ES FOR COMMUNICATION

Substance Name: NICKEL METAL (Update 2023)
EC Number: 231-111-4
CAS Number: 7440-02-0
Registration Number:
Date of Generation/Revision: 15/09/2023
Author: EBRC Consulting GmbH

Table of Contents

0. General provisions related to conditions of use and guidance to downstream users

All provisions given in this Section apply to each exposure scenario (ES) contained in this document. They are to be supplemented or exchanged for more specific measures as indicated in the individual ES.

0.1. Good occupational hygiene practice

Good occupational hygiene practices are essential to ensure safe handling of the substance. Inhalation (e.g., dust should not be blown off with compressed air) and ingestion must be avoided (e.g., no eating and smoking in the workplace, regular cleaning with suitable cleaning devices). Contaminated clothing should not be taken home. Good general ventilation in the workplace must ensure an adequate supply of fresh air. Regular training in workplace hygiene practice and proper use of personal protective equipment (if relevant) is indispensable.

0.2. General provisions related to personal protective equipment for workers

Use of personal protective equipment (PPE) for each of the exposure routes listed below is required as described here unless exposure to the substance can be excluded for the respective route(s) of exposure. Such exclusion of exposure may be determined by:

(i) the physical appearance of the substance in the specific type of application (e.g., wetting the substance can effectively prevent from the emission of dust),
(ii) the emission potential resulting from the nature of the process (e.g., splashes, emission of dust can be excluded in a closed process),
(iii) applied exposure prevention measures (segregation of the emission source or separation of the worker from the emission source), and
(iv) a very small amount of the handled/emitted material in relation to the room size (i.e., dilution factor) under consideration of the prevailing air exchange rates during use.

If PPE needs to be used, further information is provided in the applicable exposure scenarios, in the subsections of this document and in Section 8 of the SDS.

0.2.1. Dermal route (skin protection)

Skin protective equipment is to be selected in consideration of local effects caused by the substance, mechanical (acc. to EN 388, mechanical risks), cold or heat stress (acc. to EN 407, thermal risks) or any other physico-chemical hazards as relevant for the conducted tasks and working environment in addition to the effectiveness of the equipment to control exposure. Certified safety clothing including coveralls and safety shoes must be worn. The following requirements for gloves are to be met:

- Due to the classification of the substance, gloves and skin protective clothing must be worn for precautionary reasons unless dermal exposure can be excluded (please see above).
- If gloves are to be worn, either due to these general provisions or due to specific requirements set in the ES, they must comply with EN 374.
- Any prescribed gloves must be changed according to manufacturer’s information or when damaged, whatever is the earlier.

0.2.2. Inhalation route (respiratory protection)

Specific information on the required assigned protection factor (APF) is provided in the occupational contributing scenarios as relevant. Respiratory protective equipment (RPE) is to be selected based on the given APF according to EN 529 and should comply with national legislation. The following requirements for RPE are to be met in any case:

- Due to the classification of the substance, RPE must be worn for precautionary reasons unless inhalation exposure can be excluded (please see above).

- If RPE must be worn, either due to these general provisions or due to specific requirements set in the ES, an APF of 10 represents the required minimum level of protection.

If RPE is to be worn, the following should all be considered:

(i) the additional physiological stress for the worker due to the increased breathing resistance,
(ii) the mass of the RPE itself,
(iii) the increased temperature by enclosing the head, and
(iv) that the worker's capability of using tools and communicating are reduced whilst wearing RPE.

For the above-indicated reasons, the worker should therefore:

(i) be healthy (especially regarding medical problems that may affect the use of RPE), and
(ii) have facial characteristics that ensure no leakages between face and mask (e.g., leakage risk from facial hair or scar tissue).

The devices recommended in the ES which rely on a tight face seal will not provide the required protection unless they fit the contours of the face properly and securely. The employer and self-employed persons have legal responsibilities for the supply and maintenance of respiratory protective devices, and the management of their correct use in the workplace. Therefore, they should define and document a suitable policy for a respiratory protective device programme, including worker training.

0.2.3. Eye/face protection

Eye/face protective equipment is to be selected in consideration of local effects caused by the substance, mechanical, cold or heat stress or any other physico-chemical hazards as relevant for the conducted tasks and working environment in addition to the effectiveness of the equipment to control exposure. The following requirements for eye/face protective equipment are to be met:

- Avoid direct contact of the eyes with the substance.
- Suitable eye protection equipment (e.g., goggles or visors) must be worn.
- Face protection must be worn unless such protection is provided by any eye protection (e.g., face covering visor) and/or RPE used.

0.3. Generic guidance to DU to evaluate whether he works inside the boundaries set by the ES

For the ES in this document, the Downstream User (DU) works within the boundaries set by the ES if the given operational conditions (OCs) and risk management measures (RMMs) as described in the ES are met. If the DU's conditions are not explicitly included in the generic conditions described in the ES, the DU must ensure that his specific OCs and implemented RMMs are compliant. If the concentration of the substance in mixture and/or the exposure duration is not explicitly stated in the ES up to 100 % of the substance could be used and/or the duration of exposure is not restricted, respectively. Depending on the basis for the exposure assessment conducted for the contributing scenario (CS), the assessment needs to be done in multiple ways as described individually for environmental and occupational CS below.

0.3.1. Occupational contributing scenarios

For the assessment of occupational exposure, different health endpoints are relevant. In general, occupational exposure via the inhalation route and the dermal route are considered relevant. Exposure via these routes may result in systemic or local effects in humans and these may occur after acute (short-term) exposure or long-term exposure. Depending on the type of effect, either quantitative or qualitative exposure assessments are further addressed below as required.

0.3.1.1. Quantitative exposure assessment

The occupational exposure assessment may be either based on monitoring data (including analogous or published data) or based on exposure assessment models. Depending on which method has been

used for the exposure assessment, different ways for checking compliance with the conditions of use described in the ES are to be followed as given below. In any case, it needs to be ensured that the final exposure estimate remains well below the respective DNEL. For systemic effects (if relevant), the sum of the RCRs for the dermal and for the inhalation route needs to be below 1.

0.3.1.1.1. Monitoring data used as basis for assessment

If the exposure assessment in the ES is based on inhalation monitoring data, the same approach can be used by DUs for checking compliance with the conditions of use described in the ES. Please note that 6 measurements per workplace are required for an exposure assessment as a minimum. Depending on the variability of the data sets (expressed as the geometric standard deviation) and the level of the resulting risk characterisation ratio, additional measurements may be required. Only measurements of personal exposure to the inhalable fraction of airborne dust (according to EN 481) should be used. The exposure data shall either be applicable to the length of a specific task to be assessed or to a full shift (i.e., sampled over a duration of at least 120 min) if the task to be assessed is conducted for a significant portion of the work shift. From the exposure data set, the maximum likelihood estimate of the upper 90 % confidence limit for the 75th percentile of the exposure distribution is to be used as a reasonable worst-case estimate for comparison with the reported exposure level in the associated contributing scenario. Respiratory protective equipment (RPE) may be taken into account by applying the assigned protection factor as given in EN 529:2005.

If the typical duration per shift is less than full shift, (i.e., 480 minutes) exposure estimates reflect the actual exposure duration by calculated time-weighted-averages (TWAs).

0.3.1.1.1.1. Specific considerations for efficiency values for RMMs prescribed in occupational contributing scenarios

If your monitored exposure levels are equal or below those reported for the ES after consideration of any PPE worn, the efficiency of the risk management measures (RMMs) implemented at your facility can be considered compliant with the ES.

0.3.1.1.1.2. Deviations from the conditions of use if monitoring data were used for exposure assessment

Any deviations from the given conditions of use mean you need to either:

(i) inform the supplier of the eSDS about these deviations and request the ES be reviewed to include the identified deviations or
(ii) prepare your own DU CSR (according to Article 37(4)), which must be notified to ECHA and be kept at your company as in-house documentation.

0.3.1.1.2. Use of exposure models

If the exposure assessment in the ES is based on modelled data, the same model can be used to justify specific slight deviations from the generic conditions described in the ES.

All parameters needed to run the exposure estimation tools, i.e., either MEASE (version 1.02.01; available on www.ebrc.de/mease.html) or ART (version 1.5; available on https://www.advancedreachtool.com), can be found in the CS. In case of a multiple PROC assessment, the PROC used for the exposure estimation is provided in brackets with the corresponding exposure estimate. The installation of the prescribed RMMs is mandatory and only the modification of the personal protective equipment (PPE) used is allowed as a deviation. The only parameters which may therefore be modified in the exposure calculation are:

(i) concentration in mixture (only lower concentrations),
(ii) efficiency of the installed RMMs (only higher efficiencies), and
(iii) type of PPE to be used (only lower efficiencies).

0.3.1.1.2.1. Specific considerations for efficiency values for RMMs prescribed in occupational contributing scenarios

Any efficiency values reported in the ES represent typical efficiencies for a given industry sector after evaluating conditions of use as made available to the consultants and are therefore considered to adequately approximate to actual efficiencies. If downstream users want to evaluate whether prescribed efficiencies are met, exposure monitoring could be conducted. In such a case, monitored exposure levels should be the same as or lower than those reported for the contributing scenario after consideration of any PPE worn. Further information on efficiency values can be found in the glossary of MEASE (version 1.02.01).

0.3.1.1.2.2. Deviations from the conditions of use if exposure models were used for exposure assessment

Further deviations from the given conditions of use, or if the DU assessment is to be based on monitoring data, require you either to:

(i) inform the supplier of the eSDS about these deviations and request the ES be reviewed to include the identified deviations or
(ii) prepare your own DU CSR (according to Article 37(4)) which must be notified to ECHA and be kept at your company as in-house documentation.

0.3.1.2. Qualitative exposure assessment

Qualitative exposure assessments may be required due to the hazardous properties of a substance to which exposure has to be minimised by specific operational conditions (OCs) and risk management measures (RMMs) or due to the unlikeliness that exposure may occur in a specific situation.

In addition to the quantitative risk characterisation, demonstrating that prescribed OCs and RMMs effectively control exposure well below the respective DNELs, residual exposure concentrations may theoretically still cause local effects. In the applicable sections of the occupational contributing scenarios personal protective equipment (PPE) is therefore prescribed in situations in which such residual exposure concentrations cannot be excluded. The risk of local effects is therefore adequately controlled.

0.3.1.3. Specific considerations on the conditions of use

Standard phrases according to the ESCom Standard Phrase Catalogue, version 5.2, were used as much as possible. In this regard, it should be noted that the generic standard phrase “Liquids” is also covering other liquid mixtures such as aqueous solutions, pastes, slurries, and suspensions. In some cases, in which standard phrases could not be used to meet the specific requirements of the exposure situation described in the ES, additional phrases were developed and included in the relevant contributing scenarios as required.

0.3.1.4. Reflection of additional RMMs due to impurities

Information about the reflection of additional RMMs due to impurities is given in the sub-sections below. Further information about the “Substance Identification Profiles” can be found on the Nickel Consortia website (https://www.nickelconsortia.eu/nickel-consortia.html).

0.3.1.4.1. Additional qualitative risk assessment

If qualitative risk assessments were required for local effects caused by impurities, RMMs such as personal protective equipment (PPE) were prescribed as required. If exposure to the impurity as nominated in the ES below can be excluded, because this impurity is not relevant for a company or certain process, then the RMMs included for this impurity do not have to be considered. In cases, in which multiple impurities of one “SIP” (substance identity profile) leading to different qualitative hazard classes for the same route of exposure and type of effect, the hazard class with the severest effect was considered in the additional risk assessment and appropriate RMMs were prescribed for precautionary reasons.

0.3.1.4.2. Additional quantitative risk assessment

Quantitative risk assessments were conducted, if one route of exposure and type of effect were currently not covered by the current risk assessment for the pure substance, or if the DNEL derived for an impurity was significantly lower than that derived for the pure substance. In both cases, the DNEL of the impurity has been used to describe the hazard of the impurity.

If the types of emission are the same for the pure substance and impurity, the exposure assessment was conducted by linear extrapolation from substance exposure levels to exposure levels of the impurity. For the exposure assessment, the upper concentration limit of the impurity was used for extrapolation.

If an additional risk assessment was required for the same route of exposure and type of effect, the RCRs from the pure substance and the impurity or multiple impurities were summed up.

0.3.2. Environmental exposure scenarios

0.3.2.1. Deviations from the conditions of use

This can be done by using the MetalEUSES scaling tool (free download: http://www.arche-consulting.be/tools/du-scaling-tool/) to estimate the associated exposure. Following parameters can be scaled: amount used at local site, number of emission days, discharge effluent rate, dilution factor (or flow rate of the river), presence/absence of municipal sewage treatment plant (STP), removal rate municipal STP, use of municipal sludge on agricultural soil, and release factors to air and water.

0.4. Man via the environment exposure and risk characterisation assessments

Inhalation is the critical exposure pathway for humans via the environment. The PEC for air at site neighbouring residential areas should be lower than the chronic inhalation DNEL for the general public of 60 ng Ni/m^3 as annual average in PM_{10} in order to demonstrate adequate control of risk (RCR<1) for Man via the Environment (MvE).

Hereto a Generic safe use Exposure Scenario for MvE was developed based on the EUSES model. The MvE Generic ES is defined as the product of tonnage (T) and emission factor to air (EF) being lower than 74000 g Ni/year. The value of 74000 g Ni/year is derived by using EUSES model to back-calculate the product of T and EF that results in a local air concentration (C_{local}) of 56.6 ng Ni/m^3. The value of 56.6 ng Ni/m^3 is derived from the difference between the DNEL of 60 ng Ni/m^3 and the EU regional background concentration ($C_{regional}$) of 3.4 ng Ni/m^3 (average of P90 annual concentration of Ni in PM_{10} for the years 2013, 2014 and 2015).

Safe use ES for all sectors according to Tier 1 (EUSES model) Sector	**Tonnage (Ni T /year)**	**Emission factor (g Ni/T)**	**Tonnage × emission factor (g Ni/year)**	**C_{local} (ng/m^3)**	**$C_{regional}$ (ng/m^3)**	**PEC_{local} (ng/m^3)**	**RCR = PEC/DNEL (DNEL= 60 ng/m^3)**
All	T	EF	T × EF < 74000	<56.6	3.4*	<60	<1

*: EU average of country P90 annual Ni concentrations in PM10 (2013, 2014 and 2015)

If a site is not compliant with these conditions, meaning that the product of tonnage and emission factor is above 74000 g Ni/year, a tiered approach including site-specific modelling can be applied to demonstrate safe use.

1. ES 1: Manufacture; Manufacture of nickel metal from nickel chloride or nickel sulphate through hydrometallurgical process

1.1. Title section

Environment	
1: Manufacture of nickel metal from nickel chloride or nickel sulphate through hydrometallurgical process - Direct discharge to fresh water	ERC 1
2: Manufacture of nickel metal from nickel chloride or nickel sulphate through hydrometallurgical process - Direct discharge to marine water	ERC 1
Worker	
3: Electrowinning	PROC 3, PROC 2
4: Annealing of cathode sheets	PROC 22
5: Shearing and cutting	PROC 24
6: Packaging	PROC 21
7: Wet cleaning	PROC 28
8: Cleaning/removal of dust	PROC 28

1.2. Conditions of use affecting exposure

1.2.1. Control of environmental exposure: Manufacture of nickel metal from nickel chloride or nickel sulphate through hydrometallurgical process - Direct discharge to fresh water (ERC 1)

Amount used, frequency and duration of use (or from service life)
Daily amount per site <= 190 tonnes/day (All the amounts and concentrations are expressed as Ni as this is the driver for the environmental risk assessment.)
Annual amount per site <= 6.94E4 tonnes/year
Emission days >= 365 days/year
Technical and organisational conditions and measures
Chemical precipitation or sedimentation or filtration or electrolysis or reverse osmosis or ion exchange
Electrostatic precipitator or wet electrostatic precipitator or cyclones or fabric/bag filter or ceramic/metal mesh filter or wet scrubber
Conditions and measures related to external treatment of waste (including article waste)
Dispose of waste product or used containers according to local regulations.
Other conditions affecting environmental exposure
No discharge to marine water assumed
Assumed effluent discharge flow from site >= 2E3 m3/day
Local freshwater dilution factor 892

1.2.2. Control of environmental exposure: Manufacture of nickel metal from nickel chloride or nickel sulphate through hydrometallurgical process - Direct discharge to marine water (ERC 1)

Amount used, frequency and duration of use (or from service life)
Daily amount per site <= 78.21 tonnes/day (All the amounts and concentrations are expressed as Ni as this is the driver for the environmental risk assessment.)
Annual amount per site <= 2.86E4 tonnes/year
Emission days >= 365 days/year
Technical and organisational conditions and measures
Chemical precipitation or sedimentation or filtration or electrolysis or reverse osmosis or ion exchange
Electrostatic precipitator or wet electrostatic precipitator or cyclones or fabric/bag filter or ceramic/metal mesh filter or wet scrubber
Conditions and measures related to external treatment of waste (including article waste)
Dispose of waste product or used containers according to local regulations.
Other conditions affecting environmental exposure
No discharge to freshwater assumed
Receiving water dilution (fresh or marine) >= 100
Assumed effluent discharge flow from site >= 2E3 m3/day

1.2.3. Control of worker exposure: Electrowinning (PROC 3, PROC 2)

Product (article) characteristics
Physical form of product: Liquid
Additional physical form of product: Solution
Covers concentrations up to 100 %
Maximum emission potential covered in this CS: Very low.
Amount used (or contained in articles), frequency and duration of use/exposure
Covers use up to 8 h/day
Technical and organisational conditions and measures
Assumes that activities are undertaken with appropriate and well maintained equipment by trained personnel operating under supervision. Ensure regular inspection, cleaning and maintenance of equipment and machines. Clear spills immediately. Ensure daily cleaning of the equipment.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Provide specifically designed and maintained LEV (receiving hood type). Ensure effectiveness is at least 80%.
Use of styrophor beads to prevent evaporation of the electrolyte is required.
Use in closed process
Other conditions affecting workers exposure
Assumes process temperature up to 40 °C
Indoor use

1.2.4. Control of worker exposure: Annealing of cathode sheets (PROC 22)

Product (article) characteristics
Physical form of product: Massive object
Covers concentrations up to 100 %
Maximum emission potential covered in this CS: Low.
Amount used (or contained in articles), frequency and duration of use/exposure

Exposure duration <= 3 h/day
Technical and organisational conditions and measures
Assumes that activities are undertaken with appropriate and well maintained equipment by trained personnel operating under supervision. Ensure regular inspection, cleaning and maintenance of equipment and machines. Clear spills immediately. Ensure daily cleaning of the equipment.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Elevated temperature (process temperature may vary depending on the conducted process but is maintained well below the melting point of the substance).
Other conditions affecting workers exposure
Indoor use

1.2.5. Control of worker exposure: Shearing and cutting (PROC 24)

Product (article) characteristics
Physical form of product: Massive object
Covers concentrations up to 100 %
Maximum emission potential covered in this CS: Low (abrasion based).
Amount used (or contained in articles), frequency and duration of use/exposure
Exposure duration <= 4 h/day
Technical and organisational conditions and measures
Assumes that activities are undertaken with appropriate and well maintained equipment by trained personnel operating under supervision. Ensure regular inspection, cleaning and maintenance of equipment and machines. Clear spills immediately. Ensure daily cleaning of the equipment.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Very limited manual intervention is required to run the process. Contact with the substance shall only be possible for a very limited duration of time.
Semi-closed system
Other conditions affecting workers exposure
Assumes process temperature up to 40 °C
Indoor use

1.2.6. Control of worker exposure: Packaging (PROC 21)

Product (article) characteristics
Physical form of product: Massive object
Covers concentrations up to 100 %
Maximum emission potential covered in this CS: Low (abrasion based).
Amount used (or contained in articles), frequency and duration of use/exposure
Exposure duration <= 7 h/day
Technical and organisational conditions and measures
Assumes that activities are undertaken with appropriate and well maintained equipment by trained personnel operating under supervision. Ensure regular inspection, cleaning and maintenance of equipment and machines. Clear spills immediately. Ensure daily cleaning of the equipment.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Conditions and measures related to personal protection, hygiene and health evaluation
Wear chemically resistant gloves (tested to EN374) in combination with specific activity training. If skin contamination is expected to extend to other parts of the body, then these body parts should also be protected with impervious garments in a manner equivalent to those described for the hands. For further specification, refer to section 8 of the SDS.

Other conditions affecting workers exposure
Assumes process temperature up to 40 °C
Indoor use

1.2.7. Control of worker exposure: Wet cleaning (PROC 28)

Product (article) characteristics
Physical form of product: Liquid
Additional physical form of product: Solution
Covers concentrations up to 100 %
Maximum emission potential covered in this CS: Very low.
Amount used (or contained in articles), frequency and duration of use/exposure
Covers use up to 8 h/day
Technical and organisational conditions and measures
Assumes that activities are undertaken with appropriate and well maintained equipment by trained personnel operating under supervision. Ensure regular inspection, cleaning and maintenance of equipment and machines. Clear spills immediately. Ensure daily cleaning of the equipment.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Cleaning machines such as power sweeper, no direct manual cleaning.
Conditions and measures related to personal protection, hygiene and health evaluation
Wear a respirator which provides an assigned protection factor (APF) according to EN 529 of at least of 10 (APF >= 10). For further specification, refer to section 8 of the SDS.
Other conditions affecting workers exposure
Assumes process temperature up to 40 °C
Indoor use

1.2.8. Control of worker exposure: Cleaning/removal of dust (PROC 28)

Product (article) characteristics
Physical form of product: Solid, high dustiness
Covers concentrations up to 100 %
Amount used (or contained in articles), frequency and duration of use/exposure
Exposure duration <= 0.5 h/day
Technical and organisational conditions and measures
Assumes that activities are undertaken with appropriate and well maintained equipment by trained personnel operating under supervision. Ensure regular inspection, cleaning and maintenance of equipment and machines. Clear spills immediately. Ensure daily cleaning of the equipment.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Cleaning is conducted using cleaning machines, in particular hovering is applied and the use of compressed air is omitted.
Conditions and measures related to personal protection, hygiene and health evaluation
Wear a respirator which provides an assigned protection factor (APF) according to EN 529 of at least of 20 (APF >= 20). For further specification, refer to section 8 of the SDS.
Other conditions affecting workers exposure
Assumes process temperature up to 40 °C
Indoor use

1.3. Exposure estimation and reference to its source

1.3.1. Environmental release and exposure: Manufacture of nickel metal from nickel chloride or nickel sulphate through hydrometallurgical process - Direct discharge to fresh water (ERC 1)

Release route	Release rate	Release estimation method
Water	5.377 kg/day	Estimated release factor
Air	5.586 kg/day	Estimated release factor
Soil	0 kg/day	Estimated release factor

Protection target	Exposure estimate	RCR
Fresh water	5.06E-3 mg/L (EUSES 2.1.2)	0.83
Sediment (freshwater)	90.2 mg/kg dw (PEC sediment calculation method for metals)	0.828
Agricultural soil	16.87 mg/kg dw (EUSES 2.1.2)	0.429

1.3.2. Environmental release and exposure: Manufacture of nickel metal from nickel chloride or nickel sulphate through hydrometallurgical process - Direct discharge to marine water (ERC 1)

Release route	Release rate	Release estimation method
Water	0.806 kg/day	Estimated release factor
Air	2.3 kg/day	Estimated release factor
Soil	0 kg/day	Estimated release factor

Protection target	Exposure estimate	RCR
Marine water	3.19E-3 mg/L (EUSES 2.1.2)	0.334
Sediment (marine water)	92.1 mg/kg dw (PEC sediment calculation method for metals)	0.845
Agricultural soil	16.47 mg/kg dw (EUSES 2.1.2)	0.419

1.3.3. Worker exposure: Electrowinning (PROC 3, PROC 2)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.012 mg/m³ (Measured data)	0.24
Inhalation, local, long term	0.012 mg/m³ (Measured data)	0.24
Inhalation, local, acute	0.047 mg/m³ (Measured data)	< 0.01
Dermal, local, long term	0.76 µg/cm² (Measured data)	0.022

1.3.4. Worker exposure: Annealing of cathode sheets (PROC 22)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.037 mg/m³ (Measured data)	0.74
Inhalation, local, long term	0.037 mg/m³ (Measured data)	0.74
Inhalation, local, acute	0.11 mg/m³ (Measured data)	< 0.01
Dermal, local, long term	0.456 µg/cm² (Measured data)	0.013

1.3.5. Worker exposure: Shearing and cutting (PROC 24)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.02 mg/m³ (Measured data)	0.4
Inhalation, local, long term	0.02 mg/m³ (Measured data)	0.4
Inhalation, local, acute	0.12 mg/m³ (Measured data)	0.01
Dermal, local, long term	2.24 µg/cm² (Measured data)	0.064

1.3.6. Worker exposure: Packaging (PROC 21)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	8E-3 mg/m³ (Measured data)	0.16
Inhalation, local, long term	8E-3 mg/m³ (Measured data)	0.16
Inhalation, local, acute	0.037 mg/m³ (Measured data)	< 0.01
Dermal, local, long term	5.18 µg/cm² (Measured data)	0.148

1.3.7. Worker exposure: Wet cleaning (PROC 28)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	6E-3 mg/m³ (Measured data)	0.12
Inhalation, local, long term	6E-3 mg/m³ (Measured data)	0.12
Inhalation, local, acute	0.026 mg/m³ (Measured data)	< 0.01
Dermal, local, long term	0.76 µg/cm² (Measured data)	0.022

1.3.8. Worker exposure: Cleaning/removal of dust (PROC 28)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	2E-3 mg/m³ (Measured data)	0.04
Inhalation, local, long term	2E-3 mg/m³ (Measured data)	0.04
Inhalation, local, acute	0.189 mg/m³ (Measured data)	0.016
Dermal, local, long term	0.152 µg/cm² (Measured data)	< 0.01

1.4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES

Guidance: Please refer to Section 0.3 of this “ES for Communication”.

2. ES 2: Manufacture; Manufacture of nickel metal in powder form through thermal decomposition of complexed nickel

2.1. Title section

Environment	
1: Manufacture of nickel metal in powder form through thermal decomposition of complexed nickel - Direct discharge to fresh water	ERC 1
2: Manufacture of nickel metal in powder form through thermal decomposition of complexed nickel - Direct discharge to marine water	ERC 1
Worker	
3: Pyrolysis	PROC 2, PROC 27a
4: Powder pressing	PROC 14
5: Packaging of briquettes	PROC 21
6: Wet cleaning	PROC 28
7: Cleaning/removal of dust	PROC 28

2.2. Conditions of use affecting exposure

2.2.1. Control of environmental exposure: Manufacture of nickel metal in powder form through thermal decomposition of complexed nickel - Direct discharge to fresh water (ERC 1)

Amount used, frequency and duration of use (or from service life)
Daily amount per site <= 190 tonnes/day (All the amounts and concentrations are expressed as Ni as this is the driver for the environmental risk assessment.)
Annual amount per site <= 6.94E4 tonnes/year
Emission days >= 365 days/year
Technical and organisational conditions and measures
Chemical precipitation or sedimentation or filtration or electrolysis or reverse osmosis or ion exchange
Electrostatic precipitator or wet electrostatic precipitator or cyclones or fabric/bag filter or ceramic/metal mesh filter or wet scrubber
Conditions and measures related to external treatment of waste (including article waste)
Dispose of waste product or used containers according to local regulations.
Other conditions affecting environmental exposure
No discharge to marine water assumed
Assumed effluent discharge flow from site >= 2E3 m3/day
Local freshwater dilution factor 892

2.2.2. Control of environmental exposure: Manufacture of nickel metal in powder form through thermal decomposition of complexed nickel - Direct discharge to marine water (ERC 1)

Amount used, frequency and duration of use (or from service life)
Daily amount per site <= 78.21 tonnes/day (All the amounts and concentrations are expressed as Ni

as this is the driver for the environmental risk assessment.)
Annual amount per site <= 2.86E4 tonnes/year
Emission days >= 365 days/year
Technical and organisational conditions and measures
Chemical precipitation or sedimentation or filtration or electrolysis or reverse osmosis or ion exchange
Electrostatic precipitator or wet electrostatic precipitator or cyclones or fabric/bag filter or ceramic/metal mesh filter or wet scrubber
Conditions and measures related to external treatment of waste (including article waste)
Dispose of waste product or used containers according to local regulations.
Other conditions affecting environmental exposure
No discharge to freshwater assumed
Receiving water dilution (fresh or marine) >= 100
Assumed effluent discharge flow from site >= 2E3 m3/day

2.2.3. Control of worker exposure: Pyrolysis (PROC 2, PROC 27a)

Product (article) characteristics
Physical form of product: Solid, high dustiness (covering briquettes)
Additional physical form of product: Briquettes
Covers concentrations up to 100 %
Amount used (or contained in articles), frequency and duration of use/exposure
Covers use up to 8 h/day
Technical and organisational conditions and measures
Assumes that activities are undertaken with appropriate and well maintained equipment by trained personnel operating under supervision. Ensure regular inspection, cleaning and maintenance of equipment and machines. Clear spills immediately. Ensure daily cleaning of the equipment.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Automated task
Ensure enclosed transfers and enclosed processes
Ensure that worker is in a separated (control) room with independent clean air supply.
Other conditions affecting workers exposure
Assumes process temperature up to 40 °C
Indoor use
For supervision activities it is important to also respect the RMMs as prescribed in the contributing scenarios for the specific process that are supervised, as relevant.

2.2.4. Control of worker exposure: Powder pressing (PROC 14)

Product (article) characteristics
Physical form of product: Solid, high dustiness
Covers concentrations up to 100 %
Amount used (or contained in articles), frequency and duration of use/exposure
Covers use up to 8 h/day
Technical and organisational conditions and measures
Assumes that activities are undertaken with appropriate and well maintained equipment by trained personnel operating under supervision. Ensure regular inspection, cleaning and maintenance of equipment and machines. Clear spills immediately. Ensure daily cleaning of the equipment.

Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Provide specifically designed and maintained LEV (receiving hood type). Ensure effectiveness is at least 80%.
Very limited manual intervention is required to run the process. Contact with the substance shall only be possible for a very limited duration of time.
Semi-closed system
Conditions and measures related to personal protection, hygiene and health evaluation
Wear a respirator which provides an assigned protection factor (APF) according to EN 529 of at least of 10 (APF >= 10). For further specification, refer to section 8 of the SDS.
Other conditions affecting workers exposure
Indoor use
Assumes process temperature up to 40 °C

2.2.5. Control of worker exposure: Packaging of briquettes (PROC 21)

Product (article) characteristics
Physical form of product: Solid, low dustiness
Additional physical form of product: Briquettes
Covers concentrations up to 100 %
Amount used (or contained in articles), frequency and duration of use/exposure
Covers use up to 8 h/day
Technical and organisational conditions and measures
Assumes that activities are undertaken with appropriate and well maintained equipment by trained personnel operating under supervision. Ensure regular inspection, cleaning and maintenance of equipment and machines. Clear spills immediately. Ensure daily cleaning of the equipment.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Provide specifically designed and maintained LEV (receiving hood type). Ensure effectiveness is at least 80%.
Highly automated process (automated packaging line)
Use in closed process (enclosed transfer)
Other conditions affecting workers exposure
Assumes process temperature up to 40 °C
Indoor use

2.2.6. Control of worker exposure: Wet cleaning (PROC 28)

Product (article) characteristics
Physical form of product: Liquid
Additional physical form of product: Solution
Covers concentrations up to 100 %
Maximum emission potential covered in this CS: Very low.
Amount used (or contained in articles), frequency and duration of use/exposure
Covers use up to 8 h/day
Technical and organisational conditions and measures
Assumes that activities are undertaken with appropriate and well maintained equipment by trained personnel operating under supervision. Ensure regular inspection, cleaning and maintenance of equipment and machines. Clear spills immediately. Ensure daily cleaning of the equipment.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).

Cleaning machines such as power sweeper, no direct manual cleaning.
Conditions and measures related to personal protection, hygiene and health evaluation
Wear a respirator which provides an assigned protection factor (APF) according to EN 529 of at least of 10 (APF >= 10). For further specification, refer to section 8 of the SDS.
Other conditions affecting workers exposure
Assumes process temperature up to 40 °C
Indoor use

2.2.7. Control of worker exposure: Cleaning/removal of dust (PROC 28)

Product (article) characteristics
Physical form of product: Solid, high dustiness
Covers concentrations up to 100 %
Amount used (or contained in articles), frequency and duration of use/exposure
Covers use up to 8 h/day
Technical and organisational conditions and measures
Assumes that activities are undertaken with appropriate and well maintained equipment by trained personnel operating under supervision. Ensure regular inspection, cleaning and maintenance of equipment and machines. Clear spills immediately. Ensure daily cleaning of the equipment.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Cleaning is conducted using cleaning machines, in particular hovering is applied and the use of compressed air is omitted.
Conditions and measures related to personal protection, hygiene and health evaluation
Wear a respirator which provides an assigned protection factor (APF) according to EN 529 of at least of 20 (APF >= 20). For further specification, refer to section 8 of the SDS.
Other conditions affecting workers exposure
Assumes process temperature up to 40 °C
Indoor use

2.3. Exposure estimation and reference to its source

2.3.1. Environmental release and exposure: Manufacture of nickel metal in powder form through thermal decomposition of complexed nickel - Direct discharge to fresh water (ERC 1)

Release route	Release rate	Release estimation method
Water	5.377 kg/day	Estimated release factor
Air	5.586 kg/day	Estimated release factor
Soil	0 kg/day	Estimated release factor

Protection target	Exposure estimate	RCR
Fresh water	5.06E-3 mg/L (EUSES 2.1.2)	0.83
Sediment (freshwater)	90.2 mg/kg dw (PEC sediment calculation method for metals)	0.828
Agricultural soil	16.87 mg/kg dw (EUSES 2.1.2)	0.429

2.3.2. Environmental release and exposure: Manufacture of nickel metal in powder form through thermal decomposition of complexed

nickel - Direct discharge to marine water (ERC 1)

Release route	Release rate	Release estimation method
Water	0.806 kg/day	Estimated release factor
Air	2.3 kg/day	Estimated release factor
Soil	0 kg/day	Estimated release factor

Protection target	Exposure estimate	RCR
Marine water	3.19E-3 mg/L (EUSES 2.1.2)	0.334
Sediment (marine water)	92.1 mg/kg dw (PEC sediment calculation method for metals)	0.845
Agricultural soil	16.47 mg/kg dw (EUSES 2.1.2)	0.419

2.3.3. Worker exposure: Pyrolysis (PROC 2, PROC 27a)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	7E-3 mg/m³ (Measured data)	0.14
Inhalation, local, long term	7E-3 mg/m³ (Measured data)	0.14
Inhalation, local, acute	0.022 mg/m³ (Measured data)	< 0.01
Dermal, local, long term	0.76 µg/cm² (Measured data)	0.022

2.3.4. Worker exposure: Powder pressing (PROC 14)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	7E-3 mg/m³ (Measured data)	0.14
Inhalation, local, long term	7E-3 mg/m³ (Measured data)	0.14
Inhalation, local, acute	0.02 mg/m³ (Measured data)	< 0.01
Dermal, local, long term	3.73 µg/cm² (Measured data)	0.107

2.3.5. Worker exposure: Packaging of briquettes (PROC 21)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.012 mg/m³ (Measured data)	0.24
Inhalation, local, long term	0.012 mg/m³ (Measured data)	0.24
Inhalation, local, acute	0.035 mg/m³ (Measured data)	< 0.01
Dermal, local, long term	1 µg/cm² (Measured data)	0.029

2.3.6. Worker exposure: Wet cleaning (PROC 28)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	6E-3 mg/m³ (Measured data)	0.12
Inhalation, local, long term	6E-3 mg/m³ (Measured data)	0.12
Inhalation, local, acute	0.026 mg/m³ (Measured data)	< 0.01
Dermal, local, long term	0.76 µg/cm² (Measured data)	0.022

2.3.7. Worker exposure: Cleaning/removal of dust (PROC 28)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.032 mg/m³ (Measured data)	0.64

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, local, long term	0.032 mg/m³ (Measured data)	0.64
Inhalation, local, acute	0.189 mg/m³ (Measured data)	0.016
Dermal, local, long term	0.76 µg/cm² (Measured data)	0.022

2.4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES

Guidance: Please refer to Section 0.3 of this “ES for Communication”.

3. ES 3: Manufacture; Manufacture of nickel-containing catalysts from nickel oxide-containing catalyst precursors

3.1. Title section

Environment	
1: Manufacture of nickel-containing catalysts from nickel oxide-containing catalyst precursors - Discharge to fresh water via municipal sewage treatment plant	ERC 1
2: Manufacture of nickel-containing catalysts from nickel oxide-containing catalyst precursors - Direct discharge to fresh water	ERC 1
3: Manufacture of nickel-containing catalysts from nickel oxide-containing catalyst precursors - Direct discharge to marine water	ERC 1
Worker	
4: Manufacture of powdered catalysts or production of shaped catalysts (e.g. encapsulated powders) from powdered precursors	PROC 8b, PROC 3, PROC 4, PROC 9, PROC 28, PROC 2, PROC 1, PROC 8a, PROC 14
5: Manufacture of shaped catalysts (e.g. extrudates, pellets, tablets, spheres) from shaped precursors	PROC 8b, PROC 3, PROC 4, PROC 9, PROC 28, PROC 2, PROC 1, PROC 8a

3.2. Conditions of use affecting exposure

3.2.1. Control of environmental exposure: Manufacture of nickel-containing catalysts from nickel oxide-containing catalyst precursors - Discharge to fresh water via municipal sewage treatment plant (ERC 1)

Amount used, frequency and duration of use (or from service life)
Daily amount per site <= 1.4 tonnes/day (All the amounts and concentrations are expressed as Ni as this is the driver for the environmental risk assessment.)
Annual amount per site <= 476 tonnes/year
Emission days >= 340 days/year
Technical and organisational conditions and measures
Direct emissions to air should be mitigated by application of one or more of the following RMMs: • HEPA filtration (ESCOM 9267234005), Fabric filters (ESCOM 9267234003) and Bag or Ceramic Filters (ESCOM 12355002122) • Wet Scrubbers (ESCOM 9267234016) • Dry or semi-dry Scrubbers (No available ESCOM phrase) • Metallic Grids (ESCOM 12355002122)
Direct emissions to water should be mitigated by application of one or more of the following RMMs: • Precipitation (ESCOM 12355002126) • Sedimentation (ESCOM 12355002126) • Filtration (ESCOM 12355002126) • Distillation (ESCOM 9267234037) • Ion Exchange (ESCOM 12355002126)
Conditions and measures related to biological sewage treatment plant
Municipal sewage treatment plant is assumed.
Assumed domestic sewage treatment plant flow >= 2E3 m3/day

Conditions and measures related to external treatment of waste (including article waste)
Dispose of waste product or used containers according to local regulations.
Other conditions affecting environmental exposure
No discharge to marine water assumed
Local freshwater dilution factor 50

3.2.2. Control of environmental exposure: Manufacture of nickel-containing catalysts from nickel oxide-containing catalyst precursors - Direct discharge to fresh water (ERC 1)

Amount used, frequency and duration of use (or from service life)
Daily amount per site <= 1.4 tonnes/day (All the amounts and concentrations are expressed as Ni as this is the driver for the environmental risk assessment.)
Annual amount per site <= 476 tonnes/year
Emission days >= 340 days/year
Technical and organisational conditions and measures
Direct emissions to air should be mitigated by application of one or more of the following RMMs: • HEPA filtration (ESCOM 9267234005), Fabric filters (ESCOM 9267234003) and Bag or Ceramic Filters (ESCOM 12355002122) • Wet Scrubbers (ESCOM 9267234016) • Dry or semi-dry Scrubbers (No available ESCOM phrase) • Metallic Grids (ESCOM 12355002122)
Direct emissions to water should be mitigated by application of one or more of the following RMMs: • Precipitation (ESCOM 12355002126) • Sedimentation (ESCOM 12355002126) • Filtration (ESCOM 12355002126) • Distillation (ESCOM 9267234037) • Ion Exchange (ESCOM 12355002126)
Conditions and measures related to external treatment of waste (including article waste)
Dispose of waste product or used containers according to local regulations.
Other conditions affecting environmental exposure
No discharge to marine water assumed
Assumed effluent discharge flow from site >= 2E3 m3/day
Local freshwater dilution factor 100

3.2.3. Control of environmental exposure: Manufacture of nickel-containing catalysts from nickel oxide-containing catalyst precursors - Direct discharge to marine water (ERC 1)

Amount used, frequency and duration of use (or from service life)
Daily amount per site <= 1.4 tonnes/day (All the amounts and concentrations are expressed as Ni as this is the driver for the environmental risk assessment.)
Annual amount per site <= 476 tonnes/year
Emission days >= 340 days/year
Technical and organisational conditions and measures
Direct emissions to air should be mitigated by application of one or more of the following RMMs: • HEPA filtration (ESCOM 9267234005), Fabric filters (ESCOM 9267234003) and Bag or Ceramic Filters (ESCOM 12355002122) • Wet Scrubbers (ESCOM 9267234016) • Dry or semi-dry Scrubbers (No available ESCOM phrase) • Metallic Grids (ESCOM 12355002122)
Direct emissions to water should be mitigated by application of one or more of the following RMMs: • Precipitation (ESCOM 12355002126) • Sedimentation (ESCOM 12355002126) • Filtration (ESCOM 12355002126) • Distillation (ESCOM 9267234037) • Ion Exchange (ESCOM 12355002126)
Conditions and measures related to external treatment of waste (including article waste)
Dispose of waste product or used containers according to local regulations.
Other conditions affecting environmental exposure

No discharge to freshwater assumed
Assumed effluent discharge flow from site >= 2E3 m3/day
Local marine water dilution factor 100

3.2.4. Control of worker exposure: Manufacture of powdered catalysts or production of shaped catalysts (e.g. encapsulated powders) from powdered precursors (PROC 8b, PROC 3, PROC 4, PROC 9, PROC 28, PROC 2, PROC 1, PROC 8a, PROC 14)

Product (article) characteristics
Physical form of product: Solid, high dustiness (Nickel-containing powder (without forming step) or droplets (including forming step, where nickel powder is embedded/encapsulated in organic matrix))
Covers concentrations up to 95 % (Nickel concentration 1 - 95% (powder) or 10 - 35% (droplets))
Amount used (or contained in articles), frequency and duration of use/exposure
Covers use up to 8-11 hours/ day (37.5 hours/week). 80-360 days/year. Frequent, regular cleaning of production areas.
Amount used: 100-5000 kg/shift.
Technical and organisational conditions and measures
Assumes that activities are undertaken with appropriate and well maintained equipment by trained personnel operating under supervision. Ensure regular inspection, cleaning and maintenance of equipment and machines. Clear spills immediately. Ensure daily cleaning of the equipment.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Provide basic LEV such as canopy hood, movable capturing hood or other multipurpose LEV. Ensure effectiveness is at least 50%. LEV is required to avoid discharge of dust into workplace air. Extraction of gases from high temperature processes is required to avoid discharge into workplace air. Extraction of gases from hot automated and enclosed processes shall be designed to remove gaseous side products and applied to discharge points and transfer systems to prevent work place exposure.
(Semi-)automated process operated from control room or separate control areas.
Automation and complete enclosure of powder processing and transfer, handling and filling operations are designed to minimize significant exposures to inhalable nickel-containing powder or dust.
Use in closed process during the reduction process (the nickel oxide-containing catalyst precursor is placed in a closed reaction vessel and exposed to a H2-containing atmosphere where nickel oxide is converted partly or fully to nickel metal.)
Containment of raw materials and product is required to prevent dermal contact.
During cleaning use vacuum and/or (pressure) washing with water to remove dusts or powders.
Conditions and measures related to personal protection, hygiene and health evaluation
Use of RPE (Particle filter with high efficiency for solid and liquid particles (e.g. EN 143 or 149, Type P3 or FFP3)) for cleaning and maintenance operations and where exposure to Ni dust or powder is possible. Air fed RPE may be used, if entry to the equipment used for production is required.
Wear chemically resistant gloves (tested to EN374) in combination with ‘basic’ employee training. If skin contamination is expected to extend to other parts of the body, then these body parts should also be protected with impervious garments in a manner equivalent to those described for the hands. For further specification, refer to section 8 of the SDS.
Use suitable eye protection. For further specification, refer to section 8 of the SDS.
Other conditions affecting workers exposure
Indoor use
Assumes process temperature up to 40 °C

3.2.5. Control of worker exposure: Manufacture of shaped catalysts (e.g. extrudates, pellets, tablets, spheres) from shaped precursors (PROC 8b, PROC 3, PROC 4, PROC 9, PROC 28, PROC 2, PROC 1, PROC 8a)

Product (article) characteristics
Physical form of product: Solid, low dustiness (Shaped catalysts)
Covers concentrations up to 70 %
Additional physical form of product: Solid, shaped catalysts
Amount used (or contained in articles), frequency and duration of use/exposure
Covers use up to 8-11 hours/ day (37.5 hours/week). 80-360 days/year. Frequent, regular cleaning of production areas.
Amount used: 100-5000 kg/shift
Technical and organisational conditions and measures
Assumes that activities are undertaken with appropriate and well maintained equipment by trained personnel operating under supervision. Ensure regular inspection, cleaning and maintenance of equipment and machines. Clear spills immediately. Ensure daily cleaning of the equipment.
Provide basic LEV such as canopy hood, movable capturing hood or other multipurpose LEV. Ensure effectiveness is at least 50%. LEV is required to avoid discharge of dust into workplace air. Extraction of gases from high temperature processes is required to avoid discharge into workplace air. Extraction of gases from hot automated and enclosed processes shall be designed to remove gaseous side products and applied to discharge points and transfer systems to prevent work place exposure.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
(Semi-) automated process operated from control room or separate control areas.
Automation and complete enclosure of thermal processing and mechanised transfer operations are required.
Use in closed process during the reduction process (the nickel oxide-containing catalyst precursor is placed in a closed reaction vessel and exposed to a H2-containing atmosphere where nickel oxide is converted partly or fully to nickel metal.)
Containment of raw materials and product is required to prevent dermal contact.
During cleaning use vacuum and/or (pressure) washing with water to remove dusts or powders.
Conditions and measures related to personal protection, hygiene and health evaluation
Use of RPE (Particle filter with high efficiency for solid and liquid particles (e.g. EN 143 or 149, Type P3 or FFP3)) for cleaning and maintenance operations and where exposure to Ni dust or powder is possible. Air fed RPE may be used, if entry to the equipment used for production is required.
Where dermal contact is possible use protective suit conforming to EN13982-1 Type 5 and suitable chemical resistant safety gloves (EN 374) capable of providing protection during prolonged, direct contact (Recommended: Protective index 6, corresponding > 480 minutes of permeation time according to EN 374): E.g. nitrile rubber (0.4 mm), chloroprene rubber (0.5 mm), butyl rubber (0.7 mm) or other gloves meeting the required performance specifications. Other protective equipment should be chosen based on activities being undertaken, potential for exposure to airborne Ni and other relevant workplace hazards may include protective suit (with hood), safety shoes (e.g. according to EN 20346).
Use suitable eye protection. For further specification, refer to section 8 of the SDS.
Other conditions affecting workers exposure
Assumes process temperature up to 40 °C
Indoor use

3.3. Exposure estimation and reference to its source

3.3.1. Environmental release and exposure: Manufacture of nickel-containing catalysts from nickel oxide-containing catalyst precursors - Discharge to fresh water via municipal sewage treatment plant (ERC 1)

Release route	Release rate	Release estimation method
Water	0.56 kg/day	Estimated release factor
Air	0.252 kg/day	Estimated release factor
Soil	0 kg/day	Estimated release factor

Protection target	Exposure estimate	RCR
Fresh water	5.31E-3 mg/L (EUSES 2.1.2)	0.87
Sediment (freshwater)	96.88 mg/kg dw (PEC sediment calculation method for metals)	0.889
Sewage Treatment Plant	0.168 mg/L (EUSES 2.1.2)	0.509
Agricultural soil	20.93 mg/kg dw (EUSES 2.1.2)	0.533

3.3.2. Environmental release and exposure: Manufacture of nickel-containing catalysts from nickel oxide-containing catalyst precursors - Direct discharge to fresh water (ERC 1)

Release route	Release rate	Release estimation method
Water	0.56 kg/day	Estimated release factor
Air	0.252 kg/day	Estimated release factor
Soil	0 kg/day	Estimated release factor

Protection target	Exposure estimate	RCR
Fresh water	4.91E-3 mg/L (EUSES 2.1.2)	0.805
Sediment (freshwater)	86.32 mg/kg dw (PEC sediment calculation method for metals)	0.792
Agricultural soil	16.22 mg/kg dw (EUSES 2.1.2)	0.413

3.3.3. Environmental release and exposure: Manufacture of nickel-containing catalysts from nickel oxide-containing catalyst precursors - Direct discharge to marine water (ERC 1)

Release route	Release rate	Release estimation method
Water	0.56 kg/day	Estimated release factor
Air	0.252 kg/day	Estimated release factor
Soil	0 kg/day	Estimated release factor

Protection target	Exposure estimate	RCR
Marine water	2.31E-3 mg/L (EUSES 2.1.2)	0.242
Sediment (marine water)	68.92 mg/kg dw (PEC sediment calculation method for metals)	0.632
Agricultural soil	16.22 mg/kg dw (EUSES 2.1.2)	0.413

3.3.4. Worker exposure: Manufacture of powdered catalysts or production of shaped catalysts (e.g. encapsulated powders) from

powdered precursors (PROC 8b, PROC 3, PROC 4, PROC 9, PROC 28, PROC 2, PROC 1, PROC 8a, PROC 14)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.04 mg/m³ (Measured data)	0.8
Inhalation, local, long term	0.04 mg/m³ (Measured data)	0.8
Inhalation, local, acute	0.16 mg/m³ (Measured data)	0.013
Dermal, local, long term	5E-4 mg/cm² (MEASE, PROC 8b)	0.014

3.3.5. Worker exposure: Manufacture of shaped catalysts (e.g. extrudates, pellets, tablets, spheres) from shaped precursors (PROC 8b, PROC 3, PROC 4, PROC 9, PROC 28, PROC 2, PROC 1, PROC 8a)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.02 mg/m³ (Measured data)	0.4
Inhalation, local, long term	0.02 mg/m³ (Measured data)	0.4
Inhalation, local, acute	0.06 mg/m³ (Measured data)	< 0.01
Dermal, local, long term	5E-4 mg/cm² (MEASE, PROC 8b)	0.014

3.4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES

Guidance: Please refer to Section 0.3 of this “ES for Communication”.

4. ES 4: Manufacture; Manufacture of ferronickel for use in stainless steel

4.1. Title section

Environment	
1: Manufacture of ferronickel for use in stainless steel - Direct discharge to fresh water	ERC 1
2: Manufacture of ferronickel for use in stainless steel - Direct discharge to marine water	ERC 1
Worker	
3: Thermal treatment of laterite in rotary kilns (pre-reduction of laterite)	PROC 22
4: Smelting of processed raw material in electric furnace	PROC 22
5: Further refining, granulation	PROC 22
6: Packaging and transfer of granulated product	PROC 21
7: Wet cleaning	PROC 28
8: Cleaning/removal of dust	PROC 28

4.2. Conditions of use affecting exposure

4.2.1. Control of environmental exposure: Manufacture of ferronickel for use in stainless steel - Direct discharge to fresh water (ERC 1)

Amount used, frequency and duration of use (or from service life)
Daily amount per site <= 33.17 tonnes/day (All the amounts and concentrations are expressed as Ni as this is the driver for the environmental risk assessment.)
Annual amount per site <= 1.21E4 tonnes/year
Emission days >= 365 days/year
Technical and organisational conditions and measures
Chemical precipitation or sedimentation or filtration or electrolysis or reverse osmosis or ion exchange
Electrostatic precipitator or wet electrostatic precipitator or cyclones or fabric/bag filter or ceramic/metal mesh filter or wet scrubber
Conditions and measures related to external treatment of waste (including article waste)
Dispose of waste product or used containers according to local regulations.
Other conditions affecting environmental exposure
Receiving surface water flow >= 2.03E7 m3/day
No discharge to marine water assumed
Receiving water dilution (fresh or marine) >= 100
Assumed effluent discharge flow from site >= 2.05E5 m3/day

4.2.2. Control of environmental exposure: Manufacture of ferronickel for use in stainless steel - Direct discharge to marine water (ERC 1)

Amount used, frequency and duration of use (or from service life)
Daily amount per site <= 51.69 tonnes/day (All the amounts and concentrations are expressed as Ni

as this is the driver for the environmental risk assessment.)
Annual amount per site <= 1.89E4 tonnes/year
Emission days >= 365 days/year
Technical and organisational conditions and measures
Chemical precipitation or sedimentation or filtration or electrolysis or reverse osmosis or ion exchange
Electrostatic precipitator or wet electrostatic precipitator or cyclones or fabric/bag filter or ceramic/metal mesh filter or wet scrubber
Conditions and measures related to external treatment of waste (including article waste)
Dispose of waste product or used containers according to local regulations.
Other conditions affecting environmental exposure
No discharge to freshwater assumed
Receiving water dilution (fresh or marine) >= 100
Assumed effluent discharge flow from site >= 2.05E5 m3/day

4.2.3. Control of worker exposure: Thermal treatment of laterite in rotary kilns (pre-reduction of laterite) (PROC 22)

Product (article) characteristics
Physical form of product: Solid
Maximum emission potential covered in this CS: High (temperature based).
Covers concentrations up to 100 %
Amount used (or contained in articles), frequency and duration of use/exposure
Covers use up to 8 h/day
Technical and organisational conditions and measures
Assumes that activities are undertaken with appropriate and well maintained equipment by trained personnel operating under supervision. Ensure regular inspection, cleaning and maintenance of equipment and machines. Clear spills immediately. Ensure daily cleaning of the equipment.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Provide specifically designed and maintained LEV (receiving hood type). Ensure effectiveness is at least 80%.
Semi-closed system
Elevated temperature
Other conditions affecting workers exposure
Indoor use

4.2.4. Control of worker exposure: Smelting of processed raw material in electric furnace (PROC 22)

Product (article) characteristics
Physical form of product: Molten inorganic substances
Covers concentrations up to 100 %
Maximum emission potential covered in this CS: High (temperature based).
Amount used (or contained in articles), frequency and duration of use/exposure
Covers use up to 8 h/day
Technical and organisational conditions and measures
Assumes that activities are undertaken with appropriate and well maintained equipment by trained personnel operating under supervision. Ensure regular inspection, cleaning and maintenance of

equipment and machines. Clear spills immediately. Ensure daily cleaning of the equipment.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Provide specifically designed and maintained LEV (receiving hood type). Ensure effectiveness is at least 80%.
Semi-closed system (furnace loading in crane with closed cab).
High temperature
Other conditions affecting workers exposure
Indoor use

4.2.5. Control of worker exposure: Further refining, granulation (PROC 22)

Product (article) characteristics
Physical form of product: Molten inorganic substances
Covers concentrations up to 100 %
Maximum emission potential covered in this CS: High (temperature based).
Amount used (or contained in articles), frequency and duration of use/exposure
Covers use up to 8 h/day
Technical and organisational conditions and measures
Assumes that activities are undertaken with appropriate and well maintained equipment by trained personnel operating under supervision. Ensure regular inspection, cleaning and maintenance of equipment and machines. Clear spills immediately. Ensure daily cleaning of the equipment.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Provide specifically designed and maintained LEV (receiving hood type). Ensure effectiveness is at least 80%.
Semi-closed system
High temperature
Other conditions affecting workers exposure
Indoor use

4.2.6. Control of worker exposure: Packaging and transfer of granulated product (PROC 21)

Product (article) characteristics
Physical form of product: Solid, low dustiness
Additional physical form of product: Solid, granulate
Covers concentrations up to 100 %
Amount used (or contained in articles), frequency and duration of use/exposure
Covers use up to 8 h/day
Technical and organisational conditions and measures
Assumes that activities are undertaken with appropriate and well maintained equipment by trained personnel operating under supervision. Ensure regular inspection, cleaning and maintenance of equipment and machines. Clear spills immediately. Ensure daily cleaning of the equipment.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Provide specifically designed and maintained LEV (receiving hood type). Ensure effectiveness is at least 80%.
Automated task
Use in closed process

Other conditions affecting workers exposure
Assumes process temperature up to 40 °C
Indoor use

4.2.7. Control of worker exposure: Wet cleaning (PROC 28)

Product (article) characteristics
Physical form of product: Liquid
Additional physical form of product: Solution
Covers concentrations up to 100 %
Maximum emission potential covered in this CS: Very low.
Amount used (or contained in articles), frequency and duration of use/exposure
Covers use up to 8 h/day
Technical and organisational conditions and measures
Assumes that activities are undertaken with appropriate and well maintained equipment by trained personnel operating under supervision. Ensure regular inspection, cleaning and maintenance of equipment and machines. Clear spills immediately. Ensure daily cleaning of the equipment.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Cleaning machines such as power sweeper, no direct manual cleaning.
Conditions and measures related to personal protection, hygiene and health evaluation
Wear a respirator which provides an assigned protection factor (APF) according to EN 529 of at least of 10 (APF >= 10). For further specification, refer to section 8 of the SDS.
Other conditions affecting workers exposure
Assumes process temperature up to 40 °C
Indoor use

4.2.8. Control of worker exposure: Cleaning/removal of dust (PROC 28)

Product (article) characteristics
Physical form of product: Solid, high dustiness
Covers concentrations up to 100 %
Amount used (or contained in articles), frequency and duration of use/exposure
Covers use up to 8 h/day
Technical and organisational conditions and measures
Assumes that activities are undertaken with appropriate and well maintained equipment by trained personnel operating under supervision. Ensure regular inspection, cleaning and maintenance of equipment and machines. Clear spills immediately. Ensure daily cleaning of the equipment.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Cleaning is conducted using cleaning machines, in particular hovering is applied and the use of compressed air is omitted.
Conditions and measures related to personal protection, hygiene and health evaluation
Wear a respirator which provides an assigned protection factor (APF) according to EN 529 of at least of 20 (APF >= 20). For further specification, refer to section 8 of the SDS.
Other conditions affecting workers exposure
Assumes process temperature up to 40 °C
Indoor use

4.3. Exposure estimation and reference to its source

4.3.1. Environmental release and exposure: Manufacture of ferronickel for use in stainless steel - Direct discharge to fresh water (ERC 1)

Release route	Release rate	Release estimation method
Water	55.07 kg/day	Estimated release factor
Air	41.40 kg/day	Estimated release factor
Soil	0 kg/day	Estimated release factor

Protection target	Exposure estimate	RCR
Fresh water	4.83E-3 mg/L (EUSES 2.1.2)	0.792
Sediment (freshwater)	84.3 mg/kg dw (PEC sediment calculation method for metals)	0.773
Agricultural soil	21.23 mg/kg dw (EUSES 2.1.2)	0.54

4.3.2. Environmental release and exposure: Manufacture of ferronickel for use in stainless steel - Direct discharge to marine water (ERC 1)

Release route	Release rate	Release estimation method
Water	85.81 kg/day	Estimated release factor
Air	64.51 kg/day	Estimated release factor
Soil	0 kg/day	Estimated release factor

Protection target	Exposure estimate	RCR
Marine water	3.31E-3 mg/L (EUSES 2.1.2)	0.346
Sediment (marine water)	95.2 mg/kg dw (PEC sediment calculation method for metals)	0.873
Agricultural soil	24.03 mg/kg dw (EUSES 2.1.2)	0.612

4.3.3. Worker exposure: Thermal treatment of laterite in rotary kilns (pre-reduction of laterite) (PROC 22)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	5E-3 mg/m³ (Measured data)	0.1
Inhalation, local, long term	5E-3 mg/m³ (Measured data)	0.1
Inhalation, local, acute	0.016 mg/m³ (Measured data)	< 0.01
Dermal, local, long term	0.76 µg/cm² (Measured data)	0.022

4.3.4. Worker exposure: Smelting of processed raw material in electric furnace (PROC 22)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.021 mg/m³ (Measured data)	0.42
Inhalation, local, long term	0.021 mg/m³ (Measured data)	0.42
Inhalation, local, acute	0.085 mg/m³ (Measured data)	< 0.01
Dermal, local, long term	0.76 µg/cm² (Measured data)	0.022

4.3.5. Worker exposure: Further refining, granulation (PROC 22)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.021 mg/m³ (Measured data)	0.42
Inhalation, local, long term	0.021 mg/m³ (Measured data)	0.42
Inhalation, local, acute	0.085 mg/m³ (Measured data)	< 0.01
Dermal, local, long term	0.76 µg/cm² (Measured data)	0.022

4.3.6. Worker exposure: Packaging and transfer of granulated product (PROC 21)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.012 mg/m³ (Measured data)	0.24
Inhalation, local, long term	0.012 mg/m³ (Measured data)	0.24
Inhalation, local, acute	0.035 mg/m³ (Measured data)	< 0.01
Dermal, local, long term	1 µg/cm² (Measured data)	0.029

4.3.7. Worker exposure: Wet cleaning (PROC 28)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	6E-3 mg/m³ (Measured data)	0.12
Inhalation, local, long term	6E-3 mg/m³ (Measured data)	0.12
Inhalation, local, acute	0.026 mg/m³ (Measured data)	< 0.01
Dermal, local, long term	0.76 µg/cm² (Measured data)	0.022

4.3.8. Worker exposure: Cleaning/removal of dust (PROC 28)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.032 mg/m³ (Measured data)	0.64
Inhalation, local, long term	0.032 mg/m³ (Measured data)	0.64
Inhalation, local, acute	0.189 mg/m³ (Measured data)	0.016
Dermal, local, long term	0.76 µg/cm² (Measured data)	0.022

4.4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES

Guidance: Please refer to Section 0.3 of this “ES for Communication”.

5. ES 5: Manufacture; Manufacture of nickel metal powder from nickel hydroxycarbonate

5.1. Title section

Environment	
1: Manufacture of nickel metal powder from nickel hydroxycarbonate - Discharge to fresh water via municipal sewage treatment plant	ERC 1
2: Manufacture of nickel metal powder from nickel hydroxycarbonate - Direct discharge to fresh water	ERC 1
3: Manufacture of nickel metal powder from nickel hydroxycarbonate - Direct discharge to marine water	ERC 1
Worker	
4: Hydrogen reduction of nickel hydroxycarbonate to nickel powder in enclosed kilns	PROC 22, PROC 2, PROC 1
5: Crushing and homogenisation	PROC 24
6: Packaging and storage	PROC 26
7: Wet cleaning	PROC 28
8: Cleaning/removal of dust	PROC 28

5.2. Conditions of use affecting exposure

5.2.1. Control of environmental exposure: Manufacture of nickel metal powder from nickel hydroxycarbonate - Discharge to fresh water via municipal sewage treatment plant (ERC 1)

Amount used, frequency and duration of use (or from service life)
Daily amount per site <= 0.533 tonnes/day (All the amounts and concentrations are expressed as Ni as this is the driver for the environmental risk assessment.)
Annual amount per site <= 80 tonnes/year
Emission days >= 150 days/year
Technical and organisational conditions and measures
Chemical precipitation or sedimentation or filtration or electrolysis or reverse osmosis or ion exchange
Electrostatic precipitator or wet electrostatic precipitator or cyclones or fabric/bag filter or ceramic/metal mesh filter or wet scrubber
Conditions and measures related to biological sewage treatment plant
Municipal sewage treatment plant is assumed.
Assumed domestic sewage treatment plant flow >= 2E3 m3/day
Conditions and measures related to external treatment of waste (including article waste)
Dispose of waste product or used containers according to local regulations.
Other conditions affecting environmental exposure
Receiving surface water flow >= 1.8E4 m3/day
No discharge to marine water assumed
Receiving water dilution (fresh or marine) >= 10

5.2.2. Control of environmental exposure: Manufacture of nickel

metal powder from nickel hydroxycarbonate - Direct discharge to fresh water (ERC 1)

Amount used, frequency and duration of use (or from service life)
Daily amount per site <= 0.533 tonnes/day (All the amounts and concentrations are expressed as Ni as this is the driver for the environmental risk assessment.)
Annual amount per site <= 80 tonnes/year
Emission days >= 150 days/year
Technical and organisational conditions and measures
Chemical precipitation or sedimentation or filtration or electrolysis or reverse osmosis or ion exchange
Electrostatic precipitator or wet electrostatic precipitator or cyclones or fabric/bag filter or ceramic/metal mesh filter or wet scrubber
Conditions and measures related to external treatment of waste (including article waste)
Dispose of waste product or used containers according to local regulations.
Other conditions affecting environmental exposure
Receiving surface water flow >= 1.8E4 m3/day
No discharge to marine water assumed
Receiving water dilution (fresh or marine) >= 10
Assumed effluent discharge flow from site >= 2E3 m3/day

5.2.3. Control of environmental exposure: Manufacture of nickel metal powder from nickel hydroxycarbonate - Direct discharge to marine water (ERC 1)

Amount used, frequency and duration of use (or from service life)
Daily amount per site <= 0.533 tonnes/day (All the amounts and concentrations are expressed as Ni as this is the driver for the environmental risk assessment.)
Annual amount per site <= 80 tonnes/year
Emission days >= 150 days/year
Technical and organisational conditions and measures
Chemical precipitation or sedimentation or filtration or electrolysis or reverse osmosis or ion exchange
Electrostatic precipitator or wet electrostatic precipitator or cyclones or fabric/bag filter or ceramic/metal mesh filter or wet scrubber
Conditions and measures related to external treatment of waste (including article waste)
Dispose of waste product or used containers according to local regulations.
Other conditions affecting environmental exposure
No discharge to freshwater assumed
Receiving water dilution (fresh or marine) >= 100
Assumed effluent discharge flow from site >= 2E3 m3/day

5.2.4. Control of worker exposure: Hydrogen reduction of nickel hydroxycarbonate to nickel powder in enclosed kilns (PROC 22, PROC 2, PROC 1)

Product (article) characteristics
Physical form of product: Solid, high dustiness
Covers concentrations up to 100 %

Amount used (or contained in articles), frequency and duration of use/exposure
Covers use up to 8 h/day
Technical and organisational conditions and measures
Assumes that activities are undertaken with appropriate and well maintained equipment by trained personnel operating under supervision. Ensure regular inspection, cleaning and maintenance of equipment and machines. Clear spills immediately. Ensure daily cleaning of the equipment.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Provide specifically designed and maintained LEV (receiving hood type). Ensure effectiveness is at least 80%.
Automated task
Use in closed process
Ensure that worker is in a separated (control) room with independent clean air supply.
Other conditions affecting workers exposure
Assumes process temperature up to 40 °C
Indoor use
For supervision activities it is important to also respect the RMMs as prescribed in the contributing scenarios for the specific process that are supervised, as relevant.

5.2.5. Control of worker exposure: Crushing and homogenisation (PROC 24)

Product (article) characteristics
Covers concentrations up to 100 %
Physical form of product: Solid
Maximum emission potential covered in this CS: High (abrasion based).
Amount used (or contained in articles), frequency and duration of use/exposure
Covers use up to 8 h/day
Technical and organisational conditions and measures
Assumes that activities are undertaken with appropriate and well maintained equipment by trained personnel operating under supervision. Ensure regular inspection, cleaning and maintenance of equipment and machines. Clear spills immediately. Ensure daily cleaning of the equipment.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Use in closed process
Other conditions affecting workers exposure
Assumes process temperature up to 40 °C
Indoor use

5.2.6. Control of worker exposure: Packaging and storage (PROC 26)

Product (article) characteristics
Physical form of product: Solid, high dustiness
Covers concentrations up to 100 %
Amount used (or contained in articles), frequency and duration of use/exposure
Covers use up to 8 h/day
Technical and organisational conditions and measures
Assumes that activities are undertaken with appropriate and well maintained equipment by trained personnel operating under supervision. Ensure regular inspection, cleaning and maintenance of

equipment and machines. Clear spills immediately. Ensure daily cleaning of the equipment.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Provide specifically designed and maintained LEV (receiving hood type). Ensure effectiveness is at least 80%.
Highly automated process (automated filling lines)
Ensure segregation of worker from the source (fenced transfer to packaging lines).
Other conditions affecting workers exposure
Assumes process temperature up to 40 °C
Indoor use

5.2.7. Control of worker exposure: Wet cleaning (PROC 28)

Product (article) characteristics
Physical form of product: Liquid
Additional physical form of product: Solution
Covers concentrations up to 100 %
Maximum emission potential covered in this CS: Very low.
Amount used (or contained in articles), frequency and duration of use/exposure
Covers use up to 8 h/day
Technical and organisational conditions and measures
Assumes that activities are undertaken with appropriate and well maintained equipment by trained personnel operating under supervision. Ensure regular inspection, cleaning and maintenance of equipment and machines. Clear spills immediately. Ensure daily cleaning of the equipment.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Cleaning machines such as power sweeper, no direct manual cleaning.
Conditions and measures related to personal protection, hygiene and health evaluation
Wear a respirator which provides an assigned protection factor (APF) according to EN 529 of at least of 10 (APF >= 10). For further specification, refer to section 8 of the SDS.
Other conditions affecting workers exposure
Assumes process temperature up to 40 °C
Indoor use

5.2.8. Control of worker exposure: Cleaning/removal of dust (PROC 28)

Product (article) characteristics
Physical form of product: Solid, high dustiness
Covers concentrations up to 100 %
Amount used (or contained in articles), frequency and duration of use/exposure
Covers use up to 8 h/day
Technical and organisational conditions and measures
Assumes that activities are undertaken with appropriate and well maintained equipment by trained personnel operating under supervision. Ensure regular inspection, cleaning and maintenance of equipment and machines. Clear spills immediately. Ensure daily cleaning of the equipment.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Cleaning is conducted using cleaning machines, in particular hovering is applied and the use of compressed air is omitted.
Conditions and measures related to personal protection, hygiene and health evaluation

Wear a respirator which provides an assigned protection factor (APF) according to EN 529 of at least of 20 (APF >= 20). For further specification, refer to section 8 of the SDS.
Other conditions affecting workers exposure
Assumes process temperature up to 40 °C
Indoor use

5.3. Exposure estimation and reference to its source

5.3.1. Environmental release and exposure: Manufacture of nickel metal powder from nickel hydroxycarbonate - Discharge to fresh water via municipal sewage treatment plant (ERC 1)

Release route	Release rate	Release estimation method
Water	0.053 kg/day	Estimated release factor
Air	0.16 kg/day	Estimated release factor
Soil	0 kg/day	Estimated release factor

Protection target	Exposure estimate	RCR
Fresh water	4.05E-3 mg/L (EUSES 2.1.2)	0.663
Sediment (freshwater)	63.7 mg/kg dw (PEC sediment calculation method for metals)	0.584
Sewage Treatment Plant	0.016 mg/L (EUSES 2.1.2)	0.048
Agricultural soil	16.65 mg/kg dw (EUSES 2.1.2)	0.424

5.3.2. Environmental release and exposure: Manufacture of nickel metal powder from nickel hydroxycarbonate - Direct discharge to fresh water (ERC 1)

Release route	Release rate	Release estimation method
Water	0.053 kg/day	Estimated release factor
Air	0.16 kg/day	Estimated release factor
Soil	0 kg/day	Estimated release factor

Protection target	Exposure estimate	RCR
Fresh water	4.81E-3 mg/L (EUSES 2.1.2)	0.789
Sediment (freshwater)	83.8 mg/kg dw (PEC sediment calculation method for metals)	0.769
Agricultural soil	16.20 mg/kg dw (EUSES 2.1.2)	0.412

5.3.3. Environmental release and exposure: Manufacture of nickel metal powder from nickel hydroxycarbonate - Direct discharge to marine water (ERC 1)

Release route	Release rate	Release estimation method
Water	0.053 kg/day	Estimated release factor
Air	0.16 kg/day	Estimated release factor
Soil	0 kg/day	Estimated release factor

Protection target	Exposure estimate	RCR
Marine water	4.91E-4 mg/L (EUSES 2.1.2)	0.051

Protection target	Exposure estimate	RCR
Sediment (marine water)	21.1 mg/kg dw (PEC sediment calculation method for metals)	0.194
Agricultural soil	16.20 mg/kg dw (EUSES 2.1.2)	0.412

5.3.4. Worker exposure: Hydrogen reduction of nickel hydroxycarbonate to nickel powder in enclosed kilns (PROC 22, PROC 2, PROC 1)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	7E-3 mg/m³ (Measured data)	0.14
Inhalation, local, long term	7E-3 mg/m³ (Measured data)	0.14
Inhalation, local, acute	0.022 mg/m³ (Measured data)	< 0.01
Dermal, local, long term	0.76 µg/cm² (Measured data)	0.022

5.3.5. Worker exposure: Crushing and homogenisation (PROC 24)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.024 mg/m³ (Measured data)	0.48
Inhalation, local, long term	0.024 mg/m³ (Measured data)	0.48
Inhalation, local, acute	0.096 mg/m³ (Measured data)	< 0.01
Dermal, local, long term	0.76 µg/cm² (Measured data)	0.022

5.3.6. Worker exposure: Packaging and storage (PROC 26)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.031 mg/m³ (Measured data)	0.62
Inhalation, local, long term	0.031 mg/m³ (Measured data)	0.62
Inhalation, local, acute	0.093 mg/m³ (Measured data)	< 0.01
Dermal, local, long term	1 µg/cm² (Measured data)	0.029

5.3.7. Worker exposure: Wet cleaning (PROC 28)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	6E-3 mg/m³ (Measured data)	0.12
Inhalation, local, long term	6E-3 mg/m³ (Measured data)	0.12
Inhalation, local, acute	0.026 mg/m³ (Measured data)	< 0.01
Dermal, local, long term	0.76 µg/cm² (Measured data)	0.022

5.3.8. Worker exposure: Cleaning/removal of dust (PROC 28)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.032 mg/m³ (Measured data)	0.64
Inhalation, local, long term	0.032 mg/m³ (Measured data)	0.64
Inhalation, local, acute	0.189 mg/m³ (Measured data)	0.016
Dermal, local, long term	0.76 µg/cm² (Measured data)	0.022

5.4. Guidance to DU to evaluate whether he works inside

the boundaries set by the ES

Guidance: Please refer to Section 0.3 of this “ES for Communication”.

6. ES 6: Manufacture; Manufacture of nickel powder or nickel alloy powder from nickel oxide

6.1. Title section

Environment	
1: Manufacture of nickel powder or nickel alloy powder from nickel oxide - Direct discharge to fresh water	ERC 1
2: Manufacture of nickel powder or nickel alloy powder from nickel oxide - Direct discharge to marine water	ERC 1
Worker	
3: Smelting	PROC 22
4: Alloying and atomisation	PROC 27a, PROC 4
5: Drying	PROC 4, PROC 2
6: Blending and sieving	PROC 26
7: Packaging	PROC 26
8: Wet cleaning	PROC 28
9: Cleaning/removal of dust	PROC 28

6.2. Conditions of use affecting exposure

6.2.1. Control of environmental exposure: Manufacture of nickel powder or nickel alloy powder from nickel oxide - Direct discharge to fresh water (ERC 1)

Amount used, frequency and duration of use (or from service life)
Daily amount per site <= 9.837 tonnes/day (All the amounts and concentrations are expressed as Ni as this is the driver for the environmental risk assessment.)
Annual amount per site <= 2.06E3 tonnes/year
Emission days >= 209 days/year
Technical and organisational conditions and measures
Chemical precipitation or sedimentation or filtration or electrolysis or reverse osmosis or ion exchange
Electrostatic precipitator or wet electrostatic precipitator or cyclones or fabric/bag filter or ceramic/metal mesh filter or wet scrubber
Conditions and measures related to external treatment of waste (including article waste)
Dispose of waste product or used containers according to local regulations.
Other conditions affecting environmental exposure
Receiving surface water flow >= 9.96E3 m3/day
No discharge to marine water assumed
Receiving water dilution (fresh or marine) >= 250
Assumed effluent discharge flow from site >= 40 m3/day

6.2.2. Control of environmental exposure: Manufacture of nickel powder or nickel alloy powder from nickel oxide - Direct discharge to marine water (ERC 1)

Amount used, frequency and duration of use (or from service life)
Daily amount per site <= 5.014 tonnes/day (All the amounts and concentrations are expressed as Ni as this is the driver for the environmental risk assessment.)
Annual amount per site <= 1.05E3 tonnes/year
Emission days >= 209 days/year
Technical and organisational conditions and measures
Chemical precipitation or sedimentation or filtration or electrolysis or reverse osmosis or ion exchange
Electrostatic precipitator or wet electrostatic precipitator or cyclones or fabric/bag filter or ceramic/metal mesh filter or wet scrubber
Conditions and measures related to external treatment of waste (including article waste)
Dispose of waste product or used containers according to local regulations.
Other conditions affecting environmental exposure
No discharge to freshwater assumed
Receiving water dilution (fresh or marine) >= 100
Assumed effluent discharge flow from site >= 40 m3/day

6.2.3. Control of worker exposure: Smelting (PROC 22)

Product (article) characteristics
Physical form of product: Molten inorganic substances
Covers concentrations up to 100 %
Maximum emission potential covered in this CS: High (temperature based).
Amount used (or contained in articles), frequency and duration of use/exposure
Covers use up to 8 h/day
Technical and organisational conditions and measures
Assumes that activities are undertaken with appropriate and well maintained equipment by trained personnel operating under supervision. Ensure regular inspection, cleaning and maintenance of equipment and machines. Clear spills immediately. Ensure daily cleaning of the equipment.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Provide specifically designed and maintained LEV (receiving hood type). Ensure effectiveness is at least 80%.
Very limited manual intervention is required to run the process. Contact with the substance shall only be possible for a very limited duration of time.
Semi-closed system
High temperature
Other conditions affecting workers exposure
Indoor use

6.2.4. Control of worker exposure: Alloying and atomisation (PROC 27a, PROC 4)

Product (article) characteristics
Physical form of product: Solid, low dustiness
Additional physical form of product: Wet powder, covering pellets
Covers concentrations up to 100 %
Amount used (or contained in articles), frequency and duration of use/exposure
Covers use up to 8 h/day

Technical and organisational conditions and measures
Assumes that activities are undertaken with appropriate and well maintained equipment by trained personnel operating under supervision. Ensure regular inspection, cleaning and maintenance of equipment and machines. Clear spills immediately. Ensure daily cleaning of the equipment.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Provide specifically designed and maintained LEV (receiving hood type). Ensure effectiveness is at least 80%.
Very limited manual intervention is required to run the process. Contact with the substance shall only be possible for a very limited duration of time.
Semi-closed system
Other conditions affecting workers exposure
Assumes process temperature up to 1.6E3 °C
Indoor use

6.2.5. Control of worker exposure: Drying (PROC 4, PROC 2)

Product (article) characteristics
Physical form of product: Solid, high dustiness
Covers concentrations up to 100 %
Amount used (or contained in articles), frequency and duration of use/exposure
Covers use up to 8 h/day
Technical and organisational conditions and measures
Assumes that activities are undertaken with appropriate and well maintained equipment by trained personnel operating under supervision. Ensure regular inspection, cleaning and maintenance of equipment and machines. Clear spills immediately. Ensure daily cleaning of the equipment.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Provide specifically designed and maintained LEV (receiving hood type). Ensure effectiveness is at least 80%.
Very limited manual intervention is required to run the process. Contact with the substance shall only be possible for a very limited duration of time.
Semi-closed system
Other conditions affecting workers exposure
Assumes process temperature up to 125 °C
Indoor use

6.2.6. Control of worker exposure: Blending and sieving (PROC 26)

Product (article) characteristics
Physical form of product: Solid, high dustiness
Covers concentrations up to 100 %
Amount used (or contained in articles), frequency and duration of use/exposure
Covers use up to 8 h/day
Technical and organisational conditions and measures
Assumes that activities are undertaken with appropriate and well maintained equipment by trained personnel operating under supervision. Ensure regular inspection, cleaning and maintenance of equipment and machines. Clear spills immediately. Ensure daily cleaning of the equipment.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Provide specifically designed and maintained LEV (receiving hood type). Ensure effectiveness is at least 80%.

Very limited manual intervention is required to run the process. Contact with the substance shall only be possible for a very limited duration of time.
Semi-closed system
Conditions and measures related to personal protection, hygiene and health evaluation
Wear a respirator which provides an assigned protection factor (APF) according to EN 529 of at least of 10 (APF >= 10). For further specification, refer to section 8 of the SDS.
Wear chemically resistant gloves (tested to EN374) in combination with specific activity training. If skin contamination is expected to extend to other parts of the body, then these body parts should also be protected with impervious garments in a manner equivalent to those described for the hands. For further specification, refer to section 8 of the SDS.
Other conditions affecting workers exposure
Assumes process temperature up to 40 °C
Indoor use

6.2.7. Control of worker exposure: Packaging (PROC 26)

Product (article) characteristics
Physical form of product: Solid, high dustiness
Covers concentrations up to 100 %
Amount used (or contained in articles), frequency and duration of use/exposure
Covers use up to 8 h/day
Technical and organisational conditions and measures
Assumes that activities are undertaken with appropriate and well maintained equipment by trained personnel operating under supervision. Ensure regular inspection, cleaning and maintenance of equipment and machines. Clear spills immediately. Ensure daily cleaning of the equipment.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Provide specifically designed and maintained LEV (receiving hood type). Ensure effectiveness is at least 80%.
Semi-closed system
Conditions and measures related to personal protection, hygiene and health evaluation
Wear a respirator which provides an assigned protection factor (APF) according to EN 529 of at least of 10 (APF >= 10). For further specification, refer to section 8 of the SDS.
Wear chemically resistant gloves (tested to EN374) in combination with specific activity training. If skin contamination is expected to extend to other parts of the body, then these body parts should also be protected with impervious garments in a manner equivalent to those described for the hands. For further specification, refer to section 8 of the SDS.
Other conditions affecting workers exposure
Assumes process temperature up to 40 °C
Indoor use

6.2.8. Control of worker exposure: Wet cleaning (PROC 28)

Product (article) characteristics
Physical form of product: Liquid
Additional physical form of product: Solution
Covers concentrations up to 100 %
Maximum emission potential covered in this CS: Very low.
Amount used (or contained in articles), frequency and duration of use/exposure
Covers use up to 8 h/day
Technical and organisational conditions and measures

Assumes that activities are undertaken with appropriate and well maintained equipment by trained personnel operating under supervision. Ensure regular inspection, cleaning and maintenance of equipment and machines. Clear spills immediately. Ensure daily cleaning of the equipment.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Cleaning machines such as power sweeper, no direct manual cleaning.
Conditions and measures related to personal protection, hygiene and health evaluation
Wear a respirator which provides an assigned protection factor (APF) according to EN 529 of at least of 10 (APF >= 10). For further specification, refer to section 8 of the SDS.
Other conditions affecting workers exposure
Assumes process temperature up to 40 °C
Indoor use

6.2.9. Control of worker exposure: Cleaning/removal of dust (PROC 28)

Product (article) characteristics
Physical form of product: Solid, high dustiness
Covers concentrations up to 100 %
Amount used (or contained in articles), frequency and duration of use/exposure
Covers use up to 8 h/day
Technical and organisational conditions and measures
Assumes that activities are undertaken with appropriate and well maintained equipment by trained personnel operating under supervision. Ensure regular inspection, cleaning and maintenance of equipment and machines. Clear spills immediately. Ensure daily cleaning of the equipment.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Cleaning is conducted using cleaning machines, in particular hovering is applied and the use of compressed air is omitted.
Conditions and measures related to personal protection, hygiene and health evaluation
Wear a respirator which provides an assigned protection factor (APF) according to EN 529 of at least of 20 (APF >= 20). For further specification, refer to section 8 of the SDS.
Other conditions affecting workers exposure
Assumes process temperature up to 40 °C
Indoor use

6.3. Exposure estimation and reference to its source

6.3.1. Environmental release and exposure: Manufacture of nickel powder or nickel alloy powder from nickel oxide - Direct discharge to fresh water (ERC 1)

Release route	Release rate	Release estimation method
Water	0.032 kg/day	Estimated release factor
Air	2.843 kg/day	Estimated release factor
Soil	0 kg/day	Estimated release factor

Protection target	Exposure estimate	RCR
Fresh water	5.23E-3 mg/L (EUSES 2.1.2)	0.857
Sediment (freshwater)	94.4 mg/kg dw (PEC sediment calculation method for metals)	0.866

Protection target	Exposure estimate	RCR
Agricultural soil	16.39 mg/kg dw (EUSES 2.1.2)	0.417

6.3.2. Environmental release and exposure: Manufacture of nickel powder or nickel alloy powder from nickel oxide - Direct discharge to marine water (ERC 1)

Release route	Release rate	Release estimation method
Water	0.017 kg/day	Estimated release factor
Air	1.449 kg/day	Estimated release factor
Soil	0 kg/day	Estimated release factor

Protection target	Exposure estimate	RCR
Marine water	3.27E-3 mg/L (EUSES 2.1.2)	0.342
Sediment (marine water)	93.7 mg/kg dw (PEC sediment calculation method for metals)	0.86
Agricultural soil	16.30 mg/kg dw (EUSES 2.1.2)	0.415

6.3.3. Worker exposure: Smelting (PROC 22)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.021 mg/m³ (Measured data)	0.42
Inhalation, local, long term	0.021 mg/m³ (Measured data)	0.42
Inhalation, local, acute	0.085 mg/m³ (Measured data)	< 0.01
Dermal, local, long term	0.76 µg/cm² (Measured data)	0.022

6.3.4. Worker exposure: Alloying and atomisation (PROC 27a, PROC 4)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.016 mg/m³ (Measured data)	0.32
Inhalation, local, long term	0.016 mg/m³ (Measured data)	0.32
Inhalation, local, acute	0.065 mg/m³ (Measured data)	< 0.01
Dermal, local, long term	0.76 µg/cm² (Measured data)	0.022

6.3.5. Worker exposure: Drying (PROC 4, PROC 2)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	5E-3 mg/m³ (Measured data)	0.1
Inhalation, local, long term	5E-3 mg/m³ (Measured data)	0.1
Inhalation, local, acute	0.016 mg/m³ (Measured data)	< 0.01
Dermal, local, long term	0.76 µg/cm² (Measured data)	0.022

6.3.6. Worker exposure: Blending and sieving (PROC 26)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.014 mg/m³ (Measured data)	0.28
Inhalation, local, long term	0.014 mg/m³ (Measured data)	0.28
Inhalation, local, acute	0.071 mg/m³ (Measured data)	< 0.01

Route of exposure and type of effects	Exposure estimate	RCR
Dermal, local, long term	5.18 µg/cm² (Measured data)	0.148

6.3.7. Worker exposure: Packaging (PROC 26)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.014 mg/m³ (Measured data)	0.28
Inhalation, local, long term	0.014 mg/m³ (Measured data)	0.28
Inhalation, local, acute	0.071 mg/m³ (Measured data)	< 0.01
Dermal, local, long term	5.18 µg/cm² (Measured data)	0.148

6.3.8. Worker exposure: Wet cleaning (PROC 28)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	6E-3 mg/m³ (Measured data)	0.12
Inhalation, local, long term	6E-3 mg/m³ (Measured data)	0.12
Inhalation, local, acute	0.026 mg/m³ (Measured data)	< 0.01
Dermal, local, long term	0.76 µg/cm² (Measured data)	0.022

6.3.9. Worker exposure: Cleaning/removal of dust (PROC 28)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.032 mg/m³ (Measured data)	0.64
Inhalation, local, long term	0.032 mg/m³ (Measured data)	0.64
Inhalation, local, acute	0.189 mg/m³ (Measured data)	0.016
Dermal, local, long term	0.76 µg/cm² (Measured data)	0.022

6.4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES

Guidance: Please refer to Section 0.3 of this “ES for Communication”.

7. ES 7: Manufacture; Manufacture of nickel metal through hydrogen reduction

7.1. Title section

Environment	
1: Manufacture of nickel metal through hydrogen reduction - Direct discharge to fresh water	ERC 1
Worker	
2: Chemical reduction	PROC 1
3: Packaging of powder and briquettes	PROC 26, PROC 21
4: Wet cleaning	PROC 28
5: Cleaning/removal of dust	PROC 28

7.2. Conditions of use affecting exposure

7.2.1. Control of environmental exposure: Manufacture of nickel metal through hydrogen reduction - Direct discharge to fresh water (ERC 1)

Amount used, frequency and duration of use (or from service life)
Daily amount per site <= 190.0 tonnes/day (All the amounts and concentrations are expressed as Ni as this is the driver for the environmental risk assessment.)
Annual amount per site <= 6.94E4 tonnes/year
Emission days >= 365 days/year
Technical and organisational conditions and measures
Chemical precipitation or sedimentation or filtration or electrolysis or reverse osmosis or ion exchange
Electrostatic precipitator or wet electrostatic precipitator or cyclones or fabric/bag filter or ceramic/metal mesh filter or wet scrubber
Conditions and measures related to external treatment of waste (including article waste)
Dispose of waste product or used containers according to local regulations.
Other conditions affecting environmental exposure
Receiving surface water flow >= 1.78E6 m3/day
No discharge to marine water assumed
Receiving water dilution (fresh or marine) >= 892
Assumed effluent discharge flow from site >= 2E3 m3/day

7.2.2. Control of worker exposure: Chemical reduction (PROC 1)

Product (article) characteristics
Physical form of product: Solid, high dustiness (covering briquettes)
Covers concentrations up to 100 %
Additional physical form of product: Briquettes
Amount used (or contained in articles), frequency and duration of use/exposure
Covers use up to 8 h/day
Technical and organisational conditions and measures

Assumes that activities are undertaken with appropriate and well maintained equipment by trained personnel operating under supervision. Ensure regular inspection, cleaning and maintenance of equipment and machines. Clear spills immediately. Ensure daily cleaning of the equipment.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Provide specifically designed and maintained LEV (receiving hood type). Ensure effectiveness is at least 80%.
Automated task
The conducted processes (pressurised hydrogen gas reduction, powder washing and drying, powder pressing and sintering into briquettes) are fully enclosed and automated.
Ensure that worker is in a separated (control) room with independent clean air supply.
Other conditions affecting workers exposure
Assumes process temperature up to 40 °C
Indoor use

7.2.3. Control of worker exposure: Packaging of powder and briquettes (PROC 26, PROC 21)

Product (article) characteristics
Physical form of product: Solid, medium dustiness (covering briquettes)
Covers concentrations up to 100 %
Additional physical form of product: Briquettes
Amount used (or contained in articles), frequency and duration of use/exposure
Covers use up to 8 h/day
Technical and organisational conditions and measures
Assumes that activities are undertaken with appropriate and well maintained equipment by trained personnel operating under supervision. Ensure regular inspection, cleaning and maintenance of equipment and machines. Clear spills immediately. Ensure daily cleaning of the equipment.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Provide specifically designed and maintained LEV (receiving hood type). Ensure effectiveness is at least 80%.
Very limited manual intervention is required to run the process. Contact with the substance shall only be possible for a very limited duration of time.
Ensure segregation of worker from the source.
Conditions and measures related to personal protection, hygiene and health evaluation
If cobalt metal is relevant as impurity wear a respirator which provides an assigned protection factor (APF) according to EN 529 of at least of 10 (APF >= 10). For further specification, refer to section 8 of the SDS.
If cobalt metal is relevant as impurity wear suitable gloves tested to EN374 unless gloves according to EN 388 or EN 407 are required. For further specification, refer to section 8 of the SDS.
If cobalt metal is relevant as impurity use suitable eye protection. For further specification, refer to section 8 of the SDS.
Other conditions affecting workers exposure
Assumes process temperature up to 40 °C
Indoor use

7.2.4. Control of worker exposure: Wet cleaning (PROC 28)

Product (article) characteristics
Physical form of product: Liquid
Additional physical form of product: Solution

Covers concentrations up to 100 %
Maximum emission potential covered in this CS: Very low.
Amount used (or contained in articles), frequency and duration of use/exposure
Covers use up to 8 h/day
Technical and organisational conditions and measures
Assumes that activities are undertaken with appropriate and well maintained equipment by trained personnel operating under supervision. Ensure regular inspection, cleaning and maintenance of equipment and machines. Clear spills immediately. Ensure daily cleaning of the equipment.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Cleaning machines such as power sweeper, no direct manual cleaning.
Conditions and measures related to personal protection, hygiene and health evaluation
Wear a respirator which provides an assigned protection factor (APF) according to EN 529 of at least of 10 (APF >= 10). For further specification, refer to section 8 of the SDS.
If cobalt metal is relevant as impurity wear suitable gloves tested to EN374 unless gloves according to EN 388 or EN 407 are required. For further specification, refer to section 8 of the SDS.
If cobalt metal is relevant as impurity use suitable eye protection. For further specification, refer to section 8 of the SDS.
Other conditions affecting workers exposure
Assumes process temperature up to 40 °C
Indoor use

7.2.5. Control of worker exposure: Cleaning/removal of dust (PROC 28)

Product (article) characteristics
Physical form of product: Solid, high dustiness
Covers concentrations up to 100 %
Amount used (or contained in articles), frequency and duration of use/exposure
Covers use up to 8 h/day
Technical and organisational conditions and measures
Assumes that activities are undertaken with appropriate and well maintained equipment by trained personnel operating under supervision. Ensure regular inspection, cleaning and maintenance of equipment and machines. Clear spills immediately. Ensure daily cleaning of the equipment.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Cleaning is conducted using cleaning machines, in particular hovering is applied and the use of compressed air is omitted.
Conditions and measures related to personal protection, hygiene and health evaluation
Wear a respirator which provides an assigned protection factor (APF) according to EN 529 of at least of 20 (APF >= 20). For further specification, refer to section 8 of the SDS.
If cobalt metal is relevant as impurity wear suitable gloves tested to EN374 unless gloves according to EN 388 or EN 407 are required. For further specification, refer to section 8 of the SDS.
If cobalt metal is relevant as impurity use suitable eye protection. For further specification, refer to section 8 of the SDS.
Other conditions affecting workers exposure
Assumes process temperature up to 40 °C
Indoor use

7.3. Exposure estimation and reference to its source

7.3.1. Environmental release and exposure: Manufacture of nickel metal through hydrogen reduction - Direct discharge to fresh water (ERC 1)

Release route	Release rate	Release estimation method
Water	5.377 kg/day	Estimated release factor
Air	5.586 kg/day	Estimated release factor
Soil	0 kg/day	Estimated release factor

Protection target	Exposure estimate	RCR
Fresh water	5.06E-3 mg/L (EUSES 2.1.2)	0.83
Sediment (freshwater)	90.2 mg/kg dw (PEC sediment calculation method for metals)	0.828
Agricultural soil	16.87 mg/kg dw (EUSES 2.1.2)	0.429

7.3.2. Worker exposure: Chemical reduction (PROC 1)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	6E-3 mg/m³ (Measured data)	0.12
Inhalation, local, long term	6E-3 mg/m³ (Measured data)	0.12
Inhalation, local, acute For the substance	0.017 mg/m³ (Measured data)	< 0.01
Inhalation, local, acute For impurity nickel subsulphide (≥ 0.1 – ≤ 4 %)	0.001 mg/m³ (Measured data)	< 0.01*
Inhalation, local, acute Combined for substance and impurity nickel subsulphide (≥ 0.1 – ≤ 4 %) (sum of RCRs)	-	< 0.01
Dermal, local, long term For the substance	0.076 µg/cm² (Measured data)	< 0.01
Dermal, local, long term For impurity nickel oxide (≥ 0 – ≤ 10 %)	0.0076 µg/cm² (Measured data)	< 0.01**
Dermal, local, long term Combined for substance and impurity nickel oxide (≥ 0 – ≤ 10 %) (sum of RCRs)	-	< 0.01

*For inhalation, local, acute, the RCR for the impurity assessment considers the DNEL for the impurity nickel subsulphide of 0.8 mg/m³.
**For dermal, local, long-term, the RCR for the impurity assessment considers the DNEL for the impurity nickel oxide of 0.012 mg/cm².

7.3.3. Worker exposure: Packaging of powder and briquettes (PROC 26, PROC 21)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.031 mg/m³ (Measured data)	0.62
Inhalation, local, long term	0.031 mg/m³ (Measured data)	0.62
Inhalation, local, acute For the substance	0.093 mg/m³ (Measured data)	< 0.01
Inhalation, local, acute	0.004 mg/m³ (Measured data)	< 0.01*

Route of exposure and type of effects	Exposure estimate	RCR
For impurity nickel subsulphide (≥ 0.1 – ≤ 4 %)		
Inhalation, local, acute Combined for substance and impurity nickel subsulphide (≥ 0.1 – ≤ 4 %) (sum of RCRs)	-	0.012
Dermal, local, long term For the substance	1 µg/cm² (Measured data)	0.029
Dermal, local, long term For impurity nickel oxide (≥ 0 – ≤ 10 %)	0.1 µg/cm² (Measured data)	< 0.01**
Dermal, local, long term Combined for substance and impurity nickel oxide (≥ 0 – ≤ 10 %) (sum of RCRs)	-	0.037

*For inhalation, local, acute, the RCR for the impurity assessment considers the DNEL for the impurity nickel subsulphide of 0.8 mg/m³.
**For dermal, local, long-term, the RCR for the impurity assessment considers the DNEL for the impurity nickel oxide of 0.012 mg/cm².

7.3.4. Worker exposure: Wet cleaning (PROC 28)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	6E-3 mg/m³ (Measured data)	0.12
Inhalation, local, long term	6E-3 mg/m³ (Measured data)	0.12
Inhalation, local, acute For the substance	0.026 mg/m³ (Measured data)	< 0.01
Inhalation, local, acute For impurity nickel subsulphide (≥ 0.1 – ≤ 4 %)	0.001 mg/m³ (Measured data)	< 0.01*
Inhalation, local, acute Combined for substance and impurity nickel subsulphide (≥ 0.1 – ≤ 4 %) (sum of RCRs)	-	< 0.01
Dermal, local, long term For the substance	0.76 µg/cm² (Measured data)	0.022
Dermal, local, long term For impurity nickel oxide (≥ 0 – ≤ 10 %)	0.076 µg/cm² (Measured data)	< 0.01**
Dermal, local, long term Combined for substance and impurity nickel oxide (≥ 0 – ≤ 10 %) (sum of RCRs)	-	0.028

*For inhalation, local, acute, the RCR for the impurity assessment considers the DNEL for the impurity nickel subsulphide of 0.8 mg/m³.
**For dermal, local, long-term, the RCR for the impurity assessment considers the DNEL for the impurity nickel oxide of 0.012 mg/cm².

7.3.5. Worker exposure: Cleaning/removal of dust (PROC 28)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.032 mg/m³ (Measured data)	0.64
Inhalation, local, long term	0.032 mg/m³ (Measured data)	0.64

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, local, acute For the substance	0.189 mg/m³ (Measured data)	0.016
Inhalation, local, acute For impurity nickel subsulphide (≥ 0.1 – ≤ 4 %)	0.008 mg/m³ (Measured data)	0.01*
Inhalation, local, acute Combined for substance and impurity nickel subsulphide (≥ 0.1 – ≤ 4 %) (sum of RCRs)	-	0.026
Dermal, local, long term For the substance	0.76 µg/cm² (Measured data)	0.022
Dermal, local, long term For impurity nickel oxide (≥ 0 – ≤ 10 %)	0.076 µg/cm² (Measured data)	< 0.01**
Dermal, local, long term Combined for substance and impurity nickel oxide (≥ 0 – ≤ 10 %) (sum of RCRs)	-	0.028

*For inhalation, local, acute, the RCR for the impurity assessment considers the DNEL for the impurity nickel subsulphide of 0.8 mg/m³.
**For dermal, local, long-term, the RCR for the impurity assessment considers the DNEL for the impurity nickel oxide of 0.012 mg/cm².

7.4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES

Guidance: Please refer to Section 0.3 of this “ES for Communication”.