

Compliance Assessment Report CAR_NRW0042303

Permit being assessed: BR9685IX.

For: Barry Silicone Plant, **held by:** Dow Silicones UK Limited

At: Cardiff Road, Barry, Vale of Glamorgan, CF63 2YL.

Type of assessment: Site Inspection,

Reason: Other.

On: 13/03/2023 between 10:00 and 16:00.

Parts of permit assessed: Air Emissions.

NRW Lead Officer: Geraint Harris, accompanied by Antony Leakey.

Report sent to: Jude Sartor, Environmental Specialist , on 16/08/2023.

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

Part of permitted activity assessed (compliance criteria)	Assessment result	Permit condition
IR3B - Emissions and monitoring - Emissions of substances not controlled by emission limits	C3 Minor	Permit condition 3.2.1
IR1A - Management - General management	C3 Minor	Permit condition 1.1.1

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

Total non-compliances recorded	Total non-compliance score
2	8

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
IR3B	Ensure any future tube bundle disposal operations are appropriately planned from cradle to grave.	09/10/2023
IR1A	Action1: Please inform NRW that the corrective/preventive actions stated within Dow's RCI report have been completed by their target due date or prior to the next bundle disposal whichever is earlier.	09/10/2023

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 Silicones

EPR/BR9685IX

Dow's MCDS process recovers the useful material from other process units on the site. The unrecoverable long chain material from this process is sent to a bottoms tank for treatment. The material that ends up on the still pot bundles within the MCDS process is fouling material based mainly on silicon solids and longer chain silicones but with some small quantities of chlorosilanes encapsulated in the solid mass. This direct process material (DPR) contains a variable amount of chlorosilane materials. DPR self-heats when dry and reacts with water to form HCl when exposed to atmosphere. To account for these properties the cleaning and extraction of the still pot bundles needs to be undertaken as prescribed in a series of procedures developed by Dow. Such procedures include several stages of solids passivation including water quenching and caustic treatment (x 2 in 2022) followed by hydro blasting (x2 in 2022) and exposure to air during bundle removal and then water treatment in a water bath with more hydro blasting and exposure to air during bundle transit.

On the 09/03/23 activities commenced for the cutting and disposing of these obsolete bundles using an excavator fitted with shears. During this activity some of the residual DPR from the W930 bundle caught fire causing a small amount of smouldering, this was followed by a larger HCl gas release from the W958 bundle. The cutting of the bundles exposed the unquenched DPR, present within bundle, to atmosphere which initiated both the smouldering and HCl release. This initiated a BERT Response involving fire monitors to contain the gas cloud and foam to suppress smouldering. The main release was estimated by Dow to have lasted 50 minutes after which enough foam had been applied to suppress the emissions. However, during this 50-minute period the area was being heavily quenched with water sprays.

As with all incidents at regulated sites NRW need to assess the actual/potential impact and the root cause. Dow's permit condition 3.2.1 states:

"Emissions of substances not controlled by emission limits (excluding odour) shall not cause pollution. The operator shall not be taken to have breached this condition if appropriate measures, including, but not limited to, those specified in any approved emissions management plan, have been taken to prevent or where that is not practicable, to minimise, those emissions."

In this incident the emission of concern was the release of gaseous HCl from the DPR material dislodged from the scrap bundles. To determine whether the operator had breached the "pollution" limb of this EPR permit condition, I have used the definition of pollution as set out in the EPR regulations. Part 1, Section 2 ("Interpretation: general") of the Environmental Permitting (England & Wales) Regulations 2016 states:

"pollution",... means any emission as a result of human activity which may—

(a) be harmful to human health or the quality of the environment,

(b) cause offence to a human sense, ...

To establish if the release of hydrogen chloride constituted a pollution (harm to human health (including workers) and/or the quality of the environment), Dow were required to undertake a modelling exercise. Dow was asked to undertake modelling work of the release of HCl, this was completed using their dispersion tool called CHEF (Chemical Hazard Engineering Fundamentals) which is used globally by Dow and has a very good correlation with PHAST (Process Hazard Analysis Software Tool). In this exercise Dow estimated the HCl concentration at distances from the 953 MCDS reboiler release event location. Since there was no meaningful way to estimate the quantity directly, Dow used a crude/conservative estimate. Dow have made a conservative assumption that only 5wt% of the material in-between the bundle tubes contain the reactive dimethyl dichlorosilane material. Dow's global tech centre associate for this technology indicated that it's hard to see it being much more than 5%wt, in fact they offered 2wt% as a reasonable figure. The total interspatial volume of the bundle is approx. 1.8 cubic meters. However, due to the multiple stages of solids passivation prior to commencing the disposal activities a realistic worst-case volume of DPR material available to react was considered to be 200kg. Therefore, at 200kg at 5wt% = 10kg of chlorosilane materials with MW129 = 0.08KMoles liberating 0.16k moles of HCl or 5.8 kg of HCl, release rate 7 kg/hr HCl. This was modelled at approximately 1m above ground with a wind speed of 3m/s (in line with site weather station), ambient temperature 15°C and neutral stability. Dow's CHEF model gave the following HCl concentrations at the following distances from the release point at W953:

Distance from release point (m)	Estimated maximum downwind HCl concentration (ppm)
25	33.4
50	8.3
75	3.7
100	2.1
125	1.3
150	0.9
175	0.7
200	0.5

In H1 Annex F (2011) Table B5: Environmental Assessment Levels for Air (For The Protection Of Human Health), the hourly EAL value for hydrogen chloride is 750 µg/m³ or 0.5ppm. When compared to the modelling results in the table above, using a worst-case scenario the EAL would have been exceeded in an area up to 200 metres from the release point. When comparing the results from Dow's CHEF model with the AEGL's (Acute Exposure Guideline Levels) for hydrogen chloride (Annex 1), AEGL 1 (1.8ppm) would have been exceeded within 100 metres of the release point.

This represents a worst-case scenario that doesn't take into effect the abating actions of the water curtain and foam applied during the response period. At the time of the incident the wind was an east-northeast direction with light rain/drizzle. Consequently, the gas cloud would have been blown towards the docks and so away from the plant areas, the machine operator (within a cabin) and any residential housing. Had the wind been blowing from a westerly direction this may have affected some of the operators working on the western side of the plant and may have resulted in them experiencing the temporary symptoms associated with exceeding AEGL 1. Therefore, it is deemed that this incident constitutes no greater than a category 3 noncompliance.

NRW also need to ascertain if all appropriate measures were in place at the time to prevent where that is not

practicable, to minimise, such emissions. To do this NRW asked Dow to undertake a root cause investigation (RCI) for this incident. Dow shared their RCI with NRW on the 21st of June 2023. Dow's investigation into the root cause identified several pertinent areas where management of the operations fell short. In summary the Hazards of cleaning the still pot and removing the bundle on the plant itself were understood, planned and resourced as part of the turnaround (TAR) planning. However, the RCI identified that the final preparation for the disposal of the bundle was not planned as part of the whole task in quite the same way. Some of the pertinent findings from the RCI include:

Inadequate awareness of hazards:

- Decontamination Procedure - Operations procedure stopped once bundle was in the water bath, no procedure or method for dealing with contaminated bundle. Assumed bundles were clean enough for cutting.
- Post TAR procedures managed from a demolition perspective and not from a chemical management perspective.
- Process for reviewing and approving contractor RAMS not well defined.
- Allowed DPR to dry out.

Improper work planning:

- TAR workgroup structure had single person as ACGK / permit issuer.
- Work permits didn't identify unquenched DPR as a hazard.
- Limited supervision during hazardous activity.
- Inappropriate use / applicability of residual hazard checklist to control the hazard in this case.
- Heavy Equipment standard caused a variation from previous method of cut / clean / cut / clean.

Inadequate method of communication and peer communications:

- Communication through subcontracting process and on the day inadequate.
- Insufficient supervision in place on the day.

Having identified where they have fallen short Dow are undertaking the following actions:

- Assign resource to complete TAR SHE reviews to identify all high-risk activities including the 2 tube bundles.
- Ensuring that the tube bundle disposal MET is developed such that cradle to grave can be documented.
- High hazards identified from the SHE reviews to have an assigned focal point to manage cradle to grave (like critical path focal point high hazard jobs). Define and implement the focal point role and work process for management of high hazard task.

Dow was asked if this incident had any implications for any other processes since there are a few similar tube bundle systems on site. Dow highlighted several processes with similar tube bundle systems where the RCI learnings are relevant and should be applied in terms of the whole task planning and management. Dow stated that "Although these other duties are slightly less arduous the hazards are very similar and the principles will apply. The hazards of cleaning the still pot and removing the bundle on the plant itself were understood, planned and resourced as part of the TAR planning. The RCI found however that the final preparation for the disposal of the bundle was not planned as part of the whole task in quite the same way and this is a key finding to be addressed i.e. same planning and management from preparation, initial plant clean and removal right through to final disposal preparation". Consequently, there is potential for a repeated incident involving these additional bundle systems, however it is unlikely that a repeat incident would produce any worst-case impact than this recent incident.

Upon review of Dow's RCI, NRW deem that not all appropriate measures were in place to prevent or minimise the emissions of HCl from the spent tube bundles. Therefore, NRW are satisfied that this incident constitutes a breach in permit condition 3.2.1 Emissions of substances not controlled by emission limits. The operator of

a permitted site must 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 and non-conformances.

Since there were a number of findings in the RCI which demonstrated the lack of operational procedures and awareness of hazards for dealing with the contaminated bundle beyond the TAR stage, NRW have deemed the root cause of the incident to be a failure in the management system.

Noncompliance's:

1 X Minor category 3 breach of permit condition 1.1.1.

1 X Minor category 3 breach of permit condition 3.2.1

Action1: Please inform NRW that the corrective/preventive actions stated within Dow's RCI report have been completed by their target due date or prior to the next bundle disposal whichever is earlier. **Due 9th October 2023.**

Foam Disposal

Dow was asked if the AFFF foam used during this incident contained PFOA, PFOA salts or PFOA-related compounds. PFOA, its salts and PFOA-related compounds are categorised as POPs under the Stockholm Convention as they remain in the environment for very long periods of time. If they are present in firefighting foam then an operator will be required to ensure that any wastewater processing at site will adequately destroy or remove PFOA, PFOA salts or PFOA-related compounds, noting that sludges and solids may need special disposal arrangements if the PFOA, PFOA salts or PFOA-related compounds are transferred from the wastewater to the sludges and solids. Dow subsequently reported that the main component in their Reddaway AR-AFFF 3/3 firefighting foam (2-methylpentane-2,4- diol, CAS 107-41-5) is biodegradable and does not raise concern in terms of persistency. Dow also gave details on their feed rates for treating this AFFF contaminated wastewater and were able to demonstrate that they remained in compliance with their effluent discharge limits during this period.

Annex 1

US EPA Acute Exposure Guideline Levels for Airborne Chemicals Acute Exposure Level Guidelines (AEGs) are used by emergency planners and responders worldwide as guidance in dealing with rare, usually accidental, releases of chemicals into the air. AEGs are expressed as specific concentrations of airborne chemicals at which health effects may occur. They are designed to protect the elderly and children, and other individuals who may be susceptible. AEGs are calculated for five relatively short exposure periods – 10 minutes, 30 minutes, 1 hour, 4 hours, and 8 hours – as differentiated from air standards based on longer or repeated exposures. AEG "levels" are dictated by the severity of the toxic effects caused by the exposure, with Level 1 being the least and Level 3 being the most severe.

- Level 1 - Notable discomfort, irritation, or certain asymptomatic non-sensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.
- Level 2 - Irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.
- Level 3 - Life-threatening health effects or death.
- Below AEG Level 1 - Airborne concentrations below the AEG-1 represent exposure levels that could produce mild and progressively increasing but transient and non-disabling odour, taste, and sensory irritation or certain asymptomatic, non-sensory effects. With increasing airborne concentrations above each AEG,

there is a progressive increase in the likelihood of occurrence and the severity of effects described for each corresponding AEGL.

TABLE 2-1 Summary of AEGLs Values for Hydrogen Chloride
(ppm [mg/m³])

Classification	10 min	30 min	1 h	4 h	8 h	End Point (Reference)
AEGL-1 (Nondisabling)	1.8 (2.7)	1.8 (2.7)	1.8 (2.7)	1.8 (2.7)	1.8 (2.7)	NOAEL in exercising asthmatic sub- jects (Stevens et al. 1992)
AEGL-2 (Disabling)	100 (156)	43 (65)	22 (33)	11 (17)	11 (17)	Mouse RD ₅₀ (Barrow et al. 1977); histo- pathology in rats (Stavert et al. 1991)
AEGL-3 (Lethal)	620 (937)	210 (313)	100 (155)	26 (39)	26 (39)	Estimated NOEL for death from 1-h rat LC ₅₀ (Wohlschlager et al. 1976; Ver- not et al. 1977)

Abbreviations: LC₅₀, concentration lethal to 50% of subjects; mg/m³, milligrams per cubic meter; NOAEL, no-observed-adverse-effect level; NOEL, no-observed-effect level; ppm, parts per million; RD₅₀, concentration expected to cause a 50% decrease in respiratory rate.

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.