CHEMICAL SAFETY REPORT (CSR)

Public version

Legal name of applicant:	Tata Steel UK Limited
Type of application:	Review report
Submitted by:	Tata Steel UK Limited
Date:	12 June 2026
Prepared by:	Tata Steel UK Limited Sagentia Regulatory (Technology Sciences Group Consulting Ltd)
Substance:	Sodium dichromate (EC no. 234-190-3, CAS nos 10588-01-9, 7789-12-0)
Use title:	The use of sodium dichromate for the passivation of electrolytic tinplate (ETP)
Use number:	1

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Declaration

We, the Applicant (Tata Steel UK Ltd), are aware of the fact that further evidence might be requested by the Health & Safety Executive (HSE) to support the information provided in this document.

Also, we request that the information redacted from the "public version" of the Chemical Safety Report is not disclosed. We hereby declare that, to the best of our knowledge as of today (12 June 2026), the information is not publicly available, and, in accordance with the due measures of protection that we have implemented, a member of the public should not be able to obtain access to this information without our consent or that of the third party whose commercial interests are at stake.

James Davies
Works Manager – Director
Packaging - Trostre
Llanelli, Carmarthenshire
12 June 2026

On behalf of Tata Steel UK Ltd

List of abbreviations

AfA	Application for Authorisation
AoA	Analysis of Alternatives
APF	Assigned protection factor
ART	Advanced REACH Tool
BMGV	Biological monitoring guidance values
BS	British Standard (published by the British Standards Institution, BSI)
BS EN	British Standard, European Norm, i.e. a British Standard that implements a European Standard
BS EN ISO	British Standard which implements an identical European and International Standard
C&L	Classification & labelling
CAS	Chemical Abstracts Service
CLP	Regulation (EC) No 1272/2008 on classification, labelling and packaging of substances and mixtures (as amended) (References in this report to CLP should be taken as referring to GB CLP, as retained EU law following the UK's exit from the EU and the end of the Implementation Period on 31 December 2020, unless otherwise specified.)
CMR	Carcinogenic, mutagenic or toxic to reproduction
COMAH	The Control of Major Accident Hazards Regulations 2015 (as amended)
COSHH	The Control of Substances Hazardous to Health Regulations 2002 (as amended)
Cr(O)	Metallic chromium
Cr(III)	Trivalent chromium
Cr(VI)	Hexavalent chromium
CSR	Chemical Safety Report
Defra	Department for Environment, Food & Rural Affairs
EC	European Commission
ECCS	Electrolytic chromium coated steel, also known as 'tin-free steel'
ECS	Environmental contributing scenario
ECHA	European Chemicals Agency
EEA	European Economic Area, i.e. the EU plus Norway, Iceland and Liechtenstein
ELR	Excess Lifetime Risk
EN	European Norm, i.e. European Standard (published by the European Committee for Standardisation, CEN)
EN ISO	European Standard which implements an identical International Standard
EPR	The Environmental Permitting (England and Wales) Regulations 2016
ERC	Environmental Release Category
ES	Exposure scenario
ETP	Electrolytic tin plated steel (also known as tinplate)
EU	European Union
FTE	Full-time equivalent
GB	Great Britain

HSE	Health & Safety Executive
IARC	International Agency for Research on Cancer
ISO	International Standard (published by the International Organisation for Standardisation, ISO)
IUPAC	International Union of Pure and Applied Chemistry
LEV	Local exhaust ventilation
LoD	Limit of detection
MCERTS	Natural Resources Wales' Monitoring Certification Scheme
MDHS	Methods for the Determination of Hazardous Substances
$Na_2Cr_2O_7$	Sodium dichromate
OC	Operational Conditions
PC	Chemical product category
PEC	Predicted environmental concentration
PPE	Personal protective equipment
PPM	Parts per million
PROC	Process category
R&D	Research and development
RAC	Risk Assessment Committee (ECHA)
RCR	Risk characterisation ratio
REACH	Regulation (EC) No 1907/2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (as amended) (References in this report to REACH should be taken as referring to UK REACH, as retained EU law following the UK's exit from the EU and the end of the Implementation Period on 31 December 2020, unless otherwise specified.)
RMM	Risk Management Measures
RPE	Respiratory protective equipment
SDS	Safety data sheet
SEA	Socio-economic analysis
SEAC	Committee for Socio-Economic Analysis (ECHA)
SEG	Similar exposure group
SR&D	Scientific research and development
SP	Substitution Plan
SSSI	Site of Special Scientific Interest
SU	Sector of use
SVHC	Substance of very high concern
TWA	Time-weighted average
WCS	Worker Contributing Scenario
WEL	Workplace exposure limit
WWTP	Wastewater treatment plant

Introduction

Tata Steel UK Ltd ('the applicant') is the largest steel company in the United Kingdom (UK), with operations and distribution sites across the UK. It provides a vital foundation for many of the UK's key strategic supply chains, particularly in the automotive, construction, engineering and packaging sectors. It is a supplier of high-quality steel products and an innovation partner to many household names. The applicant's site in Llanelli, Carmarthenshire (the Trostre Works) is the sole producer of tinplate for packaging in the UK. The site, which celebrated its 70th year in 2022, manufactures approximately 400,000 tonnes of tin, chromium and polymer coated steels every year for food and drinks cans, bakeware and other packaging applications. It is a leading supplier of high-quality packaging steels, supplying over fifty countries worldwide.

The applicant is part of Tata Steel Europe, one of the largest steel producers in Europe which manufactures and supplies high-quality strip steel products across the construction, automotive, packaging and engineering sectors. Tata Steel Europe is in turn part of the Tata Steel Group, one of the world's most geographically diversified steel producers. Tata Steel Group's operations – from mining to manufacturing and marketing of finished products – are fully integrated with various inter-dependencies, which is especially the case for the applicant. The Tata Steel Group is itself part of the Tata Group, a global business conglomerate operating across diverse industries such as agrochemicals, automotive, chemicals, construction, finance, consumer products, and hospitality.

The applicant relies on the use of sodium dichromate at the Trostre Works for the passivation of electrolytic tinplate (ETP). Sodium dichromate is used to passivate the surface of the electrolytic tin-plated steel. This creates a thin protective, corrosion-resistant layer of metallic chromium (Cr(0)) and chromium (III) oxide (Cr_2O_3) which stabilizes the surface and prevents the growth of tin oxide. As a result, the steel becomes more resistant to the contents of the packaging and provides a suitable surface for subsequent coating by lacquer or paint. The applicant's customers rely on the ETP process to produce food and other packaging that must meet the highest standards for safety and sustainability. A brief overview of different applications of metal packaging is given in the table below.

Market segment	Application	Construction	Examples of final products
Food	Drawn wall ironed (DWI) body	2-piece body	Human and pet food
	Drawn redrawn body	2-piece body	Fish cans
	Welded body	3-piece body	Vegetables, ready meals, fruit and soup
	Ends	Ends	Can ends
Beverages	Drawn wall ironed (DWI) body	2-piece body	Beer and soft drinks cans
Aerosol cans	Welded body and ends	Welded	Personal care and household products in aerosol cans
General line	Several types of packaging	3-piece body, 2-piece body, ends	Cans for paint, oil or syrups; decorative tins (promotional packaging); tins for confectionery and for dry products (milk powder/ coffee); and unlacquered applications of tinplate for general line
Closures	Crown cork and caps	1-piece	For glass bottles and glass jars
Non-packaging	Several applications	Varies	Toys and gas canisters, including specialities and automotive parts

***Table 1**: Overview of the packaging applications for the applicant's products*

In this way, the use of sodium dichromate is essential because it produces a highly stable protective layer that meets the stringent requirements for corrosion and chemical resistance to confer safe use during the lifecycle of all packaging materials, particularly food packaging. This layer also provides an excellent substrate for lacquer or paint, ensuring strong adhesion and long-term integrity of internal coatings.

Sodium dichromate is listed in Annex XIV of REACH (entry no. 18) due to its classification as a carcinogen cat. 1B (Article 57a), mutagen cat. 1B (Article 57b) and toxicity to reproduction cat. 1B (Article 57c) and is subject to authorisation. Its latest application date was 21 March 2016 and its sunset date was 21 September 2017. Authorisation aims to manage the risks of hazardous substances by promoting their replacement with safer alternatives. Substances that are subject to authorisation may not be used after their 'sunset date' unless that use has been authorised or an exemption applies.

The applicant already has an authorisation under REACH for the use of sodium dichromate[1] for the process of ETP. The application was made under EU REACH and final opinions were issued on 28 December 2020 by the Risk Assessment Committee (RAC) and the Committee for Socio-Economic Analysis (SEAC) of the European Chemicals Agency (ECHA). However, the authorisation itself had not been granted by the European Commission by the end of the Implementation Period on 31 December 2020, following the UK's exit from the EU. Under UK REACH transitional rules, Tata Steel resubmitted its application for authorisation as an 'in-flight' application to the Secretary of State (SoS) for the Department for Environment, Food and Rural Affairs (Defra). The authorisation was granted by the SoS on 24 January 2022 (authorisation number UKREACH/22/01/1) with a review period ending on 31 December 2027.

The applicant supports the objectives of authorisation under REACH and continues to look for a suitable alternative substance or technology that will facilitate an end to the use of sodium dichromate in the ETP process. The most promising potential alternative is known as CFPA (Chrome-Free Passivation Alternative). This technology has been developed collaboratively by members of APEAL (Association of European Producers of Steel for Packaging, now Steel for Packaging Europe or SfPE) and major European steelmakers, including the applicant. CFPA is a chromium-free surface treatment based on zirconium and titanium compounds, forming a thin conversion layer comprising titanium and zirconium oxides with polymeric components, which is intended to stabilise the tin oxide layer and minimise further oxidation.

While CFPA is commercially available and has reached a relatively advanced level of technical maturity, it is not yet a fully suitable substitute for sodium dichromate passivation across the full range of the applicant's ETP products and applications. Qualification activities have demonstrated technical limitations in certain uses, particularly in relation to corrosion resistance, lacquer adhesion and performance under demanding food contact conditions. In addition, much of the historical qualification of CFPA has been undertaken using legacy lacquer systems containing bisphenol A (BPA) which are now being phased out following regulatory developments, meaning that extensive re-qualification with emerging BPA-free lacquers and long-term pack testing will be required. As a result, CFPA adoption remains limited at present and has not yet secured widespread acceptance across the supply chain. The applicant's customers have indicated that, in the absence of a technically equivalent and fully validated alternative, they intend to continue sourcing Cr(VI)-passivated ETP, either from the Trostre Works or from suppliers in regions where the use of sodium dichromate is not subject to authorisation.

Against this background, and to assure the market of its continued ability to supply high-quality products while the search for a viable alternative continues, the applicant has developed this review report application to extend its authorisation beyond 2027. This Chemical Safety Report (CSR) supports the review report application for the use of sodium dichromate for the passivation of ETP and demonstrates that exposure to sodium dichromate at the Trostre Works has been minimised.

[1] This authorisation was granted together with an authorisation for chromium trioxide for the same use. Both sodium dichromate and chromium trioxide had featured in the original AfA because the applicant had submitted the application jointly with another Tata Steel company, Tata Steel IJmuiden BV, based in the Netherlands (referred to in this report as Tata Steel Netherlands or TSN). While TSN uses chromium trioxide as well as sodium dichromate for the passivation of ETP, the applicant does not, and so this review report application covers sodium dichromate only.

Part A

Summary of risk management measures

This AfA covers one use of sodium dichromate for the passivation of ETP at one site by one applicant, a downstream user of sodium dichromate.

Article 62(4)(d) of REACH states that an application for authorisation shall contain a CSR covering the risks to human health and/or the environment from the use of the substance arising from the intrinsic properties specified in Annex XIV. The intrinsic properties listed in Annex XIV for sodium dichromate are carcinogenic cat. 1B (Article 57a), mutagenic cat. 1B (Article 57b) and toxic for reproduction cat. 1B (Article 57c). Therefore, this CSR focuses on the carcinogenicity, mutagenicity and reproductive toxicity endpoints.

In this CSR, the applicant will demonstrate minimisation of exposure through the use of suitable risk management measures (RMMs). Details of the operational conditions (OCs) and RMMs implemented by the applicant are provided in section 9 of this CSR. A succinct summary of those OCs and RMMs is provided as a separate document.

Declaration that risk management measures are implemented

The applicant declares that the risk management measures referred to in section 9 of this CSR are implemented.

Declaration that risk management measures are communicated

This is not applicable. This CSR is prepared for an individual AfA for one specific use of sodium dichromate in respect of which the applicant is a downstream user. The applicant's use represents an end use and there are no further downstream users to whom RMMs need to be communicated.

Part B

1. Identity of the substance and physical / chemical properties

1.1 Name and other identifiers of the substance

Sodium Dichromate is a mono constituent substance (origin: inorganic) having the following characteristics and physical-chemical properties (see the IUCLID dataset for further details).

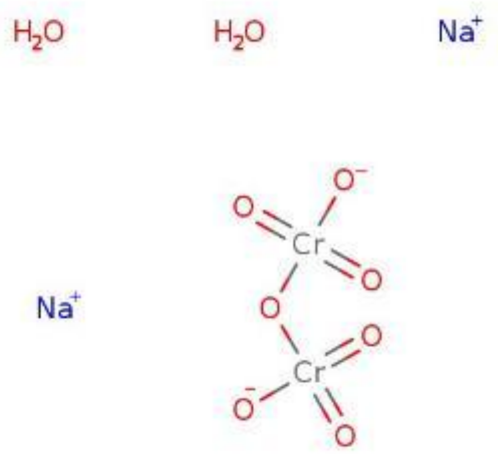
EC name:	sodium dichromate / sodium dichromate dihydrate
EC / List number:	234-190-3 / 616-541-6
CAS number:	10588-01-9 / 7789-12-0
Molecular formula:	$Cr_2Na_2O_7$ / $Na_2Cr_2H_2O_7.2H_2O$
Molecular weight:	261.9675 g/mol
Structural formula	

***Table 2**: Substance identity*

Sodium dichromate was included in the candidate list of substances of very high concern (SVHC) on 28th October 2008 (ECHA Decision ED/67/2008) and was included in Annex XIV of REACH, entry no. 18, on 17th April 2013 by virtue of Commission Regulation (EU) 348/2013. This was because of intrinsic properties relating to carcinogenicity, mutagenicity and reproductive toxicity. It was given a latest application date of 21 March 2016 and a sunset date of 21 September 2017.

1.2 Composition of the substance

The applicant currently purchases sodium dichromate in a liquid form (60% concentration sodium dichromate in water) delivered in three 1.4t intermediate bulk containers (IBCs) from their current supplier, [redacted]. The applicant's imports are covered by a UK REACH registration, [redacted], submitted as a new registration of an existing substance (NRES).

The supplier of sodium dichromate is anticipated to change to [redacted] before the date of review period expiry (31 December 2027). This change will provide a more consistent, reliable supply of sodium dichromate. The sodium dichromate from the new supplier has a higher concentration (70% sodium dichromate in water) and will be delivered in bulk, in a larger quantity [redacted]. A new [redacted] chemical storage tank is being constructed to store the sodium dichromate from the new supplier – see more in section 9.1.2.

No information on the production of sodium dichromate is presented in this CSR as the applicant is a downstream user under REACH. Compositional information is presented in the table below and relates to the sodium dichromate solution from the applicant's future supplier.

Constituent	Concentration	
Sodium dichromate solution ($Na_2Cr_2O_7.2H_2O$)	69.50 – 70.50%	
Impurities	Fe (Iron) V (Vanadium) Ca (Calcium) Cu (Copper) Al (Aluminium) SO_4^{2-} (Sulphate) Cl^- (Chloride)	Max. 50 mg/L Max. 120 mg/L Max. 90 mg/L Max. 10 mg/L Max. 30 mg/L Max. 0.2% Max. 0.1%
Other	Chromium trioxide (CrO_3) equivalent pH Density	46.64 - 47.30 % 4.0 - 5.0 1.67 - 1.73 g/cm^3
Target concentration of sodium dichromate in passivation tanks	[redacted]	

***Table 3**: Constituents of sodium dichromate as used by the applicant from its future supplier.*

1.3 Physico-chemical properties

The following physico-chemical properties are taken from information from the REACH registration of sodium dichromate available on the ECHA website.

Property	Description
Physical state:	Solid (crystalline) at 20 °C and 101.3 kPa Reddish to bright orange deliquescent crystals in hydrated form, usually dihydrated
Melting / freezing point:	Becomes anhydrous at 100 °C, salt melts at ca. 357 °C at 101.3 kPa
Boiling point:	Decomposes above 400 °C
Relative density:	2.5 g/cm³ at 20 °C
Water solubility:	2355 g/L at 20 °C
Oxidising properties:	Strong oxidiser

***Table 4**: Overview of relevant physico-chemical properties for sodium dichromate (solid)*

2. Manufacture and use

2.1 Quantities

The quantity of sodium dichromate in the scope of this AfA is indicated in section 2.3 and discussed further in section 9.1.6 of the CSR.

2.2 Manufacture

The applicant currently uses sodium dichromate that is manufactured by [redacted]. The supplier of sodium dichromate is anticipated to change to [redacted] by the date of review period expiry (31 December 2027). The impact of the change in supplier, particularly delivery arrangements, is discussed in greater detail in section 9.2.2.

Further information on the specific manufacturing process is not available to the applicant and not relevant for the current AfA, as the applicant is a downstream user. No further information on the manufacture of the substance has therefore been obtained from the substance manufacturer.

2.3 Identified uses

Sodium dichromate is used for the passivation of ETP at the applicant's site in Llanelli (the Trostre Works). Further detailed information on this use is presented in section 9 of this report.

Identifiers	Use descriptors	Other information
IS-1 *	Industrial use of sodium dichromate for the passivation of ETP	-
Further description of the use	Contributing activity/technique for the environment: - ERC5: Use at industrial site leading to inclusion into/into article Contributing activity/technique for workers: - PROC 1: Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (WCS3) - PROC 8b: Transfer of substance or mixture (charging and discharging) at dedicated facilities (WCS1, WCS8) - PROC 9: Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (WCS2, WCS8) - PROC 13: Treatment of articles by dipping and pouring (WCS4) - PROC 28: Manual maintenance (cleaning and repair) of machinery (WCS7) - PROC 0: Other (WCS5, WCS6) Product Category used: - PC 14: Metal surface treatment products	Annual tonnage: [redacted] tonnes sodium dichromate Public range: 10-20 tonnes sodium dichromate Number of sites: 1 (Trostre Works, Wales)

Identifiers	Use descriptors	Other information
	Technical function of the substance: - Plating agent Sector of end use: - SU15: Manufacture of fabricated metal products, except machinery and equipment	
Article service life	Article category related to subsequent service life (AC): - Not applicable as the substance (sodium dichromate) is not present in the article. Exposure related description of article: - None, as the substance (sodium dichromate) is not present in the article. Environmental release category (ERC): - Not applicable. During passivation, Cr(VI) is reduced to Cr(III) and Cr(0). No Cr(VI) is present in or on the finished steel articles. The ERC is not relevant as there cannot be any release from the article. Technical function of the substance during service life: - None, substance is not present in the article during its service life.	-
* IS = Use at industrial sites		

Table 5*: Identified uses of sodium dichromate by the applicant.*

2.4 Uses advised against

Not applicable – this CSR is only related to the use applied for by the applicant.

3. Classification and labelling

3.1 Classification under CLP

Sodium dichromate has mandatory classification and labelling under CLP, as follows.

Hazard class	Hazard category / differentiation	Hazard statement	Hazard pictogram
Oxidizing solid	Ox. Sol. 2	H272: May intensify fire; oxidiser.	
Skin corrosion	Skin Corr. 1B	H314 (Causes severe skin burns and eye damage)	
Acute toxicity	Acute Tox. 3 (oral) *	H301 (Toxic if swallowed)	
	Acute Tox. 4 (dermal) *	H312 (Harmful in contact with skin)	
	Acute Tox. 2 (inhalation) *	H330 (Fatal if inhaled)	
Sensitisation	Skin Sens. 1	H317 (May cause an allergic skin reaction)	
	Resp. Sens. 1	H334 (May cause allergy or asthma symptoms or breathing difficulties if inhaled)	
Germ cell mutagenicity	Muta. 1B	H340 (May cause genetic defects)	
Carcinogenicity	Carc. 1B	H350 (May cause cancer)	
Reproductive toxicity	Repr. 1B	H360FD: May damage fertility or the unborn child	
Specific target organ toxicity	STOT RE. 1	H372 (Causes damage to organs)	
Aquatic environment, acute	Aquatic Acute 1	H400 (Very toxic to aquatic life)	
Aquatic environment, chronic	Aquatic Chronic 1	H410 (Very toxic to aquatic life with long lasting effects)	
Other: - Signal word: Danger - Specific concentration limits: Resp. Sens. 1; H334: C ≥ 0.2%, STOT SE 3; H335: C ≥ 5%, Skin Sens. 1; H317: C ≥ 0.2%			

Table 6*: Mandatory classification and labelling for sodium chromate under CLP*

3.2 Classification relevant to Annex XIV of REACH

In accordance with Articles 57(a) and 57(b) of REACH, sodium dichromate has been identified as a substance of very high concern (SVHC) and included in Annex XIV based on the following criteria / intrinsic properties:

- Carcinogenicity, category 1B
- Mutagenicity, category 1B
- Toxic for reproduction, category 1B

In this CSR, the applicant will assess the hazards for which sodium dichromate was included in Annex XIV.

3.3 Classification of sodium dichromate as supplied

As referenced in section 1.2, the current supplier of sodium dichromate [redacted] is anticipated to change to [redacted] by the date of review period expiry (31 December 2027). The C&L information as communicated by both suppliers is shown in Tables 7 and 8 respectively.

C&L	Description
Classification	Ox. Sol. 2; H272 Acute Tox. 3; H301 Acute Tox. 4; H312 Acute Tox. 2; H330 Skin Corr. 1B; H314 Eye Dam. 1; H318 Skin Sens. 1; H317 Resp. Sens. 1; H334 Carc. 1B; H350 Muta. 1B; H340 Repr. 1B.; H360FD STOT RE 1; H372 STOT SE 3; H335 Aquatic Acute 1; H400 Aquatic Chronic 1; H410
Signal word	Danger
Hazard pictograms (for the label)	
Hazard statements (for the label)	H301: Toxic if swallowed. H312: Harmful in contact with skin. H330: Fatal if inhaled. H314: Causes severe skin burns and eye damage. H334: May cause allergy or asthma symptoms or breathing difficulties if inhaled. H317: May cause an allergic skin reaction. H340: May cause genetic defects. H350: May cause cancer. Route of exposure: Inhalation. H360FD: May damage fertility. May damage the unborn child. Route of exposure: Inhalation. H335: May cause respiratory irritation. H372: Causes damage to the respiratory system through prolonged or repeated exposure. Route of exposure: Inhalation. H410: Very toxic to aquatic life with long lasting effects.

C&L	Description
Precautionary statements	P202: Do not handle until all safety precautions have been read and understood. P220: Keep away from clothing and other combustible materials. P260: Do not breathe mist/vapours/spray. P260: Do not breathe dusts or mists. P270: Do not eat, drink or smoke when using this product. P273: Avoid release to the environment. P280: Wear protective gloves / eye protection. P303+P361+P353 IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water [or shower]. P304+P340 IF INHALED: Remove person to fresh air and keep comfortable for breathing. P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. P307+P311 IF exposed: Call a POISON CENTER or doctor/physician.
Supplemental information	REACH Authorisation number CAS 10588-01-9/ 7789-12-0: - [redacted] Additional information: - Any use that is not covered under the REACH Authorization is prohibited in the EC - Restricted to professional users.

***Table 7**: Classification and labelling of sodium dichromate as supplied to the applicant from its current supplier.*

C&L	Description
Classification	Ox. Sol. 2; H272 Acute Tox. 3; H301 Acute Tox. 4; H312 Acute Tox. 2; H330 Skin Corr. 1B; H314 Eye Dam. 1; H318 Skin Sens. 1; H317 Resp. Sens. 1; H334 Carc. 1B; H350 Muta. 1B; H340 Repr. 1B.; H360FD STOT RE 1; H372 STOT SE 3; H335 Aquatic Acute 1; H400 Aquatic Chronic 1; H410
Signal word	Danger
Hazard pictograms (for the label)	

C&L	Description
Hazard statements (for the label)	H301: Toxic if swallowed. H312: Harmful in contact with skin. H330: Fatal if inhaled. H314: Causes severe skin burns and eye damage. H334: May cause allergy or asthma symptoms or breathing difficulties if inhaled. H317: May cause an allergic skin reaction. H340: May cause genetic defects. H350: May cause cancer. Route of exposure: Inhalation. H360FD: May damage fertility. May damage the unborn child. Route of exposure: Inhalation. H335: May cause respiratory irritation. H372: Causes damage to the respiratory system through prolonged or repeated exposure. Route of exposure: Inhalation. H410: Very toxic to aquatic life with long lasting effects.
Precautionary statements	P260: Do not breathe dusts or mists. P284: [In case of inadequate ventilation] wear respiratory protection. P301+P310 IF SWALLOWED: Immediately call a POISON CENTER/ doctor. P303+P361+P353 IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water [or shower]. P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. P362+P364: Take off contaminated clothing and wash it before reuse. P405: Store locked up. P501: Dispose of contents/container in accordance with local/regional/national /international regulations.
Supplemental information	Additional information: - Restricted to professional users.

***Table 8**: Classification and labelling of sodium dichromate as supplied to the applicant from its future supplier.*

4. Environmental fate properties

This is not relevant for this AfA. Sodium dichromate has been included in Annex XIV for intrinsic properties relating to human health hazards only.

5. Human health hazard assessment

This CSR focuses on the carcinogenicity, mutagenicity and reproductive toxicity endpoints, i.e. the intrinsic properties referred to in Article 57 of REACH that are specified in Annex XIV for sodium dichromate. The health effects of sodium dichromate are directly linked to exposure to hexavalent chromium ions (Cr(VI)) released during industrial processes.

5.1 Carcinogenicity and mutagenicity

Potential risks of lung cancer relating to inhalation of dust and/or aerosols in the workplace is a primary concern. Potential risks of intestinal cancer for workers are also considered, as are potential risks for the general population that may be exposed to Cr(VI) in air and water released from the production facility.

ECHA's RAC has established reference dose-response relationships for lung and intestinal carcinogenicity of Cr(VI) compounds (including sodium dichromate) for both workers and the general population.[2]

For the general population, based on an exposure for 70 years (24 hrs/day, every day), an excess risk of lung cancer mortality of 2.9×10^{-2} (29/1000) per µg Cr(VI)/m^3 is used and an excess risk of small intestine cancer mortality of 8×10^{-4} (8/10000) per µg Cr(VI)/kg bw/day is used.

For workers, based on 40 years of exposure (8 hrs/day, 5 days/week), an excess risk of lung cancer mortality of 4×10^{-3} (4/1000) per µg Cr(VI)/m^3 is used. The oral route exposure for workers is not considered as it is assumed that all particles are in the respirable size range, and that no other sources of oral exposure are possible. This is a conservative assumption. For this reason, only the inhalation route relevant to airborne Cr(VI) will be considered in the worker risk assessment.

The applicant has performed the risk assessment in accordance with the approach proposed by RAC, which states that, as the mutagenic effects are considered to lead to carcinogenic effects, the mutagenic effects are expected to be indirectly covered by the reference dose-response relationships for carcinogenic effects (lung and small intestine). As the substance exhibits carcinogenic non-threshold effects, the adequate control route is not possible, and the SEA route is applicable. We note however that the dose-response relationships were derived by linear extrapolation that inevitably introduces uncertainties, as the mechanistic evidence of toxicological effects suggests non-linearity. It is acknowledged that the excess risks in the low exposure range (below 1 µg/m^3 or 1 µg Cr(VI)/kg bw/day) might be an overestimate.

5.2 Reproductive toxicity

Sodium dichromate is also included in Annex XIV of REACH due to its reproductive toxicity, for which the existence of a threshold is assumed, meaning that DNELs could be derived.[3] For workers, inhalation and dermal DNELs have been established:

- For effects on fertility:
    - inhalation DNEL systemic long-term: 43 µg Cr(VI)/m^3
    - dermal DNEL systemic long-term: 43 µg Cr(VI)/kg bw/d
- For developmental toxicity:
    - inhalation DNEL systemic long-term: 85 µg Cr(VI)/m^3
    - dermal DNEL systemic long-term: 93 µg Cr(VI)/kg bw/d

[2] ECHA, 2013.

[3] ECHA, 2015a.

For the general public, inhalation, dermal and oral DNELs have been set:

- For effects on fertility:
  - inhalation DNEL systemic long-term: 11 µg Cr(VI)/m^3
  - dermal DNEL systemic long-term: 22 µg Cr(VI)/kg bw/d
  - oral DNEL systemic long-term: 17 µg Cr(VI)/kg bw/d
- For developmental toxicity:
  - inhalation DNEL systemic long-term: 15 µg Cr(VI)/m^3
  - dermal DNEL systemic long-term: 34 µg Cr(VI)/kg bw/d
  - oral DNEL systemic long-term: 26 µg Cr(VI)/kg bw/d

The fertility DNELs are all lower than the corresponding DNELs for developmental toxicity but are nevertheless in the same range. ECHA notes that, when comparing these reproductive toxicity DNELs with the carcinogenic dose-response of Cr(VI), the carcinogenic effects of Cr(VI) are much more potent than its reprotoxic effects.[4]

[4] ECHA, 2015a.

6. Physicochemical properties hazard assessment

This is not relevant for this AfA. Sodium dichromate has been included in Annex XIV for intrinsic properties relating to human health hazards only.

7. Environmental hazard assessment

This is not relevant for this AfA. Sodium dichromate has been included in Annex XIV for intrinsic properties relating to human health hazards only.

8. PBT and vPvB assessment

This is not relevant for this AfA. Sodium dichromate has been included in Annex XIV for intrinsic properties relating to human health hazards only.

9. Exposure assessment and related risk characterisation

9.1 Introduction

The applicant is part of Tata Steel, one of the largest steel-producing companies in the world. The applicant operates extensively across the UK, with a significant presence in South Wales. The company is the largest steelmaker in the UK, supplying high-quality steel products to demanding markets such as construction, infrastructure, automotive, packaging, and engineering. Its operations include major facilities in Port Talbot, where the business is investing in state-of-the-art electric arc furnace steelmaking as part of a £1.25 billion decarbonisation initiative, as well as manufacturing sites and other service centres including Deeside, Hartlepool, Wolverhampton, Newport and Llanelli.

This chemical safety report (CSR) supports the applicant's review report AfA for the downstream use of sodium dichromate for passivation of electrolytic tinplate (ETP) at its Trostre Works manufacturing facility, located in Llanelli, Carmarthenshire. The Trostre Works is a large-scale facility that manufactures packaging steel products, predominantly ECCS (also known as tin-free steel) and ETP (also known as tinplate).

The primary function of sodium dichromate in the ETP production process is to provide a continuous fine layer of chromium metal (Cr(0)) and chromium oxide (Cr(III)) on the tin plated-steel strip. This layer stabilizes the surface and prevents the growth of tin oxide, providing chemical resistance and corrosion protection. The resulting ETP is used by the applicant's customers to produce cans for food and beverages and metal packaging for various non-food applications.

ETP is essential in certain food packaging applications. The chromium layer provides excellent chemical and corrosion resistance, which is crucial for maintaining the integrity and safety of food products, preventing rust, sulphide staining and other forms of degradation that could compromise the food inside. It provides a surface that supports excellent adhesion for subsequent lacquering, decorative printing or welding. It offers a strong barrier against external contaminants, ensuring that food remains uncontaminated and fresh for longer periods. Its high strength and durability make it suitable for various packaging applications, including can ends, crown caps, and vacuum closures for glass jars. It is also cost effective, providing similar benefits to tinplate but at a lower cost.

Sodium dichromate is listed in Annex XIV of REACH (entry 18) and is subject to authorisation. The applicant already has an authorisation under REACH for the use of sodium dichromate for the ETP process. The application was submitted under EU REACH on 3 December 2019 and final opinions were issued on 28 December 2020 by the Risk Assessment Committee (RAC) and the Committee for Socio-Economic Analysis (SEAC) of the European Chemicals Agency (ECHA). However, the authorisation itself had not been granted by the European Commission by the end of the Implementation Period on 31 December 2020, following the UK's exit from the EU. Under UK REACH transitional rules, Tata Steel resubmitted their application for authorisation as an 'in-flight' application to the Secretary of State (SoS) for the Department for Environment, Food and Rural Affairs (Defra). The authorisation was granted by the SoS on 24 January 2022 (authorisation number UKREACH/22/01/1) with a review period ending on 31 December 2027.

The applicant supports the objectives of authorisation under REACH and continues to devote considerable time, effort and resources in its search for a suitable alternative substance or technology to sodium dichromate. However, it has been very challenging for the applicant – consistent with others in its sector and indeed other sectors of industry currently relying on sodium dichromate to manufacture products needing to meet high quality and performance standards – to find one or more suitable alternatives which provide the same benefits as coatings generated from sodium dichromate. To enable the applicant to continue its search for a suitable alternative and to assure the market of its continued ability to supply high-quality ETP products in the meantime, the applicant has developed a review report application to extend its authorisation beyond 2027.

9.1.1 About the Trostre Works

The Trostre Works is a prominent manufacturing site for packaging steels with a rich history. The plant was initially built by the Steel Company of Wales in 1947. The site was chosen due to its proximity to railway access and the availability of skilled labour in the region with a strong heritage in tinplate manufacture. Production at Trostre began in 1950 and, by 1956, the plant had reached its planned output of 400,000 tonnes per year. Following nationalisation of the steel industry in 1967, the site became part of the British Steel Corporation. In 1999 ownership transferred to the Corus Packaging Plus business following the merger of British Steel with Koninlijke Hoogovens. In 2007, Tata Steel completed the acquisition of Corus Group plc and has operated the facility to the present day.

Figure 1: *The Trostre Works in Llanelli, Carmarthenshire*

At the Trostre Works, the applicant produces tin-, chromium- and polymer-coated steels, primarily for the packaging industry. The plant manufactures approximately 400,000 tonnes of steel products annually, which are used by its customers to produce food and beverage cans, aerosols, paint tins and luxury packaging. The facility is equipped with advanced technology and operates under stringent health, safety and environmental standards. Tata Steel has continuously invested in the site, focusing on innovation, sustainability, and efficiency to maintain its competitive edge in the market.

The site is certified in accordance with a number of industry, quality and environmental standards:

- ISO 9001:2015 for its quality management system, certified by Lloyds Register Quality Assurance (LRQA).
- ISO 14001:2015 for its environmental management system, certified by LRQA. The Trostre Works was one of the first large manufacturing sites in the UK to attain ISO 14001 accreditation.
- BES 6001 for the responsible sourcing of products, certified by the British Standards Institution (BSI)
- The British Retail Consortium Global Standard for Packaging Materials (BRCGS) for products intended for direct/indirect contact with food and hygiene sensitive products, certified by LRQA, achieving an AA+ grade in 2026 for the third consecutive year.
- EHDA Halal Certificate in 2025 and KLBD Kosher Certificate in 2024.

The importance and significance of the Trostre Works extends beyond its production capabilities. The facility is a major employer in the region, contributing to the local economy and providing skilled jobs to the community. Its commitment to sustainability and innovation has positioned it as a leader in packaging steels production. The plant's ability to adapt and evolve over the years has ensured its longevity and continued success, making it a vital part of Tata Steel's operations and the broader steel industry today.

Other regulatory requirements applicable to the Trostre Works

In addition to the REACH authorisation requirements for the use of sodium dichromate at the site for the passivation of ETP:

- The applicant also has a separate authorisation for the use of chromium trioxide for the manufacture of ECCS (authorisation no. UKREACH/22/02/0). This AfA was submitted on 10 April 2019 under EU REACH and final opinions were issued on 12 June 2020 by the RAC and SEAC, but a final decision had not been taken by the European Commission by the time of the UK's exit from the EU and the end of the implementation period on 31 December 2020. The applicant therefore resubmitted the application as an 'in-flight' application and was granted authorisation by Defra on 24 January 2022, with a review period ending on 31 December 2027. A review report was submitted in December 2025 concerning this use.

- The Trostre Works qualifies as a lower-tier establishment under the Control of Major Accident Hazards Regulations 2015 (COMAH) due to the quantities of chromium trioxide, chromic acid and sodium dichromate held on site, and is subject to a multi-annual intervention plan from the COMAH joint Competent Authority.

- The site is also subject to the Environmental Permitting (England and Wales) Regulations 2016 (EPR) and holds a permit issued by Natural Resources Wales (NRW), no. EPR/BX9471IU.

The surrounding area

The site is situated within the county of Carmarthenshire, 1.5 km to the east of the town of Llanelli. There are several small villages within a 5km radius. The village of Llwynhendy is situated within 1 km of the site boundary. The Trostre Business Park and Trostre Retail Park are situated within 0.5 km to the west of the site boundary and the Pemberton Retail Park and 15,000 capacity Rugby Stadium (Parc Y Scarlets) are situated within 0.5 km to the north of the site boundary. The retail parks include supermarkets, fast food outlets and large retail stores. The Wildlife and Wetlands Centre, Wales, is located to the south of the site, approximately 0.5 km from the site boundary. The New Dafen River runs parallel to the western boundary of the site.

The table below details the approximate maximum population/visitors within 1 km of the site boundary.

Population centre	Population / Visitors (estimated maximum number)
Llwynhendy (electoral ward, 2021 census data)	4,389 (permanent)
Trostre Retail Park & Trostre Industrial Estate	3,000 (transient)
Pemberton Retail Park	2,500 (transient)
Parc Y Scarlets Rugby Stadium (match day)	14,870 capacity (match day, transient)
Wetlands and Wildlife Centre	Up to 50,000 visitors per year (transient)

***Table 9**: Information on local population around the site*

An aerial view and map with the site boundary and areas within a 1 km radius of the stack serving the ETP line are provided in Figures 2 and 3 below.

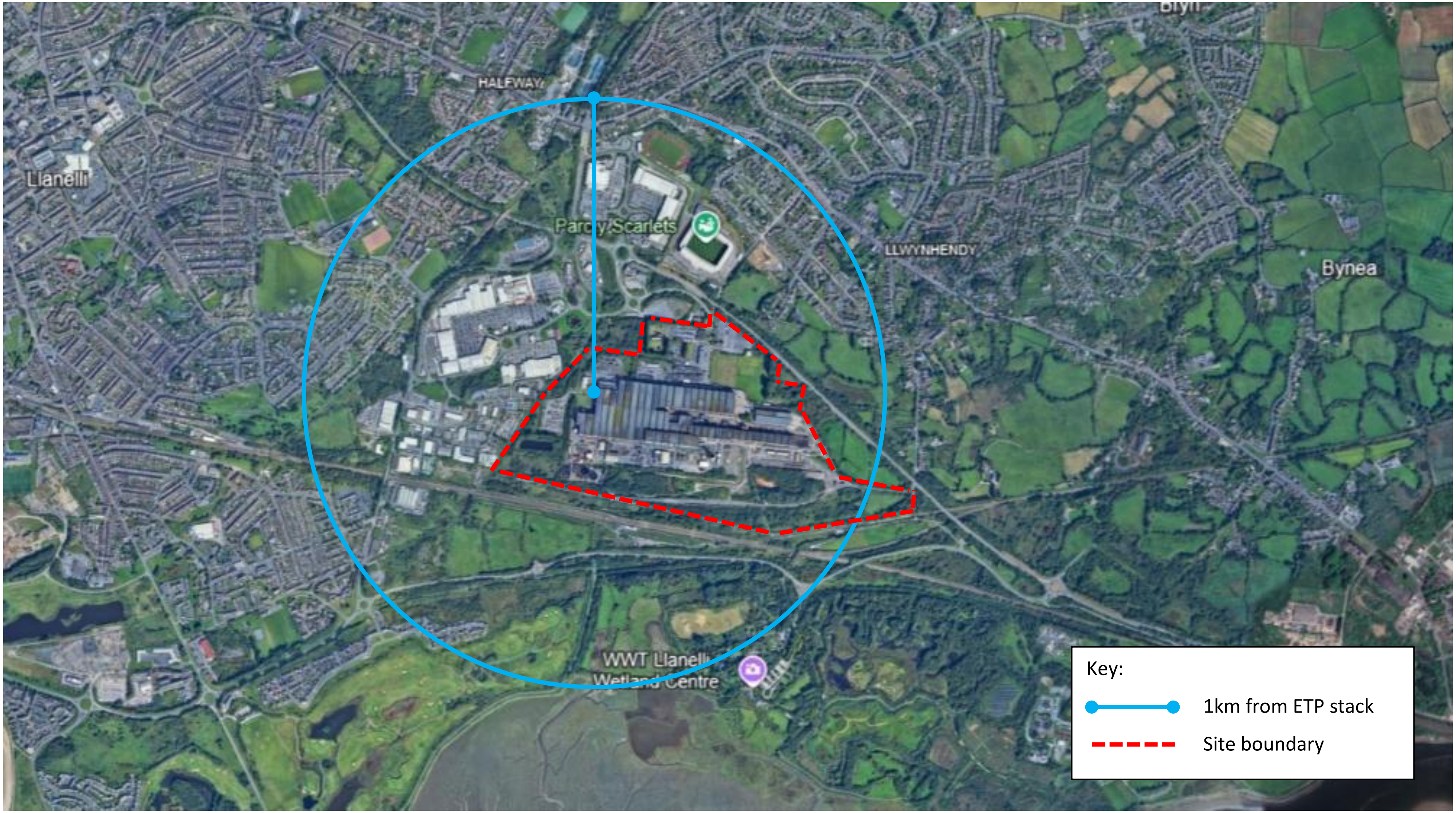


***Figure 2**: Overhead view of the Trostre Works showing the site boundary and area within a 1 km radius of the exhaust stack from the ETP line*

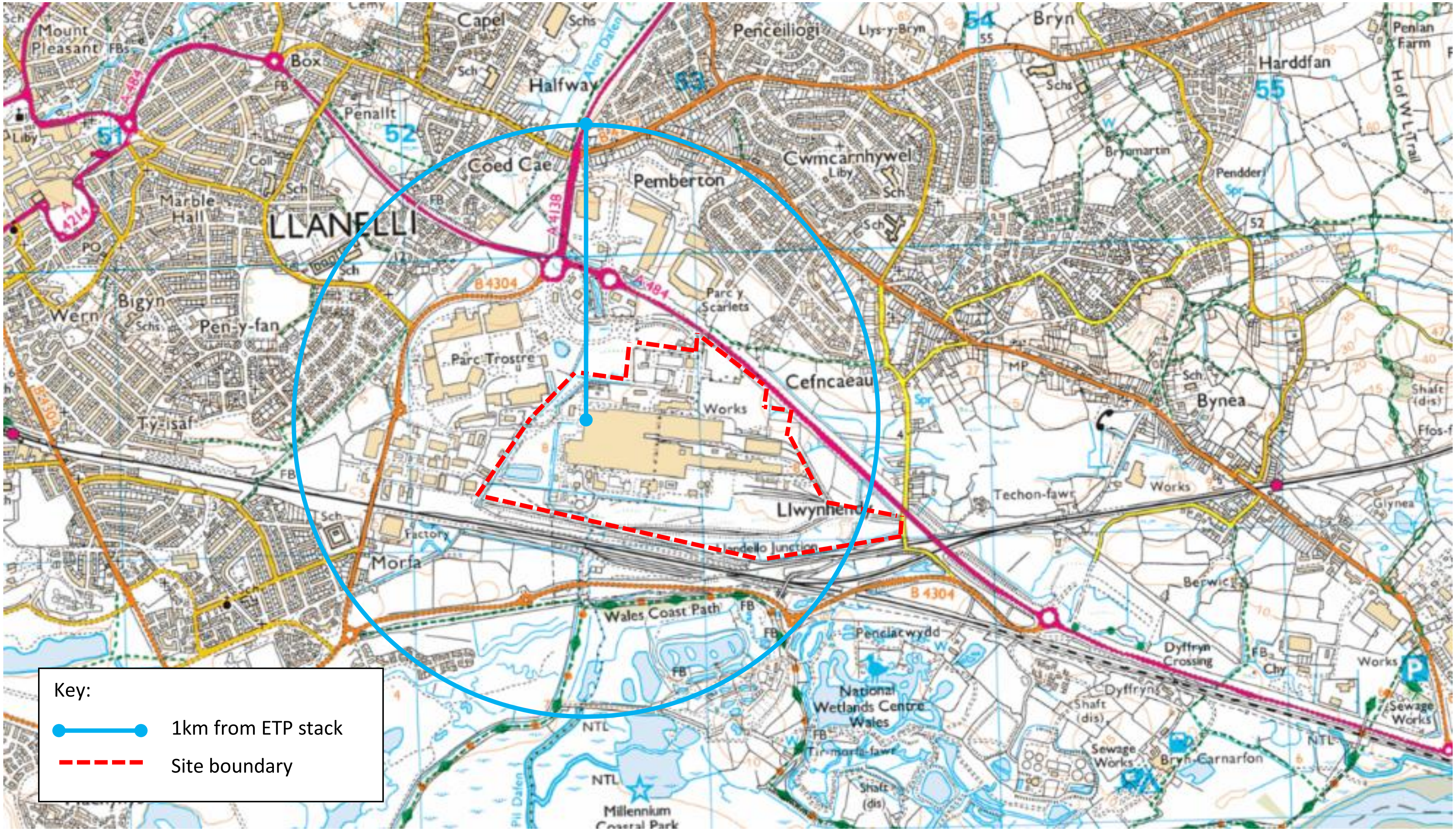


***Figure 3**: OS map (1: 25,000 scale) showing the Trostre Works site boundary and area within a 1 km radius of the exhaust stack from the ETP line*

9.1.2 Layout of the site and locations relevant to the use of sodium dichromate

The Trostre Works covers approximately 420 acres and is located on a wide, flat coastal plain. Coils of strip steel were originally produced at Abbey Works, Margam, to the east (now the Port Talbot works) and transported by rail to Trostre. Therefore, the rail sidings and coil storage area are located to the east of the main building. The main works area of the site covers approximately 200 acres and includes a pickle line, a five stand cold reduction mill, continuous and batch annealing process lines, a double reduction mill, a temper mill, electrolytic coating lines and other facilities such as packaging and warehousing areas, stores, a roll shop, an engineering workshop and offices. The layout of the production plant is a logical one, so that each consecutive process is laid out in order within the main bays.

The wastewater treatment plant (WWTP) was constructed in 1970 and vastly improved the control of site drainage and effluents, so that all process effluents plus the majority of the surface runoff are directed to the WWTP where they are treated and then discharged to the Loughor estuary. A polymer coating line was also added in 1992, in the northern part of the building, which is a physical process in which polymer film is bonded to the strip by heat and pressure.

The raw material for the Trostre Works consists of rolled steel coils, received by road or rail into the Pickle Line receipt bay. Steel strip manufacturing involves a series of process steps. The coils are unwound in each process step and rewound again to move to the next line. A continuous operation is achieved by automatically welding the leading end of the new coil to the trailing end of the previous one. The different steps of the steel strip production process at Trostre are as follows:

1) **Pickling**: To remove the surface oxides formed during the hot rolling coil process, the steel is passed through a series of tanks containing an aqueous solution of sulphuric acid in the pickling line.

2) **Cold reduction**: This reduces the coils down from a thickness of typically 2mm to a thickness ranging between 0.61mm and 0.16mm, depending on customer requirements.

3) **Continuous or batch annealing**: Annealing is a controlled process of heating and cooling which gives the steel its required ductility, strength and hardness.

4) **Temper rolling or double reduction**: This operation gives the steel the final mechanical properties and flatness, as well as the customer's required surface finish.

5) **Coating**: The majority of material is then coated through one of two coating lines at Trostre, the electrolytic chromium coating line (line no. 4, ECCS4) or the electrolytic tinning line (line no. 5, ETL5) which is the subject of this application and described in further detail in section 9.1.3.

6) **Polymer coating**: ECCS may also have a polymer laminate applied to the steel strip. ETP is not processed this way, [redacted].

7) **Preparation for storage and dispatching**: A thin film of lubricant is applied to minimise subsequent damage by abrasion, to facilitate sorting, handling, mechanical feeding and fabricating operations and to aid in lacquering and printing operations. The final product is delivered in coils or cut into flat sheets depending on customer needs. Automatic quality checks are done before cutting into sheets and a final visual inspection is performed before being stacked for packing and dispatch.

Figure 4 provides a plot plan of the site indicating the location of areas relevant to the use of sodium dichromate at the Trostre Works, namely within Area 3 (the Coating Section) on line 5, and within Area 4 (the wastewater treatment plant). These areas are described in further details in the following sections.

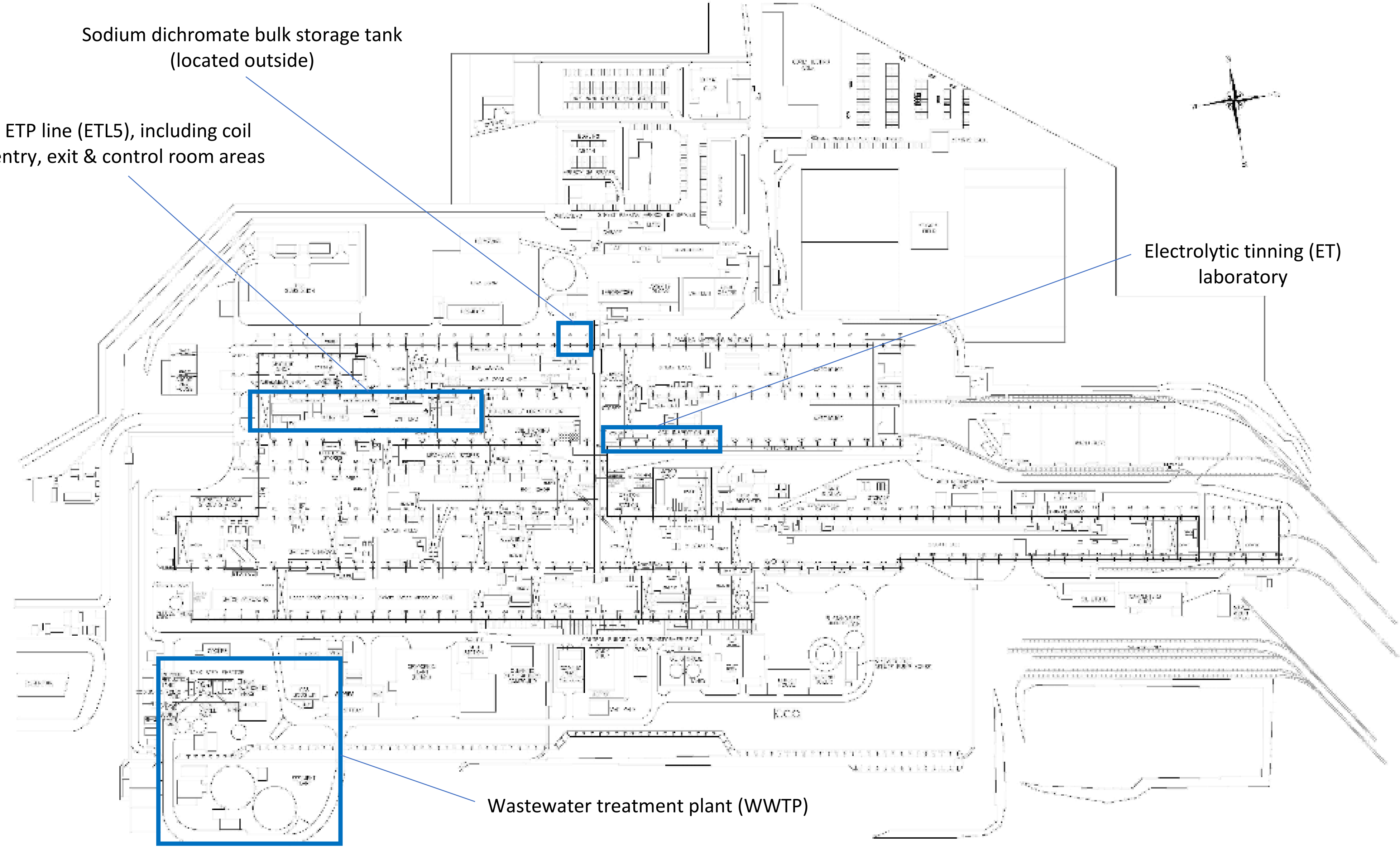


***Figure 4**: Plot plan of the Trostre Works, with areas relevant to the use of sodium dichromate for ETP passivation indicated*

9.1.2.1 Electrolytic tinning line no. 5 (ETL5)

Electrolytic tinplate is still the leading material used in the packaging industry. Tinplate is manufactured using a continuous process. The tinning line at Trostre is referred to as ETL5.

ETL5 lies within Area 3 of the Trostre Works, a large hall physically separated from other areas of the site. The ETL5 line is located on the ground floor, with strip accumulators, chemical circulation tanks and other equipment supporting the ETL line located at basement level beneath the ETL line. Access to these areas is restricted to authorised personnel. This restricted area is demarcated by blue walls.

The production process is described in further detail in section 9.1.3 below, though in summary, the steel strip is passed through the entry section of the line, cleaned, pickled and then plated with tin electrolytically and flow brightened before being passivated with a sodium dichromate solution, rinsed thoroughly, dried, oiled and then recoiled.

[redacted]

Figure 5: *Chemical treatment (passivation) section of the electrolytic tinning line no. 5 (ETL5) within Area 3 of the Trostre Works*

[redacted]

Figure 6: *Schematic of the electrolytic tinning line no. 5 (ETL5) within Area 3 of the Trostre Works*

9.1.2.2 Delivery and storage of sodium dichromate

Sodium dichromate solution is currently delivered to the applicant as a liquid in intermediate bulk containers (IBCs). A dedicated delivery location is used (see Figure 7 below) where the sodium dichromate solution is pumped directly from the IBCs to a bulk storage tank. From there, the sodium dichromate solution is dosed into a circulation tank in the ETL5 basement area by gravity, then pumped to passivation tanks on the ETL5 line for use in the production process.

Up to ca. [redacted] of sodium dichromate solution can be stored in the bulk storage tank until used for passivation. Sodium dichromate is delivered [redacted] (3 x 1.4t IBCs per delivery).

Figure 7: *Delivery compound used for sodium dichromate deliveries*

A recent decision to change the site's supplier of sodium dichromate will also lead to a change in how sodium dichromate will be delivered and stored. A new, double-skinned bulk storage tank has now been installed (see Figure 8 below, located on the concrete base visible in Figure 7 above). This tank will have a capacity of [redacted] and, as a result, deliveries will reduce in frequency, [redacted], delivered by road tanker carrying up to [redacted] of sodium dichromate solution per delivery. The new tank will be commissioned before the date of review period expiry (31 December 2027).

Figure 8: *New bulk storage tank for future supply of sodium dichromate solution*

9.1.2.3 On site laboratory

The site laboratory is located to the east of the ETP line. 200 mL samples of the Cr(VI) passivation solution (taken using a sample scoop from the drive side of the line tank) will be taken to the laboratory once per shift (twice per day, based on two 12 hour shifts) for analysis. The results of sampling are used to verify the accuracy of the automated dosing system as well as monitor other important bath parameters. Following analysis, the passivation solution is returned to the production line and discharged into a basement chemical treat sump called the 'chrome sump'.

9.1.2.4 Wastewater treatment plant (WWTP)

The wastewater treatment plant (WWTP) is located at the south-west of the Trostre Works. It is a ring-fenced site, currently managed and controlled by Veolia Water Technologies & Solutions ('Veolia'). The plant is operated on a 24/7 basis and receives approximately 30,000 m^3 of waste liquid per week.

***Figure 9**: Wastewater treatment plant*

A tank farm in the WWTP enables the segregation of the various effluents that emanate from Area 3. This consists of various storage tanks which receive the segregated effluents generated by Area 3, together with storage tanks containing the chemicals used to treat the effluents prior to their discharge into the main effluent flume. The tank farm consists of:

- One horizontal cylindrical storage tank (approx. 55 m^3) for Cr(VI) waste electrolyte from the ECCS line. Volume in this tank is restricted to 25 m^3 by a level instrument interlocked to the transfer pumps in the basement of ECCS4.
- Two horizontal cylindrical storage tanks (approx. 55 m^3 each) for waste tinning electrolyte from the ETP line.
- One horizontal cylindrical storage tank (approx. 55 m^3) for waste quench water, although this is not currently in use.
- One horizontal storage tank (approx. 27m^3) for waste sodium dichromate from the ETP line.
- Two vertical cylindrical tanks to receive and treat effluent from Area 3 (including line 4):
    - A pre-treatment tank (27 m^3) is used to lower pH by the addition of spent pickle acid to approximately 2.5.
    - A chrome reduction tank (approx. 13.5 m^3) to reduce Cr(VI) to Cr(III) by the addition of a spent pickle containing ferrous sulphate.

  These tanks are linked to permit carry over from the pre-treatment tank into the chrome reduction tank.
- Two vertical cylindrical storage tanks for the dosing of spent pickle liquor/acid and for the batch treatment of spent chromate solutions.

Figure 10*: The tank farm in the WWTP*

For treatment of wastewater from the ETP passivation process more specifically:

- **Spent passivation solution** that contains **Cr(VI)** is collected in a dedicated sump in the basement under the ETL5 line. The level in the sump is continuously monitored and pumped to the WWTP when sufficient volume is available. The Cr(VI)-containing wastewater is transferred to the tank farm in the WWTP via a dedicated, joint free stainless steel pipeline. At the WWTP, the wastewater is treated by Cr(VI) reduction in a batch process using pickling solution (ferrous sulphate) from the pickling line.

- All **rinsewaters** generated in the rinsing step of the process are directed to a separate, segregated chromic acid-resistant lined sump in the basement. Rinsewaters are then pumped through a stainless steel, non-flanged transfer line to the tank farm in the WWTP where Cr(VI) is reduced using ferrous sulphate in a two-stage tank system.

Reducing agents are dosed to Cr(VI)-containing effluent over-stoichiometrically in the chrome reduction tank (which contains a stirrer to agitate the contents) to ensure full reduction. Following treatment, the effluent joins other liquid waste entering the WWTP which is directed into one of three lagoons, which act as holding tanks. The wastewater then receives further non Cr(VI) specific treatment such as neutralisation and clarification. The by-products produced during the process are compressed into a filter cake and disposed of as waste.

Treated effluent from the lagoons is discharged to the Loughor Estuary, a designated Ramsar and SSSI site. Discharge is usually by gravity, although for larger flows or at high tide conditions one or two pumps of a two-pump installation may be used to discharge up to approximately 190 l/sec (684 m^3/hr), the maximum flow permitted under the site's permit. The effluent is discharged into the Loughor Estuary at a discharge point 1 km from the treatment plant.

A composite sampler is used to collect a representative 24 hour sample of the treated effluent discharged to the estuary which is analysed to ensure that it meets the conditions laid down in the discharge consent, part of the EPR permit issued by Natural Resources Wales (NRW). NRW personnel also visit the site on a monthly basis to conduct their own additional sampling and analysis. This includes analysis for Cr(VI) and for total chromium. The current discharge consent levels include 0.4 mg/l maximum for total chromium which has never been exceeded.

Overfill and potential loss of containment events are prevented by the use of level control instruments linked to alarms in the ETL5 control room (ETL5 sumps) and WWTP control room (bulk tanks in the tank farm). Transfers from the sumps to the bulk tanks are carried out under a procedure which demands positive confirmation that there is sufficient capacity available in the receiving tank prior to transfer. In addition, the transfer pumps are interlocked with the tank level indicator of the bulk storage tank at the WWTP, set at 55% volume. This interlock is tested annually. The sumps in ETL5 and the tank farm in the WWTP are bunded to provide secondary containment and the bunds are capable of retaining over 110% of the volume of the largest vessel in the area.

The wastewater treatment system is controlled and monitored using pH in stage one and Redox probes in stage two of the reduction process prior to discharge into the main effluent wastewater stream. Prior to further wastewater treatment (not a Cr(VI)-specific treatment), the wastewater stream is monitored for Cr(VI) using a colorimetric analyser. In the event of a positive result, an automatic alarm would be initiated and interlocked transfer pumps would stop the treatment process. Any Cr(VI)-contaminated wastewater would be segregated and directed to an available lagoon (500-600 m^3 concrete structures with acid resistant linings) for further treatment, namely reduction with ferrous sulphate and pH adjustment.

9.1.3 Process description

The applicant uses sodium dichromate at the Trostre Works for the passivation of ETP. The oxide film normally present on tin-plated steel strip, although protective to some degree, will readily grow during storage. As well as discoloration of the surface, at a certain thickness the tin oxide film will result in impairment of the adhesion of a subsequent lacquer layer and cause difficulties with welding. Conversely, too little tin oxide can have negative consequences for de-tinning the steel. This means it is critically important to control the tin oxide layer to prevent further oxidation. Sodium dichromate is therefore used to apply a thin layer of chromium metal (Cr(0)) and chromium oxide (Cr(III)) onto both sides of the tin-plated coil by passivation.

The tinplate is immersed in an electrolyte [redacted] with an electric current applied. The stable protective layer, so formed, consists of tin oxides, Cr(III) oxides and hydroxides and also metallic chromium. The produced oxide layer is free of Cr(VI).

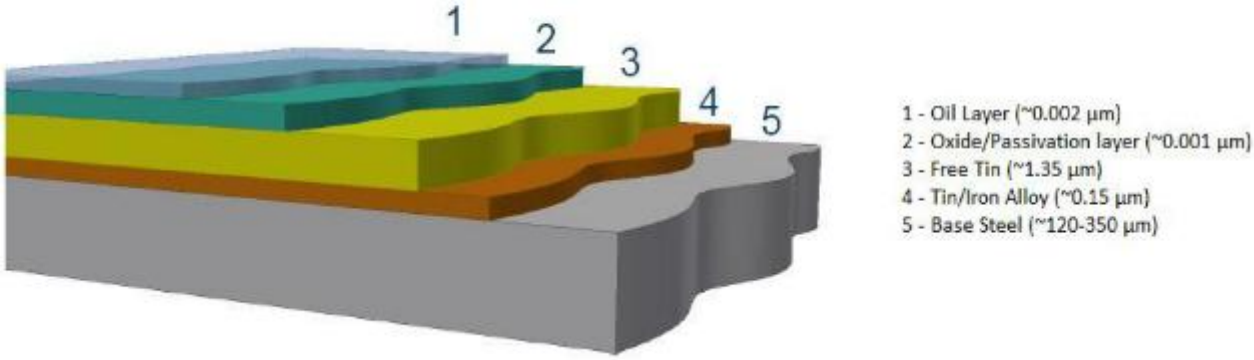


***Figure 11**: Schematic structure (not to scale) of tinplate showing the main functional layers*

The production of ETP is an automated, continuous process. At the entry end of the line, the tail end of one coil is welded to the nose of the subsequent coil and at the exit end the strip is sheared, to again separate the coils. Production involving the following process steps, illustrated in Figure 12 below:

- **Entry section**: The black plate steel coil is unwound and cut to appropriate width via a side trimmer before it passes through to the different treatment tanks. The trailing end of the preceding coil is trimmed square and welded to the prepared end of the new coil. This ensures that the process is continuous. Meanwhile the plating section of the line is fed continuously from the strip stored in the looping tower. The looping tower makes it possible to maintain a constant and high speed through the plating tanks. The looping tower consists of upper and lower sets of rolls over which the strip passes. The lower set of rolls is mounted on a frame, which can be moved up or down depending on whether strip is being drawn from or accumulated in the equipment.

- **Cleaning section**: The coiled black plate as received from the entry section is usually slightly contaminated with oils and dirt. Successful tin deposition requires the steel surface be free of these contaminants, so it is important that the cleaning operation is as thorough as possible. The strip is therefore passed through five tanks – [redacted] cleaner 1 and 2 electrolytic tanks, followed by two rinsing tanks. Cleaning consists of treating the strip with [redacted] and then cleaning in two electrolytic tanks containing [redacted]. The chemical cleaning action of the [redacted] is electrolytically aided due to the short time available for cleaning. [redacted] All baths are connected to individual circulation tanks situated in the basement of the production area.

- **Pickling section**: In addition to oils and other organic matter, the incoming steel strip will carry oxides and other acid-soluble contaminants, which must be removed by pickling. Pickling is also an electrolytic process. The purpose of the acid is to remove the oxides and lightly etch the strip surface, to present as clean a steel surface as possible to the plating solution. [redacted] is used for pickling at ambient temperature.

- **Tin plating section**: The plating section consists of a number of vertical tanks arranged in tandem so that any point on the strip passes into each tank consecutively and the tin coating thickness is increased in successive pass-throughs.

[redacted]

Figure 12*: Tandem arrangement of plating tanks*

The plating tanks are constructed of rubber lined steel and contain a rubber covered driven sink roll. In addition to the sink roll, two chromium-plated copper conductor rolls are associated with each tank. Current is transferred from the roll to the strip. The anodes are cast from electro-refined tin, which is greater than 99.85% pure and mounted in the tank. The number of anodes in use and the spacing between anodes are adjusted so that the total anode bank covers the strip width.

[redacted] All additions are made remotely from the operator's pulpit via automatic pumps and valves. Samples of solution are analysed to provide the operator with the information required to keep the solution within specification. [redacted]

- **Drag-out section**: A drag-out section minimises the loss of plating electrolyte carried over from the plating section, in order to minimise the incidence of indents and arcing and to recover carried over plating electrolyte (which is returned to the plating section). It also maintains a controlled level of dilute electrolyte on the strip surface. A separate 'flux chemical' is applied to the strip via sprays to ensure the surface of the tin is reflowed to give the desired surface finish.

- **Differential marking**: This process involves marking the surface of the strip with lines of various spacing, which are normally applied on the heavy coating surface. This is used for products with differential coating weights, to enable the customer to identify the one surface from another. Other, non-standard marks may be specified, such as interrupted marker lines or single centre line markers or edge markers.

- **Flow melting (flow brightening)**: The tin coating, as deposited on the strip, has a dull matt appearance. To give it a bright lustrous surface similar to that of hot dip tinplate, [redacted]

- **Passivation**: The tinplate surface is then stabilised either chemically or electrochemically in the passivation section (also called the chemical treatment section). This section consists of passivation tanks and rinsing tanks. [redacted] During the passage of the steel through the passivation tanks, Cr(VI) is reduced in a cathodic driven process and deposited on the steel as a mixed layer of metallic chromium (Cr(0)) and chromium (III) oxide (Cr_2O_3) on both sides of the steel. After the passivation, the steel is rinsed in successive rinsing tanks.

A number of treatments have been developed; the choice of treatment depends on the degree of oxide stability that is desired and the end use of the tin-plate steel. In view of the satisfactory results obtained commercially with [redacted] chemical treatments over many years of use, this is the normal treatment for most tinplate applications. This treatment forms a suitable surface at any line speed and is satisfactory for use with most tinplate lacquer systems. Some applications, such as caps and closures and those involving milk products, use lacquer systems which require a lower level of passivation, known as [redacted] chemical treatment, whilst applications which involve the packaging of products containing sulphides may require a higher level, called [redacted] chemical treatment.

- [redacted]
- [redacted]
- [redacted]
- **No passivation**: Certain DWI applications require a surface with no chrome deposition. This is achieved by re-routing the strip so that it completely bypasses the chemical treatment section.

[redacted]

- **Oiling**: After the tinplate has been treated, rinsed and dried, a thin film of lubricant is applied to the tinplate surface. The function of this film of lubricant is to minimise subsequent damage by abrasion, to facilitate sorting, handling, mechanical feeding and fabricating operations and to aid in lacquering and printing operations.

- **Final inspection:** Final inspection of the finished strip is by visual examination in two vertical mirrors and an online Parsytec automatic inspection system. This is to look for surface defects generated through process. Continuous monitoring of tin coating weight, strip thickness, gauge, pinhole levels, coil weight and length are also undertaken.

Other activities are integrally linked to the production process which are relevant for the evaluation of potential exposure. These are described further in each separate exposure scenario in section 9.2 and include:

1) Receipt, storage and transfer of sodium dichromate (WCS 1).
2) Sampling and analysis of the Cr(VI) solution from the passivation tanks (WCS 2).
3) Topping up/replenishing of sodium dichromate into the circulation tanks (WCS 3).
4) Control room activities (WCS 5).
5) Loading and unloading of the steel coils (WCS 6).
6) Maintenance and cleaning activities (WCS 7).
7) Waste handling and treatment (solid and liquid waste) (WCS 8).

[redacted]

9.1.4 Plant operating times, shift patterns and similar exposure groups

The Trostre Works operates 24 hours per day, 7 days a week, 52 weeks per year. Production can take place every day except for an annual shutdown for site-wide maintenance lasting up to 6 days, plus planned shutdowns for up to 8 hours typically every 3 weeks for routine maintenance tasks.

This means there is a theoretical maximum of around 353 full days production each year with the remainder for maintenance activities. In reality, the total number of production days is significantly less than this each year because the plant does not always run at full capacity or there are unanticipated breakdowns or periods of idling. The table below shows the number of operating hours and the equivalent number of production days for the past five years.

Year	Operating hours	Equivalent number of production days
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
2024	6,142	256
[redacted]	[redacted]	[redacted]

***Table 10**: Number of operating hours and production days 2020-2025*

The highest number of operating hours in the past six years was 6,142 in 2024, equating to around 256 production days. This highest number of production days is therefore used in this assessment to ensure a conservative approach is adopted.

Production operators working on the ETL line work 12-hour shifts, 2 days then 2 nights followed by 4 days off. Day shift runs from 6am to 6pm, night shift runs from 6pm to 6am. An operator has 36 days holidays per year. Operators on 12 hour shift patterns will work a total of 145 shifts per year.

There are approximately [redacted] employees (public range: > 600) and [redacted] (public range: > 150) permanent contractors at the site, including [redacted] Veolia contractors. During the annual shutdown there could be over 200 contractors on site at any one time.

There are four ETL production shift teams. The exposure assessment in this CSR is based on a conservative assumption of up to 10 workers per team per shift, comprising a team leader and a number of operators. One operator will spend their shift driving a coil truck moving steel coils to the loading area and will not perform any activities on the ETL line itself. The remaining operators may work on the line during their shifts, as outlined in the list below, with roles generally performed interchangeably (other than the team leader role). In practice, staffing levels are less than 10 workers per team per shift, and role allocation will vary, depending on operational requirements, maintenance activities and personnel availability, for example due to holidays or sickness absence. However, for the purposes of this CSR, a full complement of operators is assumed in order to ensure that all relevant tasks and potential exposure scenarios are captured and that a conservative approach to exposure assessment is adopted. Accordingly, the following role descriptions outline the responsibilities of up to 10 shift team members on the ETL line:

- **Team Leader:** The Team Leader is responsible for overall control of the ETL5 production line. They perform control rounds to inspect the passivation line from outside the sodium dichromate area at least once per shift (WCS 4). During the remainder of the shift, they undertake various activities in the control room (WCS 5).

- **Team Member 1:** Operators undertaking this role act as Deputy Team Leader and are based in the control room, where they remotely monitor strip quality and inspect coated material for defects (WCS 5). In the absence of the Team Leader, they assume those responsibilities, including undertaking control rounds.

- **Team Member 2:** Operators undertaking this role are responsible for monitoring the automated unloading of steel coils after processing through the ETL line, at which point the finished products are free of Cr(VI). [redacted] (WCS 6). For the remainder of the shift, the operator is typically present in the control room to support inspection activities (WCS 5).

- **Team Member 3:** Operators undertaking this role perform tasks similar to those described for Team Member 2 but at the loading stage. They are responsible for loading steel coils onto the ETL line. [redacted] (WCS 6). For the remainder of the shift, the operator is typically based in the control room to inspect coils and oversee their safe loading onto the line (WCS 5).

- **Team Member 4:** Operators performing this role are responsible for sampling the sodium dichromate solution from the passivation tank and subsequent laboratory analysis (WCS 2a and 2b). They also change anodes in the tin plating tanks, which requires accessing the ETL line during production, although this work is conducted from outside the sodium dichromate area (WCS 4). The remainder of the shift is typically spent in the control room (WCS 5).

- **Team Member 5:** Operators performing this role undertake activities similar to those described for Team Member 4, including sampling the sodium dichromate solution from the passivation tank and conducting subsequent laboratory analysis (WCS 2a and 2b). They also change anodes in the tin plating tanks, with activities conducted from outside the sodium dichromate area (WCS 4). The remainder of the shift is typically spent in the control room (WCS 5). Only one operator will typically undertake sampling and analysis during a given shift.

- **Team Member 6:** Operators undertaking this role are responsible for pre-processing of coils and coil expediting activities (WCS 6). The remainder of the shift is typically spent in the control room (WCS 5).

- **Team Member 7:** Operators undertaking this role are responsible for transporting steel coils to and from the production line using a forklift or overhead travelling crane (WCS 6). When not undertaking these activities, the operator is typically based in the control room (WCS 5).

- **Team Member 8:** Operators undertaking this role are primarily based in the control room, where they carry out visual inspection of steel coils exiting the passivation line at the inspection point (WCS 5).

- **Team Member 9:** Operators undertaking this role perform duties similar to those described for Team Member 8. They are primarily based in the control room, where they carry out visual inspection of steel coils exiting the passivation line at the inspection point (WCS 5).

The production shift teams will also carry out various maintenance activities themselves during the 3-weekly maintenance periods (WCS 7), given there is no production for part of these days and the contents of the passivation tank are dropped into the basement circulation tank. In addition, maintenance activities are carried out by dedicated **mechanical technicians**, **electrical technicians** and **cleaning staff** (WCS 7), a mix of contract staff as well as the applicant's employees. Unlike the production operators, they work an 8hr shift.

Veolia run the WWTP with the following roles relevant to Cr(VI) activities:

- **Operator Technician**: This operative is responsible for operating and monitoring the plant, ensuring the WWTP operation is running within the site's permit requirements and in line with all relevant operating procedures (WCS 8). This operative will also assist in routine testing of plant and equipment and carry out analytical laboratory testing of samples throughout the shift.

- **Maintenance Technician**: The maintenance technician is responsible for the service, operation and maintenance of plant and equipment to keep operations running (WCS 8).

The supplier's **delivery driver** is responsible for the delivery of sodium dichromate to the site, then transferring it from the IBCs into the bulk storage tank. While the activity is monitored by one of the applicant's shift team members, the coupling/decoupling of the hose from each IBC to the bulk storage tank is undertaken by the delivery driver (WCS 1a). However, in the future when sodium dichromate will be supplied by a different supplier and by road tanker rather than in IBCs, the delivery driver will remain in the vehicle at all times during the delivery. One of the team members will couple and decouple the hose from the road tanker to the new bulk storage tank, which is currently under construction (WCS 1b).

The following 'similar exposure groups (SEGs) have been identified for workers involved in Cr(VI)-related activities, which are summarised in Table 11 below:

1) SEG 1: Team leader and team leader deputy (when assuming the team leader role)
2) SEG 2: Operators performing team member 4 and 5 roles
3) SEG 3: Operators performing team member 1-3 and 6-9 roles
4) SEG 4: Maintenance operators:
    a. Production shift team operators undertaking maintenance activities
    b. Dedicated maintenance workers (employees and contractors)
5) SEG 5: WWTP operators
6) SEG 6: Cleaning staff responsible for desludging the basement circulation tank
7) SEG 7: Delivery driver (although only under the current arrangements for the delivery of sodium dichromate to the site)

SEG	Profile	WCS	Number of workers per SEG	Shift system
SEG 1	Team leader (or team leader deputy)	4, 5	4	12h
SEG 2	Operators performing team member 4 and 5 roles	1b, 2a, 2b, 5	8	12h
SEG 3	Operators performing team member 1-3 and 6-9 roles (including deputy team leader)	1b, 5, 6	28	12h
SEG 1 to SEG 3 = ETP production shift team			*40*	*4 teams of up to 10 persons*
SEG 4	a. Tata Steel production operators performing maintenance duties	7a	36	12h
	b. Dedicated maintenance workers (Tata Steel employees and contractors)	7a	21	8h
SEG 5	Wastewater treatment plant operators (Veolia employees)	8a, 8b	8	12h
SEG 6	Cleaners responsible for desludging the basement circulation tank	7b	2	8h

SEG 7	Delivery driver (under current delivery arrangements only)	1a	1	8h

***Table 11**: Similar exposure groups for workers involved in Cr(VI)-related activities*

SEG 3 contains different team member profiles, each having different activities. However, they are all combined within one SEG because all of the operators performing roles within this SEG can carry out each role interchangeably, being fully trained on each. For example, on one shift an operator may work at the entry-end, while on the next they may then operate the crane or inspect coil at the exit end. Any one individual worker can therefore perform all these tasks. These tasks do not involve access to the passivation area, e.g. to take samples, and are therefore remote from Cr(VI) emissions sources.

Operators performing team member 4 and 5 roles (anode attendants) are also interchangeable roles across the production shift team (other than the team leader and deputy). However, they have a separate SEG (SEG 2) because these operators will enter the passivation area wearing additional PPE ('full chromium PPE' – see section 9.1.7.6) to undertake sampling.

Similarly, the team leader (and deputy team leader when undertaking team leader duties) has a separate SEG (SEG 1) – while they do not need to enter the passivation area to perform their work, it involves being closer to this section of the line than other production shift team members. The other shift team members will remain more remote from Cr(VI) emissions sources when undertaking their respective roles, thus can be combined into one SEG (SEG 3).

SEG 4 includes operators who are only potentially exposed to Cr(VI) when participating in maintenance activities on the ETL5 line (and even then, within the passivation section). The SEG differentiates between Tata Steel production shift team operators who will perform certain maintenance duties during the 3-weekly maintenance events (employees) and dedicated maintenance operators (a mix of employees and contractors). While the risk management measures for maintenance activities they perform are the same, they are sub-divided because their shift lengths, frequency of performing the activities and job roles differ.

9.1.5 Overview of exposure scenarios

Listed below are the exposure scenarios (ES) and contributing scenarios assessed in this CSR.

Identifiers	Titles of exposure scenario	Tonnage (tonnes per year)
ES 1 – IS 1: Use at industrial sites	Use of sodium dichromate for the passivation of tin-plated steel (ETP)	[redacted] (public range: 10-20)

***Table 12**: Overview of exposure scenarios*

Contributing scenario	ERC / PROC	Name of the contributing scenario
ECS1	ERC5	Industrial use of sodium dichromate for the passivation of ETP
WCS 1	PROC 8b	Receipt and storage of sodium dichromate
WCS 2	PROC 9	Sampling and analysis of the passivation solution
WCS 3	PROC 1	Adding sodium dichromate to the circulation tank
WCS 4	PROC 13	Passivation
WCS 5	PROC 0	Control room activities
WCS 6	PROC 0	Loading and unloading of steel coils

Contributing scenario	ERC / PROC	Name of the contributing scenario
WCS 7	PROC 28	Maintenance activities
WCS 8	PROC 8b, PROC 9	Waste management including wastewater treatment

Table 13*: Overview of Contributing Scenarios*

9.1.6 Tonnage information

The tonnage information has been calculated on the basis of the quantity of sodium dichromate used in production each year. This is shown in Table 14 below. The values presented in the first row represent the quantity of product used (sodium dichromate in aqueous solution). The second row then represents the corresponding quantity of sodium dichromate used (i.e. excluding the water fraction). The third row then reflects the hexavalent chromium (Cr(VI) content.

[redacted]

Table 14*: Tonnage (tonnes/year) of sodium dichromate used at the Trostre Works for the ETL process*

The values in the table above are based on calendar years. However, in recent years, the highest quantity consumed was across a financial year rather than a calendar year – [redacted] of product in the financial year 2018/2019. This equates to [redacted] of sodium dichromate (i.e. less water) as the product used to date is an aqueous solution of sodium dichromate at 60% concentration.

However, as previously discussed, the applicant's supplier will soon change and the product purchased from them will be at a 70% concentration. [redacted] of product at this higher concentration equates to [redacted] (public range: 10-20 tonnes) of sodium dichromate, or [redacted] Cr(VI), which is used as the assessed annual tonnage for the purposes of this application. This higher quantity also accounts for any potential future increase to the consumption of sodium dichromate, e.g. in response to increased customer demand or in the event of an increase in surface area passivated due to greater width of finished products.

9.1.7 Overview of risk management measures

Operational conditions (OCs) and risk management measures (RMMs) are optimised to minimise worker and environmental exposure. OCs and RMMs are specific to each activity and described in further detail in the contributing scenarios in section 9.2 below.

A summary of the various RMMs utilised by the applicant is provided below.

9.1.7.1 Process control system

The ETL5 line operates under automated control using a combination of CEGELEC Gem 80, Siemens S7-1500 and RXi PLC systems, supported by various drive technologies including Gem Micro drives, ABB DCS800, ACS880, ACS580 and Sami drives. Plating rectifiers are supplied by CEGELEC or AEG and are managed via Micro drives or a Modicon PLC. Each plating tank is capable of handling up to 9,300 amps. Production is primarily automated, although operators have the ability to adjust parameters or deselect tanks when required. Process instrumentation is managed through a Eurotherm PC, which monitors and controls key variables such as flow rates, temperature, conductivity and chemical dosing. The system allows for both automatic and manual dosing control to ensure process stability and compliance with specifications.

As such, the site's process control systems present a number of health, safety and environmental benefits. The level of automation minimises the time required for operators to be present on the production line, thereby reducing exposure. The system also maintains operating parameters such as temperature, conductivity, flow etc more consistently, reducing the likelihood of human error, ensuring more efficient use of chemicals and reducing waste. The system will also detect and either alarm or act on deviations far more quickly and can incorporate safety interlocks, e.g. requiring the use of LEV for line operation.

9.1.7.2 Local exhaust ventilation (LEV)

While each section of the ETL5 line has its own extraction system, there is one LEV system relevant to Cr(VI), which serves the passivation tanks (above and below). This Cr(VI)-relevant LEV feeds into one common extraction duct into a wet scrubber before discharging up a stack.

LEV is positioned both above the tanks, in the form of receiving (canopy) hoods that cover the liquid surface of the tanks (see Figure 14), and below the tanks, installed to capture droplets or heavier particles that might be entrained in air currents near the tank base or otherwise accumulate in lower areas.

[redacted]

Figure 14*: LEV system to ETL5 passivation tanks*

No LEV is present to the basement circulation tanks as these are totally enclosed and isolated from the production line.

The LEV is electrically interlocked with the process line. This means that the electric current to the passivation tanks can only be switched on when the LEV is operating. If the LEV fails, the electric current to the process automatically switches off.

The LEV system is subject to regular routine inspections by suitably trained engineering personnel and an annual thorough examination by a competent third-party service provider.

All extracted air passes through a wet scrubber system (Figure 15) for removal of Cr(VI) from the air stream before external emission. Exhaust air is passed through a water spray and aerosols and dusts in the exhaust air are entrained with the water droplets. The water droplets are then separated from the air by a droplet separator (mist eliminator) as they are forced through, and collide with, a series of baffles. Cr(VI)-containing scrubber water is directed to the ETL5 chromium sump for subsequent batch reduction of Cr(VI) to Cr(III) in the WWTP.

***Figure 15**: Stack serving the ETL5 line (L), wet scrubber attached to stack (R).*

Scrubber water is automatically topped up (refreshed) via a level controller and completely replaced during every 3-weekly maintenance event. The scrubber undergoes a deep-clean every annual shutdown, where all packing is removed, pressure washed and then refitted, with the system filled with fresh water.

Exhaust air from the LEV system is discharged at height from the ETL5 stack. This stack is approximately 27.5m above ground level with a diameter of 1.36 m.

9.1.7.3 Primary containment

Primary containment of sodium dichromate is achieved through selection of appropriate materials of construction for tanks and pipework. Pipework conveying sodium dichromate is constructed from glass reinforced plastic/polymer pipe (GRP). The ETL5 chrome sump to effluent pipework is constructed from high grade (316) stainless steel. Pumps are constructed of R55 alloy, a high-performance, corrosion-resistant alloy designed for use with high temperature mixed acids. A risk-based inspection study has previously been conducted on the tanks and associated pipework within Area 3 (the Coatings Section) at the site which undertook an in-depth analysis of the materials employed within each system and the maintenance regime employed and verified the appropriateness of these materials of construction. The chrome sump is sited in a separate room to the production line, and any potential losses from the line of circulation tanks would be contained in this room.

The pipe run to the effluent plant is inspected weekly under a SAP-based maintenance management system. Line and basement pipework is not covered by specific scheduled inspection jobs. However, there are scheduled basement inspection jobs 4 times per day, which would highlight any failures in the system see below. The sodium dichromate pipework within the basement is contained within the bunded area and, therefore, any leaks that may occur would be contained within that bund.

All line process tanks are inspected with a scheduled job annually. Sink roll seals are checked and measured for wear during the maintenance shutdown every 3 weeks by the applicant's site maintenance team. There are also 'running line' inspections undertaken. These will include inspections such as circulation tanks and pumps, process pipework and valves, rinse circulating tanks and pumps, rinse pipe work, valves and heat exchangers, which are undertaken once per week.

The ETL5 line tanks are filled from the bottom, until the liquid level reaches a fixed weir return in each tank. The liquid overflows into the weir and enclosed pipework, flowing into a common return pipe for all passivation tanks into the basement circulation tank. The weir return fixed position is 415mm from the top of the tank. This system ensures no splashing when filling a tank, thereby reducing exposure, as well as maintaining a consistent freeboard distance at all times and eliminating the risk of an overfill leading to a loss of containment.

A procedure is in place governing the arrangements for transferring solution from the basement sump to the wastewater treatment plant, which includes obtaining confirmation that there is sufficient capacity in the receiving tank for the solution transfer.

Level instruments are present in the circulation tank and all bulk tanks in the WWTP tank farm and will alarm to their respective control rooms if the liquid level is too high.

9.1.7.4 Secondary containment

Any liquid deposited into the basement drains into the sump. Should the level rise above the sump, a bund wall provides further containment. Any failure of a circulation tank or associated pipework within the basement would also be contained within the basement bund, the volume of which is well in excess of 110% of the volume of the largest tank. The flooring is acid-resistant tilework on the top layer.

Any loss from the passivation section on the mill floor level (e.g. leaks or rupture of line tanks or associated pipework) would result in the liquid being channelled back into the sump in the basement. The pipework running to the WWTP is outside of the bunded area, but within the confines of the Works basements, meaning any losses will still be contained. Bund inspections are currently undertaken as part of routine maintenance activities within this area.

Bunding is provided to bulk tanks in the WWTP tank farm (see Figure 16) which can contain over 110% of the volume of the largest vessel present. Discharges from the bunded areas are directed to the inlet to the effluent treatment collection sumps or, in the case of Cr(VI), back into the sodium dichromate bulk storage tank. Pipework conveying Cr(VI)-relevant wastewater that runs from ETL5 to the WWTP has been upgraded to a fully welded stainless steel run, incorporating only two flanges, both located within fully bunded areas. The pipe run is inspected on a weekly frequency by competent engineering personnel. Work is generated automatically via the SAP-based management system, which requires inspection feedback before the job can be highlighted as complete in the SAP system.

The sodium dichromate bulk tank is also bunded (visible in Figure 7) and any releases in this area would be confined. The bulk tank currently under construction to receive sodium dichromate from the applicant's new supplier will not be bunded but is instead double-skinned, with an alarm in the interior to alert operators to any loss of containment from the inner tank.

Figure 16*: Tank farm in WWTP showing secondary containment (bunding)*

9.1.7.5 Access restriction, including sodium dichromate area decontamination block

Organisational measures in place include limiting access to specific areas, for example, entry to certain plant areas is restricted by use of signage (see Figure 17 below).

Figure 17*: Examples of access restrictions and signage (left), the chromic acid area (middle) and the decontamination block (right)*

Additional precautions are in place where Cr(VI) exposure can potentially occur, namely the area in the basement where the circulation tank is located and the area on the mill floor where the line passivation tanks are located. This area, segregated by blue walls, is known as the 'chromic acid area' and an example is visible in Figure 17 above.

Entry to the chromic acid area is restricted to trained and authorised personnel wearing full chromium PPE (see section 9.1.7.6 below for details). Access to this area requires first using the ETL5 decontamination block (see Figure 17 above). The decontamination block contains a unique isolated changing/shower room utilised when carrying out work in sodium dichromate areas.

Disposal of single use PPE is via a chute into a dedicated bin and reusable PPE is kept in lockers on the line side. Once full, the contents of the bin are disposed of as hazardous waste by a specialised waste handling company.

9.1.7.6 Personal protective equipment (PPE)

As a minimum, protective clothing (high visibility with covered arms), a safety helmet, safety footwear, hearing protection and protective eyewear are required to be worn for all activities on the factory floor. Protective clothing (trousers and jackets) is laundered by a third party although no clothing used in the chromic acid area is sent for laundering.

Figure 18*: Minimum PPE requirements for entering Trostre Works production areas*

When entering the chromic acid area, additional PPE must be worn, referred to as 'full chromium PPE'. This consists of chemical resistant gloves, respiratory protective equipment (RPE), a chemical protective suit (coveralls) and a pair of safety Wellingtons. These are described in further detail below.

The specific worker contributing scenarios (WCS) provide further details of the PPE that is used during each activity.

Workers are skilled operators and receive training as regards to how to properly wear PPE, including training in how to safely remove gloves that might be contaminated with Cr(VI). The PPE used complies with legislative requirements, relevant British standards and Tata Steel internal procedural requirements.[5]

<u>Protective clothing required for entry into sodium dichromate area</u>

Operators entering the chromic acid area must wear a single use disposable coverall, typically the DuPont Tychem 6000 F hooded coverall. This has an elasticated face, wrists, waist and ankles for an optimal fit. The

[5] For example, legislation such as the Personal Protective Equipment at Work Regulations 1992, standards such as BS EN 374 for gloves or BS EN 149 for RPE, and Tata Steel procedures such as the Area 3 PPE Standard and the Trostre RPE policy.

coverall offers 480 mins permeation time (tested against chromic acid). The coveralls are disposed of after each use.

Protective footwear required for entry into sodium dichromate area
Operators entering the chromic acid area must wear a pair of safety Wellingtons, typically a pair of Blackrock Safety Wellingtons (model no. SF43) to BS EN 20345:2022. These are of waterproof PVC nitrile construction with a protective steel toecap, a protective steel midsole and a kick spur on the heel for easy removal. The sole is anti-slip, anti-static and fuel oil resistant. The footwear is left in lockers on the line side of the decontamination block when not in use.

Protective gloves required for entry into sodium dichromate area
Operators entering the chromic acid area must wear chemical resistant gloves, typically a pair of AlphaTec Solvex 37-185 gloves to BS EN 374-1:2016 (Type A) which offer protection against inorganic mineral acids (amongst other substances). These are nitrile gloves with a thickness of 0.56mm, proving shielding up to the elbow. They offer a breakthrough time of 165 mins (palm, tested against sulphuric acid 96%). The gloves are disposed of after each use.

Respiratory protective equipment (RPE) required for entry into sodium dichromate area
Operators entering the chromic acid area must wear a tight-fitting full-face mask, typically a 3M Reusable Full Face Mask (Model 6000 series) to BS EN 136:1998, together with a P3 particulate filter, typically a 3M Particulate Filter (model no. P3 R, 2135) to EN 143:2021. These provide an assigned protection factor (APF) of 40. Filters are changed at least once in every three months. The replacement of the filters is logged and managed in the central SAP system.

***Figure 19**: RPE worn within the sodium dichromate area*

Workers (both employees and contractors) receive specific training in the correct way to don and use RPE. Operators are trained and instructed to carry out an inspection before every use, checking for cleanliness, contamination, damage or cracks. More thorough inspections and examinations are carried out in line with the manufacturer's instructions at a frequency not exceeding 12 weeks. Inspection work orders are generated within the SAP maintenance system and require positive feedback to complete the work orders.

RPE is stored in lockers on the line side of the decontamination unit, placed in the bag supplied with the mask, to ensure the masks remain clean and are not damaged whilst not in use.

Any employees who are required to wear tight-fitting RPE must undertake a face fit test before using the equipment, to ensure that there is a good, efficient seal around the face. Facepiece fit testing is conducted for all tight-fitting facepieces to relevant good practice.[6] Face fit testing is repeated every two years or more frequently if the individual has had a significant change in weight or facial shape. The site has a clean-shaven policy under which employees wearing tight-fitting RPE must have shaved within the past 24 hours.

9.1.7.7 Information, instructions and training

All operators are skilled workers, who receive regular training with regards to chemical risk management and on the use of PPE. The team leader is responsible for supervision and those receiving training will be required to sign off after training to confirm attendance.

[6] HSE, 2013.

Employees and contractors who, given the nature of their work, have a potential for exposure to Cr(VI), especially workers who carry out tasks within the sodium dichromate area, will receive information, instructions and training regarding:

- The identity, characteristics and exposure mechanisms of sodium dichromate.
- Related risks to their health and safety.
- The application of control measures and precautions they must take to protect themselves and other employees.
- Requirements for PPE/RPE, including information about what the PPE is designed to avoid or limit, the manner in which it is to be used including how to put it on and how to safely remove it, how to store and maintain it, and how it should be disposed of.
- Associated safe working procedures, defining how to safely undertake a task or set of tasks.
- Emergency procedures to deal with accidents and incidents.
- The importance of, and the arrangements for, reporting of identified hazards.

Signage is displayed at key areas, e.g. entrances to production areas, around the sodium dichromate area, in the laboratory, at the WWTP etc, displaying information on hazards and required precautions, including what PPE must be worn – see Figures 17 and 18 as examples.

Eating and drinking is prohibited throughout the production area and in all associated laboratory / storage areas. Employees are also instructed to wash their hands thoroughly when moving in and out of the sodium dichromate area via the decontamination block.

9.1.7.8 Procedures

The applicant maintains strict health, safety and environmental standards, driven both by internal Tata Steel requirements and external regulatory requirements. For example, the Trostre Works qualifies as a lower-tier COMAH establishment and operates under an environmental permit issued by NRW under the EPR. This results in the use of formal procedures (safe working practices) aimed at continuous improvement, including on health, safety and environmental exposure during Cr(VI) activities. These are underpinned by robust management systems, certified in accordance with a number of industry, quality and environmental standards (see section 9.1.1).

Internal procedures require all processes to be well-documented. This is managed using the applicant's electronic quality, safety and environmental databases. Workers are trained on all relevant procedures with records kept, both at the start of a new job role and through regular refreshers. The correct implementation of these procedures is checked by supervision and an internal audit system. Specific procedures are in place to handle emergencies and incidents (recording of near miss accidents, accidents and injuries).

As well as factory-wide work instructions (safe working practices or SWPs), procedures and instructions are in place specifically relating to Cr(VI) that cover delivery and storage, sampling and analysis, entering and leaving the decontamination block, chromium sump control, maintenance activities, sampling of wastewater and batch reduction. In addition, the applicant has an overall 'Risk Control Standard: Managing the Risks of Hexavalent Chromium Compounds' which defines the health and safety requirements for the safe use of Cr(VI) compounds, specifically chromium trioxide (chromic acid) and sodium dichromate, used within the applicant's facilities.

As well as internal inspections, the applicant also uses an external third-party service provider to conduct compliance audits.

9.1.7.9 Emergency response

A spills procedure is in place at the Trostre Works. Minor spills will be cleaned up locally within the relevant functional departments either using dedicated cleaning machines or appropriate materials from spill kits.

Recovered material will be placed in an appropriate container and disposed of as hazardous waste. The clean-up must be coordinated by the team leader or engineering coordinator in conjunction with the area cleaner. For larger volumes of spills, the WWTP on-site tanker would be used, and material would be disposed of via the WWTP after appropriate treatment. In such cases, the treatment would be determined and approved by the WWTP management team and the applicant's environmental team.

As a COMAH site, an on-site emergency plan is in place, covering how to respond to major accidents involving sodium dichromate. The plan includes protocols for immediate response actions, coordination with emergency services, and communication strategies to inform and protect employees, the public, and the environment. It outlines the responsibilities of personnel taking on specific emergency response roles, specifies the resources and equipment available for emergency response, and includes measures for medical treatment and evacuation.

The site has a purpose-built Medical Centre which is primarily to cater for the provision of occupational health services by the on-site occupational health nurse. The Medical Centre can also cater for first aid provision pending the arrival of the emergency services. First aid equipment, such as first aid kits, eye wash stations and emergency showers, are located across the site.

9.1.7.10 Atmospheric (stack) emissions monitoring

Stack emissions monitoring is undertaken annually by a specialist third-party contractor providing accredited UKAS and Monitoring Certification Scheme (MCERTS) air quality monitoring and consultancy services.

Under the site's environmental permit, there are no emission limits for total chromium or hexavalent chromium from the stack serving the Cr(VI)-related extraction system on ETL5 and no routine monitoring is required, but emissions are measured annually for other reasons, including the need to observe the conditions of the applicant's existing authorisation. Monitoring for total chromium is conducted to BS EN 14385:2004 supplemented by the relevant Methods Implementation Document (MID), and sampling and analysis are UKAS/MCERTS accredited.

The results of the last four years' monitoring campaigns (2025, 2024, 2023 and 2022 calendar years) are presented in Appendix 1. The reported emissions are for total chromium (Cr), rather than Cr(VI) specifically. The applicant has made extensive efforts to directly measure Cr(VI) in stack emissions. However, these efforts have been unsuccessful to date, with results characterised by high variability, likely due to the absence of validated techniques and standards for Cr(VI) measurement in atmospheric emissions from passivation tanks. While US EPA Method 0061 is referenced by Environment Agency guidance[7] as a standard for monitoring hexavalent chromium emissions, this was originally developed for incineration plants, which typically involve high-temperature combustion processes and different emission characteristics compared to passivation or electroplating operations. Passivation with sodium dichromate involves aqueous chemistry and lower-temperature processes, which can significantly affect the speciation and behaviour of chromium in emissions.

The US EPA guidance[8] finds that Cr(VI) is expected to constitute only a small proportion of total Cr in atmospheric emissions (it states "air emissions of chromium are predominantly of trivalent chromium…"). However, this is a general statement and does not provide any source-specific information. Accordingly, the applicant plans to continue its efforts to identify a suitable method to measure directly the Cr(VI) stack emissions reliably at the Trostre Works. In the absence of specific data on Cr(VI) emissions, emissions of total Cr are used. This is a conservative approach and will clearly overstate the concentrations of Cr(VI) in emissions to atmosphere from the site.

[7] Environment Agency, 2025.
[8] Environmental Protection Agency, 2000.

The sampling limit of detection (LoD) is influenced by several factors, including the target analyte (total chromium), the sensitivity of the selected analytical method, the stability of the analyte during and after sampling and the sampling duration and sample volume. As a result, the LoD can differ for each stack and between years. In addition, field blank samples taken using the same equipment and procedures as the actual samples can yield higher concentrations. Field blanks are a critical quality control measure, designed to detect contamination introduced during equipment preparation, transport, installation and laboratory handling. Under NRW's MCERTS guidance, it is not acceptable to report a sample result that is below the corresponding field blank value. Therefore, the field blank result may become the *de facto* sampling LoD.

9.1.7.11 Occupational (worker) exposure monitoring

The applicant carries out its own in-house worker exposure monitoring campaigns over 2-3 days on an annual basis at the Trostre Works. Monitoring comprises a combination of personal and static sampling designed to cover the majority of WCS. Samples are then sent for analysis to a specialist third-party laboratory accredited to ISO/IEC 17025:2017. The LOD quoted by the laboratory is 0.01 micrograms (µg) per sample.

Personal exposure and static background monitoring is undertaken following the HSE guidance note HSG 173 *"Monitoring Strategies for Toxic Substances"*, Methods for Determination of Hazardous Substances (MDHS) 14/4 *"General methods for sampling and gravimetric analysis of respirable, thoracic and inhalable aerosols"* and British Standard ISO 16740 *"Workplace air – Determination of Hexavalent Chromium in airborne particulate matter – Method by ion chromatography and spectrophotometric measurement using diphenyl carbazide"*. Sampling is undertaken using Casella Apex 2 or Gilair sampling pumps, with pre- and post-sampling flowrate checks undertaken using a Mesa Labs Defender 510-H.

For personal exposure monitoring, equipment such as Casella Apex 2 pumps with IOM samplers fitted with a 25mm alkaline-treated tissuquartz filter are typically used. These are affixed to operators via a harness, with the IOM sampler positioned at the shoulder of the operator within their breathing zone. For static background monitoring, sampling pumps fitted with a 25mm two-part cassettes containing a 25mm tissuquartz filter are typically used, positioned in locations around the passivation section. Field and laboratory blanks are also prepared per sampling day and submitted for analysis.

The applicant has an in-house Cr(VI) exposure limit, referred to as the Tata Risk Control Standard Limit Value (SLV). This is set at a tenth of the workplace exposure limit (WEL) established under COSHH, i.e. the SLV is set at 0.001 mg/m^3 (1 µg/m^3) over an 8hr time-weight average (TWA).

***Figure 20**: Static Cr(VI) sampler for ETL5*

The results of worker exposure monitoring are presented at Appendix 2 for the previous four years (2025, 2024, 2023 and 2022 calendar years). These demonstrate that exposure is low, consistently under 1 µg Cr(VI)/m^3 8hr TWA, indicating that Cr(VI) exposure is well controlled.

In the event that a personal sampling result is obtained that exceeds the site's internal (SLV) limit, the relevant Area manager is responsible for carrying out an investigation using an airborne Cr(VI) investigation proforma.

In addition, the site has static monitors performing continuous 24hr analysis at certain locations around the sodium dichromate areas (see Figure 20 for an example).

9.1.7.12 Biological monitoring

The applicant performs annual biomonitoring for workers potentially exposed to Cr(VI), such as production operators, maintenance technicians and cleaners on the production line and at the WWTP. During such campaigns, urine samples are taken at the start and at the end of the shift after the worker had worked for at least 4 consecutive working days. 50-100 mL urine samples are collected. ETL5 results in 2025 were an average of 0.24 µmol/mol creatinine for production operators (maximum recorded value was 0.3 µmol/mol), compared against a UK biological monitoring guidance value (BMGV) of 10 µmol/mol. This indicates exposure is well controlled.

9.1.7.13 Health surveillance

All employees potentially exposed to Cr(VI) are subject to health surveillance, undertaken by the site's occupational health adviser (a qualified occupational health nurse) based at the site's Medical Centre. The regime includes:

- A baseline health surveillance health check, required before work begins with Cr(VI).
- Periodic self-completion of a chromium health surveillance questionnaire. Staff are trained to know what to look for, how to record and report results and what they should do if they suspect a problem. In the first year of exposure, more frequent checks occur and are supported by the occupational health nurse.
- Health surveillance checks/examination and consultation with the occupational health nurse occurs after 6 weeks and then on a 3-6 month basis. This involves the use of a specific health questionnaire, lung function testing and nasal and skin inspection. Based on satisfactory results from these assessments the interval period is then extended to annual.

9.1.7.14 Waste management: wastewater

Wastewater is routed to the WWTP which is currently managed by Veolia. Detailed information on operation of the WWTP is provided in section 9.1.2.4 above, though in summary, wastewater containing Cr(VI) is pumped from the ETL5 basement sumps into the tank farm for controlled treatment using ferrous sulphate to reduce Cr(VI) into Cr(III). Reducing agents are dosed to wastewater over-stoichiometrically to ensure full reduction.

Effluent leaving the tank farm is monitored for Cr(VI) using a colorimetric analyser prior to joining the main effluent flume. The concentration of Cr(VI) is determined after colorimetric reaction with diphenyl carbazide (detection limit 0.01 mg/L). The WWTP processing pumps are interlocked to the Cr(VI) analysers meaning that, on detection of Cr(VI), the processing pumps would automatically stop to prevent any contamination entering the treated effluent stream. Any Cr(VI)-contaminated raw effluent would then be diverted into a standby lagoon for further reduction and testing prior to rejoining the main effluent stream.

The treated effluent stream is then discharged into the main flume along with wastewaters from the wider works into one of three holding lagoons. The mixed effluent then undergoes further treatment, such as neutralisation and clarification, before discharge within environmental permit limits.

A composite sampler is used to collect a representative 24 hour sample of the treated effluent discharged to the Loughor Estuary which is analysed to ensure that it meets the conditions laid down in the discharge consent, part of the EPR permit issued by NRW. This includes analysis for Cr(VI) and for total chrome (the current discharge consent levels include 0.4 mg/l maximum for total chromium).

Results of wastewater sampling are provided in Appendix 3 for the previous four years (2022 to 2025 calendar years). This demonstrates that chromium and Cr(VI) emissions have always been within permitted levels. Indeed, the site has not recorded any discharge consent breaches throughout its history (and no Cr(VI) has been detected in treated effluent discharged to the estuary). In addition to the site's own monitoring on a daily basis, NRW visits at least once per month and this includes sample collection from the composite sampler and subsequent analysis at a NRW laboratory.

9.1.7.15 Waste management: solid wastes

Sodium dichromate is delivered in liquid form in intermediate bulk containers (IBC's) (and, in the future, will be delivered from a road tanker) directly into a bulk storage tank. There is no solid waste generated in this process as the delivery vehicle removes the IBCs from the site once the delivery of sodium dichromate is complete.

Single-use disposable PPE, together with other materials that could potentially be contaminated with Cr(VI) such as cloths or rags are placed in a dedicated bin and disposed of as hazardous waste.

***Figure 21**: Filter presses in the WWTP*

The by-products produced during the effluent treatment process in the WWTP are compressed into a filter cake. This compacted sludge has historically been sent to the applicant's Port Talbot site as a recyclable product although, as the blast furnaces at Port Talbot are now shut down, it is currently being disposed of as waste. Two 128 plate filter presses are used (see Figure 21), each discharging around 8 tonnes per day. Weekly analysis of the filter cake conducted during 2024 and 2025 included analysis for the presence of Cr(VI), as well as chromium and other metals. No Cr(VI) was detected, which is to be expected given the reduction process that occurs as part of Cr(VI) wastewater treatment, described above.

9.1.8 Introduction to the assessment

A CSR prepared for an application for authorisation needs only address the risks posed by the hazardous properties of the substance that are listed in Annex XIV of REACH. Sodium dichromate[9] was placed on Annex XIV due to its harmonised classification of Carcinogen cat. 1B; H350, Mutagen cat. 1B; H340 and

[9] Entry no. 18 of Annex XIV of REACH covering sodium dichromate also covers sodium dichromate dihydrate (CAS no. 7789-12-0), which is not registered under EU REACH (and therefore not grandfathered as a UK REACH registration), nor does it have mandatory classification and labelling under CLP. Should it be used, the applicant will treat it as if it were also classified in the same way as its anhydrous form. In this case, the molecular weight fraction of 0.40 for sodium dichromate will continue to be used. This is conservative, because sodium dichromate dihydrate has a higher molecular weight (298 g/mol) with a lower Cr(VI) fraction (0.35) than sodium dichromate.

Reproductive Toxicity cat. 1B; H360FD. Therefore, only the human health risks related to the classification of sodium dichromate as carcinogenic, mutagenic and toxic to reproduction are addressed in this CSR. This requires assessing the potential exposure of workers as well as the potential exposure of humans via the environment.

The molecular entity that drives the carcinogenicity of sodium dichromate is the Cr(VI) ion which is released when sodium dichromate solubilises and dissociates. Cr(VI) can cause lung tumours in humans and animals by the inhalation route (through inhalation of dust and/or aerosols) and tumours of the gastrointestinal tract in animals by the oral route. These are both local, site-of-contact tumours – there is no evidence that Cr(VI) causes tumours elsewhere in the body.

Based on studies which show its genotoxic potential, the Risk Assessment Committee (RAC) has concluded that sodium dichromate should be considered as a non-threshold substance with respect to risk characterisation for the carcinogenic effect of hexavalent chromium.[10]

RAC has established a reference dose response relationship for the carcinogenicity of hexavalent chromium and this will be used in the risk assessment by the applicant. It was noted that the dose-response relationship for intestinal cancer is lower than that for lung cancer, and ingestion is generally not considered an important exposure route for workers. RAC did not identify cancer risks after dermal exposure for workers or the general population. The risk assessment will therefore focus on inhalation exposure of workers and oral and inhalation exposure for the general population.

As mutagenicity is a mode of action expected to contribute to carcinogenicity, the mutagenic risk is included in the assessment of carcinogenic risk, and low risks for mutagenicity are therefore expected for exposures associated with low carcinogenic risks.

Sodium dichromate is also included in Annex XIV because of its reproductive toxicity, for which reference DNELs have been derived for both fertility and development for workers and the general public. For workers, only inhalation and dermal DNELs have been established. For the general public, inhalation, dermal and oral DNELs have been set, although dermal exposure of humans via the environment is considered very unlikely. The risk assessment will therefore focus on inhalation and dermal exposure to workers and inhalation and oral exposure for the general public. For the assessment of the potential risk to reproduction (fertility as the most sensitive endpoint), the risk characterisation ratios for exposure of workers and the general population are based on the DNELs derived by RAC for effects on fertility.

In addition, in this CSR, the applicant will demonstrate minimisation of emissions through the use of suitable risk management measures (RMMs). Evaluation of any potential hazards to the environment is not required within the framework of this application. However, measures to prevent or limit release of Cr(VI) to the environment are provided as best practice at the site carrying out operations using sodium dichromate are provided. Health hazards which may potentially relate to Cr(VI) exposure of the general population via the environment are also considered accordingly.

9.1.8.1 Environment

Sodium dichromate is classified as Acute and Chronic Aquatic Toxic cat. 1 (respectively H400 and H410). These endpoints are not specified in the entry for sodium dichromate in Annex XIV of REACH. In addition, Cr(VI) from sodium dichromate is expected to be reduced to Cr(III) under most environmental conditions,[11] limiting any potential impact of Cr(VI) to the immediate vicinity of the source, and the passivation of ETP is characterised by a high degree of enclosure from an environmental perspective.

[10] Reference to the studies examined are included in the RAC document RAC/27/2013/06 Rev. 1.

[11] ECB, 2005.

Therefore, the direct effects and risks to the environment resulting from environmental release are not evaluated in detail. However, the emissions and resulting exposure to the environment that are relevant in the context of risks for 'humans via the environment' are described in detail in the section below.

9.1.8.2 Humans via the environment

Since only endpoints for which authorisable substances are included in Annex XIV need to be addressed when applying for authorisation under REACH, the focus of this assessment relates to the carcinogenicity, mutagenicity and reproductive toxicity endpoints as per the Annex XIV entry for sodium dichromate.

Humans may potentially be exposed to Cr(VI) via the environment, even though strict emission control measures are in place to avoid emissions towards all environmental compartments. The only relevant *direct* exposure path is via the air, through inhalation, while *indirect*, oral exposure can occur via food and water. Dermal exposure is not considered to be a relevant route of exposure for carcinogenicity and, while it is a relevant route of exposure for reproductive toxicity, dermal exposure of humans via the environment is considered very unlikely.

With respect to oral exposure of humans via the environment, it is important to recognise that Cr(VI) undergoes rapid reduction to Cr(III) in many environmental compartments. Consequently, estimations of human exposure based solely on the release of Cr(VI) into the environment are likely to significantly overstate actual exposure levels. Additionally, many environmental modelling parameters, particularly partition coefficients, are derived using the octanol-water partition coefficient (log Kow), a metric that is not applicable to inorganic substances such as Cr(VI). As a result, partition coefficients calculated using log Kow are not scientifically valid for Cr(VI).

In addition, data on the presence of Cr(VI) in food are limited.[12] In most studies, only total chromium concentrations were measured, with few investigations attempting to speciate chromium. Where speciation was conducted, Cr(VI) typically accounted for less than 10% of total chromium, with reported ranges between 1.31% and 12.9%. Some studies suggest that Cr(VI) is absent in food of plant origin and that any detected levels may be artefacts of the analytical method. This may also apply to food of animal origin. Based on these findings, the EFSA CONTAM Panel concluded that the available data do not support the presence of Cr(VI) in food and decided to treat all reported chromium concentrations in food as Cr(III). The Panel further noted that chromium ingested via food can be assumed to be entirely in the trivalent form, in contrast to drinking water, where Cr(VI) may be present due to the use of strong oxidising agents during water treatment. These conclusions are consistent with the earlier assessment in the EU Risk Assessment Report for chromates, which evaluated indirect oral exposure of humans via the environment based solely on exposure through drinking water and fish.[13]

Since strict emission control measures are implemented, releases of sodium dichromate to the aquatic environment (and also to soil) are nil or negligible.

Inhalation of airborne Cr(VI) emitted from the facility and exposure following deposition is considered in the risk assessment. In relation to inhalation of particulates in air, the oral route (swallowing of the non-respirable fraction) does not need to be explicitly considered since:

(i) the exposure calculations (airborne concentrations) do not provide different particle size fractions (inhalable/thoracic/respirable);

(ii) the excess lifetime risk (ELR) for intestinal cancer is one order of magnitude lower than that for lung cancer. The assessment of health impacts is therefore dominated by the potential risk of lung cancer due to inhalation of Cr(VI);

(iii) the RAC document on a reference dose-response relationship for Cr(VI) compounds[14] states that

[12] EFSA, 2014.

[13] ECB, 2005.

[14] ECHA, 2013.

"in cases where the applicant only provides data for the exposure to the inhalable particulate fraction, as a default, it will be assumed that all particles were in the respirable size range".

This assessment focuses primarily on the carcinogenicity of Cr(VI) released from sodium dichromate as the most relevant endpoint and compares the exposure estimates with the reference dose-response relationship for Cr(VI) compounds derived by RAC for the general population, as shown in the table below. In addition, risk characterisation ratios (RCRs) based on the DNELs derived by RAC are calculated to take into account possible effects on reproduction for sodium dichromate.

Route of exposure and type of effects	Type of risk characterisation	Hazard conclusion DNEL / dose-response relationship
Inhalation: Local Long Term	**Carcinogenicity** Quantitative	RAC dose-response relationship based on excess lifetime lung cancer risk Exposure to 1 µg Cr(VI)/m^3 relates to an excess risk of 2.9E-02 (for general population based on 70 years of exposure, 24 h/day)
	Reproductive toxicity Quantitative	RAC DNEL for the general population, derived for effects on fertility: 11 µg Cr(VI)/m^3
Oral: Local Long Term	**Carcinogenicity** Quantitative	RAC dose-response relationship based on excess lifetime cancer risk for intestinal cancer Exposure to 1 µg Cr(VI)/kg bw/d relates to an excess risk of 8.0E-04 (for general population, based on 70 years of exposure; 24 h/day)
	Reproductive toxicity Quantitative	RAC DNEL for the general population, derived for effects on fertility: 17 µg Cr(VI)/kg bw/d
Dermal: Local Long Term	Not required	There are no data to indicate that dermal exposure to Cr(VI) compounds presents a cancer risk to humans. For reproductive toxicity, dermal exposure of humans via the environment is considered very unlikely.

Table 15*: Type of risk characterisation required for humans via the environment.*

No regional assessment has been carried out as it can be assumed that Cr(VI) from any source will be reduced to Cr(III) in most environmental situations and therefore the effects of Cr(VI) as such are likely to be limited to the area around the source, as described in the EU Risk Assessment Report for chromates.

Environmental concentrations were calculated using EUSES software (version 2.2.0) based on emission measurements to air. Release factors used as input for the EUSES modelling of human exposure via the environment for the releases of Cr(VI) to water, air and soil were derived from measured emission data and the tonnage used.

Release to water

Detailed information about the operation of the WWTP, including handling and treatment of Cr(VI) containing wastewaters (waste Cr(VI) passivation solution and rinsewaters), is provided in sections 9.1.2.4 and 9.1.7.14 above. Details of wastewater sampling are provided in Appendix 3 for the previous three years (2024, 2023 and 2022 calendar years). The results of sampling demonstrate that chromium and Cr(VI) emissions have always been within permitted levels. Indeed, the site has not recorded any discharge consent breaches throughout its history (and no Cr(VI) has been detected in treated effluent discharged to the estuary).

Release to air
Due to its low volatility, sodium dichromate will not normally be present in air. Nevertheless, energetic processes could potentially release sodium dichromate / Cr(VI) into air, such as during passivation. LEV is installed on all Cr(VI) passivation tanks and the circulation tank to extract Cr(VI) mist generated during the process. Exhaust air is sent through a wet scrubber before being released to atmosphere. The LEV system, including wet scrubber and stacks, are described in section 9.1.7.2 above.

Stack emissions monitoring is undertaken annually by a specialist third-party contractor. The results are presented in Appendix 1 for the previous four years and summarised in the table below.

Year	Measuring point	Measured levels from stack, total Cr, mg/m^3	Mass emission, total Cr, g/hour	Operating hours	Release per annum, kg
2022	ETL5 stack	[redacted]	[redacted]	[redacted]	2.24
2023	ETL5 stack	[redacted]	[redacted]	[redacted]	0.81
2024	ETL5 stack	[redacted]	[redacted]	6,142	5.01
2025	ETL5 stack	[redacted]	[redacted]	[redacted]	0.78

***Table 16**: Stack emissions monitoring data 2022-2025*

The reported emissions are for total chromium and Cr(VI) will make up only a proportion of the total (please refer to the discussion in section 9.1.7.10 above). Nevertheless, in absence of specific data on Cr(VI) emissions, and given that back-calculation of total Cr to Cr(VI) would introduce uncertainty to the results, the emissions for total Cr are used. This is likely to significantly overstate the presence of Cr(VI) in emissions to atmosphere from the site.

Release to soil
Emissions to soil are prevented by design because the installation is contained. It is situated indoors on a watertight floor with liquid barriers surrounding the area. Procedural measures are in place to ensure that sodium dichromate is only stored or handled in areas designed for this purpose. All solid wastes that could potentially be contaminated with Cr(VI) are disposed of as hazardous waste (e.g. used PPE). Cr(VI) is not present in filter cake as it has been reduced to Cr(III).

Although release to soil is excluded by design and by operational controls, the applicant has previously undertaken an additional assessment to check against the requirements of its environmental permit. Soil was found to be free of Cr(VI) contamination, with no measurement above the detection limit for Cr(VI) (1 ppm).

Comments on assessment approach
As detailed above, exposure of the general population via the environment (ambient air and food chain) follows a worst-case approach by which all airborne Cr(VI) residues are in the respirable fraction. For this reason, the oral route (swallowing of non-respirable fraction) is not considered by this pathway. However, oral exposure via food has been considered.

A reduction factor of 97%[15] is sometimes used to account for transformation of Cr(VI) to Cr(III) in the environment but this has not been applied to the oral intake values in this assessment.

9.1.8.3 Workers
Sodium dichromate is listed in Annex XIV of REACH due to its carcinogenic, mutagenic and reprotoxic properties. In relation to carcinogenicity, the assessment is restricted to the inhalation exposure pathway. As noted by RAC, “there are no data to indicate that dermal exposure to Cr(VI) compounds presents a cancer

[15] ECB, 2005.

risk to humans".[16] The quantitative occupational exposure assessment and risk characterisation for carcinogenic effects therefore focus exclusively on worker inhalation exposure. In contrast, the assessment of reproductive toxicity includes a quantitative evaluation of both inhalation and dermal exposure routes.

The scope of the exposure assessment and type of risk characterisation required for workers are described in the table below:

Route of exposure and type of effects	Type of risk characterisation	Hazard conclusion DNEL / dose – response relationship
Inhalation: Local, long-term	**Carcinogenicity** Quantitative	RAC dose-response relationship based on excess lifetime lung cancer risk Exposure to 1 µg Cr(VI)/m^3 relates to an excess risk of 4.0E-03 (for workers based on 40 years of exposure, 8h/day; 5 days/week)
	Reproductive toxicity Quantitative	RAC DNEL for workers, derived for effects on fertility (ECHA, 2015): 43 µg Cr(VI)/m^3
Oral: Local, long-term	**Carcinogenicity** Not required	The oral exposure route for workers is not considered as it is assumed that all particles are in the respirable size range, and that no other sources of oral exposure are possible.
	Reproductive toxicity Not required	
Dermal: Local, long-term	**Carcinogenicity** Not required	Dermal exposure to sodium dichromate is not identified as presenting a cancer risk to humans.
	Reproductive toxicity Quantitative	RAC DNEL for workers, derived for effects on fertility (ECHA, 2015): 43 µg Cr(VI)/kg bw/d

Table 17*: Type of risk characterisation required for workers*

Comments on assessment approach related to toxicological hazard: general

Dose-response relationships for carcinogenic effects as proposed by RAC are used for risk characterisation. Reproductive toxicity is assessed using DNELs as proposed by RAC.

Comments on assessment approach related to toxicological hazard: inhalation

Worker inhalation exposure is assessed primarily using reliable and representative workplace air monitoring data. Exposed workers are categorised into Similar Exposure Groups (SEGs), which consist of individuals performing comparable tasks under similar conditions, thereby assumed to experience similar exposure levels. Air monitoring data from workers within the same SEG are then pooled to support a robust and representative exposure assessment.

Annual occupational (worker) exposure monitoring for Cr(VI) has been carried out for many years at the Trostre Works and detailed information on how it is conducted is provided in section 9.1.7.11 above. The applicant's monitoring campaigns involve collecting both personal and static results. Personal monitoring is deliberately designed to cover most WCS assessed in this CSR, in line with the conditions of the existing authorisation, and provide results that can be directly compared against occupational exposure limits, the applicant's own internal exposure limits and other relevant benchmarks. Static values cannot, but nevertheless can provide guidance on areas where emissions into atmosphere are present, or where controls may be failing. Static values, where available, are therefore also presented against the relevant WCS in section 9.2.

[16] ECHA, 2013.

The results of worker exposure monitoring are presented at Appendix 2 for the previous four years (2025, 2024, 2023 and 2022 calendar years). These demonstrate that exposure is low, consistently under 1 µg Cr(VI)/m^3 8hr TWA, indicating that Cr(VI) exposure is well controlled.

Personal monitoring is targeted at a minimum of 8 hours to ensure enough sample can be collected to exceed the laboratory's LOD, as well as to align with the applicant's in-house exposure limit which is set at an 8-hour TWA. However, many workers are on 12-hr shifts and while the duration of sampling often exceeds 8 hours, it does not usually last 12 hours. For such workers, the sampling results have been increased to reflect the potential exposure over 12 hours by increasing the filter concentration of Cr(VI) by the same factor required to increase the sampling duration to 12 hours. For example, if the duration of sampling for a worker on a 12 hour shift was 8 hours, the filter concentration has been increased by 50% reflecting the additional 4 hours of the shift that went unmonitored.

This is likely to overstate actual worker exposure because activities liable to result in Cr(VI) exposure only occur for a relatively short period of time across a shift and are already likely accounted for in the measured data. In particular, increasing the filter concentration is not likely to be a true reflection of potential additional exposure over the unmonitored remainder of the shift. Nevertheless, the approach reflects a conservative approach, consistent with the approach taken to the risk assessment across this CSR more broadly.

Measured data are used in preference to modelled data although, where measured data are not available or where specific activities cannot be adequately covered by measurements, exposure estimates generated by the Advanced REACH Tool (ART)[17] version 1.5 are used. The 90th percentile of the resulting distribution is used for risk assessment, as per ECHA guidance.[18]

Modelled and measured values (from personal and static monitoring) are given in terms of Cr(VI) and are provided as 12-hour time weighted averages (TWA) for staff working on a 12hr shift system and 8-hour TWAs for other staff.

Given that sodium dichromate is a non-threshold carcinogen, exposure over a lifetime is relevant to assess the risk and not the maximum exposure during a certain period of time (hour, day, shift etc). This means the same multiplication factor (0.004 per µg/m^3 Cr(VI)) can be used for calculating the excess lifetime risk (ELR) for 8h shifts as for 12h shifts, provided that the frequency of the tasks over a 40 year period is taken into account. Frequency-corrected exposure levels are therefore used as the basis for calculating the ESR.

<u>Comments on assessment approach related to toxicological hazard: oral</u>
Good industrial hygiene measures in place avoid ingestion of sodium dichromate in the workplace. Also, in relation to inhalation of particulates in air, the oral route (swallowing of the non-respirable fraction) does not need to be explicitly considered since:

(i) the exposure calculations (airborne concentrations) do not provide different particle size fractions (inhalable/thoracic/respirable);
(ii) the RAC document on a reference dose-response relationship for Cr(VI) compounds[19] states that "in cases where the applicant only provides data for the exposure to the inhalable particulate fraction, as a default, it will be assumed that all particles were in the respirable size range";
(iii) the excess lifetime risk (ELR) for intestinal cancer is one order of magnitude lower than that for lung cancer. The assessment of health impacts is therefore dominated by the potential risk of lung cancer due to inhalation of Cr(VI).

[17] See https://www.advancedreachtool.com/
[18] ECHA, 2016a.
[19] ECHA, 2013.

Comments on assessment approach related to toxicological hazard: dermal

No data exist to indicate that dermal exposure to Cr(VI) compounds present a cancer risk to humans. However, all activities using sodium dichromate that could involve the potential for dermal exposure to workers are considered, to assess possible risks for reproductive toxicity. Minimisation of dermal exposure is also required due to the corrosive and skin sensitising properties of the substance. This is achieved by a high degree of automation and, where dermal exposure cannot completely be avoided, by the use of suitable PPE (details of which are provided in section 9.1.7.6 above and in the respective worker contributing scenarios in section 9.2 below).

For processes where dermal exposure cannot be definitively excluded (receipt and storage, sampling, maintenance and waste management), potential dermal exposure is assessed through modelling, as direct quantification of exposure is often challenging. However, modelling dermal exposure from the use of Cr(VI) substances in the context of this review report presents limitations. These substances are primarily used as solids dissolved in liquids, which falls outside the applicability domain of the standard modelling tool ECETOC TRA. Similarly, the RiskofDerm model (v2.1) lacks appropriate Dermal Exposure Operation (DEO) units for several relevant activities, such as additions or maintenance activities.

To address these gaps, a calculation-based approach is used to estimate dermal exposure across all activities. This approach applies dermal load estimates and assumptions regarding contact areas based on the tasks performed (PROCs), in line with the conceptual framework of the ECETOC TRA tool. The modelling assumption is based on the upper end of the range for the dermal load (0.1 mg/cm^2/d) as provided in the EU RAR,[20] which was based on EASE for non-dispersive use with direct handling with incidental contact, which is similar to the potential exposures considered in this assessment.

As a conservative assumption, exposure of one side of both hands is considered for most activities. An exception is made for maintenance-related tasks, where there is potential for contact with a larger surface area of the body. The consumer module of the ECETOC TRA tool assumes exposure of half the body surface area (approximately 8,750 cm^2) in such cases. However, this assumption is not considered realistic in the present context, as any maintenance activities involving potential exposure to sodium dichromate can only be undertaken in full chromium PPE, which includes a full chemical protective suit, chemical resistant gloves, safety wellingtons and a tight-fitting full-face mask (for further details, see section 9.1.7.6). Therefore, for maintenance activities, a more realistic skin contact area of 2,083 cm^2 has been assumed, corresponding to the surface area of both hands and forearms, i.e. approximately one-quarter of the front of the body.

Dermal exposure is calculated taking into account body weight[21] and the efficiency of PPE.[22] The concentration of Cr(VI) is also considered, calculated using the molecular weight fraction of Cr(VI) in sodium dichromate (0.40). The assumption of 5% permeation through gloves is merely hypothetical, as dermal exposure must be prevented due to the potential for severe local effects, given sodium dichromate's classification as skin corrosive and skin sensitising.

Comments on assessment approach related to physicochemical hazard

Not relevant – physicochemical hazards are not the subject of this CSR.

General information on risk management related to toxicological hazard

This is described previously in section 9.1.7 above.

General information on risk management related to physicochemical hazard

Not relevant – physicochemical hazards are not the subject of this CSR.

[20] ECB, 2005.

[21] ECHA, 2012.

[22] European Commission, 2010.

9.1.8.4 Consumers

The final ETP articles produced at the Trostre Works are tin-plated steel coils and plates used for many different applications including food applications by consumers. During the passivation process, the Cr(VI) is reduced into chromium oxide (Cr(III)) and metallic chromium (Cr(0)). As a result, very little Cr(VI) will remain on the steel upon removal from the passivation tanks. The steel strip is then treated, rinsed and dried and a thin film of lubricant is applied to the tinplate surface. This ensures effective physical removal of traces of Cr(VI) because there are no cavities in the steel in which Cr(VI) could be entrapped and as a result not removed. Passivation is only possible when the rinsing system is operational as both steps of the process are interlocked.

As a result, no Cr(VI) is present on the steel nor in the finished article. This is confirmed by tests made by the applicant at least once per week (but typically every two days) for residual Cr(VI) on the steel surface. These checks are undertaken in the context of Regulation (EC) No 1935/2004 on materials and articles intended to come into contact with food. The test method is based on the reaction of diphenyl carbazide with Cr(VI). In the event Cr(VI) is present on the steel plate, a red-violet colour would be produced. The absorbance occurs at 540 nm, which is in the visible spectrum and hence directly observable. The reaction is very sensitive (per gram atom of Cr(VI), absorbancy index of 40,000 at 540 nm).[23] The test is a 'pass or fail' test, meaning any colour change observed would result in a fail conclusion. There is no LOD applicable to this assessment.

Consequently, since the final coating of the article is Cr(VI) free there is no risk resulting from consumer exposure during the service life of the tin-plated articles. Exposure assessment is therefore not applicable as there are no consumer-related uses for sodium dichromate given that Cr(VI) is not present in finished products.

[23] US Environmental Protection Agency (EPA) Method 7196A 'Chromium, Hexavalent (Colorimetric)' and BS EN 10202:2022 'Cold reduced tinmill products. Electrolytic tinplate and electrolytic chromium/chromium oxide coated steel'.

9.2 Exposure Scenario 1: Industrial use of sodium dichromate for the passivation of ETP

Sector of use:	
Industrial Use	IS
Environment contributing scenario(s):	
Industrial use of sodium dichromate for the passivation of ETP	ERC 5
Worker/Consumer contributing scenario(s):	
WCS1: Receipt and storage of sodium dichromate	PROC 8b
WCS2: Sampling and analysis	PROC 9
WCS3: Adding sodium dichromate to the circulation tank	PROC 1
WCS4: Passivation	PROC 13
WCS5: Control room activities	PROC 0
WCS6: Loading and unloading of steel coils	PROC 0
WCS7: Maintenance activities	PROC 28
WCS8: Waste management including wastewater treatment	PROC 8b, 9
Subsequent service life exposure scenario(s):	
Not relevant	
Exposure scenario(s) of uses leading to the inclusion of the substance into article(s):	
Not relevant	

Explanation on the approach taken for the exposure scenario
Measurements of releases to air were used to support the environmental exposure assessment. Modelling techniques were used to estimate concentrations of sodium dichromate in air 100m from the release point in accordance with ECHA guidance.[24]

The wastewater measurements supporting the environmental assessment are composite samples used to collect a representative 24 hour sample of the treated effluent discharged to the Loughor Estuary. These results show that there is no release of Cr(VI) to wastewater from the facility.

Occupational exposure estimates are based on recent personal and static measurements. Personal monitoring data were collected by attaching samplers to workers while they conducted their daily tasks within the ETP production area. Static measurements of particulate residues of Cr(VI) in air were taken at locations where relevant activities take place, or at locations which can be associated with a potential point source of Cr(VI). Where personal monitoring data was not able to be provided, then the exposure was estimated using the ART exposure model.[25] The figures obtained by modelling are considered to be worst-case estimates.

[24] ECHA, 2016.
[25] See https://www.advancedreachtool.com/

9.2.1 Environmental contributing scenario 1 (ERC 5)

9.2.1.1 Release factors

Environmental contributing scenario (ECS) 1 covers the industrial use of sodium dichromate for the passivation of ETP. The relevant environmental release category (ERC) is ERC 5 (use at industrial site leading to inclusion into/onto article). The default release factors for ERC 5 according to ECHA guidance are:

- To air (after risk management measures): 50%
- To water (before municipal sewage treatment plant): 50%
- To soil: 1%

However, the applicant has site-specific information on environmental releases available. This site-specific information is more relevant than the default factors and therefore the site-specific information has been used for the assessment. For the Trostre Works, the following release factors are calculated based on site-specific monitoring data:

- To air: 0.1315%
- To water: 0%
- To soil: 0%

These values were generated based on the following:

- **Air**: Two types of emissions to air are typically evaluated: (1) guided emissions and (2) fugitive emissions. Fugitive emissions are not relevant as Cr(VI) is transferred directly into the ETL5 circulation tank from the bulk storage tank, the vapor pressure of sodium dichromate is very low, and all relevant potential sources of Cr(VI) to air are covered by guided emissions.

  Guided emissions have been quantified. There is one Cr(VI)-relevant location where air is actively extracted by means of LEV, sent through a wet scrubber system and then released via a stack, i.e. air above and below the passivation tanks (see section 9.1.7.2 for details). Emissions from the stack are monitored on annual basis during full production. Information on stack emissions monitoring and results are presented in section 9.1.7.10 and Appendix 1. Monitoring is for total Cr, not Cr(VI), so the values for total Cr are used as a proxy for Cr(VI), which will overstate the actual release of Cr(VI).

  The total load emitted per year is calculated by multiplying the concentration in air (mg/m^3), the mass flow (m^3/day) and the number of operational days per year. The release factor can then be calculated as the quantity of total Cr released in a given year (as a proxy for Cr(VI)) divided by the quantity of Cr(VI) used that year, expressed as a percentage.

  The total load emitted for the past three calendar years and the corresponding release factors are presented in Appendix 1. The highest release factor (0.1315% in 2024) is used as the basis for the assessment.

- **Water**: The wastewater treatment process is described in detail in sections 9.1.2.4 and 9.1.7.14. Sources of Cr(VI)-containing wastewater from the ETL5 line are the circulation tank, the passivation tanks, the rinsewater tanks and water from the wet scrubber. All wastewaters are collected in their respective sumps. When there is sufficient volume for transfer (online level measurements with displays in the control room), the contents are pumped to the waste sodium dichromate bulk tank in the WWTP tank farm area. Reducing agents are dosed to Cr(VI)-containing effluent over-stoichiometrically with agitation to ensure full reduction to Cr(III). Following treatment, the effluent joins other liquid waste entering the WWTP where the mixed effluent undergoes further treatment, such as neutralisation and clarification, before discharge within environmental permit limits.

A composite sampler is used to collect a representative 24-hour sample of the treated effluent discharged to the Loughor Estuary which is analysed to ensure that it meets the conditions laid down in the site's discharge consent, part of the EPR permit issued by NRW. This includes analysis for Cr(VI) and for total chromium. Details of wastewater sampling provided in Appendix 3 demonstrate that no Cr(VI) has been detected in treated effluent discharged to the estuary. The site's own monitoring is verified by NRW who visit at least once per month and also collect samples from the composite sampler for subsequent analysis at a NRW laboratory.

The measurement data collected is 0 mg/L Cr(VI)), which is in line with expectations given the wastewater treatment process and risk management measures. Annual emissions to water are therefore assessed at 0 kg/yr with a release factor of 0%.

In addition to monitoring the release to surface water, groundwater assessment is also carried out. There are two boreholes located on the site, which are positioned in such way that they capture the groundwater flowing underneath the plant. Results are reported annually to NRW, however, measurements are carried out more frequently. The measurements demonstrate that ground water is Cr(VI) free, with all measurements below the detection limit for Cr(VI) (<1 mg/L).

- **Soil**: Annual emissions to soil are 0 kg/yr because there is no release of Cr(VI) to soil at the site, neither directly nor indirectly. The release factor is therefore 0%. Although release to soil is excluded by operational controls, an additional assessment has been carried out to check against the requirements of the site's environmental permit. Soil was found to be free of Cr(VI) contamination with all measurements below the detection limit for Cr(VI) (1 ppm).

9.2.1.2 Minimisation of emissions and resulting exposure

The table below summarises the risk management measures in place to minimise environmental exposure.

Compartment	Risk management measures
Air	The installation is located indoors. One source of Cr(VI) emissions to air relating to ETL production has been identified; the LEV system serving the passivation tanks. Extracted air is passed through wet scrubbers. Cr(VI)-containing scrubber water is directed to the chrome sump for subsequent batch reduction of Cr(VI) to Cr(III) in the WWTP. Additional information is provided in section 9.1.7.
Water	All wastewater potentially contaminated with Cr(VI) is treated by chemical reduction. Wastewater collected in the chrome sump and rinsewater sump is transferred to the WWTP and undergoes batch reduction. Here, the amount of reductant (pickling solution containing ferrous sulphate) required is calculated based on concentration measurements and is added over-stoichiometrically with agitation. The redox potential is measured in-line and a sample is taken for Cr(VI) analysis in the laboratory. The over-stoichiometric reduction and agitation (stirrer) in the tank ensure complete reduction of Cr(VI), as demonstrated by the in-line and off-line measurements, and therefore the concentration in the effluent is zero. This is described further in section 9.1.7 and Appendix 3.
Soil	Emissions to soil are prevented by design because the installation is contained. It is situated indoors on a watertight floor with liquid barriers surrounding the area. Procedural measures are in place to ensure that sodium dichromate (as a raw material) is only received, stored and used in areas designed for this purpose. Although release to soil is excluded by operational controls, an additional assessment has been carried out to check against the requirements of the site's environmental permit. Soil was found to be free of Cr(VI) contamination as all measurements were below the detection limit for Cr(VI) (1 ppm).

Table 18*: Measures for environmental exposure reduction*

9.2.1.3 Risk assessment and determination of excess risks

The physico-chemical and environmental fate properties of Cr(VI) presented below were used in the environmental assessment of sodium dichromate (given that sodium dichromate solubilises and dissociates into Cr(VI)). These data were used in the European Union System for the Evaluation of Substances (EUSES 2.2.0) software for the environmental fate estimation and are taken from the EU Risk Assessment Report.[26]

Substance property	Value (value entered into EUSES modelling in old CSR if no value presented)
Molecular weight	262 g/mol
Melting point	Becomes anhydrous at 100 °C, salt melts at ca. 357 °C at 101.3 kPa
Boiling point	Decomposes above 400 °C
Vapour pressure	N/A – nominal value of 0.00001 Pa entered into EUSES
Water solubility	2355 g/L at 20 °C
Partition coefficient (Log Kow)	N/A
Adsorption/Desorption coefficient (Koc)	Non-hydrophobics (default QSAR)
Solids-water partition coefficient in soil (Kp_{soil})	Chromium (VI) key values: 26 L/kg
Solids-water partition coefficient in sediment (Kp_{sed})	Chromium (VI) key values: 550 L/kg
Solids-water partition coefficient in suspended matter (Kp_{susp})	Chromium (VI) key values: 1100 L/kg
Bioaccumulation: BCF (aquatic species)	1 L/kg wwt (*Available data indicate that the BCF of chromium (VI) in fish is relatively low at around 1 L/kg. Once in the organism, reduction of chromium (VI) to chromium (III) appears to occur, resulting in an accumulation of total chromium in the organisms to a factor of approximately 100 times the original concentration in water.*)
Ready biodegradability	N/A for inorganic substances ('Not biodegradable' selected in EUSES 2.2.0 as a worst-case)
Hydrolysis	N/A for inorganic substances (default value used in EUSES 2.2.0)

***Table 19**: sodium dichromate key physico-chemical and environmental fate properties*

Conditions of use

Conditions of use related to the environment are presented in the table below.

Amount used, frequency and duration of use (or from service life)
▪ Daily amount used at site: [redacted] per day sodium dichromate, [redacted] per day Cr(VI)
▪ Annual amount used at site: [redacted] (public range: 10-20 tonnes) per year sodium dichromate or [redacted] per year Cr(VI).
▪ Number of days: 256
Technical and organisational conditions and measures
▪ On site WWTP.

[26] ECB, 2005.

▪ Wastewater treatment of Cr(VI) contaminated wastewater is undertaken by reduction in a batch process in the tank farm in the WWTP. The treatment includes an over-stoichiometric addition of reductant and agitation to ensure all Cr(VI) is reduced to a lower oxidation level resulting in zero emission of Cr(VI) in the released wastewater. After this reduction, the wastewater combines with other process related wastewater. There is no need for further reduction of Cr(VI) in this part of the WWTP because the wastewater is already free of Cr(VI) after batch reduction and there is no Cr(VI) in the process water.
▪ Discharge rate of on-site central WWTP: Not relevant. Discharge to estuary, tidal system. The discharge rate of the on-site central WWTP is not relevant in function of emissions of Cr(VI) as there are no Cr(VI) emissions to water from the WWTP.
▪ Application of the WWTP sludge on agricultural soil: Not applicable
Conditions and measures related to treatment of waste (including article waste)
▪ Particular considerations on the waste treatment operations: Solid waste is limited to disposable PPE that has been used inside the chromic acid area and any other materials that could potentially be contaminated with Cr(VI) such as cloths or rags. This is treated as hazardous waste by a specialist hazardous waste handler and sent for incineration.
Other conditions affecting environmental exposure
▪ Receiving surface water flow rate: Not relevant The receiving surface water flow rate is not relevant in function of emissions of Cr(VI) as there are no Cr(VI) emissions to water.

***Table 20**: Conditions of use: ECS 1*

<u>Releases</u>
The local releases to the environment are reported in the table below.

Release route	Release factor	Release Kg or T / per year
Water	Measured data	Local release rate: 0 kg/year Explanation/justification: All wastewater potentially contaminated with Cr(VI) is treated by chemical reduction. Monitoring data collected on a daily basis demonstrates no Cr(VI) is detected. Since there is an over-stoichiometric addition of reductant, readings below the detection limit are in fact zero. The release to water has therefore been set to 0% for the purposes of the model. % release factor to water entered into EUSES model: 0
Air	Measured data	Local release rate: 5.01 kg/yr. Explanation/justification: Measured releases of total Cr to air in 2022, 2023, 2024 and 2025 are presented in Appendix 1 and summarised below: - Measured release to air in 2022: 2.24 kg, release factor 0.0487% - Measured release to air in 2023: 0.81 kg, release factor 0.0229% - Measured release to air in 2024: 5.01 kg, release factor 0.1315% - Measured release to air in 2025: 0.78 kg, release factor 0.0224% Stack emissions monitoring occurs annually. Results from 2022, 2023, 2024 and 2025 are presented above. The highest emissions result (5.01 kg in 2024) has been used in the assessment, along with the highest release factor (0.1315% in 2024), to ensure a conservative approach. (Note: these figures are based on total Cr and will therefore overstate the amount of Cr(VI) actually released.) % release factor to air entered into EUSES model: 0.1315

Release route	Release factor	Release Kg or T / per year
Soil	Measured data	Local release rate: 0 kg/yr Explanation/justification: Annual emissions to soil are 0 kg/yr because there is no release of Cr(VI) to soil at the site, neither directly nor indirectly. The release factor is therefore 0%. % release factor to air entered into EUSES model: 0

Table 21*: Local releases to the environment: ECS 1*

Exposure and risks for the environment and humans via the environment

As detailed above, exposure of the general population via the environment (ambient air and food chain) follows a worst case approach where all airborne Cr(VI) residues are in the respirable fraction. The oral route (swallowing of non-respirable fraction) is not considered in this approach. The indirect route for oral exposure of Cr(VI) via food has been considered. Dermal exposure is not considered to be a relevant route of exposure for carcinogenicity and, while it is a relevant route of exposure for reproductive toxicity, dermal exposure of humans via the environment is considered very unlikely.

As the location of the site is within an industrial area then non-directly exposed workers have been included as part of the local population.

Protection target	Exposure concentration	Risk assessment
Freshwater	1.58E-07 mg Cr(VI)/L	Not relevant
Sediment (freshwater)	6.99E-06 mg Cr(VI)/kg wwt	Not relevant
Marine water	1.56E-08 mg Cr(VI)/L	Not relevant
Sediment (marine water)	6.89E-07 mg Cr(VI)/kg wwt	Not relevant
Sewage treatment plant	0 mg Cr(VI)/L	Not relevant
Predator (freshwater)	1.58E-07 mg Cr(VI)/kg wwt	Not relevant
Predator (marine water)	1.56E-08 mg Cr(VI)/kg wwt	Not relevant
Top predator (marine water)	1.56E-08 mg Cr(VI)/kg wwt	Not relevant
Agricultural soil	4.99E-05 mg Cr(VI)/kg wwt	Not relevant
Air	6.51E-06 mg Cr(VI)/m^3	Local Cr(VI) PEC in air, 100m from point source
Humans via the Environment - Inhalation	6.51E-06 mg Cr(VI)/m^3	RAC Opinion (Lung cancer, general population) ELR = 2.9E-02 per 1 µg Cr(VI)/m^3 RAC Opinion (Lung cancer, workers) ELR = 4.0E-03 per 1 µg Cr(VI)/m^3 **Excess lifetime risk by inhalation to general population = 1.89E-04 *** * Including non-directly exposed workers
Humans via the Environment - Oral	9.81E-04 mg Cr(VI)/kg bw/d	RAC Opinion (Intestinal cancer, general population): ELR = 8.0E-04 per 1 µg Cr(VI)/kg bw/d **Excess lifetime risk by oral (through food only) to general population = 7.85E-04 *** * Not required for workers. Assume food/drinking water is not locally sourced.

Protection target	Exposure concentration	Risk assessment
Humans via Environment Combined	-	**Excess lifetime cancer risk combined = 9.74E-04**

Table 22*: Exposure concentrations and risks for the environment and humans via the environment on a local scale*

Type of food	Estimated daily dose	Concentration in food
Drinking water	7.58E-07 mg Cr(VI)/kg/d	2.65E-05 mg Cr(VI)/L
Fish	2.59E-10 mg Cr(VI)/kg/d	1.58E-07 mg Cr(VI)/kg
Leaf crops	9.78E-04 mg Cr(VI)/kg/d	5.70E-02 mg Cr(VI)/kg
Root crops	1.35E-07 mg Cr(VI)/kg/d	2.47E-05 mg Cr(VI)/kg
Meat	1.32-08 mg Cr(VI)/kg/d	3.07E-06 mg Cr(VI)/kg
Milk	2.46-07 mg Cr(VI)/kg/d	3.07E-05 mg Cr(VI)/kg

Table 23*: Contribution to oral intake for humans via the environment from local contribution.*

For reproductive toxicity, risk characterisation ratios have also been calculated for the oral and inhalation route based on the oral and inhalation DNELs for systemic effects after long-term exposure. These are based on the predicted environmental concentrations above.

The RCRs in the following table document that the exposure is far below the DNELs resulting in very low RCRs (several orders of magnitude below 1), which indicate that there is negligible risk for effects on fertility and for effects on development (although values are not shown for the latter, as the DNELs for developmental effects are higher than the DNELs for effects on fertility).

Oral exposure [µg/kg x d]	DNEL oral systemic long-term [µg/kg x d]	RCR oral	Inhalation exposure [µg/m^3]	DNEL inhalation systemic long-term exposure [µg/m^3]	RCR inhalation
9.81E-01	17	5.77E-02	6.51E-03	11	5.92E-04

Table 24*: RCRs for humans via the environment*

9.2.1.4 Conclusion on environmental exposure and risk assessment

The endpoints specified in Annex XIV of REACH are human health endpoints only. Therefore, the direct effects and risks to the environment resulting from environmental release are not evaluated in detail in this CSR.

In relation to exposure to humans in the context of 'humans via the environment', a detailed exposure assessment was performed, considering emissions to air, leading to the identification of the excess risks. For these purposes, 'humans via the environment' relates to:

- employees at the Trostre site indirectly exposed
- permanent contractors at the Trostre site
- workers in the vicinity of the site (e.g. at the industrial estate, retail parks and rugby stadium)
- visitors to those locations
- people living within 1 km radius of the emission source

Emissions via air can lead to Cr(VI) exposure via following routes:

1. Direct intake via inhalation.
2. Consumption of locally grown crops which have been contaminated with Cr(VI) due to deposition of Cr(VI).

Calculations in EUSES are conservative as no dilution effects are taken into account, i.e. it does not take into account conversions between Cr(VI) and Cr(III) in air. Indeed, studies show that in air Cr(VI) can bind to particles and can be rapidly degraded into Cr(III).[27] The area considered for exposure and the impact assessment is 1km around the source of emission. Using EUSES the air concentration at 100m distance of the emission source can be calculated. This value is kept constant for the full range of 1km. This is a worst-case assumption as additional air dilution is not accounted for.

The Cr(VI) concentration in crops is influenced by 2 processes: (i) the uptake of deposited Cr(VI) from soil to plant and (ii) the contribution of aerial deposition of Cr(VI) on leaves. The former is unlikely to be a significant contribution to exposure because in soils Cr(VI) reduces to Cr(III)[28] and uptake of Cr(VI) is thus negligible. Nevertheless, EUSES calculates the contribution from soil and from air, leading to a conservative estimate.

The total emissions to air from passivation are assessed as 5.01 kg Cr(VI)/yr. This corresponds to a $PEC_{local,air}$ of 6.51 x 10^{-3} µg Cr(VI)/m^3 as calculated in EUSES at 100 m of the emission source, i.e. the stacks. The combined excess lifetime cancer risks associated with exposure of humans via the environment are 9.74 x 10^{-4} for the general population.

The ECHA dose response relationship assumes no threshold for carcinogenic effects. However, the ETeSS study[29] on which it was based states that "…*the lower the exposure (certainly below 1µg/m^3), the more likely it is that the linear [dose-response] relationship overestimates the cancer risk*". The study further states that "*the risk estimates for … exposures lower than 1 µg Cr(VI)/m^3 might well greatly overestimate the real cancer risks. It is also considered that at progressively lower Cr(VI) air concentrations (from about 0.1 µg/m^3 downwards), cancer risks may be negligible*". The calculated air concentration 100 m from the point source is 6.51 x 10^{-3} µg Cr(VI)/m^3 and therefore over 15 times lower than the concentration at which cancer risks may be negligible.

The DNEL for reproductive toxicity (humans via the environment) for sodium dichromate is 11 µg Cr(VI)/m^3 for inhalation (systemic effects-long term) and 17 µg Cr(VI)/m^3 for oral (systemic effects long-term). The RCRs in Table 24 document that the exposure is far below the DNELs resulting in very low RCRs (several orders of magnitude below 1), which indicate that there is no risk for effects on fertility nor for effects on development (values not shown, as the DNELs for developmental effects are higher than the DNELs for effects on fertility) under the calculated exposure of humans via the environment.

9.2.2 WCS 1: Receipt and storage of sodium dichromate (PROC 8b)

This WCS describes the delivery of aqueous sodium dichromate to the site in intermediate bulk containers (IBCs). The sodium dichromate is then stored until it is required for the replenishment of the passivation solution. Additions are made to the circulation tank as required and considered further in WCS 3.

<u>WCS 1a – current delivery procedure for sodium dichromate</u> [redacted]

Sodium dichromate is currently delivered to Trostre in specially designed IBCs discharged under pressure into a bunded bulk storage tank. Manual coupling and uncoupling of the transfer hose is performed by the delivery driver who is monitored by at least one of the applicant's employees (a shift team member) from

[27] European Chemicals Bureau, 2005.

[28] European Chemicals Bureau, 2005.

[29] ETeSS, 2013.

a distance. This process takes up to 2 hours, although any potential exposure is only associated with coupling and uncoupling the IBCs which takes a maximum of 20 minutes. The line is then purged using air before decoupling. Three IBCs are received per delivery (1.4 tonnes each for a total of 4.2 tonnes per delivery), each of which must be separately coupled and uncoupled. [redacted]

Workers wear standard site PPE during this process with no RPE. The storage tank is located outside, providing natural ventilation.

If there are any issues/incidents during the delivery, including spillages, the shift team member will raise the alarm. There is a storm drain located adjacent to the bunded storage tank shown in Figure 7. Should any spilt material enter the drain, it will be routed to the site's storm water facility; this facility is pH alarmed and will divert water to the WWTP for treatment to avoid material entering the environment without being treated.

<u>WCS 1b – future delivery procedure for sodium dichromate</u> [redacted]
The applicant is currently changing its supplier of sodium dichromate to improve the continuity of supply. Sodium dichromate from the new supplier will be delivered in quantities of [redacted] per delivery from a road tanker. Given current levels of sodium dichromate consumption, there will likely only be [redacted] deliveries of sodium dichromate per year.

Coupling and uncoupling of the transfer hose will be performed by one of the applicant's employees (a shift team member) who will be monitored by at least one additional shift team member from a distance. The delivery driver will remain in their vehicle for the duration of the delivery. Due to the larger quantities involved per delivery, the total time for delivery may last for several hours. However, any potential exposure to sodium dichromate will only be associated with coupling and decoupling the transfer hose, which will only occur once per delivery. This is anticipated to take no longer than 20 minutes.

Sodium dichromate from the future supplier will be supplied at a higher concentration (70% sodium dichromate solution from [redacted] in place of a 60% solution for [redacted]). To accommodate larger deliveries of sodium dichromate, the applicant is currently installing a new, larger bulk storage tank which will be capable of storing up to [redacted] of sodium dichromate. This tank will be double skinned with an inner alarm to alert if any liquid is detected. It will be located directly next to the existing bulk storage tank (see Figure 7) and mounted on a concrete slab.

9.2.2.1 Risk management measures

Risk management measures are summarised in the table below.

Means to minimise exposure	Description of the specific measures (with further information in section 9.1.7)	
	WCS 1a	WCS 1b
Containment	Sodium dichromate is delivered in specially designed IBCs discharged under pressure into a 5,000 L capacity bunded storage tank. Any spilled material that enters the site drainage system will be routed to the WWTP on pH alarm.	Sodium dichromate will be delivered by road tanker discharged under pressure into a [redacted] capacity double skinned storage tank. Any spilled material that enters the site drainage system will be routed to the WWTP on pH alarm.
Engineering controls	The connection to the bulk storage tank is padlocked when not in use, with the key kept with the ECCS4 team leader.	The connection to the bulk storage tank will be padlocked when not in use, with the key kept by the ECCS4 team leader.

Means to minimise exposure	Description of the specific measures (with further information in section 9.1.7) WCS 1a	WCS 1b
	The transfer hose is purged with air prior to being uncoupled.	An inner alarm will be present in the bulk tank to detect any leaks or spills from the inner tank. The transfer hose will be purged with air prior to being uncoupled.
Administrative controls	Procedures are in place covering delivery and receipt of sodium dichromate. Only authorised personnel perform this task. The delivery driver will couple and uncouple the transfer hose and a shift team member will monitor the operation. All personnel performing this task receive appropriate information, instructions and training.	Procedures are in place covering delivery and receipt of sodium dichromate. Only authorised personnel will perform this task. A shift team member will couple and uncouple the transfer hose with another shift team member monitoring the operation. All personnel performing this task receive appropriate information, instructions and training.
PPE	Standard PPE: protective clothing, safety helmet, safety footwear, hearing protection, protective eyewear	Standard PPE: protective clothing, safety helmet, safety footwear, hearing protection, protective eyewear
Emergency response	Emergency procedures are in place. First aiders and first aid equipment and facilities are available at all times. Firewater is retained.	Emergency procedures are in place. First aiders and first aid equipment and facilities are available at all times. Firewater is retained.
Monitoring	Health surveillance, biological monitoring.	Health surveillance, biological monitoring.

***Table 25**: Risk management measures for the current and future supply of sodium dichromate: WCS 1a and WCS 1b*

9.2.2.2 Conditions of use

The conditions of use are described in the tables below and account for estimated exposure levels.

Product (article) characteristics
Product type: Powders dissolved in a liquid or incorporated in a liquid matrix
Concentration: Weight fraction: 0.6 (60%)
Viscosity: Low
Amount used (or contained in articles), frequency and duration of use/exposure
Duration of activity: 20 minutes (across 3x IBCs delivered at once)
Frequency of task: [redacted]
Activity emission potential
Primary emission source proximity: within 1 metre
Activity class: Handling of contaminated objects (coupling and decoupling of hoses); activities with treated/contaminated objects (surface 1 - 3 m^2); contamination < 10 % of surface
Primary localised controls: No localised controls
Secondary localised controls: No localised controls
Enclosure: The process is not fully enclosed and the integrity of that enclosure is not regularly monitored, but

effective housekeeping practices are in place.
Location: Outdoors
Secondary emissions sources: No secondary emission sources
Conditions and measures related to personal protection, hygiene and health evaluation
PPE other than RPE: No
Respiratory protection: No

***Table 26**: Conditions of use: WCS 1a*

Product (article) characteristics
Product type: Powders dissolved in a liquid or incorporated in a liquid matrix
Concentration: Weight fraction: 0.7 (70%)
Viscosity: Low
Amount used (or contained in articles), frequency and duration of use/exposure
Duration of activity: 20 minutes exposure
Frequency of task: [redacted]
Activity emission potential
Primary emission source proximity: within 1 metre
Activity class: Handling of contaminated objects (coupling and decoupling of hoses); activities with treated/contaminated objects (surface 1 - 3 m^2); contamination < 10 % of surface
Primary localised controls: No localised controls
Secondary localised controls: No localised controls
Enclosure: The process is not fully enclosed and the integrity of that enclosure is not regularly monitored, but effective housekeeping practices are in place.
Location: Outdoors
Secondary emissions sources: No secondary emission sources
Conditions and measures related to personal protection, hygiene and health evaluation
PPE other than RPE: No
Respiratory protection: No

***Table 27**: Conditions of use: WCS 1b*

9.2.2.3 Worker exposure

The activities covered by WCS 1a are performed by a delivery driver not employed by the applicant. Personal monitoring campaigns do not include this driver nor shift team members, because they have not previously coincided with deliveries which only occur five times per year. For this reason, ART modelling is used in place of personal monitoring for this WCS.

In future, these activities will be performed by one of the applicant's employees rather than the visiting delivery driver, who will remain in the vehicle's cabin throughout. ART modelling has also been used to estimate exposure for WCS 1b.

While static measurements are taken annually, there are no relevant static measurements for this WCS. The exposure concentrations derived from ART modelling for WCS 1a and WCS 1b are reported in the tables below.

Route of exposure and type of effects	Results WCS 1a	Notes
Inhalation, local Exposure value (8h TWA)	7.94E-05 mg Cr(VI)/m^3	Obtained from ART, 90th percentile value.
Inhalation, local Exposure value (8h TWA) corrected for PPE	No correction	No RPE used during the delivery process.
Frequency of operation (per year) over all operators	[redacted]	[redacted]
Number of operators	[redacted]	[redacted]
Number of working days per year per operator	[redacted]	[redacted]
Number of occasions per worker per day averaged over the year	[redacted]	[redacted]
Inhalation, local Exposure value corrected for PPE and frequency	1.65E-03 µg Cr(VI)/m^3	[redacted]

***Table 28**: Exposure concentration for workers: WCS 1a*

Route of exposure and type of effects	Results WCS 1b	Notes
Inhalation, local Exposure value (8h TWA, modelled)	9.13E-05 mg Cr(VI)/m^3	Obtained from ART, 90th percentile value.
Inhalation, local Exposure value (8h TWA) corrected for PPE	No correction	No RPE used during the delivery process.
Frequency of operation (per year) over all operators	[redacted]	[redacted]
Number of operators	[redacted]	[redacted]
Number of working days per year per operator	[redacted]	[redacted]
Number of occasions per worker per day averaged over the year	[redacted]	[redacted]
Inhalation, local Exposure value corrected for PPE and frequency	3.50E-05 µg Cr(VI)/m^3	[redacted]

***Table 29**: Exposure concentration for workers: WCS 1b*

9.2.2.4 Risk characterisation: carcinogenicity

For WCS 1a, the excess risk for workers via inhalation is reported in the table below.

Route of exposure and type of effects	Results	Notes
Inhalation, local Exposure value corrected for PPE and frequency	1.65E-03 µg Cr(VI)/m³	Taken from Table 28
Excess risk level, based on RAC opinion, per worker for this task	6.62E-06	= 1.65E-03 x 0.004 (1 µg/m³ of Cr(VI) equals excess risk of 0.004)

***Table 30**: Risk characterisation for workers – carcinogenicity: WCS 1a*

For WCS 1b, the excess risk for workers via inhalation is reported in the table below.

Route of exposure and type of effects	Results	Notes
Inhalation, local Exposure value corrected for PPE and frequency	3.50E-05 µg Cr(VI)/m³	Taken from Table 29
Excess risk level, based on RAC opinion, per worker for this task	1.40E-07	= 3.50E-05 x 0.004 (1 µg/m³ of Cr(VI) equals excess risk of 0.004)

***Table 31**: Risk characterisation for workers – carcinogenicity: WCS 1b*

9.2.2.5 Risk characterisation: reproductive toxicity

The table below shows the risk characterisation for reproductive toxicity for inhalation exposure for this WCS. The risk characterisation is based on modelled Cr(VI) inhalation exposure data set out above, which are compared to the RAC DNEL for workers, derived for effects on fertility.

Route of exposure and type of effects	Results	
	WCS 1a	WCS 1b
Inhalation, local Exposure value corrected for PPE and frequency	1.65E-03 µg Cr(VI)/m³	3.50E-05 µg Cr(VI)/m³
RAC DNEL	43 µg Cr(VI)/m³	43 µg Cr(VI)/m³
Risk characterisation ratio (RCR)	3.85E-05	8.14E-07

***Table 32**: Risk characterisation: reproductive toxicity (inhalation exposure): WCS 1a and WCS 1b*

This WCS also involves the potential for dermal exposure when coupling and decoupling IBCs (or, in the future, the road tanker) to the inlet line to the bulk storage tank. The dermal exposure concentrations for this WCS are shown in the table below, based on modelling using a calculation-based approach.

Parameter	Results WCS 1a	Results WCS 1b	Notes
EU RAR modelling assumption (mg/cm²/d)	0.1	0.1	Uses upper end of range from EU RAR (ECB, 2005) from EASE for non-dispersive use with direct handling with incidental contact.
Skin contact area (cm²)	480	480	See section 9.1.8.3 for further details
Dermal load (mg/d)	48	48	Calculated: 0.1 x 480

Parameter	Results WCS 1a	Results WCS 1b	Notes
Body weight (kg)	70	70	Body weight for workers (Guidance IR & CSA, R.8 (ECHA, 2012))
Potential dermal exposure (mg/kg bw/d)	0.686	0.686	Calculated: 48/70
PPE efficiency (%)	95	95	An efficiency of 95% is assumed for hand exposure.
Potential dermal exposure, corrected for PPE (mg/kg bw/d)	0.0343	0.0343	Calculated: 0.686 x 0.05
Cr(VI) concentration (%)	23.8	27.8	The concentration of Cr(VI) is concentration of sodium dichromate as delivered x 0.397 (molecular weight fraction of Cr(VI) in sodium dichromate) For WCS 1a, concentration is 60% x 0.397 = 23.82% For WCS 1b, concentration is 70% x 0.397 = 27.79%
Frequency (number of occasions per worker per day averaged over the year)	0.0208	0.0004	Calculated in section 9.2.2.3
Potential dermal exposure to Cr(VI), corrected for frequency and PPE (µg/kg bw/d)	0.170	0.004	Calculated WCS 1a: 0.0343 x 0.238 x 0.0208 x 1,000 (to convert to µg) Calculated WCS 1b: 0.0343 x 0.278 x 0.0004 x 1,000 (to convert to µg)
RAC DNEL (µg Cr(VI)/kg bw/d)	43	43	RAC DNEL for workers (dermal), derived for effects on fertility
Risk characterisation ratio (RCR)	3.96E-03	8.49E-05	Potential dermal exposure / 43

***Table 33**: Modelled exposure and risk characterisation for reproductive toxicity (dermal exposure): WCS1*

As the risk assessment for reproductive toxicity must consider both dermal and inhalation exposure, the table below shows the dermal and inhalation exposure estimates (corrected for frequency and PPE), the RCR for both pathways of exposure separately, and the combined RCR with respect to reproductive toxicity.

Exposures and RCRs	WCS 1a	WCS 1b
Dermal exposure	0.170 µg/kg bw/d	0.004 µg/kg bw/d
RCR, dermal	3.96E-03	8.49E-05
Inhalation exposure	1.65E-03 µg Cr(VI)/m^3	3.50E-05 µg Cr(VI)/m^3
RCR, inhalation	3.85E-05	8.14E-07
RCR, combined	**4.00E-03**	**8.57E-05**
% contribution, dermal	99.04	99.05

***Table 34**: Exposure concentrations and risk characterisation for reproductive toxicity (combined): WCS1*

The data demonstrate that dermal exposure is almost exclusively responsible for the combined RCR. This finding is related to (a) the low inhalation exposure and (b) the conservative nature of dermal exposure modelling.

9.2.2.6 Conclusion on risk assessment

The modelled inhalation exposures of 7.94×10^{-5} mg Cr(VI)/m^3 8hr TWA (7.94×10^{-2} µg Cr(VI)/m^3) for WCS 1a and 9.13×10^{-5} mg Cr(VI)/m^3 8hr TWA (9.13×10^{-2} µg Cr(VI)/m^3) for WCS 1b, provide a worst case basis for risk characterisation given that the inputs for the ART modelling tool are conservative.

Carcinogenicity: An excess lung cancer mortality risk of 6.62×10^{-6} for WCS 1a and 1.40×10^{-7} for WCS 1b per worker is estimated based on the above exposure estimate and the RAC dose-response relationship for lung cancer mortality and can be considered to substantially overestimate the risk.

Reproductive toxicity: a modelled dermal exposure to Cr(VI) of 0.170 µg/kg bw/d for WCS 1a and 0.004 µg/kg bw/d for WCS 1b (corrected for frequency and PPE) per worker is estimated based on a conservative modelling approach. The RAC DNEL for dermal exposure to sodium dichromate is 43 µg Cr(VI)/kg bw/d, giving an RCR (dermal) of 3.96×10^{-3} for WCS 1a and 8.49×10^{-5} for WCS 1b, well below the threshold of 1, confirming that the estimated exposure is within acceptable limits.

Based on the above (modelled) inhalation exposures, and the RAC DNEL for inhalation exposure to sodium dichromate of 43 µg Cr(VI)/m^3, the resulting RCRs (inhalation) of 3.85×10^{-5} for WCS 1a and 8.14×10^{-7} for WCS 1b clearly demonstrate the risk is adequately controlled.

Summary: Exposure is adequately controlled. The emissions and consequently the exposures related to the receipt and storage of sodium dichromate are minimised. No further measures are considered necessary.

9.2.3 WCS 2: Sampling and analysis (PROC 9)

This WCS describes taking samples of the dichromate passivation solution from the drive side of the ETL5 line tank (WCS 2a) and their subsequent analysis in the on-site laboratory (WCS 2b). The results of sampling are used to verify the accuracy of the dosing system (see WCS 3) as well as monitor other important bath parameters. Both activities are performed by either Team Member 4 or 5 although this activity is split into two sub-WCS because the risk management measures differ.

Team Member 4 or 5 will take samples from the drive side of the ETL5 line tank via a dip method with a sample scoop once per shift. Sampling of the dichromate passivation solution takes about 10 minutes. Small volumes are collected in 200 mL PETG sample bottles with a screw top which is then manually sealed using a plastic cap and carried using a sample bottle carrier to the laboratory.

Sampling occurs only within the sodium dichromate area of the ETL5 line. Should there be any loss (e.g. spillage etc.), the passivation solution would flow into a floor drain which discharges into the chrome sump. As samples are collected within the sodium dichromate area, 'full chromium PPE' is worn.

Samples are analysed in the electrolytic tinning (ET) laboratory by transferring the passivation solution from the sample bottle using a pipette inside a fume cabinet (which is subject to thorough examination and testing in line with statutory requirements). Analysis is undertaken using Metrohm automatic titrators. Full chromium PPE is not required in the laboratory although disposable nitrile gloves and a lab coat are worn along with standard site PPE. Analysis of the samples takes approximately 10 minutes.

After analysis, samples are returned to the production line and discharged into the chemical treatment sump, after which the sodium dichromate is managed through waste management activities (see WCS 8).

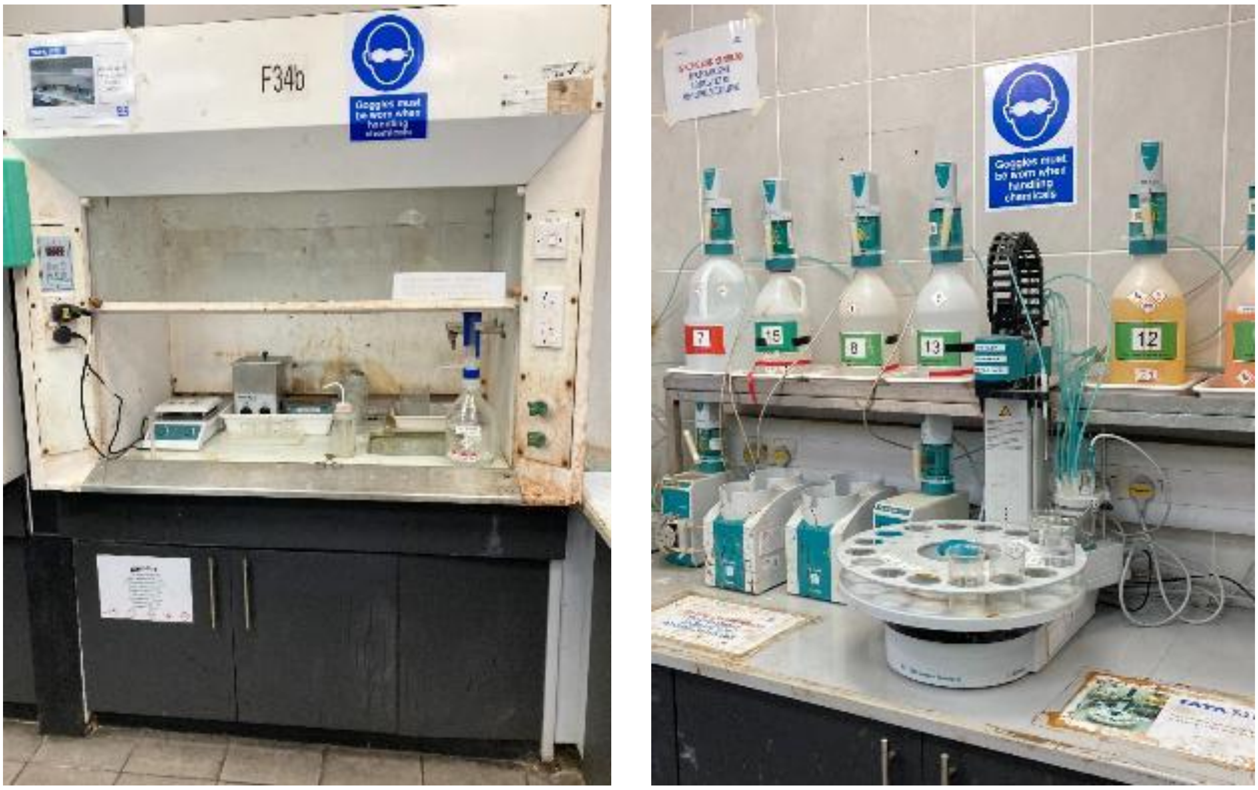


Figure 22: *On-site laboratory: fume cupboard (L) and auto-titrator (R)*

9.2.3.1 Risk management measures

Risk management measures are summarised in the tables below for WCS 2a and WCS 2b.

Means to minimise exposure	Description of the specific measures (with further information in section 9.1.7)
Containment	While taking the samples is not itself an enclosed process, once the sample bottles are filled, they are then sealed prior to being taken to the on-site laboratory. Sampling takes place in the sodium dichromate area; roller shutters segregate this area from the rest of the line. While these have to be partially opened on one side to allow access to the passivation tanks for sampling, other workers remain segregated from the area. Secondary containment is provided in that any loss from the passivation section on the mill floor level (e.g. small spills) would result in the liquid being channelled back into the sump in the basement, which is itself fully bunded. The floor under the installation is acid-resistant tilework.
Engineering controls	LEV is present to the passivation tanks and remains operational during sampling activities.
Administrative controls	Only small sample volumes are collected. Sampling time is limited. Procedures are in place covering sampling. Only authorised personnel perform this task and all personnel performing this task receive appropriate information, instructions and training.
PPE	Since the sampling point is located within the sodium dichromate area, operators must wear full chromium PPE.
Emergency response	Emergency procedures are in place. First aiders and first aid equipment and facilities are available at all times. Firewater is retained.
Monitoring	Workers performing this task are subject to health surveillance and biological monitoring.

Table 35: *Risk management measures: WCS 2a*

Means to minimise exposure	Description of the specific measures (with further information in section 9.1.7)
Engineering controls	LEV: The sample bottles are handled inside a fume cabinet.
Administrative controls	Analysis involves handling only very small quantities of solution. Following analysis, waste passivation solution is returned to the chrome sump. Procedures are in place covering analysis. Only authorised personnel perform this task and all personnel performing this task receive appropriate information, instructions and training.
PPE	Standard site PPE plus lab coat and nitrile gloves.
Emergency response	Emergency procedures are in place. First aiders and first aid equipment and facilities are available at all times.
Monitoring	Workers performing this task are subject to health surveillance and biological monitoring.

Table 36*: Risk management measures: WCS 2b*

9.2.3.2 Conditions of use

The conditions of use for WCS 2a (taking samples) are described in the table below, personal monitoring data provides exposure levels.

Product (article) characteristics
• Product type: Powders dissolved in a liquid
• Weight Fraction: [redacted]
• Viscosity: Liquid with low viscosity (like water)
Amount used (or contained in articles), frequency and duration of use/exposure
• Exposure duration: 10 minutes
• Frequency: once per shift (based on the 12h shift regime, twice per day)
• Emission sources: Near field exposure is relevant
Technical and organisational conditions and measures
• Activity Class for liquids: Transfer of liquid products (small sample taken)
• Process temperature: room temperature, temperature in the tanks is [redacted]
• Local exhaust ventilation (select efficiency): Yes, LEV provided to all passivation tanks.
• Room size: Large room
Conditions and measures related to personal protection, hygiene and health evaluation
• Respiratory protection: yes, full face masks with P3 filter, APF of 40.
• Effective housekeeping practices in place?: Yes, demonstrable and effective housekeeping practices are present.
Other conditions affecting workers exposure
• Process fully enclosed?: No
• Segregation: No, in that the operator is already present within the boundaries of the segregated sodium dichromate area. However, other workers are segregated from this area.
• Place of use: Indoors

Table 37*: Conditions of use: WCS 2a*

The conditions of use for WCS 2b (laboratory analysis) are described in the table below, personal monitoring data provides exposure levels.

Product (article) characteristics
Product type: Powders dissolved in a liquid
Weight Fraction: [redacted]
Viscosity: Liquid with low viscosity (like water)
Amount used (or contained in articles), frequency and duration of use/exposure
Exposure duration: 10 minutes
Frequency: once per shift (based on the 12h shift regime, twice per day)
Emission sources: Near field exposure is relevant
Technical and organisational conditions and measures
Activity class: Transfer of liquid products, falling liquids, < 0.1 L/minute, open process, splash loading
Localised controls: LEV (fume cabinet). No secondary controls.
Full enclosure: No
Effective housekeeping practices in place: Yes
Secondary source: No
Conditions and measures related to personal protection, hygiene and health evaluation
Respiratory protection: No
Other conditions affecting workers exposure
Place of use: Indoors, small room, good natural ventilation

***Table 38**: Conditions of use: WCS 2b*

9.2.3.3 Worker exposure

Personal exposure measurements for the ‘anode attendant’ (team members 4 and 5) covering both sampling and laboratory analysis are collected during each annual campaign. Static measurements are also taken annually above the passivation line tanks (drive side) which are relevant for WCS 2a.

Both personal and static monitoring cover the majority of the duration of the shift and so do not allow for differentiation of exposure during the short periods of time taking samples (WCS 2a) or performing laboratory analysis (WCS 2b). However, personal and static measurements over these longer periods show that the total exposure of the anode attendant is low.

The measurements relevant to this WCS are reported in the table below (note: ‘<’ denotes any recorded value below limit of detection (LOD)).

Type	Year	Filter conc. of Cr(VI) (mg/m^3)	Sampling duration (mins)	Shift length (hrs)	12hr TWA (mg/m^3) (factored)
Personal: Anode Attendant 1	2025	<0.000009	528	12	1.23E-05
Personal: Anode Attendant 2	2025	<0.00001	493	12	1.46E-05
Personal: Anode Attendant	2024	<0.000009	559	12	1.16E-05
Personal: Anode Attendant	2023	0.000039	507	12	5.54E-05
Personal: Anode attendant	2022	<0.0000095	534	12	1.28E-05
Static: Above Passivation (Drive Side)	2025	<0.000009	573	N/A	N/A

Type	Year	Filter conc. of Cr(VI) (mg/m^3)	Sampling duration (mins)	Shift length (hrs)	12hr TWA (mg/m^3) (factored)
Static: Above Passivation (Drive Side)	2024	0.000014	541	N/A	N/A
Static: Above Passivation (Drive Side)	2023	0.000028	489	N/A	N/A
Static: Above Passivation (Drive Side)	2022	0.00035	481	N/A	N/A

Table 39*: Measurement data: WCS 2a and 2b*

For WCS 2a (taking samples), the exposure concentrations are reported in the table below. These use the highest recorded personal measurement (5.54E-05 mg Cr(VI)/m^3 12hr TWA) from the previous four years.

Route of exposure and type of effects	Results	Notes
Inhalation, local Exposure value (12hr TWA)	5.54E-05 mg Cr(VI)/m^3	Highest recorded measurement (filter concentration has been factored upwards to adjust to 12hr shift length).
Inhalation, local Exposure value (12hr TWA) corrected for PPE	1.38E-06 mg Cr(VI)/m^3	RPE of APF 40 used.
Frequency of operation (per year) over all operators	512	= 1 x per shift x 2 shifts per day x 1 operator x 256 max operational days = activity occurs up to 512 times / year
Number of operators	36	This is the total number of operators that could perform this task. 4 shift teams with 9 workers capable of performing this task.
Number of working days per year per operator	145	Working days for production shift team operators on 12hr shifts.
Number of occasions per worker per day averaged over the year	0.0981	= 512 / 36 / 145
Inhalation, local Exposure value corrected for PPE and frequency	1.36E-04 µg Cr(VI)/m^3	= 1.38E-06 x 0.0981 x 1,000 (to convert to µg)

Table 40*: Exposure concentrations for workers: WCS 2a*

For WCS 2b (laboratory analysis), the operator does not wear RPE and so the exposure value cannot be corrected for PPE. The resulting exposure concentrations are reported in the table below, again using the highest recorded personal measurement from the previous four years.

Route of exposure and type of effects	Results	Notes
Inhalation, local Exposure value (12hr TWA)	5.54E-05 mg Cr(VI)/m^3	Highest recorded measurement (filter concentration has been factored upwards to adjust to 12hr shift length).
Inhalation, local Exposure value (12hr TWA) corrected for PPE	5.54E-05 mg Cr(VI)/m^3	No RPE used in the laboratory.

Route of exposure and type of effects	Results	Notes
Frequency of operation (per year) over all operators	512	= 1 x per shift x 2 shifts per day x 1 operator x 256 max operational days = activity occurs up to 512 times per year
Number of operators	36	This is the total number of operators that could perform this task.
Number of working days per year per operator	145	Working days for production shift team operators on 12hr shifts.
Number of occasions per worker per day averaged over the year	0.0981	= 512 / 36 / 145
Inhalation, local Exposure value corrected for PPE and frequency	5.43E-03 µg Cr(VI)/m^3	= 5.54E-05 x 0.0981 x 1,000 (to convert to µg)

***Table 41**: Exposure concentrations for workers: WCS 2b*

9.2.3.4 Risk characterisation: carcinogenicity

For WCS 2a (taking samples), the excess risk for workers via inhalation is reported in the table below.

Route of exposure and type of effects	Results	Notes
Inhalation, local Exposure value corrected for PPE and frequency	1.36E-04 µg Cr(VI)/m^3	Taken from Table 40
Excess risk level, based on RAC opinion, per worker for this task	5.43E-07	= 1.36-04 x 0.004 (1 µg/m^3 of Cr(VI) equals excess risk of 0.004)

***Table 42**: Risk characterisation for workers – carcinogenicity: WCS 2a*

For WCS 2b (laboratory analysis), the excess risk for workers via inhalation is reported in the table below.

Route of exposure and type of effects	Results	Notes
Inhalation, local Exposure value corrected for PPE and frequency	5.43-03 µg Cr(VI)/m^3	Taken from Table 41
Excess risk level, based on RAC opinion, per worker for this task	2.17E-05	= 5.43E-03 x 0.004 (1 µg/m^3 of Cr(VI) equals excess risk of 0.004)

***Table 43**: Risk characterisation for workers – carcinogenicity: WCS 2b*

9.2.3.5 Risk characterisation: reproductive toxicity

The table below shows the risk characterisation for reproductive toxicity for inhalation exposure for this WCS. The risk characterisation is based on measured Cr(VI) inhalation exposure data set out above, which are compared to the RAC DNEL for workers, derived for effects on fertility.

Route of exposure and type of effects	Results		
Source	WCS 2a	WCS 2b	Notes
Inhalation, local Exposure value corrected for PPE and frequency	1.36E-04 µg $Cr(VI)/m^3$	5.43E-03 µg $Cr(VI)/m^3$	Calculated in section 9.2.3.3 for WCS 2a and WCS 2b
RAC DNEL	43 µg $Cr(VI)/m^3$	43 µg $Cr(VI)/m^3$	RAC DNEL for workers (inhalation), derived for effects on fertility
Risk characterisation ratio (RCR)	3.16E-06	1.26E-04	-

Table 44: *Risk characterisation: reproductive toxicity (inhalation exposure): WCS 2a and 2b*

This WCS also involves the potential for dermal exposure when sampling from the drive side of the passivation tank and whilst analysing sodium dichromate samples in the laboratory. Gloves are worn in both cases and so WCS 2a and 2b can be assessed together to produce one value for dermal exposure. The dermal exposure concentrations for this WCS are shown in the table below, based on modelling using a calculation-based approach.

Parameter	Results	Notes
EU RAR modelling assumption ($mg/cm^2/d$)	0.1	Uses upper end of range from EU RAR (ECB, 2005) from EASE for non-dispersive use with direct handling with incidental contact.
Skin contact area (cm^2)	480	See section 9.1.8.3 for further details
Dermal load (mg/d)	48	Calculated: 0.1 $mg/cm^2/d$ x 480 cm^2
Body weight (kg)	70	Body weight for workers (Guidance IR & CSA, R.8 (ECHA, 2012))
Potential dermal exposure (mg/kg bw/d)	0.686	Calculated: 48 mg/d / 70 kg
PPE efficiency (%)	95%	An efficiency of 95% is assumed for hand exposure.
Potential dermal exposure, corrected for PPE (mg/kg bw/d)	0.0343	Calculated: 0.686 x 0.05
Cr(VI) concentration (%)	[redacted]	[redacted]
Frequency (number of occasions per worker per day averaged over the year)	[redacted]	[redacted]
Potential dermal exposure to Cr(VI), corrected for frequency and PPE (µg/kg bw/d)	[redacted]	[redacted]
RAC DNEL (µg Cr(VI)/kg bw/d)	43	RAC DNEL for workers (dermal), derived for effects on fertility
Risk characterisation ratio (RCR)	9.31E-04	[redacted]

Table 45: *Modelled exposure and risk characterisation for reproductive toxicity (dermal exposure): WCS 2a and 2b*

As the risk assessment for reproductive toxicity must consider both dermal and inhalation exposure, the table below shows the dermal and inhalation exposure estimates (corrected for frequency and PPE), the RCR for both pathways of exposure separately, and the combined RCR with respect to reproductive toxicity.

Exposures and RCRs	WCS 2a	WCS 2b
Dermal exposure	0.040 µg/kg bw/d	0.040 µg/kg bw/d
RCR, dermal	9.31E-04	9.31E-04
Inhalation exposure	1.36E-04 µg Cr(VI)/m^3	5.43E-03 µg Cr(VI)/m^3
RCR, inhalation	3.16E-06	1.26E-04
RCR, combined	**9.35E-04**	**1.06E-03**
% contribution, dermal	99.66%	88.06%

Table 46*: Exposure concentrations and risk characterisation for reproductive toxicity (combined): WCS2a and 2b*

The data demonstrate that dermal exposure is almost exclusively responsible for the combined RCR. This finding is related to (a) the low inhalation exposure and (b) the conservative nature of dermal exposure modelling.

9.2.3.6 Conclusion on risk assessment

The measured inhalation exposure of 5.54×10^{-5} mg Cr(VI)/m³ 12hr TWA (0.0554 µg Cr(VI)/m^3) provides a worst case basis for risk characterisation given that this represents the highest level of exposure measured since 2022 and accounts for the anode operator's measured exposure across a whole shift performing this and other tasks, rather than the short period of time that this WCS covers (10 mins for sampling and 10 mins for subsequent laboratory analysis).

Carcinogenicity: An excess lung cancer mortality risk of 5.43×10^{-7} for WCS 2a (sampling) and 2.17×10^{-5} for WCS 2b (laboratory analysis) per worker is estimated based on the above exposure estimate and the RAC dose-response relationship for lung cancer mortality and can be considered to substantially overestimate the risk.

Reproductive toxicity: a modelled dermal exposure to Cr(VI) of 0.040 µg/kg bw/d for WCS 2a (sampling) and WCS 2b (laboratory analysis) per worker, corrected for frequency and PPE, is estimated based on a conservative modelling approach. The RAC DNEL for dermal exposure for sodium dichromate is 43 µg Cr(VI)/kg bw/d, giving an RCR (dermal) of 9.31×10^{-4}.

A potential inhalation exposure to Cr(VI) of 1.36×10^{-4} µg Cr(VI)/m^3 for WCS 2a (sampling) and 5.43×10^{-3} µg Cr(VI)/m^3 for WCS 2b (laboratory analysis) per worker, corrected for frequency and RPE, is estimated based on personal exposure measurements. The RAC DNEL for inhalation exposure for sodium dichromate is 43 µg Cr(VI)/m^3. This gives a RCR (inhalation) of 3.16×10^{-6} for WCS 2a (sampling) and 1.26×10^{-4} for WCS 2b (laboratory analysis).

Summing the RCR (dermal) and RCR (inhalation) for WCS 2a and WCS 2b gives a total RCR of 9.35×10^{-4} and 1.06×10^{-3} respectively, well below the threshold of 1, clearly demonstrating the risk is adequately controlled.

Summary: Exposure is adequately controlled. The emissions and consequently the exposures related to the sampling and analysis of the dichromate passivation solution are minimised. No further measures are considered necessary.

9.2.4 WCS 3: Adding sodium dichromate to the circulation tank (PROC 1)

This WCS describes the addition of aqueous sodium dichromate from the bulk storage tank to the circulation tank in order to replenish the passivation solution (to meet a target sodium dichromate concentration of [redacted]). Dosing from the bulk storage tank to the circulation tank is automatic based on conductivity (determined by a probe in the circulation tank) and gravity-fed.

This process is automated, requires no human intervention and is fully enclosed. Therefore, there is no potential exposure to workers.

9.2.4.1 Risk management measures

Risk management measures are summarised in the tables below for this WCS.

Means to minimise exposure	Description of the specific measures (with further information in section 9.1.7)
Containment	Primary containment is maintained at all times throughout WCS 3. The existing bulk storage tank is bunded and the future bulk storage tank will be double-skinned, providing secondary containment. Any spillages in the circulation tank will be channelled into the sump in the basement area which is also bunded, again providing secondary containment.
Engineering controls	There is a dosing probe in the circulation tank that alerts the system when additional sodium dichromate is required. The sodium dichromate is then replenished automatically and gravity-fed into the circulation tank in the basement.
Administrative controls	Not applicable to WCS 3. This process is automated and enclosed. There is no potential worker exposure.
PPE	Not applicable to WCS 3. This process is automated and enclosed. There is no potential worker exposure.
Emergency response	Emergency procedures are in place. First aiders and first aid equipment and facilities are available at all times. Firewater is retained.
Monitoring	Not applicable to WCS 3. This process is automated and enclosed, meaning that there is no potential worker exposure route.

Table 47*: Risk management measures: WCS 3*

9.2.4.2 Conditions of use

The conditions of use are described in the table below:

Product (article) characteristics
Product type: Powders dissolved in a liquid or incorporated in a liquid matrix
Concentration: Weight fraction: 0.6 (60%) or 0.7 (70%) based on current and future supply arrangements
Viscosity: Low
Amount used (or contained in articles), frequency and duration of use/exposure
Duration of activity: Not applicable. Additions are controlled by an automated system and made as required to maintain the target concentration of sodium dichromate in the circulation tank.
Frequency of task: Not applicable. Additions are controlled by an automated system and made as required to maintain the target concentration of sodium dichromate in the circulation tank.
Technical and organisational conditions and measures
Primary emission source located in the breathing zone of the worker: No

Activity class: Transfer of liquids
Enclosure: Process is fully enclosed and the integrity of that enclosure regularly monitored
Location: Indoors, only good natural ventilation
Secondary emissions sources: No
Conditions and measures related to personal protection, hygiene and health evaluation
Respiratory protection: No

***Table 48**: Conditions of use: WCS 3*

9.2.4.3 Worker exposure

For WCS 3, the process is fully enclosed within a sealed piping system running from the bulk storage tank to the circulation tank. Additions are controlled automatically via a dosing probe in the circulation tank, therefore eliminating any direct handling or manual intervention by workers. As a result, there is no feasible pathway for worker exposure under normal operating conditions.

Given the absence of potential exposure, a quantitative risk assessment based on measured or modelled data has not been performed for this WCS. Instead, a qualitative risk assessment has been conducted to confirm that the design and operational controls effectively prevent worker contact with sodium dichromate, ensuring that the risk is negligible.

9.2.4.4 Risk characterisation: carcinogenicity

Not applicable – no quantitative risk assessment has been conducted for this WCS as there is no potential exposure.

9.2.4.5 Risk characterisation: reproductive toxicity

Not applicable – no quantitative risk assessment has been conducted for this WCS as there is no potential exposure.

9.2.4.6 Conclusion on risk assessment

Sodium dichromate is added to the circulation tank via a fully enclosed system, i.e. from the bulk storage tank via dedicated pipework to the circulation tank. The circulation tank is enclosed and located in a segregated room to the production line. Primary containment is maintained throughout and no worker exposure is reasonably foreseeable under normal operating conditions. There is no potential for worker exposure (even indirect or incidental) meaning that quantitative exposure estimates (measured or modelled) are not required for this WCS. In such cases, and in line with ECHA guidance (ECHA, 2016c), a qualitative approach has been taken to this WCS, supported by a clear description of operational conditions and risk management measures. The risk is considered adequately controlled and no further measures are considered necessary.

9.2.5 WCS 4: Passivation (PROC 13)

This WCS considers the passivation process, described in detail in section 9.1.3 above. The passivation of tin-plated steel strip is a continuous process, and also a mostly contained process. The steel strip enters and leaves the passivation tanks with suspended anodes through openings on either side of the tanks. LEV in the form of receiving (canopy) hoods cover the entire surface area of the top of the tanks, with LEV also fitted below the tanks. The passivation section of the ETL5 line is itself enclosed within industrial roller-shutter doors which segregate this area from the rest of the line (see Figure 23 below).

[redacted]

Figure 23*: Passivation section on the ETL5 line. Image on the left shows roller shutters closed (ground floor). Image on the right shows roller shutters open for maintenance purposes (first floor). Bottom of roller shutters go all the way to the floor when closed.*

The team leader (or deputy team leader when the team leader is unavailable) carries out control rounds to inspect the ETL5 production line and performs housekeeping tasks. For these activities, the team leader/deputy does not need to enter the chemical treatment (passivation) area behind the roller-shutters. The team leader normally performs two inspection rounds per shift, which take about 20 minutes each. The housekeeping tasks take around 20 minutes per shift. Although the team leader will not be in the immediate vicinity of the passivation area and outside the roller-shutter doors, there is the potential for exposure as a result of being in proximity to the passivation tanks during the inspection rounds and housekeeping activities.

When the line is not running (i.e. during maintenance – WCS 7), liquid in the passivation tanks is dropped back into the circulation tank and held, i.e. the tanks only contain liquid during production. In the event of any loss of containment from the passivation tanks (e.g. overfill, leak, catastrophic tank failure), liquid will be channelled into the sump in the basement area which is bunded (secondary containment).

9.2.5.1 Risk management measures

Risk management measures are summarised in the tables below for this WCS.

Means to minimise exposure	Description of the specific measures (with further information in section 9.1.7)
Containment	The passivation tanks are mostly (but not wholly) enclosed. This is achieved through the design of the tanks (steel strip passes through openings on the sides) and the LEV (canopy hoods positioned above and below the entire liquid surface of the passivation solution). The passivation section is itself enclosed behind industrial roller shutter doors which physically segregate this area from the rest of the ETL5 line. Secondary containment is provided in that any loss from the passivation section on the mill floor level (e.g. leaks or rupture of line tanks or associated pipework) would result in the liquid being channelled back into the sump in the basement, which is itself fully bunded.
Engineering controls	The process control systems allow for automated and remote operation of the passivation line, almost eliminating the need for operator intervention on the line itself (within the passivation area), thereby significantly reducing exposure.

Means to minimise exposure	Description of the specific measures (with further information in section 9.1.7)
	LEV in the form of receiving (canopy) hoods cover the entire surface area of the top and the bottom of the tanks and extract Cr(VI)-containing air through a wet scrubber system. Waste scrubber water is directed to the chrome sump and then enters the WWTP where it is treated (over-stoichiometric addition of a reductant).
Administrative controls	Only dedicated personnel perform this task. All personnel performing this task receive appropriate information, instructions and training.
PPE	Standard PPE: protective clothing, safety helmet, safety footwear, hearing protection, protective eyewear. Workers that must enter the sodium dichromate area will wear full chromium PPE.
Emergency response	Emergency procedures are in place. First aiders and first aid equipment and facilities are available at all times. Firewater is retained.
Monitoring	Workers performing this task are subject to health surveillance and biological monitoring.

***Table 49**: Risk management measures: WCS 4*

9.2.5.2 Conditions of use

The conditions of use are described in the table below and account for estimated exposure levels.

Product (article) characteristics
• Concentration of substance in mixture: [redacted] sodium dichromate
Amount used (or contained in articles), frequency and duration of use/exposure
• Exposure duration: 1h per shift Inspection rounds take approximately 20 min. each, hence 40 min per shift. Housekeeping tasks take approximately 20 min per shift.
• Frequency: 2 control rounds per shift, 1 set of housekeeping tasks.
• Emission sources: No near field exposure. The operator does not enter the chemical treatment area and hence does not go near the passivation tanks.
Technical and organisational conditions and measures
• Activity Class for liquids: Presence of liquid in mostly enclosed container (passivation tanks)
• Local exhaust ventilation: Yes, LEV provided to all passivation tanks.
• General ventilation: Good level of general ventilation in the production hall due to vehicle bay access doors.
• Room size: Large room
Conditions and measures related to personal protection, hygiene and health evaluation
• Effective housekeeping practices in place?: Yes, demonstrable and effective housekeeping practices are present.
Other conditions affecting workers exposure
• Process fully enclosed?: Yes
• Personal Enclosure: No personal enclosure during this activity.
• Place of use: Indoors.

***Table 50**: Conditions of use: WCS 4*

9.2.5.3 Worker exposure

Personal exposure measurements for the team leader covering WCS 4 are collected during each annual campaign. Static measurements are also taken annually around the passivation line tanks, both inside the segregated area (drive side) and outside it (operator side, front and rear of passivation section), which provide further insight into exposure during passivation. The measurements relevant to this WCS are reported in the table below (note: ‘<’ denotes any recorded value below limit of detection (LOD)).

Type	Year	Filter conc. of Cr(VI) (mg/m^3)	Sampling duration (mins)	Shift length (hrs)	12hr TWA (mg/m^3) (factored)
Personal: Team leader	2024	<0.000009	557	12	1.16E-05
Personal: Team leader	2023	0.000032	512	12	4.50E-05
Personal: Team leader	2022	<0.00001	526	12	1.37E-05
Static: Above Passivation (Drive Side)	2025	<0.000009	573	N/A	N/A
Static: Above Passivation (Drive Side)	2024	0.000014	541	N/A	N/A
Static: Above Passivation (Drive Side)	2023	0.000028	489	N/A	N/A
Static: Above Passivation (Drive Side)	2022	0.00035	481	N/A	N/A
Static: Above Passivation (Operator Side)	2025	<0.000009	572	N/A	N/A
Static: Above Passivation (Operator Side)	2024	0.000023	541	N/A	N/A
Static: Above Passivation (Operator Side)	2023	0.00001	489	N/A	N/A
Static: Above Passivation (Operator Side)	2022	0.00048	480	N/A	N/A
Static: Front of Passivation	2025	<0.000009	544	N/A	N/A
Static: Front of Passivation	2024	0.000053	542	N/A	N/A
Static: Front of Passivation (day 1)	2023	0.00015	501	N/A	N/A
Static: Front of Passivation (day 2)	2023	0.00019	526	N/A	N/A
Static: Front of Passivation (day 1)	2022	0.00024	482	N/A	N/A
Static: Front of Passivation (day 2)	2022	<0.000011	437	N/A	N/A
Static: Rear of Passivation	2025	<0.000009	582	N/A	N/A
Static: Rear of Passivation	2024	0.000029	541	N/A	N/A
Static: Rear of Passivation	2023	0.000063	492	N/A	N/A
Static: Rear of Passivation	2022	0.00019	479	N/A	N/A
Static: Below Passivation (Operator Side)	2025	<0.000009	590	N/A	N/A
Static: Below Passivation (Operator Side)	2024	0.000055	533	N/A	N/A
Static: Below Passivation (Operator Side)	2023	0.00025	498	N/A	N/A
Static: Below Passivation (Operator Side)	2022	0.0001	480	N/A	N/A
Static: Passivation Basement ('Cellar')	2025	<0.000009	588	N/A	N/A
Static: Passivation Basement ('Cellar')	2024	<0.0000094	535	N/A	N/A
Static: Passivation Basement ('Cellar')	2023	<0.00001	485	N/A	N/A
Static: Passivation Basement ('Cellar')	2022	<0.000011	480	N/A	N/A

***Table 51**: Measurement data: WCS 4*

For WCS 4, the exposure concentrations are reported in the table below. These use the highest recorded personal measurement (4.50E-05 mg Cr(VI)/m^3 12hr TWA) from the previous four years.

Route of exposure and type of effects	Results	Notes
Inhalation, local Exposure value (12hr TWA)	4.50E-05 mg Cr(VI)/m^3	Highest recorded measurement (filter concentration has been factored upwards to adjust to 12hr shift length).
Inhalation, local Exposure value (12hr TWA) corrected for PPE	4.50E-05 mg Cr(VI)/m^3	No RPE used during inspections of line.
Frequency of operation (per year) over all operators	512	= 1 x per shift x 2 shifts per day x 1 operator x 256 max operational days = activity occurs up to 512 times / year
Number of operators	4	This is the total number of operators that could perform this task. 4 shift teams with 1 team leader capable of performing this task.
Number of working days per year per operator	145	Working days for production shift team operators on 12hr shifts.
Number of occasions per worker per day averaged over the year	0.8828	= 512 / 4 / 145
Inhalation, local Exposure value corrected for PPE and frequency	3.97E-02 µg Cr(VI)/m^3	= 4.50E-05 x 0.8828 x 1,000 (to convert to µg)

***Table 52**: Exposure concentrations for workers: WCS 4*

9.2.5.4 Risk characterisation: Carcinogenicity

For WCS 4, the excess risk for workers via inhalation is reported in the table below.

Route of exposure and type of effects	Results	Notes
Inhalation, local Exposure value corrected for PPE and frequency	3.97E-02 µg Cr(VI)/m^3	Taken from Table 52
Excess risk level, based on RAC opinion, per worker for this task	1.59E-04	= 3.97E-02 x 0.004 (1 µg/m^3 of Cr(VI) equals excess risk of 0.004)

***Table 53**: Risk characterisation for workers – carcinogenicity: WCS 4*

9.2.5.5 Risk characterisation: reproductive toxicity

The table below shows the risk characterisation for reproductive toxicity for inhalation exposure for this WCS. The risk characterisation is based on measured Cr(VI) inhalation exposure data set out above, which are compared to the RAC DNEL for workers, derived for effects on fertility.

Route of exposure and type of effects	Results	
Source	**WCS 4**	**Notes**
Inhalation, local Exposure value corrected for PPE and frequency	3.97E-02 µg Cr(VI)/m^3	Taken from Table 52
RAC DNEL	43 µg Cr(VI)/m^3	RAC DNEL for workers (inhalation), derived for effects on fertility
Risk characterisation ratio (RCR)	9.24E-04	3.97E-02 / 43

***Table 54**: Risk characterisation: reproductive toxicity (inhalation exposure): WCS 4*

This WCS does not involve the potential for dermal exposure; the team leader remains outside the segregated passivation area during inspection and housekeeping tasks, therefore no sodium dichromate is expected to come into contact with the skin. As a result, no modelling of dermal exposure has been undertaken for this WCS.

9.2.5.6 Conclusion on risk assessment

The measured inhalation exposure of 4.50 x 10^{-5} mg Cr(VI)/m³ 12hr TWA (0.045 µg Cr(VI)/m^3) provides a worst case basis for risk characterisation given that this represents the highest level of exposure measured since 2022 and accounts for the team leader's measured exposure across a whole shift performing this and other tasks, rather than the short period of time that this WCS covers (1 hour total per shift).

Carcinogenicity: An excess lung cancer mortality risk of 1.59 x 10^{-4} for WCS 4 per worker is estimated based on the above exposure estimate and the RAC dose-response relationship for lung cancer mortality and can be considered to substantially overestimate the risk.

Reproductive toxicity: Dermal exposure is not modelled for this WCS as dermal exposure can be ruled out, given the activities conducted. A potential inhalation exposure to Cr(VI) of 3.97 x 10^{-2} µg Cr(VI)/m^3 per worker, corrected for frequency, is estimated based on the above exposure estimate. The RAC DNEL for inhalation exposure for sodium dichromate is 43 µg Cr(VI)/m^3. This gives a RCR (inhalation) of 9.24 x 10^{-4} for WCS 4, well below the target of 1, clearly demonstrating the risk is adequately controlled.

Summary: Exposure is adequately controlled. The emissions and consequently the exposures related to activities near the passivation process are minimised. No further measures are considered necessary.

9.2.6 WCS 5: Control room activities (PROC 0)

All control room activities are covered under this WCS. During a shift, all production shift team operators will spend time in one of two control rooms, the entry end control room or the exit end control room. The actual amount of time is dependent on the team member's role. For example, team members 8 and 9 (exit end inspector) performing inspections of the finished steel strip will usually spend 10 or more hours of their 12-hour shift in the exit end control room. Team members working in the control rooms are in the 'far field' of any Cr(VI) source.

The entry end ETL5 control room is located approximately 100 m from the nearest Cr(VI) source (the passivation area). The exit end ETL5 control room is located approximately 20 m from the passivation area. Given these distances, and because both control rooms are separate rooms, any exposure in either of the control rooms is expected to be negligible.

[redacted] 

Figure 24: *ETL5 entry end control room from inside (left) and outside (right)*

9.2.6.1 Risk management measures

Risk management measures are summarised in the tables below for this WCS.

Means to minimise exposure	Description of the specific measures (with further information in section 9.1.7)
General comments	All measures concerning minimisation of emissions and control of exposure described in the various other WCS are relevant for this scenario as well, because control room activities are 'far field'.
Containment	The operators are in separate rooms (personal enclosure) ca. 20 m (exit end control room) and ca. 100 m (entry end control room) away from any potential Cr(VI) source.
Engineering controls	The process control systems allow for automated and remote operation of the production line, almost eliminating the need for operator intervention on the line itself (including within the enclosed passivation area), thereby significantly reducing exposure.
Administrative controls	Only dedicated and authorised personnel will be present in the control room. Workers in the control room follow specific procedures in which they have been appropriately trained.
PPE	Standard PPE: protective clothing, safety helmet, safety footwear, hearing protection, protective eyewear.
Emergency response	Emergency procedures are in place. First aiders and first aid equipment and facilities are available at all times.
Monitoring	Production shift team members are subject to health surveillance and biological monitoring.

Table 55: *Risk management measures: WCS 5*

9.2.6.2 Conditions of use

The conditions of use are described in the table below and account for estimated exposure levels.

Product (article) characteristics
• Concentration of substance in mixture: not relevant as the operator is 'far field' of any potential source of Cr(VI)
Amount used (or contained in articles), frequency and duration of use/exposure
• Exposure duration: dependent on function and other activities, but can last up to 12h (i.e. full shift)
• Frequency: Each operator uses the control room each shift

• Emission sources: Far field exposure is relevant
Technical and organisational conditions and measures
• Activity Class for liquids: No Cr(VI) related activities relevant for this activity
• Process temperature: Room temperature
• Local exhaust ventilation (select efficiency): No LEV. Only natural ventilation, air supply is from the factory floor.
• Room size: 30 m^2 / 105 m^3
Conditions and measures related to personal protection, hygiene and health evaluation
• Effective housekeeping practices in place?: Yes, demonstrable and effective housekeeping practices are present.
Other conditions affecting workers exposure
• Process fully enclosed?: No (although all potential Cr(VI) sources are far field)
• Segregation: No
• Personal Enclosure: Yes, operator in control room
• Place of use: Indoors

***Table 56**: Conditions of use: WCS 5*

9.2.6.3 Worker exposure

The activities covered by this WCS are performed by all production shift team members who spend the majority of their time in the control room over the course of their shifts. However, the personal exposure measurements for the team leader and team members 4 and 5 ('anode attendants') obtained during the annual campaigns are not used for this WCS because their roles involve additional activities which are not 'far field' in nature. Instead, the personal exposure measurements for team member 3 (loading coils to line) and team member 2 (exit end inspector) in addition to team member 7 (crane operation) are used as they are more representative.

Static measurements are also taken annually with a static sampler positioned in the control room and exit end pulpit.

Both personal and static monitoring cover the majority of the duration of the shift. As with other WCS, the filter concentrations recorded have been factored upwards to account for the unmonitored time over the remainder of the shift. The measurements relevant to this WCS are reported in the table below. All measurements show that exposure is low (note: '<' denotes any recorded value below limit of detection (LOD)).

Type	Year	Filter conc. of Cr(VI) (mg/m^3)	Sampling duration (mins)	Shift length (hrs)	12hr TWA (mg/m^3) (factored)
Personal: Tata Operative (Shift Team): Team Member Exit End Feed	2025	<0.00001	520	12	1.38E-05
Personal: Tata Operative (Shift Team): Team Member Entry End Feed	2025	<0.00001	485	12	1.48E-05
Personal: Tata Operative (Shift Team): Exit End Inspector ('General Inspector')	2025	<0.000009	545	12	1.19E-05
Personal: Tata Operative (Shift Team): Crane Operator ('Logistics Manager')	2025	<0.00001	478	12	1.51E-05

Type	Year	Filter conc. of Cr(VI) (mg/m³)	Sampling duration (mins)	Shift length (hrs)	12hr TWA (mg/m³) (factored)
Personal: Tata Operative (Shift Team): Exit End Inspector ('General Inspector')	2024	<0.000009	557	12	1.16E-05
Personal: Tata Operative (Shift Team): Crane Operator ('Logistics Manager')	2024	<0.000009	557	12	1.16E-05
Personal: Tata Operative (Shift Team): Exit End Inspector ('General Inspector')	2023	0.000017	510	12	2.40E-05
Personal: Tata Operative (Shift Team): Crane Operator ('Logistics Manager')	2023	0.000016	497	12	2.32E-05
Personal: Tata Operative (Shift Team): Exit End Inspector ('General Inspector')	2022	<0.0000094	529	12	1.28E-05
Personal: Tata Operative (Shift Team): Crane Operator ('Logistics Manager')	2022	0.00007	527	12	9.56E-05
Static: Exit End Control Room (day 1, production)	2025	<0.000009	588	N/A	N/A
Static: Exit End Control Room (day 2, maintenance)	2025	<0.00001	512	N/A	N/A
Static: Exit End Control Room	2024	<0.0000091	552	N/A	N/A
Static: Exit End Control Room	2023	<0.00001	506	N/A	N/A
Static: Exit End Control Room	2022	<0.00001	523	N/A	N/A
Static: Exit End pulpit	2024	<0.0000093	523	N/A	N/A
Static: Exit End pulpit	2023	0.000015	531	N/A	N/A
Static: Exit End pulpit	2022	0.000047	481	N/A	N/A

***Table 57**: Measurement data: WCS 5*

The exposure concentrations and excess risk level are reported in the table below. These use the highest recorded personal measurement (9.56E-05 mg Cr(VI)/m³ 12hr TWA) from the previous four years.

Route of exposure and type of effects	Results	Notes
Inhalation, local Exposure value (12hr TWA)	9.56E-05 mg Cr(VI)/m³	Highest recorded measurement (filter concentration has been factored upwards to adjust to 12hr shift length).
Inhalation, local Exposure value (12hr TWA) corrected for PPE	No correction	RPE not used for this activity.
Frequency of operation (per year) over all operators	N/A	All operators spend time in the control room during their shifts.
Number of operators	40	This is the total number of production shift team operators (4 teams of 10).
Number of working days per year per operator	145	Working days for production shift team operators on 12hr shifts.
Number of occasions per worker per day averaged over the year	1	All operators spend time in the control room during their shifts

Route of exposure and type of effects	Results	Notes
Inhalation, local Exposure value corrected for PPE and frequency	9.56E-02 µg Cr(VI)/m³	= 9.56E-05 x 1 x 1,000 (to convert to µg)

***Table 58**: Exposure concentrations for workers: WCS 5*

9.2.6.4 Risk characterisation: Carcinogenicity

For WCS 5, the excess risk for workers via inhalation is reported in the table below.

Route of exposure and type of effects	Results	Notes
Inhalation, local Exposure value corrected for PPE and frequency	9.56E-02 µg Cr(VI)/m³	Taken from Table 58
Excess risk level, based on RAC opinion, per worker for this task	3.83E-04	= 9.56E-02 x 0.004 (1 µg/m³ of Cr(VI) equals excess risk of 0.004)

***Table 59**: Risk characterisation for workers – carcinogenicity: WCS 5*

9.2.6.5 Risk characterisation: reproductive toxicity

The table below shows the risk characterisation for reproductive toxicity for inhalation exposure for this WCS. The risk characterisation is based on measured Cr(VI) inhalation exposure data set out above, which are compared to the RAC DNEL for workers, derived for effects on fertility.

Route of exposure and type of effects Source	Results WCS 5	Notes
Inhalation, local Exposure value corrected for PPE and frequency	9.56E-02 µg Cr(VI)/m³	Taken from Table 58
RAC DNEL	43 µg Cr(VI)/m³	RAC DNEL for workers (inhalation), derived for effects on fertility
Risk characterisation ratio (RCR)	2.22E-03	9.56E-02 / 43

***Table 60**: Risk characterisation: reproductive toxicity (inhalation exposure): WCS 5*

This WCS does not involve the potential for dermal exposure; shift team members in the control room will be 'far field' of any potential source of sodium dichromate, therefore skin contact with sodium dichromate will not occur. As a result, no modelling of dermal exposure has been undertaken for this WCS.

9.2.6.6 Conclusion on risk assessment

The measured inhalation exposure of 9.56 x 10^{-5} mg Cr(VI)/m³ 12hr TWA (0.0956 µg Cr(VI)/m³) provides a worst-case basis for risk characterisation given that this represents the highest level of exposure measured since 2022 and accounts for the team members' measured exposure across a whole shift within the control room and across other tasks.

Carcinogenicity: An excess lung cancer mortality risk of 3.83 x 10^{-4} for WCS 5 per worker is estimated based on the above exposure estimate and the RAC dose-response relationship for lung cancer mortality and can be considered to substantially overestimate the risk.

Reproductive toxicity: Dermal exposure is not modelled for this WCS as dermal exposure is not foreseeable as part of the activities conducted. A potential inhalation exposure to Cr(VI) of 9.56 x 10^{-2} µg Cr(VI)/m^3 per worker is estimated based on the above exposure estimate. The RAC DNEL for inhalation exposure for sodium dichromate is 43 µg Cr(VI)/m^3. This gives a RCR (inhalation) of 2.22 x 10^{-3} for WCS 5, clearly demonstrating the risk is adequately controlled.

Summary: All operators spend some time in the control room during their shift, with the duration dependent on their role. For the purposes of this WCS, it was assumed that the entire 12 hour shift was spent in the control room. However, personal monitoring measurements include time spent outside the control room as well as inside it. Because the entry and exit end control rooms are 100 m and 20 m away from the nearest Cr(VI) source respectively, and because each form separate rooms, any liquid droplets containing Cr(VI) are highly unlikely to ever reach the control rooms (and for the exit end control room, even more so as it has a porch so access requires passing through two doors). It is therefore reasonable to conclude that Cr(VI) exposure in the control rooms is negligible. Exposure is adequately controlled and no further measures are considered necessary.

9.2.7 WCS 6: Loading and unloading of steel coils (PROC 0)

This WCS considers the transport of steel coils around the ETL5 line by forklift truck and overhead travelling crane and their loading and unloading at the entry and exit ends of the line. Once the coil is offloaded from the line (an automated process), operators band the completed coil, affix a sticker with identification details, then a forklift truck is used to move the coil to the storage area.

[redacted]

Figure 25*: ETL5 entry end coil storage prior to loading (L) and coil exit area (R)*

This work will be undertaken by team member 7 (crane operator / forklift truck driver), team members 3 and 6 (who work at the entry-end) and team member 2 (the exit-end operator / inspector). These operators are in the ‘far field’ of any Cr(VI) source as these activities take place at least 20m away from the nearest Cr(VI) source. When these operators are not performing these tasks, they will spend the remainder of their time inside the respective control room (see WCS 5).

9.2.7.1 Risk management measures

Risk management measures are summarised in the tables below for this WCS.

Means to minimise exposure	Description of the specific measures (with further information in section 9.1.7)
General comments	All measures concerning minimisation of emissions and control of exposure described in the various other WCS are relevant for this scenario as well, because activities involving the loading and unloading of steel coils are ‘far field’.

Means to minimise exposure	Description of the specific measures (with further information in section 9.1.7)
Engineering controls	Areas where Cr(VI) emissions can occur are physically segregated and marked as the sodium dichromate area. Offloading of steel coils is an automated process.
Administrative controls	Only dedicated personnel perform this task. All personnel performing this task receive appropriate information, instructions and training.
PPE	Standard PPE: protective clothing, safety helmet, safety footwear, hearing protection, protective eyewear.
Emergency response	Emergency procedures are in place. First aiders and first aid equipment and facilities are available at all times.
Monitoring	Production shift team members are subject to health surveillance and biological monitoring.

***Table 61**: Risk management measures: WCS 6*

9.2.7.2 Conditions of use

The conditions of use are described in the table below and account for estimated exposure levels.

Product (article) characteristics
• Concentration of substance in mixture: Not relevant, the operator is not present near any Cr(VI) source.
Amount used (or contained in articles), frequency and duration of use/exposure
• Exposure duration: Limited to presence in the production hall and vicinity of the ETL5 line (steel coil entry and exit areas)
• Emission sources: Only far field is relevant
Technical and organisational conditions and measures
• Process temperature: Room temperature (15-25 °C)
• Local exhaust ventilation (select efficiency): No Natural ventilation only, provided by vehicle bay access doors
• Room size: Large room
Conditions and measures related to personal protection, hygiene and health evaluation
• Effective housekeeping practices in place?: Yes, demonstrable and effective housekeeping practices are present.
Other conditions affecting workers exposure
• Process fully enclosed?: No
• Segregation: No
• Personal Enclosure: No personal enclosure during the activity
• Place of use: Indoors

***Table 62**: Conditions of use: WCS 6*

9.2.7.3 Worker exposure

The activities covered by this WCS are performed by team member 7 (crane / forklift truck operator), team members 3 and 6 (entry-end operators) and team member 2 (exit-end operator / inspector). No static measurements are relevant to this WCS; they are not collected in the entry or exit ends of the ETL5 line given the distance from any Cr(VI) sources.

The measurements relevant to this WCS are reported in the table below. These have not been lowered further to reflect the actual time spent performing the activities covered by this WCS; the majority of time during each team member's shifts are spent in the control room (note: '<' denotes any recorded value below limit of detection (LOD)).

Type	Year	Filter conc. of Cr(VI) (mg/m^3)	Sampling duration (mins)	Shift length (hrs)	12hr TWA (mg/m^3) (factored)
Personal: Tata Operative (Shift Team): Team Member Exit End Feed	2025	<0.00001	520	12	1.38E-05
Personal: Tata Operative (Shift Team): Team Member Entry End Feed	2025	<0.00001	485	12	1.48E-05
Personal: Tata Operative (Shift Team): Exit End Inspector ('General Inspector')	2025	<0.000009	545	12	1.19E-05
Personal: Tata Operative (Shift Team): Crane Operator ('Logistics Manager')	2025	<0.00001	478	12	1.51E-05
Personal: Tata Operative (Shift Team): Exit End Inspector ('General Inspector')	2024	<0.000009	557	12	1.16E-05
Personal: Tata Operative (Shift Team): Crane Operator ('Logistics Manager')	2024	<0.000009	557	12	1.16E-05
Personal: Tata Operative (Shift Team): Exit End Inspector ('General Inspector')	2023	0.000017	510	12	2.40E-05
Personal: Tata Operative (Shift Team): Crane Operator ('Logistics Manager')	2023	0.000016	497	12	2.32E-05
Personal: Tata Operative (Shift Team): Exit End Inspector ('General Inspector')	2022	<0.0000094	529	12	1.28E-05
Personal: Tata Operative (Shift Team): Crane Operator ('Logistics Manager')	2022	0.00007	527	12	9.56E-05

***Table 63**: Measurement data: WCS 6*

The exposure concentrations and excess risk level are reported in the table below. These use the highest recorded personal measurement (9.56E-05 mg Cr(VI)/m^3 12hr TWA) from the previous four years.

Route of exposure and type of effects	Results	Notes
Inhalation, local Exposure value (12hr TWA)	9.56E-05 mg Cr(VI)/m^3	Highest recorded measurement (filter concentration has been factored upwards to adjust to 12hr shift length).
Inhalation, local Exposure value (12hr TWA) corrected for PPE	No correction	RPE not used for this activity.
Frequency of operation (per year) over all operators	2048	1 x per shift (task performed each shift), 2 x shifts per day, 4 x operators perform this task, 256 operational days
Number of operators	36	This is the total number of production shift team operators (4 teams of 9).
Number of working days per year per operator	145	Working days for production shift team operators on 12hr shifts.

Route of exposure and type of effects	Results	Notes
Number of occasions per worker per day averaged over the year	0.3923	= 2048 / 36 / 145
Inhalation, local Exposure value corrected for PPE and frequency	3.75E-02 µg $Cr(VI)/m^3$	= 9.56E-05 x 0.3923 x 1,000 (to convert to µg)

***Table 64**: Exposure concentrations for workers: WCS 6*

9.2.7.4 Risk characterisation: Carcinogenicity

For WCS 6, the excess risk for workers via inhalation is reported in the table below.

Route of exposure and type of effects	Results	Notes
Inhalation, local Exposure value corrected for PPE and frequency	3.75E-02 µg $Cr(VI)/m^3$	Taken from Table 64
Excess risk level, based on RAC opinion, per worker for this task	1.50E-04	= 3.75E-02 x 0.004 (1 µg/m^3 of Cr(VI) equals excess risk of 0.004)

***Table 65**: Risk characterisation for workers – carcinogenicity: WCS 6*

9.2.7.5 Risk characterisation: reproductive toxicity

The table below shows the risk characterisation for reproductive toxicity for inhalation exposure for this WCS. The risk characterisation is based on measured Cr(VI) inhalation exposure data set out above, which are compared to the RAC DNEL for workers, derived for effects on fertility.

Route of exposure and type of effects	Results	
Source	**WCS 6**	**Notes**
Inhalation, local Exposure value corrected for PPE and frequency	3.75E-02 µg $Cr(VI)/m^3$	Taken from Table 64
RAC DNEL	43 µg $Cr(VI)/m^3$	RAC DNEL for workers (inhalation), derived for effects on fertility
Risk characterisation ratio (RCR)	8.73E-04	3.75E-02 / 43

***Table 66**: Risk characterisation: reproductive toxicity (inhalation exposure): WCS 6*

This WCS does not involve the potential for dermal exposure; shift team members loading and unloading steel coils will be 'far field' of any source of sodium dichromate, therefore, skin contact will not occur with sodium dichromate. As a result, no modelling of dermal exposure has been undertaken for this WCS.

9.2.7.6 Conclusion on risk assessment

The measured inhalation exposure of 9.56×10^{-5} mg $Cr(VI)/m^3$ 12hr TWA (0.0956 µg $Cr(VI)/m^3$) provides a worst case basis for risk characterisation given that this represents the highest level of exposure measured since 2022 and accounts for the team members' measured exposure across a whole shift, not merely whilst performing tasks relevant to this WCS.

Carcinogenicity: An excess lung cancer mortality risk of 1.50×10^{-4} per worker is estimated based on the above exposure estimate and the RAC dose-response relationship for lung cancer mortality and can be considered to substantially overestimate the risk.

Reproductive toxicity: Dermal exposure has not been modelled for this WCS as dermal exposure is not foreseeable as part of the activities conducted. A potential inhalation exposure to Cr(VI) of 3.75×10^{-2} Cr(VI)/m^3 per worker is estimated based on the above exposure estimate. The RAC DNEL inhalation exposure for sodium dichromate is 43 µg Cr(VI)/m^3. This gives a RCR (inhalation) of 8.73×10^{-4} for WCS 6, clearly demonstrating the risk is adequately controlled.

Summary: The personal sampling measurements used as the basis of the risk assessment for this scenario cover the majority of the shift and do not differentiate between the time spent loading and unloading steel coils and the remainder of the shift spent in the control room. As the relevant shift team members will spend a significant amount of time in the control room during a shift, the measured exposures and excess risk calculations for WCS 5 can also be said to cover this WCS. While presenting them separately therefore significantly overstates the actual level of risk, exposures are still demonstrably very low. Exposure is adequately controlled and no further measures are considered necessary.

9.2.8 WCS 7: Maintenance activities (PROC 28)

This WCS covers maintenance on the ETL5 line which is both scheduled and non-scheduled. Major scheduled maintenance occurs annually, during a 7-day plant shutdown. Minor scheduled maintenance occurs once every three weeks when the line is shut down for up to 8 hours. In addition, the hold-down rolls (which guide the steel strip through the passivation tanks) are inspected once every three weeks and are replaced if necessary, typically every nine weeks. The inspection takes around 30 minutes and roll replacement takes between 2-3 hours. Once per year, the basement circulation tank requires cleaning ('desludging'), which takes up to 4 hours. Unscheduled maintenance may also occur on the ETL5 line, e.g. in response to a breakdown. By its very nature, the frequency of unscheduled maintenance is difficult to predict but an average of once per month provides a reasonable estimate.

Maintenance work in the passivation area typically involves mechanical and piping inspection and maintenance work, electrical and instrumentation inspection and maintenance work, cleaning activities and inspection and replacement of hold-down rolls. A summary of the maintenance activities with their frequency and duration is provided in the table below.

Type of maintenance	Duration and Frequency	Total duration	WCS
Major annual maintenance	Once per year	144 hours	WCS 7a
Minor (3-weekly) maintenance	Up to 8 hours every 3 weeks	< 136 hours	
Inspection of hold down roll	30 minutes every 3 weeks	7.5 hours	
Replacement of hold down roll	2-3 hours, every 9 weeks	< 15 hours	
Unscheduled maintenance (in sodium dichromate area)	1-3 hours, once per month	< 36 hours	
Cleaning (desludging) of the circulation tank	Up to 4 hours, once per year	≤ 4 hours	WCS 7b

***Table 67**: Type of maintenance activities, frequency and total duration*

These maintenance activities have been subdivided into WCS 7a (covering general maintenance activities other than cleaning the circulation tank) and WCS 7b (cleaning the circulation tank). This is because of differences in personnel involved, operational conditions and risk management measures between WCS 7a and WCS 7b.

[redacted]

Figure 26*: Passivation section during maintenance, showing the top (left) and bottom (right) of the passivation line tanks*

Further detail about the types of maintenance activities are provided below:

(1) For **major annual maintenance**, the plant will be shut down for up to 7 days. Up to four maintenance workers (either employees or contractors) may be inside the passivation area and will wear full chromium PPE as a result. For the remainder of their time, these workers will be active outside the passivation area and will not work on equipment that comes into contact with Cr(VI).

(2) During **minor (3-weekly) maintenance**, there may be up to four workers in the passivation area for up to 8 hours. These workers will typically be a mix of production shift team operators, who are free to conduct maintenance duties instead of their usual duties as production is paused, and dedicated maintenance workers (employees or contractors) as required. If inside the passivation area, the workers will wear full chromium PPE. For the remainder of their time, these workers will be active outside the chromic acid area and will not work on equipment that comes into contact with Cr(VI).

(3) For **inspection of the hold-down rolls**, two Tata Steel maintenance operators will be active in the passivation area for up to 30 mins. When active in the passivation area, the workers wear full chromium PPE.

(4) For **replacement of hold-down rolls** two Tata Steel maintenance operators will be involved. When active in the passivation area, the workers will wear full chromium PPE. One production shift team member will support the activity from outside the passivation area, e.g. controlling the overhead crane.

(5) In case of **unscheduled maintenance**, a maximum of four Tata Steel maintenance operators will be active in the passivation area, typically for one to three hours. When active in the passivation area, the workers wear full chromium PPE. One production shift team member will support the activity from outside the sodium dichromate area, e.g. controlling the overhead crane if required.

(6) The **basement circulation tank** is cleaned, or desludged, once per year under a formal permit-to-work system. The entire task typically lasts up to four hours and involves two trained workers (cleaners) working from outside the tank. Cleaning is carried out by spraying water from a hose onto the internal surfaces to remove accumulated sludge and residues, which typically takes around 30 minutes. The resulting wash water is collected and transferred to the site's WWTP for appropriate treatment and disposal (see WCS 8). The workers stand outside the circulation tank and will wear full chromium PPE.

9.2.8.1 Risk management measures

All maintenance activities are subject to risk assessment and covered by a number of safe working procedures. For routine tasks, standard task-risk analyses have been made and preventive and protective measures are defined on this basis. For non-scheduled maintenance, ad hoc risk assessment is made prior to start of work. For all maintenance activities, a permit-to-work is required prior to commencing the activity. The following risk management measures will then be used as a minimum:

- Production is stopped: this means that there is no passivation of tin-plated steel and the formation of any mist as a result of passivation ceases. As such the inhalation exposure to sodium dichromate mist is avoided and the LEV system to the passivation tanks is not used during maintenance activities.

- The production line passivation tanks are emptied by dropping the Cr(VI) passivation solution into the circulation tank. This means that there is no volume of sodium dichromate solution left in the line.

- The passivation tanks are isolated from the circulation tank by means of double valves or blind flanges preventing any sodium dichromate to re-enter.

- The line tank section is flushed with water to remove any residual liquid sodium dichromate from the system. Although this cannot guarantee the complete removal of sodium dichromate, any remaining concentration of sodium dichromate solution on wet surfaces will be very low, certainly much lower than the concentration in the original passivation solution. The rinsing water is evacuated through the basement sump from where it will reach the WWTP.

- After maintenance work, all tools and parts prior to leaving the passivation area are thoroughly rinsed with water. As a result, there is no exposure from handling of contaminated tools or parts outside of the passivation area. The rinsing water is disposed of via the sump to the WWTP.

Risk management measures for WCS 7a (general maintenance activities) and WCS 7b (cleaning/desludging the basement circulation tank) are summarised in the table below.

Means to minimise exposure	Description of the specific measures (with further information in section 9.1.7)
Containment	Production is stopped during all maintenance activities. The passivation solution containing sodium dichromate is then dropped to the circulation tank in the basement. Secondary containment is provided in that any loss from the passivation section on the mill floor level results in the liquid being channelled back into the passivation sump in the basement, which is itself fully bunded.
Engineering controls	The passivation line is physically isolated from the circulation tank by means of double valves or blind flanges. The installation is thoroughly flushed with water. Water from flushing is collected in the basement sump prior to wastewater treatment by reduction. Prior to leaving the passivation area all tools and parts are thoroughly rinsed with water. Rinsing water is collected in the basement chromium sump prior to wastewater treatment.
Administrative controls	Maintenance activities are subject to risk assessment which informs the risk management measures required for, and procedures covering, the work. A permit-to-work must be issued before any maintenance activity can commence. The permit will describe the specific preparatory procedures that need to be completed and communicated before maintenance activities can be initiated.

Means to minimise exposure	Description of the specific measures (with further information in section 9.1.7)
	All personnel performing maintenance activities receive appropriate information, instructions and training.
PPE	For maintenance activities within the passivation area, operators wear full chromium PPE.
Emergency response	Emergency procedures are in place. First aiders and first aid equipment and facilities are available at all times.
Monitoring	Workers performing this task are subject to health surveillance and biological monitoring.

Table 68: *Risk management measures: WCS 7a and 7b*

9.2.8.2 Conditions of use

The conditions of use for WCS 7a (general maintenance activities) and WCS 7b (cleaning/desludging the basement circulation tank) are described in the table below and account for estimated exposure levels.

Product (article) characteristics
• Concentration of substance in mixture: [redacted] sodium dichromate Note: passivation tanks are always emptied and the lines are flushed prior to the start of maintenance activities. Hence the concentration mentioned is a *maximum* concentration for a *small residual volume only*.
Amount used (or contained in articles), frequency and duration of use/exposure
• Exposure duration: variable, see Table 67, as it depends on the type of maintenance. For cleaning/desludging, the time spent cleaning (i.e. where the potential for exposure arises) takes up to 30 minutes.
• Frequency: variable, see Table 67, as it depends on the type of maintenance. For cleaning/desludging, once per year.
• Emission sources: Near field exposure is relevant
Technical and organisational conditions and measures
• Manipulation of contaminated articles
• Process temperature: Room temperature (15-25 °C)
• Local exhaust ventilation: No. When the tanks are free of passivation solution, the LEV is switched off.
• Room size: Large room
Conditions and measures related to personal protection, hygiene and health evaluation
• Respiratory protection: Yes, full-face mask with P3 filter, APF of 40 for all tasks in the passivation area.
• Effective housekeeping practices in place?: Yes, demonstrable and effective housekeeping practices are present.
Other conditions affecting workers exposure
• Process fully enclosed?: No
• Segregation: No
• Personal Enclosure: No personal enclosure during the activity
• Place of use: Indoors

Table 69: *Conditions of use: WCS 7a and WCS 7b*

9.2.8.3 Worker exposure: WCS 7a

The activities covered by WCS 7a may be performed by production shift team members on 12-hour shifts, and Tata Steel maintenance workers and contractors on 8-hour shifts. Personal exposure measurements for these workers are obtained during each annual campaign whilst they perform maintenance duties. The monitoring does not necessarily cover all maintenance activities described in WCS 7a, because monitoring campaigns are usually timed to coincide with the 3-weekly maintenance events. However, all maintenance activities considered under WCS 7a involve the same risk management measures and so the measurement results are representative of all maintenance activities covered by WCS 7a.

Personal monitoring covers the majority of the duration of the shifts (although shift lengths are either 8 hours or 12 hours depending on the workers in question). As with other WCS, for workers on 12-hour shifts, the filter concentrations recorded have been factored upwards to account for the unmonitored time over the remainder of the shift (note: ‘<’ denotes any recorded value below limit of detection (LOD)).

Personal monitoring measurements relevant to WCS 7a are reported in the table below.

Type	Year	Filter conc. of Cr(VI) (mg/m^3)	Sampling duration (mins)	Shift length (hrs)	8hr TWA (mg/m^3)	12hr TWA (mg/m^3) (factored)
Personal: Shift team member on maintenance duties	2025	<0.00001	500	12	N/A (work 12hr shifts)	1.44E-05
Personal: Shift team member on maintenance duties	2025	<0.00001	509	12	N/A (work 12hr shifts)	1.41E-05
Personal: Mechanical 1	2025	0.00013	434	8	1.18E-04	N/A (work 8hr shifts)
Personal: Mechanical 2	2025	0.00012	421	8	1.05E-04	N/A (work 8hr shifts)
Personal: Electrical 1	2025	0.000018	424	8	1.59E-05	N/A (work 8hr shifts)
Personal: Electrical 2	2025	<0.000012	425	8	1.06E-05	N/A (work 8hr shifts)
Personal: Cleaner	2025	<0.000018	270	8	1.01E-05	N/A (work 8hr shifts)
Personal: Shift team member on maintenance duties	2024	<0.00001	518	12	N/A (work 12hr shifts)	1.39E-05
Personal: Shift team member on maintenance duties	2024	<0.00001	513	12	N/A (work 12hr shifts)	1.40E-05
Personal: Shift team member on maintenance duties	2024	<0.00001	520	12	N/A (work 12hr shifts)	1.38E-05
Personal: Shift team member on maintenance duties	2024	<0.0000056	519	12	N/A (work 12hr shifts)	7.77E-06
Personal: Mechanical	2024	<0.00001	491	8	1.02E-05	N/A (work 8hr shifts)
Personal: Electrical	2024	0.000037	426	8	3.28E-05	N/A (work 8hr shifts)
Personal: Cleaner 1	2024	<0.000013	372	8	1.01E-05	N/A (work 8hr shifts)

Type	Year	Filter conc. of Cr(VI) (mg/m^3)	Sampling duration (mins)	Shift length (hrs)	8hr TWA (mg/m^3)	12hr TWA (mg/m^3) (factored)
Personal: Cleaner 2	2024	<0.000013	373	8	1.01E-05	N/A (work 8hr shifts)
Personal: Shift team member on maintenance duties	2023	0.000042	528	12	N/A (work 12hr shifts)	5.73E-05
Personal: Shift team member on maintenance duties	2023	0.000057	528	12	N/A (work 12hr shifts)	7.77E-05
Personal: Shift team member on maintenance duties	2023	0.0000095	529	12	N/A (work 12hr shifts)	1.29E-05
Personal: Shift team member on maintenance duties	2023	0.000017	524	12	N/A (work 12hr shifts)	2.34E-05
Personal: Mechanical 1	2023	0.000062	444	8	5.74E-05	N/A (work 8hr shifts)
Mechanical 2	2023	0.000016	444	8	1.48E-05	N/A (work 8hr shifts)
Personal: Electrical 1	2023	0.00019	476	8	1.88E-04	N/A (work 8hr shifts)
Personal: Electrical 2	2023	0.00017	472	8	1.67E-04	N/A (work 8hr shifts)
Personal: Cleaner 1	2023	0.000022	442	8	2.03E-05	N/A (work 8hr shifts)
Personal: Cleaner 2	2023	0.000019	437	8	1.73E-05	N/A (work 8hr shifts)
Personal: Shift team member on maintenance duties	2022	<0.000011	445	12	N/A (work 12hr shifts)	1.78E-05
Personal: Shift team member on maintenance duties	2022	<0.000011	453	12	N/A (work 12hr shifts)	1.75E-05
Personal: Shift team member on maintenance duties	2022	0.000047	459	12	N/A (work 12hr shifts)	7.37E-05
Personal: Shift team member on maintenance duties	2022	0.000034	459	12	N/A (work 12hr shifts)	5.33E-05
Personal: Mechanical 1	2022	0.000072	422	8	6.33E-05	N/A (work 8hr shifts)
Personal: Mechanical 2	2022	0.000071	423	8	6.26E-05	N/A (work 8hr shifts)
Personal: Electrical 1	2022	<0.000012	415	8	1.04E-05	N/A (work 8hr shifts)
Personal: Electrical 2	2022	<0.000011	442	8	1.01E-05	Not sampled
Personal: Cleaner	2022	<0.000012	411	8	1.03E-05	N/A (work 8hr shifts)

***Table 70**: Measurement data: WCS 7a*

The exposure concentrations and excess risk levels are reported in the tables below. Two tables are presented for WCS 7a which differentiate between workers on 12-hour shifts and workers on 8-hour shifts. While these workers perform activities subject to the same risk management measures, exposure concentrations and excess risk levels are reported separately to calculate the combined risks for different worker roles (see section 10) because their shift lengths, frequency of performing the activities and job roles differ.

The exposure concentrations and excess risk levels use the highest recorded personal measurements from the previous four years, i.e. 7.77E-05 mg Cr(VI)/m^3 (12hr TWA) for workers on 12-hour shifts and 1.88E-04 mg Cr(VI)/m^3 (8hr TWA) for workers on 8-hour shifts.

Route of exposure and type of effects	Results (workers on 12hr shifts)	Notes
Inhalation, local Exposure value (12hr TWA)	7.77E-05 mg Cr(VI)/m^3	Highest recorded measurement (filter concentration has been factored upwards to adjust to 12hr shift length).
Inhalation, local Exposure value (12hr TWA) corrected for PPE	1.94E-06 mg Cr(VI)/m^3	RPE of APF 40 used.
Frequency of operation (per year) over all operators	68	Up to 4 shift team workers carry out Cr(VI)-relevant minor maintenance every 3 weeks (~17 days per year) = 4 x 17
Number of operators	36	This is the total number of operators that could perform this task.
Number of working days per year per operator	145	Working days for production shift team operators on 12hr shifts.
Number of occasions per worker per day averaged over the year	0.013	= 68 / 36 / 145
Inhalation, local Exposure value corrected for PPE and frequency	2.53E-05 µg Cr(VI)/m^3	= 1.94E-06 x 0.013 x 1,000 (to convert to µg)

***Table 71**: Exposure concentrations for workers on 12-hour shifts: WCS 7a*

Route of exposure and type of effects	Results (workers on 8hr shifts)	Notes
Inhalation, local Exposure value (8hr TWA)	1.88E-04 mg Cr(VI)/m^3	Highest recorded measurement (8hr TWA).
Inhalation, local Exposure value (8hr TWA) corrected for PPE	4.71E-06 mg Cr(VI)/m^3	RPE of APF 40 used.
Frequency of operation (per year) over all operators	232	Up to 4 maintenance workers carry out Cr(VI)-relevant activities on the following frequency: - Major maintenance (shut down) – Up to 6 days per year - Minor maintenance: Up to 17 days per year - Inspection of hold down rolls: Up to 17 days per year

Route of exposure and type of effects	Results (workers on 8hr shifts)	Notes
		- Replacement of hold down rolls: Up to 6 days per year - Unscheduled maintenance: Up to 12 days per year Total of up to 58 days per year x up to 4 workers = 232
Number of operators	21	This is the total number of operators that could perform this task (5 Tata Steel maintenance operators, 16 contracted maintenance operators).
Number of working days per year per operator	240	As these workers work 8hr shifts, this results in 240 shifts per year.
Number of occasions per worker per day averaged over the year	0.046	= 232 / 21 / 240
Inhalation, local Exposure value corrected for PPE and frequency	2.17E-04 µg Cr(VI)/m^3	= 4.71E-06 x 0.046 x 1,000 (to convert to µg)

Table 72: *Exposure concentrations for workers on 8-hour shifts: WCS 7a*

9.2.8.4 Worker exposure: WCS 7b

For WCS 7b relating to cleaning/desludging the circulation tank, the 2025 personal monitoring campaign coincided with this activity and so results are available for two cleaners, resulting in a maximum 8hr TWA of 2.10E-05 mg Cr(VI)/m^3.

Type	Year	Filter conc. of Cr(VI) (mg/m^3)	Sampling duration (mins)	Shift length (hrs)	8hr TWA (mg/m^3)	12hr TWA (mg/m^3) (factored)
Cleaner 1 (desludging)	2025	<0.000034	297	8	2.10E-05	N/A (work 8hr shifts)
Cleaner 2 (desludging)	2025	<0.000034	295	8	2.09E-05	N/A (work 8hr shifts)

Table 73: *Measurement data: WCS 7b*

However, personal monitoring was not undertaken for cleaners involved in desludging in any of the previous years because the infrequency of this activity (once per year) means that it has not previously coincided with the monitoring campaigns. In addition, the monitoring that was conducted in 2025 covers general line cleaning as well as circulation tank sludge cleaning, i.e. it covers more than the activities that are the focus of WCS 7a.

As the available personal monitoring data are not sufficient, modelling has also been conducted for WCS 7b. ART modelling results in an estimated exposure value of 2.54E-03 mg Cr(VI)/m^3 (8hr TWA), significantly higher than the measured values of 2025 and likely resulting from the conservative nature of the model. Nevertheless, in line with the approach taken throughout this CSR, the higher ART estimate for occupational exposure relating to the basement circulation tank desludging is used as the basis for calculating the risk.

Route of exposure and type of effects	Results	Notes
Inhalation, local Exposure value, personal monitoring (8h TWA)	2.10E-05 mg Cr(VI)/m^3	Highest recorded measurement (8hr TWA).

Route of exposure and type of effects	Results	Notes
Inhalation, local Exposure value, modelled (8h TWA)	2.54E-03 mg Cr(VI)/m^3	Obtained from ART, 90th percentile value, and used for the purposes of this assessment.
Inhalation, local Exposure value (8h TWA) corrected for PPE	6.35E-05 mg Cr(VI)/m^3	RPE of APF 40 used (based on modelled data).
Frequency of operation (per year) over all operators	2	Activity occurs once every year and may involve up to 2 operators = 1 x 2
Number of operators	2	This is the total number of operators that could perform this task.
Number of working days per year per operator	240	As these workers work 8hr shifts, this results in 240 shifts per year.
Number of occasions per worker per day averaged over the year	0.0042	= 2 / 2 / 240
Inhalation, local Exposure value corrected for PPE and frequency	2.65E-04 µg Cr(VI)/m^3	= 6.35E-05 x 0.0042 x 1,000 (to convert to µg)

***Table 74**: Exposure concentrations and risks for workers: WCS 7b*

9.2.8.5 Risk characterisation: Carcinogenicity

For WCS 7a (maintenance activities – 12hr TWA), the excess risk for workers via inhalation is reported in the table below.

Route of exposure and type of effects	Results	Notes
Inhalation, local Exposure value corrected for PPE and frequency	2.53E-05 µg Cr(VI)/m^3	Taken from Table 71
Excess risk level, based on RAC opinion, per worker for this task	1.01E-07	= 2.53E-05 x 0.004 (1 µg/m^3 of Cr(VI) equals excess risk of 0.004)

***Table 75**: Risk characterisation for workers – carcinogenicity: WCS 7a (12hr TWA)*

For WCS 7a (maintenance activities – 8hr TWA), the excess risk for workers via inhalation is reported in the table below.

Route of exposure and type of effects	Results	Notes
Inhalation, local Exposure value corrected for PPE and frequency	2.17E-04 µg Cr(VI)/m^3	Taken from Table 72
Excess risk level, based on RAC opinion, per worker for this task	8.67E-07	= 2.17E-04 x 0.004 (1 µg/m^3 of Cr(VI) equals excess risk of 0.004)

***Table 76**: Risk characterisation for workers – carcinogenicity: WCS 7a (8hr TWA)*

For WCS 7b (desludging of basement circulation tank – 8hr TWA), the excess risk for workers via inhalation is reported in the table below.

Route of exposure and type of effects	Results	Notes
Inhalation, local Exposure value corrected for PPE and frequency	2.65E-04 µg Cr(VI)/m³	Taken from Table 74
Excess risk level, based on RAC opinion, per worker for this task	1.06E-06	= 2.65E-04 x 0.004 (1 µg/m³ of Cr(VI) equals excess risk of 0.004)

***Table 77**: Risk characterisation for workers – carcinogenicity: WCS 7b (8hr TWA)*

9.2.8.6 Risk characterisation: reproductive toxicity

The table below shows the risk characterisation for reproductive toxicity for inhalation exposure for this WCS. The risk characterisation is based on measured Cr(VI) inhalation exposure data set out above, which are compared to the RAC DNEL for workers, derived for effects on fertility.

Route of exposure and type of effects	Results			
Source	WCS 7a (12 hr TWA)	WCS 7a (8hr TWA)	WCS 7b	Notes
Inhalation, local Exposure value corrected for PPE and frequency	2.53E-05 µg Cr(VI)/m³	2.17E-04µg Cr(VI)/m³	2.65E-04 µg Cr(VI)/m³	Taken from Tables 71, 72 and 74
RAC DNEL	43 µg Cr(VI)/m³	43 µg Cr(VI)/m³	43 µg Cr(VI)/m³	RAC DNEL for workers (inhalation), derived for effects on fertility
Risk characterisation ratio (RCR)	5.89E-07	5.04E-06	6.16E-06	-

***Table 78**: Risk characterisation: reproductive toxicity (inhalation exposure): WCS 7a (12 hr TWA), WCS 7a (8 hr TWA) and WCS 7b.*

This WCS also involves the potential for dermal exposure during general maintenance activities (WCS 7a) and desludging the basement circulation tank (WCS 7b). The dermal exposure concentrations for this WCS are shown in the table below, based on modelling using a calculation-based approach.

Parameter	Results (WCS 7a – 12hr TWA)	Results (WCS 7a – 8hr TWA)	Results (WCS 7b)	Notes
EU RAR modelling assumption (mg/cm²/d)	0.1	0.1	0.1	Uses upper end of range from EU RAR (ECB, 2005) from EASE for non-dispersive use with direct handling with incidental contact.
Skin contact area (cm²)	2083	2083	2083	See section 9.1.8.3 for further details
Dermal load (mg/d)	208.3	208.3	208.3	Calculated: 0.1 mg/cm²/d x 2083 cm²
Body weight (kg)	70	70	70	Body weight for workers (Guidance IR & CSA, R.8 (ECHA, 2012))
Potential dermal exposure (mg/kg bw/d)	2.98	2.98	2.98	Calculated: 208.3 mg/d / 70 kg
PPE efficiency (%)	95%	95%	95%	An efficiency of 95% is assumed for hand exposure.

Parameter	Results (WCS 7a – 12hr TWA)	Results (WCS 7a – 8hr TWA)	Results (WCS 7b)	Notes
Potential dermal exposure, corrected for PPE (mg/kg bw/d)	0.149	0.149	0.149	Calculated: 2.98 x 0.05
Cr(VI) concentration (%)	[redacted]	[redacted]	[redacted]	[redacted]
Frequency (number of occasions per worker per day averaged over the year)	[redacted]	[redacted]	[redacted]	[redacted]
Potential dermal exposure to Cr(VI), corrected for frequency and PPE (µg/kg bw/d)	[redacted]	[redacted]	[redacted]	[redacted]
RAC DNEL (µg Cr(VI)/kg bw/d)	43	43	43	RAC DNEL for workers (dermal), derived for effects on fertility
Risk characterisation ratio (RCR)	5.37E-04	1.90E-03	1.72E-04	Dermal exposure / 43

***Table 79**: Modelled exposure and risk characterisation for reproductive toxicity (dermal exposure): WCS 7a (12 hr TWA and 8 hr TWA) and WCS 7b*

As the risk assessment for reproductive toxicity must consider both dermal and inhalation exposure, the table below shows the dermal and inhalation exposure estimates (corrected for frequency and PPE), the RCR for both pathways of exposure separately, and the combined RCR with respect to reproductive toxicity.

Exposures and RCRs	WCS 7a – 12hr TWA	WCS 7a – 8hr TWA	WCS 7b
Dermal exposure	0.023 µg/kg bw/d	0.082 µg/kg bw/d	0.007 µg/kg bw/d
RCR, dermal	5.37E-04	1.90E-03	1.72E-04
Inhalation exposure	2.53E-05 µg Cr(VI)/m^3	2.17E-04 µg Cr(VI)/m^3	2.65E-04 µg Cr(VI)/m^3
RCR, inhalation	5.89E-07	5.04E-06	6.16E-06
RCR, combined	**5.37E-04**	**1.90E-03**	**1.78E-04**
% contribution, dermal	99.89%	99.73%	96.54%

***Table 80**: Exposure concentrations and risk characterisation for reproductive toxicity (combined): WCS7a and WCS 7b*

The data demonstrate that dermal exposure is almost exclusively responsible for the combined RCR. This finding is related to (a) the low inhalation exposure and (b) the conservative nature of dermal exposure modelling.

9.2.8.7 Conclusion on risk assessment

For WCS 7a, the measured inhalation exposures of 7.77 x 10^{-5} mg Cr(VI)/m^3 or 0.078 µg Cr(VI)/m^3 (12hr TWA) and 1.88 x 10^{-4} mg Cr(VI)/m^3 or 0.190 µg Cr(VI)/m^3 (8hr TWA) provide a worst-case basis for risk characterisation. They are based on the highest level of exposure measured since 2022 and account for measured exposure of workers performing maintenance activities across a whole shift performing Cr(VI)-related and other tasks, rather than merely the period of time that this WCS covers.

For WCS 7b, the ART modelled inhalation exposure is 2.54 x 10^{-3} mg Cr(VI)/m^3 or 2.54 µg Cr(VI)/m^3 (8hr TWA), not corrected for PPE or frequency. This provides a worst-case estimate of exposure as it uses conservative inputs which result in a much higher estimated level of exposure than those obtained through personal monitoring data recorded in 2025.

Carcinogenicity: An excess lung cancer mortality risk of 1.01 x 10^{-7} for WCS 7a (maintenance – 12hr TWA), 8.67 x 10^{-7} for WCS 7a (maintenance – 8hr TWA) and 1.06 x 10^{-6} for WCS 7b (desludging of circulation tank) per worker is estimated based on the above exposure estimates and the RAC dose-response relationship for lung cancer mortality and can be considered to substantially overestimate the risk.

Reproductive toxicity: A modelled dermal exposure to Cr(VI) of 0.023 µg/kg bw/d for WCS 7a (maintenance – 12hr TWA), 0.082 µg/kg bw/d for WCS 7a (maintenance – 8hr TWA) and 0.007 µg/kg bw/d for WCS 7b (desludging of circulation tank) per worker is estimated, based on a conservative modelling approach and adjusted for frequency and PPE. The RAC DNEL for dermal exposure for sodium dichromate is 43 µg Cr(VI)/kg bw/d, giving an RCR (dermal) of 5.37 x 10^{-4}, 1.9 x 10^{-3} and 1.72 x 10^{-4} for each WCS respectively.

A potential inhalation exposure to Cr(VI) of 2.53 x 10^{-5} µg Cr(VI)/m^3 for WCS 7a (maintenance – 12hr TWA), 2.17 x 10^{-4} µg Cr(VI)/m^3 for WCS 7a (maintenance – 8hr TWA) and 2.65 x 10^{-4} µg Cr(VI)/m^3 for WCS 7b (desludging of circulation tank) per worker, corrected for frequency and PPE, is estimated. The RAC DNEL for inhalation exposure for sodium dichromate is 43 µg Cr(VI)/m^3. This gives an RCR (inhalation) of 5.89 x 10^{-7}, 5.04 x 10^{-6} and 6.16 x 10^{-6} for each WCS respectively.

Summing all of the RCR (dermal) and RCR (inhalation) reported above gives a total RCR for this WCS of 2.62 x 10^{-3}, well below the threshold of 1, clearly demonstrating the risk is adequately controlled.

Summary: Exposure is adequately controlled. A robust range of risk management measures are employed to reduce emissions and consequently minimise exposures related to maintenance activities. No further measures are considered necessary.

9.2.9 WCS 8: Waste management including wastewater treatment (PROC 8b, PROC 9)

This WCS covers the sampling and analysis of Cr(VI)-containing wastewater prior to batch reduction (WCS 8a) and the cleaning of the filter press (WCS 8b). These activities are conducted by Veolia personnel (the operator/laboratory technician and the maintenance technician) at the on-site WWTP.

<u>Sampling and analysis of Cr(VI) containing wastewater prior to batch reduction (WCS 8a)</u>
Cr(VI)-containing wastewater collected from the ETL5 line is treated in the reduction tank at the WWTP via a reduction reaction in batch. Waste pickling solution from the pickle line is used as the reductant as it contains ferrous sulphate. Prior to reduction, the Cr(VI)-containing wastewater is sampled from the Cr(VI) ETL5 bulk tank and a manual titration is then performed. This allows for determination of the appropriate ratio of Cr(VI)-containing wastewater to pickling solution to ensure the reductant is dosed over-stoichiometrically, to result in full reduction of Cr(VI) to Cr(III) and Cr(0). There is the potential for exposure during this sampling and analysis process as the wastewater will still contain Cr(VI). Sampling at later points of the process does not result in exposure since the reduction is completed after this point. This is confirmed via an in-line redox potential in the reduction tank.

When redox and pH probes indicate that the batch reduction process is complete, the operator will take a sample which is tested using a phenol-Spekker acid solution (60/40). If Cr(VI) is still present, the sample becomes pink in colour and further reduction will be initiated. Further samples are taken until the presence of Cr(VI) can no longer be detected. A second sample is then taken and analysed by another Veolia employee to confirm reduction is complete.

Batch reduction, and hence also the sampling of the Cr(VI)-containing wastewater and pickling solution, only takes place during the day shift.

<u>Cleaning of the filter press (WCS 8b)</u>
The filter press separates solids from liquids in the waste streams. The sludge from the clarifier is pumped into a 450m^3 filter press sludge storage tank and from there into one of two filter presses. The sludge fills the spaces between a series of porous plates lined with filter cloths. High pressure is then applied, which forces the liquid (filtrate) through the filter cloths, leaving the solid particles behind. The filtrate is collected and discharged, while the solid particles form a filter cake on the plates. Once the filtration cycle is complete, the plates are separated and the compacted sludge is then removed by operators. The sludge has historically been sent to the applicant's Port Talbot site as a recyclable product although, as the blast furnaces at Port Talbot are now shut down, it is currently being disposed of as waste.

One operator will discharge each of the two 128-plate filter presses daily, which usually takes up to an hour. Each filter press discharges around 8 tonnes per day. The operators will wear standard site PPE throughout. Weekly analysis of the filter cake is conducted and includes analysis for the presence of Cr(VI), as well as chromium, lead and other metals. This analysis confirms the absence of Cr(VI), which is to be expected given the batch reduction process that occurs as part of Cr(VI) wastewater treatment, described above.

Figure 27*: Bulk tank farm in the WWTP*

***Figure 28**: Testing station for chromic acid wastewater*

***Figure 29**: Cr(VI) analyser (L) and laboratory (R) in the WWTP*

9.2.9.1 Risk management measures

Risk management measures are summarised in the tables below for WCS 8a and WCS 8b.

Means to minimise exposure	Description of the specific measures (with further information in section 9.1.7)
Containment	Primary containment: The sodium dichromate bulk tank and the batch reduction tank on the WWTP are enclosed Secondary containment: The bulk tanks on the WWTP are fully bunded.
Engineering controls	A fume cabinet is present in the WWTP laboratory.
Administrative controls	Operators will take samples of a limited volume only, and via a dedicated sampling system, reducing exposure. The only exposure that can arise is from the sampling point itself. Procedures are in place covering sampling. Only authorised personnel perform this task and all personnel performing this task receive appropriate information, instructions and training.
PPE	Standard site PPE is worn plus nitrile gloves.
Emergency response	Emergency procedures are in place. First aiders and first aid equipment and facilities are available at all times.
Monitoring	Workers performing this task are subject to health surveillance and biological monitoring.

***Table 81**: Risk management measures: WCS 8a*

Means to minimise exposure	Description of the specific measures (with further information in section 9.1.7)
Engineering controls	The reductant (ferrous sulphate) is dosed over-stoichiometrically, to result in full reduction of Cr(VI) to Cr(III) and Cr(0). No Cr(VI) is present in the filter cake, confirmed by weekly analysis.
Administrative controls	Procedures are in place covering cleaning of the filter press. Only authorised personnel perform this task and all personnel performing this task receive appropriate information, instructions and training.
PPE	Standard site PPE is worn.
Emergency response	Emergency procedures are in place. First aiders and first aid equipment and facilities are available at all times.
Monitoring	Workers performing this task are subject to health surveillance and biological monitoring.

***Table 82**: Risk management measures: WCS 8b*

9.2.9.2 Conditions of use

The conditions of use for WCS 8a (sampling and analysis of Cr(VI) containing wastewater prior to batch reduction) and WCS 8b (cleaning of the filter press) are described in the tables below and account for estimated exposure levels.

Product (article) characteristics
• Concentration of substance in mixture: maximum of [redacted] sodium dichromate (though likely to be less)
Amount used (or contained in articles), frequency and duration of use/exposure
• Exposure duration: 10 min.
• Frequency: Once per day, during day shift
• Emission sources: Near field exposure is relevant during sampling

Technical and organisational conditions and measures
• Activity class for liquids: Transfer of liquids
• Process temperature: 15-20 °C (ambient)
• Local exhaust ventilation (select efficiency): No.
• Room size: Large room
Conditions and measures related to personal protection, hygiene and health evaluation
• Effective housekeeping practices in place?: Yes, demonstrable and effective housekeeping practices are present.
Other conditions affecting workers exposure
• Process fully enclosed?: Bulk tanks containing Cr(VI) wastewater are fully enclosed although sampling and subsequent analysis are not fully enclosed.
• Segregation: No
• Personal Enclosure: No personal enclosure during the activity
• Place of use: Indoors.

***Table 83**: Conditions of use: WCS 8a*

Product (article) characteristics
Product type: Paste, slurry, clearly soaked wet powder
Weight Fraction: Nil/negligible
Liquid with low viscosity (like water)
Amount used (or contained in articles), frequency and duration of use/exposure
Duration of activity: Up to 45 minutes daily, depending on moisture content
Technical and organisational conditions and measures
Primary emission source located in the breathing zone of the worker: Yes
Activity class: Handling of contaminated solid objects or paste
Careful handling, involves workers showing attention to potential danger, error or harm and carrying out the activity in a very exact and thorough (or cautious) manner
Local exhaust ventilation: No
Integrity of the enclosure regularly monitored: No Effective housekeeping practices in place: Yes
Conditions and measures related to personal protection, hygiene and health evaluation
Respiratory protection: No
Other conditions affecting workers exposure
Place of use: Indoors, large room, good natural ventilation

***Table 84**: Conditions of use: WCS 8b*

9.2.9.3 Worker exposure

The activities covered by WCS 8a and 8b are undertaken primarily by the operator/laboratory technician but also can be undertaken by the maintenance technician. Although they are not the applicant's employees, they are both included in the applicant's annual exposure monitoring campaigns. Static measurements are also taken annually in the WWTP laboratory and the tank farm control room, which are relevant for WCS 8a.

Both personal and static monitoring cover the majority of the duration of the shift and so do not allow for differentiation of exposure during the short periods of time taking samples (WCS 8a) or cleaning the filter press (WCS 8b). However, personal and static measurements over these longer periods show that the total exposures of the Veolia technicians are low.

The measurements relevant to this WCS are reported in the table below (note: '<' denotes any recorded value below limit of detection (LOD)).

Type	Year	Filter conc. of Cr(VI) (mg/m^3)	Sampling duration (mins)	Shift length (hrs)	12hr TWA (mg/m^3) (factored)
Personal: WWTP Maintenance Technician	2025	<0.000011	456	12	1.74E-05
Personal: WWTP Operator/Laboratory Technician	2025	<0.000011	464	12	1.71E-05
Personal: WWTP Maintenance Technician	2024	0.000016	490	12	2.35E-05
Personal: WWTP Operator/Laboratory Technician	2024	<0.000011	522	12	1.52E-05
Personal: WWTP Maintenance Technician	2023	0.00005	490	12	7.35E-05
Personal: WWTP Operator/Laboratory Technician	2023	0.00004	522	12	5.52E-05
Personal: WWTP Maintenance Technician	2022	0.000014	500	12	2.02E-05
Personal: WWTP Operator/Laboratory Technician	2022	0.000015	507	12	2.13E-05
Static: WWTP Control Room Laboratory	2025	<0.000011	461	N/A	N/A
Static: WWTP Tank Farm Control Room	2025	<0.000011	471	N/A	N/A
Static: WWTP Control Room Laboratory	2024	<0.00001	516	N/A	N/A
Static: WWTP Tank Farm Control Room	2024	<0.00001	517	N/A	N/A
Static: WWTP Control Room Laboratory	2023	<0.00001	516	N/A	N/A
Static: WWTP Tank Farm Control Room	2023	0.0004	517	N/A	N/A
Static: WWTP Control Room Laboratory	2022	<0.00001	497	N/A	N/A
Static: WWTP Tank Farm Control Room	2022	<0.00001	488	N/A	N/A

***Table 85**: Measurement data: WCS 8a and 8b*

The exposure concentrations and excess risk level are reported in the table below. These use the highest recorded personal measurement (7.35E-05 mg Cr(VI)/m^3 12hr TWA) from the previous four years.

Route of exposure and type of effects	Results	Notes
Inhalation, local Exposure value (12hr TWA)	7.35E-05 mg Cr(VI)/m^3	Highest recorded measurement (filter concentration has been factored upwards to adjust to 12hr shift length).
Inhalation, local Exposure value (12hr TWA) corrected for PPE	No correction.	RPE is not used for these activities.

Route of exposure and type of effects	Results	Notes
Frequency of operation (per year) over all operators	256	= 1 x per day x 1 operator x 256 max operational days = activity occurs up to 256 times / year
Number of operators	4	This is the total number of operators that could perform this task. As the WWTP operator/lab technician usually performs the sampling and cleaning of the filter press, the other 4 shift team members are not counted, to avoid reducing the average number of occasions per worker per day artificially.
Number of working days per year per operator	145	Working days for WWTP shift team operators on 12hr shifts.
Number of occasions per worker per day averaged over the year	0.4414	= 256 / 4 / 145
Inhalation, local Exposure value corrected for PPE and frequency	3.24E-02 µg Cr(VI)/m^3	= 7.35E-05 x 0.4414 x 1,000 (to convert to µg)

***Table 86**: Exposure concentrations and risks for workers: WCS 8a and 8b*

9.2.9.4 Risk characterisation: Carcinogenicity

For WCS 8a and 8b, the excess risk for workers via inhalation is reported in the table below.

Route of exposure and type of effects	Results	Notes
Inhalation, local Exposure value corrected for PPE and frequency	3.24E-02 µg Cr(VI)/m^3	Taken from Table 86
Excess risk level, based on RAC opinion, per worker for this task	1.30E-04	= 3.24E-02 x 0.004 (1 µg/m^3 of Cr(VI) equals excess risk of 0.004)

***Table 87**: Risk characterisation for workers – carcinogenicity: WCS 8a and 8b*

9.2.9.5 Risk characterisation: reproductive toxicity

The table below shows the risk characterisation for reproductive toxicity for inhalation exposure for this WCS. The risk characterisation is based on measured Cr(VI) inhalation exposure data set out above, which are compared to the RAC DNEL for workers, derived for effects on fertility.

Route of exposure and type of effects	Results	
Source	WCS 8a and WCS 8b	Notes
Inhalation, local Exposure value corrected for PPE and frequency	3.24E-02 µg Cr(VI)/m^3	Calculated in section 9.2.9.3 for WCS 8a and WCS 8b
RAC DNEL	43 µg Cr(VI)/m^3	RAC DNEL for workers (inhalation), derived for effects on fertility
Risk characterisation ratio (RCR)	7.54E-04	3.24E-02 / 43

***Table 88**: Risk characterisation: reproductive toxicity (inhalation exposure): WCS 8a and 8b*

This WCS also involves the potential for dermal exposure when sampling the wastewater (WCS 8a) and cleaning the filter press (WCS 8b). Gloves are worn in both cases, therefore WCS 8a and 8b can be assessed together, to produce one value for dermal exposure. The dermal exposure concentrations for this WCS are shown in the table below, based on modelling using a calculation-based approach.

Parameter	Results	Notes
EU RAR modelling assumption ($mg/cm^2/d$)	0.1	Uses upper end of range from EU RAR (ECB, 2005) from EASE for non-dispersive use with direct handling with incidental contact.
Skin contact area (cm^2)	480	See section 9.1.8.3 for further details
Dermal load (mg/d)	48	Calculated: 0.1 $mg/cm^2/d$ x 480 cm^2
Body weight (kg)	70	Body weight for workers (Guidance IR & CSA, R.8 (ECHA, 2012))
Potential dermal exposure (mg/kg bw/d)	0.686	Calculated: 48 mg/d / 70 kg
PPE efficiency (%)	95%	An efficiency of 95% is assumed for hand exposure.
Potential dermal exposure, corrected for PPE (mg/kg bw/d)	0.0343	Calculated: 0.686 x 0.05
Cr(VI) concentration (%)	[redacted]	[redacted]
Frequency (number of occasions per worker per day averaged over the year)	[redacted]	[redacted]
Potential dermal exposure to Cr(VI), corrected for frequency and PPE (µg/kg bw/d)	[redacted]	[redacted]
RAC DNEL (µg Cr(VI)/kg bw/d)	43	RAC DNEL for workers (dermal), derived for effects on fertility
Risk characterisation ratio (RCR)	4.19E-03	[redacted]

***Table 89**: Modelled exposure and risk characterisation for reproductive toxicity (dermal exposure): WCS 8a and 8b*

As the risk assessment for reproductive toxicity must consider both dermal and inhalation exposure, the table below shows the dermal and inhalation exposure estimates (corrected for frequency and PPE), the RCR for both pathways of exposure separately, and the combined RCR with respect to reproductive toxicity.

Exposures and RCRs	WCS 8a and WCS 8b
Dermal exposure	0.180 µg/kg bw/d
RCR, dermal	4.19E-03
Inhalation exposure	3.24E-02 µg Cr(VI)/m^3
RCR, inhalation	7.54E-04
RCR, combined	**4.95E-03**

Exposures and RCRs	WCS 8a and WCS 8b
% contribution, dermal	84.75%

***Table 90**: Exposure concentrations and risk characterisation for reproductive toxicity (combined): WCS8a and 8b*

The data demonstrate that dermal exposure is mainly responsible for the combined RCR. This finding is related to (a) the low inhalation exposure and (b) the conservative nature of dermal exposure modelling.

9.2.9.6 Conclusion on risk assessment

The measured inhalation exposure of 7.35 x 10^{-5} mg Cr(VI)/m^3 12hr TWA (7.35 x 10^{-2} µg Cr(VI)/m^3) provides a worst case basis for risk characterisation given that this represents the highest level of exposure measured since 2022 and accounts for the WWTP operators' measured exposure across a whole shift performing this and other tasks, rather than the short period of time that WCS 8a and 8b covers.

Carcinogenicity: An excess lung cancer mortality risk of 1.30 x 10^{-4} for WCS 8a and WCS 8b per worker is estimated based on the above exposure estimate and the RAC dose-response relationship for lung cancer mortality and can be considered to substantially overestimate the risk.

Reproductive toxicity: A modelled dermal exposure to Cr(VI) of 0.180 µg/kg bw/d for WCS 8a and WCS 8b per worker is estimated based on a conservative modelling approach. The RAC DNEL for dermal exposure for sodium dichromate is 43 µg Cr(VI)/kg bw/d, giving an RCR (dermal) of 4.19 x 10^{-3}.

A potential inhalation exposure to Cr(VI) of 3.24 x 10^{-2} µg Cr(VI)/m^3 for WCS 8a and WCS 8b per worker is estimated based on the above exposure estimate (corrected for frequency and PPE). The RAC DNEL for inhalation exposure for sodium dichromate is 43 µg Cr(VI)/m^3. This gives a RCR (inhalation) of 7.54 x 10^{-4} for WCS 8a and WCS 8b.

Summing the RCR (dermal) and RCR (inhalation) for both WCS 8a and WCS 8b gives a total RCR for this WCS of 4.95 x 10^{-3}, well below the threshold of 1, clearly demonstrating the risk is adequately controlled.

Summary: Exposure is adequately controlled. The emissions and consequently the exposures related to the sampling and analysis of Cr(VI) containing wastewater prior to batch reduction and cleaning of the filter press are minimised. No further measures are considered necessary.

10 Risk characterisation relating to combined exposure

10.1 Human health (related to combined, shift-long exposure)

Workers are clearly assigned to specific roles, although for the production shift teams, operators will perform a range of roles interchangeably. In section 9, the various tasks performed by each of the different workers and the exposure levels were described. In this section, the various tasks performed during a typical shift for each worker role will be described in order to determine the total exposure to Cr(VI) for a worker during one shift.

10.2.1 Carcinogenicity

The combined exposure and annual excess risk for each worker position and the tasks which are performed in their role are summarised in the table below. It should be noted that workers can also perform activities not directly related to the production process involving Cr(VI). In other words, they perform tasks in other parts of the plant, which are non-Cr(VI) areas. These activities will be regarded as non-exposure activities.

Worker role	Total no. of workers	WCS covered in this role	Combined exposure per worker µg/m^3	Excess risk level per worker *
Team leader / deputy	4	WCS 4, WCS 5	1.35E-01	5.41E-04
Rest of production shift team †	Up to 36	WCS1b, WCS 2a, WCS 2b, WCS 5, WCS 6, WCS 7a	1.39E-01	5.55E-04
Maintenance operators (dedicated)	21	WCS 7a	2.17E-04	8.67E-07
WWTP technicians	8	WCS 8a, WCS 8b	3.24E-02	1.30E-04
Cleaners responsible for desludging	2	WCS 7a, WCS 7b	4.81E-04	1.93E-06
Delivery driver	1	WCS 1a	1.65E-03	6.62E-06
Notes: * The excess risk is based on 40-year worker exposure as per RAC guidance and has not been adjusted for the requested review period (10 years). † Covers operators performing team member 1-9 roles. Also accounts for the maintenance duties undertaken by production shift team members. These are grouped together because all these members of the production shift team are interchangeable between these various roles.				

***Table 91**: Combined exposure and risk characterisation for workers: carcinogenicity*

10.2.2 Reproductive toxicity

The combined RCR (inhalation) and RCR (dermal) are summed to give a total RCR (inhalation + dermal) for each worker based on their role and the tasks they perform in their role. These are summarised in the table below. The total RCR (inhalation + dermal) for each worker is <1, confirming that the risk is adequately controlled.

Worker role	Total no. of workers	WCS covered in this role	Combined RCR (inhalation)	Combined RCR (dermal)	Total RCR (inhalation and dermal) per worker
Team leader / deputy	4	WCS 4, WCS 5	3.15E-03	- *	3.15E-03
Rest of production shift team †	Up to 36	WCS1b, WCS 2a, WCS 2b, WCS 5, WCS 6, WCS 7a	3.23E-03	2.48E-03	5.71E-03
Maintenance operators (dedicated)	21	WCS 7a	5.04E-06	1.90E-03	1.90E-03
WWTP technicians	8	WCS 8a, WCS 8b	7.54E-04	4.19E-03	4.95E-03
Cleaners responsible for desludging	2	WCS 7a, WCS 7b	1.12E-05	2.07E-03	2.08E-03
Delivery driver	1	WCS 1a	3.85E-05	3.96E-03	4.00E-03
Notes: * No foreseeable dermal exposure for any tasks related to the team leader. † Covers operators performing team member 1-9 roles. Also accounts for the maintenance duties undertaken by production shift team members. These are grouped together because all these members of the production shift team are interchangeable between these various roles.					

***Table 92**: Combined exposure and risk characterisation for workers: Reproductive toxicity.*

10.2 Environment (combined for all emission sources)

10.2.1 Total releases

The table below shows total Cr(VI) releases to the environment per year from all life cycle stages.

Release route	Total Cr(VI) releases per year
Water	0 kg/year
Air	5.01 kg/year
Soil	0 kg/year

***Table 93**: Total releases to the environment per year from all life cycle stages*

10.2.2 Regional exposure

10.2.2.1 Environment

No regional assessment has been carried out as it can be assumed that Cr(VI) from any source will be reduced to Cr(III) in most environmental situations and therefore the effects of Cr(VI), if any, are likely to be limited to the area around the source, as per the EU Risk Assessment Report for chromates.[30] Therefore, combined exposures from various sources on the regional scale do not need to be considered.

On the local scale, all relevant exposures from the emission source to air and wastewater have been assessed (see section 9.2.1).

[30] ECB, 2005.

Appendix 1: Atmospheric (stack) emissions monitoring

Stack emissions monitoring is undertaken annually by a specialist third-party contractor providing accredited UKAS and Monitoring Certification Scheme (MCERTS) air quality monitoring and consultancy services. Monitoring for total chromium is conducted to BS EN 16911-1:2013 and BS EN 14385:2004 supplemented by the relevant Methods Implementation Document (MID).

The results of the last four years' monitoring campaigns (2025, 2024, 2023 and 2022 calendar years) are presented in the table below. The reported emissions are for total chromium, and Cr(VI) will make up only a proportion of the total (please refer to the discussion in section 9.1.7.10 above). Nevertheless, in absence of specific data on Cr(VI) emissions, and given that back-calculation of total Cr to Cr(VI) would introduce uncertainty to the results, only total chromium emissions are presented below. These will overstate the presence of Cr(VI) in emissions to atmosphere from the site.

Year	Emission Point	Substance	Periodic Result	Reference Conditions 273K 101.3kPa	Date	Start / End times
2022	System 1 ETL5	Volumetric Flowrate	14.0363 Nm^3/sec	Stack Conditions	09/06/2022	09.02 - 09.31
		Volumetric Flowrate	12.6615 Nm^3/sec	STP & Wet Gas		10.15 - 12.15
		[redacted]	[redacted]			
		Total Chromium	2.24 kg/yr	Mass release		
		Release factor	0.0487%	-		
2023	System 1 ETL5	Volumetric Flowrate	10.3694 Nm^3/sec	Stack Conditions	23/06/2023	15.30 - 17.30
		Volumetric Flowrate	9.3138 Nm^3/sec	STP & Wet Gas		
		[redacted]	[redacted]			
		Total Chromium	0.81 kg/yr	Mass release		
		Release factor	0.0229%	-		
2024	System 1 ETL5	Volumetric Flowrate	12.0094 Nm^3/sec	Stack Conditions	16/05/2024	11:07 – 13:07
		Volumetric Flowrate	10.7977 Nm^3/sec	STP & Wet Gas		
		[redacted]	[redacted]			
		Total Chromium	5.01 kg/yr	Mass release		
		Release factor	0.1315%	-		
2025	System 1 ETL5	Volumetric Flowrate	10.1847 Nm^3/sec	Stack Conditions	07/02/2025	10:20 – 12:20
		Volumetric Flowrate	9.5523 Nm^3/sec	STP & Wet Gas		
		[redacted]	[redacted]			
		Total Chromium	0.78 kg/yr	Mass release		
		Release factor	0.0224%	-		

***Table 94**: Results of the last four calendar years' stack emissions monitoring campaigns*

Appendix 2: Occupational (worker) exposure monitoring

The applicant has its own suitably qualified in-house occupational hygiene team who conduct worker exposure monitoring campaigns over 2-3 days on an annual basis at the Trostre Works. Monitoring comprises a combination of personal and static sampling designed to cover the majority of WCS. Samples are then sent for analysis to a specialist third-party laboratory accredited to ISO/IEC 17025:2017. The LOD quoted by the laboratory is 0.01 micrograms (µg) per sample.

Personal exposure and static background monitoring is undertaken following the HSE guidance note HSG 173 *"Monitoring Strategies for Toxic Substances"*, Methods for Determination of Hazardous Substances (MDHS) 14/4 *"General methods for sampling and gravimetric analysis of respirable, thoracic and inhalable aerosols"* and British Standard ISO 16740 *"Workplace air – Determination of Hexavalent Chromium in airborne particulate matter – Method by ion chromatography and spectrophotometric measurement using diphenyl carbazide"*.

The results of the last four years' monitoring campaigns (2025, 2024, 2023 and 2022 calendar years) are presented in the tables below.

(Please note: '<' denotes any recorded value below limit of detection (LOD)).

2025	Role (Personal) / Location (Static)	Relevant WCS	Filter conc. of Cr(VI) (mg/m^3)	Sampling duration (min)	Sampling duration (hrs)	Shift length (hrs)	Activities conducted & duration	8hr TWA (mg/m^3)	12hr TWA (mg/m^3) (factored)
Personal	Tata Operative (Shift Team): Team Member Exit End Feed	WCS5, WCS6	<0.00001	520	8.67	12	Left ETL 5 during the morning (after 9am) to support on another production line exit end duties therefore fell to the Anode Exit Attendant.	1.08E-05	1.38E-05
Personal	Tata Operative (Shift Team): Team Member Entry End Feed	WCS5, WCS6	<0.00001	485	8.08	12	Typical shift duties involving threading on of coils and welding coils together on the shop floor. Monitoring the line from within the entry control room.	1.01E-05	1.48E-05
Personal	Tata Operative (Shift Team): Exit End Inspector ('General Inspector')	WCS5, WCS6	<0.000009	545	9.08	12	Undertook general inspection tasks such as visual inspection of strip quality from within the control room and assisted with bailer breakdowns on the line	1.02E-05	1.19E-05

2025	Role (Personal) / Location (Static)	Relevant WCS	Filter conc. of Cr(VI) (mg/m³)	Sampling duration (min)	Sampling duration (hrs)	Shift length (hrs)	Activities conducted & duration	8hr TWA (mg/m³)	12hr TWA (mg/m³) (factored)
Personal	Tata Operative (Shift Team): Anode Attendant 1 (exit)	WCS2, WCS4, WCS5, WCS6	<0.000009	528	8.80	12	Visited the anode section during the morning the rest of the time was spent on exit end duties	9.90E-06	1.23E-05
Personal	Tata Operative (Shift Team): Anode Attendant 2 (entry)	WCS2, WCS4, WCS5, WCS6	<0.00001	493	8.22	12	No actual time was spent on the anode section on the day, time was spent assisting with entry end duties	1.03E-05	1.46E-05
Personal	Tata Operative (Shift Team): Crane Operator ('Logistics Manager')	WCS5, WCS6	<0.00001	478	7.97	12	Undertook crane operations throughout the shift identifying coils and moving stock onto the line. Rest of time spent within the control room	9.96E-06	1.51E-05
Static	Above Passivation (Drive Side)	WCS4	<0.000009	573	9.55	N/A	N/A	N/A (static)	N/A (static)
Static	Above Passivation (Operator Side)	WCS4	<0.000009	572	9.53	N/A	N/A	N/A (static)	N/A (static)
Static	Front of Passivation (day 1)	WCS4	<0.000009	544	9.07	N/A	N/A	N/A (static)	N/A (static)
Static	Rear of Passivation	WCS4	<0.000009	582	9.70	N/A	N/A	N/A (static)	N/A (static)
Static	Below Passivation (Operator Side)	WCS4	<0.000009	590	9.83	N/A	N/A	N/A (static)	N/A (static)
Static	Exit End Control Room	WCS5	<0.000009	588	9.80	N/A	N/A	N/A (static)	N/A (static)
Static	Passivation Basement ('Cellar')	WCS4	<0.000009	588	9.80	N/A	N/A	N/A (static)	N/A (static)
Static	Exit end pulpit	WCS5	<0.00001	512	8.53	N/A	N/A	N/A (static)	N/A (static)
Personal	Tata Operative (Shift Team): Maintenance Operative	WCS7a	<0.00001	500	8.33	12	Crane Operator	1.04E-05	1.44E-05
Personal	Tata Operative (Shift Team): Maintenance Operative	WCS7a	<0.00001	509	8.48	12	General Operative	1.06E-05	1.41E-05

2025	Role (Personal) / Location (Static)	Relevant WCS	Filter conc. of Cr(VI) (mg/m³)	Sampling duration (min)	Sampling duration (hrs)	Shift length (hrs)	Activities conducted & duration	8hr TWA (mg/m³)	12hr TWA (mg/m³) (factored)
Personal	Tata Operative / Third Party (Maintenance): Mechanical 1	WCS7a	0.00013	434	7.23	8	Working on Chem treatment synchro seals under passivation throughout the maintenance period	1.18E-04	N/A (work 8hr shifts)
Personal	Tata Operative / Third Party (Maintenance): Mechanical 2	WCS7a	0.00012	421	7.02	8	Working on Chem treatment synchro seals under passivation throughout the maintenance period	1.05E-04	N/A (work 8hr shifts)
Personal	Tata Operative / Third Party (Maintenance): Electrical 1	WCS7a	0.000018	424	7.07	8	General line inspections and line walk over, ETL 5 oiler	1.59E-05	N/A (work 8hr shifts)
Personal	Tata Operative / Third Party (Maintenance): Electrical 2	WCS7a	<0.000012	425	7.08	8	General line inspections and line walk over, ETL 5 oiler	1.06E-05	N/A (work 8hr shifts)
Personal	Tata Operative / Third Party (Maintenance): Cleaner 1	WCS7a, WCS 7b	<0.000018	270	4.50	8	Specific work areas: Drag out tank. Cleaning general floors and oily areas.	1.01E-05	N/A (work 8hr shifts)
Personal	Tata Operative / Third Party (Maintenance): Cleaner 1 (desludging)	WCS 7b	0.000034	297	4.95	8	General line cleaning as well as tank sludge cleaning within the basement. Chemical suites and gloves worn during tasks. 45 min total break time.	2.10E-05	N/A (work 8hr shifts)
Personal	Tata Operative / Third Party (Maintenance): Cleaner 2 (desludging)	WCS 7b	0.000034	295	4.92	8	As above	2.09E-05	N/A (work 8hr shifts)
Personal	Veolia: WWTP Maintenance Operator / Technician	WCS8	<0.000011	456	7.60	12	Control room duties (180min) Duties in DAF (60min) Duties in Press (60min) Maintenance workshop duties (120min) Break (60min)	1.045E-05	1.74E-05
Personal	Veolia: WWTP Operator / Laboratory Technician	WCS8	<0.000011	464	7.73	12	General plant duties (60min) Chrome Additions (45min) Control Room Duties (300min) Break (60min)	1.063E-05	1.71E-05

2025	Role (Personal) / Location (Static)	Relevant WCS	Filter conc. of Cr(VI) (mg/m^3)	Sampling duration (min)	Sampling duration (hrs)	Shift length (hrs)	Activities conducted & duration	8hr TWA (mg/m^3)	12hr TWA (mg/m^3) (factored)
Static	WWTP Control Room Laboratory	WCS8	<0.000011	461	7.68	N/A	N/A	N/A	N/A
Static	WWTP Tank Farm Control Room	WCS8	<0.000011	471	7.85	N/A	N/A	N/A	N/A

***Table 95**: Results of the 2025 occupational (worker) exposure monitoring campaign.*

2024	Role (Personal) / Location (Static)	Relevant WCS	Filter conc. of Cr(VI) (mg/m^3)	Sampling duration (min)	Sampling duration (hrs)	Shift length (hrs)	Activities conducted & duration	8hr TWA (mg/m^3)	12hr TWA (mg/m^3) (factored)
Personal	Tata Operative (Shift Team): Team Leader	WCS4, WCS5	<0.000009	557	9.28	12	Undertook multiple walks on the line. Twice visited the basement - 30min total. Rest of shift in the control room. 15 min away to collect food and have a face fit test	1.04E-05	1.16E-05
Personal	Tata Operative (Shift Team): Exit End Inspector ('General Inspector')	WCS5, WCS6	<0.000009	557	9.28	12	2 visits onto the line for total of 2.5 hours, including anode change Rest of shift in the control room, including lunch break.	1.04E-05	1.16E-05
Personal	Tata Operative (Shift Team): Anode Attendant 1 (exit)	WCS2, WCS4, WCS5, WCS6	<0.000009	559	9.32	12	30min on the line adjusting marker. Rest of shift in the control room, including lunch break.	1.05E-05	1.16E-05
Personal	Tata Operative (Shift Team): Crane Operator ('Logistics Manager')	WCS5, WCS6	<0.000009	557	9.28	12	Up and down the line all shift completing crane operations 1.5hrs in the control room, including lunch break.	1.04E-05	1.16E-05
Static	Above Passivation (Drive Side)	WCS4	0.000014	541	9.02	N/A	N/A	N/A (static)	N/A (static)
Static	Above Passivation (Operator Side)	WCS4	0.000023	541	9.02	N/A	N/A	N/A (static)	N/A (static)
Static	Front of Passivation (day 1)	WCS4	0.000053	542	9.03	N/A	N/A	N/A (static)	N/A (static)
Static	Rear of Passivation	WCS4	0.000029	541	9.02	N/A	N/A	N/A (static)	N/A (static)
Static	Below Passivation (Operator Side)	WCS4	0.000055	533	8.88	N/A	N/A	N/A (static)	N/A (static)
Static	Exit End Control Room	WCS5	<0.0000091	552	9.20	N/A	N/A	N/A (static)	N/A (static)
Static	Passivation Basement ('Cellar')	WCS4	<0.0000094	535	8.92	N/A	N/A	N/A (static)	N/A (static)

2024	Role (Personal) / Location (Static)	Relevant WCS	Filter conc. of Cr(VI) (mg/m^3)	Sampling duration (min)	Sampling duration (hrs)	Shift length (hrs)	Activities conducted & duration	8hr TWA (mg/m^3)	12hr TWA (mg/m^3) (factored)
Static	Exit end pulpit	WCS5	<0.000013	523	8.72	N/A	N/A	N/A (static)	N/A (static)
Personal	Tata Operative (Shift Team): Maintenance Operative	WCS7a	<0.00001	518	8.63	12	Crane Operator (TB0813)	1.08E-05	1.39E-05
Personal	Tata Operative (Shift Team): Maintenance Operative	WCS7a	<0.00001	513	8.55	12	Team Leader (TB0812)	1.07E-05	1.40E-05
Personal	Tata Operative (Shift Team): Maintenance Operative	WCS7a	<0.00001	520	8.67	12	Crane Operator (TB0815)	1.08E-05	1.38E-05
Personal	Tata Operative (Shift Team): Maintenance Operative	WCS7a	<0.0000056	519	8.65	12	General Operative (TB0814)	6.06E-06	7.77E-06
Personal	Tata Operative / Third Party (Maintenance): Mechanical 1	WCS7a	<0.00001	491	8.18	8	Level Spray Bars, Pump exit end hydraulics, Filter Changes, Hose Changes	1.02E-05	N/A (work 8hr shifts)
Personal	Tata Operative / Third Party (Maintenance): Electrical 1	WCS7a	0.000037	426	7.10	8	Looper On Top and Small tasks all over the line	3.28E-05	N/A (work 8hr shifts)
Personal	Tata Operative / Third Party (Maintenance): Cleaner 1	WCS7a, WCS 7b	<0.000013	372	6.20	8	(TB0819) Cleaning across the whole line, all areas, all day Specific areas: Drag out tank, coil carpets	1.01E-05	N/A (work 8hr shifts)
Personal	Tata Operative / Third Party (Maintenance): Cleaner 2	WCS7a, WCS 7b	<0.000013	373	6.22	8	(TB0820) Cleaning across the whole line, all areas, all day Specific areas: Drag out tank, coil carpets	1.01E-05	N/A (work 8hr shifts)

2024	Role (Personal) / Location (Static)	Relevant WCS	Filter conc. of Cr(VI) (mg/m³)	Sampling duration (min)	Sampling duration (hrs)	Shift length (hrs)	Activities conducted & duration	8hr TWA (mg/m³)	12hr TWA (mg/m³) (factored)
Personal	Veolia: WWTP Maintenance Operator / Technician	WCS8	0.000016	490	8.17	12	Strimming yard Washing willets Wash under press Test showers Check polymer bins Change Protact bollards on ETL5 (10 mins) Sorting out skips	1.63E-05	2.35E-05
Personal	Veolia: WWTP Operator / Laboratory Technician	WCS8	<0.000011	522	8.70	12	Lab Tests within Laboratory (360 mins) Visit to Occupational Health (30 mins) On-site work and sample collection (120 mins) Chrome hatch (60 mins)	1.20E-05	1.52E-05
Static	WWTP Control Room Laboratory	WCS8	<0.00001	516	8.60	N/A	N/A	N/A (static)	N/A (static)
Static	WWTP Tank Farm Control Room	WCS8	<0.00001	517	8.62	N/A	N/A	N/A (static)	N/A (static)

Table 96*: Results of the 2024 occupational (worker) exposure monitoring campaign*

2023	Role (Personal) / Location (Static)	Relevant WCS	Filter conc. of Cr(VI) (mg/m³)	Sampling duration (min)	Sampling duration (hrs)	Shift length (hrs)	Activities conducted & duration	8hr TWA (mg/m³)	12hr TWA (mg/m³) (factored)
Personal	Tata Operative (Shift Team): Team Leader	WCS4, WCS5	0.000032	512	8.53	12	Not reported	3.41E-05	4.50E-05
Personal	Tata Operative (Shift Team): Exit End Inspector ('General Inspector')	WCS5, WCS6	0.000017	510	8.50	12	Not reported	1.81E-05	2.40E-05
Personal	Tata Operative (Shift Team): Anode Attendant 1 (exit)	WCS2, WCS4, WCS5, WCS6	0.000039	507	8.45	12	Not reported	4.12E-05	5.54E-05
Personal	Tata Operative (Shift Team): Crane Operator ('Logistics Manager')	WCS5, WCS6	0.000016	497	8.28	12	Not reported	1.66E-05	2.32E-05
Static	Above Passivation (Drive Side)	WCS4	0.000028	489	8.15	N/A	N/A	N/A (static)	N/A (static)
Static	Above Passivation (Operator Side)	WCS4	0.00001	489	8.15	N/A	N/A	N/A (static)	N/A (static)
Static	Front of Passivation (day 1)	WCS4	0.00015	501	8.35	N/A	N/A	N/A (static)	N/A (static)
Static	Front of Passivation (day 2)	WCS4	0.00019	526	8.77	N/A	N/A	N/A (static)	N/A (static)
Static	Rear of Passivation	WCS4	0.000063	492	8.20	N/A	N/A	N/A (static)	N/A (static)
Static	Below Passivation (Operator Side)	WCS4	0.00025	498	8.30	N/A	N/A	N/A (static)	N/A (static)
Static	Exit End Control Room	WCS5	<0.00001	506	8.43	N/A	N/A	N/A (static)	N/A (static)
Static	Passivation Basement ('Cellar')	WCS4	<0.00001	485	8.08	N/A	N/A	N/A (static)	N/A (static)
Static	Exit end pulpit	WCS5	0.000015	531	8.85	N/A	N/A	N/A (static)	N/A (static)
Personal	Tata Operative (Shift Team): Maintenance Operative	WCS7a	0.000042	528	8.80	12	Crane Operator	4.62E-05	5.73E-05
Personal	Tata Operative (Shift Team): Maintenance Operative	WCS7a	0.000057	528	8.80	12	Team Leader	6.27E-05	7.77E-05

2023	Role (Personal) / Location (Static)	Relevant WCS	Filter conc. of Cr(VI) (mg/m³)	Sampling duration (min)	Sampling duration (hrs)	Shift length (hrs)	Activities conducted & duration	8hr TWA (mg/m³)	12hr TWA (mg/m³) (factored)
Personal	Tata Operative (Shift Team): Maintenance Operative	WCS7a	0.0000095	529	8.82	12	57 Crane Operator	1.05E-05	1.29E-05
Personal	Tata Operative (Shift Team): Maintenance Operative	WCS7a	0.000017	524	8.73	12	General Operative	1.86E-05	2.34E-05
Personal	Tata Operative / Third Party (Maintenance): Mechanical 1	WCS7a	0.000062	444	7.40	8	Not reported	5.74E-05	N/A (work 8hr shifts)
Personal	Tata Operative / Third Party (Maintenance): Mechanical 2	WCS7a	0.000016	444	7.40	8	Not reported	1.48E-05	N/A (work 8hr shifts)
Personal	Tata Operative / Third Party (Maintenance): Electrical 1	WCS7a	0.00019	476	7.93	8	Not reported	1.88E-04	N/A (work 8hr shifts)
Personal	Tata Operative / Third Party (Maintenance): Electrical 2	WCS7a	0.00017	472	7.87	8	Not reported	1.67E-04	N/A (work 8hr shifts)
Personal	Tata Operative / Third Party (Maintenance): Cleaner 1	WCS7a, WCS 7b	0.000022	442	7.37	8	Not reported	2.03E-05	N/A (work 8hr shifts)
Personal	Tata Operative / Third Party (Maintenance): Cleaner 2	WCS7a, WCS 7b	0.000019	437	7.28	8	Not reported	1.73E-05	N/A (work 8hr shifts)
Personal	Veolia: WWTP Maintenance Operator / Technician	WCS8	0.00005	490	8.17	12	Basement checks - 25min Press house 1.5hrs dropping press plates. Tank farm checks on tanks 1hr. Lagoon submersibles cleaned.	5.10E-05	7.35E-05

2023	Role (Personal) / Location (Static)	Relevant WCS	Filter conc. of Cr(VI) (mg/m^3)	Sampling duration (min)	Sampling duration (hrs)	Shift length (hrs)	Activities conducted & duration	8hr TWA (mg/m^3)	12hr TWA (mg/m^3) (factored)
Personal	Veolia: WWTP Operator / Laboratory Technician	WCS8	0.00004	522	8.70	12	Press House (1 hr 30 mins) Dropping Press Plates – 2 Batches (1 hr 30 mins) Bottom Hose Oily Waste Tanks (30 mins) A Clarifier – Cleaning Loader (30 mins) Daily Site Inspections (2 hrs) Poly Room Cleaning (1 hr) Chrome Analyser – Daily Inspection and Clean (1 hr)	4.35E-05	5.52E-05
Static	WWTP Control Room Laboratory	WCS8	<0.00001	516	8.60	N/A	N/A	N/A (static)	N/A (static)
Static	WWTP Tank Farm Control Room	WCS8	0.0004	517	8.62	N/A	N/A	N/A (static)	N/A (static)

Table 97*: Results of the 2023 occupational (worker) exposure monitoring campaign*

2022	Role (Personal) / Location (Static)	Relevant WCS	Filter conc. of Cr(VI) (mg/m³)	Sampling duration (min)	Sampling duration (hrs)	Shift length (hrs)	Activities conducted & duration	8hr TWA (mg/m³)	12hr TWA (mg/m³) (factored)
Personal	Tata Operative (Shift Team): Team Leader	WCS4, WCS5	<0.00001	526	8.77	12	Not reported	1.10E-05	1.37E-05
Personal	Tata Operative (Shift Team): Exit End Inspector ('General Inspector')	WCS5, WCS6	<0.0000094	529	8.82	12	Not reported	1.04E-05	1.28E-05
Personal	Tata Operative (Shift Team): Anode Attendant 1 (exit)	WCS2, WCS4, WCS5, WCS6	<0.0000095	534	8.90	12	Not reported	1.06E-05	1.28E-05
Personal	Tata Operative (Shift Team): Anode Attendant 2 (entry)	WCS2, WCS4, WCS5, WCS6	N/A (Not sampled)	N/A (Not sampled)	N/A (Not sampled)	N/A (Not sampled)	N/A (Not sampled)	N/A (Not sampled)	N/A (Not sampled)
Personal	Tata Operative (Shift Team): Crane Operator ('Logistics Manager')	WCS5, WCS6	0.00007	527	8.78	12	Not reported	7.69E-05	9.56E-05
Static	Above Passivation (Drive Side)	WCS4	0.00035	481	8.02	N/A	N/A	N/A (static)	N/A (static)
Static	Above Passivation (Operator Side)	WCS4	0.00048	480	8.00	N/A	N/A	N/A (static)	N/A (static)
Static	Front of Passivation (day 1)	WCS4	0.00024	482	8.03	N/A	N/A	N/A (static)	N/A (static)
Static	Front of Passivation (day 2)	WCS4	<0.000011	437	7.28	N/A	N/A	N/A (static)	N/A (static)
Static	Rear of Passivation	WCS4	0.00019	479	7.98	N/A	N/A	N/A (static)	N/A (static)
Static	Below Passivation (Operator Side)	WCS4	0.0001	480	8.00	N/A	N/A	N/A (static)	N/A (static)
Static	Exit End Control Room	WCS5	<0.00001	523	8.72	N/A	N/A	N/A (static)	N/A (static)
Static	Passivation Basement ('Cellar')	WCS4	<0.000011	480	8.00	N/A	N/A	N/A (static)	N/A (static)
Static	Exit end pulpit	WCS5	0.000047	481	8.02	N/A	N/A	N/A (static)	N/A (static)

2022	Role (Personal) / Location (Static)	Relevant WCS	Filter conc. of Cr(VI) (mg/m^3)	Sampling duration (min)	Sampling duration (hrs)	Shift length (hrs)	Activities conducted & duration	8hr TWA (mg/m^3)	12hr TWA (mg/m^3) (factored)
Personal	Tata Operative (Shift Team): Maintenance Operative	WCS7a	<0.000011	445	7.42	12	TATA Production Operative/s - Sorting Anodes in plating line ready for changing.	1.02E-05	1.78E-05
Personal	Tata Operative (Shift Team): Maintenance Operative	WCS7a	<0.000011	453	7.55	12	TATA Production Operative/s - Sorting Anodes in plating line ready for changing.	1.04E-05	1.75E-05
Personal	Tata Operative (Shift Team): Maintenance Operative	WCS7a	0.000047	459	7.65	12	TATA Production Operative/s - Sorting Anodes in plating line ready for changing.	4.49E-05	7.37E-05
Personal	Tata Operative (Shift Team): Maintenance Operative	WCS7a	0.000034	459	7.65	12	TATA Production Operative/s - Sorting Anodes in plating line ready for changing.	3.25E-05	5.33E-05
Personal	Tata Operative / Third Party (Maintenance): Mechanical 1	WCS7a	0.000072	422	7.03	8	Mechanical - Completing a flange change - Original job cancelled. (No times provided)	6.33E-05	N/A (work 8hr shifts)
Personal	Tata Operative / Third Party (Maintenance): Mechanical 2	WCS7a	0.000071	423	7.05	8	Mechanical - Completing a flange change - Original job cancelled. (No times provided)	6.26E-05	N/A (work 8hr shifts)
Personal	Tata Operative / Third Party (Maintenance): Electrical 1	WCS7a	<0.000012	415	6.92	8	Electrical - Changing brushes on drive side of the Tin plating section. (No times provided)	1.04E-05	N/A (work 8hr shifts)
Personal	Tata Operative / Third Party (Maintenance): Electrical 2	WCS7a	<0.000011	442	7.37	8	Electrical - Changing brushes on drive side of the Tin plating section. (No times provided)	1.01E-05	N/A (work 8hr shifts)
Personal	Tata Operative / Third Party (Maintenance): Cleaner 1	WCS7a, WCS 7b	<0.000012	411	6.85	8	Cleaner - General cleaning of flooring. Mopping and squeegeeing/floor cleaning machine. (No times provided)	1.03E-05	N/A (work 8hr shifts)

2022	Role (Personal) / Location (Static)	Relevant WCS	Filter conc. of Cr(VI) (mg/m^3)	Sampling duration (min)	Sampling duration (hrs)	Shift length (hrs)	Activities conducted & duration	8hr TWA (mg/m^3)	12hr TWA (mg/m^3) (factored)
Personal	Veolia: WWTP Maintenance Operator / Technician	WCS8	0.000014	500	8.33	12	Not provided	1.46E-05	2.02E-05
Personal	Veolia: WWTP Operator / Laboratory Technician	WCS8	0.000015	507	8.45	12	Not provided	1.58E-05	2.13E-05
Static	WWTP Control Room Laboratory	WCS8	<0.00001	488	8.13	N/A	N/A	N/A (static)	N/A (static)
Static	WWTP Tank Farm Control Room	WCS8	<0.00001	497	8.28	N/A	N/A	N/A (static)	N/A (static)

Table 98*: Results of the 2022 occupational (worker) exposure monitoring campaign*

Appendix 3: Wastewater monitoring

A composite sampler is used to collect a representative 24-hour sample of the treated effluent discharged to the Loughor Estuary which is analysed to ensure that it meets the conditions laid down in the discharge consent, part of the EPR permit issued by Natural Resources Wales (NRW). This includes analysis for Cr(VI) and for total chromium. The current discharge consent levels include 0.4 mg/l maximum for total chromium (no discharge of Cr(VI) is permitted).

The table below contains information on the reported emissions to water in the previous four calendar years and demonstrates that total chromium and Cr(VI) emissions were within permitted levels.

Year	Volume flow (m3)	Total Cr (kg)	Cr(VI) (kg)
2025	1,661,570	12.86	0
2024	1,719,869	19.12	0
2023	1,695,400	21.19	0
2022	1,400,100	23.24	0

Table 99: *Annual mass emissions to water, 2022-2025*

Further detail for 2024 is provided below as an example of how the applicant monitors compliance against its permit for Cr(VI) and total Cr. (Data are also collected for pH, iron, chemical oxygen demand (COD), total suspended matter (TSM), total oil and temperature, but are not reported below as they are not relevant to this application.)

Year	Parameter	Cr(VI)	Total chromium (mg/l)
2024	Permitted limit	0	0.400
	average	0.0	0.010
	minimum	0.0	0.001
	maximum	0.0	0.124
	Std Dev	0.0	0.017
	Mean + 3 Sigma	0.0	0.062
	No. of data points (24hr composite samples)	365	365
	% in compliance	100	100
	% near misses	0	0

Table 100: *Example of system used for monitoring compliance with permit for emissions to water*

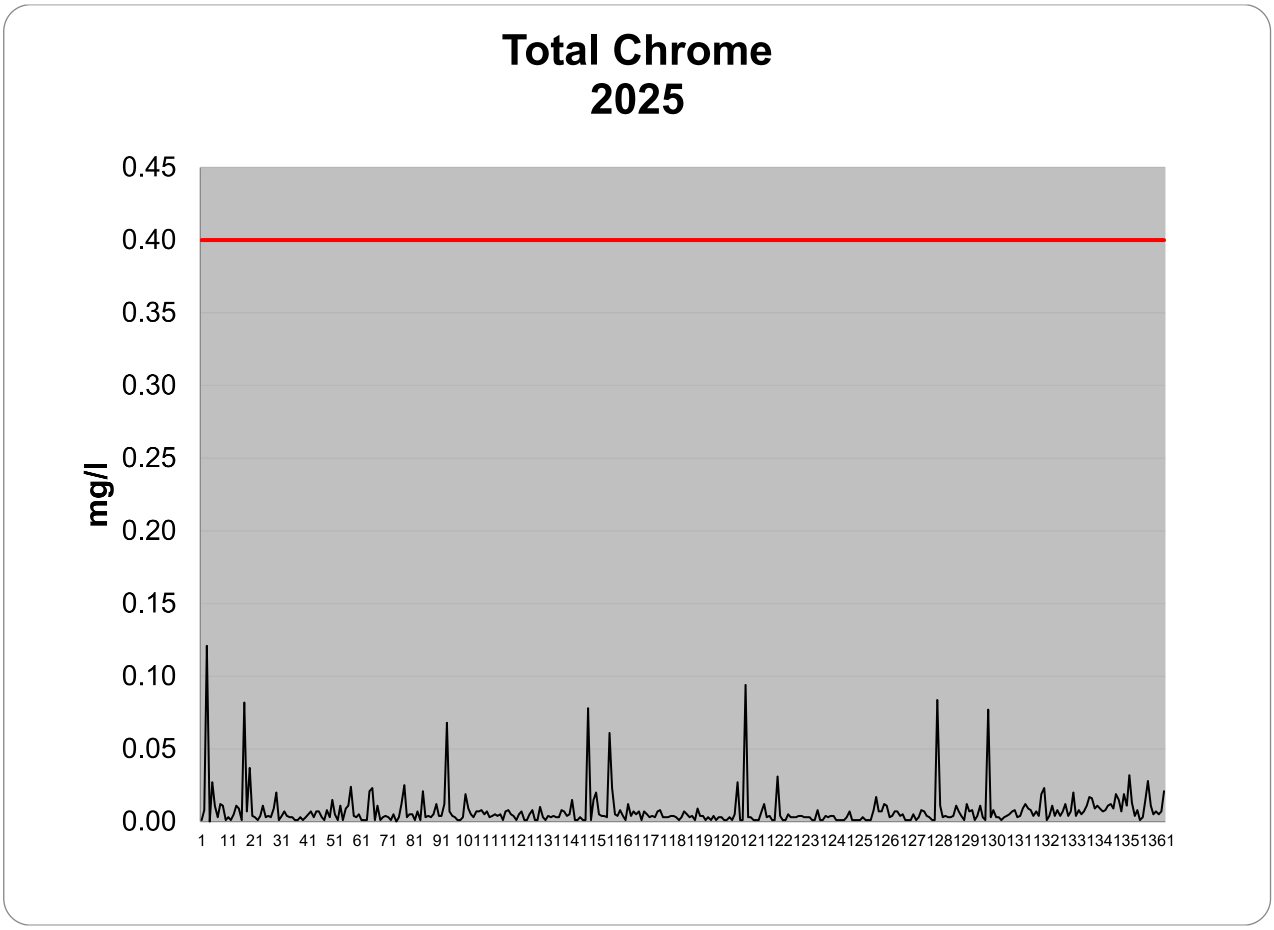


Figure 30*: Emissions to water, total Cr, 2025*

References

Environment Agency (EA), 2025. *Monitoring stack emissions: techniques and standards for periodic monitoring*. Available at https://www.gov.uk/government/publications/monitoring-stack-emissions-techniques-and-standards-for-periodic-monitoring/monitoring-stack-emissions-techniques-and-standards-for-periodic-monitoring

ETeSS (Expert Team providing scientific support for ECHA), 2013. *Services to support the assessment of remaining cancer risks related to the use of chromium- and arsenic-containing substances in Applications for Authorisation*. Helsinki: ECHA. Available at https://echa.europa.eu/documents/10162/17233/carcinogenicity_dose_response_cr_vi_report_en.pdf/7158ab67-0801-4307-bf5b-30c75c15518e?t=1395235087502

European Chemicals Agency (ECHA), 2008. *Member State Committee Support Document for Identification of Sodium Dichromate as a Substance of Very High Concern.* Helsinki: ECHA. Available from https://echa.europa.eu/documents/10162/159357fd-1597-e4c3-9532-7c0bf55cc109

European Chemicals Agency (ECHA), 2012. *Guidance on Information Requirements and Chemical Safety Assessment. Chapter R.8: Characterisation of dose [concentration]-response for human health.* (Version 2.1, November 2012.) Helsinki: ECHA. Available at https://echa.europa.eu/documents/10162/17224/information_requirements_r8_en.pdf/e153243a-03f0-44c5-8808-88af66223258

European Chemicals Agency (ECHA), 2013. *RAC/27/2013/06 Rev.1 – Application for authorisation: Establishing a reference dose response relationship for carcinogenicity of hexavalent chromium*. Helsinki: ECHA. Available from https://echa.europa.eu/documents/10162/17090/rac_carcinogenicity_dose_response_crvi_en.pdf/facc881f-cf3e-40ac-8339-c9d9c1832c32?t=1388753502163

European Chemicals Agency (ECHA), 2015a. *RAC/27/2013/06 Rev.1: Amendment of the RAC note "Application for Authorisation: Establishing a reference dose-response relationship for carcinogenicity of hexavalent chromium" to include the intrinsic property "Toxic to reproduction" of the Cr(VI) compounds.* Helsinki: ECHA. Available at: https://www.echa.europa.eu/documents/10162/1564405/rac_35_09_1_c_dnel_cr-vi-_en.pdf

European Chemicals Agency (ECHA), 2015b. *ECHA 2015/248: Assess the risk estimate for the intrinsic property "Toxic to reproduction" of the Cr(VI) compounds listed in Annex XIV except for lead chromate. Final Report.* (Report prepared by the UK Health and Safety Executive's Chemicals Regulation Directorate.) Available at https://www.echa.europa.eu/documents/10162/1564405/rac_35_09_1_c_dnel_cr-vi_report_en.pdf

European Chemicals Agency (ECHA), 2015c. *Guidance on Information Requirements and Chemical Safety Assessment. Chapter R.12: Use description.* (Version 3.0, December 2015.) Helsinki: ECHA. Available from https://echa.europa.eu/documents/10162/17224/information_requirements_r12_en.pdf/

European Chemicals Agency (ECHA), 2016a. *Guidance on Information Requirements and Chemical Safety Assessment. Chapter R.14: Occupational Exposure Assessment.* (Version 3.10, August 2016.) Helsinki: ECHA. Available from https://echa.europa.eu/documents/10162/17224/information_requirements_r14_en.pdf/bb14b581-f7ef-4587-a171-17bf4b332378

European Chemicals Agency (ECHA), 2016b. *Guidance on Information Requirements and Chemical Safety Assessment. Chapter R.16: Environmental exposure assessment*. (Version 3.0, February 2016.) Helsinki: ECHA. Available from https://echa.europa.eu/documents/10162/13632/information_requirements_r16_en.pdf/b9f0f406-ff5f-4315-908e-e5f83115d6af

European Chemicals Agency (ECHA), 2016c. *Guidance on Information Requirements and Chemical Safety Assessment. Part E: Risk Characterisation.* (Version 3.0, May 2016.) Helsinki: ECHA. Available from https://echa.europa.eu/documents/10162/17224/information_requirements_part_e_en.pdf/1da6cadd-895a-46f0-884b-00307c0438fd

European Chemicals Agency (ECHA), 2021. *Guidance on the preparation of an application for authorisation*. Helsinki: ECHA. Available at https://echa.europa.eu/documents/10162/17235/authorisation_application_en.pdf

European Chemicals Agency (ECHA), 2022. *Guidance on Information Requirements and Chemical Safety Assessment*. [Online] Helsinki: ECHA. Accessed 19/09/2022. Available at https://echa.europa.eu/guidance-documents/guidance-on-information-requirements-and-chemical-safety-assessment

European Chemicals Bureau (ECB), 2005. *European Union Risk Assessment Report: chromium trioxide, sodium chromate, sodium dichromate, ammonium dichromate and potassium dichromate*. Brussels: European Commission. Available from https://echa.europa.eu/documents/10162/3be377f2-cb05-455f-b620-af3cbe2d570b

European Commission, 2010. *HEEG opinion 9: Default protection factors for protective clothing and gloves*. Joint Research Centre: Institute for Health and Consumer Protection, Ispra. Available at https://echa.europa.eu/documents/10162/1060554/heeg_opinion_9_default_protection_factors_for_clothing_and_gloves_en.pdf/07fd65d3-8ec8-4f7c-9247-4159841ca9fd

European Food Safety Authority (EFSA), 2014. *Scientific Opinion on the risks to public health related to the presence of chromium in food and drinking water. EFSA Panel on Contaminants in the Food Chain (CONTAM)*. The EFSA Journal, 12(3):3595, http://www.efsa.europa.eu/de/efsajournal/doc/3595.pdf

HSE (Health and Safety Executive), 2013. *HSG53: Respiratory protective equipment at work: A practical guide*. London: HSE. Available from https://www.hse.gov.uk/pubns/priced/hsg53.pdf

International Organisation for Standardization (ISO), 2005. *ISO 16740:2005: Workplace air — Determination of hexavalent chromium in airborne particulate matter — Method by ion chromatography and spectrophotometric measurement using diphenyl carbazide*. Geneva, ISO. Available at https://www.iso.org/standard/30432.html