily for oil contamination as required by LP/ENV/1005/1:-

- CW outfall chambers
- Site Drains interceptor pits
- Dirty drains sumps
- Discharge point of the 36-inch drain.

Under emergency conditions, for example a major oil spillage, facilities exist to shut off the flow of water at the discharge point of the 36-inch drain and from the site drains sump and where it enters the CW Outfall Seal Pit. This incident scenario is identified within the site's Minor and Serious Incident Plan. During the fuel oil fire of Oct 2004, the Plan was initiated and successfully prevented any oil contamination from being discharged off site.

The procedures to be followed to control a minor or serious oil spillage that could lead to contamination of discharges off site are detailed in LP/ENV/1005/2 and Appendix 12 of the Minor & Serious Incident Plan.

Oily Water Drainage-System Description

Water that could potentially be contaminated with oil is kept separate from the clean water and foul water systems until it has been suitably treated. It is collected and passed through one or more separation systems prior to discharge the CW Outlet Seal Pit and from there to the Channel via twin outlet structures at NGR ST 0165 6588 and ST 0163 6595.

These areas served by the oily water drains are (shown in red on Figure B.2):

- Roadways adjacent to Generator & Unit Transformers
- Roadway at rear of boilerhouse running alongside auxiliary transformers
- Roadway running between Precipitator rectifier buildings & ID fans
- Roadways at North and South ends of Main building including workshops canteen and ash disposal pits.
- LP Fuel Oil pumphouse
- Boiler house basement area
- Turbine hall basement area

The turbine and boiler house basement areas drain by gravity into one of two sumps referred to as the North End Dirty Drains pit and South End Dirty Drains pit. Both of these pits have skimmers to remove oil contamination. A recent site enhancement proposed by the Oil Management Continuous Improvement Group (CIG) has seen the installation of belt type skimmers instead of the feathered type skimmer. This workforce lead initiative affords a greater level of efficiency as the former belts tended to “blind” should any ash contamination also be present in the sumps. Although the feathered belts could be cleaned, the new belt type skimmers now avoid this cleaning procedure which was extremely laborious and involved use of significant volumes of solvent. Hence the advancement has improved efficiency of environmental control measures, reduced cost associated with belt cleaning, reduced workforce maintenance and also reduced volumes of waste solvent associated with the cleaning process.

From these pits the water is pumped to the Site Drains Sump which contains a further oil interception facility, a skimmer and an-oil-in water detector. From here, the drains flow by gravity or are pumped, dependant on the state of the tide, to the CW Outlet Seal Pit and hence onto the sea.

Under emergency conditions, for example a major oil spillage, facilities exist to shut off the flow of drainage from the site drains sump and where it enters the CW Outfall Seal Pit.

The procedures to be followed to control a minor or serious oil spillage that could lead to contamination of discharges off site are detailed in LP/ENV/1005/2 and Appendix 12 of the Minor & Serious Incident Plan.

Water quality of both discharge points is analysed as per the requirements of IPC authorisation, site EMS and LP/ENV/1012/1.

The following points are checked daily for oil contamination as required by LP/ENV/1005/1:-

CW outfall chambers
Site Drains interceptor pits
Dirty drains sumps

The drainage system is supported by a series of blind sumps that function to collect potential spillages or major leaks. These sumps would be routinely inspected and emptied under operator control in the event of an incident. Plant areas whose protection includes blind sumps are: -

- Transformers at rear of boiler house (21 off)
- Generator transformers (3 off)
- Generator transformer oil cooler (3 off)
- Unit transformer oil coolers (3 off)
- Station transformers (2 off)
- Waste oil transfer area
- LP Fuel oil pumphouse delivery point
- Bio-Oil and Heavy Fuel Oil delivery points
- Workshop Steam Cleaning Bay
- T46 Oil Tanks delivery point

Oily water collected from these points is collected by the site Waste Management Contractor and sent for appropriate off site disposal.

Any oily residues would be collected by the site Waste Management Contractor and sent off site for disposal.

Fire Fighting Water

In the event of a fire, depending on the precise location, fire-fighting water would drain either into the clean drainage system, the oily water system or blind sumps.

Should a major fire occur which required vast amounts of water to extinguish, and should the resultant composition of the firewater be deemed to possess a significant detrimental potential to the environment, then the Station would activate the shutdown procedure and close in the Station's discharge points. The principal area of concern would be a fire in the fuel oil tank farm and subsequent oil contamination of the fire waters. The bunds surrounding the oil tanks are sized to hold the volume of each tank + 10% to hold any spillage e.g if tank rupture occurred. It is envisaged that these bunds would act as the first control measure to contain any fire water. Oil skimmers and specialist "gulpers" would be employed as described in the Emergency Response Call Out Plan. No release of effluent from an authorised discharge point would be permitted without the approval of the Station Chemist.

It is recognised that the foam used to extinguish oil fires can have a detrimental effect to river waters. However the potential of the firewater to have a significant detrimental effect on the receiving waters would be considerably reduced as the effluent would initially pass into the site drainage system and contact with large amounts of sea water used for condenser cooling.

The fixed fire-fighting installation, that protects the high risk areas, uses a water spray system to control potential fires. The spray system with its greatest surface area effect is recognised as a far more efficient mechanism to controlling fire than application of water streams. The use of a spray system also minimises the volume of fire water produced.

Either drainage system is sized appropriately to manage the volumes of water produced by any foreseen incident.

BAT for Drainage Systems

The configuration and operation of the drainage systems as described above is considered aligned with the BAT principles set out in Environment Agency (2005) and in guidance EC (2003). The key aspect of the system is the separation of the systems for:

Clean water
Oily water
Foul water

There are appropriate treatment, inspection facilities and monitoring procedures instituted for each.

Only drainage which would be expected to meet the requirements of the Station's authorisation is discharged direct to surface waters without treatment or other control.

Gravity flows are exploited as far as possible to minimise pumping requirements.

Whilst EC (2003) indicates that above ground drainage systems are to be preferred, the reduced operational reliability, the costs incurred, the additional pumping which would be required and the risks associated with cold weather render the installed sub-surface systems BAT for power plant in UK conditions.

The principal treatments within the systems are suspended solids removal and oil-water separation. These are discussed in detail above. The effluent in these systems is in line with indicative BAT emission concentration guidance in EC (2003) and BAT emission concentrations for waste water treatment plant (Environment Agency, 2005 table 3.2).

Opportunities for re-use of effluent from the drainage systems have been considered as described in the sections above of this application above.

Effluents Arising from Intermittent Washings
From time to time optimised operation requires the washing of items of plant equipment such as –

Boilers
Precipitators
Air heaters

In each case the use of water and cleaning agents is considered *a prior* as well as the substances likely to be removed from the equipment via the required job method statement. The arisings from such washings are contained. Depending on the arisings any effluent may, if permitted, be discharged after analysis, may be discharged after suitable treatment (such as pH adjustment and settlement) or may be removed for off-site treatment and disposal.

Consideration is given to the frequency of washing operations in order to optimise use of water and emissions to water.

3. B2.2.2.8 Is secondary treatment employed?

No.

The classification 'secondary treatment' is not in common use in the combustion sector.

4. B2.2.2.9 Is tertiary treatment employed?

No.

The classification 'tertiary treatment' is not in common use in the combustion sector.

5. B2.2.2.10 Improvements

Basic compliance with BAT has been demonstrated in B2.2.2.6 and B2.2.2.17, however to assist Station further identify potential areas for water re-use, the following improvements will be undertaken –

- Undertake survey of boiler operations such as sootblowing and blowdown to attain accurate release data and where possible quality analysis.
- Undertake survey of WTP regeneration procedures to attain accurate effluent release data and where possible quality analysis.
- Investigate opportunities for water recycling facilities at the lorry wash and ash silo operations.

6. B2.2.2.11 Existing Annual Mass Limits

Volume flux limits and concentration limits as shown below are applied. There are no authorised annual limits for water discharges from the Aberthaw Power Station installation.

Determinand	W1 (CW outlet)	W 2 (36" drain)
SS (mg/l)	Increase ≤50	200
pH max	8.5	9
pH min	7.5	5
Oil (mg/l)	<5	<10
Temp (C)	Increase ≤12	-

7. B2.2.2.12 Benchmark Data for Emissions from each emission point

Benchmark data for each emission point are taken to be the consented limits, as described in Section 2.2.11

8. B2.2.2.13 Effluent from Co-incinerators produced from gas cleaning

Not applicable for Aberthaw Power Station

9. B2.2.2.14 Longer term studies to establish fate and impact of the emissions

For current emissions no further studies are deemed necessary. For future discharge post FGD please refer to the supplementary report assessing the impact of significant emissions (ENV/088/2006).

10. B2.2.2.15 The treated effluent – summarise any assessment work done or proposed

"Account for the presence of substances listed under Schedule 5 (Pollutants – Water) to Regulation 12(2) of the PPC Regulations 2000 to be accounted for here along with biocides, corrosion inhibitors, flocculants or similar additives."

The substances listed under schedule 5 are listed below along with reasons for their presence in the discharges. The presence of substances in an aquatic discharge indicated does not indicate an emission from the installation activity nor that the substance is present at a concentration which would warrant monitoring or abatement. In many cases the substance would be expected to be present at below the limit of detection.

Substance(s)	Origin	Comment
1. Organohalogen compounds and substances which may form such compounds in the aquatic environment	Industrial Raw Water / Towns Mains supplies (trace)	Not expected to be added as a result of installation activity other than chlorination. Chlorination is not practiced at the Aberthaw Power Station installation.
2. Organophosphorus compounds	Industrial Raw Water / Towns Mains supplies (trace)	Not expected to be added as a result of installation activity

3. Organotin compounds	Industrial Raw Water / Towns Mains supplies (trace)	Not expected to be added as a result of installation activity
4. Substances and preparations which have been proved to possess carcinogenic or mutagenic properties or properties which may affect reproduction in or via the aquatic environment	Boiler water chemicals (hydrazine)	Not expected to be added as a result of installation activity other than chlorination. Chlorination is not practiced at the Aberthaw Power Station installation. Although used in very low volume and very dilute solutions, hydrazine is an extremely toxic chemical. The use of hydrazine is strictly controlled within enclosed systems. When subjected to boiler temperatures and pressures the hydrazine is converted to ammonia. No hydrazine is released from the installation.
5. Persistent hydrocarbons and persistent and bioaccumulable organic toxic substances	Cooling water abstraction Oil leaks & spills & oil contaminated area drainage	Procedures to minimise oil leaks and spills. Oil interception provided on pathways liable to contain oil. Oil interception measures have been found to be effective and demonstrate BAT
6. Cyanides	Cooling water abstraction (Concentrations less than LOD) Site area drains Industrial Raw Water / Towns Mains supplies (trace)	Not expected to be added as a result of installation activity
7. Metals and their compounds	Cooling water abstraction Trace contamination of Water Treatment Plant bulk chemicals Solubilisation of metal pipe surfaces Intermittent washings Site area drains Removal from Flue Gasses by FGD Process	Settlement of solids in interceptors acts as an effective removal methodology. Solubilisation managed as part of cooling water circuit chemistry optimisation. Bulk chemical procurement strategy Refer to Section B2.1.4 of the IPPC application for details of trace element removal by FGD.
8. Arsenic and its compounds	Cooling water abstraction Intermittent washings	Settlement of solids in interceptors acts as an effective removal methodology.

	Site area drains Industrial Raw Water / Towns Mains supplies (trace)	
9. Biocides and plant health products	Cooling water abstraction Application of site maintenance products Chlorination	Only licensed site maintenance products are used with procedures aimed at preventing entry into water courses Chlorination is not practiced at the Aberthaw Power Station installation.
10. Materials in suspension	Cooling water abstraction Intermittent washings Site area drains	Settlement of solids in interceptors acts as an effective removal methodology
11. Substances which contribute to eutrophication (in particular, nitrates and phosphates)	Cooling water abstraction Intermittent washings Ammonia sources Removal of NO_2 from Flue Gasses by FGD Process	Receiving Waters (Bristol Channel) not designated as Sensitive Area (Eutrophic) Refer to Section B2.1.4 of the IPPC application for details of NO_2 removal by FGD
12. Substances which have an unfavourable influence on the oxygen balance (and can be measured using parameters such as BOD, COD, etc)	Cooling water abstraction Intermittent washings Ammonia sources	Levels discharged not sufficient to significantly impact on receiving waters.

11. B2.2.2.16 Where any studies above identified harmful substances or levels of residual toxicity, summarise any information available on the causes of the toxicity and any techniques proposed to reduce the potential impacts

The potential for harm resulting from substances emitted from the combustion sector processed is well-understood through chemical analysis of the discharge streams over many years. No further studies on such streams are necessary. Environment Agency (2005 2.10.1 batbox point 11) indicates that Direct Toxicity Assessment (DTA) is unlikely to be applicable.

A study is currently on-going reviewing an alternative oxygen scavenger to the currently used hydrazine.

12. B2.2.2.17 Indicative benchmarks for emissions to water

Benchmarks for each substance for each release point are detailed in B2.2.2.11.

Parameter	Installation performance (a)		Benchmark mg/l (b)	If the installation performance is higher than the benchmark either justify here or give date when you will comply .
	No2 Outlet CW outlet	No 3 Outlet 36 " drain		
Ammoniacal nitrogen	0.04	1.16	5	
Cadmium	0.00015	0.0019	$1x10^{-2}$	
Mercury	0.00007	<0.00002	$5x10^{-3}$	
Suspended solids	7 (differential)	59.9	25	The release from No.3 outlet is approximately 40% of authorised Station limit. It must also be stated that this outlet is not a continuous release.
pH	7.9	7.9	5-9	

13. B2.10.2 Monitoring & Reporting of Emissions to Controlled Waters

The monitoring of emissions to controlled waters from each of the outfall is described in section 2.2.7of this IPPC application. The monitoring is in line with the existing IPC authorisation requirements. The determinands monitored differ between release points and reflect the streams released at that point. None of the equipment/sampling/labs combinations are MCERTS certified.

To ensure that the requirements of the Authorisation are met, monitoring and sampling is captured within the station's environmental management system in the operating procedure "Analysis of Liquid Discharges". This Local Proceedure shows how the station intends to meet the monitoring requirements under the Authorisation, detailing such factors as responsibilities, records and actions.

The Station has two discharge points to controlled waters (see also B2.2.2.2 of this application). These points are:

- Outlet 2: discharges from water treatment plant, condenser cooling, boiler blowdown combined with water from dirty drains within B Station power plant building and surface water run off to the Bristol Channel via the twin concrete discharge structures defined in the Station's authorisation at OS National Grid ref ST 0165 6588 and ST 0163 6595 respectively.
- Outlet 3 (discharges from fuel oil storage areas, coal plant areas and associated surface water run off to the Bristol Channel via the twin concrete discharge structures defined in the Station's authorisation at OS National Grid ref ST 0291 6574.

A water sample is taken from the intake in order that the suspended solids differential at outlet 2 can be calculated. In addition the CW intake temperature is monitored to allow the calculation of the maximum daily temperature differential between the CW intake and outfall.

The equipment or method used for current monitoring of the aquatic discharge is given in the table below:

Determinand	Continuous/intermittent	Instrument
Temperature	Continuous	Platinum resistance thermocouple
pH	Intermittent (weekly)	Mettler Toledo pH meter
Oil & Grease	Intermittent (daily)	OCM 310 benchtop oil in water meter
Suspended soilds	Intermittent (weekly)	To BS2690

The instruments are maintained by qualified staff and calibrated as necessary. All laboratory staff are qualified to degree standard.

Monitoring of emissions from the FGD plant will include continuous monitoring of pH, DO and temperature (for FGD plant control purposes) in the return channel to the seal pit. Additionally, composite manual samples will be taken from the outlet of each unit absorber on a regular basis, and will be taken off site for analysis of the following trace elements: arsenic, cadmium, chromium, copper, lead, mercury, nickel, antimony, manganese, selenium.

The instrumentation associated with the FGD plant will be MCERTS certified if such are available at the time of construction.

14. B2.10.3 Monitoring & Reporting of Emissions to Sewer

There are no process emissions to sewer.

15. B2.10.6 Monitoring of in-process variables

Optimised operation is an integral part of BAT attainment. As discussed in section B2.3 the operation of the installation is carried out according to extensive Operational Procedures and the site Environmental Management System. These aim to deliver, inter alia, robust compliance with the environmentally protective conditions in the installations permits and licences etc. Emission monitoring is discussed in section B2.10.2 In addition; there is extensive monitoring of internal plant processes in order to achieve optimised and compliant operation. Such internal monitoring includes routine "DA drops" to ascertain the leakage rate of each individual boiler unit and WTP consumption analyses.

With regard to Mercury and cadmium levels in bulk chemicals, the supply of bulk chemicals is procured centrally to a contract specification, which includes the maximum acceptable mercury and cadmium content.

16. References

Environment Agency, 2005, 'IPPC Sector Guidance Note : Combustion Activities', Oct 2005 but dated v2.0327.07.05

Environment Agency, 2005, 'PPC Combustion Sector Application' , received Nov 2005 but dated v1.3 29th September 2005 (in footer)

EC, 2001, 'Reference Document on the Application of Best Available Techniques to Industrial Cooling Systems, Dec 2001, European IPPC Bureau, Seville

EC, 2003, 'Reference Document on Best Available Techniques in Common Waste Water & Waste Gas Treatment & Management Systems in the Chemical Sector, Feb 2003, European IPPC Bureau, Seville

EC, 2005, ‘Reference Document on Best Available Techniques for Large Combustion Plants’, May 2005, European IPPC Bureau, Seville

Appendix A. Process Water Flow Diagram

Appendix B. Drainage System Diagram

Appendix C. Ambient Water Quality

Analyte	July '03	Nov '03	July '04	Nov '04	July '05	Dec '05
	CW Intake Concentration (g/l)					
Arsenic	<0.8	<0.8	<0.8	<0.8	<1.8	1.9
Cadmium	0.13	0.11	0.12	8.76	0.19	0.09
Chromium	0.18	0.2	0.15	0.52	0.31	0.48
Copper	3.48	2.86	3.24	29.2	4.18	0.81
Lead	0.14	0.09	0.16	0.06	0.08	0.07
Mercury	0.027	0.008	<0.002	0.003	<0.002	<0.002
Nickel	1.48	1.93	1.46	7.22	1.45	0.9
Zinc	14.4	43.6	13	51.4	12.7	15
AOX	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0
	Concentration (mg/l)					
Phosphate (Total) (Filtered)	<0.02	0.079	0.09	0.07	0.05	0.06
Chloride	17300	18600	15800	16700	16600	18300
Carbon (TOC)	1.2	1.69	1.34	3.07	0.53	0.48