

Pembroke CCGT Power Station

Annual Environmental Performance Report 2019

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Annual Environmental Performance Report 2019



Prepared for:

Natural Resources Wales	
Client Contact :	N/A

Prepared by:


Dafydd Williams

Reviewed by:

 Ben Williams	Authorised by:  Ben Williams
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1. Introduction

RWE Generation UK plc owns and operates Pembroke Power Station, West Pennar, Pembroke, SA71 5SS.

Pembroke is a Combined Cycle Gas Turbine (CCGT) power station. The station consists of five units; each unit consists of a single power train (or single shaft) that includes a gas turbine and a steam turbine both of which drive a single generator. Exhaust gases from the gas turbines are fed through individual heat recovery steam generators (HRSGs or boilers) which produce steam to supply the steam turbines. Exhaust gases are released through separate stacks for each gas turbine.

The fuel for the gas turbines is natural gas that is delivered to the site by underground pipeline connected to the National Grid gas transmission system.

The steam turbine exhaust steam is cooled to form condensate using a 'once-through' main cooling water system. This system passes cooling water (seawater) through the steam turbine condensers. The steam condensate produced is re-circulated in the power station and the seawater discharged directly to the Milford Haven Waterway.

The boiler feed water, of high purity, is obtained by treating industrial raw water using filtration, reverse osmosis and polishing ion exchange processes (in the water treatment plant [WTP])

The power station supplies electricity to the National Grid via the 400kv substation which was built when the original oil fired station was built during the 1960s.

The power station is in full commercial operation and is able to generate 2199 MW of electricity.

This report has been produced in line with Condition 4.2.2 of the EPR Permit, DP3333TA.

2. Environmental Performance Against Permit Limits

The following sections detail the environmental performance during 2019 against the environmental permit limits.

The Industrial Emissions Directive (IED) requires emission limit values be set for the load range of 70% to full load. In addition to this, within the permit variation to incorporate the IED requirements, NRW set limits for the load range from end of start-up (MSUL) and start of shutdown (MSDL) up to full load. The sub-sections below describe the performance against both sets of limits.

2.1. Gaseous emissions to air from point sources

2.1.1. Maximum Hourly Average NOx Emissions 70% to Base Load

Table 1 below compares the Maximum Hourly Average Nitrogen Oxides (NOx) emissions during 2019 against the limits within the station's Environmental Permit. It can be seen that the maximum hourly average NOx concentrations, above 70% load, on all units were below the environmental permit limits, throughout the year.

Table 1. Maximum Hourly Average NOx Emissions 70% to Base Load

Parameter	Permit Limit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Max
Unit 11 Max Hourly Average NOx (Above 70% Load)	<u>50mg/nm³</u>	21	16	16	19	19	18	18	0	16	16	15	15	21
Unit 21 Max Hourly Average NOx (Above 70% Load)	<u>50mg/nm³</u>	26	26	26	29	31	36	36	36	34	27	19	19	36
Unit 31 Max Hourly Average NOx (Above 70% Load)	<u>50mg/nm³</u>	15	12	13	14	14	0	15	16	17	16	16	17	17
Unit 41 Max Hourly Average NOx (Above 70% Load)	<u>50mg/nm³</u>	17	18	20	17	16	17	24	20	17	17	17	17	24
Unit 51 Max Hourly Average NOx (Above 70% Load)	<u>50mg/nm³</u>	16	16	17	16	16	15	37	31	39	40	38	38	40

2.1.2. Maximum Daily Average NOx Emissions MSUL/MSDL to Base load

Table 2 below compares the Maximum Daily Average Nitrogen Oxides (NOx) emissions during 2019 against the limits within the station's Environmental Permit. It can be seen that the maximum daily average NOx concentrations, on all units were below the environmental permit limits, throughout the year.

Table 2. Maximum Daily Average NOx Emissions MSUL/MSDL to Base load

Parameter	Permit Limit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Max
Unit 11 Max daily mean NOx (MSUL/MSDL to Base Load)	<u>50mg/nm³</u>	19	19	19	18	27	18	17	0	15	13	12	11	27
Unit 21 Max daily mean NOx (MSUL/MSDL to Base Load)	<u>50mg/nm³</u>	24	28	28	27	27	33	32	32	32	26	16	17	33
Unit 31 Max daily mean NOx (MSUL/MSDL to Base Load)	<u>50mg/nm³</u>	11	11	12	13	12	0	14	14	14	12	13	15	15
Unit 41 Max daily mean NOx (MSUL/MSDL to Base Load)	<u>50mg/nm³</u>	14	16	16	13	13	13	17	20	14	15	14	14	20
Unit 51 Max daily mean NOx (MSUL/MSDL to Base Load)	<u>50mg/nm³</u>	14	14	13	14	14	12	24	28	35	37	35	34	37

2.1.3. Maximum Hourly Average CO Emissions 70% to Base Load

Table 3 below compares the Maximum Hourly Average Carbon Monoxide (CO) emissions during 2019 against the limits within the station's Environmental Permit. It can be seen that the maximum hourly average CO concentrations, above 70% load, on all units were below the environmental permit limits, throughout the year.

Table 3. Maximum Hourly Average CO Emissions 70% to Base Load

Parameter	Permit Limit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Max
Unit 11 Max Hourly Average CO (Above 70% load)	<u>200mg/nm³</u>	3	6	6	3	3	3	3	0	5	9	10	15	15
Unit 21 Max Hourly Average CO (Above 70% load)	<u>200mg/nm³</u>	1	1	1	1	1	1	1	1	1	1	1	11	11
Unit 31 Max Hourly Average CO (Above 70% load)	<u>200mg/nm³</u>	20	3	11	8	6	0	3	1	3	4	3	7	20
Unit 41 Max Hourly Average CO (Above 70% load)	<u>200mg/nm³</u>	25	14	17	5	11	8	6	4	3	4	5	9	25
Unit 51 Max Hourly Average CO (Above 70% load)	<u>200mg/nm³</u>	1	1	1	1	1	1	1	3	10	1	1	2	10

2.1.4. Maximum Daily Average CO Emissions MSUL/MSDL to Base load

Table 4 below compares the Maximum Daily Average Carbon Monoxide (CO) emissions during 2019 against the limits within the station's Environmental Permit. It can be seen that the maximum daily average CO concentrations, on all units were below the environmental permit limits, throughout the year. The slightly elevated daily average CO concentration on Unit 41 during May was associated with mapping the unit following its C Inspection Outage.

Table 4. Maximum Daily Average CO Emissions MSUL/MSDL to Base load

Parameter	Permit Limit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Max
Unit 11 Max daily mean CO (MSUL/MSDL to Base Load)	<u>250mg/nm³</u>	4	6	3	3	5	6	5	0	7	10	17	14	17
Unit 21 Max daily mean CO (MSUL/MSDL to Base Load)	<u>250mg/nm³</u>	1	1	2	1	1	3	1	2	1	1	14	20	20
Unit 31 Max daily mean CO (MSUL/MSDL to Base Load)	<u>250mg/nm³</u>	7	27	19	12	11	0	11	12	7	2	4	11	27
Unit 41 Max daily mean CO (MSUL/MSDL to Base Load)	<u>250mg/nm³</u>	53	38	25	13	157	13	2	4	2	5	5	7	157
Unit 51 Max daily mean CO (MSUL/MSDL to Base Load)	<u>250mg/nm³</u>	1	1	1	1	1	1	3	9	8	2	1	7	9

3. Emissions to water

3.1. Main Cooling Water (W1)

3.1.1. Main Cooling Water Emissions

Table 5 below compares the Main Cooling Water emissions during 2019 against the limits within the station's Environmental Permit. It can be seen that the maximum concentrations, of all substances are within the environmental permit limits.

Table 5. Main Cooling Water Emissions

Parameter	Permit Limit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Max
Main CW Flow (Max)	<u>40m³/sec</u>	40	40	40	40	39	36	40	34	39	39	39	40	40
Main CW Delta T (Max Daily Average)	<u>7.6°C</u>	7.1	7.5	7.3	7.5	7.5	7.3	7.6	7.2	7.3	7.0	7.4	7.4	7.6
CW Temperature (Max)	<u>30.4°C</u>	19.4	18.2	19.4	21.5	24.6	27.4	28.3	27.9	26.4	24	20.6	18.9	28.3
CW TRO (Max Daily Average)	<u>50ug/l</u>	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
CW pH (Max)	<u>9</u>	7.9	7.9	8.1	8.2	8.3	8.3	8.1	8.1	8.2	8.2	8.0	8.1	8.3
CW pH (Min)	<u>6</u>	7.7	7.6	7.7	7.5	7.5	7.4	7.1	7.2	7.4	7.6	7.8	7.8	7.1

3.2. Water Treatment Plant Effluent (W1a)

3.2.1. Water Treatment Plant Emissions

Table 6 below compares the water treatment plant effluent emissions during 2019 against the limits within the station's Environmental Permit. No limits were proposed for this source within the stations application for an environmental permit as it was felt that this discharge is insignificant in its impact on the Haven. It can be seen that the YTD annual average concentrations, of all substances are below the environmental permit limits. The station has little influence over the composition of this effluent as it is dependent on the composition of our raw feed water.

Table 6. Water Treatment Plant Emissions

<i>Substance</i>	<i>Units</i>	<i>Limit</i>	<i>YTD Average</i>
Chloride	mg/l	121	51
Ammoniacal Nitrogen as N	mg/l	0.297	0.027
Phosphate : Total as P	mg/l	0.460	0.070
Arsenic	ug/l	4.37	0.53
Selenium	ug/l	6.84	0.43
Chromium	ug/l	4.47	0.65
Copper	ug/l	22.1	2.57
Lead	ug/l	45.9	0.2
Nickel	ug/l	11.9	2.2
Zinc	ug/l	67.0	7.2
Antimony	ug/l	6.65	0.46
Aluminium	ug/l	13000	91
Cadmium	ug/l	0.700	0.043
Calcium	mg/l	59.0	35.6
Iron	mg/l	2.17	0.36
Manganese	ug/l	151	52
Mercury	ug/l	0.370	0.005
Nitrate as N	mg/l	12.1	4.7
Flow	l/s	7.48	3.32

3.3. Heat Recovery Steam Generator Blowdown (W1b)

3.3.1. HRSG Blowdown Emissions

Table 7 below compares the Heat Recovery Steam Generator (HRSG) blowdown emissions during 2019 against the limits within the station's Environmental Permit. Again no limits were proposed for this source within the stations application for an environmental permit as it was felt that this discharge is also insignificant in its impact on the Haven.

It can be seen that the annual average concentrations, of all substances, with the exception of Aluminium and Nickel, are below the environmental permit limits. In the case of Aluminium and Nickel, agreement was reached with NRW that as long as the combined annual mass release from W1a and W1b is less than that allowed within the Environmental Permit, NRW would not take enforcement action as the stations overall discharge to the haven would be within permit levels.

The combined mass releases were reported within the December 2019 Quarterly EPR Report which demonstrated that the combined mass release from W1a and W1b was well below that permitted by the Environmental Permit.

The combined mass of Aluminium released from W1a and W1b during 2019 was 11kg against a combined mass allowed by the permit of 3072kg. The combined mass of Nickel released from W1a and W1b during 2019 was 0.4kg against a combined mass allowed by the permit of 3.3kg.

Table 7. HRSG Blowdown Emissions

<i>Substance</i>	<i>Units</i>	<i>Limit</i>	<i>YTD Average</i>
Ammoniacal Nitrogen as N	mg/l	0.776	0.221
Silicate, reactive as SiO ₂	mg/l	3.00	0.18
Iron	mg/l	5.5	1.15
Potassium & Sodium	mg/l	3.00	2.02
Mercury	ug/l	0.0100	0.005
Aluminium	ug/l	10.0	21.7
Nickel	ug/l	1.00	2.63
Flow	l/s	16.8	2.3

3.4. Sewage Treatment Plant (W1c)

3.4.1. Sewage Treatment Plant Emissions

Table 8 below compares the Sewage Treatment Plant (STP) emissions during 2019 against the limits within the station's Environmental Permit. It can be seen that the quarterly average concentrations, of all substances, with the exception of suspended solids during Q3, are below the environmental permit limits. Following the receipt of the September result a root cause investigation was undertaken which concluded that the sampler disturbed sediment whilst sampling and that the sample from September was not representative of the sewage treatment plant effluent. Actions to lower the potential for reoccurrence were identified as part of the investigation and communicated to NRW.

Table 8. STP Emissions

<i>Substance</i>	<i>Units</i>	<i>Limit</i>	<i>Q1</i>	<i>Q2</i>	<i>Q3</i>	<i>Q4</i>
Ammoniacal Nitrogen as N	mg/l	20	7	9	4	13
BOD	mg/l	20	3	6	14	8
Suspended Solids	mg/l	30	4	17	148	15
Flow	m3/day	23	6	10	12	13

4. Other Environmental Issues

4.1. Attributable Complaints

During 2019 there were no public complaints received by the power station.

4.2. STP effluent pump chamber

During 2018 RWE identified there was a leak of treated effluent from a pumping chamber downstream of the sewage treatment plant. As a short term measure the operating level of this chamber was adjusted to below the leak point and in 2019 work was undertaken to glass fibre line the inside of this chamber to prevent it leaking.

4.3. Foam Reduction Project

During 2019 a specialist contractor produced a scaled model of the seal pit and trialled various measures aimed at foam reduction. These measures are currently being assessed for feasibility and effectiveness, the station continues to keep NRW informed of progress.

4.4. Waste management

Waste volumes during 2019 have been higher than typical years due to the planned outages which were completed. In 2015 (the last major outage year) approximately 8% of waste generated was recovered/recycled. During 2019 this percentage rose significantly to approximately 50% of the waste generated being recovered/recycled illustrating the effectiveness of some of the improvement measures implemented.

4.5. Haven Environmental Monitoring Programme

During 2019 the Power Station continued to deliver a comprehensive environmental monitoring programme in line with that agreed with NRW during 2015.

The 2018 monitoring programme was reported during 2019 and any NRW comments discussed and resolved. Comprehensive reports on the 2019 monitoring programme are in the process of being prepared for internal review and submission to NRW.

During 2019 a new monitoring programme was agreed with NRW for the period 2020 to 2026. This has now begun, RWE will continue to report the results and discuss them with NRW.

4.6. Fish Retention and Return System (FFR)

During 2019 the work to replace the fish return water supply pipework was completed and RWE continues to keep NRW informed of progress.

4.7. Tank Inspections

During 2019 RWE conducted a significant inspection programme on its above ground storage tanks. Any remedial work has either been completed or planned for 2020 and RWE continues to keep NRW informed of progress.

4.8. Bubble Curtain Trials

During 2019 RWE developed plans to work with SEACAMS on trialling a bubble curtain in front of the main cooling water intake as an additional fish deterrent. This work is planned to be completed during 2020 and RWE continues to keep NRW informed of progress.

4.9. ISO 14001

RWE continues to implement and maintain its environmental management systems. Internal and external audits have ensured the continuation of the ISO 14001 certification.

5. Conclusions

Pembroke Power Station is the largest and most efficient CCGT power station in the UK.

The site is located adjacent to a Special Area of Conservation, in an area where public interest in development is high and has previously attracted a large amount of local and national media interest. During 2019, there was one permit condition breach associated with the stations tank inspection programme and no attributable complaints from members of the public.

Despite the challenges offered by the size and location of Pembroke Power Station, together with over 200 days of planned outages during 2019, last year's operation was very successful from a health and safety, environmental and operational perspective.

Through the quality of plant equipment and plant management, Pembroke Power Station has been able to minimise the impact from its emissions on the SAC, the surrounding area and its neighbours. The site is managed in accordance with a written management system certified to ISO14001, one of the leading principles of this system is to strive for continual improvement. During 2020 these principles will continue to be applied in order to further improve our environmental performance.

RWE Generation UK plc

RWE Generation UK plc
Windmill Hill Business Park
Whitehill Way
Swindon
Wiltshire
SN5 6PB

T +44 (0)1793 877777
F +44 (0)1793 892525
I <http://www.rwegeneration.com>

Registered Office:
RWE Generation UK plc
Windmill Hill Business Park
Whitehill Way
Swindon
Wiltshire
SN5 6PB
Registered in England
& Wales: No. 3892782