

Pembroke CCGT Power Station

Annual Environmental Performance Report 2022

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Annual Environmental Performance Report 2022

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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 (HRSG) 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 in the 1960's during the construction of the original oil-fired station.

The power station is in full commercial operation and can 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 2022 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 NO_x Emissions 70% to Base Load

Table 1 below compares the Maximum Hourly Average Nitrogen Oxides (NO_x) emissions during 2022 against the limits within the station's Environmental Permit. The maximum hourly average NO_x concentrations, above 70% load, on all units were below the environmental permit limits throughout the year.

Table 1. Maximum Hourly Average NO_x 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 NO _x (Above 70% Load)	<u>50mg/nm³</u>	20	18	22	21	17	16	15	17	14	14	14	14	22
Unit 21 Max Hourly Average NO _x (Above 70% Load)	<u>50mg/nm³</u>	22	21	22	23	23	24	23	23	21	21	21	22	24
Unit 31 Max Hourly Average NO _x (Above 70% Load)	<u>50mg/nm³</u>	16	18	19	18	18	18	19	21	18	17	17	18	21
Unit 41 Max Hourly Average NO _x (Above 70% Load)	<u>50mg/nm³</u>	14	15	16	16	18	14	16	16	15	15	15	23	23
Unit 51 Max Hourly Average NO _x (Above 70% Load)	<u>50mg/nm³</u>	24	24	25	25	24	24	24	28	23	21	22	23	28

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 2022 against the limits within the station's Environmental Permit. 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>	17	15	16	18	16	15	13	15	13	12	13	13	18
Unit 21 Max daily mean NOx (MSUL/MSDL to Base Load)	<u>50mg/nm³</u>	21	18	19	21	21	21	21	21	20	18	18	20	21
Unit 31 Max daily mean NOx (MSUL/MSDL to Base Load)	<u>50mg/nm³</u>	14	16	15	15	16	16	17	19	16	14	16	16	19
Unit 41 Max daily mean NOx (MSUL/MSDL to Base Load)	<u>50mg/nm³</u>	13	12	13	13	18	12	14	15	13	14	14	14	18
Unit 51 Max daily mean NOx (MSUL/MSDL to Base Load)	<u>50mg/nm³</u>	20	22	22	21	23	21	27	24	20	18	21	20	27

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 2022 against the limits within the station's Environmental Permit. 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>	11	16	10	15	2	4	3	5	3	16	14	5	16
Unit 21 Max Hourly Average CO (Above 70% load)	<u>200mg/nm³</u>	0	9	5	3	1	1	1	0	9	19	9	7	19
Unit 31 Max Hourly Average CO (Above 70% load)	<u>200mg/nm³</u>	2	24	13	12	12	8	1	1	7	27	44	20	44
Unit 41 Max Hourly Average CO (Above 70% load)	<u>200mg/nm³</u>	4	41	14	43	28	10	1	1	16	43	24	20	43
Unit 51 Max Hourly Average CO (Above 70% load)	<u>200mg/nm³</u>	20	6	2	18	1	0	1	1	12	7	8	17	20

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 2022 against the limits within the station's Environmental Permit. The maximum daily average CO concentrations, on all units were below the environmental permit limits throughout the year.

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/</u> <u>nm³</u>	25	22	5	26	13	7	18	10	14	24	32	17	32
Unit 21 Max daily mean CO (MSUL/MSDL to Base Load)	<u>250mg/</u> <u>nm³</u>	15	13	17	3	3	2	1	3	10	23	19	60	60
Unit 31Max daily mean CO (MSUL/MSDL to Base Load)	<u>250mg/</u> <u>nm³</u>	18	34	30	36	7	17	3	3	11	40	35	97	97
Unit 41 Max daily mean CO (MSUL/MSDL to Base Load)	<u>250mg/</u> <u>nm³</u>	61	48	3	16	13	20	6	3	16	43	28	33	61
Unit 51 Max daily mean CO (MSUL/MSDL to Base Load)	<u>250mg/</u> <u>nm³</u>	68	20	30	18	1	7	4	0	5	12	13	57	68

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 2022 against the limits within the station's Environmental Permit. 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	39	40	40	40	40	40	40	40	40	40	40	40
Main CW Delta T (Max Daily Average)	<u>7.6°C</u>	7.5	7.3	7.5	7.5	7.6	7.6	7.6	7.6	7.6	7.6	7.5	7.6	7.6
CW Temperature (Max)	<u>30.4°C</u>	19.2	18.8	20.0	21.7	25.0	27.8	29.5	29.3	28.2	26.0	25.0	19.9	29.5
CW TRO (Max Daily Average)	<u>50ug/l</u>	0	0	0	0	0	0	0	0	0	0.01	0.014	0.018	0.018
CW pH (Max)	<u>9</u>	8.6	8.0	8.7	8.6	8.4	8.1	7.9	8.0	8.0	8.0	8.0	8.0	8.7
CW pH (Min)	<u>6</u>	7.6	7.5	7.0	7.0	7.4	7.3	7.0	7.0	7.2	7.2	6.8	7.6	6.8

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 2022 against the limits within the station's Environmental Permit. No limits were proposed for this source within the station's application for an environmental permit as it was felt that this discharge is insignificant in its impact to the Haven. 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

Substance	Units	Limit	YTD Average
Chloride	mg/l	121	47
Ammoniacal Nitrogen as N	mg/l	0.297	0.205
Phosphate: Total as P	mg/l	0.460	0.019
Arsenic	ug/l	4.37	0.67
Selenium	ug/l	6.84	0.43
Chromium	ug/l	4.47	0.57
Copper	ug/l	22.1	2.7
Lead	ug/l	45.9	0.3
Nickel	ug/l	11.9	2.5
Zinc	ug/l	67.0	31.4
Antimony	ug/l	6.65	0.80
Aluminium	ug/l	13000	85
Cadmium	ug/l	0.700	0.035
Calcium	mg/l	59.0	29.1
Iron	mg/l	2.17	0.34
Manganese	ug/l	151	64
Mercury	ug/l	0.370	0.013
Nitrate as N	mg/l	12.1	3.8
Flow	l/s	7.48	3.49

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 2022 against the limits within the station's Environmental Permit.

Again, no limits were proposed for this source within the station's application for an environmental permit as it was felt that this discharge is also insignificant in its impact to the Haven.

The annual average concentrations of all substances, except for Mercury, Aluminium and Nickel, Sodium and Potassium are below the environmental permit limits.

In the case of Mercury, Aluminium and Nickel, Sodium and Potassium an agreement was reached with NRW that if 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 station's overall discharge to the haven would be within permit limits.

The combined mass releases were reported within the December 2022 Quarterly EPR Report which demonstrated that the combined mass release from W1a and W1b was well below the permit limits.

During 2022 the actual combined mass release of Aluminium from W1a and W1b was 11kg against a permitted combined mass release of 3072kg. During 2022 the actual combined mass release of Nickel from W1a and W1b was 1kg against a permitted combined mass release of 3.3kg. During 2022 the actual combined mass release of Mercury from W1a and W1b was 0.003kg against a permitted combined mass release of 0.09kg. During 2022 the actual mass release of sodium and potassium from W1b was 382kg against a permitted mass release of 1589kg. The mass releases are therefore significantly below the mass allowed by the Station's environmental permit.

Table 7. HRSG Blowdown Emissions

Substance	Units	Limit	YTD Average
Ammoniacal Nitrogen as N	mg/l	0.776	0.431
Silicate, reactive as SiO ₂	mg/l	3.00	0.15
Iron	mg/l	5.5	0.47
Potassium & Sodium	mg/l	3.00	3.33
Mercury	ug/l	0.0100	0.0129
Aluminium	ug/l	10.0	11.1
Nickel	ug/l	1.00	6.29
Flow	l/s	16.8	3.6

3.4. Sewage Treatment Plant (W1c)

3.4.1. Sewage Treatment Plant Emissions

Table 8 below compares the Sewage Treatment Plant (STP) emissions during 2022 against the limits within the station's Environmental Permit. The quarterly average concentrations of all substances are below the environmental permit limits.

Table 8. STP Emissions

Substance	Units	Limit	Q1	Q2	Q3	Q4
Ammoniacal Nitrogen as N	mg/l	20	0.2	0.2	7.7	0.2
BOD	mg/l	20	3	3	8	3
Suspended Solids	mg/l	30	12	12	10	10
Flow	m3/day	23	3	3	3	2

4. Other Environmental Issues

4.1. Attributable Complaints/Enquires

During 2022 there were two enquiries. The first enquiry was made after a report of foam under the Cleddau bridge. After an investigation, it was concluded the foam was unlikely to be from Pembroke power station outfall.

The second enquiry was from a Milford haven resident asking about dark smoke coming for the station's stacks. The enquirer was informed that the dark smoke was not smoke but condensation which is caused by combustion of hydrocarbons. The power station was operating normally and within permit limits. The enquirer was satisfied with the response given.

4.2. Waste management

Waste volumes during 2022 were representative of a typical year. During 2022 the percentage of the total waste that was recovered/recycled was 57.8%.

4.3. Haven Environmental Monitoring Programme

During 2022 the Power Station continued to deliver a comprehensive environmental monitoring programme in line with that agreed with NRW.

4.4. 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 (SAC), in an area where public interest in development is high and has previously attracted a large amount of local and national media interest. During 2022, there were no permit condition breaches.

Despite the challenges offered by the size and location of Pembroke Power Station, 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. These principles will continue to be applied to further improve our environmental performance.

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