

Compliance Assessment Report CAR_NRW0042792

Permit being assessed: JP3632ZH.

For: Barry CHP , **held by:** Dow Silicones UK Limited

At: Wimborne Road - Dock 2, Barry, Vale of Glamorgan, CF63 3DH.

Type of assessment: Site Inspection,

Reason: Routine.

On: 23/08/2023 between 09:00 and 16:00.

Parts of permit assessed: Monitoring Returns.

NRW Lead Officer: Geraint Harris.

Report sent to: Jude Sartor, Environmental Specialist , on 14/11/2023.

1. Summary of our findings (full details in section 4)

Part of permitted activity assessed (compliance criteria)	Assessment result	Permit condition
IR3A - Emissions and monitoring - Emissions to water, air or land	C3 Minor	Permit Condition 3.1.2
IR3A - Emissions and monitoring - Emissions to water, air or land	C3 Minor	Permit condition 3.1.2
IR1A - Management - General management	C3 Minor	Permit condition 1.1.1
IR3A - Emissions and monitoring - Emissions to water, air or land	C4 No impact	Permit condition 3.1.2

Result types are explained in more detail in the 'Important Information' section below.

Total non-compliances recorded	Total non-compliance score
4	12.1

How we use the non-compliance score to calculate your annual fee is explained in the 'Important Information' section below.

2. What action is required?

Criteria	Action needed	Complete by
IR3A	Improve the reliability and maintenance of the GT's to limit the risk of having to operate in forced draft mode.	31/12/2023
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Criteria	Action needed	Complete by
IR1A	Improve Management and maintenance systems to ensure that the correct filters are used going forward.	Already completed
IR3A	Improve the reliability of the GT's so that the fired Boiler doesn't need to be run so hard.	31/12/2023

Compliance criteria codes are listed in the 'Important information' section below.

3. What will happen next?

Any non-compliance we have identified and recorded on this form is an offence. It can result in criminal prosecution and/or suspension or revocation of your permit.

At this time, we do not intend to take any further action.

This statement does not stop us from taking additional enforcement action if further relevant information comes to light or offences continue.

4. Details of our assessment

Dow CHP

NRW attended the Dow site on the 23rd of August 2023 for a routine compliance discussion regarding the Dow Silicones permit and the CHP permit.

Reverse Power Event

During this meeting Dow reported that the GTA-HRSG experienced a reverse power event due to the system failing to trip as designed. I asked Dow for further information to ascertain if there were any permit compliance implications related to this incident. Dow reported that GT-B tripped on low gas pressure and the generator HV circuit breaker failed to open leading to a reverse power event. The upstream breaker had to be opened to resolve this. The root cause of the breaker failing to open was due to a broken trip link inside the breaker mechanism causing the breaker to be in a partially tripped state with the broken trip link jamming against the trip prop support casing. The OEM findings and comment on this was that *"This part failure seems to have been caused because of a blow hole inside the casting itself which would have been impossible to detect until this failure. This has not been seen before throughout the range of mechanisms which use this casting. Numbers are likely to exceed the tens of thousands."* Hence, on this basis Dow insist that it is highly unlikely that all other similar breakers on site are affected by this failure mode. Ultimately there were no implications for environmental compliance related to this incident and no further information and actions are being considered.

Ripped Bellows

During the meeting on the 26th of August Dow reported that the Bellows within HRSG-A were recently ripped.

Action1: Please provide detailed information explaining the cause and consequence of the ripped bellows?
Due 23rd of December 2023.

Quarterly Monitoring Returns

Quarter 2

There are several noncompliance's within the monitoring returns for Q2. The background to these

noncompliance's and the subsequent scores are explained in the following text.

Dow strive to utilise their CHP plant for both onsite electrical and steam requirements. The main Silicones site requires a substantial amount of steam to supply and maintain operations which is fed from numerous sources within the CHP plant. It is significantly cheaper and more efficient for Dow to generate both steam and electricity simultaneously in house, which is what they have been striving to do. However, since 2022 there have been several operational issues related to the running of the CHP. Issues related to GTA-HRSG-A have been ongoing and include problems with the FD fan and problems with the flame sensors tripping the HRSG unit to 'off'. The problems with the flame sensors appear to have started following the statutory inspection and repairs in Q4-2021/Q1-2022. With regards to GTB, two primary filters were fitted instead of one 10-micron primary filter and a 0.3-micron secondary filter. Consequently, small particles got through into the turbine and blocked 2 out of the 16 hollow core vanes on the CT2 section of the engine causing a localised hot spot and distortion of the blade. As a result, GTB was non-operational from October 2022 and HRSG-B was operational in forced draft mode only. Since the issues with GT-A-HRSG-A were related to the flame sensors tripping the unit off, Dow decided to combine GTA-with HRSG-B. However, due to one of the dampers not reaching its limits this new arrangement wasn't able to be used. The HP boiler was offline from November 2022 to March 2023 for statutory inspection and so both HRSG's were required to operate in FD mode to supply enough steam to the site. Higher emissions and lower flow rates are associated with FD operations which is why some of the reported emissions from A1 were more than the permit ELV. Dow have stated that for some unbeknown reason HRSG-B operates at a lower NO_x than HRSG-A which is evident in the previous 18 months monitoring returns (A3).

Higher emissions are associated with FD operations which is why the JEP Protocol (Electricity Supply Industry – IED Compliance Protocol for Utility Boilers and Gas Turbines (LCP BREF Update), Joint Environmental Programme) provides concessions for plant running in forced draft mode (auxiliary mode). To summarise this the oxygen reference condition for reporting and the boiler ELV reference shall therefore also be increased to 15% O₂ (for short periods when the gas turbine is unavailable). The boiler ELV is taken to be the same numerical value as that applied at 3% O₂. However, in these situations, the Operator shall provide a credible recovery plan for the gas turbine to the competent authority and agree a course of action. When a credible recovery plan cannot be agreed, or is not appropriate, then the auxiliary firing then needs to comply with the original boiler ELV at 3% O₂ (for convenience this ELV can be divided by 3 if reporting continues at 15% O₂). The original boiler ELV's (referenced to 3% O₂, dry, 273.15K, 101.325 kPa) according to IED annex V part 1 (6) and part 4 (1) are:

- 100 mg/Nm³ monthly mean of validated hourly averages
- 110 mg/Nm³ Daily mean of validated hourly averages
- 200 mg/Nm³ 95% of validated hourly averages within a calendar year

The NO_x emissions from emission point A1 have consistently been above the permitted ELV's since Dow started having issues after Q4 2021/Q1/2022. Whereas for emission point A3 they have only been above the ELV's on three occasions in early 2022. As mentioned above, the JEP Protocol allows for the original boiler ELV's to be used provided there is a credible recovery plan. Dow have made it clear that it is in their best interest to generate their own electricity and have been continuously striving to bring the GTs back online. Therefore, it has been determined that the original boiler ELV at 3% O₂ can continue to be applied. Therefore, in Quarter 2 of 2023 there were two exceedances of the original boiler NO_x ELV's (the NO_x monthly mean and daily mean for May 2023).

Permit condition 1.1.1 requires the operator to manage and operate the activities in accordance with a written management system that identifies and minimises risks of pollution, including those arising from operations, maintenance, accidents, incidents, non-conformances. Unfortunately, the incorrect use of two primary filters caused GTB to require repairs and hence the CHP to operate in FD mode only which is not a permitted activity.

Dow was asked to provide more information as to why this occurred and if the root cause was a lack of management procedures or lack of training. Dow have since replied stating that “There is a 12-month preventative maintenance in place and now both filters have separate stores ID numbers and separate procedures so this shouldn’t get mixed up again”. Although HRSG -B operating in FD mode operates within the permitted NO_x ELV’s, the criticality of using the correct filter types wasn’t identified by the management system and the maintenance procedures were inadequate as a result. Even though this mix up of filters with GTB didn’t result in a NO_x ELV breach there was potential for this to occur, especially if this situation had occurred with GTA-HRSG-A which operates at a higher NO_x rate. Consequently, a noncompliance score is being issued against the management system permit condition for not having the appropriate systems in place to prevent a mix up with such filters.

To ascertain the severity of the noncompliance’s related to this incident, I needed to understand the degree of environmental impact. To do this I asked Dow to compare the total quantity of NO_x released since the start of the plant upset (since Q4 2021/Q1/2022) with the total quantity that would have been released if operating compliantly at the annual NO_x emission limit. The maximum permitted mass of NO_x was calculated using the annual average permit limit, with the GTs operating in TEG mode, along with the correct flow gas rates, reference conditions and operating hours.

The results provided by Dow demonstrated that the total annual mass of NO_x emitted for the years 2021, 2022 and 2023 (to date) were lower than if they operated at the annual permitted NO_x limit (55mg/Nm³). Some of the more pertinent points raised by Dow include:

- Whilst the NO_x concentrations from the plant are higher, they are still lower than historical as we installed the low NO_x GT’s, so the period when the GT is running (SF or TEG mode), the NO_x concentration is much lower than it used to be.
- Whilst running in FD mode, the actual stack flowrate is significantly less (around half) – so the mass impact when running in FD mode is similar or less.
- This data provided has a conservative approach to it – counting a full hour where actually Dow were only running in that mode for part of the hour. Dow compared the detailed breakdown to check this.

Since each of the total annual mass emissions of NO_x, since the plant upset in 2021, were less than what is permitted to be released on an annual basis, the noncompliance scores for exceeding the ELV’s for NO_x are only considered minor category 3 non-compliances. The same reasoning can also be applied to the management system failure mentioned previously. Consequently, the following noncompliance’s are being issued:

1 x category 3 noncompliance score is being issued against the management system permit condition 1.1.1.

2 x category 3 noncompliance scores are being issued against permit condition 3.1.2. for exceeding the NO_x monthly mean and daily mean ELV’s for May 2023.

Dow reported an exceedance of the carbon monoxide ELV in June 2023 from emission point A2 with a maximum daily mean of 115.8 mg/m³ vs an ELV of 110 mg/m³. Dow reported that the spike of CO was during a period where the fired boiler was running very hard. Consequently, the steam flowrate was reduced and the CO returned to normal levels. This is considered to be a no impact, **category 4, breach of permit condition 3.1.2** because the CO levels were not sufficiently high to result in significant levels of partial combustion products emissions or exceedance of the CO air quality standard.

Quarter 3

The NO_x emissions for emission point A1 in Q3 are above the permitted ELV and below the original boiler

ELV's. Therefore, these are not considered a breach of the permit.

Dow initially reported a NO_x max daily mean emission as high as 261.5mg/Nm³ for emission point A3. However, these elevated emissions were reported during a period of CEMS malfunction. The IED requires that any calendar day in which more than three hourly average values are lost, during normal operation, due to malfunction or maintenance of the CEMS, shall be invalidated and shall not be considered with regards to ELV compliance. Upon reviewing Dow's hourly monitoring results for the 11th and 12th of July it doesn't appear that any data was lost. However, the data that was obtained appears to be potentially spurious. The analyser and the HRSG had been offline from the 7th of July due to a complete failure. The analyser vendor LAND reattended site on the 11th of July and changed all the tubing, solenoids and the main motherboard on HRSG B CEMS analyser. According to Dow, they kept the LAND engineers on site on the 11th and the 12th to fix the problem. Once they successfully finished their work these elevated NO_x emissions were no longer observed and Dow experienced typical NO_x emissions for firing in forced draft mode. The JEP Protocol states that "a CEMS result is invalidated if it cannot deliver a reportable value for compliance purposes. This may result, for example, from the breakdown of an analyser component or a fault in the data acquisition system (if the data cannot be retrieved from a back-up system). A less serious Malfunction of the CEM, in which the system is not performing according to its design specification, should be discussed with the competent authority in order to determine if

- I. corrections to reportable data are required (where possible) and
- II. if further invalidation periods need to be declared"

Dow have a very old CEM's which is unreliable and had to have significant maintenance (motherboard change). Dow are due to replace this CEM's in December 2023. Since the elevated NO_x on the 11th and 12th of July can be attributed to the malfunction of the CEMs NRW deemed that the emissions reported on these days can be considered as further invalidation periods and not considered for permit compliance.

Invalid CEMs Data

19 invalid days were reported for unit B, emission point A3, at the end of quarter 1. Dow's permit (3.6.2) states that within 28 days of becoming aware of 10 or more invalid days throughout a year they should review the causes of the invalidations and submit to Natural Resources Wales for approval, proposals for measures to improve the reliability of the continuous measurement systems. Dow reported in early May that they intended to replace the existing CEM's package. In early July 2023 Dow reported further invalid days for Q2 2023. Dow reported the following: "The HRSG B NO_x analyser has duplicate electrochemical cells for O₂, NO & CO, a so-called red track and blue track. It alternates between them every 30 minutes. This is part of the design of the system and cannot be disabled. We have a situation where the analyser is only working for half of the time. HRSG B continues to operate with the CEMS analyser operating only 50% of the time, NO_x results on the analyser are in specification when the analyser operates and the HRSG B unit is being run steady state with minimum fluctuations to feed rates. We have a project proposal to replace the LAND analysers with ABB CEMS with a lead time of 12-14 weeks and are internally escalating this through our Business and project workflows".

Dow later reported that the analyser failed completely on the evening of the 6th of July and HRSG B was immediately shutdown by the operations team. Dow stated the analyser vendor LAND reattended the site on the 11th of July and changed all tubing, solenoids and the main motherboard on HRSG B CEMS analyser. The analyser channels since this intervention have been functioning correctly and are being monitored closely. During the period, where invalid days were reported, Dow was still able to achieve 30 minutes' worth of data within every hour. Given that natural gas-fired plant tend to operate at a stable load it is unlikely that these 30 minute 'black outs' would have missed an exceedance in the ELV's. Therefore, NRW are content that the

environment was still suitably protected during this period. Since there is a plan to replace the CEM's then this isn't considered a breach of the permit.

Improvement Condition 8 (IC8)

Permit condition 2.3.5 states for the following activities referenced in schedule 1, table S1.1: LCP60 MP boilers. The activities shall not operate for more than 1500 hours per year from the date agreed upon following completion of improvement condition IC8. The completion date is stated as the 31st of December 2022. This has since passed without IC8 being satisfied. However, IC8 states "Following the commissioning of low NOx burner/FGR conversion of the CHP HP boiler and optimisation of the MP boilers and a period of operation for optimisation of the HP boiler, the Operator shall submit a written post-commissioning report to Natural Resources Wales for approval". Due to a prolonged commissioning period and a statutory inspection of the HP boiler Dow have been delayed in submitting a response to IC8. **NRW expect to receive a response by the end of 2023.** The annual operating hours for 2022 in the table below are not considered a breach of the permit.

	Year:	A1 (hours)	A2 (hours)	A3 (hours)	A4 (hours)	A5 (hours)
Annual Operating Hours	2022	1139.977	2967	7126.879	906.5	1608

Dow responses to CAR Form CAR_NRW0040875 are tabulated below and considered complete:

Action needed	Complete by	Response	Response date
Action1: Dow need to check that the reported fired boiler emissions are actually referenced to an oxygen concentration of 3% not 15%	31/03/2023	I have the Envirosoft parameters for correction factors and the FB emissions are referenced to 3% not 15 % - Unit A and B are referenced to 15%. (see attached JPG)	30/03/2023
Action 2: At what load is GT-A operating at? Is the current DAHS capable of separating out part load operations?	31/03/2023	GT's do not operate at part load - they are either ON or OFF. DAHS receives ON or OFF signal from DCS.	30/03/2023
Action 3: Are you able to provide a breakdown on the number of hours HRSG-A and B were operated both below and above the 25tonnes/hr of steam	31/03/2023	Data provided via email - 2 tables, one for Unit A and one for Unit B	30/03/2023
Action 4: It is not clear why HRSG-A is not being used with GT-A, is there a fault with HRSG-A.	31/03/2023	Since the statutory inspection and repairs Q4 2021/Q1/2022 Unit A has had operational problems. The unit has been unable to operate at higher flowrates or with the GT running due to the flame sensors tripping the unit off. We believe	30/03/2023

		this may be caused by the repairs that were carried out and the unit will be taken down for investigation as soon as the FB is running reliably again.	
Action 5: Has the implementation of the additional Tags to their PI system for real time updates been complete?	31/03/2023	Following on from a recent Envirosoft service visit, where we data mined all the OUT tags, we have now submitted the request to add all OPC link values going both in and out of Envirosoft into our Pi system.	30/03/2023
Investigate how the FD Fan became damaged and how this can be prevented or the likelihood of reoccurrence reduced.	31/03/2023	The bearing failed on the FD fan. Catastrophic failure - zero vibration to destruction is a few minutes, unsure of what the cause of it was. All other FD fans have been checked for vibration with nothing found. Spare FD fan (suitable for all 3 units) is now on stores stock.	30/03/2023

Dow responses to CAR Form CAR_NRW0041255 are tabulated below and considered complete:

Action needed	Complete by	Response	Response date
Please respond to the outstanding actions from CAR Form CAR_NRW0040875	31/03/2023	Response in table above.	30/03/2023
Please amend the reporting forms for air emission point A2 (IED CON 2 (Gas Turbines))	31/03/2023	This form is from the IEP Protocol and is specifically requested in the permit Table S4.4 Reporting forms. Should we be using CON1 form and just filing in NOx and CO or would you like me to adapt the CON2 form for Boiler and 3% O2.	30/03/2023
share your findings, with NRW, into the root cause of the GT upsets and provide NRW with details on Dow's planned preventative maintenance regime for both GT-HRSG A and B	31/03/2023	GTB damage - Incorrect secondary filter was fitted to the induction side of the turbine. Should be a 10 micron primary filter and a 0.3 micron secondary filter. 2 primary filters fitted. Small particles got through into turbine and blocked 2 of the 16 hollow core vanes on the CT2 section of the engine causing a localised hot spot and distortion of the blade. The hot spot was identified during a routine inspection. This damage was detected using a routine borescope inspection of	30/03/2023

		the engine. Should have been a 6 week repair, currently at 20 weeks. Delay caused by the surface coating replacement of the new vane. Done wrong taken off and done again. Flame cans on the outside of the engine during initial testing failed due to flame out so waiting for this to be fixed - if this is OK then due back on 17th April. Original GTA now coupled with HRSG-B awaiting damper bearing change. All other damper elements repaired / replaced. Original GTB now due back on site 17th April (pending FAT) will be coupled with HRSG-A and started up following HRSG-A investigation.	
Please complete and submit part B of the schedule 5 sent in April 2022 relating to the NOx exceedances in March	31/03/2023	At this time we do not know the cause of this, initially believed to be the FD fan, but subsequent issues following installation of the new fan have disproved this. Until we have successfully identified the issues with Unit A I don't think we should complete Part B.	30/03/2023
Please send a Schedule 5 Notice for all high NOx emissions in 2022.	31/03/2023	Schedule 5's submitted as requested	21/02/2023
Please update NRW if GTA was combined with HRSG-B to create one operating GT-HRSG?	31/03/2023	The engine from GTA has been removed from HRSG-A and attached to HRSG-B. As yet we have been unable to run Unit B with the GT as one of the dampers is not reaching its limits. All the external modifications and actuator maintenance has now been completed, the last piece of this is the bearings, for which the unit must be shutdown. We had hoped the other maintenance would have been enough to allow the dampers to operate. As soon as FB is running reliably, the damper bearings will be changed and then HRSG-B and associated GT will be started up. The Unit A will be taken down for investigation and installation of the returning GT (currently due to arrive 17/4)	30/03/2023

End.

If you have any queries about this report, or to discuss completion of any actions, please contact the NRW Officer named above.

Important information

Legal status of this report

Your permit is issued to you under the Environmental Permitting Regulations. You have a responsibility to comply with the conditions of your permit and prevent pollution/harm of the environment. You must also ensure that you comply with any other relevant legislation that may apply to your site's operations.

This report explains the findings of our assessment and any action you are required to take. We categorise non-compliance using our guidance for assessing non-compliance at regulated sites.

When we find potential non-compliance/s we will normally give you advice on how to maintain compliance.

To correct non-compliance, we may:

- require you to take specific actions
- issue a notice
- review the conditions of your permit.

Any advice and guidance we give will be without prejudice to any other enforcement response that we consider may be required.

Assessment results and non-compliance categories (used in section 1):

Assessment result	Description
Assessed (A)	Assessed or assessed in part, no evidence of non-compliance found
Action only (X)	Action only relating to the activity assessment
Ongoing (O)	Ongoing non-compliance, not scored

Non-compliance category	Description	Score
C1 Major	Potential to have a major, serious, persistent and/or extensive impact or effect on the environment, people and/or property	60
C2 Significant	Potential to have a significant impact or effect on the environment, people and/or property	31
C3 Minor	Potential to have a minor or minimal impact or effect on the environment, people and/or property	4
C4 No environmental impact	Non-compliance at a regulated site that cannot foreseeably have any impact on the environment, people and/or property	0.1

How we use assessment scores

The number and severity of non-compliances recorded in a year will affect your annual subsistence fee the following year. A non-compliance factor is added to your site's Operator

Performance Risk Appraisal (OPRA) score when we calculate your fee to reflect the additional resource we use to assess permit compliance.

If your assessment result in Section 1 is suspended, what does this mean?

In line with our guidance, we may suspend scores for up to six months to allow time for remedial action to be taken. Suspended scores will be re-instated if the action is not completed.

Full list of Industry compliance criteria (used in section 1 and 2):

1. Management

- IR1A – General management
- IR1B – Finance (only applicable to Landfill)
- IR1C – Energy efficiency
- IR1D - Efficient use of raw materials
- IR1E - Avoidance, recovery and disposal of wastes produced by the activities
- IR1F - Multiple operator installations

2. Operations

- IR2A – Permitted activities
- IR2B – The site
- IR2C – Operating techniques
- IR2D – Technical requirements
- IR2E – Improvement programme
- IR2F – Pre-operational conditions
- IR2G – Landfill engineering (only applicable to Landfill)
- IR2H – Waste acceptance (only applicable to Landfill)
- IR2I – Leachate levels (only applicable to Landfill)
- IR2J – Closure and aftercare (only applicable to Landfill)
- IR2K – Landfill gas management (only applicable to Landfill)

3. Emission and Monitoring

- IR3A – Emissions to water, air or land
- IR3B – Emissions of substances not controlled by emission limits
- IR3C – Odour
- IR3D – Noise and vibration
- IR3E – Monitoring
- IR3F – Pests
- IR3G – Air quality management plans
- IR3H – Monitoring for the purposes of the Industrial Emissions Directive (this heading includes Large Combustion Plants)
- IR3I – Fire

4. Information

- IR4A – Records
- IR4B – Reporting
- IR4C – Notification

Enforcement response

Any non-compliance with a permit condition is an offence and we may take legal action against you. Action we take can include prosecution, serving a notice on you and/or

suspension or revocation of your permit. See our Enforcement and Sanctions Guidance for further information.

Data protection notice

You should make sure that anyone named in this report knows that the information it contains will be processed by Natural Resources Wales to fulfil its regulatory and monitoring functions and to maintain the relevant public register(s).

We may also use and/or disclose the report in connection with:

- offering or providing you with our literature or services relating to environmental matters
- consulting with the public, public bodies and other organisations (e.g. Health and Safety Executive, local authorities) on environmental issues
- carrying out statistical analysis, research and development on environmental issues
- providing public register information to enquirers
- investigating possible breaches of environmental law
- assessing customer service satisfaction and improving our service
- Freedom of Information Act or Environmental Information Regulations requests.

We may also pass it on to our agents or representatives to do these things on our behalf.

Disclosure of information – this report will be available to view on-line

If you think this report contains commercially confidential information that should not be placed on our public register, you must contact your local Natural Resources Wales office within **fifteen working days** of receiving this report, using the contact details in the accompanying email or letter. You must give a full explanation of why it should not be added to our public register, including specifying which information is commercially confidential. We will assess your request and respond to you within twenty working days to let you know if we agree to your request.

What do I do if I disagree with the report or have a complaint?

If you disagree with this compliance assessment report, you should contact the lead officer without delay to discuss your concerns.

If you are unable to resolve the issue with the lead officer or their line manager you should contact our Customer Contact team on 0300 065 3000 (Monday to Friday 08:00 to 18:00), or email enquiries@naturalresourceswales.gov.uk for details of how to raise your dispute further through our Complaints and Commendations procedure.

If you are dissatisfied with our response, you can contact the Public Services Ombudsman for Wales by phone on 0300 7900203 or by email at ask@ombudsman.wales

Welsh Language Standards

We are committed to establishing Natural Resources Wales as a naturally bilingual organisation. We will provide compliance reports in your preferred language.