CHEMICAL SAFETY REPORT

PUBLIC VERSION

Legal name of applicant(s):	Linde AMT UK Ltd
Submitted by:	Linde AMT UK Ltd
Date:	November 2023
Substance:	Chromium trioxide, EC 215-607-8 and CAS 1333-82-0
Use title:	Industrial spraying of chromium trioxide mixtures for the coating of metallic articles subject to harsh environment, to ensure a high temperature corrosion & oxidation resistance, as well as anti-fouling properties or lubricity at high temperature, for automotive, aviation, power generation machinery, Oil and Gas and marine applications.
Use number:	Use-1

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9. EXPOSURE SCENARIO

9.1. EXPOSURE ASSESSMENT

This AfA concerns the uses of Chromium trioxide in a mixture for the coating of metallic articles by spraying process. Linde AMT is the applicant for the Use-1 of this AfA related to an initial authorization dossier (Commission Decision C(2017)5880 dated 31st August 2017[1], authorized use "REACH/17/X/0") initially covering 2 different uses taking place at 4 industrial sites present in UK and EU. For the present AfA, only one use at 1 UK site is considered as indicated in the Table below.

Company	Use applied for	Country	Site	Number of workers
Linde AMT	Use-1	United Kingdom	Lincoln	29

Table 1. Overview of Linde AMT's Application for Authorisation

The applicant performed the risk assessment in accordance to the excess risk values for general population and workers proposed by RAC, however, dose-response relationships were derived by linear extrapolation that inevitably introduces uncertainties, as the mechanistic evidence is suggestive of non-linearity. It is acknowledged that the excess risks in the low exposure range (below 1 µg/m^3 or 1 µg/kg bw/day of Cr^{6+}) might be an overestimate.

Furthermore, in Lincoln site, environmental water releases are monitored by local authorities to ensure the low exposure of both general population around production plants.

In the UK, the Health and Safety Commission (HSC) has established a workplace exposure limit (WEL) of 0.05 mg/m^3 (air averaged over an 8-hour period) for chromium (VI) compounds. Also, the Biological monitoring guidance value (BMGV) in the legislation EH40/2005 Workplace Exposure Limits for chromium VI in urine is set at 10 µmol/mol creatinine. In the table below, Environmental release thresholds (air) and OEL for workers are summarized.

[1] REACH/17/X/0: Industrial spraying or brush application of chromium trioxide mixtures for the coating of metallic articles subject to harsh environment, to ensure a high temperature corrosion and oxidation resistance, as well as deposit-resistant properties of the surface or lubricity at high temperature, for automotive, aviation, power generation machinery, oil and gas and marine applications

Information Type	Cr^{6+} limit	Related threshold
Human safety		
The Biological monitoring guidance value (BMGV) in the legislation EH40/2005 Workplace Exposure Limits	10 µmol/mol creatinine	Urine, Workers
The Health and Safety Commission (HSC) has established a workplace exposure limit (WEL)	50 µg/m^3	Cr^{6+}Air, Workers
Environmental safety		
Plant licence - Air	15 mg/m^3	Cr Total

Table 2. Overview of the applicable Cr^{6+} exposure limits for UK site

As the substance exhibits carcinogenic non-threshold effects, demonstrating the adequate control is not possible and the Socio-Economical Analysis (SEA) route is applicable. In that respect, the present excess risk calculations highlighted in this document are taken into consideration in the socio-economical assessment performed by the applicant in order to demonstrate the risks and the benefits to use the substance in the applicant context.

9.1.1. Overview of uses and Exposure Scenarios

Use-1 related Activities are performed on dedicated workshops on UK site. Manual spraying operation is performed on Lincoln site.

	Titles of identified uses	Title of Exposure Scenario
Use 1	Industrial spraying of chromium trioxide mixtures for the coating of metallic articles subject to harsh environment, to ensure a high temperature corrosion & oxidation resistance as well as anti-fouling properties or lubricity at high temperature for automotive, aviation, power generation machinery, Oil and Gas and marine applications.	ES-1: Industrial spraying of chromium trioxide mixtures for the coating of metallic articles

Table 3. Use of the Application for Authorisation dossier and Exposure Scenarios

9.1.1.1. Process Explanation

This CSR will discuss about the use of chromium trioxide and acids generated from chromium trioxide, for the spraying application, on metallic articles to protect them against corrosion at high temperature.

Chromium trioxide is used in an aqueous solution with phosphoric acid to form a chromate-phosphate compound. The chromate-phosphate product serves as the binder component of the coating. The binder provides adhesion to the substrate, as well as cohesion of the metallic particle component.

Parts coated with the hexavalent chromium-containing slurries serve in many different industries which require corrosion resistance and high temperature resistance. Metallic components in turbomachinery, aerospace parts, automotive parts, and oil & gas industry parts all make use of these slurry derived coatings. The metals are often composed of steel, but may also be composed of other metals such as magnesium and aluminium.

9.1.1.2. Tonnage information / Number of workers exposed:

The hexavalent chromium compounds were included in Annex XIV due to their carcinogenic properties. As mentioned in section 5, this Chemical Safety Report focuses on the use of hexavalent chromium for their carcinogenic effects (Table 10). Thus,

exposures and excess risk characterisation will be analysed considering carcinogenic and mutagenic effects.

Substance name	EC Number	CAS Number	Intrinsic properties specified in annex XIV/recommendation	Tonnage band registered (t/y)
Chromium Trioxide	215-607-8	1333-82-0	Carcinogenic cat 1A Mutagenic cat 1B	1,000 -10,000
Acids generated from chromium trioxide and their oligomers	231-801-5 or 236-881-5	7738-94-5 or 13530-68-2	Carcinogenic cat 1B	

Table 4. Substances considered in the CSR

Moreover, exposures and excess risk of cancer will be developed considering hexavalent chromium without making any difference between the uses of chromium trioxide and acids generated from chromium trioxide. Indeed, the SDS of the different mixtures used mention only chromium trioxide.

As already mentioned in the section 2, a maximum yearly consumption of CrO_3 of [redacted] #1 [0.100-0.400] tons per year ([redacted] #1 [0.052-0.208] tons per year of Cr^{6+}) for the Use-1 is expected during the review period.

Currently, 29 workers are considered in the risk assessment. Workers are working 8 hours per day during spraying operations and a maximum of 240 days per year.

Exposure scenario	Total tonnage of CrO_3 (tons/year)	Total Number of workers exposed
ES-1	**[redacted] #1 [0.100-0.400] CrO_3/year** ([redacted] #1 [0.052-0.208] tons Cr^{6+}/year)	29

Table 5. Tonnage used and people exposed for Use-1

In the exposure scenario (ES-1) presented in the document, a total of 29 workers are currently involved in the production process:

Worker Type	Number of workers (total)	Activities	Other tasks done by the same workers

Chrome sprayers	6	Preparation of the coating and manual spraying	Drying of coating, parts transportation and cleaning of the spray rooms
Cell leaders	1	Spend 50% of their time in an office and 50% on the shop floor dealing with production issues	None
Operators	12	Curing and burnish of coating, removal of coating	Parts transportation
Inspectors	2	Inspection of the finished parts	None
Maintenance workers	5	Maintenance tasks	Cleaning of the spray rooms
External maintenance workers	3	Maintenance tasks	Cleaning of the spray rooms

Table 6. Repartition of activities between workers

9.1.1.3. Overview of exposure scenarios

The following table lists the exposure scenarios (ES) assessed in this CSR with its environmental contributing scenario (ECS-1) and its different worker contributing scenario (WCS-1 to WCS-9) assessed in this CSR.

Identifiers*)	Market Sector	Titles of exposure scenarios and the related contributing scenarios	Tonnage of Chromium trioxide (tonnes per year)	Comments
ES-1		ES-1- Industrial spraying of chromium trioxide mixtures for the coating of metallic articles	[redacted] #1 [0.100-0.400]	This is the quantity used by Linde AMT for Use-1 in Lincoln site
ECS-1		- Industrial spraying of chromium trioxide mixtures for the coating of metallic articles **(ERC 5)**		Wastes resulting from the process are collected by a

Identifiers*)	Market Sector	Titles of exposure scenarios and the related contributing scenarios	Tonnage of Chromium trioxide (tonnes per year)	Comments
WCS-1 WCS-2 WCS-3 WCS-4 WCS-5 WCS-6 WCS-7 WCS-8	PC14 SU 17	- Preparation of the coating (mixing and screening compound) **(PROC 8b)** - Manual spraying **(PROC 7)** - Parts transportation **(PROC 26)** - Drying of coating **(PROC 21)** - Curing of coating **(PROC 22)** - Removal of coating **(PROC 13)** - Cleaning of the spraying room **(PROC 21)** - Maintenance **(PROC 28)**		specialised waste management company. Air effluents are collected and filtered before being released outside. Liquid wastes are produced & collected without release, and solid wastes are stocked in a dedicated area and managed by a specialised waste company
ES-2	PC 14	ES-2- Professional use		
ECS: Environmental Contributing Scenario, ES: Exposure Scenario, ERC: Environmental Release Category, PC: chemical Product Category, PROC: PROcess Category, SU: Sector of Use, WCS: Workers Contributing Scenario, PW: Professional end use				

Table 7. Overview of exposure scenarios and contributing scenarios

9.1.2. Introduction to the assessment

9.1.2.1. Environment

The environmental assessment is not relevant for this CSR dedicated to the Application for Authorisation regarding the SVHC properties of the Chromium trioxide specified in Annex XIV of the REACH regulation. Direct environmental impacts will not be assessed but the measured on-site emissions of the substance and the resulting environmental exposure will be described in order to perform the man via environment assessment.

9.1.2.2. Man via environment

Direct (air) and indirect (water/food) human exposures (general population) to Cr^{6+} via environmental sources will be considered in the applicant context. Direct exposure to the non-respirable fraction via oral route is not considered, as:

- exposure estimates do not allow the difference between the respirable and the non-respirable fractions of the substance,

- the main health impacts are expected to be dominated by lung cancer due to inhalation (Excess lifetime mortality risk (ELR) for lung cancer > ELR intestinal cancer).

Consequently, it will be assumed as a conservative approach that all particles are in the respirable size range which is in accordance with RAC statement of the dose-response relationship of Cr^{6+} compounds (RAC/27/2013/06 Rev.1).

Environmental exposure for the man via environment assessment will be modelled under EUSES v2.2 thanks to the maximum tonnage of the substance used in the applicant context and air/water releases measured on-site, or extrapolated thanks to the corresponding environmental release category defined for the applicant activities (ERC5). Further description of model parameters will be presented in the ECS-1 section.

As ELR for lung cancer are different between the workers and inhabitants, the two populations will be taken into consideration for the risk characterisation at the local scale. In Table 8, the ELR values used in the context of the man via environment assessment are summarized. The excess risk calculations will be based on ELR derived by the RAC and presented in the document RAC/27/2013/06 Rev.1 that establishes a reference dose-responses relationship for carcinogenicity of hexavalent chromium (lung & intestine).

Exposure route	ELR mortality (RAC)	Cancer type
Direct, Inhalation (respirable fraction, Local Long-term effects)	**General population** (for inhabitants, 70 years of exposure; 24h/day) **= 2.9*10^{-2}** for an exposure to 1 µg/m^3 of Cr^{6+}	Lung
Indirect, Oral (non-respirable fraction, Local Long-term effects)	**General population** (for inhabitants, 70 years of exposure; 24h/day) **= 8*10^{-4}** for an exposure to 1 µg/kg/day of Cr^{6+}	Intestine

Table 8. Summary of ELR used for the man via environment assessment

9.1.2.3. Workers

The excess risk calculation will be based on RAC/27/2013/06 Rev.1 which establishes a reference dose response relationship for carcinogenicity of hexavalent chromium.

Regarding the advice of the RAC, no data clearly indicate that dermal exposure to Cr^{6+} compounds and CrO_3 create a risk of cancer to humans. As a consequence, the risk induced *via* dermal exposure will not be assessed in the document. However, it has to be noted that relevant dermal protections are implemented on site. PPE destined to dermal protection will be described in each relevant WCS.

The oral route exposure for worker is not relevant as it is assumed that all particles are in respirable size range, and that no other sources of oral exposure seems possible. In this

way, only the inhalation route restricted to airborne Cr^{6+} will be considered in the worker risk assessment.

In United-Kingdom, the regulatory constraining level is fixed at 50 µg/m^3 by the Health and Safety Commission (HSC). For each WCS, ART 1.5 software has been used to estimate exposure values and **long terme values at 90th percentile** have been kept for the risk assessment when no occupational monitoring data were available. The ART modelling reports are given in Annex. Nevertheless, to calculate the excess risk of cancer (Chapter 10), a combination of ART estimates and monitoring values has been used to perform a realistic worst-case analysis.

In **Table 9**, the ELR values used in the context of the man via environment assessment are summarized. The excess risk calculations will be based on ELR derived by the RAC and presented in the document RAC/27/2013/06 Rev.1 that establishes a reference dose-response relationship for carcinogenicity of hexavalent chromium (lung).

Exposure route	ELR mortality (RAC)	Cancer type
Direct, Inhalation (respirable fraction, Local Long-term effects)	**Workers** (for worker, 40 years of exposure; 8h/day; 5days/week) **= 4*10^{-3}** for an exposure to 1 µg/m^3 of Cr^{6+}	Lung

Table 9. Summary of ELR used for the worker assessment

Efficiency of respiratory protective equipment

The following table presents the protective factors assigned to the breathing equipment used in this CSR according to the manufacturer's documentation on the RPE and the Annex C of the standard NF EN 529 for UK.

Respiratory protection used	Assigned protection factor (APF) according to the manufacturer and the Annex C of the standard NF EN 529
Respirator with full face shield (EN 14594 3B)	**40**
Sperian Turbovisor power assisted respirator (EN 12942)	**20**
Battery face Respirator with full face shield and filter (EN 12942)	**20**

Table 10. Assigned protection factor values for respiratory protective equipment

Workers are made aware of the correct way to use and wear the masks, thanks to training sessions as well as instruction sheets displayed at the workplace.

9.1.2.4. **Consumers**

This assessment is not relevant since no consumer will use the article produced. Linde AMT will advise its downstream supply chain (professional users) on the concentration of hexavalent chromium in the article coated.

9.2. EXPOSURE SCENARIO 1: INDUSTRIAL SPRAYING OF CHROMIUM TRIOXIDE MIXTURES FOR THE COATING OF METALLIC ARTICLES

Sector of use:

General manufacturing, e.g. machinery, equipment, vehicles, other transport equipment **(SU 17)**

Chemical Products Categories:

Metal surface treatment products **(PC14)**

Environment contributing scenario(s):

Industrial use resulting in inclusion into or onto a matrix **(ERC 5)**

Worker contributing scenario(s):

- Preparation of the coating (mixing and screening compound) **(PROC 8b)**
- Manual spraying **(PROC 7)**
- Parts transportation **(PROC 26)**
- Drying of coating **(PROC 21)**
- Curing of coating **(PROC 22)**
- Removal of coating **(PROC 13)**
- Cleaning of the spraying room **(PROC 21)**
- Maintenance **(PROC 28)**

This ES assessment is based on monitoring data and exposure modelling performed thanks to EUSES v2.2 (man *via* environment exposure) and ART 1.5 online software (workers). In each contributing scenario, specific operational conditions and risk management measures are described. For air emissions and water release, monitoring measurement campaign is planned one time per year.

The site is divided into different mains areas. For each area there are different operators as well as specialised operators for more specific operations. The area related to the chrome section is highlighted in grey in the plan above.

Figure 1. Overview of Lincoln site #2

The following contributing scenarios are considered for Lincoln site: preparation, manual spraying, part transportation, drying, curing, removal,cleaning and maintenance.

Contributing scenario	PROC / ERC	Additional information
ECS 1	ERC 5	Industrial spraying of chromium trioxide mixtures for the coating of metallic articles
WCS 1 **Preparation of the coating (mixing and screening compound)**	PROC 8b	Mixtures already formulated are re-mixed prior to spraying using a paint shaker to ensure that Aluminium pigment particles are well dispersed in the slurry. After re-mixing, the mixtures must be screened to remove oversized pigment agglomerates and any foreign contaminants. The container is then transferred to the spray booth for use.
WCS-2 **Manual spraying**	PROC 7	In the spray booth, it should be emphasized that an air-supplied respirator (not a simple face shield) is employed during spraying. The mixture is transferred to the spray gun recipient (directly locked on the spray gun). Then, the spraying of metallic articles is realised in a dedicated place of the spray booth with fixed capturing hood.

WCS-3 Parts transportation	PROC 26	After the spraying, the parts are transferred to a heat chamber and then to a furnace for the curing step.
WCS-4 Drying of coating	PROC 21	Articles coated are transferred to heat chamber to be dried typically at temperature such as 80°C during 15 minutes.
WCS-5 Curing of coating	PROC 22	Immediately after the drying, articles must be transferred to furnace for the curing step. This step is realised at different temperature between 165 to 350°C, depending of curing time (curve linked between time and temperature of curing) and the metal base properties. After the cooling of articles, articles are burnished to achieve the conductivity properties of the parts.
WCS-6 Removal of coating	PROC 13	If necessary (e.g. defect on the coating…), the coating is removed by immersion using a stripping process with alkali solution in bath at 80°C. Then, the process restarts normally.
WCS-7 Cleaning of the spraying room	PROC 21	The worker cleans the spraying room by removing solid (paperboard) protection and cleans the spray gun and its recipient with water. At the end of the process, all these wastes are managed by a specialised waste company which collects them (paper, PPE, waste water…).
WCS-8 Maintenance	PROC 28	Maintenance filter change, cleaning

Table 11. Description of the activities and technical processes covered in the exposure scenario

9.2.1. Environmental contributing scenario 1: Industrial use resulting in inclusion into or onto a matrix

The activities performed on the site under the use-1 are related to the default release factors ERC5. However, measurement data obtained on-site will be used in order to calculate realistic release fractions (in air and in water) that will be used further to assess the potential contamination of the general population via the environment.

Soil contamination is considered non-relevant by the applicant. Indeed, no direct release in soil is expected during the process, as equipment and activities are performed on retention areas.

Concerning water releases, process effluents are treated on-site thanks to an internal wastewater treatment plant (WWTP). Then, treated water is released to the sewers. Measurements of Cr(VI) concentrations in the treated releases are controlled on a

monthly basis by a certified company. Moreover, the Water Authority in UK, visit and take random samples from the release point on site.

Concerning air releases, each spray booth where the substance is used is equipped with LEV where the exhaust air is then filtered before being released to the atmosphere. Measurements of atmospheric emissions are performed every year after the filtration system of each relevant chimney.

9.2.1.1. Risk management measures on-site

The risk management measures on-site have been added from the initial submission in order to complete all environmental compartments. This section briefly describes and illustrates the RMM implemented on-site to limit the release of the substance in the environment.

- Soil compartment:

They are no discharges in soil during the process. All contamitaned liquid and wastes are collected and treated by Linde AMT or by a specialised company. In case of accidental spillage, contaminated liquids can be transferred in retention (for subsequent pumping in the specific container destined to contaminated liquids) or absorbed on specific equipment (granular material, absorbent socks, mat pads, rolls & pillows) which is then disposed of as solid "hazardous waste" by a certified company.

- Water compartment:

A wastewater treatment plant is present on site. CrVI-containing wastewater is collected through dedicated channels and sent to the internal wastewater treatment plant, where a reduction of Cr6+ to Cr3+ is performed thanks to chemical agents. At the end of the process (see Figure below related to Sample Point T14), treated effluent is sent to the sewers towards a municipal waste water treatment plant. The produced sludge passes in a filter press before being collected in dedicated containers, regularly disposed of by a licenced contractor. Moreover, a diverter system has been added to discharge in drain only when there is someone on site.

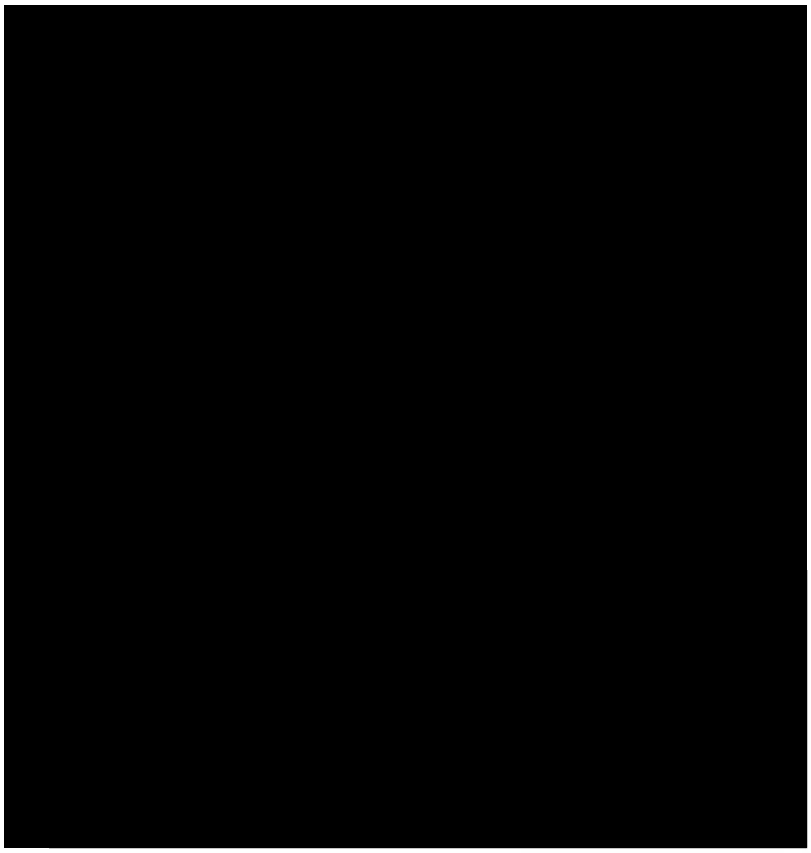

Figure 2: [redacted]#2

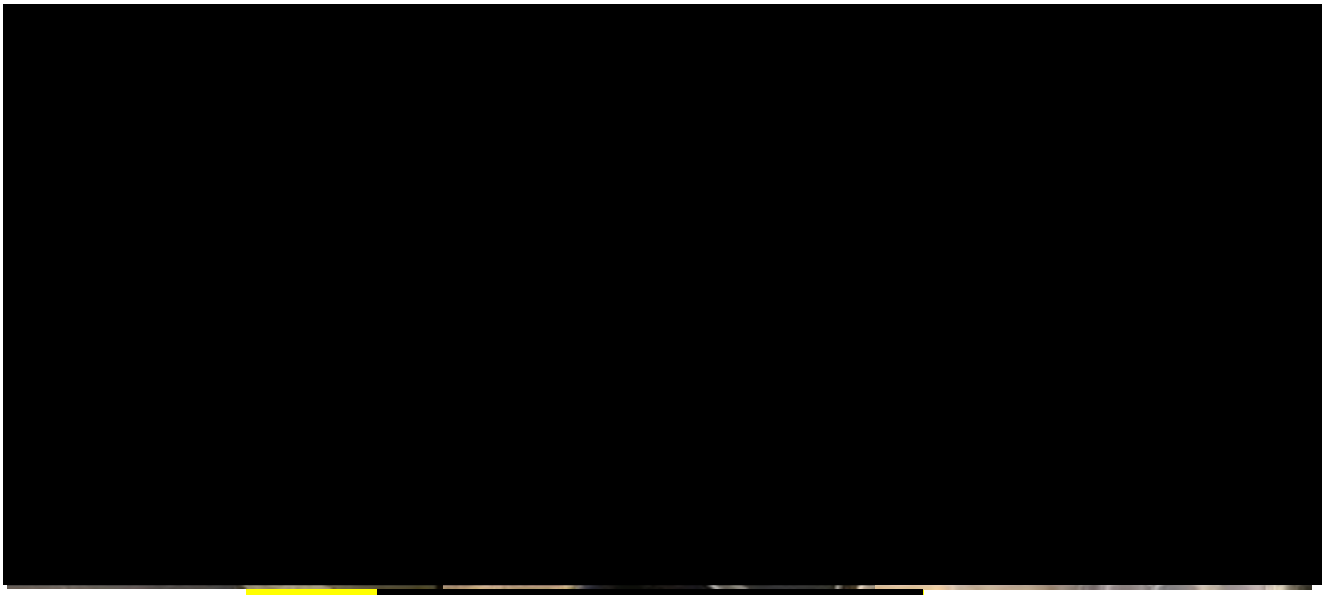

Figure 3. #2

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The wastewater treatment is monitored daily, weekly and monthly by a Maintenance team present on site and a service contractor visit the site every month. In the CSR, we have conservatively considered that the WWTP works 365 days per year.

- Air compartment:

Spray booths have filter systems to avoid Chrome contamination of the atmosphere. The filters are change as per preventative maintenance (TPM) requirements. Each spray booth is equipped with is own filtration system. Stack monitoring is realised onsite every year.

Figure 4. #2

On site, there are a total of 8 atmospheric release points (chimneys) linked to the use of Cr^{6+} from a total of 28 atmospheric chimneys.

Release Point	Walk in Burnisher - Hardware Dept	Spray Booth 1 - Hardware Dept	Spray Booth 3 - Hardware Dept	Spray Booth 2 - Hardware Dept	Spray Booth 1 - Blades Dept	Spray Booth 2 - Blades Dept	Spray Booth 3 - Diffusion Dept	Spray Booth 4 - Diffusion Dept
Number attached	1	2	4	5	7	8	9	10

Table 12. Atmospheric release points linked to Cr^{6+}

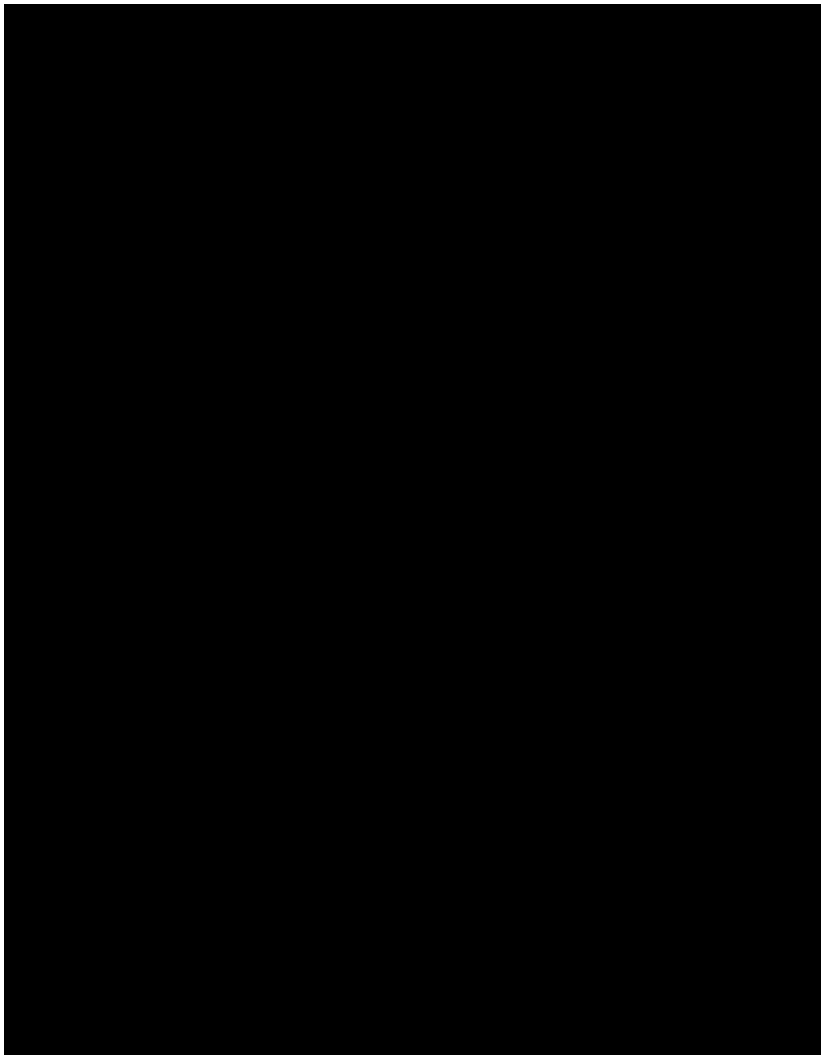

Figure 5. [redacted]#2

The air extraction system is turned on when required, usually at the start of the shift and turned off at the end of the shift or when the work is completed. We have considered a maxiumum air discharge of 8 hours per day and 250 days per year (mean of working days), for workers, we considered 240 working days taking into account days off.

- Storage of Substances and Waste storage and disposal:

Sludges from the WWTP (called “chrome cake”) are stored on-site in dedicated containers before being disposed of by a specialised waste company. Sludges from the WWTPSolid wastes from the process are collected in a Yellow HAZ bin. Each chrome area has one dedicated Yellow HAZ bin. The full bags are placed in an external press which compacts them and surrounds them with an extra strong bag to create a double bag system. The

extra strong bag is placed in outside HAZ bin, ready for collection by an external waste disposal contractor.

Figure 6. Storage areas

(Left: Press; Right: Yellow HAZ bin)

9.2.1.2. Conditions of use

Parameter	Information
Amount used, frequency and duration of use (or from service life)	
Lincoln	
Annual use (highest value)	≈[redacted] #1 [0.052-0.208] tons/year as Cr^{6+}
Max. Number of emission days	365 days/year
Daily use	[redacted] #1 [1E-04-1E-03] tons/day as Cr^{6+} *(based on the number of emissions per day)*
Percentage of EU tonnage used at regional scale:	100 %
Conditions and measures related to sewage treatment plant	
On-site STP: *Evapoconcentrator and IER, no release in the collective network*	
Discharge rate of on-site STP: *348 m^3/year in 2021 and 499 m^3/year in 2022*	
Municipal STP: *Yes*	
Discharge rate of Municipal STP: *2000 m^3/day (default)*	

Application of the STP sludge on agricultural soil: *Yes (default)*

Table 13. Environmental contributing scenario 1 conditions of use

9.2.1.3. Releases

Waste water

In 2021, the discharge rate of effluent was 348 m^3/year and in 2022 it was 499 m^3/year.

YEAR	MONTH	Discharge rate of effluent (L/h)	Cr^{6+} concentration (mg/L)	Daily Flux of Cr^{6+} (kg/day)
2022	March	39.7	Unconclusive	No value can be calculated
	February		Positive	
	January		Positive	
2021	Jan to Dec (without June)	57.0	0.02	1.91E-5 (same result for 11 measured values)
2020	December	No data given	0.76	No value can be calculated
	November		0.02	
	October		0.69	
	September		0.21	
	July		0.02	
	June		0.003	
	May		0.02	
	April		0.096	
	February		0.097	
	January		0.01	
2019	December		0.003	
	November		0.011	
	October		0.009	
	September		0.026	
	August		0.003	

Table 14. Summary of water release data obtained on Lincoln site

The maximal yearly flux of Cr^{6+} (kg/year) for the site is calculated based on the data for 2021. Data for other years are incomplete to derive a release factor, so, only 2021 data will be used to calculate the release factor that will be used for the review period.

Year	Site Emission Cr6+ (Kg/year;)	Tonnage Cr^{6+} (Kg/year)	Total Release factor (%)
MAX	**6.96E-03**	[redacted] **#1 [52-208]**	[redacted] **#1 [10^{-5} – 10^{-1}]**
2022	No data	[redacted] #1 [52-208]	No value can be calculated
2021	6.96E-03	[redacted] #1 [52-208]	[redacted] #1 [10^{-5} – 10^{-1}]
2020	No value can be calculated		
2019	No value can be calculated		

Table 15. Estimated release fraction for the water compartment for Lincoln site

A max. release factor of [redacted] #1 [10^{-5} – 10^{-1}] of the substance per year in the water compartment (Table above) is considered for the Use-1 will be used in the EUSES model for the man *via* environment assessment.

Atmospheric emission

Spray booth are equipped with filter system to avoid chrome release in atmosphere. Regarding the behaviour of the substance in the environment, the main potential exposure pathway to the substance for the general population is *via* the atmospheric compartment (Main Exposure route: inhalation), particularly at a local scale. Thus, Cr^{6+} releases measured on-site are presented and used to calculate a release fraction of the substance in the atmospheric compartment.

Specific monitoring campaign (sampling & analyses) are performed on-site in once a year according to the authorities' requirements. Certified companies performed the operations using standard operating protocol (ICP/AES). Measured values are expressed as Cr^{6+} concentrations (µg/m^3). Cr^{6+} release measurements obtained are summarized in the tables below.

YEAR	Extraction tower	Extraction flow (m^3/h)	Cr^{6+}concentration (mg/m^3)	Daily Flux of Cr^{6+} (kg/day ; 8 hours) per extraction tower	Total Daily Flux of Cr^{6+} (kg/day)
2022	**Spray Booth 4 – Diffusion Dept**	1966.7	0.0131	2.06E-04	3.38E-03
	Spray Booth 3 – Diffusion Dept	2246.1	0.0219	3.94E-04	
	Spray Booth 2 – Blades Dept	2018.1	0.127	2.05E-03	
	Spray Booth 1 – Blades Dept	2612.2	0.0067	1.40E-04	

	Spray Booth 2 – Hardware Dept	5834	0.0054	2.52E-04	
	Spray Booth 3 – Hardware Dept	6496.7	0.0062	3.22E-04	
	Spray Booth 1 – Hardware Dept	3243	0.0005	1.30E-05	
	Walk in Burnisher – Hardaware Dept	3909.3	0.0002	6.25E-06	
2021	**Spray Booth 4 – Diffusion Dept**	1959.2	0.0461	7.23E-04	4.42E-03
	Spray Booth 3 – Diffusion Dept	2248.7	0.0184	3.31E-04	
	Spray Booth 2 – Blades Dept	1934.8	0.017	2.63E-04	
	Spray Booth 1 – Blades Dept	2257.5	0.0356	6.43E-04	
	Spray Booth 2 – Hardware Dept	4776.8	0.0385	1.47E-03	
	Spray Booth 3 – Hardware Dept	5681.1	0.0205	9.32E-04	
	Spray Booth 1 – Hardware Dept	2764.3	0.0023	5.09E-05	
	Walk in Burnisher – Hardaware Dept	4485.3	0.0001	3.59E-06	
2020	**Spray Booth 4 – Diffusion Dept**	2347.7	0.0628	1.18E-03	6.54E-03
	Spray Booth 3 – Diffusion Dept	2323.2	0.0723	1.34E-03	
	Spray Booth 2 – Blades Dept	2184.7	0.0115	2.01E-04	
	Spray Booth 1 – Blades Dept	2699.3	0.0175	3.78E-04	
	Spray Booth 2 – Hardware Dept	4533.1	0.0635	2.30E-03	
	Spray Booth 3 – Hardware Dept	7232.9	0.0192	1.11E-03	
	Spray Booth 1 – Hardware Dept	2654.6	0.0006	1.27E-05	
	Walk in Burnisher – Hardaware Dept	4092.3	0.0002	6.55E-06	
2019	**Spray Booth 4 – Diffusion Dept**	1792.5	0.0622	8.92E-04	4.89E-03
	Spray Booth 3 – Diffusion Dept	1937.8	0.0443	6.87E-04	
	Spray Booth 2 – Blades Dept	2125.8	0.0205	3.49E-04	
	Spray Booth 1 – Blades Dept	2569	0.0174	3.58E-04	
	Spray Booth 2 – Hardware Dept	6006.8	0.0154	7.40E-04	

	Spray Booth 3 – Hardware Dept	6723.3	0.0344	1.85E-03	
	Spray Booth 1 – Hardware Dept	2895.6	0.0004	9.27E-06	
	Walk in Burnisher – Hardaware Dept	3396.2	0.0002	5.43E-06	

Table 16. Summary of atmospheric release data obtained on Lincoln site

The maximal yearly flux of Cr^{6+}(Kg/year) for the site is calculated based on the sum of the maximal daily flow rate of Cr^{6+} over 8-h (kg/day) measured on each extraction tower, the work schedule of the applicant's activities (250 emission days per year) and is further used for the calculation of the release fraction in air. Compared to the quantity of Cr^{6+} used on site (conversion based on CrO_3 tonnages as presented in section 2 and conversion factor of 0.52), the applicant has estimated the following release factors of Cr(VI) to air (Table below).

Year	Site Emission Cr6+ (Kg/year; 8-h;250-d)	Tonnage Cr^{6+} (Kg/year)	Release factor (%)
2022	0.85	[redacted]#1 [52-208]	[redacted] **#1 [10^{-5} – 10^{-1}]**
2021	1.10	[redacted]#1 [52-208]	[redacted] **#1 [10^{-5} – 10^{-1}]**
2020	1.63	[redacted]#1 [52-208]	[redacted] **#1 [10^{-5} – 10^{-1}]**
2019	1.22	[redacted]#1 [52-208]	[redacted] **#1 [10^{-5} – 10^{-1}]**

Table 17. Estimated release fraction for the atmospheric compartment for Lincoln site

A mean value is calculated on the four last years and gives a release factor of [redacted] #1 [10^{-5} – 10^{-1}].

This release factor of [redacted] #1 [10^{-5} – 10^{-1}] of CrVI to the atmospheric compartment is considered for the Use-1 and will be used in the EUSES model for the man *via* environment exposure and risk assessment.

9.2.1.4. Exposure and risks for the environment and man via the environment

Air and water releases of the substance measured on-site have been considered in the environmental exposure of man *via* the environment. Two exposure routes (inhalation and oral) are taken into consideration in the general population exposure. Air and water release factor calculated previously have been used in EUSES in order to calculate, for both local and regional scales, the predicted environmental concentration in the atmospheric compartment (PEC_{air}) and the total human daily intake (fish & water only).

Conservative parameters have been chosen in order to present a worst-case assessment. Estimated release fractions have been used. The parameters listed below were chosen and inputted in EUSES v2.2 in order to represent the most relevant worst-case scenario for ECS-1.

Criteria	Value
Molecular weight (g/mol)	52 (Cr)
Melting point (°C)	500 (maximum default value)
Boiling point (°C)	500 (maximum default value)
Vapour pressure (25°C) (Pa)	1E-06 (minimum default value)
Water solubility (22°C) (mg/L)	1E+05 (maximum default value)
Log Kow (20.5°C)	-1 (minimum default value)
Chemical class	Non-hydrophobic (default)
Solid-water partition coefficient in soil	50 (according to annex XV, Cr^{6+}, alkaline conditions)
Solid-water partition coefficient in sediment	1000 (according to annex XV, Cr^{6+}, alkaline conditions)
Solid-water partition coefficient suspended matter	2000 (according to annex XV, Cr^{6+}, alkaline conditions)
Bioconcentration factor for fish	1 (according to annex XV, Cr^{6+})
Biodegradability	Not readily biodegradable
STP local freshwater assessment	Yes (Default)
Production volume of Chemical in UE (Tons/year)	[redacted] #1 [0.052-0.208] (as Cr^{6+})
Regional fraction (%)	100
Fraction of tonnage released to air	[redacted] #1 [10^{-5} – 10^{-1}]
Fraction of tonnage released to water	[redacted] #1 [10^{-5} – 10^{-1}]
Fraction of tonnage released to soil	0
Fraction of the main local source	1
Number of emission days per year	365

Table 18. EUSES input for Exposure calculation

In the tables below are presented the exposure concentration of the substance in air and in the food daily intake (drink and fish) at local and regional scales and the consequent total excess risks.

	Local	Regional
PECair (µg/m³)	**2.12E-03**	**1.04E-14**
Excess lifetime lung cancer risk, per µg/m³ of Cr(VI) based on 70 years, 365 days per year, 24h per day (RAC 2013)	2.90E-04	
Individual Excess risk of lung cancer_70 years	**6.15E-05**	**3.02E-16**
Number of people considered	103000[2]	2E+07
Expected number of statistical cases of lung cancer in the population_70 years	**6.33**	**6.03E-09**

Table 19. PECair and Total excess risk of lung cancer mortality – General population

	Local	Regional
Total daily intake (µg/kg/d)	**2.52E-04**	**5.74E-06**
Excess lifetime intestinal cancer risk, per µg/kg/day of Cr(VI) based on **70 years, 365 days per year**, 24h per day (RAC 2013)	8.00E-04	
Individual Excess risk of intestinal cancer _70 years	**2.02E-07**	**4.59E-09**
Number of people considered	103000	2E+07
Expected number of statistical cases of intestinal cancer in the population_70 years	**2.08E-02**	**9.18E-12**

Table 20. Total daily intake and Total excess risk of intestinal cancer mortality – General population

[2] City of Lincoln council reports 100,049 inhabitants in the city in 2020 and has estimated 104,200 inhabitants in 2039. In order to consider a realistic value for the 2-year review period, a number of 103,000 inhabitants is taken into account in the CSR for the local population. The value was chosen to cover potential population growth over the 2-year review period. https://www.lincoln.gov.uk/downloads/file/1216/lincoln-city-profile-2021-2022-population

Individual Excess Risk of lung and intestinal cancers - All routes_70 years	**6.17E-05**	**4.59E-09**
	Local /103000 habs	**Regional /20 000 000 habs**
Expected number of statistical cases of lung and intestinal cancers in the population - All routes_70 years	**6.35**	**9.18E-02**

Table 21. Use-1 related Total Excess risk of cancer mortality/all route for General population

According to the applicant estimates, Use-1 related total excess risk of cancer mortality *via* all routes for the general population for 70 years of exposure reach **6.17E-05/103000 inhabitants at the local scale** and **4.59E-09/20000000 inhabitants at the regional scale.** In the section 10, risk calculated over 2 years of exposure (review period asked) are presented.

It is worth mentioning that the local PEC in air is based on an annual average concentration at 100 m from the source, which represents an overestimation of the general population exposure. Not all the people that could be affected are located at 100 m from the factory. Furthermore, Cr(VI) is rapidly reduced in the environment to Cr(III) under most environmental conditions , which reduces the potential exposure to Cr(VI) for the general population. This reduction transformation is not considered in the model, and thus values of PECair and daily intake for humans represent an overestimation.

9.2.2. Worker contributing scenario 1: Preparation of the coating (mixing and screening compound)

9.2.2.1. Preparation of the coating (mixing and screening compound)

The process starts with a non-exposing step regarding exposure to chromium trioxide. Before the spraying of hexavalent mixtures, parts are cleaned (degreasing), an abrasive blasting step is then performed to facilitate the adhesion coating and finally the parts are masked. No exposure to hexavalent chromium is considered. The steps described below are the exposing steps.

Figure 7. Blast room

Mixtures already formulated are re-mixed prior to spraying, using a paint shaker to ensure that pigment particles are well dispersed in the slurry. This operation is performed in a dedicated area called the mixing area (Figure 8).

Figure 8.) #2

Mixture bottles are shaked and they are not opened during this step of the process. Consequently, there is no possibility of exposure. Then, the bottle is opened and the mixture is transferred into a small container, in a spray booth, and directly clipped to the spray gun. Local exhaust ventilation (LEV) are localised inside the mixing area and the spray booth.

If there is a problem in the mixture consistence, during the transfer, the mixtures must be screened with a sieve, to remove oversized pigment agglomerates and any foreign contaminants (Figure 10).

Figure 9. #2

The operating condition and risk management measures of the transfer, with or without use of a sieve, are identical. They will be considered in the same contributing scenario. In this contributing scenario, the applicant will consider that the exposure to hexavalent chromium happened during the transfer of the substance.

9.2.2.2. Conditions of use

Parameter	Information
Product characteristics	
Product	*Chromium trioxide solution or chromic acids and their oligomers*
Physical form	*Powders dissolved in a liquid or incorporated in a liquid matrix*
Weight fraction of the substance in the liquid mixture	*Minor (5-10%)*
Viscosity of the liquid mixture	*Liquids with low viscosity (like water)*
Operational conditions	
Duration of use	*15 mins*
Frequency	*240 days/ year*
Primary emission source located in the breathing zone of the worker	*Yes, <1m*
Secondary Emission Source	*No*
Type of activity	*Falling liquids* *Transfer of liquid product with flow of 0.1 - 1 l/minute* *Handling that reduces contact between product and adjacent air. Note: This does not include processes that are fully contained by localised controls* *Submerged loading, where the liquid dispenser remains below the fluid level reducing the amount of aerosol formation*
Site and room size of the work area	*Indoors, small workrooms only*
Risk Management measures	
Local exhaust ventilation (LEV)	*Other enclosing hoods*
General ventilation in the work area	*Mechanical ventilation giving at least 1 ACH*
Fugitive Emission Sources	*Process not fully enclosed.* *Demonstrable and effective housekeeping practices in place.*
Version of modeling tool: ART (Advanced Reach Tool) version 1.5	

Table 22. Condition of use for the contributing scenario 1, by a modelling approach

The ART modelling tool doesn't take into account all the information required for the risk assessment of a chemical safety report. The table below gives complementary information that does not influence the modelling calculation.

Parameter	Information
Personal protective Equipment	
• Respiratory protective equipment	*none*
• Other personal protective equipment	*Nitrile Gloves* *Sperian Turbovisors* *Boots covers* *Safety clothing (Tyvek disposable suit with hood)* 
Other parameter	
• Amount of Cr^{6+}	[redacted]*#1 [0.100-0.400] t/year*
• Number of workers	*6 Chrome sprayers*

Table 23. Other using condition of the contributing scenario 1

9.2.2.3. Exposure for workers_modelled

Estimated exposures are listed in the table below. No respiratory protections are taken into account for this assessment. The ART exposure estimation is a **predicted 90th percentile long term exposure**.

Type of exposure	Exposure concentration estimation (not adjusted to the time)	Time duration
ART estimation	0.16 µg/m^3	15 mins

Table 24. Estimated raw exposure concentrations for contributing scenario 1

No specific measurement has been performed for this WCS but it is included in the monitoring time frame of a full shift for a chrome sprayer. For the risk assessment of the workers, the risk estimate will be carried out thanks to the monitored concentration of Cr^{6+} during a full shift (section 10).

9.2.3. Worker contributing scenario 2: Manual spraying

This operation can be performed in different sizes of spray booth (from 7.9 to 22.5 m^3) depending of the size of the parts to be coated. There are located in the different departments of the plant: 3 are in the Hardware department, and the Blades and Diffusion department include 2 spray booth each. This provides a total of 7 paint booths at the Lincoln site and there are three types of air circulation inside the spray booth:

- Air flows top to bottom through a filter system and it recirculates. 20% is sent out through the stack to the atmosphere throughout the process.
- Air flows from the front of the booth and is extracted at the bottom of the booth through the filter system and to the atmosphere via the stack.
- Air extracted through the spray booths own filtration and out to extraction

The extraction units run throughout the day as they are turned on at the start of the shift and are turned off at the end of the shift.

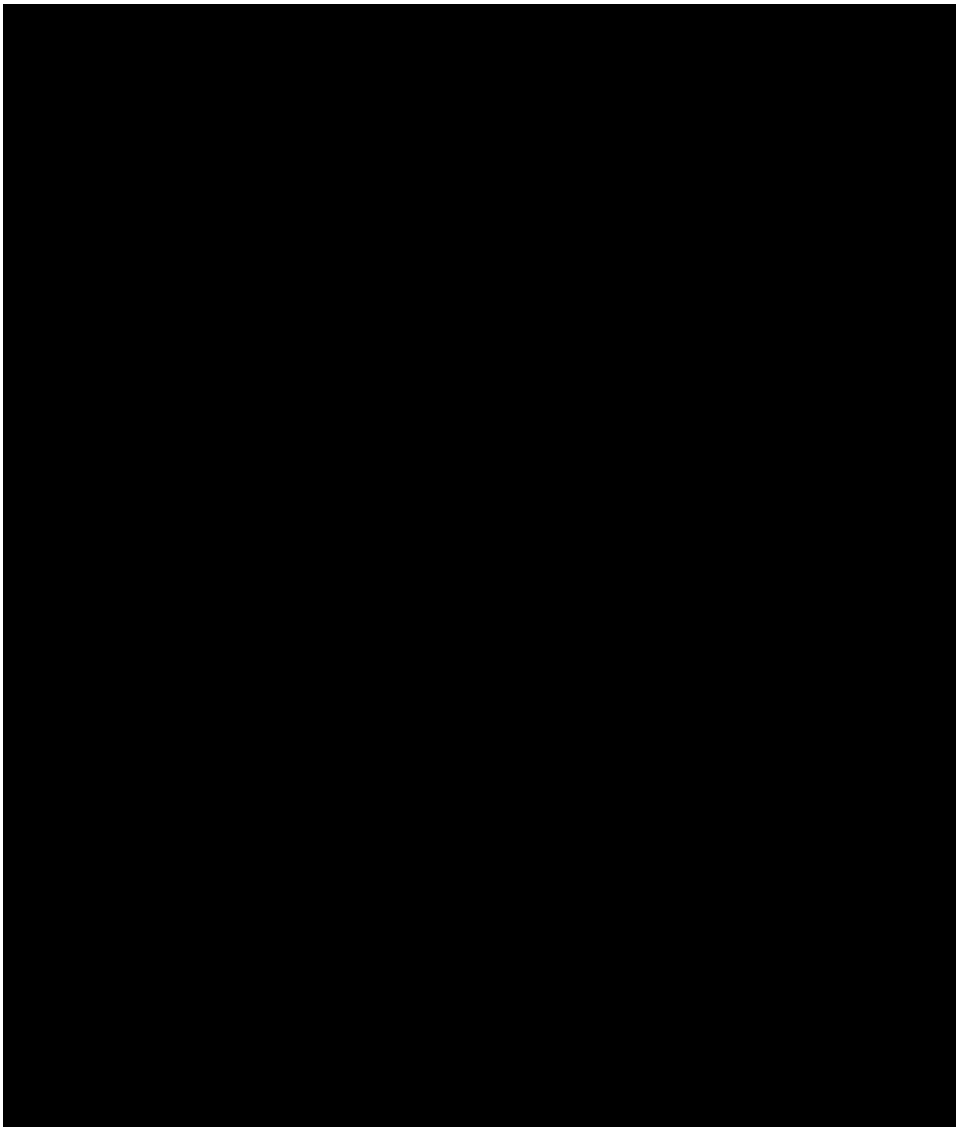

Figure 10. **#2**

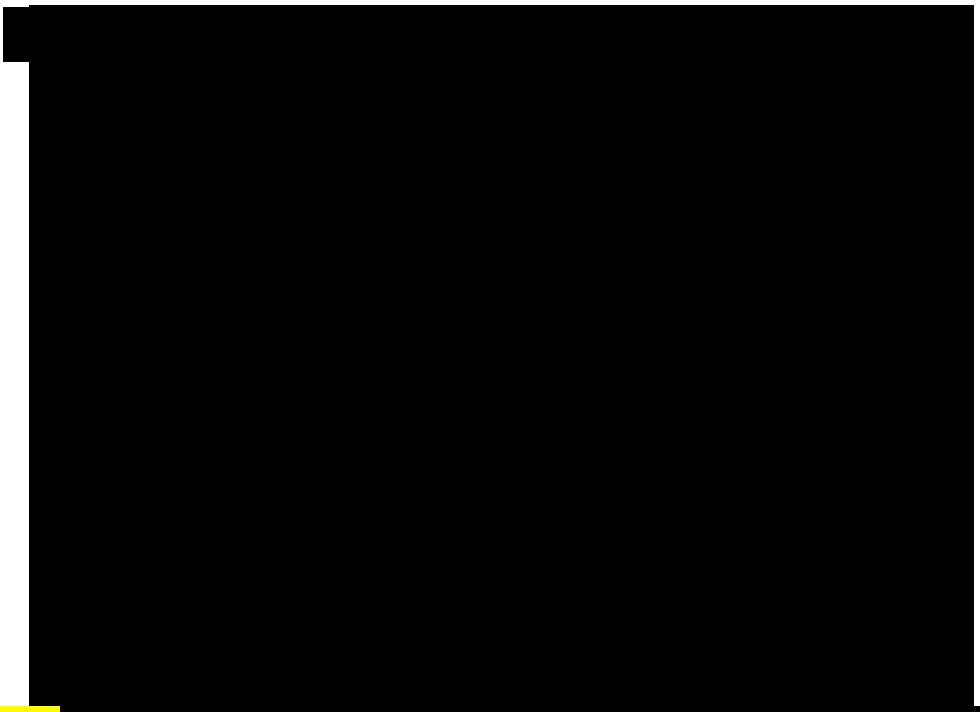

Figure 11. **#2**

Figure 12. **#2**

The workers perform the spraying by using a manual process and there is no automated spraying on site. In the spray booth, the workers employ an air-supplied respirator (not simply a face shield) (Figure 14).

Figure 13. Safety protection of the worker during the spraying step

The small container containing the mixture is clipped to the spray gun recipient (directly locked on the spray gun) (Figure below). Then, the spraying of metallic articles is performed in the spray booth.

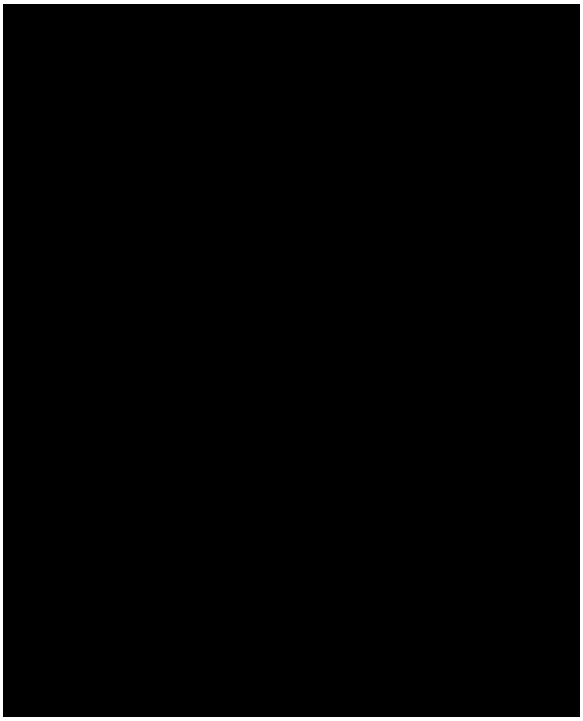

Figure 14. Photo of the spray gun with its recipient for mixtures #2

If touch-up paint is required, workers apply a chrome-free coating with a brush in a dedicated area called “inspection area” on a bench next to the curing oven (Figure 2). This process is performed when needed for finishing works and is not considered as an exposing step in this WCS because no exposure to hexavalent chromium occurs.

9.2.3.1. Conditions of use

Parameter	Information
Product characteristics	
Product	*Chromium trioxide solution or chromic acids and their oligomers*
Physical form	*Powders dissolved in a liquid or incorporated in a liquid matrix*
Weight fraction of the substance in the liquid mixture	*Minor (5-10%)*
Viscosity of the liquid mixture	*Liquids with low viscosity (like water)*
Operational conditions	
Duration of use	*300 mins*
Frequency	*240 days/ year*
Primary emission source located in the breathing zone of the worker	*Yes, <1m*
Secondary Emission Source	*No*
Type of activity	*Surface spraying of liquids* *Moderate application rate (0.3-3l/minute)* *Only horizontal or downward* *Spraying with no or low compressed air use*
Site and room size of the work area	*Spray room* *Cross-flow spray room*
Risk Management measures	
Local exhaust ventilation (LEV)	*Other enclosing hoods (90% reduction)*
General ventilation in the work area	*The spray room is with at least 10 air changes per hour.*
Fugitive Emission Sources	*Process not fully enclosed.* *Demonstrable and effective housekeeping practices in place.*
Version of modeling tool: ART (Advanced Reach Tool) version 1.5	

Table 25. Condition of use for the contributing scenario 2, by a modelling approach

The ART modelling tool doesn't take into account all the information required for the risk assessment of a chemical safety report. The table below gives complementary information that does not influence the modelling calculation.

Parameter	Information
Personal protective Equipment	
Respiratory protective equipment	*Respirator with full face shield (EN 14594 3B) with associated protection factor of 40*  
Other personal protective equipment	*Acid resistant gloves* *Safety clothing* *Safety shoes*
Other parameter	
Amount of Cr^{6+}	[redacted] *#1 [0.100-0.400] t/year*
Number of workers	*6 Chrome sprayers*

Table 26. Other using condition of the contributing scenario 2

9.2.3.2. Exposure for workers_modelled

Estimated exposures are listed in the table below. The ART exposure estimation is **a predicted 90th percentile long-term exposure.** Raw estimates have been weighed according to the APF (40) considered for the use of RPE during near field activities.

Type of exposure	Exposure concentration estimation (not adjusted to the time)	Time duration
ART estimate	170 µg/m^3	300 mins
ART estimate_RPE (APF 40)	4.25 µg/m^3	

Table 27. Estimated raw exposure concentrations for contributing scenario 2

No specific measurement has been performed for this WCS but it is included in the monitoring time frame of a full shift for a chrome sprayer. For the risk assessment of the workers, the risk estimate will be carried out thanks to the monitored concentration of Cr^{6+} during a full shift (section 10).

9.2.4. Worker contributing scenario 3: Parts transportation

After the coating, parts on site are unpacked and placed on steel pallets or in baskets to be moved around site, this can be in special trolleys/baskets or on pallets moved around with forklifts / pedestrian trucks or pump-up trucks depending on size of the parts. They are transported from the spraying both to the dryer (5 mins). After the drying step, the parts are transferred in the furnace for the curing step (5 mins). After the curing step, a near-complete conversion of hexavalent to trivalent chromium is observed, and the remaining hexavalent chromium is included in a matrix. The transportation and the manipulation of articles after the curing step create a negligible risk.

9.2.4.1. Conditions of use

Parameter	Information
Product characteristics	
Product	*Chromium trioxide solution or chromic acids and their oligomers*
Physical form	*Powders dissolved in a liquid or incorporated in a liquid matrix*
Weight fraction of the substance in the liquid mixture	*Minor (5-10%)*
Viscosity of the liquid mixture	*Liquids with low viscosity (like water)*
Operational conditions	
Duration of use	*10 mins (2x5mins)*
Frequency	*240 days/ year*
Primary emission source located in the breathing zone of the worker	*Yes, <1m*
Secondary Emission Source	*No*
Type of activity	*Handling of contaminated objects* *Activities with treated/contaminated objects (surface 1-3m^2)* *Contamination >90%*
Site and room size of the work area	*Indoors, Large workrooms only*
Risk Management measures	
Local exhaust ventilation (LEV)	*No localised control*
General ventilation in the work area	*Mechanical ventilation giving at least 1ACH*

Fugitive Emission Sources	*Process not fully enclosed.* *Demonstrable and effective housekeeping practices in place.*
Version of modeling tool: ART (Advanced Reach Tool) version 1.5	

Table 28. Condition of use for the contributing scenario 3, by a modelling approach

The ART modelling tool doesn't take into account all the information required for the risk assessment of a chemical safety report. The table below gives complementary information that does not influence the modelling calculation.

Parameter	Information
Personal protective Equipment	
Respiratory protective equipment	*none*
Other personal protective equipment	*Boots covers* *Nitrile Gloves* *Safety clothing (Tyvek disposable suit with hood)*
Other parameter	
Amount of Cr^{6+}	[redacted] *#1 [0.100-0.400] t/year*
Number of workers	*18 in total: 6 Chrome sprayers + 12 Operators*

Table 29. Other using condition of the contributing scenario 3

9.2.4.2. Exposure for workers_modelled

Estimated exposures are listed in the table below. The ART exposure estimation is **a predicted 90th percentile long-term exposure**. No respiratory protections are taken into account for this assessment.

Type of exposure	Exposure concentration estimation (not adjusted to the time)	Time duration
ART estimate	2 µg/m^3	10 mins

Table 30. Estimated raw exposure concentrations for contributing scenario 3

No specific measurement has been performed for this WCS but it is included in the monitoring time frame of a full shift for a chrome sprayer. For the risk assessment of the

workers, the risk estimate will be carried out thanks to the monitored concentration of Cr^{6+} during a full shift (section 10).

9.2.5. Worker contributing scenario 4: Drying of coating

After the spraying, parts must be air dried at temperature between 65 and 95°C in a dedicated heat chamber (Figure 15) to drive out all the water inside the coating. This operation takes place in special areas close to all spray booths. All workers in the site are considered exposed on a far field basis including the chrome sprayers as they are responsible of the drying step of the parts.

After the drying the masking tape is removed from the parts 90% of the time.

Figure 15. Drying room outside (left) and inside (right) in the Hardware department #2

9.2.5.1. Conditions of use

Parameter	Information
Product characteristics	
Product	*Chromium trioxide solution or chromic acids and their oligomers*
Physical form	*Powders dissolved in a liquid or incorporated in a liquid matrix*
Weight fraction of the substance in the liquid mixture	*Minor (5-10%)*
Viscosity of the liquid mixture	*Liquids with low viscosity (like water)*
Operational conditions	

Duration of use	*30 mins*
Frequency	*240 days/ year*
Primary emission source located in the breathing zone of the worker	*No, >1m*
Secondary Emission Source	*No*
Type of activity	*Handling of contaminated objects* *Activities with treated/contaminated objects (surface 1-3m^2)* *Contamination >90%*
Site and room size of the work area	*Indoors, Large workrooms only*
Risk Management measures	
Local exhaust ventilation (LEV)	*No localised control*
Segregation	*Partial segregation with ventilation and filtration of recirculated air (70% reduction)*
Personal enclosure	*Partial personal enclosure with ventilation (70% reduction)*
General ventilation in the work area	*Mechanical ventilation giving at least 1 ACH*
Fugitive Emission Sources	*Process not fully enclosed.* *Demonstrable and effective housekeeping practices in place.*
Version of modeling tool: ART (Advanced Reach Tool) version 1.5	

Table 31. Condition of use for the contributing scenario 4, by a modelling approach

The ART modelling tool doesn't take into account all the information required for the risk assessment of a chemical safety report. The table below gives complementary information that does not influence the modelling calculation.

Parameter	Information
Personal protective Equipment	
Respiratory protective equipment	*none*
Other personal protective equipment	*Boots covers* *Nitrile Gloves* *Safety clothing (Tyvek disposable suit with hood)*

Other parameter	
Amount of Cr^{6+}	[redacted]#1 [0.100-0.400] t/ year
Number of workers	29 in total: 6 Chrome sprayers + 1 Cell leader + 12 Operators + 2 Inspectors + 5 Maintenance workers + 3 External workers

Table 32. Other using condition of the contributing scenario 4

9.2.5.2. Exposure for workers_modelled

Estimated exposures are listed in the table below. The ART exposure estimation is a **predicted 90th percentile long-term exposure**. No respiratory protections are taken into account for this assessment.

Type of exposure	Exposure concentration estimation (not adjusted to the time)	Time duration
ART estimate	0.029 µg/m^3	30 mins

Table 33. Estimated raw exposure concentrations for contributing scenario 5

No specific measurement has been performed for this WCS but it is included in the monitoring time frame of a full shift for a chrome sprayer. For the risk assessment of the workers, the risk estimate will be carried out thanks to the monitored concentration of Cr^{6+} during a full shift (section 10).

9.2.6. Worker contributing scenario 5: Curing and burnish of coating

Immediately after the drying, the parts are cured in chrome designated ovens. This step is performed in a furnace (Figure 16) at different temperature between 165 to 350°C, depending of curing time (curve linked between time and temperature of curing) and the metal base properties. This step is the most important step of the process because it allows the crosslink of the binder to obtain a corrosion protection. Moreover, during this step, a conversion of hexavalent to trivalent chromium happens. This conversion is complete or near-complete.

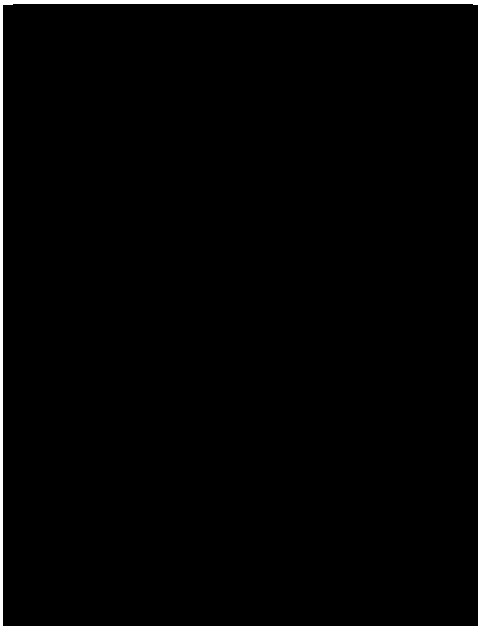

Figure 16. Curing oven #2

After the cooling of articles, articles are burnished to achieve the conductivity properties of the parts. To perform this step of the process, the cured articles are re-transferred in a furnace for a new “sub-curing step”. In terms of exposure, the 2 previous steps described (Curing/burnishing) will be included in the same contributing scenario. All workers in the site are considered exposed on a far field basis with the exception of the chrome sprayers isolated in the spray rooms.

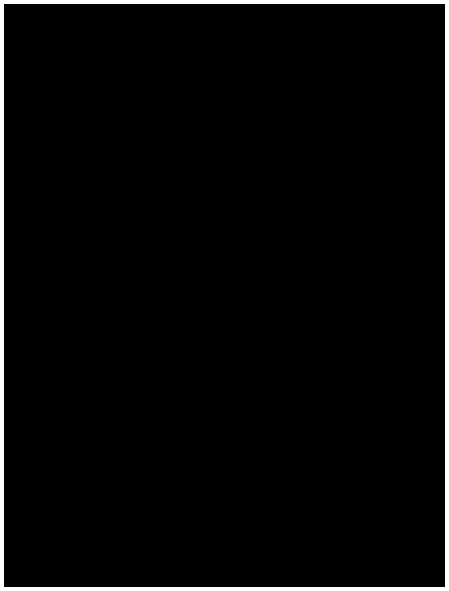

Figure 17. Burnish room #2

The finished parts are then ready to be inspected and packed in the inspection area next to the curing oven (Figure 2). There is also a portable extraction unit at this bench. The chrome in the finish parts has been coated, dried and cured so it is not considered as an exposing step in this WCS because no exposure to hexavalent chromium occurs.

9.2.6.1. **Conditions of use**

Parameter	Information
Product characteristics	
Product	*Chromium trioxide solution or chromic acids and their oligomers*
Physical form	*Powders dissolved in a liquid or incorporated in a liquid matrix*
Weight fraction of the substance in the liquid mixture	*Minor (5-10%)*
Viscosity of the liquid mixture	*Liquids with low viscosity (like water)*
Operational conditions	
Duration of use	*120 mins*
Frequency	*240 days/ year*
Primary emission source located in the breathing zone of the worker	*No, >1m*
Secondary Emission Source	*No*
Type of activity	*Handling of contaminated objects*

	Activities with treated/contaminated objects (surface 1-3m^2) *Contamination >90%*
Site and room size of the work area	*Indoors, Large workrooms only*
Risk Management measures	
Local exhaust ventilation (LEV)	*No localised control*
Segregation	*Partial segregation with ventilation and filtration of recirculated air (70% reduction)*
Personal enclosure	*Partial personal enclosure with ventilation (70% reduction)*
General ventilation in the work area	*Mechanical ventilation giving at least 1 ACH*
Fugitive Emission Sources	*Process not fully enclosed.* *Demonstrable and effective housekeeping practices in place.*
Version of modeling tool: ART (Advanced Reach Tool) version 1.5	

Table 34. Condition of use for the contributing scenario 5, by a modelling approach

The ART modelling tool doesn't take into account all the information required for the risk assessment of a chemical safety report. The table below gives complementary information that does not influence the modelling calculation.

Parameter	Information
Personal protective Equipment	
Respiratory protective equipment	*none*
Other personal protective equipment	*Boots covers* *Nitrile Gloves* *Safety clothing (Tyvek disposable suit with hood)*
Other parameter	
Amount of Cr^{6+}	[redacted]*#1 [0.100-0.400] t/ year*
Number of workers	*23 in total: 1 Cell leader + 12 Operators + 2 Inspectors + 5 Maintenance workers + 3 External workers*

Table 35. Other using condition of the contributing scenario 5

9.2.6.2. Exposure for workers_modelled

Estimated exposures are listed in the table below. The ART exposure estimation is a **predicted 90th percentile long-term exposure**. No respiratory protections are taken into account for this assessment.

Type of exposure	Exposure concentration estimation (not adjusted to the time)	Time duration
ART estimate	0.03 µg/m^3	120 mins

Table 36. Estimated and measured Exposure concentrations for contributing scenario 5

No specific measurement has been performed for this WCS. For the risk assessment of the workers, the risk estimate will be carried out thanks to the estimated exposures modelled using ART.

9.2.7. Worker contributing scenario 6: Removal of coating

If necessary (e.g. defect on the coating…), the coating is removed, using a stripping process with alkali solution in bath at 80°C. Then, the process restarts normally as described above.

9.2.7.1. Conditions of use

Parameter	Information
Product characteristics	
Product	*Chromium trioxide solution or chromic acids and their oligomers*
Physical form	*Powders dissolved in a liquid or incorporated in a liquid matrix*
Weight fraction of the substance in the liquid mixture	*Minor (5-10%)* *(This is the concentration of the substance in the mixtures, because it too difficult to estimate the remaining quantities during the cleaning. Nevertheless, it is clear that the remaining proportion of the substance is clearly lower)*
Viscosity of the liquid mixture	*Liquids with low viscosity (like water)*
Operational conditions	
Duration of use	*60 mins*
Frequency	*120 days/ year*
Primary emission source located in the breathing zone of the worker	*Yes, <1m*
Secondary Emission Source	*No*
Type of activity	*Handling of contaminated objects* *Activities with treated/contaminated objects (surface 1-3m^2)* *Contamination >90%* *(Coating are remove from article via a stripping process / Linde AMT Use)*
Site and room size of the work area	*Indoors, Large workrooms only*
Risk Management measures	
Local exhaust ventilation (LEV)	*No*
General ventilation in the work area	*Mechanical ventilation giving at least 1 ACH*

Fugitive Emission Sources	*Process not fully enclosed.* *Demonstrable and effective housekeeping practices in place.*
Version of modeling tool: ART (Advanced Reach Tool) version 1.5	

Table 37. Condition of use for the contributing scenario 6, by a modelling approach

The ART modelling tool doesn't take into account all the information required for the risk assessment of a chemical safety report. The table below gives complementary information that does not influence the modelling calculation.

Parameter	Information
Personal protective Equipment	
Respiratory protective equipment	*none*
Other personal protective equipment	*Boots covers* *Nitrile Gloves* *Safety clothing (Tyvek disposable suit with hood)*
Other parameter	
Amount of Cr^{6+}	[redacted]*#1 [0.100-0.400] t/ year*
Number of workers	*12 Operators*

Table 38. Other using condition of the contributing scenario 6

9.2.7.2. Exposure for workers_modelled

Estimated exposures are listed in the table below. The ART exposure estimation is a **predicted 90th percentile long-term exposure**. No respiratory protections are taken into account for this assessment.

Type of exposure	Exposure concentration estimation (not adjusted to the time)	Time duration
ART estimate	2 µg/m^3	60 mins

Table 39. Estimated raw exposure concentrations for contributing scenario 6

No specific measurement has been performed for this WCS. For the risk assessment of the workers, the risk estimate will be carried out thanks to the estimated exposures modelled using ART.

9.2.8. Worker contributing scenario 7: Cleaning of the spraying room

The filters in the spray booths are the responsibility of the sprayers: at the start of the shift they will inspect their filters and decide on if they are operational, also through the shift, if needed, they would change the filters. Full PPE is worn to change out the filters including the respirator's which are air fed from the system onsite.

The workers clean the spray gun and its recipient with water. At the end of the process, all these wastes are disposed in yellow hazard bins with ones dedicated to each spray booth plus others dotted around the cells. All waste filters, PPE and everything in the cell are placed in these bins (even non hazard) so there are no contamination issues. The bins contain a bin liner and when they are full, the liners are put inside an outside press which compacts them. In addition, the liner is enclosed in another extra strong bin liner to create a double bag system. The double bag system is placed in the hazard bins once full and disposed by an outside waste disposal contractor's. For water waste disposal, there is a water treatment plant onsite.

9.2.8.1. Conditions of use

Parameter	Information
Product characteristics	
Product	*Chromium trioxide solution or chromic acids and their oligomers*
Physical form	*Powders dissolved in a liquid or incorporated in a liquid matrix*
Weight fraction of the substance in the liquid mixture	*Minor (5-10%)* *(This is the concentration of the substance in the mixtures, because it too difficult to estimate the remaining quantities during the cleaning. Nevertheless, it is clear that the remaining proportion of the substance is clearly lower)*
Viscosity of the liquid mixture	*Liquids with low viscosity (like water)*
Operational conditions	
Duration of use	*60 mins*
Frequency	*240 days/ year*
Primary emission source located in the breathing zone of the worker	*Yes, <1m*

Secondary Emission Source	*No*
Type of activity	*Handling of contaminated objects* *Activities with treated/contaminated objects (surface 1-3m^2)* *Contamination 10-90%*
Site and room size of the work area	*Spray room* *Cross-flow spray room*
Risk Management measures	
Local exhaust ventilation (LEV)	*Other enclosing hoods (90% reduction)*
General ventilation in the work area	*The spray room is with at least 10 air changes per hour.*
Fugitive Emission Sources	*Process not fully enclosed.* *Demonstrable and effective housekeeping practices in place.*
Version of modeling tool: ART (Advanced Reach Tool) version 1.5	

Table 40. Condition of use for the contributing scenario 7, by a modelling approach

The ART modelling tool doesn't take into account all the information required for the risk assessment of a chemical safety report. The table below gives complementary information that does not influence the modelling calculation. Full PPE is worn to change out the filters including the air-supplied respirator.

Parameter	Information
Personal protective Equipment	
Respiratory protective equipment	*Respirator with full face shield (EN 14594 3B) with associated protection factor of 40* 

	
Other personal protective equipment	*Boots covers* *Nitrile Gloves* *Safety clothing (Tyvek disposable suit with hood)*
Other parameter	
Amount of Cr^{6+}	[redacted] *#1 [0.100-0.400] t/ year*
Number of workers	*14 in total: 6 Chrome sprayers + 5 Maintenance workers + 3 External workers*

Table 41. Other using condition of the contributing scenario 7

9.2.8.2. Exposure for workers_modelled

Estimated exposures are listed in the table below. The ART exposure estimation is a **predicted 90th percentile long-term exposure**. No respiratory protections are taken into account for this assessment.

Type of exposure	Exposure concentration estimation (not adjusted to the time)	Time duration
ART estimate	0.05 µg/m^3	60 mins
ART estimate_RPE (APF 40)	0.00125 µg/m^3	

Table 42. Estimated raw exposure concentrations for contributing scenario 7

No specific measurement has been performed for this WCS. For the risk assessment of the workers, the risk estimate will be carried out thanks to the estimated exposures modelled using ART.

9.2.9. Worker contributing scenario 8: Maintenance

The maintenance operations are partly done by operators in the chrome area and partly by external operators from a contract company.

The internal maintenance team is involved in monthly activities such as:

- Checking, monitoring and changing of the filters in the chrome cells. All of this when there is no spraying application.
- Monitoring of the water treatment plant daily / weekly and monthly checks are in place

Additionnally, any other maintenance requirement that may be found by an operator would be logged on the Maintenance system and be carried out. Maintenance workers have all been trained in how to work in these areas including PPE and disposal of all waste involved with the chrome areas. Maintenance workers have respirators that are portable and have a battery pack and an individual filter pack which can be changed to suit the conditions in which they are working in.

The external maintenance team carry out:

- All servicing and booth flow checks and visits schedule 2 or 4 times a year.
- Emergencies
- The water treatment plant visits every 3 months

The duration of maintenance tasks can vary depending on what is required for example, just checking in line filters takes 30 to 60 minutes per room and changing the filters 3 hours. As a worst-case scenario 3 hours monthly will be considered in this WCS.

9.2.9.1. Conditions of use

Parameter	Information
Product characteristics	
Product	*Chromium trioxide solution or chromic acids and their oligomers*
Physical form	*Powders dissolved in a liquid or incorporated in a liquid matrix*

Weight fraction of the substance in the liquid mixture	*Minor (5-10%)* *(This is the concentration of the substance in the mixtures, because it too difficult to estimate the remaining quantities during the maintenance. Nevertheless, it is clear that the remaining proportion of the substance is lower)*
Viscosity of the liquid mixture	*Liquids with low viscosity (like water)*
Operational conditions	
Duration of use	*180 mins*
Frequency	*12 days/ year*
Primary emission source located in the breathing zone of the worker	*Yes, <1m*
Secondary Emission Source	*No*
Type of activity	*Handling of contaminated objects* *Activities with treated/contaminated objects (surface > 3 m^2)* *Contamination 10-90%*
Site and room size of the work area	*Indoors, Any size workroom (bewteen 30-1000m^3)*
Risk Management measures	
Local exhaust ventilation (LEV)	*No*
General ventilation in the work area	*Mechanical ventilation giving at least 1 ACH*
Fugitive Emission Sources	*Process not fully enclosed.* *Demonstrable and effective housekeeping practices in place.*
Version of modeling tool: ART (Advanced Reach Tool) version 1.5	

Table 43. Condition of use for the contributing scenario 8, by a modelling approach

The ART modelling tool doesn't consider all the information required for the risk assessment of a chemical safety report. The table below gives complementary information that does not influence the modelling calculation.

Parameter	Information
Personal protective Equipment	
Respiratory protective equipment	*Either:* *Sperian Turbovisor power assisted respirator (EN 12942) for exposing tasks with chromium with associated protection factor of 20*  *Or, Battery face Respirator with full face shield and filter (EN 12942) for all kind of maintenance work with associated protection factor of 20* 
Other personal protective equipment	*Boots covers* *Nitrile Gloves* *Safety clothing (Tyvek disposable suit with hood)*
Other parameter	
Amount of Cr^{6+}	[redacted]*#1 [0.100-0.400] t/ year*
Number of workers	*8 in total: 5 Maintenance workers + 3 External workers*

Table 44. Other using condition of the contributing scenario 8

9.2.9.2. **Exposure for workers_modelled**

Estimated exposures are listed in the table below. The ART exposure estimation is a **predicted 90th percentile long-term exposure**. No respiratory protections are taken into account for this assessment.

Type of exposure	Exposure concentration estimation (not adjusted to the time)	Time duration
ART estimate	1 µg/m^3	180 mins
ART estimate_RPE (APF 20)	0.05 µg/m^3	

Table 45. Estimated raw exposure concentrations for contributing scenario 8

No specific measurement has been performed for this WCS. For the risk assessment of the workers, the risk estimate will be carried out thanks to the estimated exposures modelled using ART.

9.3. EXPOSURE SCENARIO 2: PROFESSIONAL USERS

This exposure scenario deals with the use of final treated articles. They are parts of industrial equipments and they are not intended to be used by consumers. Only professional workers are therefore concerned by this ES.

Considering that there is no liquid from the mixture of hexavalent chromium remaining on the article, there is no possibility of exposure to hexavalent chromium via inhalation route.

Considering that:

- the remaining hexavalent chromium on the article is included into a matrix composed of the formation of hydroxyl-oxides of aluminium;
- the thick layer of this matrix is in the order of magnitude of micrometer;
- the remaining hexavalent chromium is lower than 0.01% for each article (a maximum of 60 ppm are find in rare case)
- once they are treated, all the articles are painted and the paint coating is designed to form a physical barrier and remain all the lifetime of the article.

The cutaneous route of exposure is considered negligible.

Furthermore, as indicated by RAC, there is no data to indicate that dermal exposure to Cr(VI) compounds presents a cancer risk to humans. NIOSH reports[3] that some data indicates that CrVI is reduced prior to systemic uptake (Corbett GE et al. 1997; Liu KJ et al. 1997).

The cancer risk to workers via dermal route in the case of Linde AMT is therefore considered negligible and it will not be considered for the calculation of the excess of risk to have a cancer in the part 10 of the CSR.

[3] National Institute for Occupational Safety and Health, Occupational Safety and Health Administration Request for information Occupational Exposure to Hexavalent Chromium (CrVI); Novermber 20, 2002.

10. RISK CHARACTERISATION

10.1. MAN VIA ENVIRONMENT

In the table below are presented the summary of the Man via environment risk assessment.

	Local	Regional
INHALATION		
Excess lifetime fatal lung cancer risk – adjusted to 2 years	8.29E-04 per µg/m3	
Individual Excess risk of lung cancer – 2 years	1.76E-06	8.62E-18
Number of people considered	103 000	20 000 000
Expected number of statistical fatal lung cancer cases in the general population – 2 years	**1.81E-01**	**1.72E-10**
ORAL		
Excess lifetime fatal small intestine cancer risk – adjusted to 2 years	2.29E-05 per µg/kg/day	
Individual Excess risk of fatal small intestine cancer – 2 years	5.76E-09	1.31E-10
Number of people considered	**103 000**	**20 000 000**
Expected number of statistical fatal small intestine cases in the general population – 2 years	**5.93E-04**	**2.62E-03**
ALL ROUTES		
Number of people considered	103 000	20 000 000
Expected number of statistical cancer cases in the general population – 2 years	**1.82E-01**	**2.62E-03**

Table 46. Summary of Man via Environment risk assessment

According to the applicant estimates for the duration of the review period (2 years), the number of statistical fatal lung and small intestine cancer cases in the general population reaches **5.93E-04/103000 inhabitants at the local scale**.

10.2. HUMAN HEALTH (RELATED TO COMBINED EXPOSURE)

10.2.1. Workers

10.2.1.1. Exposure scenario

A summary of the Cr^{6+} exposure concentrations considered in the worker risk assessment is presented. When no monitoring data is available for a specific WCS, the modelled value is used (ART). When it is relevant, the exposure concentrations (modelled or monitored) are weighted by the APF of the RPE used during the activity.

Contributing scenario	Modelled exposure concentration (µg/m³)	APF	Exposure weighted considering RPE protection (APF) (µg/m³)	Time duration	Number of workers (total)
WCS 1 Preparation of the coating	0.16	-	-	15 min	6
WCS 2 Manual spraying	170	40	4.25	300 min	6
WCS 3 Parts transportation	2	-	-	10 min	18
WCS 4 Drying of coating	0.029	-	-	30 min	29
WCS 5 Curing and burnish of coating	0.03	-	-	120 min	23
WCS 6 Removal of coating	2	-	-	60 min	12
WCS 7 Cleaning of the spraying room	0.05	40	0.00125	60 min	14
WCS 8 Maintenance	1	20	0.05	180 min	8

Table 47. Modelling exposure for the manual workers

Personal and static measurements have been performed in the different spray booths.
The personal monitoring captured the exposure concentration of Cr6+ for chrome sprayers during an entire work shift (420-510 min). The sprayers performed the actions details below during the monitoring time frame:

- Preparation of the coating (mixing),
- Spraying,
- Parts transportation,
- Drying of coating,
- Cleaning of the spray room.

A summary of the values monitored are presented in the table below.

Date of sampling	Type of sampling / Activities or Location	Method of sample analysis	Limit of Quantification	Measured value CrVI
Static spray booth measurement				
24/01/2022	Filter cassette in the White room: during the spraying of parts in spray booth 2	Static (420 min)	unknown	0.073 µg/m^3
25/01/2022	Filter cassette in the White room: during the spraying of parts in spray booth 1	Static (450 min)	unknown	0.15 µg/m^3
07/03/2022	Filter cassette in the spray booth 2: during the spraying of parts	Static (510 min)	unknown	21 µg/m^3
12/01/2023	Filter cassette in the spray booth 1: during the spraying of parts	Static (450 min)	unknown	0.4 µg/m^3
Chrome sprayers full shift measurement				
24/01/2022	Filter cassette on a sprayer who sprays parts in spray booth 2	Personal (450 min)	unknown	22 µg/m^3
25/02/2022	Filter cassette on a sprayer who sprays parts in spray booth 2	Personal (450 min)	unknown	8.1 µg/m^3
07/03/2022	Filter cassette on a sprayer who sprays parts in spray booth 2	Personal (510 min)	unknown	26 µg/m^3
07/03/2022	Filter cassette on a sprayer who sprays parts in spray booth 1	Personal (480 min)	unknown	150 µg/m^3
07/03/2022	Filter cassette on a sprayer who sprays parts in spray booth 1	Personal (480 min)	unknown	8.2 µg/m^3
12/01/2023	Filter cassette on a sprayer who sprays parts in spray booth 1	Personal (450 min)	unknown	5.4 µg/m^3
10/01/2023	Filter cassette on a sprayer who sprays parts in spray booth 2	Personal (450 min)	unknown	79 µg/m^3
10/01/2023	Filter cassette on a sprayer who sprays parts in spray booth 3	Personal (450 min)	unknown	16 µg/m^3
11/01/2023	Filter cassette on a sprayer who masks, blasts and sprays parts in spray booth 1	Personal (450 min)	unknown	160 µg/m^3
18/01/2023	Filter cassette on a sprayer who sprays parts in spray booth 3	Personal (450 min)	unknown	23 µg/m^3
23/02/2022	Filter cassette on a sprayer who sprays parts in spray booth 3	Personal (420 min)	unknown	540 µg/m^3

Table 48. Monitored exposure concentrations

For the risk assessment of the chrome sprayers, the risk estimate will be carried out thanks to the 90th percentile of the monitored concentrations of Cr^{6+} to reflect accurately the data set. However, the four static measurements are excluded from the data set used for the calculation of the 90th percentile because they do not capture all the tasks of a chrome sprayer during an entire shift. The concentration of 160 µg/m^3 of Cr^{6+} will then be considered for the chrome sprayers risk assessment (0.4 µg/m^3 with RPE).

The maximum value monitored on an operator was 540 µg/m^3 on February 23th 2022. This operator was unexperienced and because of its high personal sample result, it was recommended that the operator be further trained with an experienced sprayer. As a result, one year later in January 18th 2023, the same operator's personal sample result is 23 µg/m^3 which is a lot lower.

As each group of workers is performing different activities with specific durations and frequencies during year, the **average one-year exposure** has been estimated for each group of workers involved in activities presented in the AfA. As already listed in the section 9.1.1. Therefore, risk assessment is available for each worker group in the following tables:

Worker Type	Number of workers (total)	Activities	Other tasks done by the same workers
Chrome sprayers	6	Preparation of the coating and manual spraying	Drying of coating, parts transportation and cleaning of the spray rooms
Cell leaders	1	Spend 50% of their time in an office and 50% on the shop floor dealing with production issues	None
Operators	12	Curing and burnish of coating, removal of coating	Parts transportation
Inspectors	2	Inspection of the finished parts	None
Maintenance workers	5	Maintenance tasks	Cleaning of the spray rooms
External maintenance workers	3	Maintenance tasks	Cleaning of the spray rooms

Table 49. Repartition of activities between workers

Therefore, risk assessment is available for each worker group in the following tables:

	WCS 1	WCS 2	WCS 3	WCS 4	WCS 7
Sub-task	*WCS 1 Preparation of the coating*	*WCS 2 Manual spraying*	*WCS 3 Parts transportation*	*WCS 4 Drying of coating*	*WCS 7 Cleaning of the spraying room*
Exposure considered (µg/m3) WITHOUT RPE	160.000 µg/m3				
Exposure considered (µg/m3) WITH RPE	not relevant	4.000 µg/m3	not relevant	not relevant	4.000 µg/m3
Time of the task (min)	15 min	300 min	10 min	30 min	60 min
Frequency per worker (times/year)	240 /year	240 /year	240 /year	240 /year	240 /year
Average one-year exposure (µg/m3) (for 1 worker) WITHOUT RPE	**1.36E+07**				
Average one-year exposure (µg/m3) (for 1 worker) WITH RPE	**2.13E+01**				

Table 50. Average one-year exposure for Chrome sprayers

	WCS 4	WCS 5
Sub-task	*WCS 4 Drying of coating*	*WCS 5 Curing and burnish of coating*
Exposure considered (µg/m3) WITHOUT RPE	0.029 µg/m3	0.03 µg/m3
Exposure considered (µg/m3) WITH RPE	not relevant	not relevant
Time of the task (min)	30 min	120 min
Frequency per worker (times/year)	120 /year	120 /year
Average one-year exposure (µg/m3) (for 1 worker) WITHOUT RPE	**0.005**	

Table 51. Average one-year exposure for Cell leaders

	WCS 3	WCS 4	WCS 5	WCS 6
Sub-task	*WCS 3 Parts transportation*	*WCS 4 Drying of coating*	*WCS 5 Curing and burnish of coating*	*WCS 6 Removal of coating*

Exposure considered (µg/m3) WITHOUT RPE	2.00 µg/m3	0.029 µg/m3	0.03 µg/m3	2.00 µg/m3
Exposure considered (µg/m3) WITH RPE	not relevant	not relevant	not relevant	not relevant
Time of the task (min)	10 min	30 min	120 min	60 min
Frequency per worker (times/year)	240 /year	240 /year	240 /year	120 /year
Average one-year exposure (µg/m3) (for 1 worker) WITHOUT RPE	**0.176**			

Table 52. Average one-year exposure for Operators

	WCS 4	**WCS 5**
Sub-task	*WCS 4 Drying of coating*	*WCS 5 Curing and burnish of coating*
Exposure considered (µg/m3) WITHOUT RPE	0.029 µg/m3	0.030 µg/m3
Exposure considered (µg/m3) WITH RPE	not relevant	not relevant
Time of the task (min)	30 min	120 min
Frequency per worker (times/year)	240 /year	240 /year
Average one-year exposure (µg/m3) (for 1 worker) WITHOUT RPE	**0.009**	

Table 53. Average one-year exposure for Inspectors

	WCS 7	**WCS 8**
Sub-task	*WCS 7 Cleaning of the spraying room*	*WCS 8 Maintenance*
Exposure considered (µg/m3) WITHOUT RPE	0.05 µg/m3	1.00 µg/m3
Exposure considered (µg/m3) WITH RPE	0.0013 µg/m3	0.050 µg/m3
Time of the task (min)	60 min	180 min
Frequency per worker (times/year)	240 /year	12 /year
Average one-year exposure (µg/m3) (for 1 worker) WITHOUT RPE	**0.025**	
Average one-year exposure (µg/m3) (for 1 worker) WITH RPE	**0.0011**	

Table 54. Average one-year exposure for Maintenance workers

	WCS 7	**WCS 8**
Sub-task	*WCS 7 Cleaning of the spraying room*	*WCS 8 Maintenance*

Exposure considered (µg/m3) WITHOUT RPE	0.05 µg/m3	1.00 µg/m3
Exposure considered (µg/m3) WITH RPE	0.0013 µg/m3	0.050 µg/m3
Time of the task (min)	60 min	180 min
Frequency per worker (times/year)	240 /year	12 /year
Average one-year exposure (µg/m3) (for 1 worker) WITHOUT RPE	**0.025**	
Average one-year exposure (µg/m3) (for 1 worker) WITH RPE	**0.0011**	

Table 55. Average one-year exposure for External workers

As discussed previously in chapter 9.1.2.3, the **risk characterisation will be based on the RAC/27/2013/06 Rev.1 which establishes a reference dose response relationship for the carcinogenicity of hexavalent chromium.**

Excess of lung cancer risk: $4*10^{-3}$ per µg Cr(VI)/m^3 based on a 40 years working life (8h/day, 220 days per year)

Regarding the publication of the RAC, no data clearly indicates that dermal exposure to Cr(VI) compounds presents a risk of cancer to human. In the risk analysis, we will not consider the risk induced via dermal exposure, especially considering the dermal protection used in coating shops. However, skin checks are conducted as a precautionary measure on the Lincol site and their results are exposed as a supporting information in section 10.2.1.4.

Moreover, and since particles' size distribution is not reliable (substance used in a liquid mixture), we will estimate the cancer risk mainly for lung cancer and maximise the excess of cancer risk without considering the risk for small intestine cancer.

Based on these information, the table below shows the calculation of the excess of lung cancer risk weighted by the duration of Use-1 review period.

Weighted excess of lung cancer risk	Value
Excess risk of lung cancer, per µg/m3 of Cr(VI) based on 40 working years, 220 days per year, 8h per day (RAC 2013)	4.0×10^{-3}
Excess risk of lung cancer, per µg/m3 of Cr(VI) based on 1 working year, 220 days per year, 8h per day	1.0×10^{-4}

Weighted excess of lung cancer risk	Value
Excess risk of lung cancer, per µg/m3 of Cr(VI) based on 2 working years (asking review period), 240 days per year, 8h per day	2.0×10^{-4}

Table 56. Excess of lung cancer risk calculation considering the time of review period applied for

Therefore, the estimates of individual excess risk and number of statistical lung cancer cases are available based on 40 and 2 working years, in the following tables:

Use-1	Chrome sprayers	Cell leaders	Operators	Inspectors	Maintenance workers	External workers
	direct	indirect	direct	indirect	direct	direct
Number of exposed persons	6	1	12	2	5	3
Individual Excess lifetime cancer risk_40 years	8.53E-02	1.86E-05	7.04E-04	3.73E-05	4.38E-06	4.38E-06
Number of statistical fatal lung cancer cases per type of workers_40 years	**5.12E-01**	**1.86E-05**	**8.45E-03**	**7.45E-05**	**2.19E-05**	**1.31E-05**
Individual Excess risk_2 years	4.27E-03	9.31E-07	3.52E-05	1.86E-06	2.19E-07	2.19E-07
Number of statistical fatal lung cancer cases per type of workers_2 years	**2.56E-02**	**9.31E-07**	**4.22E-04**	**3.73E-06**	**1.09E-06**	**6.56E-07**
Number of statistical fatal lung cancer cases for workers_40 years	**5.21E-01**					
Number of statistical fatal lung cancer cases for workers_2 years	**2.60E-02**					

Table 57. Calculation of excess risk for workers for the Use-1

10.2.1.2. Supporting information based on urinary analyses

Urinary analyses have been done on operators every 12 months. The samples were done at the end of the shift.

The urinary concentrations reflect the amount of chromium absorbed by all routes. The Biological monitoring guidance value (BMGV) for Cr^{6+} is set at 10 µmol/mol creatinine in urine. According to the legislation, EH40/2005 Workplace Exposure Limits states "BMGVs are intended to be used as tools in meeting the employer's primary duty to ensure adequate control under the Control of Substances Hazardous to Health (COSHH). Where a BMGV is exceeded, it does not necessarily mean that any corresponding airborne standard has been exceeded or that ill health will occur. It is intended that where they are exceeded, this will give an indication that investigation into current control measures and work practices is necessary".

The values of chromium VI concentrations in urinary samples collected since 2017 are expressed in µmol of Cr^{6+}per mol of creatinine and are reported in annex I. When the Creatinine levels are outside of the HSE guidance values [3393 – 339mg/l], the results should be interpreted with caution and a re-test is advised. Consequently, the table below is a summary, per year, of the number of samples with a chromium VI urinary concentration exceeding the threshold value only when the creatinine levels is whitin the normal range.

Year	Number of samples	Number of samples exceeding the threshold (Cr VI > 10 µmol/mol) and with creatinine levels in the normal range (3393 – 339mg/l)	Range of detected values (Cr VI µMol/mol)
2017	15	0	1.4-3.6
2018	15	4	5.2-14
2019	16	0	1.2-7.9
2020	29	1	0.2-55
2021	9	0	1-38
2022	16	0	0.5-4.6
2023	14	2	0.5-27

Table 58. Chromium VI concentrations in urinary samples exceeding the threshold

The majority of the samples collected show chromium concentrations below the threshold level defined in the UK (< 10 µmol chromium VI/mol creatinine).

10.2.1.3. Supporting information based on skin checks

A Fornightly skin surveillance questionnaire is administered by a trained personnel for skin checks (annexe II). First, a background check is conducted including information regarding past skin problems then, the hands are visualy assessed and looked for signs of dryness, crackness, redness, blisters, infection, open sores and bleeding. If no such signs are detected the employee's skin is considered visually normal. If the signs are present, a referral is send to Occupational Health.

The chrome workers in the Hardware and Diffusion department submitted to the hand survey and the results are provided in Table x for January 2023, February 2023 and March 2023:

Date	Department in the plant	Number of workers inspected for the first skin check of the month	Number of workers inspected for the second skin check of the month	Normal visual assessment
January 2023	Hardware department	10	10	YES
	Diffusion department	9	4	YES
February 2023	Hardware department	9	9	YES
	Diffusion department	9	5	YES
March 2023	Hardware department	10	10	YES
	Diffusion department	9	9	YES

Table 59. Results of hand surveys for workers in the Hardware and Diffusion department

As a result, no anomalies were detected in the hand surveys of January 2023, February 2023 and March 2023.

10.2.2. Professional user

The risk for professional user is therefore limited and it will not be considered for the calculation of the excess of risk to have a cancer in the part 10 of the CSR.

11. UNCERTAINTIES ANALYSIS AND MANAGEMENT IMPROVEMENT

The exposure considered in this CSR is based on several hypotheses. They are made in order to respect a realistic approach and consequently, lead to a realistic estimation of the exposure. They mainly concern the following items:

Worker assessment

- Inputs for modelling

The inputs used for modelling cannot be strictly representative of the realistic use performed on site. In order to be completely transparent, for all the contributing scenarios, the inputs have been chosen in order to represent the most conservative or realistic exposure.

- Modelling approach

Measurement data were not always available for each WCS identified in the document, in this case model estimates were kept for the risk assessment as a conservative approach. The 90th percentile of the monitored concentrations of Cr^{6+} was used to reflect accurately the data set in the appropriate WCS.

- Duration of tasks and frequency used

The duration and the frequencies of the tasks were considered to represent a conservative and realistic scenario considering the maximum possible increase of activity presented in accordance with the tonnage estimation for this site.

Hence the excess risk previously presented can be considered as the realistic consideration, taking into account uncertainties.

Furthermore, the compliance with the operating conditions described in this CSR will be periodically controlled and the efficiency of the risk management measures (mainly ventilations and RPE) will be regularly verified according to a written procedure. All the workers involved will be made aware of the best practices of work to ensure that the level of exposure is as low as possible.

Man via environment assessment

The assessment represents a worst-case scenario that overestimates the real risks linked to the use of the substance by the applicant.

First, the most conservative parameters have been taken in the model: from the physico-chemical properties to the measurement values used. The man via environment risk assessment is based on a conservative assumption regarding the total number of inhabitants from the municipality in Lincoln where the site is located, i.e., 103,000 inhabitants. However, as the modelling tool EUSES gives an estimate of the PEC_{AIR} value

at 100 m from the emission source, the number of people potentially exposed to this concentration level in air would obviously be significantly lower.

Moreover, the mean value was retained for air release, as a worst-case. Similarly, the highest tonnage value (2019) was taken as a worst-case value. After 2019, CrO_3 tonnage at the Lincoln site has been divided by 2.

Furthermore, Cr^{6+} is expected to be reduced rapidly in the environment. As the model does not take into consideration the reduction of Cr^{6+} in Cr^{3+}, PEC_{AIR} and total daily intake values considered in the assessment are also extremely conservative at both local and regional scales. In this way, the applicant activities in a realistic scenario are expected to lead to lower individual excess risk at both local and regional scales.

12. REFERENCES

[ANSES]	ANSES is the French agency for sanitary security. Anses, Valeurs limites d'exposition en milieu professionnel, les composés du chrome hexavalent
[Doury, 1980]	Abaques d'evaluation directe des transferts atmospheriques d'effluents gazeux, Doury et al, February 1980
[ECHA]	ECHA (European Chemicals Agency) Member state committee support document for identification of chromium trioxide as a substance of very high concern because of its CMR properties
[ECHA]	ECHA Guidance on information requirements and chemical safety assessment, chapiter R8, Appendix R. 8-14 page 141.
EPA	EPA Ground Water Issue, Natural Attenuation of Hexavalent Chromium in Groundwater and Soils, EPA154015-941505, 1994
[European Commission, 2013]	EUROPEAN COMMISSION. REGULATION (EC) No 348/2013 amending Annex XIV to Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), 17 April 2013
[EU RAR]	European Union Risk Assessment Report on hexavalent chromium substances (Volume 53 3rd priority list)
[INERIS]	INERIS - Fiche de données toxicologiques et environnementales du chrome et de ses dérivés
[INRS, 2011]	INRS (Institut National de Recherche et de Sécurité). Les appareils de protection respiratoire, choix et utilisation. 2011. Ref : ED 6106
[NIOSH, 2002]	National Institute for Occupational Safety and Health, Occupational Safety and Health Administration Request for information Occupational Exposure to Hexavalent Chromium (CrVI); November 20, 2002.
[RAC, 2013]	RAC (Risk Assessment Committee). Application for authorisation: Establishing a reference dose response relationship for carcinogenicity of hexavalent chromium. 2013. Ref: RAC/27/2013/07 Rev.1
[SCOEL, 2004]	SCOEL is the European Scientific Committee on Occupational Exposure Limits. SCOEL, recommendation from the Scientific Committee on occupational Exposure Limits : Risk assessment for Hexavalent Chromium. 2004
[TGD]	Technical Guidance Document on risk assessment, part II about environmental risk assessment

13. JUSTIFICATION FOR CONFIDENTIALITY CLAIMS

Confidential information was blanked-out in the public version in order to preserve the strategic data of the present AfA.

The following table provides a justification for confidentiality of the blanked-out data of this document.

Blanked-out item reference	Justification for confidentiality
#1	The blanked-out values are directly or indirectly related to the annual consumption of chromium trioxide and cannot be publicly disclosed because they constitute strategic data.
#2	The pictures and technical data regarding the site are kept confidential.
#3	The detailed information regarding the calculations data is kept confidential.

Table 60. Justification for confidentiality claims

Please note that, wherever possible, and in order to not affect the understanding of the application, an effort was made to provide range of values for key confidential data.

#3

14. ANNEX

14.1. ANNEX I: CHROMIUM VI CONCENTRATIONS IN URINARY SAMPLES

Date	SAMPLE	CREATININE LEVEL MG/L	CHROMIUM VI RESULT	
			uMol/mol	BMGV (umol/mol)
DEC-2017	1	850	Not detected	10
	2	970	Not detected	
	3	270	Not detected	
	4	1600	1.4	
	5	520	Not detected	
	6	1200	3.6	
	7	2100	Not detected	
	8	1100	Not detected	
	9	730	Not detected	
	10	680	Not detected	
	11	960	Not detected	
	12	1800	Not detected	
	13	1800	Not detected	
	14	1000	2.2	
	15	2000	Not detected	

Date	SAMPLE	CREATININE LEVEL MG/L	CHROMIUM VI RESULT	
			uMol/mol	BMGV (umol/mol)
DEC-2018	1	2200	Not detected	10
	2	1500	8.7	
	3	2500	5.2	
	4	1100	12	
	5	730	Not detected	
	6	690	13	
	7	1200	7.2	
	8	1700	14	
	9	2000	Not detected	
	10	1100	Not detected	
	11	1200	Not detected	
	12	1600	Not detected	
	13	1600	Not detected	
	14	940	12	
	15	1300	Not detected	

Date	SAMPLE	CREATININE LEVEL MG/L	CHROMIUM VI RESULT	
			uMol/mol	BMGV (umol/mol)
FEB-2019	1	610	Not detected	10
	2	870	Not detected	
	3	1400	Not detected	
	4	1100	Not detected	
	5	2200	Not detected	
	6	1200	Not detected	
AUG-2019	1	2100	4.7	10
	2	2100	1.9	
	3	250	6.1	

	4	1900	2	
	5	2800	7.9	
	6	550	2.8	
	7	1300	1.2	
	8	1500	2	
	9	1800	1.2	
	10	2100	1.4	
TOTAL for the year	16			

Date	SAMPLE	CREATININE LEVEL MG/L	CHROMIUM VI RESULT	
			uMol/mol	BMGV (umol/mol)
JAN-2020	1	1980	1.4	10
	2	2188	0.2	
	3	1794	0.6	
	4	1937	3.6	
	5	1845	2	
	6	1652	2	
	7	1980	4.8	
	8	14199	Not detected	
	9	875	2.4	
	10	1338	0.2	
JUN-2020	1	1150	55	10
	2	1240	2.6	
	3	1470	1	
	4	170	12	
	5	1280	2.7	
	6	1210	Not detected	
	7	1930	1.6	
	8	1920	1.7	
	9	630	Not detected	
	10	1440	0.91	
DEC-2020	1	2850	1.3	10
	2	2190	1.5	
	3	1630	3.1	
	4	1900	Not detected	
	5	1490	2.2	
	6	1650	Not detected	
	7	1610	0.8	
	8	1850	7.1	
	9	190	Not detected	
TOTAL for the year	29			

Date	SAMPLE	CREATININE LEVEL MG/L	CHROMIUM VI RESULT	
			uMol/mol	BMGV (umol/mol)
DEC-2021	1	2760	1.3	10

	2	1010	3.7	
	3	2310	1.6	
	4	290	38	
	5	2110	1.4	
	6	660	Not detected	
	7	1370	1	
OCT-2021	1	1500	1.3	10
	2	220	32	
TOTAL for the year	9			

Date	SAMPLE	CREATININE LEVEL MG/L	CHROMIUM VI RESULT	
			uMol/mol	BMGV (umol/mol)
APR-2022	1	1518	3	10
MAY-2022	2	683	4	10
JUN-2022	3	1186	1.8	10
	1	1235	< 0.9	
	2	1602	< 0.7	
	3	857	< 1.3	
	4	323	3.5	
	5	960	< 1.1	
	6	2073	4.6	
	7	2043	4	
	8	2162	1.8	
	9	1868	< 0.6	
	10	2150	< 0.5	
	11	2493	3.3	
	12	575	< 1.9	
SEPT-2022	1	588	2.5	10
TOTAL for the year	16			

Date	SAMPLE	CREATININE LEVEL MG/L	CHROMIUM VI RESULT	
			uMol/mol	BMGV (umol/mol)
JAN-2023	1	999	20	10
	2	1002	27	
	3	1009	3.9	
	4	1297	<0.8	
	5	1096	<1.0	
	6	1156	<0.9	
	7	797	4.1	
	8	770	<1.4	
	9	2237	<0.5	
	10	2018	<0.5	
	11	1822	<0.6	
	12	614	<1.8	

	13	1177	1.3
	14	**87**	<12

BMGV : Biological monitoring guidance value

In bold and red: value outside the normal range for creatinine level (3393 – 339mg/l) or threshold for Cr VI concentrations (Cr VI > 10 µmol/mol)

	4	1900	2	
	5	2800	7.9	
	6	550	2.8	
	7	1300	1.2	
	8	1500	2	
	9	1800	1.2	
	10	2100	1.4	
TOTAL for the year	16			

Date	SAMPLE	CREATININE LEVEL MG/L	CHROMIUM VI RESULT	
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	8	14199	Not detected	
	9	875	2.4	
	10	1338	0.2	
JUN-2020	1	1150	55	10
	2	1240	2.6	
	3	1470	1	
	4	170	12	
	5	1280	2.7	
	6	1210	Not detected	
	7	1930	1.6	
	8	1920	1.7	
	9	630	Not detected	
	10	1440	0.91	
DEC-2020	1	2850	1.3	10
	2	2190	1.5	
	3	1630	3.1	
	4	1900	Not detected	
	5	1490	2.2	
	6	1650	Not detected	
	7	1610	0.8	
	8	1850	7.1	
	9	190	Not detected	
TOTAL for the year	29			

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DEC-2021	1	2760	1.3	10

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	3	2310	1.6	
	4	290	38	
	5	2110	1.4	
	6	660	Not detected	
	7	1370	1	
OCT-2021	1	1500	1.3	10
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TOTAL for the year	9			

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	2	1602	< 0.7	
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	4	323	3.5	
	5	960	< 1.1	
	6	2073	4.6	
	7	2043	4	
	8	2162	1.8	
	9	1868	< 0.6	
	10	2150	< 0.5	
	11	2493	3.3	
	12	575	< 1.9	
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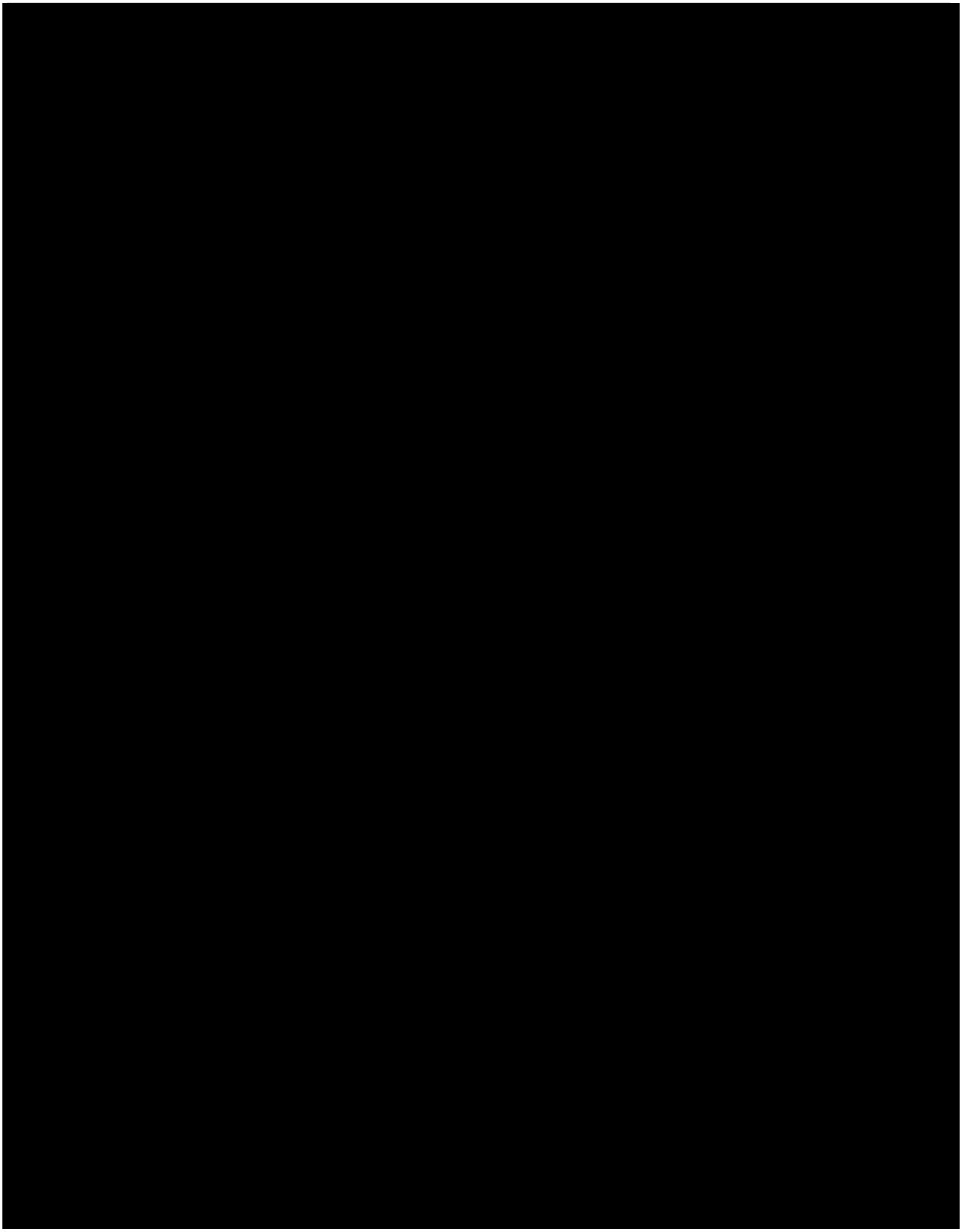
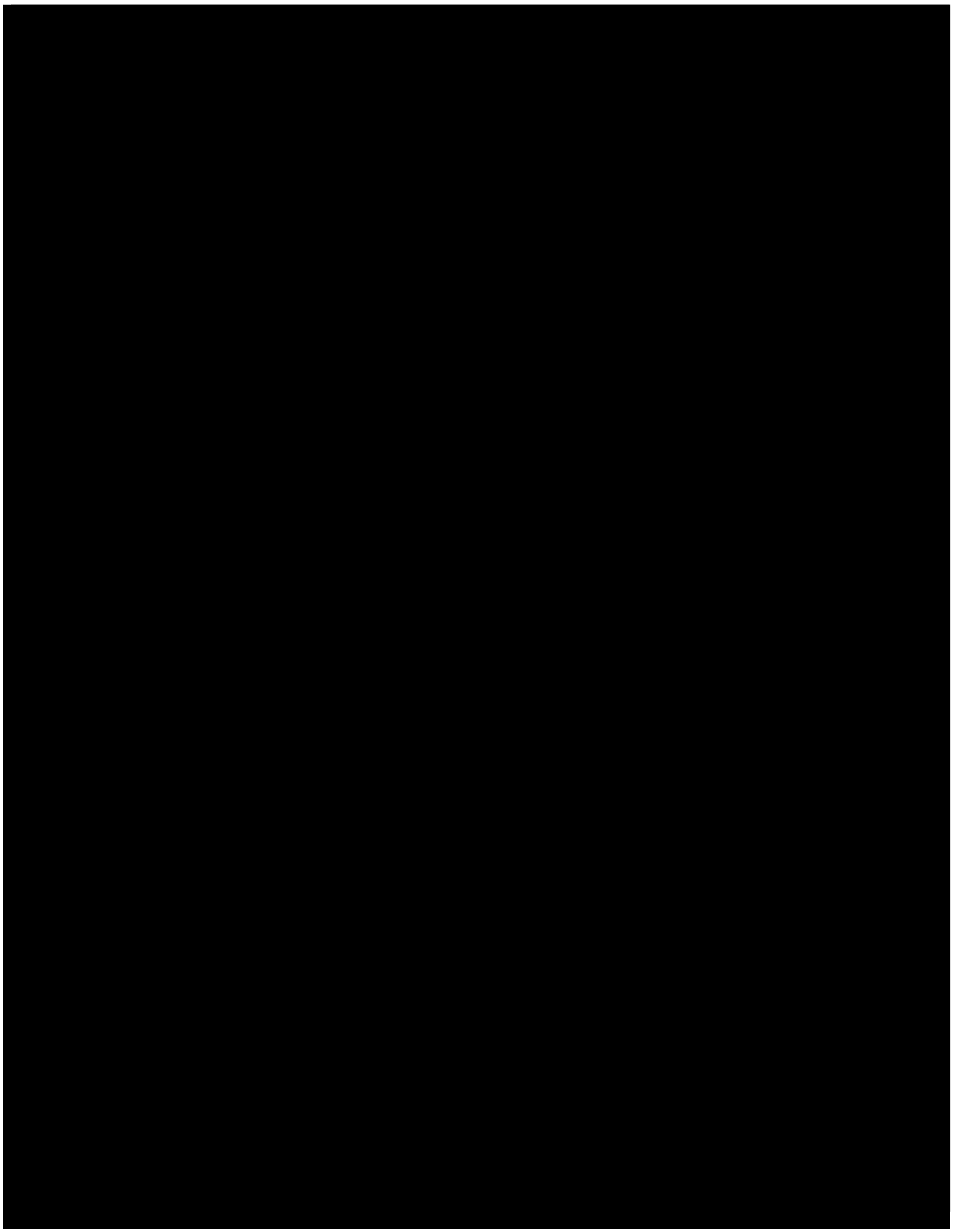
TOTAL for the year	16			

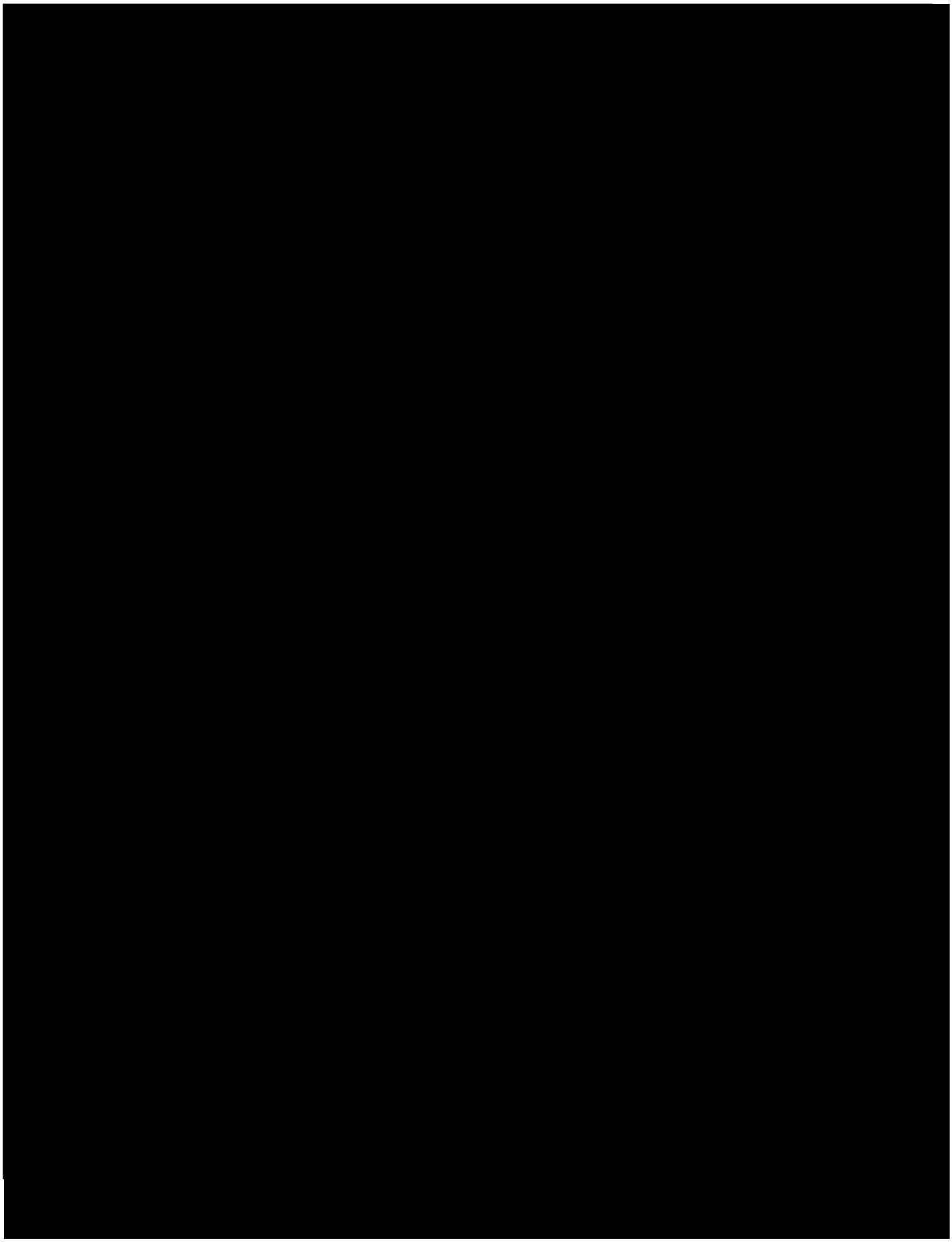
Date	SAMPLE	CREATININE LEVEL MG/L	CHROMIUM VI RESULT	
			uMol/mol	BMGV (umol/mol)
JAN-2023	1	999	20	10
	2	1002	27	
	3	1009	3.9	
	4	1297	<0.8	
	5	1096	<1.0	
	6	1156	<0.9	
	7	797	4.1	
	8	770	<1.4	
	9	2237	<0.5	
	10	2018	<0.5	
	11	1822	<0.6	
	12	614	<1.8	

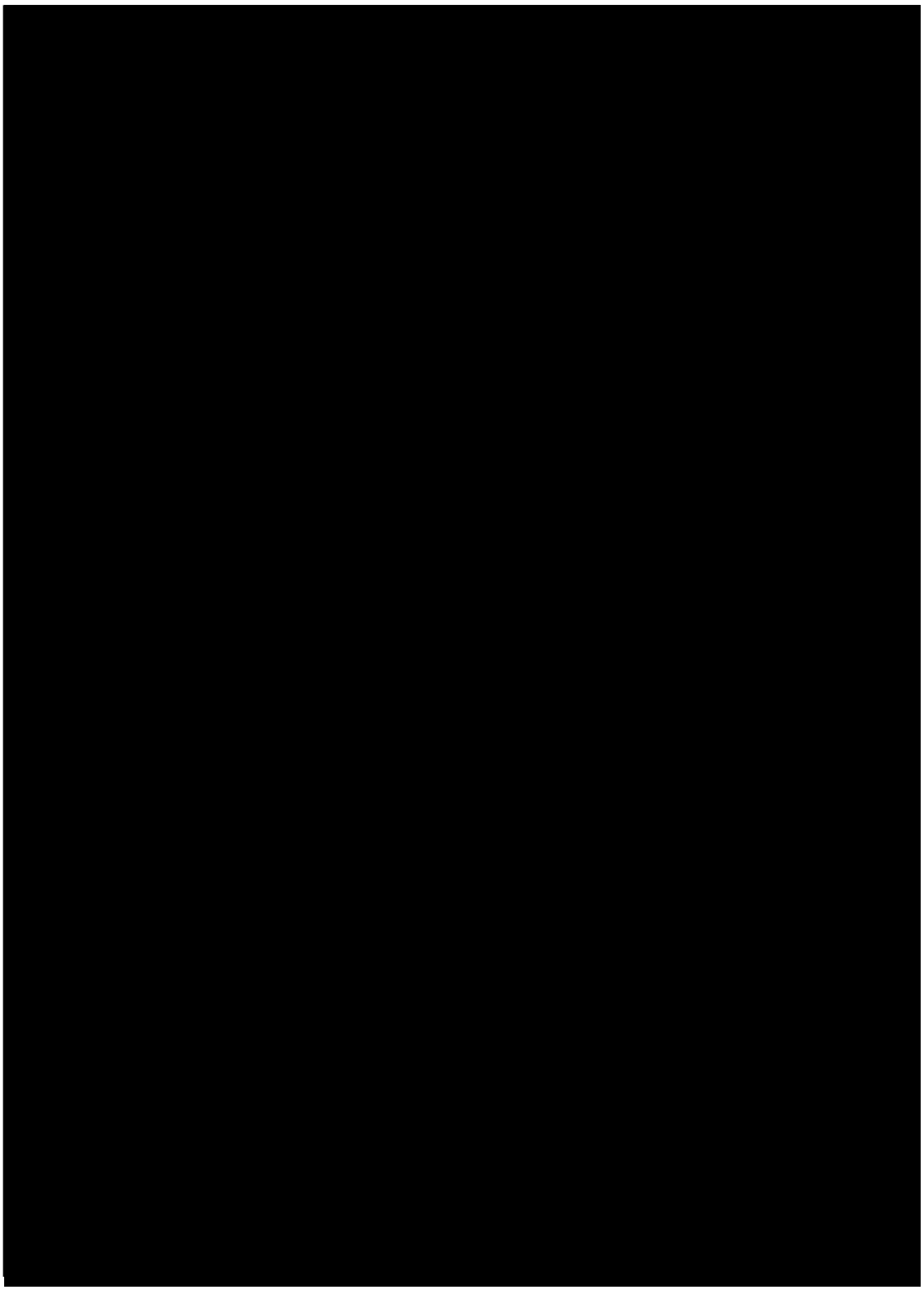
14.2. ANNEX II: [redacted]

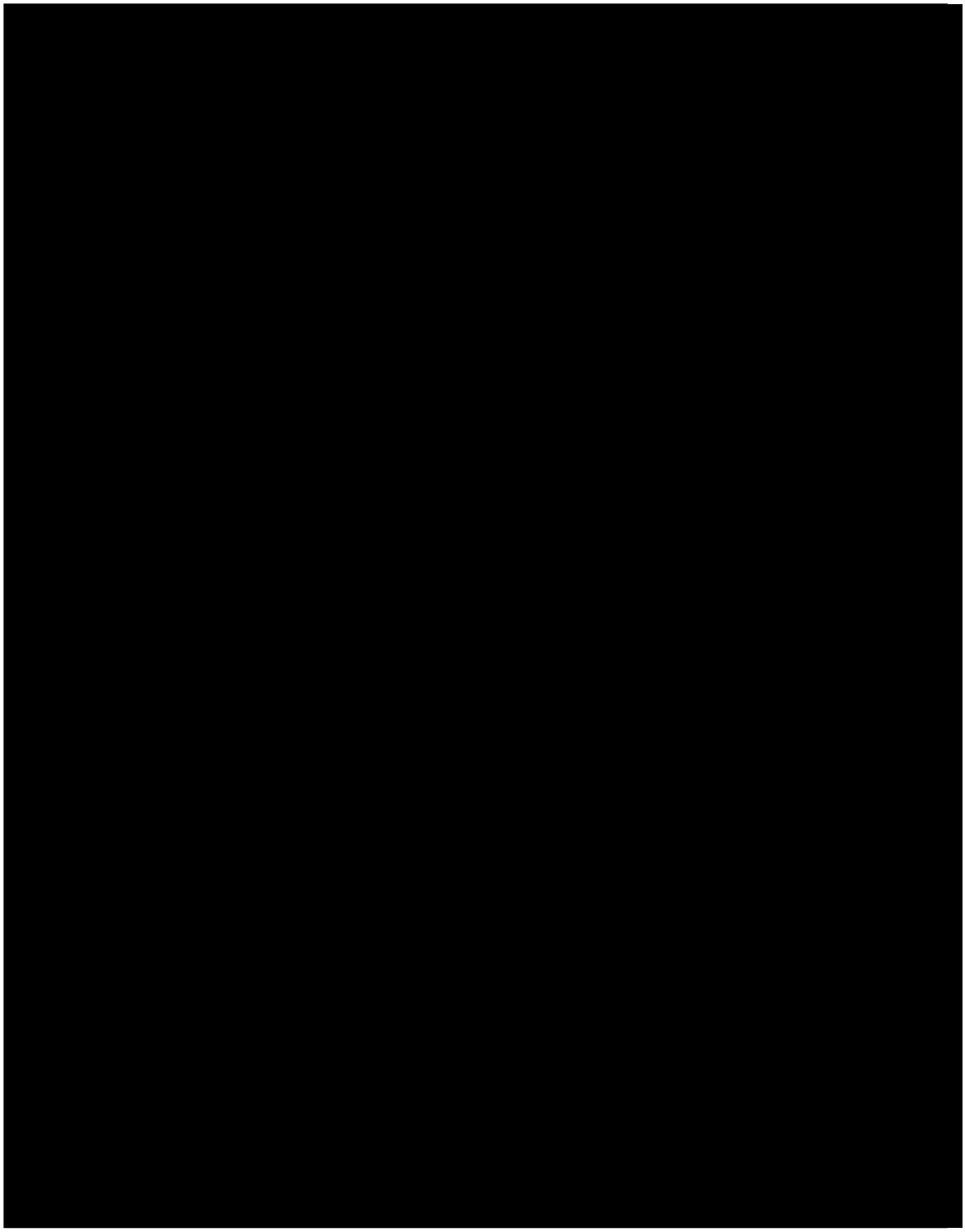


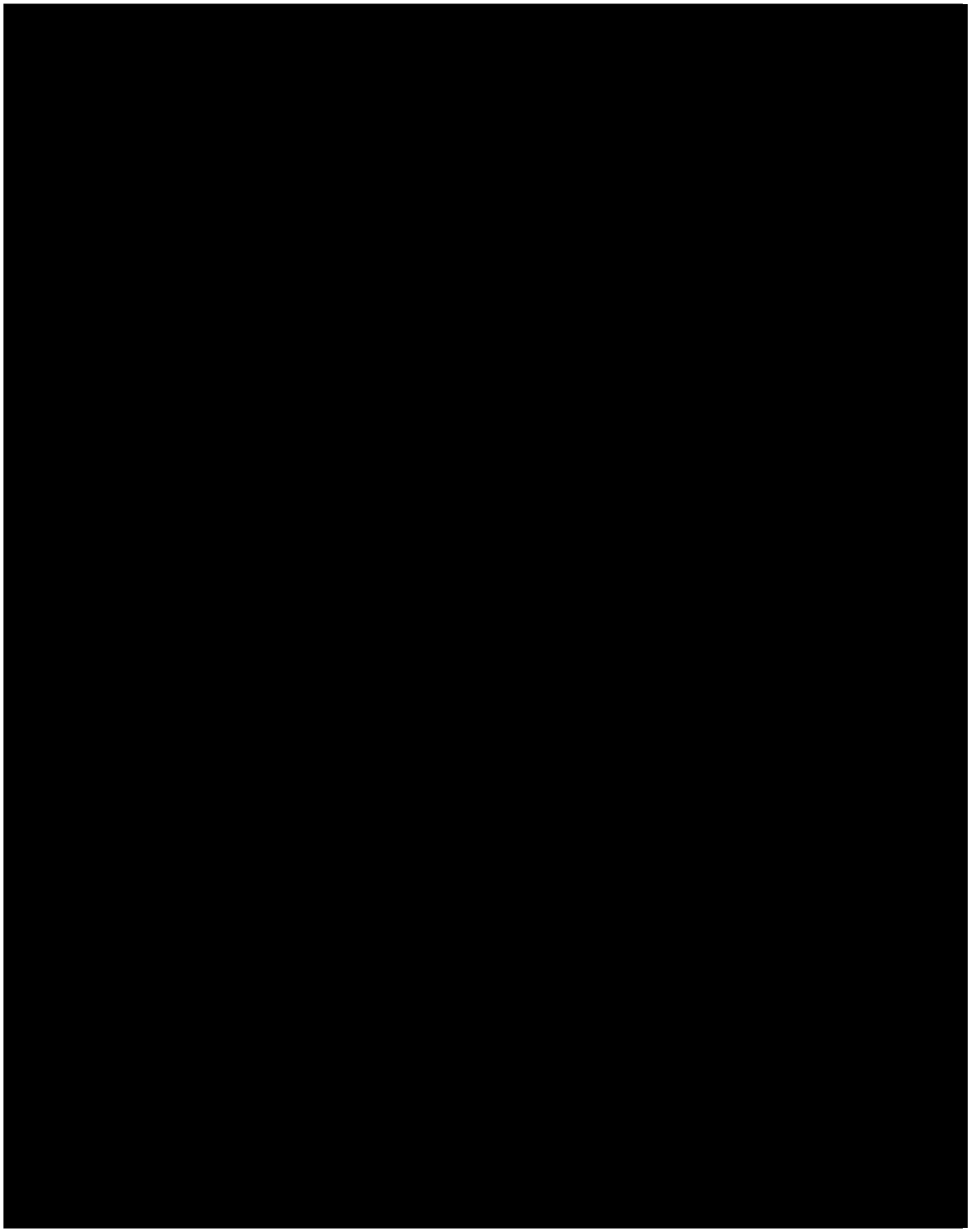


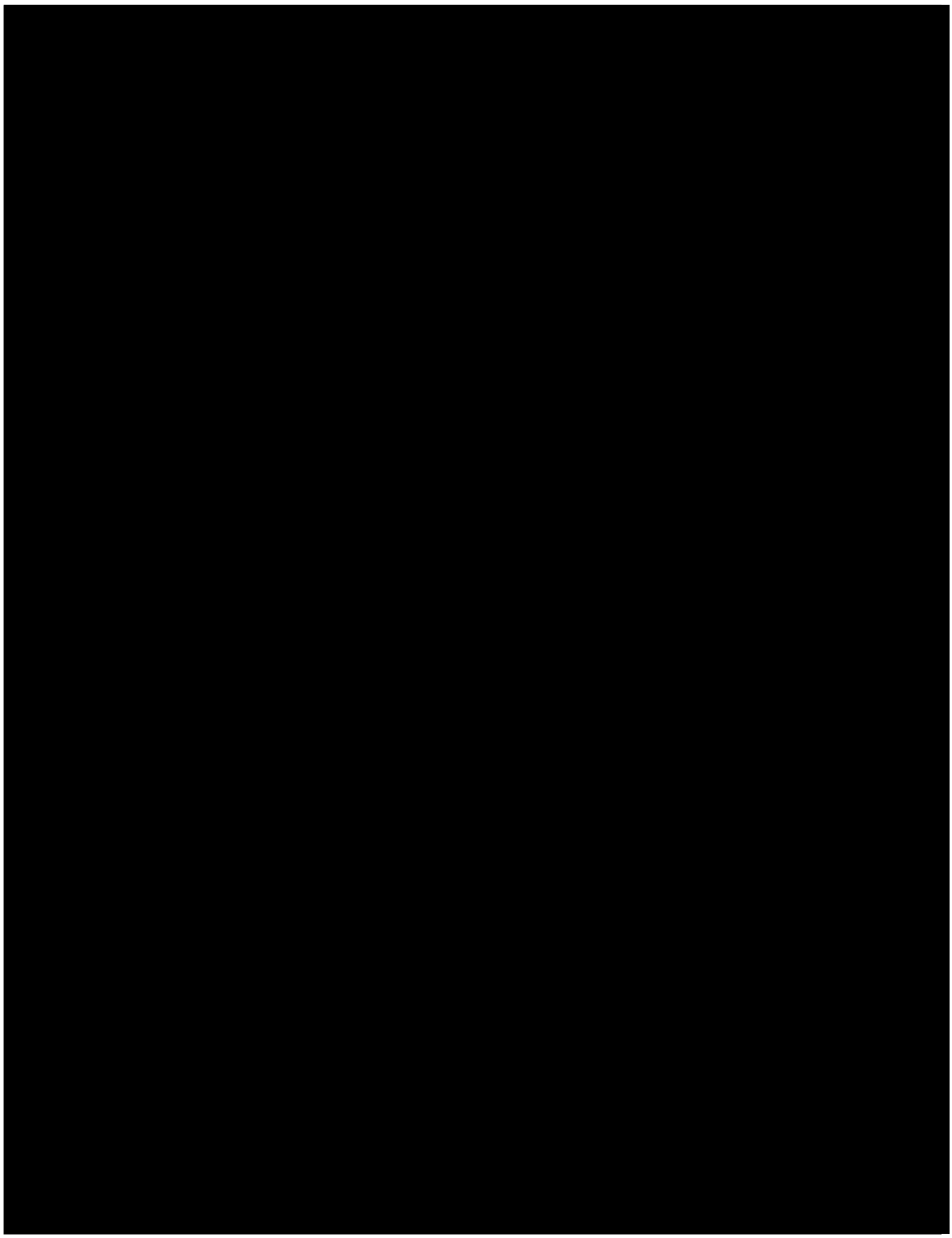
14.3. ANNEX III: [redacted]

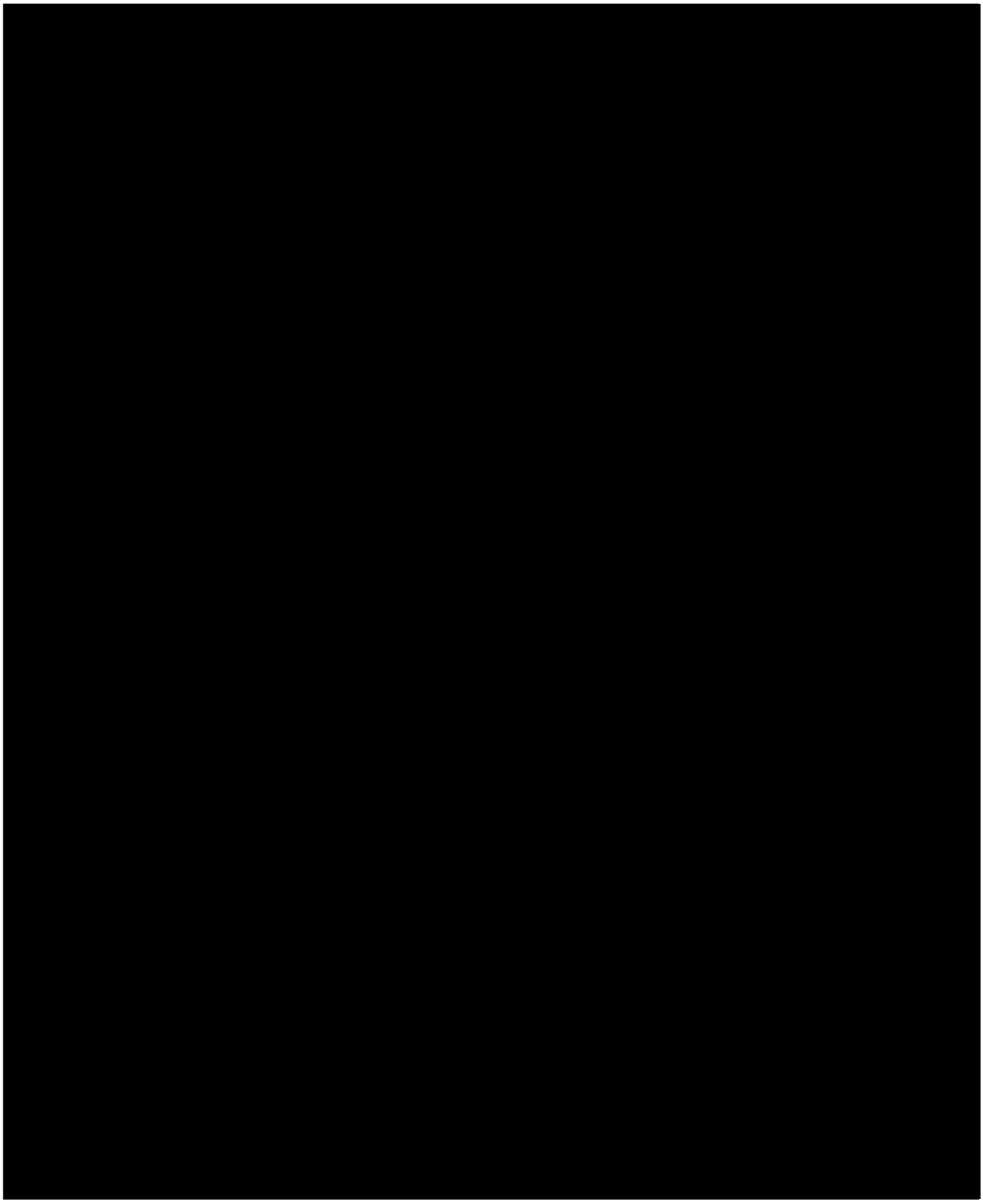


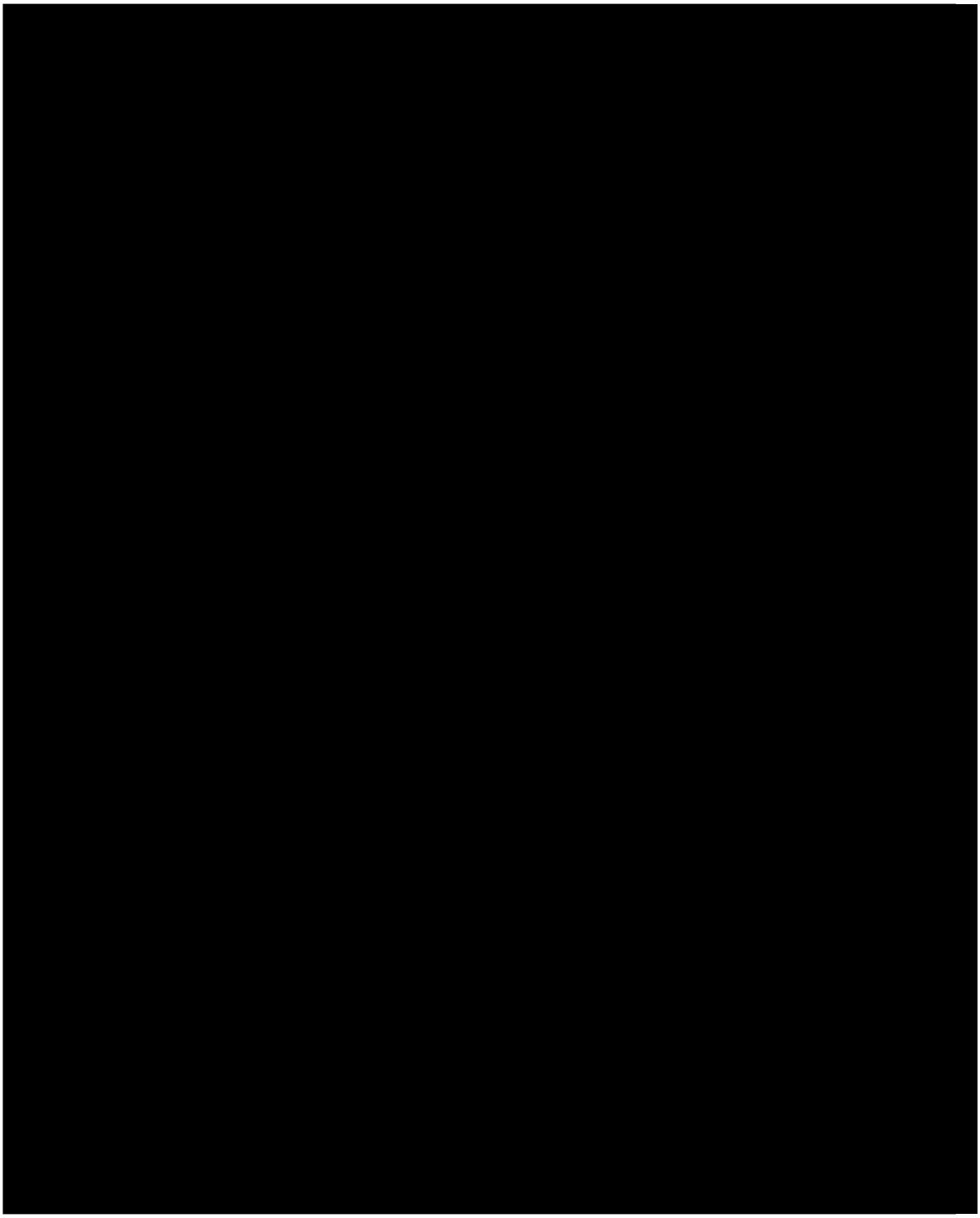


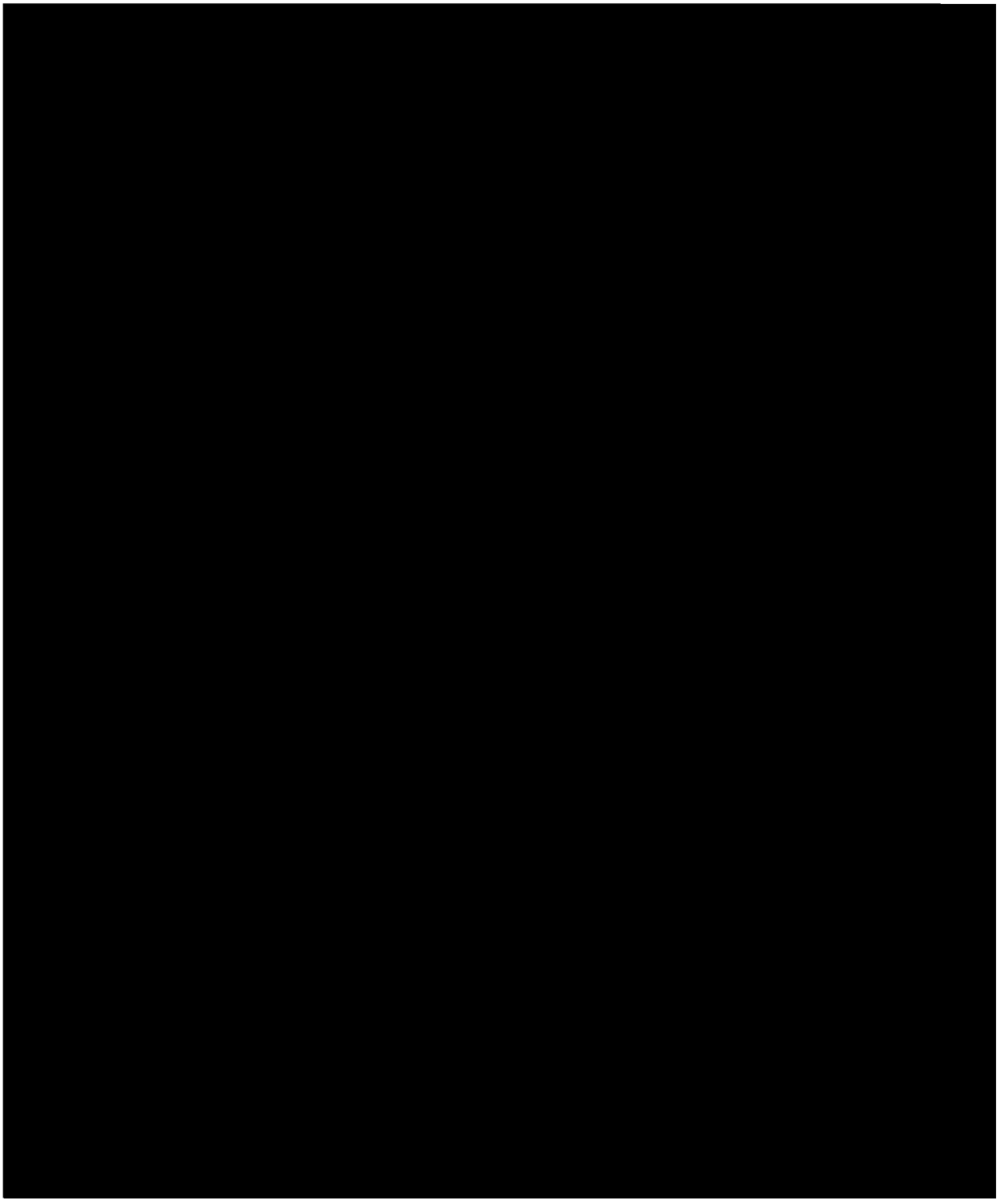












14.4. ANNEX IV: ART REPORTS

Details for Activity Preparation of the coating

Emission sources: Near field ✓ Duration (mins): 15

Far field

Near-field exposure

Operational Conditions

Substance emission potential	
Substance product type	Powders dissolved in a liquid or incorporated in a liquid matrix
Liquid matrix weight fraction	Minor
Viscosity	Low
Activity emission potential	
Activity class	Falling liquids
Situation	Transfer of liquid product with flow of 0.1 - 1 l/minute
Containment level	Handling that reduces contact between product and adjacent air. Note: This does not include processes that are fully contained by localised controls (see next questions).
Loading type	Submerged loading, where the liquid dispenser remains below the fluid level reducing the amount of aerosol formation
Surface contamination	
Process fully enclosed?	No
Effective housekeeping practices in place?	Yes
Dispersion	
Work area	Indoors
Room size	Small workrooms only

Risk Management Measures

Localised controls	
Primary	Other enclosing hoods (90.00 % reduction)
Secondary	No localized controls (0.00 % reduction)
Dispersion	
Ventilation rate	Mechanical ventilation giving at least 1 ACH

Predicted exposure levels

ART predicts air concentrations in a worker's personal breathing zone outside of any Respiratory Protection Equipment (RPE). The use of RPE must be considered separately.

Mechanistic model results

The predicted 90th percentile long-term exposure is 0.00016 mg/m³.

The inter-quartile confidence interval is 0.000073 mg/m³ to 0.00039 mg/m³.

Details for Activity Manual spraying

Emission sources: Near field ✓ Duration (mins): 300

Far field

Near-field exposure

Operational Conditions

Substance emission potential	
Substance product type	Powders dissolved in a liquid or incorporated in a liquid matrix
Liquid matrix weight fraction	Minor
Viscosity	Low
Activity emission potential	
Activity class	Surface spraying of liquids
Situation	Moderate application rate (0.3 - 3 l/minute)
Spray direction	Only horizontal or downward
Spray technique	Spraying with no or low compressed air use
Surface contamination	
Process fully enclosed?	No
Effective housekeeping practices in place?	Yes
Dispersion	
Work area	Spray room
Type	Cross-flow spray room

Risk Management Measures

Localised controls	
Primary	Other enclosing hoods (90.00 % reduction)
Secondary	No localized controls (0.00 % reduction)
Dispersion	
Work area	Cross-flow spray room (30.00 % reduction)
Reduction in comparison with a medium sized room (300 m³) with moderate ventilation rate (1 ACH).	

Predicted exposure levels

ART predicts air concentrations in a worker's personal breathing zone outside of any Respiratory Protection Equipment (RPE). The use of RPE must be considered separately.

Mechanistic model results

The predicted 90th percentile long-term exposure is 0.17 mg/m³.

The inter-quartile confidence interval is 0.074 mg/m³ to 0.4 mg/m³.

Details for Activity Parts transportation

Emission sources: Near field ✓ Duration (mins): 10

Far field

Near-field exposure

Operational Conditions

Substance emission potential	
Substance product type	Powders dissolved in a liquid or incorporated in a liquid matrix
Liquid matrix weight fraction	Minor
Viscosity	Low
Activity emission potential	
Activity class	Handling of contaminated objects
Situation	Activities with treated/contaminated objects (surface 1-3 m²)
Contamination level	Contamination > 90 % of surface
Surface contamination	
Process fully enclosed?	No
Effective housekeeping practices in place?	Yes
Dispersion	
Work area	Indoors
Room size	Large workrooms only

Risk Management Measures

Localised controls	
Primary	No localized controls (0.00 % reduction)
Secondary	No localized controls (0.00 % reduction)
Dispersion	
Ventilation rate	Mechanical ventilation giving at least 1 ACH

Predicted exposure levels

ART predicts air concentrations in a worker's personal breathing zone outside of any Respiratory Protection Equipment (RPE). The use of RPE must be considered separately.

Mechanistic model results

The predicted 90th percentile long-term exposure is 0.002 mg/m³.

The inter-quartile confidence interval is 0.0009 mg/m³ to 0.0048 mg/m³.

Details for Activity Drying of coating

Emission sources: Near field
Far field ✓

Duration (mins): 30

Far-field exposure

Operational Conditions

Substance emission potential	
Substance product type	Powders dissolved in a liquid or incorporated in a liquid matrix
Liquid matrix weight fraction	Minor
Viscosity	Low
Activity emission potential	
Activity class	Handling of contaminated objects
Situation	Activities with treated/contaminated objects (surface 1-3 m²)
Contamination level	Contamination > 90 % of surface
Surface contamination	
Process fully enclosed?	No
Effective housekeeping practices in place?	Yes
Dispersion	
Work area	Indoors
Room size	Large workrooms only

Risk Management Measures

Localised controls	
Primary	No localized controls (0.00 % reduction)
Secondary	No localized controls (0.00 % reduction)
Segregation	Partial segregation with ventilation and filtration of recirculated air (70.00 % reduction)
Personal enclosure	Partial personal enclosure with ventilation (70.00 % reduction)
Dispersion	
Ventilation rate	Mechanical ventilation giving at least 1 ACH

Predicted exposure levels

ART predicts air concentrations in a worker's personal breathing zone outside of any Respiratory Protection Equipment (RPE). The use of RPE must be considered separately.

Mechanistic model results

The predicted 90th percentile long-term exposure is 0.000029 mg/m³.

The inter-quartile confidence interval is 0.000013 mg/m³ to 0.00007 mg/m³.

Details for Activity Curing of coating

Emission sources: Near field

Far field ✓

Duration (mins): 120

Far-field exposure

Operational Conditions

Substance emission potential	
Substance product type	Powders dissolved in a liquid or incorporated in a liquid matrix
Liquid matrix weight fraction	Minor
Viscosity	Low
Activity emission potential	
Activity class	Handling of contaminated objects
Situation	Activities with treated/contaminated objects (surface 1-3 m²)
Contamination level	Contamination > 90 % of surface
Surface contamination	
Process fully enclosed?	No
Effective housekeeping practices in place?	Yes
Dispersion	
Work area	Indoors
Room size	Large workrooms only

Risk Management Measures

Localised controls	
Primary	No localized controls (0.00 % reduction)
Secondary	No localized controls (0.00 % reduction)
Segregation	Partial segregation with ventilation and filtration of recirculated air (70.00 % reduction)
Personal enclosure	Partial personal enclosure with ventilation (70.00 % reduction)
Dispersion	
Ventilation rate	Mechanical ventilation giving at least 1 ACH

Predicted exposure levels

ART predicts air concentrations in a worker's personal breathing zone outside of any Respiratory Protection Equipment (RPE). The use of RPE must be considered separately.

Mechanistic model results

The predicted 90th percentile long-term exposure is 0.00003 mg/m³.

The inter-quartile confidence interval is 0.000013 mg/m³ to 0.000071 mg/m³.

Details for Activity Removal of coating

Emission sources: Near field ✓ Duration (mins): 60

Far field

Near-field exposure

Operational Conditions

Substance emission potential	
Substance product type	Powders dissolved in a liquid or incorporated in a liquid matrix
Liquid matrix weight fraction	Minor
Viscosity	Low
Activity emission potential	
Activity class	Handling of contaminated objects
Situation	Activities with treated/contaminated objects (surface 1-3 m²)
Contamination level	Contamination > 90 % of surface
Surface contamination	
Process fully enclosed?	No
Effective housekeeping practices in place?	Yes
Dispersion	
Work area	Indoors
Room size	Large workrooms only

Risk Management Measures

Localised controls	
Primary	No localized controls (0.00 % reduction)
Secondary	No localized controls (0.00 % reduction)
Dispersion	
Ventilation rate	Mechanical ventilation giving at least 1 ACH

Predicted exposure levels

ART predicts air concentrations in a worker's personal breathing zone outside of any Respiratory Protection Equipment (RPE). The use of RPE must be considered separately.

Mechanistic model results

The predicted 90th percentile long-term exposure is 0.002 mg/m³.

The inter-quartile confidence interval is 0.0009 mg/m³ to 0.0048 mg/m³.

Details for Activity Cleaning of the spraying room

Emission sources: Near field ✓ Duration (mins): 60

Far field

Near-field exposure

Operational Conditions

Substance emission potential	
Substance product type	Powders dissolved in a liquid or incorporated in a liquid matrix
Liquid matrix weight fraction	Minor
Viscosity	Low
Activity emission potential	
Activity class	Handling of contaminated objects
Situation	Activities with treated/contaminated objects (surface 1-3 m²)
Contamination level	Contamination 10-90 % of surface
Surface contamination	
Process fully enclosed?	No
Effective housekeeping practices in place?	Yes
Dispersion	
Work area	Spray room
Type	Cross-flow spray room

Risk Management Measures

Localised controls	
Primary	Other enclosing hoods (90.00 % reduction)
Secondary	No localized controls (0.00 % reduction)
Dispersion	
Work area	Cross-flow spray room (30.00 % reduction)
Reduction in comparison with a medium sized room (300 m³) with moderate ventilation rate (1 ACH).	

Predicted exposure levels

ART predicts air concentrations in a worker's personal breathing zone outside of any Respiratory Protection Equipment (RPE). The use of RPE must be considered separately.

Mechanistic model results

The predicted 90th percentile long-term exposure is 0.00005 mg/m³.

The inter-quartile confidence interval is 0.000022 mg/m³ to 0.00012 mg/m³.

Details for Activity Waste management

Emission sources: Near field ✓ Duration (mins): 180
Far field

Near-field exposure

Operational Conditions

Substance emission potential	
Substance product type	Powders dissolved in a liquid or incorporated in a liquid matrix
Liquid matrix weight fraction	Minor
Viscosity	Low
Activity emission potential	
Activity class	Handling of contaminated objects
Situation	Activities with treated/contaminated objects (surface > 3 m²)
Contamination level	Contamination 10-90 % of surface
Surface contamination	
Process fully enclosed?	No
Effective housekeeping practices in place?	Yes
Dispersion	
Work area	Indoors
Room size	Any size workroom

Risk Management Measures

Localised controls	
Primary	No localized controls (0.00 % reduction)
Secondary	No localized controls (0.00 % reduction)
Dispersion	
Ventilation rate	Mechanical ventilation giving at least 1 ACH

Predicted exposure levels

ART predicts air concentrations in a worker's personal breathing zone outside of any Respiratory Protection Equipment (RPE). The use of RPE must be considered separately.

Mechanistic model results

The predicted 90th percentile long-term exposure is 0.001 mg/m³.

The inter-quartile confidence interval is 0.00045 mg/m³ to 0.0024 mg/m³.

14.5. ANNEX: EUSES REPORT

STUDY
STUDY IDENTIFICATION

Study name	LINCOLNS
Study description	LINCOLNS
Author	D
Institute	D
Address	D
Zip code	D
City	D
Country	D
Telephone	D
Telefax	D
Email	D
Calculations checksum	F6399ED7S

DEFAULTS
DEFAULT IDENTIFICATION

General name	Standard Euses 2.2 D	
Description	According to Vol. IV Part B+C and R16 D	

CHARACTERISTICS OF COMPARTMENTS
GENERAL

Density of solid phase	2.5 D	[kg.l-1]
Density of water phase	1 D	[kg.l-1]
Density of air phase	1.3E-03 D	[kg.l-1]
Environmental temperature	12 D	[oC]
Standard temperature for Vp and Sol	25 D	[oC]
Temperature correction method	Temperature correction for local distribution D	
Constant of Junge equation	0.01 D	[Pa.m]
Surface area of aerosol particles	0.01 D	[m2.m-3]
Gas constant	8.314472 [Pa.m3.mol-1.K-1]	D

SUSPENDED MATTER

Volume fraction solids in suspended matter	0.1 D	[m3.m-3]
Volume fraction water in suspended matter	0.9 D	[m3.m-3]
Weight fraction of organic carbon in suspended matter	0.1 D	[kg.kg-1]
Bulk density of suspended matter	1.15E+03 O	[kgwwt.m-3]
Conversion factor wet-dry suspended matter	4.6 [kgwwt.kgdwt-1]	O

SEDIMENT

Volume fraction solids in sediment	0.2 D	[m3.m-3]
Volume fraction water in sediment	0.8 D	[m3.m-3]
Weight fraction of organic carbon in sediment	0.05 D	[kg.kg-1]

SOIL

Volume fraction solids in soil	0.6 D	[m3.m-3]
Volume fraction water in soil	0.2 D	[m3.m-3]
Volume fraction air in soil	0.2 D	[m3.m-3]
Weight fraction of organic carbon in soil	0.02 D	[kg.kg-1]
Weight fraction of organic matter in soil	0.034 O	[kg.kg-1]
Bulk density of soil	1.70026E+03 O	[kgwwt.m-3]
Conversion factor wet-dry soil	1.133507 [kgwwt.kgdwt-1]	O

STP SLUDGE

Fraction of organic carbon in raw sewage sludge	0.3 D	[kg.kg-1]
Fraction of organic carbon in settled sewage sludge	0.3 D	[kg.kg-1]
Fraction of organic carbon in activated sewage sludge	0.37 D	[kg.kg-1]
Fraction of organic carbon in effluent sewage sludge	0.37 D	[kg.kg-1]

DEGRADATION AND TRANSFORMATION RATES		
Rate constant for abiotic degradation in STP	0 D	[d-1]
Rate constant for abiotic degradation in bulk sediment (12[oC])	0 D	[d-1]
Rate constant for anaerobic biodegradation in sediment (12[oC])	0 D	[d-1]
Fraction of sediment compartment that is aerated	0.1 D	[m3.m-3]
Concentration of OH-radicals in atmosphere	5E+05 D	[molec.cm-3]
Rate constant for abiotic degradation in bulk soil (12[oC])	0 D	[d-1]
RELEASE ESTIMATION		
Fraction of EU production volume for region	100 D	[%]
Fraction of EU tonnage for region (private use)	10 D	[%]
Fraction connected to sewer systems	80 D	[%]
SEWAGE TREATMENT		
MODEL VERSION		
Calculation model	SimpleTreat 4.0 D	
GENERAL		
Number of inhabitants feeding one STP	1E+04 D	[eq]
Sewage flow	0.2 D	[m3.d-1.person-1]
Effluent discharge rate of local STP	2E+06 O	[l.d-1]
pH	7 D	[-]
Temperature correction for STP degradation	Yes D	
Temperature of air above aeration tank	15 D	[oC]
Temperature of water in aeration tank	15 D	[oC]
Height of air column above STP	10 D	[m]
REGIONAL AND CONTINENTAL DEFAULTS		
Number of inhabitants of region	2E+07 D	[eq]
Number of inhabitants of continental system	3.5E+08 O	[eq]
Windspeed in the system	3 D	[m.s-1]
RAW SEWAGE		
Mass of O2 binding material in sewage	60 D	[g.d-1.person-1]
Fraction of BOD in sewage solids	0.5417 D	[-]
Mass of sewage solids	0.09 D	[kg.d-1.person-1]
Density solids in raw sewage	1.5 D	[kg.l-1]
Fraction of organic carbon in raw sewage sludge	0.3 D	[kg.kg-1]
PRIMARY SETTLER		
Depth of primary settler	4 D	[m]
Hydraulic retention time of primary settler	2 D	[hr]
Density suspended and settled solids in primary settler	1.5 D	[kg.l-1]
Fraction of organic carbon in settled sewage sludge	0.3 D	[kg.kg-1]

ACTIVATED SLUDGE TANK

Depth of aeration tank	3 D	[m]
Density solids of activated sludge	1.3 D	[kg.l-1]
Concentration solids of activated sludge	4 D	[kg.m-3]
Steady state O2 concentration in activated sludge	2E-03 D	[kg.m-3]
Type of aeration	Surface aeration D	
Aeration rate of bubble aeration	1.31E-05 D	[m3.s-1.eq-1]
Fraction of organic carbon in activated sewage sludge	0.37 D	[kg.kg-1]
Sludge loading rate	0.1 D	[kg.kg-1.d-1]
Hydraulic retention time in aerator (9-box STP)	11.5 O	[hr]
Hydraulic retention time in aerator (6-box STP)	18 O	[hr]
Sludge retention time of aeration tank	14.0659 O	[d]

SOLIDS-LIQUIDS SEPARATOR

Depth of solids-liquid separator	3 D	[m]
Density suspended and settled solids in solids-liquid separator	1.3 D	[kg.l-1]
Concentration suspended solids effluent	0.03 D	[kg.m-3]
Hydraulic retention time of solids-liquid separator	6 D	[hr]
Fraction of organic carbon in effluent sewage sludge	0.37 D	[kg.kg-1]

LOCAL DISTRIBUTION

AIR AND SURFACE WATER

Concentration in air at source strength 1 [kg.d-1]	2.78E-04 D	[mg.m-3]
Standard deposition flux of aerosol-bound compounds	0.01 D	[mg.m-2.d-1]
Standard deposition flux of gaseous compounds	5E-04 O	[mg.m-2.d-1]
Suspended solids concentration in STP effluent water	15 D	[mg.l-1]
Dilution factor (rivers)	10 D	[-]
Flow rate of the river	1.8E+04 D	[m3.d-1]
Calculate dilution from river flow rate	No D	
Dilution factor (coastal areas)	100 D	[-]

SOIL		
Mixing depth of grassland soil	0.1 D	[m]
Dry sludge application rate on agricultural soil	5E+03 D	[kg.ha-1.yr-1]
Dry sludge application rate on grassland	1E+03 D	[kg.ha-1.yr-1]
Averaging time soil (for terrestrial ecosystem)	30 D	[d]
Averaging time agricultural soil	180 D	[d]
Averaging time grassland	180 D	[d]
PMTC, air side of air-soil interface	1.04776E-03 O	[m.s-1]
Soil-air PMTC (air-soil interface)	5.56E-06 D	[m.s-1]
Soil-water film PMTC (air-soil interface)	5.56E-10 D	[m.s-1]
Mixing depth agricultural soil	0.2 D	[m]
Fraction of rain water infiltrating soil	0.25 D	[-]
Average annual precipitation	700 D	[mm.yr-1]
REGIONAL AND CONTINENTAL DISTRIBUTION CONFIGURATION		
Fraction of direct regional emissions to seawater	1 D	[%]
Fraction of direct continental emissions to seawater	0 D	[%]
Fraction of regional STP effluent to seawater	0 D	[%]
Fraction of continental STP effluent to seawater	0 D	[%]
Fraction of flow from continental rivers to regional rivers	0.034 D	[-]
Fraction of flow from continental rivers to regional sea	0 D	[-]
Fraction of flow from continental rivers to continental sea	0.966 O	[-]
Number of inhabitants of region	2E+07 D	[eq]
Number of inhabitants in the EU	3.7E+08 D	[eq]
Number of inhabitants of continental system	3.5E+08 O	[eq]

AREAS
REGIONAL

Area (land+rivers) of regional system	4E+04 D	[km2]
Area fraction of freshwater, region (excl. sea)	0.03 D	[-]
Area fraction of natural soil, region (excl. sea)	0.27 D	[-]
Area fraction of agricultural soil, region (excl. sea)	0.6 D	[-]
Area fraction of industrial/urban soil, region (excl. sea)	0.1 D	[-]
Length of regional seawater	40 D	[km]
Width of regional seawater	10 D	[km]
Area of regional seawater	400 O	[km2]
Area (land+rivers+sea) of regional system	4.04E+04 O	[km2]
Area fraction of freshwater, region (total)	0.029703 O	[-]
Area fraction of seawater, region (total)	9.90099E-03 O	[-]
Area fraction of natural soil, region (total)	0.267327 O	[-]
Area fraction of agricultural soil, region (total)	0.594059 O	[-]
Area fraction of industrial/urban soil, region (total)	0.09901 O	[-]

CONTINENTAL

Total area of EU (continent+region, incl. sea)	7.04E+06 D	[km2]
Area (land+rivers+sea) of continental system	6.9996E+06 O	[km2]
Area (land+rivers) of continental system	3.4998E+06 O	[km2]
Area fraction of freshwater, continent (excl. sea)	0.03 D	[-]
Area fraction of natural soil, continent (excl. sea)	0.27 D	[-]
Area fraction of agricultural soil, continent (excl. sea)	0.6 D	[-]
Area fraction of industrial/urban soil, continent (excl. sea)	0.1 D	[-]
Area fraction of freshwater, continent (total)	0.015 O	[-]
Area fraction of seawater, continent (total)	0.5 D	[-]
Area fraction of natural soil, continent (total)	0.135 O	[-]
Area fraction of agricultural soil, continent (total)	0.3 O	[-]
Area fraction of industrial/urban soil, continent (total)	0.05 O	[-]

MODERATE

Area of moderate system (incl.continent,region)	8.5E+07 D	[km2]
Area of moderate system (excl.continent, region)	7.796E+07 O	[km2]
Area fraction of water, moderate system	0.5 D	[-]

ARCTIC

Area of arctic system	4.25E+07 D	[km2]
Area fraction of water, arctic system	0.6 D	[-]

TROPIC		
Area of tropic system	1.275E+08 D	[km2]
Area fraction of water, tropic system	0.7 D	[-]
TEMPERATURE		
Environmental temperature, regional scale	12 D	[oC]
Environmental temperature, continental scale	12 D	[oC]
Environmental temperature, moderate scale	12 D	[oC]
Environmental temperature, arctic scale	-10 D	[oC]
Environmental temperature, tropic scale	25 D	[oC]
Enthalpy of vaporisation	50 D	[kJ.mol-1]
Enthalpy of solution	10 D	[kJ.mol-1]
MASS TRANSFER		
Air-film PMTC (air-water interface)	6.30809E-03 O	[m.s-1]
Water-film PMTC (air-water interface)	6.73132E-06 O	[m.s-1]
PMTC, air side of air-soil interface	1.04776E-03 O	[m.s-1]
PMTC, soil side of air-soil interface	1.88236E-08 O	[m.s-1]
Soil-air PMTC (air-soil interface)	5.56E-06 D	[m.s-1]
Soil-water film PMTC (air-soil interface)	5.56E-10 D	[m.s-1]
Water-film PMTC (sediment-water interface)	2.78E-06 D	[m.s-1]
Pore water PMTC (sediment-water interface)	2.78E-08 D	[m.s-1]
AIR		
GENERAL		
Atmospheric mixing height	1E+03 D	[m]
Windspeed in the system	3 D	[m.s-1]
Aerosol deposition velocity	1E-03 D	[m.s-1]
Aerosol collection efficiency	2E+05 D	[-]
RAIN		
Average precipitation, regional system	700 D	[mm.yr-1]
Average precipitation, continental system	700 D	[mm.yr-1]
Average precipitation, moderate system	700 D	[mm.yr-1]
Average precipitation, arctic system	250 D	[mm.yr-1]
Average precipitation, tropic system	1.3E+03 D	[mm.yr-1]
RESIDENCE TIMES		
Residence time of air, regional	0.687228 O	[d]
Residence time of air, continental	9.045791 O	[d]
Residence time of air, moderate	30.1888 O	[d]
Residence time of air, arctic	22.28971 O	[d]
Residence time of air, tropic	38.60691 O	[d]

WATER
DEPTH

Water depth of freshwater, regional system	3 D	[m]
Water depth of seawater, regional system	10 D	[m]
Water depth of freshwater, continental system	3 D	[m]
Water depth of seawater, continental system	200 D	[m]
Water depth, moderate system	1E+03 D	[m]
Water depth, arctic system	1E+03 D	[m]
Water depth, tropic system	1E+03 D	[m]

SUSPENDED SOLIDS

Suspended solids conc. freshwater, regional	15 D	[mg.l-1]
Suspended solids conc. seawater, regional	5 D	[mg.l-1]
Suspended solids conc. freshwater, continental	15 D	[mg.l-1]
Suspended solids conc. seawater, continental	5 D	[mg.l-1]
Suspended solids conc. seawater, moderate	5 D	[mg.l-1]
Suspended solids conc. seawater, arctic	5 D	[mg.l-1]
Suspended solids conc. seawater, tropic	5 D	[mg.l-1]
Concentration solids in effluent, regional	30 D	[mg.l-1]
Concentration solids in effluent, continental	30 D	[mg.l-1]
Concentration biota	1 D	[mgwwt.l-1]

RESIDENCE TIMES

Residence time of freshwater, regional	43.32637 O	[d]
Residence time of seawater, regional	4.643294 O	[d]
Residence time of freshwater, continental	172.2149 O	[d]
Residence time of seawater, continental	365 O	[d]
Residence time of water, moderate	2.69395E+03 O	[d]
Residence time of water, arctic	5.84462E+03 O	[d]
Residence time of water, tropic	1.09343E+04 O	[d]

SEDIMENT
DEPTH

Sediment mixing depth	0.03 D	[m]

SUSPENDED SOLIDS		
(Biogenic) prod. susp. solids in freshwater, reg	10 D	[g.m-2.yr-1]
(Biogenic) prod. susp. solids in seawater, reg	10 D	[g.m-2.yr-1]
(Biogenic) prod. susp. solids in freshwater, cont	10 D	[g.m-2.yr-1]
(Biogenic) prod. susp. solids in seawater, cont	5 D	[g.m-2.yr-1]
(Biogenic) prod. susp. solids in water, moderate	1 D	[g.m-2.yr-1]
(Biogenic) prod. susp. solids in water, arctic	1 D	[g.m-2.yr-1]
(Biogenic) prod. susp. solids in water, tropic	1 D	[g.m-2.yr-1]
SEDIMENTATION RATES		
Settling velocity of suspended solids	2.5 D	[m.d-1]
Net sedimentation rate, freshwater, regional	2.79765 O	[mm.yr-1]
Net sedimentation rate, seawater, regional	1.529398 O	[mm.yr-1]
Net sedimentation rate, freshwater, continental	2.750931 O	[mm.yr-1]
Net sedimentation rate, seawater, continental	6.68529E-03 O	[mm.yr-1]
Net sedimentation rate, moderate	2.80178E-03 O	[mm.yr-1]
Net sedimentation rate, arctic	2E-03 O	[mm.yr-1]
Net sedimentation rate, tropic	2E-03 O	[mm.yr-1]
SOIL		
GENERAL		
Fraction of rain water infiltrating soil	0.25 D	[-]
Fraction of rain water running off soil	0.25 D	[-]
DEPTH		
Chemical-dependent soil depth	No D	
Mixing depth natural soil	0.05 D	[m]
Mixing depth agricultural soil	0.2 D	[m]
Mixing depth industrial/urban soil	0.05 D	[m]
Mixing depth of soil, moderate system	0.05 D	[m]
Mixing depth of soil, arctic system	0.05 D	[m]
Mixing depth of soil, tropic system	0.05 D	[m]
EROSION		
Soil erosion rate, regional system	0.03 D	[mm.yr-1]
Soil erosion rate, continental system	0.03 D	[mm.yr-1]
Soil erosion rate, moderate system	0.03 D	[mm.yr-1]
Soil erosion rate, arctic system	0.03 D	[mm.yr-1]
Soil erosion rate, tropic system	0.03 D	[mm.yr-1]

CHARACTERISTICS OF PLANTS, WORMS AND CATTLE

PLANTS

Volume fraction of water in plant tissue	0.65 D	[m3.m-3]
Volume fraction of lipids in plant tissue	0.01 D	[m3.m-3]
Volume fraction of air in plant tissue	0.3 D	[m3.m-3]
Correction for differences between plant lipids and octanol	0.95 D	[-]
Bulk density of plant tissue (wet weight)	0.7 D	[kg.l-1]
Rate constant for metabolism in plants	0 D	[d-1]
Rate constant for photolysis in plants	0 D	[d-1]
Leaf surface area	5 D	[m2]
Conductance	1E-03 D	[m.s-1]
Shoot volume	2 D	[l]
Rate constant for dilution by growth	0.035 D	[d-1]
Transpiration stream	1 D	[l.d-1]

WORMS

Volume fraction of water inside a worm	0.84 D	[m3.m-3]
Volume fraction of lipids inside a worm	0.012 D	[m3.m-3]
Density of earthworms	1 D	[kgwwt.l-1]
Fraction of gut loading in worm	0.1 D	[kg.kg-1]

CATTLE

Daily intake for cattle of grass (dryweight)	16.9 D	[kg.d-1]
Conversion factor grass from dryweight to wetweight	4 D	[kg.kg-1]
Daily intake of soil (dryweight)	0.41 D	[kg.d-1]
Daily inhalation rate for cattle	122 D	[m3.d-1]
Daily intake of drinking water for cattle	55 D	[l.d-1]

CHARACTERISTICS OF HUMANS

Daily intake of drinking water	2 D	[l.d-1]
Daily intake of fish	0.115 D	[kg.d-1]
Daily intake of leaf crops (incl. fruit and cereals)	1.2 D	[kg.d-1]
Daily intake of root crops	0.384 D	[kg.d-1]
Daily intake of meat	0.301 D	[kg.d-1]
Daily intake of dairy products	0.561 D	[kg.d-1]
Inhalation rate for humans (consumers, environment)	0.83333333 D	[m3.hr-1]
Inhalation rate for humans (worker exposure)	1.5 D	[m3.hr-1]
Body weight of the human considered	70 D	[kg]
Correction factor for duration and frequency of exposure	2.8 D	[-]

SUBSTANCE
SUBSTANCE IDENTIFICATION

General name	Linde AMT S	
Description	Chromium (VI) Trioxide S	
CAS-No	1333-82-0 S	
EC-notification no.	D	
EINECS no.	D	

PHYSICO-CHEMICAL PROPERTIES

Molecular weight	52 S	[g.mol-1]
Melting point	500 S	[oC]
Boiling point	500 S	[oC]
Vapour pressure at 20 [oC]	7.08916E-07 O	[Pa]
Vapour pressure at 25 [oC]	1E-06 S	[Pa]
Water solubility at 20 [oC]	9.3351E+04 O	[mg.l-1]
Water solubility at 25 [oC]	1E+05 S	[mg.l-1]
Octanol-water partition coefficient	-1 S	[log10]

PARTITION COEFFICIENTS AND BIOCONCENTRATION FACTORS
SOLIDS-WATER

Chemical class for Koc-QSAR	Non-hydrophobics (default QSAR) D	
Organic carbon-water partition coefficient	3.161889 O	[l.kg-1]
Solids-water partition coefficient in soil	0.063238 O	[l.kg-1]
Solids-water partition coefficient in sediment	0.158094 O	[l.kg-1]
Solids-water partition coefficient suspended matter	0.316189 O	[l.kg-1]
Solids-water partition coefficient in raw sewage sludge	0.948567 O	[l.kg-1]
Solids-water partition coefficient in settled sewage sludge	0.948567 O	[l.kg-1]
Solids-water partition coefficient in activated sewage sludge	1.169899 O	[l.kg-1]
Solids-water partition coefficient in effluent sewage sludge	1.169899 O	[l.kg-1]
Soil-water partition coefficient	0.294857 O	[m3.m-3]
Suspended matter-water partition coefficient	0.979047 O	[m3.m-3]
Sediment-water partition coefficient	0.879047 O	[m3.m-3]

AIR-WATER

Environmental temperature	12 D	[oC]
Water solubility at environmental temperature	8.32012E+04 O	[mg.l-1]
Vapour pressure at environmental temperature	3.98703E-07 O	[Pa]
Sub-cooled liquid vapour pressure	0.044388 O	[Pa]
Fraction of chemical associated with aerosol particles	2.24778E-03 O	[-]
Henry's law constant at test temperature	?? [Pa.m3.mol-1]	D
Temperature at which Henry's law constant was measured	25 D	[oC]
Henry's law constant at 25 [oC]	5.2E-10 [Pa.m3.mol-1]	O
Henry's law constant at environmental temperature	2.49185E-10 [Pa.m3.mol-1]	O
Air-water partitioning coefficient	1.05103E-13 O	[m3.m-3]

BIOCONCENTRATION FACTORS
PREDATOR EXPOSURE

Bioconcentration factor for earthworms	0.8412 O	[l.kgwwt-1]

HUMAN AND PREDATOR EXPOSURE

Bioconcentration factor for fish	1.412538 O	[l.kgwwt-1]
QSAR valid for calculation of BCF-Fish	Yes O	
Biomagnification factor in fish	1 O	[-]
Biomagnification factor in predator	1 O	[-]

HUMAN EXPOSURE

Partition coefficient between leaves and air	6.19509E+12 O	[m3.m-3]
Partition coefficient between plant tissue and water	0.651122 O	[m3.m-3]
Transpiration-stream concentration factor	0.033017 O	[-]
Bioaccumulation factor for meat	7.94328E-07 O	[d.kg-1]
Bioaccumulation factor for milk	7.94328E-06 O	[d.kg-1]
Purification factor for surface water	1 O	[-]

BIOTA-WATER
FOR REGIONAL/CONTINENTAL DISTRIBUTION

Bioconcentration factor for aquatic biota	1.412538 O	[l.kgwwt-1]

DEGRADATION AND TRANSFORMATION RATES
CHARACTERIZATION

Characterization of biodegradability	Not biodegradable S	

STP

Select biodegradation test method	Method 1: estimated from standardized biodegradability tests (OECD 301 series, 310, 302 series) D	
Percentage removal due to biodegradation	Select percentage (%) D	
Aquatic first order degradation constant (at 15 oC)	0 D	[hr-1]
First order degradation constant valid for combined aqueous phase/sludge (at 15 oC)	?? [hr-1]	D
First order degradation constant valid for aqueous phase (at 15 oC)	?? D	[hr-1]

WATER/SEDIMENT		
WATER		
Rate constant for hydrolysis in surface water (12[oC])	6.93147E-07 O	[d-1]
Rate constant for photolysis in surface water	6.93147E-07 O	[d-1]
Rate constant for biodegradation in surface water (12[oC])	6.93147E-07 O	[d-1]
Total rate constant for degradation in bulk surface water (12[oC])	2.07944E-06 O	[d-1]
Rate constant for biodegradation in saltwater (12[oC])	6.93147E-07 O	[d-1]
Total rate constant for degradation in bulk saltwater (12[oC])	2.07944E-06 O	[d-1]
SEDIMENT		
Rate constant for biodegradation in aerated sediment (12[oC])	6.93147E-07 O	[d-1]
Total rate constant for degradation in bulk sediment (12[oC])	6.93147E-08 O	[d-1]
AIR		
Specific degradation rate constant with OH-radicals	0 [cm3.molec-1.s-1]	D
Rate constant for degradation in air	0 O	[d-1]
SOIL		
Rate constant for biodegradation in bulk soil (12[oC])	6.93147E-07 O	[d-1]
Total rate constant for degradation in bulk soil (12[oC])	6.93147E-07 O	[d-1]
REMOVAL RATE CONSTANTS SOIL		
Total rate constant for degradation in bulk soil (12[oC])	6.93147E-07 O	[d-1]
Rate constant for volatilisation from agricultural soil	1.61342E-10 O	[d-1]
Rate constant for leaching from agricultural soil	8.13026E-03 O	[d-1]
Total rate constant for removal from agricultural top soil	8.13095E-03 O	[d-1]
Rate constant for volatilisation from grassland soil	3.22685E-10 O	[d-1]
Rate constant for leaching from grassland soil	0.016261 O	[d-1]
Total rate constant for removal from grassland top soil	0.016261 O	[d-1]
Rate constant for volatilisation from industrial soil	6.45369E-10 O	[d-1]
Rate constant for leaching from industrial soil	0.032521 O	[d-1]
Total rate constant for removal from industrial soil	0.032522 O	[d-1]

RELEASE ESTIMATION
CHARACTERIZATION AND TONNAGE

High Production Volume Chemical	No	S	
Production volume of chemical in EU	165.53	S	[kg.yr-1]
Fraction of EU production volume for region	100	D	[%]
Regional production volume of substance	0.16553	O	[tonnes.yr-1]
Continental production volume of substance	0	O	[tonnes.yr-1]
Volume of chemical imported to EU	0	D	[tonnes.yr-1]
Volume of chemical exported from EU	0	D	[tonnes.yr-1]
Tonnage of substance in Europe	0.16553	O	[tonnes.yr-1]

USE PATTERNS
PRODUCTION STEPS
EMISSION INPUT DATA

Usage/production title		D	
Industry category	15/0 Others	D	
Use category	55/0 Others	S	
Extra details on use category	No extra details necessary	D	
Extra details on use category	No extra details necessary	D	
Main category production	Ib Intermed. stored on-site/continuous prod.	S	
Use specific emission scenario	No	D	
Emission scenario	no special scenario selected/available	S	
Fraction of tonnage for application	1	O	[-]
Total of fractions for all production steps	1	O	[-]
Relevant production volume for usage	0.16553	O	[tonnes.yr-1]
Regional production volume of substance	0.16553	O	[tonnes.yr-1]
Regional production volume for usage	0.16553	O	[tonnes.yr-1]

OTHER LIFE CYCLE STEPS

Total of fractions for all applications	1	O	[-]

INTERMEDIATE RESULTS
INTERMEDIATE
RELEASE FRACTIONS AND EMISSION DAYS
PRODUCTION

Emission tables	A1.1 (general table), B1.2 (specific uses)	S	

RELEASE FRACTIONS

Fraction of tonnage released to air	0.01684	S	[-]
Fraction of tonnage released to wastewater	1.1E-04	S	[-]
Fraction of tonnage released to surface water	0	O	[-]
Fraction of tonnage released to industrial soil	0	S	[-]
Fraction of tonnage released to agricultural soil	0	O	[-]
Emission fractions determined by special scenario	No	O	

EMISSION DAYS		
Fraction of the main local source	1 O	[-]
Number of emission days per year	365 S	[-]
Release to wastewater only	No D	
Emission days determined by special scenario	No O	
REGIONAL AND CONTINENTAL RELEASES		
PRODUCTION		
REGIONAL		
Regional release to air	7.63706E-03 O	[kg.d-1]
Regional release to wastewater	4.98858E-05 O	[kg.d-1]
Regional release to surface water	0 O	[kg.d-1]
Regional release to industrial soil	0 O	[kg.d-1]
Regional release to agricultural soil	0 O	[kg.d-1]
CONTINENTAL		
Continental release to air	0 O	[kg.d-1]
Continental release to wastewater	0 O	[kg.d-1]
Continental release to surface water	0 O	[kg.d-1]
Continental release to industrial soil	0 O	[kg.d-1]
Continental release to agricultural soil	0 O	[kg.d-1]
REGIONAL AND CONTINENTAL TOTAL EMISSIONS		
Total regional emission to air	7.63706E-03 O	[kg.d-1]
Total regional emission to wastewater	3.99086E-05 O	[kg.d-1]
Total regional emission to surface water	0 S	[kg.d-1]
Total regional emission to industrial soil	0 O	[kg.d-1]
Total regional emission to agricultural soil	0 O	[kg.d-1]
Total continental emission to air	0 O	[kg.d-1]
Total continental emission to wastewater	0 O	[kg.d-1]
Total continental emission to surface water	0 O	[kg.d-1]
Total continental emission to industrial soil	0 O	[kg.d-1]
Total continental emission to agricultural soil	0 O	[kg.d-1]
LOCAL		
[PRODUCTION]		
RELEASE VIA STP		
Local emission to air	7.63706E-03 O	[kg.d-1]
Emission to air calculated by special scenario	No O	
Local emission to wastewater	4.98858E-05 O	[kg.d-1]
Emission to water calculated by special scenario	No O	
Show this step in further calculations	Yes O	
Intermittent release	No D	

DISTRIBUTION
SEWAGE TREATMENT
CONTINENTAL

Fraction of emission directed to air	0 O	[%]
Fraction of emission directed to water	0 O	[%]
Fraction of emission directed to sludge	0 O	[%]
Fraction of the emission degraded	0 O	[%]
Total of fractions	0 O	[%]
Indirect emission to air	0 O	[kg.d-1]
Indirect emission to surface water	0 O	[kg.d-1]
Indirect emission to agricultural soil	0 O	[kg.d-1]

REGIONAL

Fraction of emission directed to air	7.22647E-10 O	[%]
Fraction of emission directed to water	99.95903 O	[%]
Fraction of emission directed to sludge	0.040967 O	[%]
Fraction of the emission degraded	0 O	[%]
Total of fractions	100 O	[%]
Indirect emission to air	2.88398E-16 O	[kg.d-1]
Indirect emission to surface water	3.98923E-05 O	[kg.d-1]
Indirect emission to agricultural soil	1.63494E-08 O	[kg.d-1]

LOCAL
[PRODUCTION]
INPUT AND CONFIGURATION [PRODUCTION]
INPUT

Use or bypass STP (local freshwater assessment)	Use STP D	
Use or bypass STP (local marine assessment)	Bypass STP D	
Local emission to wastewater	4.98858E-05 O	[kg.d-1]
Concentration in untreated wastewater	2.49429E-05 O	[mg.l-1]
Local emission entering the STP	4.98858E-05 O	[kg.d-1]
Chemical class	Neutral D	
Dow (apparent octanol-water partition coefficient at actual pH)	?? O	[-]
pKa (acid dissociation constant)	7 D	[-]

PARTITION COEFFICIENTS

Organic carbon-water partition coefficient	3.161889 O	[l.kg-1]
Solids-water partition coefficient in raw sewage sludge	0.948567 O	[l.kgdwt-1]
Solids-water partition coefficient in activated sewage sludge	1.169899 O	[l.kgdwt-1]

STP CONFIGURATION
OPERATION MODE

Facility type	Municipal D	
Type of local STP	Include primary solids removal (9-box) D	
Fraction of sewage solids removed by primary sedimentation	0.67 D	[-]
pH	7 O	[-]
Effluent discharge rate of this STP	2E+06 O	[l.d-1]

DILUTION

Calculate dilution from river flow rate	No O	
Flow rate of the river	1.8E+04 O	[m3.d-1]
Dilution factor (rivers)	10 O	[-]
Dilution factor (coastal areas)	100 O	[-]

OUTPUT [PRODUCTION]
DISTRIBUTION

Fraction of emission directed to air by STP	7.55817E-10 O	[%]
Fraction of emission directed to water by STP	99.95903 O	[%]
Fraction of emission via primary settler	0.028587 O	[%]
Fraction of emission via surplus sludge	0.01238 O	[%]
Fraction of the emission degraded in STP	0 O	[%]
Total of fractions	100 O	[%]

ELIMINATION AND EMISSION
ELIMINATION IN THE PRIMARY SETTLER

- Volatilization	6.18863E-11 O	[%]
- Via primary sludge	0.028587 O	[%]
- Total elimination in the primary settler	0.028587 O	[%]

ELIMINATION IN THE AERATOR

- Stripping	4.73096E-10 O	[%]
- Biodegradation	0 O	[%]
- Total elimination in the aerator	4.73096E-10 O	[%]

ELIMINATION IN THE SOLIDS LIQUID SEPARATOR

- Volatilization	2.47541E-10 O	[%]
- Via surplus sludge	0.01238 O	[%]
- Total elimination in the solids liquid separator	0.01238 O	[%]
Total elimination from waste water	0.040967 O	[%]
Emission to effluent	99.95903 O	[%]
Total sum of elimination and emission	100 O	[%]
Local indirect emission to air from STP during episode	3.77045E-16 O	[kg.d-1]

CONCENTRATIONS		
Concentration of chemical in untreated wastewater	2.49429E-05 O	[mg.l-1]
Concentration of chemical in air	6.33737E-21 O	[g.m-3]
CONCENTRATION OF CHEMICAL IN SLUDGE		
- In primary sludge	2.36499E-05 O	[mg.kg-1]
- In surplus sludge	2.91663E-05 O	[mg.kg-1]
- Total concentration of chemical in combined sludge	2.50836E-05 O	[mg.kg-1]
CONCENTRATION OF CHEMICAL IN MIXED LIQUOR		
- Dissolved in mixed liquor	2.49318E-05 O	[mg.l-1]
- Associated in mixed liquor	1.16665E-07 O	[mg.l-1]
- Total concentration of chemical in mixed liquor	2.50484E-05 O	[mg.l-1]
CONCENTRATION OF CHEMICAL IN THE STP-EFFLUENT		
- Dissolved in the STP-effluent	2.49318E-05 O	[mg.l-1]
- Associated in the STP-effluent	8.74989E-10 O	[mg.l-1]
- Total concentration in the STP-effluent	2.49327E-05 O	[mg.l-1]
Concentration of chemical in solids effluent	2.91663E-05 O	[mg.kg-1]
Concentration in effluent exceeds solubility	No O	
PEC for micro-organisms in the STP	2.49327E-05 O	[mg.l-1]
REGIONAL, CONTINENTAL AND GLOBAL DISTRIBUTION PECS **REGIONAL**		
Regional PEC in surface water (total)	4.73376E-08 O	[mg.l-1]
Regional PEC in seawater (total)	4.66161E-09 O	[mg.l-1]
Regional PEC in surface water (dissolved)	4.73373E-08 O	[mg.l-1]
Qualitative assessment might be needed (TGD Part II, 5.6)	No O	
Regional PEC in seawater (dissolved)	4.6616E-09 O	[mg.l-1]
Qualitative assessment might be needed (TGD Part II, 5.6)	No O	
Regional PEC in air (total)	1.03832E-14 O	[µg.m-3]
Regional PEC in agricultural soil (total)	3.41851E-08 O	[mg.kgwwt-1]
Regional PEC in pore water of agricultural soils	1.97125E-07 O	[mg.l-1]
Regional PEC in natural soil (total)	3.41861E-08 O	[mg.kgwwt-1]
Regional PEC in industrial soil (total)	3.41861E-08 O	[mg.kgwwt-1]
Regional PEC in sediment (total)	3.5383E-08 O	[mg.kgwwt-1]
Regional PEC in seawater sediment (total)	3.53649E-09 O	[mg.kgwwt-1]

CONTINENTAL		
Continental PEC in surface water (total)	8.61235E-17 O	[mg.l-1]
Continental PEC in seawater (total)	8.8931E-12 O	[mg.l-1]
Continental PEC in surface water (dissolved)	8.6123E-17 O	[mg.l-1]
Continental PEC in seawater (dissolved)	8.89307E-12 O	[mg.l-1]
Continental PEC in air (total)	4.80388E-27 O	[mg.m-3]
Continental PEC in agricultural soil (total)	1.5816E-17 O	[mg.kgwwt-1]
Continental PEC in pore water of agricultural soils	9.12012E-17 O	[mg.l-1]
Continental PEC in natural soil (total)	1.58165E-17 O	[mg.kgwwt-1]
Continental PEC in industrial soil (total)	1.58165E-17 O	[mg.kgwwt-1]
Continental PEC in sediment (total)	6.4374E-17 O	[mg.kgwwt-1]
Continental PEC in seawater sediment (total)	6.74668E-12 O	[mg.kgwwt-1]
GLOBAL: MODERATE		
Moderate PEC in water (total)	6.84818E-12 O	[mg.l-1]
Moderate PEC in water (dissolved)	6.84816E-12 O	[mg.l-1]
Moderate PEC in air (total)	1.07735E-29 O	[mg.m-3]
Moderate PEC in soil (total)	3.54711E-20 O	[mg.kgwwt-1]
Moderate PEC in sediment (total)	5.19532E-12 O	[mg.kgwwt-1]
GLOBAL: ARCTIC		
Arctic PEC in water (total)	6.83389E-12 O	[mg.l-1]
Arctic PEC in water (dissolved)	6.83387E-12 O	[mg.l-1]
Arctic PEC in air (total)	2.52717E-30 O	[mg.m-3]
Arctic PEC in soil (total)	3.14478E-20 O	[mg.kgwwt-1]
Arctic PEC in sediment (total)	5.18448E-12 O	[mg.kgwwt-1]
GLOBAL: TROPIC		
Tropic PEC in water (total)	6.43427E-12 O	[mg.l-1]
Tropic PEC in water (dissolved)	6.43425E-12 O	[mg.l-1]
Tropic PEC in air (total)	3.03875E-29 O	[mg.m-3]
Tropic PEC in soil (total)	5.01422E-20 O	[mg.kgwwt-1]
Tropic PEC in sediment (total)	4.8813E-12 O	[mg.kgwwt-1]

STEADY-STATE FRACTIONS
REGIONAL

Steady-state mass fraction in regional freshwater	0.016671 O	[%]
Steady-state mass fraction in regional seawater	1.82409E-03 O	[%]
Steady-state mass fraction in regional air	4.10359E-11 O	[%]
Steady-state mass fraction in regional agricultural soil	0.027293 O	[%]
Steady-state mass fraction in regional natural soil	3.0705E-03 O	[%]
Steady-state mass fraction in regional industrial soil	1.13722E-03 O	[%]
Steady-state mass fraction in regional freshwater sediment	1.433E-04 O	[%]
Steady-state mass fraction in regional seawater sediment	4.77423E-06 O	[%]

CONTINENTAL

Steady-state mass fraction in continental freshwater	2.65374E-09 O	[%]
Steady-state mass fraction in continental seawater	0.608944 O	[%]
Steady-state mass fraction in continental air	3.2894E-18 O	[%]
Steady-state mass fraction in continental agricultural soil	1.10481E-09 O	[%]
Steady-state mass fraction in continental natural soil	1.24295E-10 O	[%]
Steady-state mass fraction in continental industrial soil	4.60352E-11 O	[%]
Steady-state mass fraction in continental freshwater sediment	2.2811E-11 O	[%]
Steady-state mass fraction in continental seawater sediment	7.96899E-05 O	[%]

GLOBAL: MODERATE

Steady-state mass fraction in moderate water	26.1137 O	[%]
Steady-state mass fraction in moderate air	8.21635E-20 O	[%]
Steady-state mass fraction in moderate soil	1.14988E-11 O	[%]
Steady-state mass fraction in moderate sediment	6.83478E-04 O	[%]

GLOBAL: ARCTIC

Steady-state mass fraction in arctic water	17.04746 O	[%]
Steady-state mass fraction in arctic air	1.05069E-20 O	[%]
Steady-state mass fraction in arctic soil	4.44606E-12 O	[%]
Steady-state mass fraction in arctic sediment	4.46186E-04 O	[%]

GLOBAL: TROPIC

Steady-state mass fraction in tropic water	56.17707 O	[%]
Steady-state mass fraction in tropic air	3.79015E-19 O	[%]
Steady-state mass fraction in tropic soil	1.59504E-11 O	[%]
Steady-state mass fraction in tropic sediment	1.47033E-03 O	[%]

STEADY-STATE MASSES
REGIONAL

Steady-state mass in regional freshwater	0.170415 O	[kg]
Steady-state mass in regional seawater	0.018646 O	[kg]
Steady-state mass in regional air	4.19481E-10 O	[kg]
Steady-state mass in regional agricultural soil	0.278993 O	[kg]
Steady-state mass in regional natural soil	0.031388 O	[kg]
Steady-state mass in regional industrial soil	0.011625 O	[kg]
Steady-state mass in regional freshwater sediment	1.46486E-03 O	[kg]
Steady-state mass in regional seawater sediment	4.88036E-05 O	[kg]

CONTINENTAL

Steady-state mass in continental freshwater	2.71274E-08 O	[kg]
Steady-state mass in continental seawater	6.224813 O	[kg]
Steady-state mass in continental air	3.36252E-17 O	[kg]
Steady-state mass in continental agricultural soil	1.12937E-08 O	[kg]
Steady-state mass in continental natural soil	1.27058E-09 O	[kg]
Steady-state mass in continental industrial soil	4.70586E-10 O	[kg]
Steady-state mass in continental freshwater sediment	2.33181E-10 O	[kg]
Steady-state mass in continental seawater sediment	8.14614E-04 O	[kg]

GLOBAL: MODERATE

Steady-state mass in moderate water	266.9421 O	[kg]
Steady-state mass in moderate air	8.399E-19 O	[kg]
Steady-state mass in moderate soil	1.17544E-10 O	[kg]
Steady-state mass in moderate sediment	6.98671E-03 O	[kg]

GLOBAL: ARCTIC

Steady-state mass in arctic water	174.2643 O	[kg]
Steady-state mass in arctic air	1.07405E-19 O	[kg]
Steady-state mass in arctic soil	4.5449E-11 O	[kg]
Steady-state mass in arctic sediment	4.56105E-03 O	[kg]

GLOBAL: TROPIC

Steady-state mass in tropic water	574.259 O	[kg]
Steady-state mass in tropic air	3.8744E-18 O	[kg]
Steady-state mass in tropic soil	1.6305E-10 O	[kg]
Steady-state mass in tropic sediment	0.01503 O	[kg]

LOCAL
[PRODUCTION]
LOCAL CONCENTRATIONS AND DEPOSITIONS [PRODUCTION]
RELEASE VIA STP
AIR

Concentration in air during emission episode	2.1231E-03 O	[µg.m-3]
Annual average concentration in air, 100 m from point source	2.1231E-06 O	[mg.m-3]
Total deposition flux during emission episode	3.98161E-06 O	[mg.m-2.d-1]
Annual average total deposition flux	3.98161E-06 O	[mg.m-2.d-1]

WATER, SEDIMENT

Concentration in surface water during emission episode (dissolved)	2.49325E-06 O	[mg.l-1]
Concentration in surface water exceeds solubility	No O	
Annual average concentration in surface water (dissolved)	2.49325E-06 O	[mg.l-1]
Concentration in seawater during emission episode (dissolved)	2.49428E-07 O	[mg.l-1]
Annual average concentration in seawater (dissolved)	2.49428E-07 O	[mg.l-1]

SOIL, GROUNDWATER

Concentration in agric. soil averaged over 30 days	1.47453E-06 O	[mg.kgwwt-1]
Concentration in agric. soil averaged over 180 days	1.46045E-06 O	[mg.kgwwt-1]
Concentration in grassland averaged over 180 days	1.44488E-06 O	[mg.kgwwt-1]
Fraction of steady-state (agricultural soil)	1 O	[-]
Fraction of steady-state (grassland soil)	1 O	[-]

LOCAL PECS [PRODUCTION]
RELEASE VIA STP
AIR

Annual average local PEC in air (total)	2.1231E-03 O	[µg.m-3]

WATER, SEDIMENT

Local PEC in surface water during emission episode (dissolved)	2.54059E-06 O	[mg.l-1]
Qualitative assessment might be needed (TGD Part II, 5.6)	No O	
Annual average local PEC in surface water (dissolved)	2.54059E-06 O	[mg.l-1]
Local PEC in freshwater sediment during emission episode	2.16292E-06 O	[mg.kgwwt-1]
Local PEC in seawater during emission episode (dissolved)	2.54089E-07 O	[mg.l-1]
Qualitative assessment might be needed (TGD Part II, 5.6)	No O	
Annual average local PEC in seawater (dissolved)	2.54089E-07 O	[mg.l-1]
Local PEC in marine sediment during emission episode	2.16318E-07 O	[mg.kgwwt-1]

SOIL, GROUNDWATER		
Local PEC in agric. soil (total) averaged over 30 days	1.50872E-06 O	[mg.kgwwt-1]
Local PEC in agric. soil (total) averaged over 180 days	1.49464E-06 O	[mg.kgwwt-1]
Local PEC in grassland (total) averaged over 180 days	1.47906E-06 O	[mg.kgwwt-1]
Local PEC in pore water of agricultural soil	8.61866E-06 O	[mg.l-1]
Local PEC in pore water of grassland	8.52886E-06 O	[mg.l-1]
Local PEC in groundwater under agricultural soil	8.61866E-06 O	[mg.l-1]

EXPOSURE		
SECONDARY POISONING		
SECONDARY POISONING [PRODUCTION]		
Concentration in fish for secondary poisoning (freshwater)	1.82777E-06 O	[mg.kgwwt-1]
Concentration in earthworms from agricultural soil	3.40824E-06 O	[mg.kg-1]
Concentration in fish for secondary poisoning (marine)	1.82748E-07 O	[mg.kgwwt-1]
Concentration in fish-eating marine top-predators	4.18173E-08 O	[mg.kgwwt-1]
HUMANS EXPOSED TO OR VIA THE ENVIRONMENT		
REGIONAL		
CONCENTRATIONS IN FISH, PLANTS AND DRINKING WATER		
Regional concentration in wet fish	6.68657E-08 O	[mg.kg-1]
Regional concentration in root tissue of plant	1.8336E-07 O	[mg.kg-1]
Regional concentration in leaves of plant	1.32827E-07 O	[mg.kg-1]
Regional concentration in grass (wet weight)	1.32827E-07 O	[mg.kg-1]
Fraction of total uptake by crops from pore water	0.999999 O	[-]
Fraction of total uptake by crops from air	6.87629E-07 O	[-]
Fraction of total uptake by grass from pore water	0.999999 O	[-]
Fraction of total uptake by grass from air	6.87629E-07 O	[-]
Regional concentration in drinking water	1.97125E-07 O	[mg.l-1]
CONCENTRATIONS IN MEAT AND MILK		
Regional concentration in meat (wet weight)	1.5757E-11 O	[mg.kg-1]
Regional concentration in milk (wet weight)	1.5757E-10 O	[mg.kg-1]
Fraction of total intake by cattle through grass	0.452648 O	[-]
Fraction of total intake by cattle through drinking water	0.546551 O	[-]
Fraction of total intake by cattle through air	6.38584E-11 O	[-]
Fraction of total intake by cattle through soil	8.00888E-04 O	[-]

DAILY HUMAN DOSES

Daily dose through intake of drinking water	5.63214E-09 O	[mg.kg-1.d-1]
Fraction of total dose through intake of drinking water	0.623975 O	[-]
Daily dose through intake of fish	1.09851E-10 O	[mg.kg-1.d-1]
Fraction of total dose through intake of fish	0.01217 O	[-]
Daily dose through intake of leaf crops	2.27704E-09 O	[mg.kg-1.d-1]
Fraction of total dose through intake of leaf crops	0.252269 O	[-]
Daily dose through intake of root crops	1.00586E-09 O	[mg.kg-1.d-1]
Fraction of total dose through intake of root crops	0.111438 O	[-]
Daily dose through intake of meat	6.7755E-14 O	[mg.kg-1.d-1]
Fraction of total dose through intake of meat	7.50647E-06 O	[-]
Daily dose through intake of milk	1.26281E-12 O	[mg.kg-1.d-1]
Fraction of total dose through intake of milk	1.39905E-04 O	[-]
Daily dose through intake of air	2.96663E-18 O	[mg.kg-1.d-1]
Fraction of total dose through intake of air	3.28668E-10 O	[-]
Regional total daily intake for humans	9.02622E-09 O	[mg.kg-1.d-1]

LOCAL
[PRODUCTION]
CONCENTRATIONS IN FISH, PLANTS AND DRINKING WATER [PRODUCTION]

Local concentration in wet fish	3.58868E-06 O	[mg.kg-1]
Local concentration in root tissue of plant	8.01686E-06 O	[mg.kg-1]
Local concentration in leaves of plant	0.018682 O	[mg.kg-1]
Local concentration in grass (wet weight)	0.018682 O	[mg.kg-1]
Fraction of total uptake by crops from pore water	3.10863E-04 O	[-]
Fraction of total uptake by crops from air	0.999689 O	[-]
Fraction of total uptake by grass from pore water	3.07625E-04 O	[-]
Fraction of total uptake by grass from air	0.999692 O	[-]
Local concentration in drinking water	8.61866E-06 O	[mg.l-1]
Annual average local PEC in air (total)	2.1231E-03 O	[µg.m-3]

CONCENTRATIONS IN MEAT AND MILK [PRODUCTION]

Local concentration in meat (wet weight)	1.00372E-06 O	[mg.kg-1]
Local concentration in milk (wet weight)	1.00372E-05 O	[mg.kg-1]
Fraction of total intake by cattle through grass	0.999419 O	[-]
Fraction of total intake by cattle through drinking water	3.75136E-04 O	[-]
Fraction of total intake by cattle through air	2.04983E-04 O	[-]
Fraction of total intake by cattle through soil	5.43978E-07 O	[-]

DAILY HUMAN DOSES [PRODUCTION]		
Daily dose through intake of drinking water	2.46247E-07	[mg.kg-1.d-1]
Fraction of total dose through intake of drinking water	7.66542E-04	[-]
Daily dose through intake of fish	5.89569E-09	[mg.kg-1.d-1]
Fraction of total dose through intake of fish	1.83526E-05	[-]
Daily dose through intake of leaf crops	3.20257E-04	[mg.kg-1.d-1]
Fraction of total dose through intake of leaf crops	0.996926	[-]
Daily dose through intake of root crops	4.39782E-08	[mg.kg-1.d-1]
Fraction of total dose through intake of root crops	1.36899E-04	[-]
Daily dose through intake of meat	4.316E-09	[mg.kg-1.d-1]
Fraction of total dose through intake of meat	1.34352E-05	[-]
Daily dose through intake of milk	8.04411E-08	[mg.kg-1.d-1]
Fraction of total dose through intake of milk	2.50404E-04	[-]
Daily dose through intake of air	6.066E-07	[mg.kg-1.d-1]
Fraction of total dose through intake of air	1.88828E-03	[-]
Local total daily intake for humans	3.21245E-04	[mg.kg-1.d-1]