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:	23 December 2025
Prepared by:	Tata Steel UK Limited Sagentia Regulatory (Technology Sciences Group Consulting Ltd)
Substance:	Chromium trioxide (EC no. 215-607-8, CAS no. 1333-82-0)
Use title:	The use of chromium trioxide for the manufacture of electrolytic chromium coated steel (ECCS)
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 (23 December 2025), 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
23 December 2025

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
COSHH	The Control of Substances Hazardous to Health Regulations 2002 (as amended)
Cr(O)	Metallic chromium
Cr(III)	Trivalent chromium
Cr(VI)	Hexavalent chromium
CrO_3	Chromium trioxide
CSR	Chemical Safety Report
CTAC	Chromium Trioxide REACH Authorisation Consortium
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
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 electrolytic chromium coated steel (ECCS, also known as tin-free steel) and electrolytic tin plated steel (ETP, also known as tinplate) for packaging in the UK. The site, which celebrated its 70th year in 2022, manufactures up to 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 use of chromium trioxide at the Trostre Works to manufacture ECCS. The substance is used to apply a thin layer of chromium (Cr(0)) and chromium oxide onto flat metal products (steel surfaces) by electrolytic deposition. The resulting coating is free of chromium trioxide and supports excellent adhesion for a subsequent functional lacquer or laminate layer. The applicant's customers rely on this high-quality ECCS 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.

ECCS Product	Examples of use in final products
Food cans	Vegetable and soup cans; pet food cans; tinned fish cans
Beverage cans	Beer and soft drinks cans
Aerosol cans	Personal care and household products in aerosol cans
General line	Two-piece cans for paints or oils; decorative packaging (special packaging); cans for confectionery and for dry products (milk powder/coffee)
Closures and can ends	For glass bottles and glass jars; ends/rings (classic, easy open, peel off ring)
Non-packaging	Baking ware, printing plates (electronic sector)

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

The use of chromium trioxide is to provide the required corrosion and chemical resistance to confer safe use during the lifecycle of all these packaging and non-packaging materials.

Chromium trioxide is listed in Annex XIV of REACH (entry no. 16) due to its classification as a carcinogen (cat. 1A) and mutagen (cat. 1B) 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 chromium trioxide for the manufacture of ECCS. The application was made under EU REACH and final opinions were issued on 12 June 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/22/02/0) 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 chromium trioxide in the manufacture of ECCS. Promising technologies include, for example, a chromium-based coating process that uses trivalent chromium (Cr(III)) compounds which are not subject to authorisation. The applicant is investigating this potential alternative, which would require capital investment of [redacted] (public range: > £100 million), to replace ECCS production at the Trostre Works. However, significant concern remains over the technical and economic feasibility of this potential alternative. The technology is not yet fully established at scale and resulting products do not exhibit the same consistently high performance as ECCS produced with Cr(VI). As a result, products made using the Cr(III)-based technology have not secured widespread acceptance by the market, with ECCS customers indicating their intent to continue to source Cr(VI)-based ECCS, whether from Trostre or suppliers in regions where the use of chromium trioxide 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 chromium trioxide for ECCS and demonstrates that exposure to chromium trioxide at the Trostre Works has been minimised.

Part A

Summary of risk management measures

The AfA covers one use of chromium trioxide (for the manufacture of ECCS) at one site by one applicant, a downstream user of chromium trioxide. Article 62(4)(d) of REACH states that an application for authorisation (AfA) 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, i.e. carcinogenic cat. 1A and mutagenic cat.1B for chromium trioxide. Therefore, this CSR focuses on the carcinogenicity and mutagenicity endpoints.

Based on studies which show its genotoxic potential, the Risk Assessment Committee (RAC) has concluded that chromium trioxide should be considered as a non-threshold substance with respect to risk characterisation for carcinogenic effect of hexavalent chromium (reference to the studies examined are included in the RAC document RAC/27/2013/06 Rev. 1).[1] As a result, demonstrating adequate control is not possible and the socio-economic analysis (SEA) route is applicable.

RAC has established a reference dose response relationship for the carcinogenicity of hexavalent chromium[2] and this will be used in the risk assessment by the applicant. In addition, 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 chromium trioxide 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.

[1] ECHA, 2013.
[2] ECHA, 2013.

Part B

1. Identity of the substance and physical / chemical properties

1.1 Name and other identifiers of the substance

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

EC name:	Chromium (VI) trioxide
EC / List number:	215-607-8
CAS number:	1333-82-0
Molecular formula:	CrO_3
Molecular weight:	99.994 g/mol
Structural formula	

***Table 2**: Substance identity*

Chromium trioxide was included in the candidate list of substances of very high concern (SVHC) on 15th December 2010 (ECHA Decision ED/95/2010) and was included in Annex XIV of REACH, entry no. 16, on 17th April 2013 by virtue of Commission Regulation (EU) 348/2013. This was because of intrinsic properties relating to carcinogenicity and mutagenicity. 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 purchases chromium trioxide in a solid, crystalline form delivered in 25kg or 50kg containers 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).

As a downstream user under REACH, the applicant applies for authorisation to use chromium trioxide and its aqueous solutions (i.e. chromic acid) for the manufacture of ECCS. In line with the European Chemicals Agency (ECHA) Question & Answer no. 805, this AfA for chromium trioxide therefore also covers the use of chromic acid and their oligomers generated from adding chromium trioxide to water.[3]

[3] See https://www.echa.europa.eu/sv/support/qas

Constituent	Concentration	
Chromium trioxide (solid, crystalline)	Min. 99.7%	
Impurities	Sodium / Na^+ Sulfate / SO_4^{2-} Chloride / Cl^- Ferro / Fe Insolubles	Max. 0.2% Max. 0.2% Max. 100 mg/kg Max. 50 mg/kg Max. 100 mg/kg
Chromium trioxide (dissolved in water)	Target concentration of [redacted] chromic acid in plating tanks	Chromium trioxide dissolved in water will result in a solution of mainly chromic acid, dichromic acid and other oligomers

***Table 3**: Constituents of chromium trioxide as used by the applicant.*

1.3 Physico-chemical properties

The following physico-chemical properties are taken from information from ECHA[4] and as provided by the applicant's current supplier.

Property	Description
Physical state:	Solid (crystalline) at 20°C and 101.3 kPa Colour: Dark red
Melting / freezing point:	196 °C at 101.3 kPa
Boiling point:	Not applicable. Decomposes at approximately 250°C to Cr_2O_3 and O_2
Vapour pressure:	4.74E-9 Pa at 25°C.
Water solubility:	1.69E+6 mg/L at 25°C. A 1% solution has a pH <1
Partition coefficient n-octanol/water (log value):	Not applicable. Inorganic ionic compound.
Dissociation constant:	Not applicable. Inorganic ionic compound.
Relative density:	2.7 g/cm^3 at 20°C

***Table 4**: Overview of relevant physico-chemical properties for chromium trioxide (solid)*

4 ECHA, 2010.

2. Manufacture and use

2.1 Quantities

The quantity of chromium trioxide 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 chromium trioxide that is manufactured by [redacted].

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

Chromium trioxide is used for the production of ECCS at the applicant's site in Llanelli (Trostre Works). Further detailed information on this use is presented in section 9 of this report.

Identifiers	Use descriptors	Other information
IS-1 *	Use of chromium trioxide for the manufacture of electrolytic chromium coated steel (ECCS).	-
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 (WCS1) - PROC 8b: Transfer of substance or mixture (charging and discharging) at dedicated facilities (WCS3, 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] Public range: 100-150 tonnes 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 (chromium trioxide) is not present in the article. Exposure related description of article: - None, as the substance (chromium trioxide) is not present in the article. Environmental release category (ERC): - Not applicable. During electroplating Cr(VI) is reduced to Cr(III) and Cr(0). Any potentially remaining Cr(VI) on the surface of the steel is removed by rinsing the steel strip in 2 stage cascade rinsing tanks, followed by 3 sets of squeeze rolls and a hot air drier. 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 chromium trioxide 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

Chromium trioxide has mandatory classification and labelling under CLP, as follows.

Hazard class	Hazard category / differentiation	Hazard statement	Hazard pictogram
Oxidizing solid	Ox. Sol. 1	H271 (May cause fire or explosion; strong oxidiser)	
Skin corrosion	Skin Corr. 1A	H314 (Causes severe skin burns and eye damage)	
Acute toxicity	Acute Tox. 3 (oral) *	H301 (Toxic if swallowed)	
	Acute Tox. 3 (dermal) *	H311 (Toxic 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. 1A	H350 (May cause cancer)	
Reproductive toxicity	Repr. 2	H361f (Suspected of damaging fertility)	
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: STOT SE 3; H335: C ≥ 1%			

***Table 6**: Mandatory classification and labelling for chromium trioxide under CLP*

3.2 Classification relevant to Annex XIV of REACH

In accordance with Articles 57(a) and 57(b) of REACH, chromium trioxide 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 1A
- Mutagenicity, category 1B

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

3.3 Classification of chromium trioxide as supplied

The following classification and labelling information reflects the substance as supplied to the applicant, taken from information provided by the applicant's current supplier in the SDS. The classification differs from the harmonised classification only in respect to dermal acute toxicity, where the supplier classifies as category 2 (H310) rather than category 3 (H311).

C&L	Description
Classification	Ox. Sol. 1; H271 Acute Tox. 3; H301 Acute Tox. 2; H310 Acute Tox. 2; H330 Skin Corr. 1A; H314 Skin Sens. 1; H317 Resp. Sens. 1; H334 Carc. 1A; H350 Muta. 1B; H340 Repr. 2; H361f STOT RE 1; H372 Aquatic Acute 1; H400 Aquatic Chronic 1; H410
Signal word	Danger
Hazard pictograms (for the label)	
Hazard statements (for the label)	H271: May cause fire or explosion; strong oxidiser. H301: Toxic if swallowed. H310+H330: Fatal in contact with skin or 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. H361f: Suspected of damaging fertility. H372: Causes damage to the lung, the respiratory system and the respiratory tract through

C&L	Description
	prolonged or repeated exposure. Route of exposure: Inhalation. H410: Very toxic to aquatic life with long lasting effects.
Precautionary statements	P210: Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. P283: Wear fire resistant or flame retardant clothing. 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. P361+P364: Take off immediately all 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	Restricted to professional users. REACH authorisation number: [redacted]

***Table 7**: Classification and labelling of chromium trioxide as supplied to the applicant.*

4. Environmental fate properties

This is not relevant for this AfA. Chromium trioxide 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 and mutagenicity endpoints, i.e. the intrinsic properties referred to in Article 57 of REACH that are specified in Annex XIV for chromium trioxide. The health effects of chromium trioxide are directly linked to exposure to hexavalent chromium ions (Cr(VI)) released during industrial processes. 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 chromium trioxide) for both workers and the general population.[5]

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] ECHA, 2013.

6. Physicochemical properties hazard assessment

This is not relevant for this AfA. Chromium trioxide 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. Chromium trioxide 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. Chromium trioxide 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 chromium trioxide to produce ECCS 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 chromium trioxide in the manufacture of ECCS is to provide a continuous fine layer of chromium metal (Cr(0)) and chromium oxide (Cr(III)) on the steel strip. This layer provides corrosion protection and supports excellent adhesion for a subsequent functional lacquer or laminate layer. The ECCS is used by the applicant's customers to produce cans for food and beverages and metal packaging for various non-food applications.

ECCS is essential in certain food packaging applications. It provides excellent corrosion resistance, which is crucial for maintaining the integrity and safety of food products, preventing rust and other forms of degradation that could compromise the food inside. 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.

Chromium trioxide is listed in Annex XIV of REACH (entry 16) and is subject to authorisation. The applicant already has an authorisation under REACH for the use of chromium trioxide for the manufacture of ECCS. The application was submitted under EU REACH on 10 April 2019 and final opinions were issued on 12 June 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/22/02/0) 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 chromium trioxide. However, it has been very challenging for the applicant – consistent with others in its sector and indeed other sectors of industry currently relying on chromium trioxide 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 chromium trioxide.

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 ECCS 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.
- 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 chromium trioxide at the site for the production of ECCS:

- The applicant also has a separate authorisation for the use of sodium dichromate and chromium trioxide for the passivation of electrolytic tinplate (authorisation nos. UKREACH/22/01/1 and UKREACH/22/01/0 respectively). This AfA was submitted on 28 November 2019 under EU REACH 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, so the applicant 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.

- 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 8**: 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 stacks serving the ECCS line are provided in Figures 2 and 3 below.

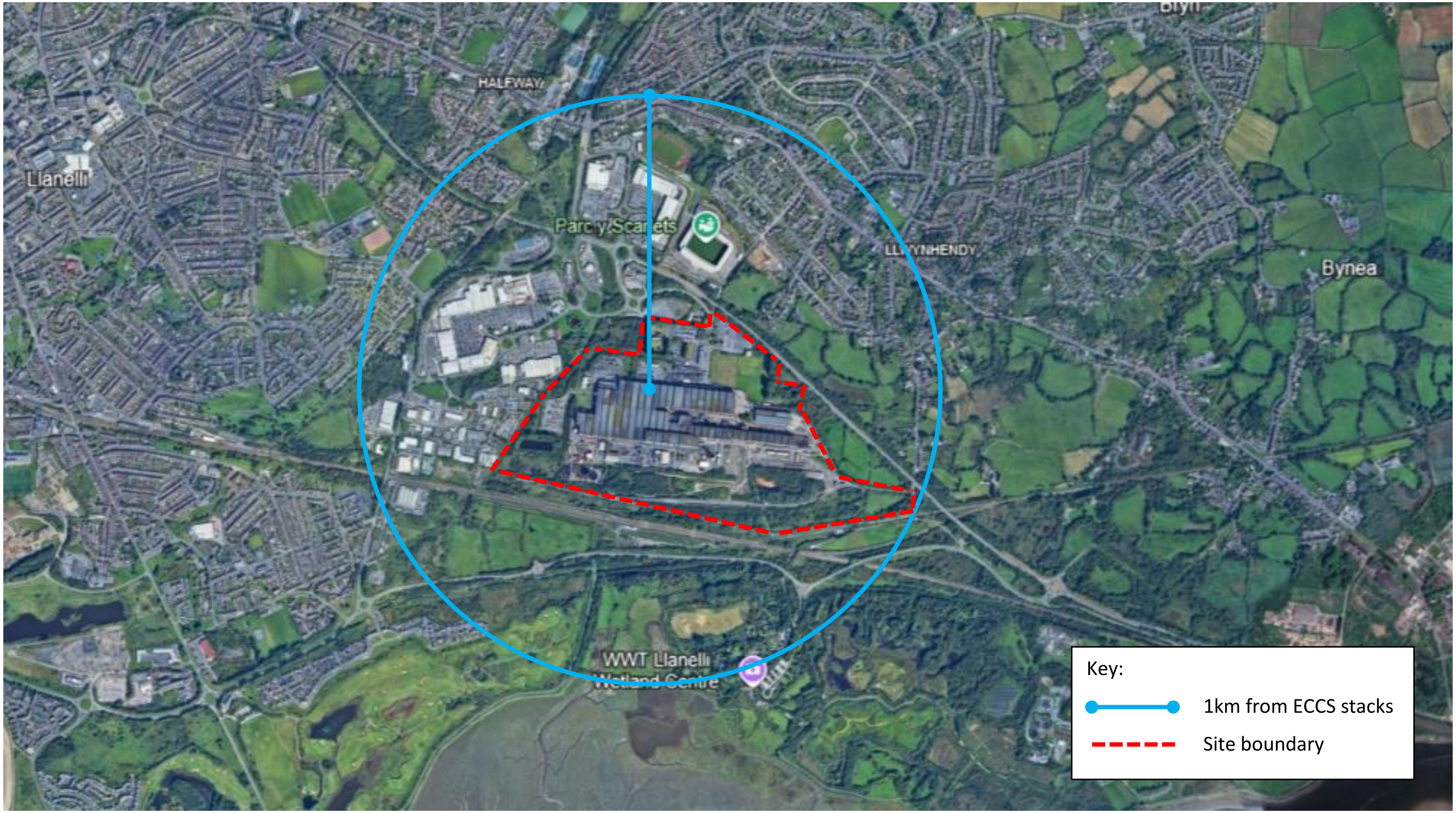

***Figure 2**: Overhead view of the Trostre Works showing the site boundary and area within a 1 km radius of the exhaust stacks from the ECCS line*

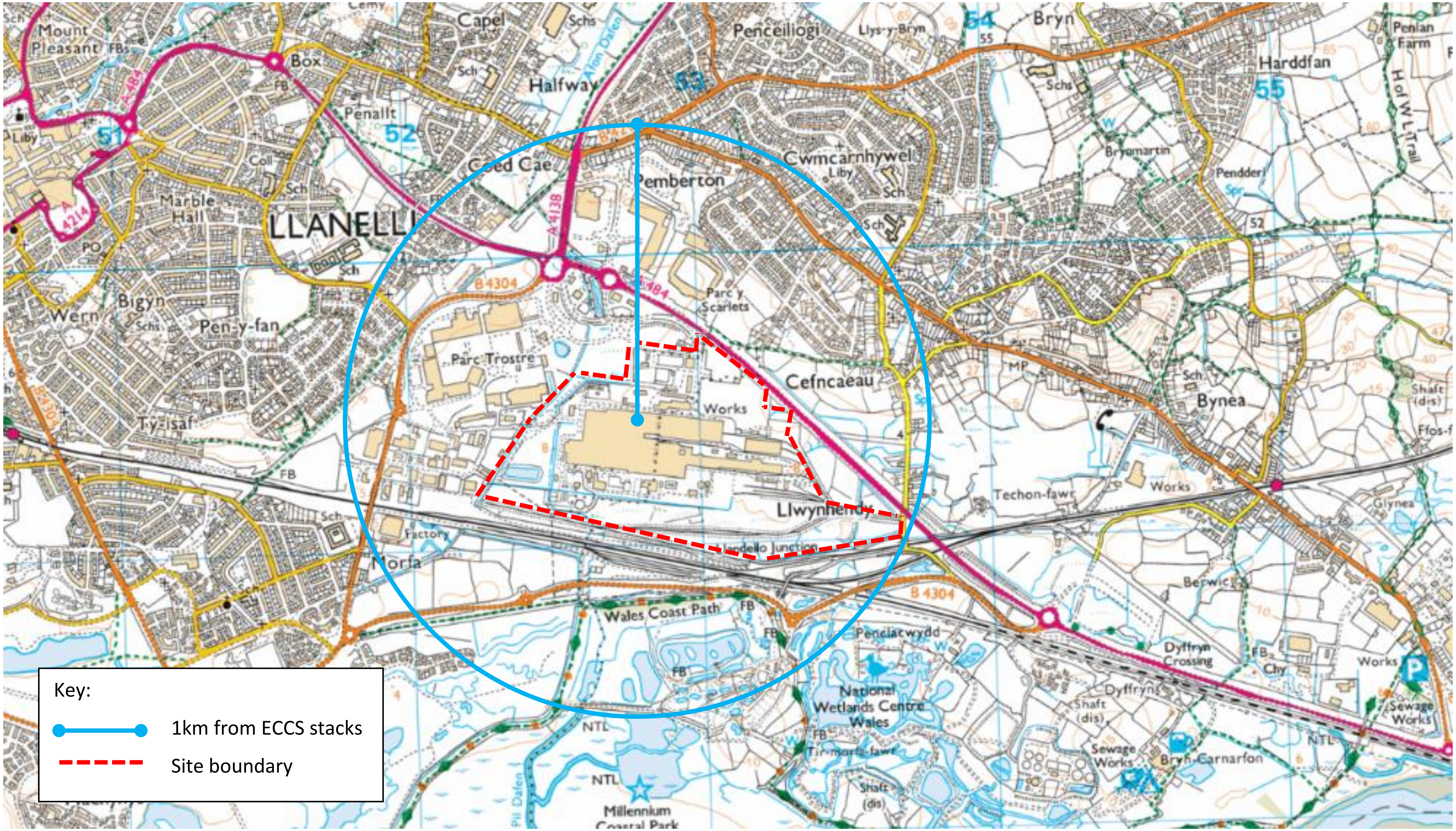

***Figure 3**: OS map (1: 25,000 scale) showing the Trostre Works site boundary and area within a 1 km radius of the exhaust stacks from the ECCS line*

9.1.2 Layout of the site and locations relevant to the use of chromium trioxide

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) **Electroplating**: The majority of material is then coated through one of two coating lines at Trostre, the electrolytic tinning lines (lines nos 5 & 6) or the electrolytic chromium coating line (line no. 4) that is the subject of this application and described in further detail in section 9.1.3.

6) **Polymer coating**: Some material may also have a polymer laminate applied to the steel strip, normally using ECSS as the base. The steel substrate is induction heated before the film is applied. The coated steel is then post heated to form a strong bond between the film and substrate before being water quenched.

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 chromium trioxide at the Trostre Works, namely within Area 3 (the Coating Section) on line 4, and within area 4 (the Wastewater treatment plant). These areas are described in further details in the following sections.

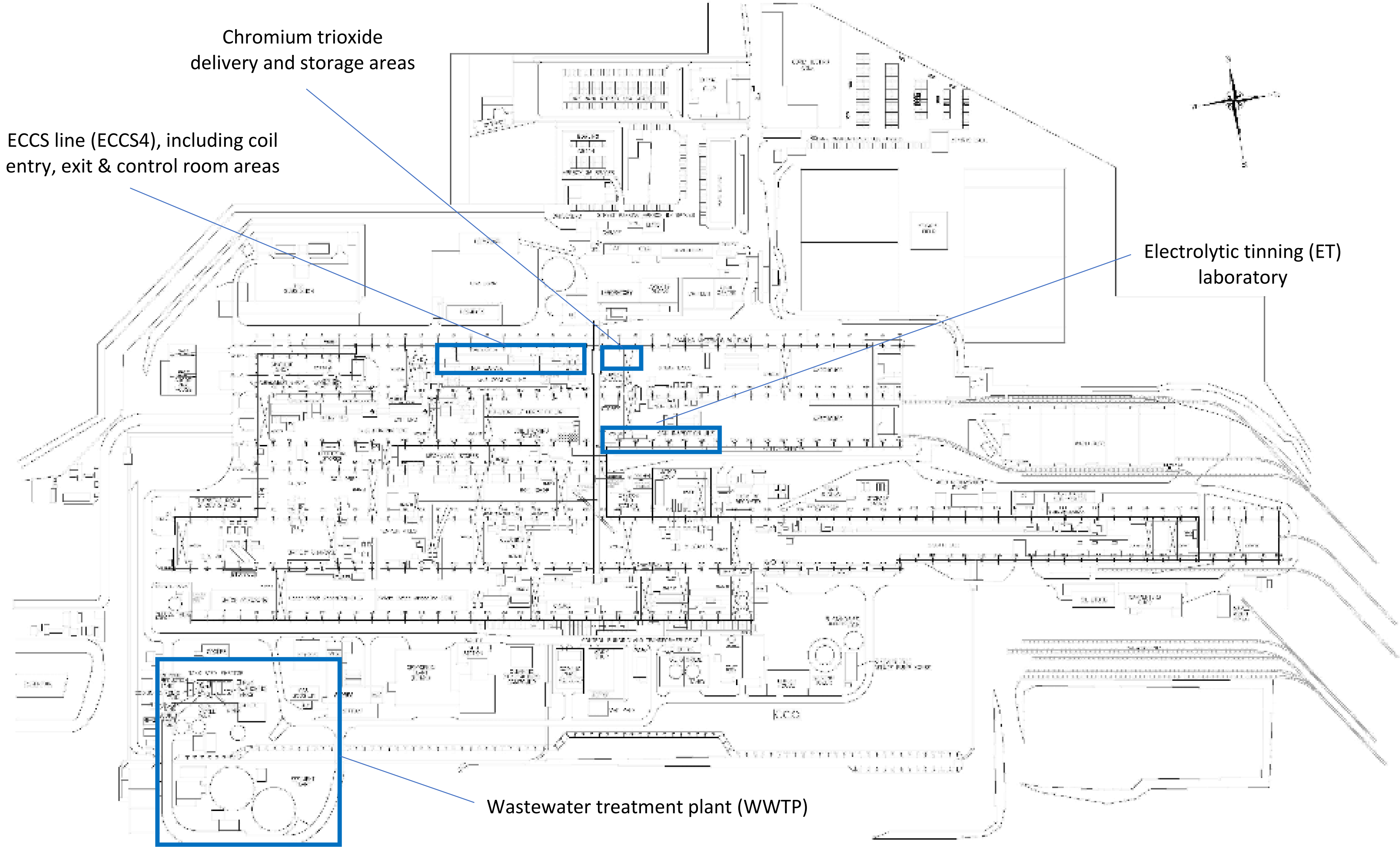

***Figure 4**: Plot plan of the Trostre Works, with areas relevant to the use of chromium trioxide for ECCS production indicated*

9.1.2.1 Electrolytic chromium coating line no. 4 (ECCS4)

Processing line no. 4 was originally commissioned in 1965 as an electrolytic tinning line and was later updated to a dual-purpose tinning/chromium coating line. The line was modified in the 1990s to become a dedicated ECCS line and is now referred to as ECCS4.

ECCS4 lies within Area 3 of the Trostre Works, a large hall physically separated from other areas of the site. The ECCS line is located on the ground floor, with circulation tanks and other equipment supporting the ECCS line located at basement level beneath the ECCS line. Access to these areas is restricted to authorised personnel. This restricted area (the 'chromic acid 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 treated electrolytically in a solution containing chromic acid, rinsed thoroughly, dried, oiled and then recoiled.

***Figure 5**: Electrolytic chromium coating line no. 4 (ECCS4) within Area 3 of the Trostre Works*

9.1.2.2 Delivery and storage of chromium trioxide

Chromium trioxide is delivered to the applicant as solid flakes in 25kg or 50kg metal containers. A delivery compound is used (see Figure 6 below) where the containers will be removed from a curtain-sided heavy goods delivery vehicle by forklift truck. The containers are then transported by forklift truck to a dedicated chromium trioxide storage area with restricted access (see Figure 7 below).

Up to 360 containers or 18 tonnes of chromium trioxide can be stored until used for electrolyte preparation. When needed [redacted] a pallet of containers [redacted] will be transported to the additions area by forklift truck.

***Figure 6**: Delivery compound used for chromium trioxide deliveries*

***Figure 7:** Dedicated chromium trioxide storage compound*

9.1.2.3 On site laboratory

The site laboratory is located to the south of the ECCS line. Three samples of the Cr(VI) electrolyte solution [redacted] will be taken to the laboratory once per shift (twice per day) for analysis. The results of the analysis will determine the quantity of chromium trioxide to be added to the Cr(VI) circulation tank. Following analysis, the samples are returned to the production line and discharged into a basement 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 30,000m^3 of waste liquid per week.

Figure 8*: Wastewater treatment plant*

A tank farm in the WWTP enables the segregation of the various effluents that emanate from Area 3. This includes various storage tanks which receive the segregated effluents generated by the coating lines, 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. 55m^3) for Cr(VI) waste electrolyte.
- Two horizontal cylindrical storage tanks (approx. 55 m^3 each) for waste tinning electrolyte.
- 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.
- 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 9**: The tank farm in the WWTP*

For treatment of wastewater from the ECCS process more specifically:

- **Spent electrolyte** that contains Cr(VI) is collected in the chrome sump. 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 electroplating 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 a non-hazardous 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 ECCS4 control room (ECCS4 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 ECCS4 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 chromium trioxide at the Trostre Works for the manufacture of ECCS. Chromium trioxide is used to apply a thin layer of chromium metal (Cr(0)) and chromium oxide (Cr(III)) onto flat metal products (steel surfaces) by electrolytic deposition.

ECCS production 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 Figures 12 and 13 below:

- **Entry section**: The steel coil is unwound and cut to appropriate width before it passes through to the different treatment tanks.

- **Cleaning section**: This section consists of five tanks – [redacted] cleaner 1 and 2 electrolytic tanks, followed by two rinsing tanks. Cleaning consists of treating the strip with [redacted] then cleaning in two electrolytic tanks containing [redacted]. This is followed by rinsing by spraying water with a low concentration of sulphuric acid in two rinsing tanks. All baths are connected to individual circulation tanks situated in the basement of the production area.

- **Pickling section**: This section consists of four tanks. Sulphuric acid pickling is used to remove the iron oxides (rust) formed on the surface of the strip and to lightly etch the strip, providing a clean surface for subsequent electroplating. The strip is treated with a pickling solution (an aqueous solution of sulphuric acid) in two tanks in the pickling section. The pickling tanks are followed by two rinsing tanks to remove excess of acid.

- **Chromium 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 chromium coating thickness is increased in successive pass-throughs.

[redacted]

***Figure 10**: Tandem arrangement of plating tanks*

[redacted] tanks in the plating section that contain Cr(VI) electrolyte:

- [redacted]

- The steel strip is then electroplated. The ECCS electrolyte is composed of chromic acid [redacted] The electroplating section consists of [redacted] chromium plating tanks, each measuring approximately [redacted] (at the liquid level) and containing approximately [redacted] of electrolyte. Each tank is connected to a common recirculating system (situated in the basement of the production area). [redacted]

- [redacted]

[redacted]

[redacted]

***Figure 11**: Schematic diagram of chromium plating tank*

- **Post chromium plating section**: Here, the strip passes through two rinsing tanks with hot water [redacted] to remove residual Cr(VI) electrolyte and impurities, followed by [redacted] squeeze rolls and a hot air dryer. 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. After inspection (a visual inspection by an operator and a continuous in-line inspection system), the strip is rewound for further processing (e.g. polymer coating application) or supply to the customer.

The electrolyte solution in the chromium plating tanks has a targeted concentration of [redacted] chromic acid. To keep this target concentration, chromium trioxide has to be added to compensate for the deposit of chromium metal and chromium oxide from the electrolyte onto the surface of the strip. The concentration of chromic acid in the circulation tank located in the basement is sampled once per shift (twice per day) using dedicated sample points [redacted]. Analysis of the samples is performed automatically by titration in the on-site laboratory. Depending on the measured concentration, chromium trioxide is added to the electrolyte circulation tanks to maintain the target concentration of chromic acid.

There are two electrolyte circulation tanks installed (named the 'East' and 'West' tanks) of which one is in operation and the other in stand-by. Typically, chromium trioxide additions occur each shift (twice per day) with [redacted] added directly from containers into the circulation tanks. The additions are performed via a dedicated hatch (tundish) into the operational circulation tank. After the addition of chromium trioxide, empty containers are rinsed in a dedicated closed washing system. The cleaned containers are then crushed, collected in a skip and then disposed of as waste to a local company for recycling. The absence of chromium trioxide on cleaned containers is verified by weekly measurements.

[redacted]

***Figure 12**: Manufacture of ECCS: process flow*

[redacted]

***Figure 13**: Manufacture of ECCS: three-dimensional diagram*

[redacted]

[redacted]

Related activities
Other activities are integrally linked to the production process which are relevant for the evaluation of potential exposure. These include:

1) Receipt, storage and transfer of chromium trioxide (WCS 1).
2) Sampling and analysis of the Cr(VI) electrolyte solution from the plating tanks (WCS 2).
3) Topping up/replenishing of 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).

These activities are described further in each separate exposure scenario in section 9.2.

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 two-week shutdown for site-wide maintenance, plus a planned shutdown for one day every nine weeks for routine maintenance tasks.

This means there is a theoretical maximum 346 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	6,412	267

***Table 9**: Number of operating hours and production days 2020-2024*

The highest number of operating hours in the past five years was 6,412 in 2024, equating to around 267 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 ECCS 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] (public range: > 600) employees 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 ECCS production shift teams, each team composed of 8 operators. One of these operators will spend their shift driving a coil truck moving steel coils to the loading area and will not perform any activities on the ECCS line itself. This means 7 operators may work on the line during their shifts, as outlined below, with operators carrying out these roles interchangeably (other than the team leader roles). The shift teams will sometimes run with 6 operators (e.g. when a shift team member is absent due to holidays or sickness) but the assessments in this CSR assume 7 operators are always present to ensure a more conservative approach is adopted. Production job descriptions outline the responsibilities of the individuals with regards to tasks relevant to potential exposure to Cr(VI).

- **Team Leader**: The Team Leader is responsible for the ECCS line operation. They perform control rounds to inspect the electroplating line from outside the chromic acid area (WCS 4). During the remainder of their shift they spend time in the control room (WCS 5).

- **Deputy Team Leader**: The Deputy Team Leader will spend all their time in the control room, where they remotely monitor strip quality and inspect the coated material for defects (WCS 5). If the Team Leader is absent, the Deputy will take over their responsibilities and performs the control rounds.

- **Entry End Operator**: This operator is in charge of loading the steel coils onto the electroplating line. Loading of the coil takes approximately 10-15 minutes and approximately 30 steel coils need to be loaded onto the line per shift (= 300 to 450 minutes) (WCS 6). For the remainder of their shift, the operator spends time in the control room to inspect the coils and to oversee the safe loading of the coil onto the line (WCS 5).

- **Exit End Operator**: The tasks of this operator are similar to these of the entry-end operator. This operator is responsible for unloading the steel coils after passing through the electroplating line, at which point the finished products will be free of Cr(VI). Unloading a coil takes approximately 10-15 minutes and 30 coils need to be unloaded per shift (= 300 to 450 minutes) (WCS 6). The remainder the time, the operator will be present in the control room to assist the exit-end inspector (WCS 5).

- **Exit End Inspector**: This operator spends nearly all their time in the control room, where they are responsible for the visual inspection of the steel coils exiting the electroplating line at the inspection point (WCS 5).

- **Chemical Additions Operator**: This operator is responsible for the transport of chemicals from the storage compound to the line (WCS 1), sampling of the circulation tanks and subsequent laboratory analysis (WCS 2a and 2b) and the additions of chromium trioxide to the circulation tanks (WCS 3). The rest of their time is spent in the control room (WCS 5).

- **Forklift Truck Operator**: This operator brings and removes the steel coils to the electroplating line by forklift (WCS 6). The operator is otherwise not involved in Cr(VI) related activities and spends their time in the control room (WCS 5).

The production shift teams will also carry out various maintenance activities themselves during the 9-weekly maintenance days (WCS 7), given there is no production on these days and the contents of the plating line tanks are dropped into the basement circulation tanks. 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 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 following 'similar exposure groups (SEGs) have been identified for workers involved in Cr(VI)-related activities, which are summarised in Table 10 below:

1) SEG 1: Team leader and team leader deputy (when assuming the team leader role)
2) SEG 2: Chemicals additions operator
3) SEG 3: Team leader deputy (when not assuming the team leader role), entry-end operator, exit-end operator, exit-end inspector and forklift truck driver
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

<table>
<tr><th>SEG</th><th>Profile</th><th>WCS</th><th>Number of workers per SEG</th><th>Shift system</th></tr>
<tr><td>SEG 1</td><td>Team leader (or team leader deputy when team leader is absent)</td><td>WCS4, WCS5</td><td>4</td><td>12h</td></tr>
<tr><td>SEG 2</td><td>Chemicals additions operator</td><td>WCS2a, WCS2b, WCS3</td><td>4</td><td>12h</td></tr>
<tr><td rowspan="5">SEG 3</td><td>Team leader deputy</td><td rowspan="5">WCS1, WCS5, WCS6</td><td rowspan="5">20</td><td rowspan="5">12h</td></tr>
<tr><td>Entry-end operator</td></tr>
<tr><td>Exit-end inspector</td></tr>
<tr><td>Exit-end operator</td></tr>
<tr><td>Forklift truck driver</td></tr>
<tr><td colspan="3">SEG 1 to SEG 3 = ECCS production shift team</td><td>28</td><td>4 teams of 7 persons</td></tr>
<tr><td rowspan="2">SEG 4</td><td>a. Tata Steel production operators performing maintenance duties</td><td>WCS7a</td><td>20</td><td>12h</td></tr>
<tr><td>b. Dedicated maintenance workers (Tata Steel employees and contractors)</td><td>WCS7a, WCS7b</td><td>21</td><td>8h</td></tr>
<tr><td>SEG 5</td><td>Wastewater treatment plant operators (Veolia employees)</td><td>WCS8a, WCS8b</td><td>8</td><td>12h</td></tr>
</table>

***Table 10**: Similar exposure groups for workers involved in Cr(VI)-related activities*

SEG 3 contains different operator profiles, each having different activities. However, they are all combined within one SEG because all of the operators within this SEG carry out each role interchangeably, being fully trained on each. For example, on one shift an operator will be the entry-end operator, while on the next they may then be the forklift truck driver. Any one individual worker will therefore perform all these tasks. These tasks do not involve access to the chromic acid area and are remote from Cr(VI) emissions sources.

The chemicals additions operator is also an interchangeable role across the production shift team (other than the team leader and deputy). However, the chemicals additions operator has a separate SEG (SEG 2) because this operator must enter the chromic acid area wearing additional PPE ('full chromium PPE' – see section 9.1.7.6) to undertake work such as additions and 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 chromic acid area to perform their work, it involves being closer to the plating section 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 ECCS line (and even then, within the plating section). The SEG differentiates between Tata Steel production shift team operators who will perform certain maintenance duties during the 9-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 chromium trioxide for the manufacture of electrolytic chromium coated steel (ECCS).	[redacted] (public range: 100-150)

***Table 11**: Overview of exposure scenarios*

Contributing scenario	ERC / PROC	Name of the contributing scenario
ECS1	ERC5	Industrial use of chromium trioxide for the manufacture of electrolytic chromium coated steel (ECCS).
WCS 1	PROC 1	Receipt, transport and storage of chromium trioxide
WCS 2	PROC 9	Sampling of the electrolyte solution
WCS 3	PROC 8b	Adding chromium trioxide to the circulation tank
WCS 4	PROC 13	Electroplating
WCS 5	PROC 0	Control room activities
WCS 6	PROC 0	Loading and unloading of steel coils
WCS 7	PROC 28	Maintenance activities
WCS 8	PROC 8b, PROC 9	Waste management including wastewater treatment

***Table 12**: Overview of Contributing Scenarios*

9.1.6 Tonnage information

The tonnage information has been calculated on the basis of the quantity of chromium trioxide used in production each year. This is shown in Table 13 below. In recent years, the highest quantity consumed was [redacted]

[redacted]

***Table 13**: Tonnage (tonnes/year) of chromium trioxide used at the Trostre Works for the production of ECCS*

However, there is a possibility the consumption of chromium trioxide could increase in the future, e.g. in response to increased customer demand or in the event of an increase in surface area coated due to greater width of the finished product. To ensure sufficient headroom for any potential future production increase, the assessed total tonnage is [redacted] tonnes (public range: 100-150 tonnes) per year chromium trioxide or [redacted] tonnes per year Cr(VI).

9.1.7 Overview of risk management measures

As discussed in Section 9.1.3, [redacted]. Measures are in place to protect workers from e.g., equipment moving under tension and at speed, electric current and exposure to corrosive chemicals.

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 ECCS4 line is controlled by GE Gem 80 & RXi programmable logic controllers (PLCs) using various drives (Gem Micro drive, ABB ACS580 etc). The current for the electroplating process is provided by AEG plating rectifiers controlled using either Schneider Modicon or Siemens S7 1200 PLCs. Process instrumentation uses an Alstom Alspa PLC which controls/monitors the process flows, temperatures, conductivity and dosing as applicable.

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 plating 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 ECCS4 line has its own extraction system, there are two LEV systems relevant to Cr(VI), each connected to a respective stack. These serve (1) the plating tanks [redacted] and (2) the circulation tanks in the basement.

The LEV is in the form of receiving (canopy) hoods that cover the entire liquid surface of the tanks (see Figure 14). To reduce potential emissions from the tank sides, blanking plates are used (see Figure 15). Although the tanks are not fully enclosed, the LEV system is designed to achieve a high degree of enclosure.

The LEV is electrically interlocked with the process line. This means that the electric current to the electroplating line 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.

[redacted]

***Figure 14**: LEV system in ECCS4 plating section (from above)*

[redacted]

Figure 15: *LEV system in ECCS4 plating section (from the side, with blanking plates visible)*

All extracted air passes through a wet scrubber system 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 chrome plating sump for subsequent batch reduction of Cr(VI) to Cr(III) in the WWTP.

Scrubber water is automatically topped up (refreshed) via a level controller and completely replaced during every 9-weekly maintenance event. The scrubber undergoes a deep-clean every annual shutdown, where all packing is removed, pressure washed and replaced or refitted dependent on status, with the system filled with fresh water.

Exhaust air from the two LEV systems are discharged at height from two stacks on ECCS, stack no. A13 (ECCS4 process stack, also known as System 2) and stack no. A22 (ECCS4 circulation tanks, also known as System 4). These stacks are approximately 29.7m and 22.0m above ground level.

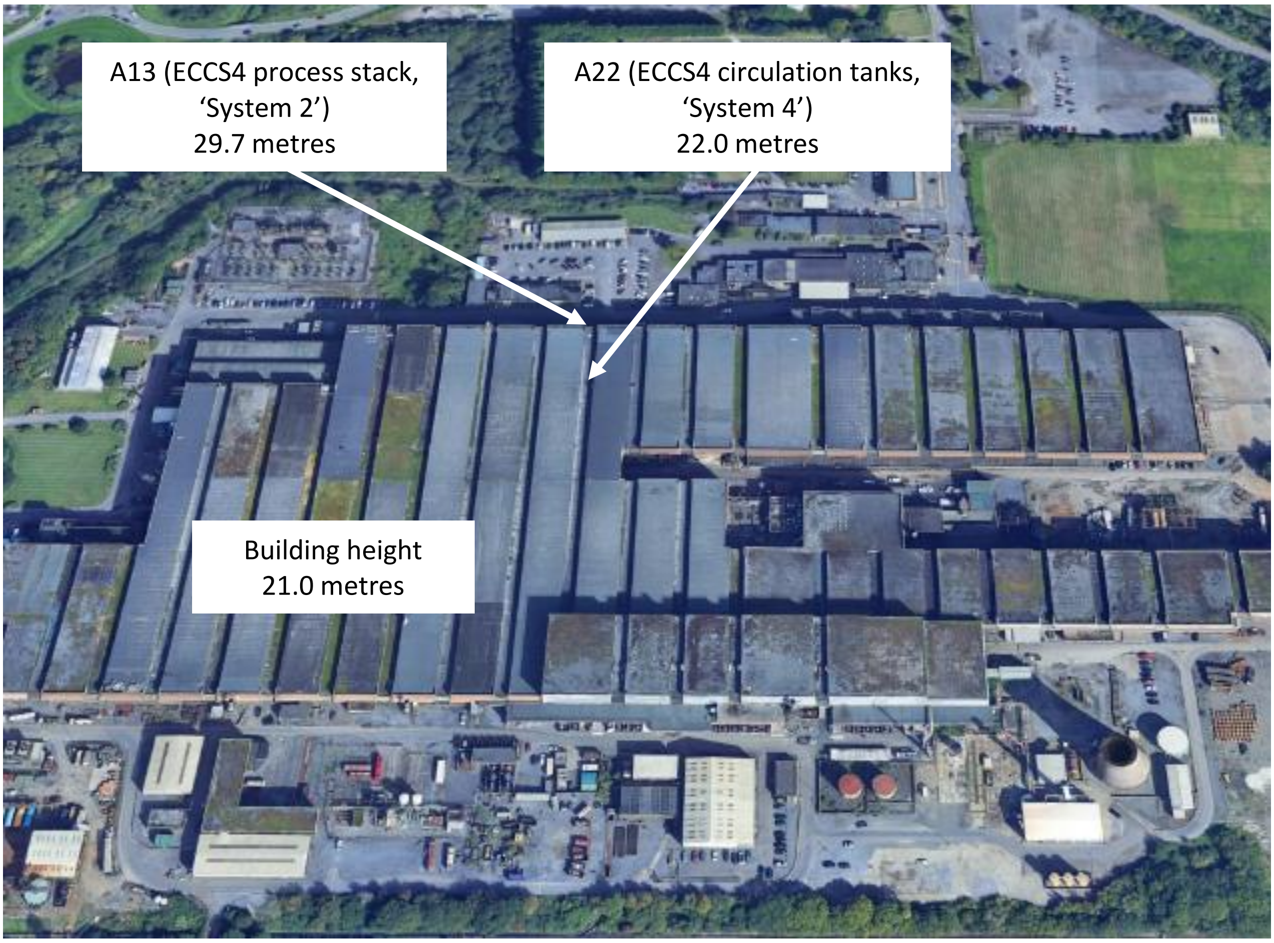

***Figure 16**: Location and height of Cr(VI)-relevant stacks serving the ECCS line*

9.1.7.3 Primary containment

Primary containment of chromium trioxide and chromic acid is achieved through selection of appropriate materials of construction for tanks and pipework. Pipework conveying chromic acid is PTFE, PVDF or PFA lined, which are all acid resistant. The chrome sump to effluent pipework is constructed from high grade (316) stainless steel 316. Pumps are constructed of R55 alloy, a special alloy designed for use with high temperature mixed acids. A risk-based inspection study has previously been conducted on the tanks and associated pipe-work 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 chromic acid pipe run to the effluent plant is inspected weekly under a SAP-based maintenance management system. All 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. Process chromic acid 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 9 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 pipe-work and valves, rinse circulating tanks and pumps, rinse pipe work, valves and heat exchangers, which are undertaken once per week.

The ECCS 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 plating 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, which has a maximum capacity of 73.8m^3. The largest tank in this area, the electrolyte circulation tank, has a volume of 37m^3, so the bund volume 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 plating 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 plating sump in the basement. The waste chromic acid 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.

Figure 17*: Tank farm in WWTP showing secondary containment (bunding)*

Bunding is provided to bulk tanks in the WWTP tank farm (see Figure 17) 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 chromic acid bulk storage tank.

The chromic acid pipe run from ECCS4 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 chromium trioxide store is also a contained area. It is not bunded as such but any releases in this area would be confined to the store. The chromium trioxide is delivered in solid, not aqueous, form and any spilt material and would be handled in line with the site's spill procedure (see section 9.1.7.9 below).

9.1.7.5 Access restriction, including chromic acid area and decontamination block

Organisational measures in place include limiting access to specific areas, for example, the chromium trioxide storage compound is kept padlocked and entry to certain plant areas is restricted by use of signage (see Figure 18 below).

***Figure 18**: Examples of access restrictions and signage*

Additional precautions are in place where Cr(VI) exposure can occur, namely the area in the basement where the circulation tanks are located and the area on the mill floor where the line plating tanks are located, sampling of the circulation tanks is undertaken and chromium trioxide is added to the circulation tanks. This area, segregated by blue walls, is known as the 'chromic acid area' and is visible in Figures 19 and 20 below.

Entry to this area is restricted to trained and authorised personnel wearing full chromium PPE (see section 9.1.7.6 below for details).

[redacted]

Figure 19*: Segregated ‘chromic acid area’ on mill floor*

Figure 20*: Segregated ‘chromic acid area’ in basement*

Entry to the chromic acid area can only be gained via a decontamination block. This is a purpose built, three-stage unit comprising a clean end, shower/wash area and ‘dirty’ end on the line side.

The entry door into the decontamination block has been fitted with a ‘Maglock’ system, which restricts access to those authorised to enter the chromic acid area using a personal ID card. Lockers are provided in the clean end to store normal workwear prior to entering the line side. The required PPE is obtained from lockers within the unit and, once work is finished, contaminated PPE is removed. When exiting the line side, operators must clean the floor area with a hose provided, must wash their hands and may shower as required. The use of blue overshoes is required at all times within the unit.

***Figure 21**: Left: Access to the decontamination block with magnetic lock highlighted. Centre: Two closed room to dress and disrobe PPE. Right: Fully dressed operator leaving the decontamination block.*

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) are laundered by a third party although no clothing used in the chromic acid area is sent for laundering.

***Figure 22**: 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.[6]

<u>Protective clothing required for entry into chromic acid 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 coverall offers 480 mins permeation time (tested against chromic acid). The coveralls are disposed of after each use.

<u>Protective footwear required for entry into chromic acid area</u>

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.

<u>Protective gloves required for entry into chromic acid area</u>

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.

<u>Respiratory protective equipment (RPE) required for entry into chromic acid area</u>

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 23**: RPE worn within the chromic acid area*

[6] 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.

Workers (both employees and contractors) receive specific training in the correct way to don and use RPE. Operators are 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.[7] 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.

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 chromic acid area, will receive information, instructions and training regarding:

- The identity, characteristics and exposure mechanisms of chromium trioxide and chromic acid.
- 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 chromic acid area, in the laboratory, at the WWTP etc, displaying information on hazards and required precautions, including what PPE must be worn – see Figures 18, 19, 20 and 22 as examples.

Eating and drinking is prohibited throughout the plating area and in all associated laboratory / storage areas. Employees are also instructed to wash their hands thoroughly when moving in and out of the chromic acid 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).

[7] HSE, 2013.

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 documented 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), the following procedures and instructions are in place specifically relating to Cr(VI):

Overall

- Risk Control Standard: Managing the Risks of Hexavalent Chromium Compounds. This standard 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

Storage of chromium trioxide (WCS 1):

- Delivery of chromium trioxide from storage compound to ECCS additions area (document no. GWAS-7KMAUX)

Sampling of Cr(VI) electrolyte (WCS 2):

- Taking a Sample, process sections (document no. GWAS-7F2JJC)

Addition of chromium trioxide (WCS 3) and other process chemicals:

- Delivery of chromium trioxide from storage compound to ECCS additions area (document no. GWAS-7KMAUX)
- Addition of chromium trioxide flakes (document no. PRED-6RUJAW)
- Entering and leaving the decontamination block (plating section) (document no. GDIN-8ETGA5)
- Additions of sulphuric acid (H_2SO_4) (to electrolyte) (document no. GWAS-7F2HR4)
- [redacted]

Electroplating (WCS 4):

- Entering and leaving the decontamination block (plating section) (document no. GDIN-8ETGA5)
- Chromium plating sump control (document no. AFAN-8AD8XK)

Maintenance activities (WCS 7):

- Accessing and cleaning the oiler & repeller plates of the ECCS line (document no. GDIN-8ESF7K)
- Changing top pair of wringer rolls (document no. GDIN-8EUDDZ)
- Removing and replacing hoods (Cleaner / Pickler section) (document no. GWAS-7FYCRX)
- Removing Plating Extractor Hoods (document no. GWAS-7G4B9G)
- Washing down the line (process sections) (document no. GWAS-7G4BVK)
- Wringer roll change, middle and bottom pairs only (document no. GWAS-7G5AF5)
- Removing dents (chromic acid section) (document no. GWAS-7G5AGG)
- Changing hold down rolls (Chromic and non-chromic sections) (document no. GWAS-7G6J4R)

Sampling of wastewater prior batch reduction (WCS 8):

- Procedure to monitor and measure water (document no. AFAN-7478GN)

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 chromium trioxide. 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 two stacks serving the Cr(VI)-related extraction systems on ECCS4 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 REACH 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 three years' monitoring campaigns (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 chromium plating lines. While US EPA Method 0061 is referenced by Environment Agency guidance[8] 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 electroplating operations. Electroplating with chromium trioxide involves aqueous chemistry and lower-temperature processes, which can significantly affect the speciation and behaviour of chromium in emissions.

The US EPA guidance[9] 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.

[8] Environment Agency, 2025.

[9] 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. For example, for 2024, the calculated sampling LoDs for total chromium were 0.00035 mg/Nm^3 for System 2 (serving the line plating tanks) and 0.00033 mg/Nm^3 for System 4 (serving the circulation tanks). These values were derived by applying the laboratory analysis LoD to the sample volumes extracted during each test.

However, field blank samples, taken for each stack using the same equipment and procedures as the actual samples, yielded higher concentrations: 0.00068 mg/m^3 for System 2 and 0.0011 mg/m^3 for System 4. 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 becomes the *de facto* sampling LoD. Consequently, the reported sampling LoDs for 2024 are 0.00068 mg/Nm^3 for System 2 and 0.0011 mg/Nm^3 for System 4.

9.1.7.11 Occupational (worker) exposure monitoring

The applicant has its own 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"*. 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, Casella Apex 2 pumps with IOM samplers fitted with a 25mm alkaline-treated tissuquartz filter are affixed to operators via a harness, with the IOM sampler positioned at the left 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 positioned in locations around the electroplating section and the chromic acid area. 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).

The results of worker exposure monitoring are presented at Appendix 2 for the previous three years (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.

Sampling 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 are increased to reflect the potential exposure over 12 hours by increasing the filter concentration of Cr(VI) detected by the same factor required to increase the actual 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 the actual 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, which means that 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.

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 chromic acid areas (see Figure 24 below for an example).

***Figure 24**: Static sampler located above the chemical additions area*

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. ECCS4 results in 2024 were an average of 1.17 µmol/mol creatinine for production operators (maximum recorded value was 1.60 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) are pumped from the ECCS4 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 process improvement has recently been implemented involving a new rinsewater sump and treatment route, used to prevent Cr(VI)-contaminated rinsewaters entering the main site effluent flume. Previously, the discharge from the plating line rinsewater tanks was pumped into the main works flume which also carries wastewater from other production lines to the effluent plant. The flume is continuously sampled by a Cr(VI) analyser using spectrophotometry which monitors the Cr(VI) concentration levels in the wastewater. If high Cr(VI) levels were detected, the WWTP would contact site management and the line team requesting they check for any chromic acid solution losses. However, plating line rinsewater discharge is now routed into a separate sump with a chromic acid-resistant lining. From here, rinse waters are pumped directly to the WWTP tank farm where they are treated under controlled conditions along with other chromate solutions from ECCS4 and ETL5.

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 chromium (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 three years (2024, 2023 and 2022 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 reaches 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

Nominally empty containers of chromium trioxide that has been added to the electrolyte circulation tanks each shift are washed in a dedicated barrel wash machine (see Figure 25) located within the chromic acid area, near to the tundish used for additions. The water from the barrel washer feeds into the basement sump. The cleaned containers are then crushed in a drum crusher located in the same area, collected in a skip and then disposed of as waste to a local company for recycling (see Figure 26).

***Figure 25**: Barrel wash used for washing empty containers of chromium trioxide (closed (L) and view of inside showing washing nozzle (R))*

***Figure 26**: Drum crushing machine (L) and crushed containers (R)*

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.

Solid waste can accumulate as a deposit in the bottom of the chromium plating tanks (see Figure 27). As a result, one of the maintenance tasks that occurs every 9 weeks, i.e. 6 times per year, is to remove the deposit. The collected deposit is placed in containers with an inner plastic lining, treated as hazardous waste and sent for incineration.

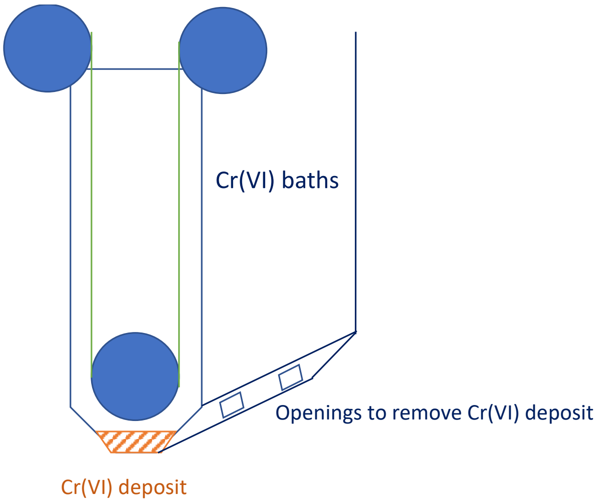

Figure 27: *Removal of Cr(VI)-containing deposits of the Cr(VI) baths via openings at the bottom*

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 28), each discharging around 8 tonnes per day. Weekly analysis of the filter cake conducted during 2024 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.

Figure 28: *Filter presses in the WWTP*

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. In the case of chromium trioxide, the substance was placed on Annex XIV due to its harmonised classification of Carcinogen Cat. 1A; H350 and Mutagen Cat. 1B; H340.

The molecular entity that drives the carcinogenicity of chromium trioxide is the Cr(VI) ion which is released when chromium trioxide 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 chromium trioxide should be considered as a non-threshold substance with respect to risk characterisation for 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. The risk assessment will therefore focus on the exposure through inhalation to workers.

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 chromium trioxide 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

Scope and type of assessment

Chromium trioxide is classified as Acute and Chronic Aquatic Toxic category 1 (respectively H400 and H410). These endpoints are not specified in the entry for chromium trioxide in Annex XIV of REACH. Therefore, the direct effects and risks to the environment resulting from environmental release are not evaluated in detail (see Table 14 below). 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.

Protection target	Type of risk characterisation	Hazard conclusion DNEL / dose – response relationship
Freshwater	Not required	Not relevant
Sediment (freshwater)	Not required	Not relevant
Marine water	Not required	Not relevant
Sediment (marine water)	Not required	Not relevant
Sewage treatment plant	Not required	Not relevant
Air	Not required	Not relevant
Agricultural soil	Not required	Not relevant

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

Protection target	Type of risk characterisation	Hazard conclusion DNEL / dose – response relationship
Predator	Not required	Not relevant

***Table 14**: Type of risk characterisation required for the environment (if relevant)*

Release to water

Detailed information about the operation of the WWTP, including handling and treatment of Cr(VI) containing wastewaters (waste electrolyte 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, chromium trioxide will not normally be present in air. Nevertheless, energetic processes could potentially release chromium trioxide / Cr(VI) into air, such as during electroplating where the bursting of small gas bubbles generated by electrolysis causes the formation of mists (fine droplets of electrolyte).

LEV is installed on all Cr(VI) plating tanks and the circulation tanks to extract Cr(VI) mist generated during the electrolytic 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 three years and summarised in the table below.

Year	Measuring point	Measured levels from stack, total Cr, mg/Nm^3	Mass emission, total Cr, g/hour	Operating hours	Release per annum, kg
2022	ECCS4 System 2	[redacted]	2.05	[redacted]	[redacted]
2022	ECCS4 System 4	[redacted]	0.70	[redacted]	[redacted]
TOTAL RELEASE (2022)					**15.55**
2023	ECCS4 System 2	[redacted]	1.79	[redacted]	[redacted]
2023	ECCS4 System 4	[redacted]	0.12	[redacted]	[redacted]
TOTAL RELEASE (2023)					**11.00**
2024	ECCS4 System 2	[redacted]	2.40	6413	[redacted]
2024	ECCS4 System 4	[redacted]	0.07	6413	[redacted]
TOTAL RELEASE (2024)					**15.82**

***Table 15**: Stack emissions monitoring data 2022-2024*

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 attempting to back-calculate total Cr to Cr(VI) would introduce uncertainty to the results, the emissions for total Cr are used. This will 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 chromium trioxide 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, an additional assessment has been carried out to check against the requirements of the environmental permit. Soil was found to be free of Cr(VI) contamination, with no measurement above the detection limit for Cr(VI) (1 ppm).

9.1.8.2 Humans via the environment

Scope and type of assessment

Since only endpoints for which authorisable substances are included in Annex XIV need to be addressed when applying for authorisation under REACH (ref. Article 60(4)), the focus of this assessment relates to the carcinogenicity/mutagenicity endpoints as per the Annex XIV entry for chromium trioxide.

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. Moreover, there are no data to indicate that dermal exposure to Cr(VI) compounds results in carcinogenicity effects in humans.

Since strict emission control measures are implemented, releases of chromium trioxide 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[11] 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".

The scope of exposure assessment and type of risk characterisation required for humans via the environment are described in the table below. The hazard information used to perform the risk assessment is based on the RAC document on a reference dose-response relationship for Cr(VI) compounds.

Route of exposure and type of effects	Type of risk characterisation	Hazard conclusion DNEL / dose-response relationship
Inhalation: Local Long Term	Quantitative (dose-response curves)	Lung cancer: ELR = 2.9E-02 per 1 µg Cr(VI)/m^3 (for general population based on 70 years of exposure, 24 h/day)

[11] ECHA, 2013.

Route of exposure and type of effects	Type of risk characterisation	Hazard conclusion DNEL / dose-response relationship
Oral: Local Long Term	Quantitative (dose-response curves)	Intestinal cancer: ELR = 8.0E-04 per 1 µg Cr(VI)/kg bw/d for 70 years (based on 70 years of exposure; 24 h/day)
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.

***Table 16**: Type of risk characterisation required for humans via the environment.*

<u>Comments on assessment approach</u>

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%[12] 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

<u>Scope and type of assessment</u>

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

Route	Type of effect	Type of risk characterisation	Hazard conclusion DNEL / dose – response relationship
Inhalation	Systemic Long Term	Not required	-
	Local Long Term	Quantitative (dose-response curves)	Lung cancer: ELR = 4.0 E-03 per 1 µg Cr(VI)/m^3 for 40 years (for workers based on 40 years of exposure, 8 h/day; 5 days/week)
Oral	Systemic Long Term	Not required	-
	Local Long Term	Quantitative (dose-response curves)	Intestinal cancer: ELR = 2E-04 per 1 µg Cr(VI)/m^3 for 40 years (for workers based on 40 years of exposure, 8 h/day; 5 days/week)
Dermal	Systemic Long Term	Not required	Dermal exposure to chromium trioxide is not identified as a cancer risk to humans.
	Local Long Term	Not required	
Notes: - ELR = Excess Lifetime Risk			

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

<u>Comments on assessment approach related to toxicological hazard</u>

The excess risk levels in the worker risk assessment will be determined for the inhalation route only. Exposure estimates generated by the Advanced REACH Tool (ART)[13] version 1.5, or measured values (from

[12] European Chemicals Bureau, 2005.

[13] See https://www.advancedreachtool.com/

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 chromium trioxide 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 $\mu g/m^3$ 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.

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. Measured data are used in preference to modelled data although, in the absence of measured data for certain WCS, modelled data are presented.

No data exist to indicate that dermal exposure to Cr(VI) compounds present a cancer risk to humans and as a result this route of exposure need not be considered in the worker risk assessment.

Good industrial hygiene measures in place avoid ingestion of chromium trioxide 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[14] 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).

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.

9.1.8.4 Consumers

The final ECCS articles produced at the Trostre Works are chromium-coated steel coils and plates used for many different applications including food applications (tins etc) by consumers. During the electrolytic plating, process the Cr(VI) is reduced into Cr(III) oxide and metallic Cr(0). Cr(VI) is very reactive with the steel strip and, as a result, little Cr(VI) will remain on the steel upon removal from the electrolyte bath. The

[14] ECHA, 2013.

steel strip is then rinsed with an excess of hot water [redacted] in a 2-stage cascade rinse followed by three sets of squeeze rolls and a hot drier. 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. Electroplating 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 strip, 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).[15] 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 chromium plated articles. Exposure assessment is therefore not applicable as there are no consumer-related uses for chromium trioxide given that Cr(VI) is not present in finished products.

Route	Type of effect	Type of risk characterisation	Hazard conclusion DNEL / dose – response relationship
Inhalation	Systemic Long Term	Not required	-
	Local Long Term	Not required	-
Dermal	Systemic Long Term	Not required	-
	Local Long Term	Not required	-
Oral	Systemic Long Term	Not required	-

Table 18*: Type of risk characterisation required for consumers.*

[15] 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 chromium trioxide for the manufacture of ECCS

Sector of use:	
Industrial Use	IS
Environment contributing scenario(s):	
Industrial use of chromium trioxide for the manufacture of ECCS	ERC 5
Worker/Consumer contributing scenario(s):	
WCS1: Receipt, transport and storage of chromium trioxide	PROC 1
WCS2: Sampling of the electrolyte solution	PROC 9
WCS3: Adding chromium trioxide to the circulation tank	PROC 8b
WCS4: Electroplating	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 chromium trioxide in air 100m from the release point in accordance with ECHA guidance.[16]

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 ECCS 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.[17] The figures obtained by modelling are considered to be worst-case estimates.

[16] ECHA, 2016.

[17] 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 chromium trioxide for the manufacture of ECCS. 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: 0.0293%
- 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 added as chromium trioxide flakes, the vapor pressure of chromium trioxide and chromic acid are very low, and all relevant potential sources of Cr(VI) to air are covered by guided emissions.

  Guided emissions have been quantified. There are two Cr(VI)-relevant locations where air is actively extracted by means of LEV, sent through a wet scrubber system and then released via the respective stack, i.e. air above the line plating tanks (System 2) and the circulation tanks (System 4) (see section 9.1.7.2 for details). Emissions from the two stacks 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 (0.0293% in 2022) 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 ECCS4 line are the circulation tanks, the plating tanks, the rinsewater tanks and water from the two wet scrubbers. 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 chromic acid 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. Two sources of Cr(VI) emissions to air relating to ECCS production have been identified; the LEV system serving the line plating tanks and the LEV system serving the circulation tanks. For each, 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 chromium trioxide (as a raw material) is only stored and handled 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 19*: 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 chromium trioxide (given that chromium trioxide 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 current chromium trioxide REACH registration dossier.

Substance property	Value
Molecular weight	99.994
Melting point	196°C
Boiling point	–
Vapour pressure	4.74E-9 Pa at 25°C
Water solubility	1.69E+6 mg/L at 25°C
Partition coefficient (Log Kow)	0.1 (estimated default value for inorganic substances)
Adsorption/Desorption coefficient (Koc)	11.8 L/kg (calculated in EUSES 2.2.0 using the OSAR 'Non-hydrophobics (default QSAR)')
Solids-water partition coefficient in soil (Kp_{soil})	Chromium (VI) key values: 2 L/kg (alkaline conditions, worst-case for human intake via the environment); 50 L/kg (acid conditions)
Solids-water partition coefficient in sediment (Kp_{sed})	Chromium (VI) key values: 100 L/kg (alkaline conditions, worst-case for human intake via the environment); 1000 L/kg (acid conditions)
Solids-water partition coefficient in suspended matter (Kp_{susp})	Chromium (VI) key values: 200 L/kg (alkaline conditions, worst-case for human intake via the environment); 2000 L/kg (acid conditions)
Henry's law constant	2.8E-13 Pa/m^3/mol at 25 °C (calculated in EUSES 2.2.0)
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. The REACH registration dossier states a dimensionless BCF of 23.11 as the key value, however EUSES 2.2.0 only allows values expressed in L/kg wwt to be input*).
Ready biodegradability	N/A for inorganic substances ('Not readily biodegradable' selected in EUSES 2.2.0 as a worst-case)
Hydrolysis	N/A for inorganic substances (default DT50 value of 1E+6-days at 12 °C used in EUSES 2.2.0)

***Table 20**: Chromium trioxide key physico-chemical and environmental fate properties*

<u>Conditions of use</u>

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] tonnes per day CrO_3, [redacted] tonnes per day Cr(VI)
▪ Annual amount used at site: [redacted] tonnes (public range: 100-150 tonnes) per annum CrO_3, [redacted] tonnes per annum Cr(VI)
▪ Number of days: 267
Technical and organisational conditions and measures
▪ On site WWTP. ▪ 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 the Cr(VI) deposit from the Cr(VI) plating tanks and PPE that has been used inside the chromic acid area. This is treated as hazardous waste by a specialist hazardous waste handler and sent for incineration. (Empty chromium trioxide drums are washed, crushed and sent as waste to a local company for recycling.)
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 21**: 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: 15.82 kg/yr. Explanation/justification: Measured releases of total Cr to air in 2022, 2023 and 2024 are presented in Appendix 1 and summarised below: - Measured release to air in 2022: 15.55 kg, release factor 0.0293% - Measured release to air in 2023: 11.01 kg, release factor 0.0193% - Measured release to air in 2024: 15.82 kg, release factor 0.0238%

Release route	Release factor	Release Kg or T / per year
		Stack emissions monitoring occurs annually. Results from 2022, 2023 and 2024 are presented above. The highest emissions result (15.82 kg in 2024) has been used in the assessment, along with the highest release factor (0.0293% in 2022), 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: 0.0293
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 22*: 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.

As the location of the site is within an industrial area then workers have been taken into consideration as far as inhalation exposure is concerned. Oral intake is not considered as it is assumed that the food/drinking water source is not locally sourced.

Protection target	Exposure concentration	Risk assessment
Freshwater	3.67E-07 mg Cr(VI)/L	Not relevant
Sediment (freshwater)	1.62E-05 mg Cr(VI)/kg wwt	Not relevant
Marine water	3.62E-08 mg Cr(VI)/L	Not relevant
Sediment (marine water)	1.60E-06 mg Cr(VI)/kg wwt	Not relevant
Sewage treatment plant	0 mg Cr(VI)/L	Not relevant
Predator (freshwater)	3.67E-07 mg Cr(VI)/kg wwt	Not relevant
Predator (marine water)	3.62E-08 mg Cr(VI)/kg wwt	Not relevant
Top predator (marine water)	3.62E-08 mg Cr(VI)/kg wwt	Not relevant
Agricultural soil	2.00E-03 mg Cr(VI)/kg wwt	Not relevant
Air	1.51E-05 mg Cr(VI)/m^3	Local Cr(VI) PEC in air, 100m from point source
Humans via the Environment - Inhalation	1.51E-05 mg Cr(VI)/m^3	RAC Opinion (Lung cancer, general population) ELR = 2.9 E-02 per 1 µg Cr(VI)/m^3 RAC Opinion (Lung cancer, workers) ELR = 4.0 E-03 per 1 µg Cr(VI)/m^3 **Excess risk by inhalation to general population = 4.39E-04 *** * Including non-directly exposed workers

Protection target	Exposure concentration	Risk assessment
Humans via the Environment - Oral	1.36E-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 Not required for workers. Assume food/drinking water is not locally sourced. **Excess risk by oral (through food only) to general population = 1.09E-04**
Humans via Environment Combined	-	**Excess risk combined = 5.48E-04**

Table 23: *Exposure concentrations and risks for the environment – on local scale.*

Type of food	Estimated daily dose	Concentration in food
Drinking water	3.05E-05 mg Cr(VI)/kg/d	1.07E-03 mg Cr(VI)/L
Fish	6.03E-10 mg Cr(VI)/kg/d	3.67E-07 mg Cr(VI)/kg
Leaf crops	9.55E-05 mg Cr(VI)/kg/d	5.57E-03 mg Cr(VI)/kg
Root crops	5.54E-06 mg Cr(VI)/kg/d	1.01E-03 mg Cr(VI)/kg
Meat	1.57-09 mg Cr(VI)/kg/d	3.66E-07 mg Cr(VI)/kg
Milk	2.93E-08 mg Cr(VI)/kg/d	3.66E-06 mg Cr(VI)/kg

Table 24: *Contribution to oral intake for humans via the environment from local contribution.*

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).[18] 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.

[18] European Chemicals Bureau, 2005.

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)[19] 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 electroplating are assessed as 15.82 kg Cr(VI)/yr. This corresponds to a $PEC_{local,air}$ of 1.51 x 10^{-2} µg Cr(VI)/m^3 as calculated in EUSES at 100m of the emission source, i.e. the stacks. The excess risks associated with exposure of humans via the environment are 5.48 x 10^{-4} for the general population.

The ECHA dose response relationship assumes no threshold for effects. However, the ETeSS study[20] on which it was based states that "*…the lower the exposure (certainly below 1µg/m³), 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)/m³ 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/m³ downwards), cancer risks may be negligible*". The calculated air concentration 100m from the point source is 1.51 x 10^{-2} µg Cr(VI)/m^3 and therefore over 6 times lower than the concentration at which cancer risks may be negligible.

9.2.2 WCS 1: Receipt, transport and storage of chromium trioxide (PROC 1)

This WCS describes the delivery of solid of chromium trioxide to the site in containers. The chromium trioxide is then stored until it is required for the replenishment of the plating solution. Additions are made to the circulation tanks each shift and considered further in WCS 3.

Chromium trioxide is delivered to the Trostre Works as solid flakes in sealed, metal containers of 25kg or 50kg on shrink-wrapped pallets. Each pallet will typically contain 18 containers. Deliveries occur once per month on average. A curtain-sided heavy goods vehicle (HGV) delivers to a dedicated unloading area in the Coatings Section and the pallets are removed by forklift truck driven by a trained operator. The HGV driver remains in his vehicle at all times. The pallets are transported to a dedicated storage room which is kept locked shut and has restricted access (see Figure 7). The storage area is naturally ventilated and has a brick/concrete bund to the sides and rear (the doors are to the front). The quantity of chromium trioxide that may be stored in this area is limited to a maximum of 18 tonnes (360 containers). No other chemicals are stored in this area.

When needed, a pallet is transported by forklift truck to the chromic acid additions area where individual containers will be removed and their contents added to the circulation tanks using a mechanical handling aid (see WCS 3). Until this point, primary containment of chromium trioxide is maintained throughout. The containers are delivered sealed and shrink-wrapped. No work activities are performed within the storage room, i.e. no manipulations of the containers, decanting etc, except for transport in and out of the storage room. The containers are not opened until they are in the additions area which is considered in WCS 3. As a result, there is no potential for exposure in this WCS.

9.2.2.1 Risk management measures

Risk management measures are summarised in the table below.

[19] European Chemicals Bureau, 2005.

[20] ETeSS, 2013.

Means to minimise exposure	Description of the specific measures (with further information in section 9.1.7)
Containment	Chromium trioxide is delivered in sealed containers on shrink-wrapped containers and transported by forklift truck. The containers are stored in a dedicated storage room. The containers are not opened at any point in this WCS.
Engineering controls	The storage area is kept locked shut by padlock when not in use.
Administrative controls	Restricted access: the keys to the storage room are kept locked in the control room. Only the team leader has access to these keys. Maximum storage capacity of 360 containers (18 tonnes). Procedures are in place covering receipt, delivery and transport of chromium trioxide. Only authorised 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. Firewater is retained.
Monitoring	Health surveillance, biological monitoring.

Table 25: *Risk management measures: WCS 1*

9.2.2.2 Conditions of use

The conditions of use, described in the table below, are based on ART parameters and are used to estimate exposure levels.

Product (article) characteristics
Product type: Powders, granules or pelletised material
Concentration: 100% chromium trioxide or 52% Cr(VI)
Primary Emission Source - Dustiness: Granules, flakes or pellets
Moisture content: Dry product (<5% moisture content)
Powder weight fraction: Pure material (100%)
Amount used (or contained in articles), frequency and duration of use/exposure
Duration of activity: 15 mins, 12 times a year
Technical and organisational conditions and measures
Primary emission source located in the breathing zone of the worker: No
Activity class: Handling of contaminated solid objects or paste (handling of apparent clean objects)
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
General control measures: Containment, no extraction (no secondary localised controls)
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
Other conditions affecting workers exposure
Process Temperature: Room Temperature

Table 26: *Conditions of use: WCS 1*

9.2.2.3 Exposure and risks for workers

Although there is no potential for exposure during this WCS, the Advanced REACH Tool (ART) estimate for occupational exposure relating to the handling of contaminated objects is used as the basis for calculating the risk. The exposure concentrations and excess risk levels are reported in the table below.

Route of exposure and type of effects	Results	Notes
Inhalation, local Exposure value (8h TWA)	1.92E-08 mg Cr(VI)/m^3	Obtained from ART, 90^{th} percentile value.
Inhalation, local Exposure value (8h TWA) corrected for PPE	No correction	RPE not used for this activity
Frequency of operation (per year) over all operators	12	= 1 x per month x 1 operator = activity occurs 12 times per year
Number of operators	20	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	0.00414	= 12 / 20 / 145
Inhalation, local Exposure value corrected for PPE and frequency	7.96E-08 µg Cr(VI)/m^3	= 1.92E-08 x 0.00414 x 1,000 (to convert to µg)
Excess risk level, based on RAC opinion, per worker for this task	3.18E-10	= 7.96E-08 x 0.004 (1 µg/m^3 of Cr(VI) equals excess risk of 0.004)

Table 27: *Exposure concentrations and risks for workers: WCS 1*

9.2.2.4 Conclusion on risk assessment

The containers are tightly sealed and arrive on pallets, shrink wrapped upon receipt. They are transported by forklift truck to a dedicated storage area which is kept locked. No work activities take place in the storage area. The containers are then transported to the additions area when required, a pallet at a time, where only then are they opened. The activity is carried out by trained personnel following the procedure for this activity. Exposure is checked by health surveillance and biological monitoring.

The modelled exposure estimate (ART) of 1.92×10^{-8} mg Cr(VI)/m^3 8hr TWA provides a worst case basis for risk characterisation and assumes some careful handling of apparently clean containers in relation to this WCS. An excess lung cancer mortality risk of 3.18×10^{-10} 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 over-estimate the risk.

Exposure is adequately controlled. The emission and consequently the exposure related to the receipt, transport and storage of Cr(VI) is minimised. No further measures are considered necessary.

9.2.3 WCS 2: Sampling of the electrolyte solution (PROC 9)

This WCS describes taking samples of the electrolyte solution in the basement area underneath the ECCS4 line (WCS 2a) and their subsequent analysis in the on-site laboratory (WCS 2b). Both activities are performed by the chemicals additions operator although they are split into two sub-WCS because the risk management measures differ. The results of sampling inform how much chromium trioxide needs to be added to the circulation tanks (see WCS 3).

The chemicals additions operator will sample the circulation tank (as well as other tanks involved in the electroplating process) once per shift. Sampling of the circulation tank takes about 10 minutes and is performed once per shift, i.e. the activity occurs two times per day.

***Figure 29**: Sampling of the electrolyte solution*

Sampling is undertaken at dedicated closed loop sampling points using an in-line sample bottle valve (see Figure 29 for an example). Small volumes are collected in 200ml PETG sample bottles with a screw top. Three Cr(VI)-related samples are taken, [redacted]. The bottles are then manually sealed using their plastic cap and carried by hand to the laboratory using a bottle carrier basket.

The sampling system is dedicated (not used for other activities) and located within the bunded area in the basement. The system is designed to minimise exposure and prevent overfill by maintaining primary containment during sample bottle filling, although should there be any loss (e.g. on decoupling), the electrolyte solution would flow into a floor drain which has a discharge connection pipe either end (west and east) that discharges into the chrome sump. As samples are collected within the chromic acid area, 'full chromium PPE' is worn.

Samples are analysed in the electrolytic tinning (ET) laboratory by transferring the electrolyte from the sample bottle using a pipette inside a fume cabinet. Analysis is undertaken using Metrohm automatic titrators. Following analysis, the electrolyte is returned to the production line and discharged into the chrome sump. Full chromium PPE is not required in the laboratory although disposable nitrile gloves and a lab coat are worn along with other standard site PPE.

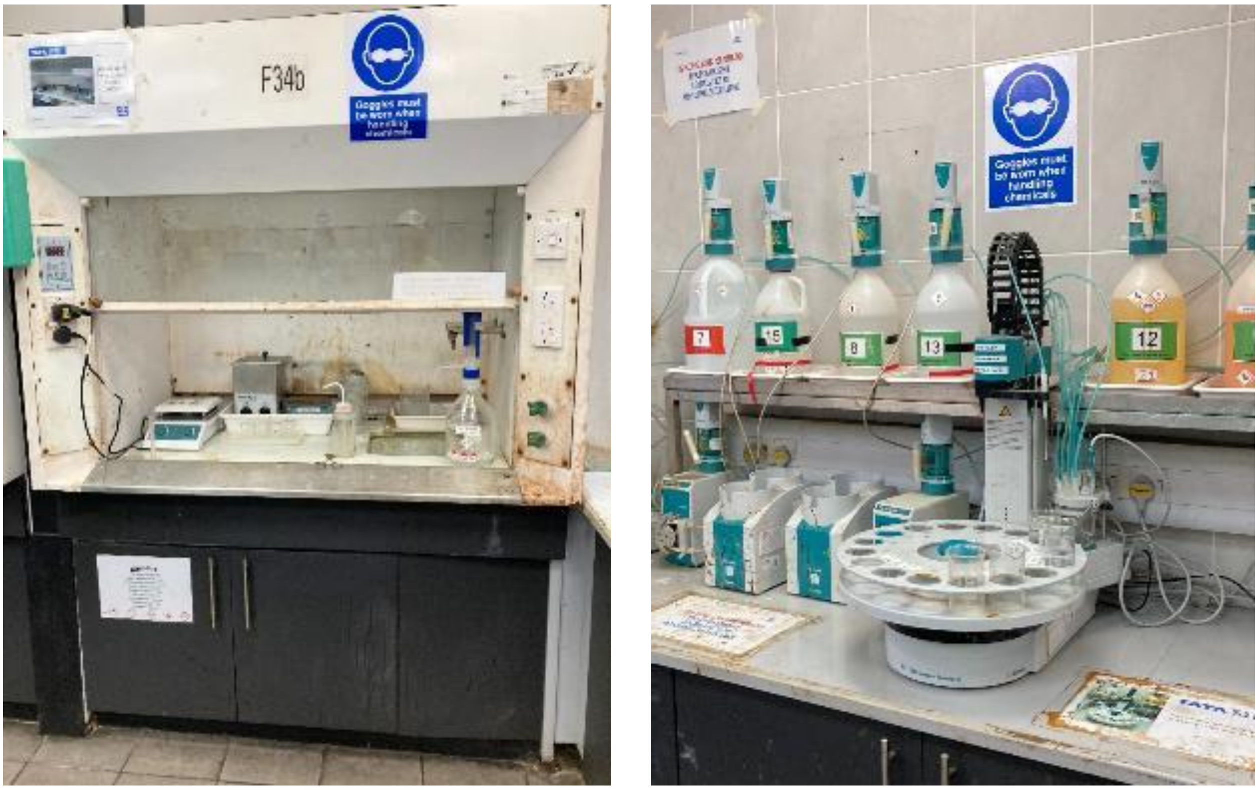

***Figure 30**: On-site laboratory: fume cupboard (L) and auto-titrator (R)*

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	Primary 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. Secondary containment: Sampling is undertaken at a dedicated location in the basement area which is bunded.
Engineering controls	Sampling takes place inside the chromic acid area which is segregated from the rest of the ECCS4 line.
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 chromic acid 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 28**: 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 electrolyte. Following analysis, waste electrolyte 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 29: *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 and account for estimated exposure levels.

Product (article) characteristics
• Concentration of substance in mixture: [redacted] chromic acid
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 58 ± 2 °C
• Local exhaust ventilation (select efficiency): No LEV situated on the sampling point.
• 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 chromic acid area. However, other workers are segregated from this area.
• Place of use: Indoors

Table 30: *Conditions of use: WCS 2a*

The conditions of use for WCS 2b (laboratory analysis) are described in the table below and are based on ART parameters which are used to account for estimated exposure levels.

Product (article) characteristics
Product type: Powders dissolved in a liquid
Weight Fraction: [redacted] chromic acid)
Viscosity: Liquid with low viscosity (like water)
Amount used (or contained in articles), frequency and duration of use/exposure
Duration & frequency of activity: 10 minutes, once per shift (based on the 12h shift regime, twice per day)
Technical and organisational conditions and measures
Primary emission source located in the breathing zone of the worker: Yes
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 31**: Conditions of use: WCS 2b*

9.2.3.3 Exposure and risks for workers

Personal exposure measurements for the chemicals additions operator are collected during each annual campaign. Static measurements are also taken annually in the basement of the plating area 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 chemicals additions operator is low.

The measurements relevant to this WCS are reported in the table below.

Type	Year	Filter conc. of Cr(VI) (mg/m^3)	Sampling duration (mins)	Shift length (hrs)	12hr TWA (mg/m^3) (factored)
Personal: Chemicals Additions Operator	2024	0.00011	529	12	1.50E-04
Static: Plating Basement	2024	0.00028	514	N/A	N/A
Personal: Chemicals Additions Operator (day 1)	2023	0.00037	535	12	4.98E-04
Personal: Chemicals Additions Operator (day 2)	2023	0.00028	561	12	3.59E-04
Static: Plating Basement (day 1)	2023	0.00025	508	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: Plating Basement (day 2)	2023	0.00025	540	N/A	N/A
Personal: Chemicals Additions Operator (day 1)	2022	0.00021	622	12	2.43E-04
Personal: Chemicals Additions Operator (day 2)	2022	0.000046	587	12	5.64E-05
Static: Plating Basement (day 1)	2022	0.000081	590	N/A	N/A
Static: Plating Basement (day 2)	2022	0.000019	575	N/A	N/A

Table 32*: Measurement data: WCS 2a and 2b*

For WCS 2a (taking samples), the exposure concentrations and excess risk level are reported in the table below. These use the highest recorded personal measurement (4.98E-04 mg Cr(VI)/m^3 12hr TWA) from the previous three years.

Route of exposure and type of effects	Results	Notes
Inhalation, local Exposure value (12hr TWA)	4.98E-04 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	1.24E-05 mg Cr(VI)/m^3	RPE of APF 40 used.
Frequency of operation (per year) over all operators	534	= 1 x per shift x 2 shifts per day x 1 operator x 267 max operational days = activity occurs up to 534 times / year
Number of operators	20	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	0.1841	= 534 / 20 / 145
Inhalation, local Exposure value corrected for PPE and frequency	2.29E-03 µg Cr(VI)/m^3	= 1.24E-05 x 0.1841 x 1,000 (to convert to µg)
Excess risk level, based on RAC opinion, per worker for this task	9.17E-06	= 2.29E-03 x 0.004 (1 µg/m^3 of Cr(VI) equals excess risk of 0.004)

Table 33*: Exposure concentrations and risks 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 and excess risk levels are reported in the table below, again using the highest recorded personal measurement from the previous three years.

Route of exposure and type of effects	Results	Notes
Inhalation, local Exposure value (12hr TWA)	4.98E-04 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	No RPE used in the laboratory.
Frequency of operation (per year) over all operators	534	= 1 x per shift x 2 shifts per day x 1 operator x 267 max operational days = activity occurs up to 534 times per year
Number of operators	20	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	0.1841	= 534 / 20 / 145
Inhalation, local Exposure value corrected for PPE and frequency	9.17E-02 µg Cr(VI)/m^3	= 4.98E-04 x 0.1841 x 1,000 (to convert to µg)
Excess risk level, based on RAC opinion, per worker for this task	3.67E-04	= 9.17E-02 x 0.004 (1 µg/m^3 of Cr(VI) equals excess risk of 0.004)

***Table 34**: Exposure concentrations and risks for workers: WCS 2b*

9.2.3.4 Conclusion on risk assessment

The measured exposure of 4.98 x 10^{-4} mg Cr(VI)/m^3 12hr TWA (0.498 µg Cr(VI)/m^3) provides a worst case basis for risk characterisation given that this accounts for the chemicals additions 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).

An excess lung cancer mortality risk of 9.17E x 10^{-6} for WCS 2a (sampling) and 3.67 x 10^{-4} 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.

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

9.2.4 WCS 3: Adding chromium trioxide to the circulation tank (PROC 8b)

The Cr(VI) concentration in the electrolyte is targeted at [redacted] chromic acid. To maintain this concentration in the plating tanks, chromium trioxide needs to be dosed once per shift into the circulation tanks. This will involve adding [redacted] containers [redacted] an activity which takes approximately 30 minutes. The quantity of chromium trioxide to be added is determined from the results of analysis (WCS 2b).

***Figure 31**: The additions area (L) and lifting of a chromium trioxide container for controlled pouring into the tundish (R)*

To make the additions, the chemicals additions operator enters the chromic acid area on the mill floor wearing full chromium PPE. The operator takes the required number of containers from the pallet that has been brought to the area by forklift truck (see WCS 1). A drum lifting device (see Figure 31) is used to handle the container, which eliminates hazardous manual handling activities and also ensures that chromium trioxide flakes can be poured in a controlled way into the circulation tanks. The additions are made to the circulation tanks in the basement below through a custom-made device (a tundish) to avoid spillage of flakes. There is no additional LEV to the tundish itself but because the LEV to the plating tanks remains operational, this creates a certain degree of negative pressure around the tundish opening which helps draw in any dusts created when pouring from containers. The tundish hatch is closed immediately afterwards.

Empty containers are washed in a dedicated rinsing machine in the additions area, left to dry, then crushed in a drum crusher also in the additions area. Crushed containers are placed into a waste container and sent as waste to a local company for recycling. The absence of Cr(VI) on cleaned, crushed containers is verified by weekly measurements. Rinse waters from the washing process are collected and flow via dedicated pipework into the chrome sump and from there transferred to the WWTP for treatment via reduction in a batch process.

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	Chromium trioxide is delivered in sealed metal containers and only opened immediately prior to their addition into the circulation tanks. Drums are always emptied completely. The addition to the circulation tanks in the basement is through a dedicated entry (tundish) on the mill floor above which is designed to avoid contact with the chromic acid in the circulation tanks.
Engineering controls	Additions take place inside the chromic acid area which is segregated from the rest of the ECCS4 line. Additions are made using a lifting device to allow controlled pouring into the tundish. There is no dedicated LEV around the tundish but the LEV to the plating tanks remains operational throughout and creates negative pressure around the tundish opening, helping capture and draw in any dusts created during pouring. The LEV is interlocked to plating line operation. Chromium trioxide is supplied and used as flakes, limiting dust formation and exposure by inhalation as compared to powder.
Administrative controls	Procedures are in place covering additions. Only authorised personnel can perform this task which takes place in a restricted area. All personnel performing this task receive appropriate information, instructions and training.
PPE	Since the additions area is within the chromic acid 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 3*

9.2.4.2 Conditions of use

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

Product (article) characteristics
• Concentration: 100% chromium trioxide (52% Cr(VI))
Amount used (or contained in articles), frequency and duration of use/exposure
• Exposure duration: Total activity takes approximately 30 mins.
• Frequency: once per shift, twice per day
• Emission sources: Near field exposure
Technical and organisational conditions and measures
• Activity Class for solids: transfer of solid products
• Process temperature: room temperature (15-25 °C)
• Local exhaust ventilation: No
• General ventilation system: Natural ventilation in the Area 3 Coatings Section by virtue of vehicle bay access doors. LEV to the plating line remains operational and creates some degree of negative pressure around the tundish opening, helping to capture and draw in any dusts during the additions process.
• 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, since the operator is present within the boundaries of the segregated chromic acid area.
• Personal Enclosure: No
• Place of use: Indoors

***Table 36**: Conditions of use: WCS 3*

9.2.4.3 Exposure and risks for workers

Additions are only performed by the chemicals additions operator. Personal exposure measurements for the chemicals additions operator are collected during each annual campaign. Static measurements are also taken annually in the vicinity of the additions area which are relevant for this WCS.

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 30 minutes it takes to perform the additions. However, personal and static measurements over these longer periods show that the total exposure of the chemicals additions operator is low.

The measurements relevant to this WCS are reported in the table below.

Type	Year	Filter conc. of Cr(VI) (mg/m^3)	Sampling duration (mins)	Shift length (hrs)	12hr TWA (mg/m^3) (factored)
Personal: Chemicals Additions Operator	2024	0.00011	529	12	1.50E-04
Static: Above chemical additions area	2024	0.00021	515	N/A	N/A
Personal: Chemicals Additions Operator (day 1)	2023	0.00037	535	12	4.98E-04
Personal: Chemicals Additions Operator (day 2)	2023	0.00028	561	12	3.59E-04
Static: Above chemical additions area (day 1)	2023	0.00124	531	N/A	N/A
Static: Above chemical additions area (day 2)	2023	0.00092	551	N/A	N/A
Personal: Chemicals Additions Operator (day 1)	2022	0.00021	622	12	2.43E-04
Personal: Chemicals Additions Operator (day 2)	2022	0.000046	587	12	5.64E-05
Static: Above chemical additions area (day 1)	2022	0.000064	609	N/A	N/A
Static: Above chemical additions area (day 2)	2022	0.00092	551	N/A	N/A

***Table 37**: Measurement data: WCS 3*

The exposure concentrations and excess risk level are reported in the table below. These use the highest recorded personal measurement (4.98E-04 mg Cr(VI)/m^3 12hr TWA) from the previous three years.

Route of exposure and type of effects	Results	Notes
Inhalation, local Exposure value (12hr TWA)	4.98E-04 mg Cr(VI)/m^3	Highest recorded measurement (filter concentration has been factored upwards to adjust to 12hr shift length).

Route of exposure and type of effects	Results	Notes
Inhalation, local Exposure value (12hr TWA) corrected for PPE	1.24E-05 mg Cr(VI)/m^3	RPE of APF 40 used.
Frequency of operation (per year) over all operators	534	= 1 x per shift x 2 shifts per day x 1 operator x 267 max operational days = activity occurs up to 534 times / year
Number of operators	20	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	0.1841	= 534 / 20 / 145
Inhalation, local Exposure value corrected for PPE and frequency	2.29E-03 µg Cr(VI)/m^3	= 1.24E-05 x 0.1841 x 1,000 (to convert to µg)
Excess risk level, based on RAC opinion, per worker for this task	9.17E-06	= 2.29E-03 x 0.004 (1 µg/m^3 of Cr(VI) equals excess risk of 0.004)

***Table 38**: Exposure concentrations and risks for workers: WCS 3*

9.2.4.4 Conclusion on risk assessment

The measured exposure of 4.98 x 10^{-4} mg Cr(VI)/m^3 12hr TWA (0.498 µg Cr(VI)/m^3) provides a worst case basis for risk characterisation given that this accounts for the chemicals additions operator's measured exposure across a whole shift performing this and other tasks.

An excess lung cancer mortality risk of 9.17 x 10^{-6} per worker is estimated based on the above exposure estimate and the RAC dose-response relationship for lung cancer mortality. These are based on the theoretical maximum number of production days on the ECCS4 line and, in reality, the actual number of production days (and therefore the actual number of tank additions) will be significantly lower. The ELR can therefore be considered an over-estimate of the risk.

The emissions and consequently the exposures related to the sampling and analysis of the plating solution are minimised through a combination of technical and administrative controls, the effectiveness of which are verified through monitoring and health surveillance. Exposure is adequately controlled and no further measures are considered necessary.

9.2.5 WCS 4: Electroplating (PROC 13)

This WCS considers the electroplating process, described in detail in section 9.1.3 above. Electroplating of steel strip is a continuous process, and also a mostly-contained process. The steel strip enters and leaves the plating tanks through openings on either side of the tanks. LEV in the form of receiving (canopy) hoods covers the entire surface area of the top of the tanks. Blanking plates are positioned on the tank sides to further reduce emissions.

The team leader (or deputy team leader when the team leader is unavailable) carries out control rounds to inspect the electroplating line and performs housekeeping tasks. For these activities, the team leader does not need to enter the chromic acid area. 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 operator is not in the immediate vicinity of the electroplating line and outside the chromic acid area, there is the potential for exposure as a result of being in proximity to the plating tanks during the inspection rounds and housekeeping activities.

[redacted]

Figure 32: *Plating section on the ECCS4 line*

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 plating tanks are mostly (but not wholly) enclosed. This is achieved through the design of the tanks (steel strip passes through openings on the sides), the LEV (canopy hoods positioned above the entire liquid surface of the electrolyte) and the use of blanking plates (minimising emissions from the tank sides). Secondary containment is provided in that any loss from the plating 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 plating sump in the basement, which is itself fully bunded. The floor under the installation is acid-resistant tilework.
Engineering controls	The process control systems allow for automated and remote operation of the plating line, almost eliminating the need for operator intervention on the line itself (within the chromic acid area), thereby significantly reducing exposure. LEV in the form of receiving (canopy) hoods covers the entire surface area of the top of the tanks and extracts 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). The plating area is physically segregated from the rest of the ECCS4 line.

Means to minimise exposure	Description of the specific measures (with further information in section 9.1.7)
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. Firewater is retained.
Monitoring	Workers performing this task are subject to health surveillance and biological monitoring.

***Table 39**: 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] chromic acid
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 chromic acid area and hence does not go near the electroplating line.
Technical and organisational conditions and measures
• Activity Class for liquids: Presence of liquid in mostly enclosed container (plating tanks)
• Process temperature: 58 ± 2 °C
• Local exhaust ventilation: Yes, LEV provided to all plating 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?: No
• Segregation: Partial segregation, the team leader will remain outside the chromic acid area.
• Personal Enclosure: No personal enclosure during this activity.
• Place of use: Indoors.

***Table 40**: Conditions of use: WCS 4*

9.2.5.3 Exposure and risks for workers

The activities covered by this WCS are only performed by the team leader (or team leader deputy). Personal exposure measurements for the team leader are collected during each annual campaign. Static measurements are also taken annually although the position of the static samples are within the chromic acid area, not outside it; they are nevertheless presented below. 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 60 minutes of work performing control rounds and housekeeping. However, personal and static measurements over these longer periods show that the total exposure of the team leader is low.

The measurements relevant to this WCS are reported in the table below.

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	0.00014	528	12	1.91E-04
Static: Above plating section	2024	0.00018	512	N/A	N/A
Static: Rear of plating section	2024	0.0027	516	N/A	N/A
Personal: Team leader (day 1)	2023	0.000075	542	12	9.96E-05
Personal: Team leader (day 2)	2023	0.00012	566	12	1.53E-04
Static: Above plating section (day 1)	2023	0.00082	534	N/A	N/A
Static: Rear of plating section (day 1)	2023	0.00092	512	N/A	N/A
Static: Above plating section (day 2)	2023	0.00082	548	N/A	N/A
Static: Rear of plating section (day 2)	2023	0.00111	543	N/A	N/A
Personal: Team leader (day 1)	2022	0.000083	616	12	9.70E-05
Personal: Team leader (day 2)	2022	0.00026	597	12	3.14E-04
Static: Above plating section (day 1)	2022	0.000083	602	N/A	N/A
Static: Rear of plating section (day 1)	2022	0.00025	592	N/A	N/A
Static: Above plating section (day 2)	2022	0.00082	548	N/A	N/A
Static: Rear of plating section (day 2)	2022	0.000073	576	N/A	N/A

Table 41*: Measurement data: WCS 4*

The exposure concentrations and excess risk level are reported in the table below. These use the highest recorded personal measurement (3.14E-04 mg Cr(VI)/m^3 12hr TWA) from the previous three years.

Route of exposure and type of effects	Results	Notes
Inhalation, local Exposure value (12hr TWA)	3.14E-04 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	534	= 1 x per shift x 2 shifts per day x 1 operator x 267 max operational days = activity occurs up to 534 times / year

Route of exposure and type of effects	Results	Notes
Number of operators	4	This is the total number of operators that could perform this task. Whenever the team leader (4 in rotation) is present he performs the tasks. When not present, the team leader deputy (4 in rotation) assumes the role.
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	0.9207	= 534 / 4 / 145
Inhalation, local Exposure value corrected for PPE and frequency	2.89E-01 µg Cr(VI)/m^3	= 3.14E-04 x 0.9207 x 1,000 (to convert to µg)
Excess risk level, based on RAC opinion, per worker for this task	1.15E-03	= 2.89E-01 x 0.004 (1 µg/m^3 of Cr(VI) equals excess risk of 0.004)

***Table 42**: Exposure concentrations and risks for workers: WCS 4*

9.2.5.4 Conclusion on risk assessment

The measured exposure of 3.14 x 10^{-4} mg Cr(VI)/m^3 12hr TWA (0.314 µg Cr(VI)/m^3) provides a worst case basis for risk characterisation given that this accounts for the team leader's measured exposure across a whole shift, with the measurement factored up to account for the period not subject to personal monitoring during the 12 hr shift, despite no additional control rounds or housekeeping performed during this time.

An excess lung cancer mortality risk of 1.15 x 10^{-3} per worker is estimated based on the above exposure estimate and the RAC dose-response relationship for lung cancer mortality. These are based on the theoretical maximum number of production days on the ECCS4 line and can therefore be considered an over-estimate of the risk.

The emissions and consequently the exposures related to the team leader's activities covered by this WCS are minimised through a combination of technical and administrative controls, the effectiveness of which are verified through monitoring and health surveillance. Exposure is adequately controlled and 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 the control room. The actual amount of time is dependent on the operator's role. For example, the exit-end inspector performing inspections of the finished steel strip will usually spend 10 or more hours of their 12 hour shift in the control room. Operators working in the control room are in the 'far field' of any Cr(VI) source. The ECCS4 control room is approximately 30m^2 (105m^3) and is located 5m from the end of the line and 20m from nearest Cr(VI) source. Given these distances, and because it is a separate room, any exposure in the control room itself is expected to be negligible.

Figure 33: *ECCS4 control room*

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 operator is in a separate room (personal enclosure) 20m away from any potential Cr(VI) source.
Engineering controls	The process control systems allow for automated and remote operation of the plating line, almost eliminating the need for operator intervention on the line itself (within the chromic acid 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 43: *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 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 44**: Conditions of use: WCS 5*

9.2.6.3 Exposure and risks for workers

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 chemicals additions operator obtained during the annual campaigns are not used for this WCS because their roles involve additional activities which are not 'far field' in nature. The personal exposure measurements for the exit-end inspector and the entry-end operator are used instead as they are more representative. Static measurements are also taken annually with a static sampler positioned in the control room.

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.

Type	Year	Filter conc. of Cr(VI) (mg/m^3)	Sampling duration (mins)	Shift length (hrs)	12hr TWA (mg/m^3) (factored)
Personal: Exit-end inspector	2024	0.00017	529	12	2.31E-04
Personal: Entry-end operator	2024	0.000075	525	12	1.03E-04
Static: Control room (day 1)	2024	0.000087	546	N/A	N/A
Static: Control room (day 2)	2024	0.000087	430	N/A	N/A
Personal: Exit-end inspector (day 1)	2023	0.000085	539	12	1.14E-04

Type	Year	Filter conc. of Cr(VI) (mg/m^3)	Sampling duration (mins)	Shift length (hrs)	12hr TWA (mg/m^3) (factored)
Personal: Entry-end operator (day 1)	2023	0.000017	533	12	2.30E-05
Personal: Exit-end inspector (day 2)	2023	0.0001	565	12	1.27E-04
Personal: Entry-end operator (day 2)	2023	0.00011	555	12	1.43E-04
Static: Control room (day 1)	2023	0.000054	546	N/A	N/A
Static: Control room (day 2)	2023	0.000054	564	N/A	N/A
Static: Control room (day 3)	2023	0.00001	485	N/A	N/A
Personal: Exit-end inspector (day 1)	2022	0.000036	530	12	4.89E-05
Personal: Entry-end operator (day 1)	2022	0.000041	629	12	4.69E-05
Personal: Exit-end inspector (day 2)	2022	0.000089	593	12	1.08E-04
Personal: Entry-end operator (day 2)	2022	0.000023	582	12	2.85E-05
Static: Control room (day 1)	2022	0.000038	621	N/A	N/A
Static: Control room (day 2)	2022	0.000066	595	N/A	N/A
Static: Control room (day 3)	2022	0.000014	545	N/A	N/A

***Table 45**: Measurement data: WCS 5*

The exposure concentrations and excess risk level are reported in the table below. These use the highest recorded personal measurement (2.31E-04 mg Cr(VI)/m^3 12hr TWA) from the previous three years.

Route of exposure and type of effects	Results	Notes
Inhalation, local Exposure value (12hr TWA)	2.31E-04 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	N/A	All operators spend time in the control room during their shifts
Number of operators	28	This is the total number of production shift team operators (4 teams of 7).
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
Inhalation, local Exposure value corrected for PPE and frequency	2.31E-01 µg Cr(VI)/m^3	= 2.31E-04 x 1 x 1,000 (to convert to µg)
Excess risk level, based on RAC opinion, per worker for this task	9.26E-04	= 2.31E-01 x 0.004 (1 µg/m^3 of Cr(VI) equals excess risk of 0.004)

***Table 46**: Exposure concentrations and risks for workers: WCS 5*

9.2.6.4 Conclusion on risk assessment

The measured exposure of 2.31 x 10^{-4} mg Cr(VI)/m³ 12hr TWA (0.231 µg Cr(VI)/m^3) provides a worst case basis for risk characterisation. This accounts for the exit-end inspector's and entry-end operator's measured exposures across a whole shift, performing activities both inside and outside the control room, with the measurement factored up to account for the period not subject to personal monitoring during the 12 hr shift.

An excess lung cancer mortality risk of 9.26 x 10^{-4} per worker is estimated based on the above exposure estimate and the RAC dose-response relationship for lung cancer mortality.

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 control room is 20m away from the nearest Cr(VI) source and because it is located in a separate room, any liquid droplets containing Cr(VI) are highly unlikely to ever reach the control room. It is therefore reasonable to conclude that Cr(VI) exposure in the control room 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 ECCS4 line by forklift truck and overhead travelling crane and their loading and unloading at the entry and exit ends of the line. This work will be undertaken by the forklift truck driver, the entry-end operator and the exit-end operator. 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 control room (see WCS 5).

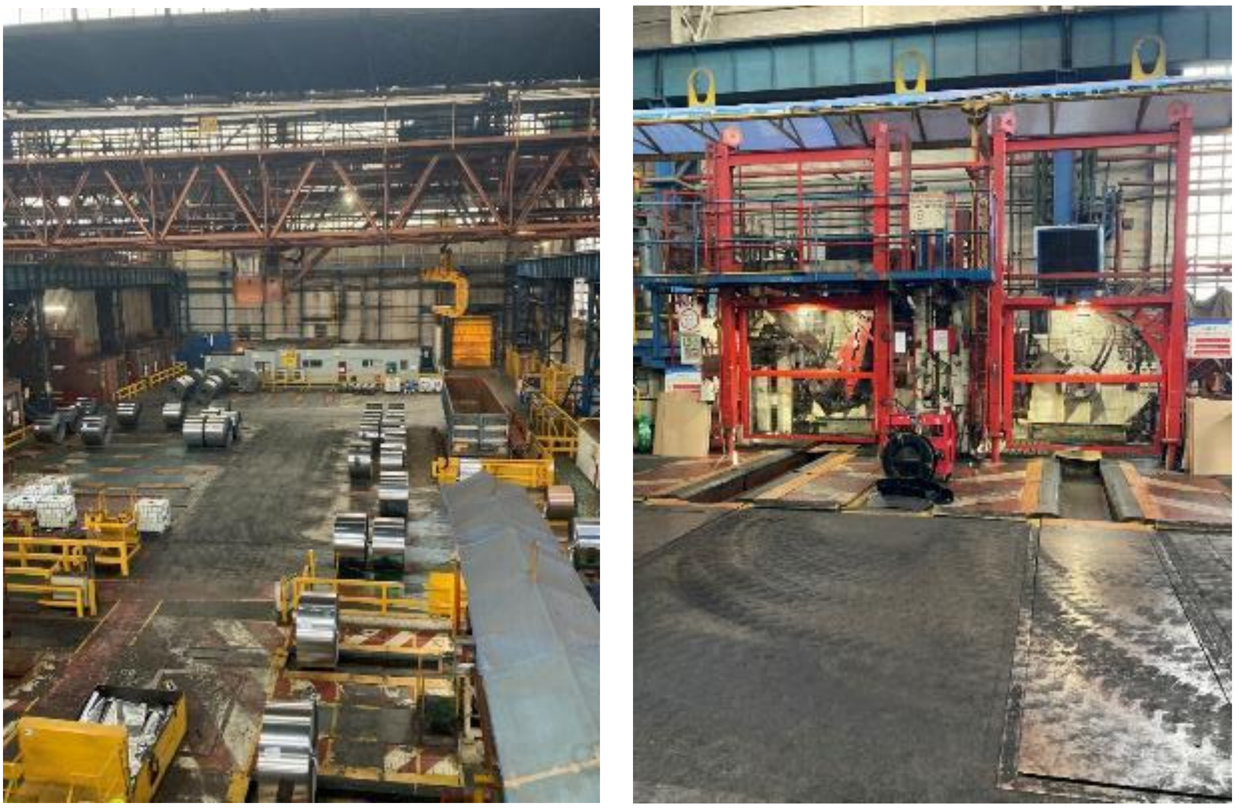

***Figure 34**: ECCS4 entry end coil storage prior to loading (L) and coil exit area (R)*

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'.
Engineering controls	Areas where Cr(VI) emissions can occur are physically segregated and marked as the chromic acid area.
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 47**: 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 ECCS4 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 48**: Conditions of use: WCS 6*

9.2.7.3 Exposure and risks for workers

The activities covered by this WCS are performed by the forklift truck operator, the entry-end operator and the exit-end operator. As such, the personal exposure measurements for the entry-end operator are considered representative (personal exposure measurements are not collected for the forklift truck driver or exit-end operator during the annual campaigns). No static measurements re relevant to this WCS; they are not collected in the entry or exit ends of the ECCS4 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 the forklift truck operator's, the entry-end operator's and the exit-end operator's shifts are spent in the control room.

Type	Year	Filter conc. of Cr(VI) (mg/m^3)	Sampling duration (mins)	Shift length (hrs)	12hr TWA (mg/m^3) (factored)
Personal: Entry-end operator	2024	0.000075	525	12	1.03E-04
Personal: Entry-end operator (day 1)	2023	0.000017	533	12	2.30E-05
Personal: Entry-end operator (day 2)	2023	0.00011	555	12	1.43E-04
Personal: Entry-end operator (day 1)	2022	0.000041	629	12	4.69E-05
Personal: Entry-end operator (day 2)	2022	0.000023	582	12	2.85E-05

***Table 49**: Measurement data: WCS 6*

The exposure concentrations and excess risk level are reported in the table below. These use the highest recorded personal measurement (1.43E-04 mg Cr(VI)/m^3 12hr TWA) from the previous three years.

Route of exposure and type of effects	Results	Notes
Inhalation, local Exposure value (12hr TWA)	1.43E-04 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	1,602	1 x per shift (task performed each shift), 2 x shifts per day, 3 x operators perform this task, 267 operational days = activity occurs up to 1,602 times / year
Number of operators	20	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	0.5524	= 1602 / 20 / 145
Inhalation, local Exposure value corrected for PPE and frequency	7.88E-02 µg Cr(VI)/m^3	= 1.43E-04 x 0.5524 x 1,000 (to convert to µg)

Route of exposure and type of effects	Results	Notes
Excess risk level, based on RAC opinion, per worker for this task	3.15E-04	= 7.88E-02 x 0.004 (1 µg/m^3 of Cr(VI) equals excess risk of 0.004)

***Table 50**: Exposure concentrations and risks for workers: WCS 6*

9.2.7.4 Conclusion on risk assessment

The measured exposure of 1.43 x 10^{-4} mg Cr(VI)/m^3 12hr TWA (0.143 µg Cr(VI)/m^3) provides a worst case basis for risk characterisation, based on the entry-end operator's measured exposure across a whole shift, with the measurement factored upwards to account for the additional time over the 12 hour shift that exposure was not measured.

An excess lung cancer mortality risk of 3.15 x 10^{-4} per worker is estimated based on the above exposure estimate and the RAC dose-response relationship for lung cancer mortality.

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 forklift truck driver, the entry-end operator and the exit-end operator will in fact spend the majority of their 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 ECCS4 line which is both scheduled and non-scheduled. Major scheduled maintenance occurs annually, during a 14-day plant shutdown. Minor scheduled maintenance occurs once every nine weeks when the line is shut down for up to 24 hours. In addition, the hold-down rolls (which guide the steel strip through the electroplating tanks) are inspected once every three weeks and are replaced if necessary, typically every other inspection. The inspection takes around 30 minutes and roll replacement takes between 2-3 hours. Very rarely, confined space entry is required to the circulation tanks or the bulk chrome tank in the WWTP, e.g. to re-line the tanks. Unscheduled maintenance may also occur on the ECCS4 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 chromic acid area typically involves mechanical and piping inspection and maintenance work, electrical and instrumentation inspection and maintenance work, the inspection and replacement of hold-down rolls, and removal of Cr(VI) deposits from the bottom of the plating tanks (see section 9.1.7.15, performed as part of the 9-weekly minor maintenance tasks).

A summary of the maintenance activities with their frequency and duration is provided in the table below.

Type of maintenance	Frequency	Total duration	WCS
Major annual maintenance	Once per year	14 days	WCS 7a
Minor (9-weekly) maintenance	6 times per year, every 9 weeks	1 day	
Inspection of hold down roll	Every 3 weeks	30 min	
Replacement of hold down roll	Approximately 7 times per year, every 7 weeks	2-3 hours	

Type of maintenance	Frequency	Total duration	WCS
Unscheduled maintenance (in chromic acid area)	Once per month	Variable, between 1 to 3 hours	
Confined space entry	Once every 2.5 years	Variable, up to 4 hrs depending on task	WCS 7b

***Table 51**: Type of maintenance activities, frequency and total duration*

[redacted]

***Figure 35**: Plating section during maintenance (blanking plates have been removed to allow for maintenance activities to be undertaken)*

These maintenance activities have been subdivided into WCS 7a (covering maintenance activities other than confined space entry) and WCS 7b (covering confined space entry). This is because the risk management measures used for WCS 7a are the same, even though the activities differ, while additional risk management measures are used for WCS 7b.

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 14 days. Up to four maintenance workers (either employees or contractors) may be inside the chromic acid area and will wear full chromium PPE as a result. 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).

(2) During **minor (9-weekly) maintenance**, there may be up to four workers in the chromic acid area for up to a 15-hour period (though the work will often last only one shift). 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 may be required. If inside the chromic acid 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 chromic acid area for up to 30 mins. When active in the chromic acid 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 chromic acid area, the workers will wear full chromium PPE. One production shift team member will support the activity from outside the chromic acid 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 chromic acid area, typically for one to three hours. When active in the chromic acid area, the workers wear full chromium PPE. One production shift team member will support the activity from outside the chromic acid area, e.g. controlling the overhead crane if required.

(6) The need for **confined space entry**, e.g. access into the circulation tanks or bulk chrome tank on the WWTP, is very infrequent. In the past five years, confined space entry to Cr(VI) relevant vessels has occurred twice, most recently to shot-blast then re-line the circulation tanks. A frequency of once every 2.5 years is therefore assumed. Confined space entry typically involves up to 2 vessel entrants and 1 rescue operative. Entry could potentially be made by appropriately trained Tata Steel personnel but more commonly an external contractor will undertake this work, given that the purpose of entry will typically be for specialist inspection or maintenance activities. MRS Training & Rescue (formerly known as the Mines Rescue Service) provide the rescue operatives.

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 electrolytic deposition of Cr(VI) and the formation of any mist as a result of electrolysis ceases. As such the inhalation exposure to chromic acid mist is avoided and the LEV system to the plating tanks is not used during maintenance activities.

- The plating tanks are emptied by dropping the Cr(VI) electrolyte solution into the circulation tanks. This means that apart from the circulation tanks, there is no large volume of chromic acid left in the line.

- The plating line is isolated from the circulation tanks by means of double valves or blind flanges preventing any chromic acid to re-enter.

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

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

For confined space entry, in addition to the above controls, the activity can only be carried out under a permit-to-work following a detailed risk assessment. The relevant vessel will be emptied of Cr(VI) electrolyte which is sent to the WWTP and the vessel fully washed with water prior to entry. The line will be isolated both mechanically and electrically following a lock out tag out procedure with personnel carrying out the task following a “one person, one lock” protocol. Entrants will carry gas monitors and a two-way radio. Full chromium PPE will be worn inside the tank. A rescue plan will be in place and entrants wear a harness with a rescue rope attached.

Risk management measures for WCS 7a (maintenance activities other than confined space entry) 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 electrolyte solution is then dropped to the circulation tanks in the basement. Secondary containment is provided in that any loss from the plating section on the mill floor level results in the liquid being channelled back into the plating sump in the basement, which is itself fully bunded. The floor under the installation is acid-resistant tilework.
Engineering controls	The plating line is physically isolated from the circulation tanks by means of double valves or blind flanges. The installation is thoroughly flushed with water. Water from flushing is collected in the basement chromium plating sump prior to wastewater treatment by reduction. Prior to leaving the chromic acid area all tools and parts are thoroughly rinsed with water. Rinsing water is collected in the basement chromium plating 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. All personnel performing maintenance activities receive appropriate information, instructions and training.
PPE	For maintenance activities within the chromic acid 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 52**: Risk management measures: WCS 7a*

Risk management measures for WCS 7a (confined space entry) 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 confined space entry. The electrolyte solution is removed and sent to the WWTP where it is treated by reduction. Secondary containment is provided around the circulation tanks in the basement and around the bulk tanks in the WWTP tank farm.
Engineering controls	The line will be isolated both mechanically and electrically following a lock out tag out procedure with personnel carrying out the task following a “one person, one lock” protocol. The vessel is thoroughly flushed with water. Water from flushing is collected and treated at the WWTP by reduction. Entrants to a vessel will carry gas monitors and a two-way radio. After work is completed, all tools and parts are thoroughly rinsed with water. Rinse water is collected in the basement chromium plating sump prior to wastewater treatment in the WWTP.

Means to minimise exposure	Description of the specific measures (with further information in section 9.1.7)
Administrative controls	Confined space entry can only be carried out under permit-to-work and based on a thorough risk assessment. Only authorised personnel can carry out these activities. All personnel performing confined space entry receive appropriate information, instructions and training.
PPE	Workers wear full chromium PPE.
Emergency response	A rescue plan will be in place and rescue operatives remain present outside the vessel at all times. Entrants wear a harness with a rescue rope attached. 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 53**: Risk management measures: WCS 7b*

9.2.8.2 Conditions of use

The conditions of use for WCS 7a (maintenance activities other than confined space entry) are described in the table below and account for estimated exposure levels.

Product (article) characteristics
• Concentration of substance in mixture: [redacted] chromic acid Note: tanks are always emptied and the plating line is 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 51, as it depends on the type of maintenance
• Frequency: variable, see Table 51, as it depends on the type of maintenance
• 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 electrolyte, 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
• 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 54**: Conditions of use: WCS 7a*

The conditions of use for WCS 7b (confined space entry) are described in the table below and are based on ART parameters which are used to account for estimated exposure levels.

Product (article) characteristics
Product type: Powders dissolved in a liquid
Weight Fraction: [redacted] chromic acid)
Liquid with low viscosity (like water)
Amount used (or contained in articles), frequency and duration of use/exposure
Duration of activity: Up to 4 hours
Technical and organisational conditions and measures
Primary emission source located in the breathing zone of the worker: Yes
Activity class: Handling of contaminated objects Activities with treated/contaminated objects (surface >3 m^3) Contamination >90% of surface (however, inside of vessel has been washed thoroughly with water)
Local exhaust ventilation: No
Is the process fully enclosed?: No
Effective housekeeping practices in place: Yes
Secondary source: No
Conditions and measures related to personal protection, hygiene and health evaluation
Respiratory protection: Yes, full flow respiratory protection, APF 40 by external contractor
Other conditions affecting workers exposure
Place of use: Indoors (confined space)

***Table 55**: Conditions of use: WCS 7b*

9.2.8.3 Exposure and risks for workers

The activities covered by WCS 7a may be performed by production shift team members, Tata Steel maintenance workers and contractors. Personal exposure measurements for these workers are obtained during each annual campaign whilst they perform maintenance duties. The monitoring does not cover all maintenance activities described in WCS 7a, because monitoring campaigns are usually timed to coincide with the 9-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.

Static measurements are also taken annually. The position of the static samples are within the chromic acid area and so are relevant to WCS 7a.

Both personal and static monitoring cover 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.

Personal monitoring measurements relevant to this WCS are reported in the table below. The relevant static monitoring measurements are the same as those presented under WCS 4 and are reported in Table 41 above.

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)
Tata Maintenance Operative	2024	0.00053	535	12	-	7.13E-04
Tata Maintenance Operative	2024	0.00074	521	12	-	1.02E-03
Tata Maintenance Operative	2024	0.00033	527	12	-	4.51E-04
Tata Maintenance Operative	2024	0.00013	517	12	-	1.81E-04
Mechanical 1	2024	0.0005	547	8	5.70E-04	-
Mechanical 2	2024	0.00022	534	8	2.45E-04	-
Electrical 1	2024	0.00016	399	8	1.33E-04	-
Electrical 2	2024	0.000043	323	8	2.89E-05	-
Tata Maintenance Operative	2023	0.00055	566	12	-	7.00E-04
Tata Maintenance Operative	2023	0.00054	565	12	-	6.88E-04
Tata Maintenance Operative	2023	0.000055	561	12	-	7.06E-05
Tata Maintenance Operative	2023	0.00017	555	12	-	2.21E-04
Mechanical 1	2023	0.00012	435	8	1.09E-04	-
Mechanical 2	2023	0.000072	300	8	4.50E-05	-
Electrical 1 (day 1)	2023	0.0011	209	8	4.79E-04	-
Electrical 2 (day 1)	2023	0.00028	208	8	1.21E-04	-
Electrical 1 (day 2)	2023	0.00014	411	8	1.20E-04	-
Electrical 2 (day 2)	2023	0.00033	405	8	2.78E-04	-
Cleaner 1	2023	0.000069	365	8	5.25E-05	-
Cleaner 2	2023	0.000049	365	8	3.73E-05	-
Tata Maintenance Operative	2022	0.000076	522	12	-	1.05E-04
Tata Maintenance Operative	2022	0.000083	520	12	-	1.15E-04
Tata Maintenance Operative	2022	0.00021	525	12	-	2.88E-04
Tata Maintenance Operative	2022	0.00004	531	12	-	5.42E-05
Mechanical 1	2022	0.00027	499	8	2.81E-04	-
Mechanical 2	2022	0.00041	498	8	4.25E-04	-
Electrical	2022	0.000011	476	8	1.09E-05	-
Cleaner 1	2022	0.000034	479	8	3.39E-05	-
Cleaner 2	2022	0.00001	482	8	1.00E-05	-

Table 56*: Measurement data: WCS 7a*

The exposure concentrations and excess risk levels are reported in the tables below. Two tables are presented to 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 three years, i.e. 1.02E-03 mg Cr(VI)/m^3 (12hr TWA) for workers on 12 hour shifts and 5.70E-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)	1.02E-03 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	2.56E-05 mg Cr(VI)/m^3	RPE of APF 40 used.
Frequency of operation (per year) over all operators	30	6 x shifts per year (every 9 weeks), 5 x operators per shift
Number of operators	20	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	0.0103	= 30 / 20 / 145
Inhalation, local Exposure value corrected for PPE and frequency	2.64E-04 µg Cr(VI)/m^3	= 2.56E-05 x 0.0103 x 1,000 (to convert to µg)
Excess risk level, based on RAC opinion, per worker for this task	1.06E-06	= 2.64E-04 x 0.004 (1 µg/m^3 of Cr(VI) equals excess risk of 0.004)

***Table 57**: Exposure concentrations and risks 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)	5.70E-04 mg Cr(VI)/m^3	Highest recorded measurement (8hr TWA).
Inhalation, local Exposure value (8hr TWA) corrected for PPE	1.42E-05 mg Cr(VI)/m^3	RPE of APF 40 used.
Frequency of operation (per year) over all operators	392	Up to 14 days major maintenance, 6 days minor maintenance, 17 inspections of hold down rolls (and their replacement when required) and 12 days of unscheduled maintenance = 49 days. Up to 8 operators will be required per shift for the work.
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).

Route of exposure and type of effects	Results (workers on 8hr shifts)	Notes
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	0.0778	= 392 / 21 / 240
Inhalation, local Exposure value corrected for PPE and frequency	1.11E-03 µg Cr(VI)/m^3	= 1.42E-05 x 0.0778 x 1,000 (to convert to µg)
Excess risk level, based on RAC opinion, per worker for this task	4.43E-06	= 1.11E-03 x 0.004 (1 µg/m^3 of Cr(VI) equals excess risk of 0.004)

***Table 58**: Exposure concentrations and risks for workers on 8 hour shifts: WCS 7a*

For WCS 7b, it has not been possible to obtain personal monitoring of confined space entry as this activity is so infrequently carried out. Instead, the ART estimate for occupational exposure relating to the handling of contaminated objects is used as the basis for calculating the risk. ART modelling results in an estimated exposure value of 3.22E-03 mg Cr(VI)/m^3 (8hr TWA)

Route of exposure and type of effects	Results	Notes
Inhalation, local Exposure value (8h TWA)	3.22E-03 mg Cr(VI)/m^3	Obtained from ART, 90th percentile value.
Inhalation, local Exposure value (8h TWA) corrected for PPE	8.06E-05 mg Cr(VI)/m^3	RPE of APF 40 used.
Frequency of operation (per year) over all operators	0.8	Activity occurs once every 2.5 years and may involve up to 2 operators entering a confined space = 0.4 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	0.00167	= 0.8 / 2 / 240
Inhalation, local Exposure value corrected for PPE and frequency	1.34E-04 µg Cr(VI)/m^3	= 8.06E-05 x 0.00167 x 1,000 (to convert to µg)
Excess risk level, based on RAC opinion, per worker for this task	5.37E-07	= 1.34E-04 x 0.004 (1 µg/m^3 of Cr(VI) equals excess risk of 0.004)

***Table 59**: Exposure concentrations and risks for workers: WCS 7b*

9.2.8.4 Conclusion on risk assessment

The highest measured exposures of 1.02 x 10^{-3} mg Cr(VI)/m^3 12hr TWA (1.02 µg Cr(VI)/m^3) for workers on 12 hour shifts and 5.70 x 10^{-4} mg Cr(VI)/m^3 8hr TWA (0.570 µg Cr(VI)/m^3) for workers on 8 hour shifts provide a worst case basis for risk characterisation for WCS 7a.

The value predicted by the ART model for WCS 7b, i.e. 3.22 x 10^{-3} mg Cr(VI)/m^3 8hr TWA (3.22 µg Cr(VI)/m^3), provides a worst case basis for risk characterisation and is likely to be an overestimation, as the model assumes that over 90% of the interior surface of the vessel is contaminated with chromic acid, despite the contents of the vessel having been washed thoroughly with water prior to confined space entry.

An excess lung cancer mortality risk of 1.06 x 10^{-6} and 4.43 x 10^{-6} for WCS 7a (maintenance activities other than confined space entry) and 5.37 x 10^{-7} for WCS 7b (confined space entry) per worker is estimated based on the above exposure estimates and the RAC dose-response relationship for lung cancer mortality.

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.

Sampling and analysis of Cr(VI) containing wastewater prior to batch reduction (WCS 8a)
Cr(VI)-containing wastewater collected in the ECCS4 sumps 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) electrolyte 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.

Cleaning of the filter press (WCS 8b)
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 36**: Bulk tank farm in the WWTP*

***Figure 37**: Testing station for chromic acid wastewater*

***Figure 38**: 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 chromic acid 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 60**: 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 61**: 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] chromic acid (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 62**: 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 63**: Conditions of use: WCS 8b*

9.2.9.3 Exposure and risks for workers

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.

Type	Year	Filter conc. of Cr(VI) (mg/m³)	Sampling duration (mins)	Shift length (hrs)	12hr TWA (mg/m³) (factored)
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
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
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

Type	Year	Filter conc. of Cr(VI) (mg/m^3)	Sampling duration (mins)	Shift length (hrs)	12hr TWA (mg/m^3) (factored)
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
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	2022	0.00001	497	N/A	N/A
Static: WWTP Tank Farm Control Room	2022	0.00001	488	N/A	N/A

Table 64*: 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 three 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.
Frequency of operation (per year) over all operators	267	= 1 x per day x 1 operator x 267 max operational days = activity occurs up to 267 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	0.4603	= 267 / 4 / 145
Inhalation, local Exposure value corrected for PPE and frequency	3.38E-02 µg Cr(VI)/m^3	= 7.35E-05 x 0.4603 x 1,000 (to convert to µg)
Excess risk level, based on RAC opinion, per worker for this task	1.35E-04	= 3.38E-02 x 0.004 (1 µg/m^3 of Cr(VI) equals excess risk of 0.004)

Table 65*: Exposure concentrations and risks for workers: WCS 8a and 8b*

9.2.9.4 Conclusion on risk assessment

The measured exposure of 7.35 x 10^{-5} mg Cr(VI)/m³ 12hr TWA (0.07 µg Cr(VI)/m^3) provides a worst case basis for risk characterisation given that this accounts for the technicians' measured exposure across a whole shift performing this and other tasks, rather than the shorter period of time that this WCS covers.

An excess lung cancer mortality risk of 1.35 x 10^{-4} for WCS 8a and 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.

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.

The combined exposure 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	No. of workers per shift	Total no. of workers	WCS covered in this role	Combined exposure per worker µg/m^3	Excess risk level per worker *
Team leader / Deputy team leader	2	8	WCS 4, WCS 5	0.520	2.08×10^{-3}
Rest of production shift team **	5	20	WCS1, WCS 2a, WCS 2b, WCS 3, WCS 5, WCS 6, WCS 7a	0.407	1.63×10^{-3}
Maintenance operators (employees and contractors)	8	21	WCS 7a, WCS 7b	1.24×10^{-3}	4.97×10^{-6}
WWTP technicians	2	8	WCS 8a, WCS 8b	0.034	1.35×10^{-4}
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 (15 years). ** Covers chemicals additions operator, forklift truck driver, entry-end operator, exit-end inspector and exit-end operator and also accounts for the maintenance duties they undertake. These roles are grouped together because all members of the production shift team are interchangeable between these various roles.					

***Table 66**: Combined exposure and risk characterisation for workers*

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	15.82 kg/year
Soil	0 kg/year

***Table 67**: Total releases to the environment per year from all life cycle stages*

10.2.2 Regional exposure

10.2.1.1 Environment

The regional predicted environmental concentration (PEC regional) and the related risk characterisation ratios when a PNEC is available are presented below.

Protection target	Regional PEC	Risk characterisation (RCR or Excess risk) *
Freshwater	3.68×10^{-7} mg/L	Not relevant
Sediment (freshwater)	2.59×10^{-5} mg/kg	Not relevant
Marine water	3.62×10^{-8} mg/L	Not relevant
Sediment (marine water)	2.14×10^{-6} mg/kg	Not relevant
Air	2.87×10^{-17} mg/m^3	Not relevant
Agricultural soil	2.94×10^{-6} mg/kg	Not relevant
Notes: * Chromium trioxide is classified as Aquatic Acute and Aquatic Chronic Category 1 (H400 and H410 respectively). These endpoints are not specified in Annex XIV of REACH. Therefore, the direct effects (both on a local and regional scale) and risks to the environment resulting from environmental release are not evaluated in detail in this CSR. The emissions and resulting exposure to the environment that are relevant in the context of risks for "humans via the environment" have been described in detail.		

***Table 68**: Predicted regional environmental concentrations (regional PEC)*

10.2.1.2 Humans via the environment

Although not considered relevant due to the transformation of Cr(VI) to Cr(III) that occurs rapidly under most environmental conditions, the exposure to humans via the environment from regional exposure has been calculated using EUSES. The exposure to humans via the environment from regional exposure and the related risk characterisation ratios are provided (when relevant) in the table below. The exposure concentration for humans via inhalation is equal to the PEC air.

Route	Regional exposure	Risk characterisation (RCR or Excess risk)
Inhalation	2.87×10^{-17} mg/m^3	Excess risk by inhalation to general population = 4.39E-04
Oral	1.88×10^{-7} mg/kg/day	Exces risk by oral is not required for workers as it is assumed that food/drinking water is not locally sourced. Excess risk by oral (through food only) to general population = 1.09E-04

***Table 69**: Regional exposure and risk to humans via the environment*

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 14385:2004 supplemented by the relevant Methods Implementation Document (MID).

The results of the last three years' monitoring campaigns (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.

Emission Point Reference	Parameter	Periodic Monitoring Result	Units
2024			
ECCS4 System 2 2024	flowrate/hr	26,363	Nm^3/hr
	mass/hr	2,399.01	mg/hr
		0.00240	kg/hr
	Volumetric Flowrate	7.323	Nm^3/sec
	[redacted]	[redacted]	[redacted]
	Operating Hours	6413	hrs
	[redacted]	[redacted]	[redacted]
ECCS4 System 4 2024	flowrate/hr	7,663	Nm^3/hr
	mass/hr	68.20	mg/hr
		0.00006820	kg/hr
	Volumetric Flowrate	2.129	Nm^3/sec
	[redacted]	[redacted]	[redacted]
	Operating Hours	6413	hrs
	[redacted]	[redacted]	[redacted]
Totals, 2024	Total Chromium	15.82	kg/yr
	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]
	Release factor	0.0238	%
2023			
ECCS4 System 2 2023	flowrate/hr	25,873	Nm^3/hr
	mass/hr	1,785.25	mg/hr
		0.00178525	kg/hr
	Volumetric Flowrate	7.187	Nm^3/sec
	[redacted]	[redacted]	[redacted]

Emission Point Reference	Parameter	Periodic Monitoring Result	Units
	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]
ECCS4 System 4 2023	flowrate/hr	8,424	Nm^3/hr
	mass/hr	117.93	mg/hr
		0.00011793	kg/hr
	Volumetric Flowrate	2.33996	Nm^3/sec
	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]
Totals, 2023	Total Chromium	11.01	kg/yr
	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]
	Release factor	0.0193	%
2022			
ECCS4 System 2 2022	flowrate/hr	25,992	Nm^3/hr
	mass/hr	2,053.37	mg/hr
		0.00205337	kg/hr
	Volumetric Flowrate	7.22	Nm^3/sec
	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]
ECCS4 System 4 2022	flowrate/hr	7,884	Nm^3/hr
	mass/hr	701.68	mg/hr
		0.00070168	kg/hr
	Volumetric Flowrate	2.19	Nm^3/sec
	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]
Totals, 2022	Total Chromium	15.55	kg/yr
	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]
	Release factor	0.0293	%

***Table 70**: Results of the last three 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 three years' monitoring campaigns (2024, 2023 and 2022 calendar years) are presented in the tables below.

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: Team Leader	WCS4, WCS5	0.00014	528	8.80	12	The majority of the time was spent occupying the exit end control room, with some time spent completing line inspections	1.54E-04	1.91E-04
Personal	Tata Operative: Exit End Inspector	WCS5, WCS6	0.00017	529	8.82	12	Time split between occupying the exit end control room and removing coils off the exit end	1.87E-04	2.31E-04
Personal	Tata Operative: Chemicals Additions Operator	WCS1, WCS2, WCS3	0.00011	529	8.82	12	Responsible for adding chromium trioxide into the circulation tanks and for the sampling of electrolyte. Majority of time spent in a control room, with the rest of the shift completing line chemistry and solution integrity tasks.	1.21E-04	1.50E-04
Personal	Tata Operative: Entry End Operator	WCS5, WCS6	0.000075	525	8.75	12	Time split between occupying the entry end control room and loading coils onto the entry end.	8.20E-05	1.03E-04
Static	Above Plating Section	WCS4	0.00018	512	8.53	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	Above Chemical Additions	WCS3	0.00021	515	8.58	N/A	N/A	N/A (static)	N/A (static)
Static	Rear of Plating Section	WCS4	0.0027	516	8.60	N/A	N/A	N/A (static)	N/A (static)
Static	Plating basement (cellar)	WCS2a	0.00028	514	8.57	N/A	N/A	N/A (static)	N/A (static)
Static	Plating basement (cellar) escape		0.00023	514	8.57	N/A	N/A	N/A (static)	N/A (static)
Static	Exit End Control Room	WCS5	0.000087	546	9.10	N/A	N/A	N/A (static)	N/A (static)
Personal	Tata Maintenance Operative	WCS7	0.00053	535	8.92	12	Unavailable	5.91E-04	7.13E-04
Personal	Tata Maintenance Operative	WCS7	0.00074	521	8.68	12	Unavailable	8.03E-04	1.02E-03
Personal	Tata Maintenance Operative	WCS7	0.00033	527	8.78	12	Unavailable	3.62E-04	4.51E-04
Personal	Tata Maintenance Operative	WCS7	0.00013	517	8.62	12	Unavailable	1.40E-04	1.81E-04
Personal	Mechanical 1	WCS7	0.0005	547	9.12	8	Working on expansion cylinder - changing filters - measuring caps on sync roll seals. 15 min total in chromic acid area whilst working on Sync Rolls - No additional PPE requirements. Break - 1hr in total (2 x 30mins).	5.70E-04	N/A (work 8hr shifts)
Personal	Mechanical 2	WCS7	0.00022	534	8.90	8	As above	2.45E-04	N/A (work 8hr shifts)
Personal	Electrical 1	WCS7	0.00016	399	6.65	8	Rerouting supplies and switch gear all over line with parts near the chromic acid area 30 min in chromic acid area helping lift motor roller in.	1.33E-04	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)
							Rest of time completing tasks on the line. Break - 30 min.		
Personal	Electrical 2	WCS7	0.000043	323	5.38	8	As above	2.89E-05	N/A (work 8hr shifts)
Personal	Cleaner 1	WCS7	Not sampled	N/A	N/A	8	The cleaners were not captured during monitoring due to personnel issues impacting their attendance.	Not sampled	Not sampled
Personal	Cleaner 2	WCS7	Not sampled	N/A	N/A	8	As above	Not sampled	Not sampled
Static	Exit End Control Room	WCS5	0.000087	430	7.17	N/A	N/A	N/A (static)	N/A (static)
Personal	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	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	WCS8a	0.00001	516	8.60	N/A	N/A	N/A (static)	N/A (static)
Static	WWTP Tank Farm Control Room	WCS8a	0.00001	517	8.62	N/A	N/A	N/A (static)	N/A (static)

***Table 71**: 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: Team Leader (first day)	WCS4, WCS5	0.000075	542	9.03	12	Control room occupancy (600mins) Food Break (60mins) Line Inspections (60 mins)	8.47E-05	9.96E-05
Personal	Tata Operative: Exit End Inspector (first day)	WCS5, WCS6	0.000085	539	8.98	12	Control room occupancy (600mins) Food Break (60mins) Removing coils off exit end (60 mins)	9.54E-05	1.14E-04
Personal	Tata Operative: Chemicals Additions Operator (first day)	WCS1, WCS2, WCS3	0.00037	535	8.92	12	Control room occupancy (540mins) Food Break (60mins) Line Chemistry and Solutions Integrity (120 mins)	4.12E-04	4.98E-04
Personal	Tata Operative: Entry End Operator (first day)	WCS5, WCS6	0.000017	533	8.88	12	Control room occupancy (600mins) Food Break (60mins) Loading coils onto entry end (60 mins)	1.89E-05	2.30E-05
Personal	Tata Operative: Team Leader (second day)	WCS4, WCS5	0.00012	566	9.43	12	Same as day 1	1.42E-04	1.53E-04
Personal	Tata Operative: Exit End Inspector (second day)	WCS5, WCS6	0.0001	565	9.42	12	Same as day 1	1.18E-04	1.27E-04
Personal	Tata Operative: Chemicals Additions Operator (second day)	WCS1, WCS2, WCS3	0.00028	561	9.35	12	Same as day 1	3.27E-04	3.59E-04
Personal	Tata Operative: Entry End Operator (second day)	WCS5, WCS6	0.00011	555	9.25	12	Same as day 1	1.27E-04	1.43E-04
Static	Above Plating Section (first day)	WCS4	0.00082	534	8.90	N/A	N/A	N/A (static)	N/A (static)
Static	Above Chemical Additions (first day)	WCS3	0.00124	531	8.85	N/A	N/A	N/A (static)	N/A (static)
Static	Rear of Plating Section (first day)	WCS4	0.00092	512	8.53	N/A	N/A	N/A (static)	N/A (static)

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)
Static	Plating basement (cellar) (first day)	WCS2a	0.00025	508	8.47	N/A	N/A	N/A (static)	N/A (static)
Static	Plating basement (cellar) escape (first day)		0.00031	505	8.42	N/A	N/A	N/A (static)	N/A (static)
Static	Exit End Control Room (first day)	WCS5	0.000054	546	9.10	N/A	N/A	N/A (static)	N/A (static)
Static	Above Plating Section (second day)	WCS4	0.00082	548	9.13	N/A	N/A	N/A (static)	N/A (static)
Static	Above Chemical Additions (second day)	WCS3	0.00092	551	9.18	N/A	N/A	N/A (static)	N/A (static)
Static	Rear of Plating Section (second day)	WCS4	0.00111	543	9.05	N/A	N/A	N/A (static)	N/A (static)
Static	Plating basement (cellar) (second day)	WCS2a	0.00025	540	9.00	N/A	N/A	N/A (static)	N/A (static)
Static	Plating basement (cellar) escape (second day)		0.00031	539	8.98	N/A	N/A	N/A (static)	N/A (static)
Static	Exit End Control Room (second day)	WCS5	0.000054	564	9.40	N/A	N/A	N/A (static)	N/A (static)
Personal	Tata Maintenance Operative	WCS7	0.00055	566	9.43	12	Numerous roll changes throughout maintenance	6.49E-04	7.00E-04
Personal	Tata Maintenance Operative	WCS7	0.00054	565	9.42	12	Numerous roll changes throughout maintenance	6.36E-04	6.88E-04
Personal	Tata Maintenance Operative	WCS7	0.000055	561	9.35	12	Numerous roll changes throughout maintenance plus cleaning out rinse spray bars	6.43E-05	7.06E-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 Maintenance Operative	WCS7	0.00017	555	9.25	12	Numerous roll changes throughout maintenance plus cleaning out rinse spray bars	1.97E-04	2.21E-04
Personal	Mechanical 1	WCS7	0.00012	435	7.25	8	Roll alignment and level checks	1.09E-04	N/A (work 8hr shifts)
Personal	Mechanical 2	WCS7	0.000072	300	5.00	8	Roll alignment and level checks	4.50E-05	N/A (work 8hr shifts)
Personal	Electrical 1 (first day)	WCS7	0.0011	209	3.48	8	Plating brushgear inspections	4.79E-04	N/A (work 8hr shifts)
Personal	Electrical 2 (first day)	WCS7	0.00028	208	3.47	8	Plating brushgear inspections	1.21E-04	N/A (work 8hr shifts)
Personal	Electrical 1 (second day)	WCS7	0.00014	411	6.85	8	Same as day 1	1.20E-04	N/A (work 8hr shifts)
Personal	Electrical 2 (second day)	WCS7	0.00033	405	6.75	8	Same as day 1	2.78E-04	N/A (work 8hr shifts)
Personal	Cleaner 1	WCS7	0.000069	365	6.08	8	Washdown plating section and brushgear general cleaning duties	5.25E-05	N/A (work 8hr shifts)
Personal	Cleaner 2	WCS7	0.000049	365	6.08	8	Washdown plating section and brushgear general cleaning duties	3.73E-05	N/A (work 8hr shifts)
Static	Exit End Control Room	WCS5	0.00001	485	8.08	N/A	N/A	N/A (static)	N/A (static)
Personal	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
Personal	WWTP Operator / Laboratory Technician	WCS8	0.00004	522	8.70	12	Control Room Occupancy (420 mins) Mess room food breaks (60 mins) Laboratory analysis (90 mins) Wastewater sampling (60 mins)	4.35E-05	5.52E-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)
							Batch reduction testing (30 mins) Discharge filter press (60 mins)		
Static	WWTP Control Room Laboratory	WCS8a	0.00001	516	8.60	N/A	N/A	N/A (static)	N/A (static)
Static	WWTP Tank Farm Control Room	WCS8a	0.0004	517	8.62	N/A	N/A	N/A (static)	N/A (static)

***Table 72**: 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: Team Leader (first day)	WCS4, WCS5	0.000083	616	10.27	12	Control Room Occupancy (600 mins) Food Break (60 mins) Line Inspections (60mins)	1.07E-04	9.70E-05
Personal	Tata Operative: Exit End Inspector (first day)	WCS5, WCS6	0.000036	530	8.83	12	Control Room Occupancy (360 mins) Food Break (60 mins) Removing coils off exit end (300mins)	3.98E-05	4.89E-05
Personal	Tata Operative: Chemicals Additions Operator (first day)	WCS1, WCS2, WCS3	0.00021	622	10.37	12	Control Room Occupancy (540 mins) Food Break (60 mins) Line Chemistry and solutions integrity (120mins)	2.72E-04	2.43E-04
Personal	Tata Operative: Entry End Operator (first day)	WCS5, WCS6	0.000041	629	10.48	12	Control Room Occupancy (300 mins) Food Break (60 mins) Loading coils onto entry end (60mins)	5.37E-05	4.69E-05
Personal	Tata Operative: Team Leader (second day)	WCS4, WCS5	0.00026	597	9.95	12	Same as day 1	3.23E-04	3.14E-04
Personal	Tata Operative: Exit End Inspector (second day)	WCS5, WCS6	0.000089	593	9.88	12	Same as day 1	1.10E-04	1.08E-04

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: Chemicals Additions Operator (second day)	WCS1, WCS2, WCS3	0.000046	587	9.78	12	Same as day 1	5.63E-05	5.64E-05
Personal	Tata Operative: Entry End Operator (second day)	WCS5, WCS6	0.000023	582	9.70	12	Same as day 1	2.79E-05	2.85E-05
Static	Above Plating Section (first day)	WCS4	0.000083	602	10.03	N/A	N/A	N/A (static)	N/A (static)
Static	Above Chemical Additions (first day)	WCS3	0.000064	609	10.15	N/A	N/A	N/A (static)	N/A (static)
Static	Rear of Plating Section (first day)	WCS4	0.00025	592	9.87	N/A	N/A	N/A (static)	N/A (static)
Static	Plating basement (cellar) (first day)	WCS2a	0.000081	590	9.83	N/A	N/A	N/A (static)	N/A (static)
Static	Plating basement (cellar) escape (first day)		0.000033	579	9.65	N/A	N/A	N/A (static)	N/A (static)
Static	Exit End Control Room (first day)	WCS5	0.000038	621	10.35	N/A	N/A	N/A (static)	N/A (static)
Static	Above Plating Section (second day)	WCS4	0.00082	548	9.13	N/A	N/A	N/A (static)	N/A (static)
Static	Above Chemical Additions (second day)	WCS3	0.00092	551	9.18	N/A	N/A	N/A (static)	N/A (static)
Static	Rear of Plating Section (second day)	WCS4	0.000073	576	9.60	N/A	N/A	N/A (static)	N/A (static)
Static	Plating basement (cellar) (second day)	WCS2a	0.000019	575	9.58	N/A	N/A	N/A (static)	N/A (static)

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)
Static	Plating basement (cellar) escape (second day)		0.000042	569	9.48	N/A	N/A	N/A (static)	N/A (static)
Static	Exit End Control Room (second day)	WCS5	0.000066	595	9.92	N/A	N/A	N/A (static)	N/A (static)
Personal	Tata Maintenance Operative	WCS7	0.000076	522	8.70	12	Unavailable	8.27E-05	1.05E-04
Personal	Tata Maintenance Operative	WCS7	0.000083	520	8.67	12	Unavailable	8.99E-05	1.15E-04
Personal	Tata Maintenance Operative	WCS7	0.00021	525	8.75	12	Unavailable	2.30E-04	2.88E-04
Personal	Tata Maintenance Operative	WCS7	0.00004	531	8.85	12	Unavailable	4.43E-05	5.42E-05
Personal	Mechanical 1	WCS7	0.00027	499	8.32	8	Unavailable	2.81E-04	N/A (work 8hr shifts)
Personal	Mechanical 2	WCS7	0.00041	498	8.30	8	Unavailable	4.25E-04	N/A (work 8hr shifts)
Personal	Electrical 1 (first day)	WCS7	0.000011	476	7.93	8	Unavailable	1.09E-05	N/A (work 8hr shifts)
Personal	Electrical 2 (first day)	WCS7	Not sampled	N/A	N/A	8	Not sampled	Not sampled	Not sampled
Personal	Electrical 1 (second day)	WCS7	Not sampled	N/A	N/A	8	Not sampled	Not sampled	Not sampled
Personal	Electrical 2 (second day)	WCS7	Not sampled	N/A	N/A	8	Not sampled	Not sampled	Not sampled
Personal	Cleaner 1	WCS7	0.000034	479	7.98	8	Unavailable	3.39E-05	N/A (work 8hr shifts)

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	Cleaner 2	WCS7	0.00001	482	8.03	8	Unavailable	1.00E-05	N/A (work 8hr shifts)
Static	Exit End Control Room	WCS5	0.000014	545	9.08	N/A	N/A	1.59E-05	N/A (static)
Personal	WWTP Maintenance Operator / Technician	WCS8	0.000014	500	8.33	12	Control room occupancy (420 mins) Mess room food breaks (60 mins) Laboratory analysis (90 mins) Wastewater sampling (60 mins) Batch reduction room testing (30 mins) Discharge filter press (60 mins)	1.46E-05	2.02E-05
Personal	WWTP Operator / Laboratory Technician	WCS8	0.000015	507	8.45	12	Control room occupancy (420 mins) Mess room food breaks (60 mins) Laboratory analysis (90 mins) Wastewater sampling (60 mins) Batch reduction room testing (30 mins) Discharge filter press (60 mins)	1.58E-05	2.13E-05
Static	WWTP Control Room Laboratory	WCS8a	0.00001	497	8.28	N/A	N/A	N/A (static)	N/A (static)
Static	WWTP Tank Farm Control Room	WCS8a	0.00001	488	8.13	N/A	N/A	N/A (static)	N/A (static)

***Table 73**: 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 three 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)
2024	1,719,869	19.12	0
2023	1,695,400	21.19	0
2022	1,400,100	23.24	0

Table 74*: Annual mass emissions to water, 2022-2024*

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

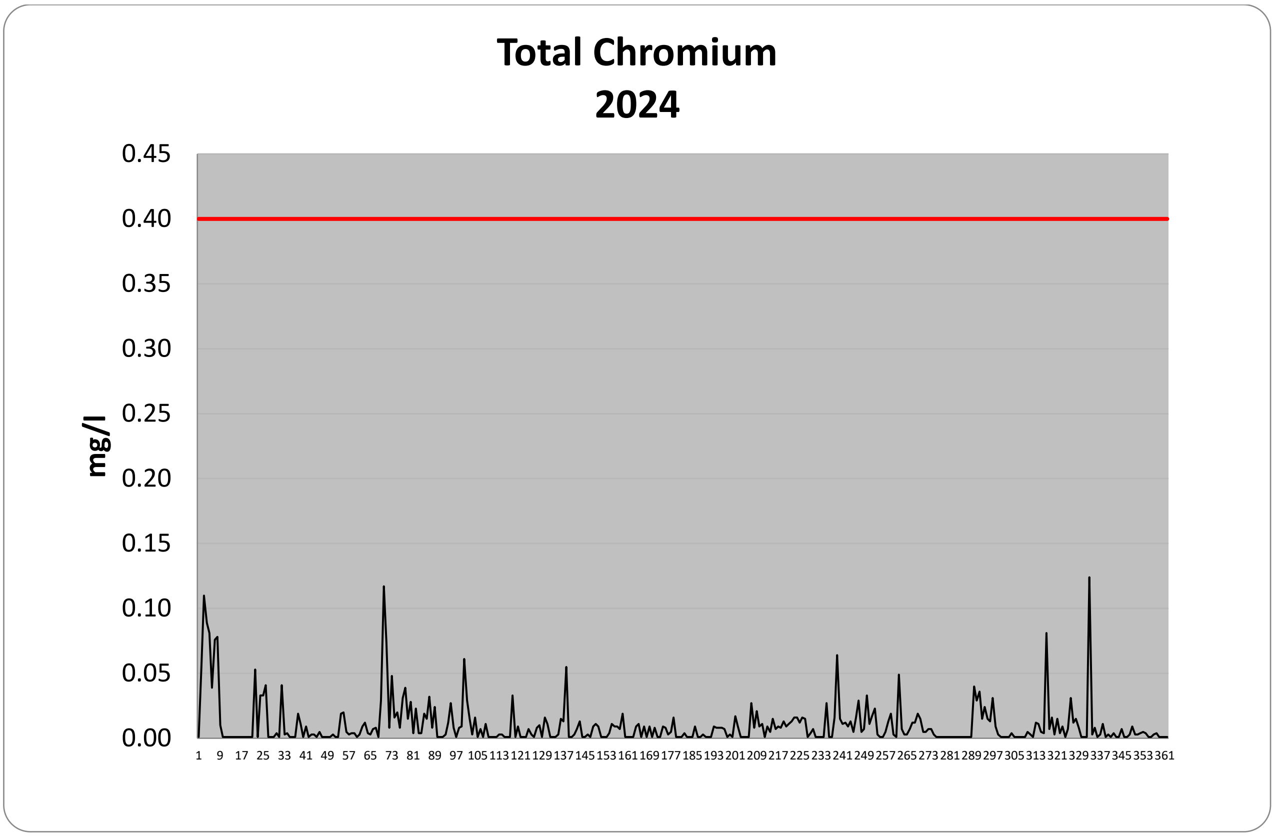

***Figure 39**: Emissions to water, total Cr, 2024*

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