DRAFT ENVIRONMENTAL EXPOSURE SCENARIOS DIAMMINEDICHLOROPALLADIUM

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Please note that the section headings presented below will be integrated with those presented by EBRC for the occupational exposure scenarios in the final CSR document.

These environmental scenarios have been developed using the current predicted no-effect concentrations (PNECs). An additional chronic *Daphnia* test has been commissioned. The results of this test will be used to refine the FW PNEC following which the generic scenarios presented here will be updated.

9.0.2 Methodology – environmental exposure

Assessment has been undertaken of risks posed to all relevant environmental compartments by releases of palladium during the manufacture and use of diamminedichloropalladium (DDP). Environmental risk assessment has been based on measured emission data and estimation of environmental concentrations based on algorithms taken from ECHA technical guidance[1]. Risk characterisation is performed by comparison of the 'predicted environmental concentrations' (PECs) to appropriate 'predicted no effect concentrations' PNECs.

Exposure estimates are based on recently collected monitoring data supplemented by modelling based on the recommendations of ECHA's technical guidance on exposure assessment for REACH registration. Data on environmental emissions of palladium during manufacture of palladium compounds and their use as chemical intermediates were collected during 2011-12 at 13 sites across Europe. The exposure scenarios for manufacturing and use of DDP as a chemical intermediate (ES 1 & 2) are based on emissions of total palladium during production and use of a variety of palladium compounds. Due to the difficulty of assigning emissions of Pd to a specific compound or process, the release factors for emissions to waste-water calculated from site data from across Europe are considered applicable across the palladium processing sector. A summary of the site emission data used to quantify the environmental aspects of the generic exposure scenarios (GES) for manufacture of palladium compounds and their use as chemical intermediates is detailed below in Table 1. The selected environmental GES parameter values have been used to calculate the maximum safe tonnage (Msafe) of DDP that can be manufactured without posing an unacceptable risk to the environment.

Table 1. Statistical analysis of site emission data to derive parameter values for generic exposure scenarios

	Waste-water discharge					**Stack emissions to air**	
	Release factor (g/T)	**Treatment efficiency (%)**	**Emission days**	**WWTP flow rate (m^3/d)**	**STP flow rate (m^3/d)**	**Release factor (g/T)**	**Emission days**
Value for GES	68.2	99.9	250	120	3000	300 *160**	300
Derivation	50P	50P	50P	50P	10P	*SpERC* (Max*)	Mean
n	11	7	13	13	9	*3**	9

*There was an insufficient amount of site emission data to derive parameter values for modelling emissions to air (only three fully quantified sets of stack emission data were provided with a maximum release factor of 160 g/T). Environmental modelling was therefore undertaken using values from the Sector-specific Environmental Release Category (SpERC) for 'Manufacture of metal compounds'[2] (RF = 300 g/T or 0.03%); this is discussed in further detail in Section 9.0.3.

Data on environmental exposure arising from downstream use of DDP in the electroplating of massive objects is based on the SpERC for 'Industrial use of metals and metal compounds in metallic coating'[3]. The release factors detailed in this SpERC are based on measured emissions from sites undertaking galvanising and plating processes using base metals such nickel, tin and zinc. Due to the considerably higher monetary value of palladium it is considered that emissions from electroplating with DDP are likely to be at least an order of magnitude lower and release factors for water and air from the SpERC have

[1] ECHA (2012) Guidance on information requirements and chemical safety assessment. Chapter R16: Environmental exposure estimation (Version 2.1, October 2012)

[2] ARCHE (2013) Manufacture of metal compounds. spERC code Eurometaux 1.2.v2.1. Available online at http://www.arche-consulting.be/metal-csa-toolbox/SPERCs-tool-for-metals/

[3] ARCHE (2013) Industrial use of metals and metal compounds in metallic coating. spERC code Eurometaux 5.1 v2.1. Available online at http://www.arche-consulting.be/metal-csa-toolbox/SPERCs-tool-for-metals/

been adjusted accordingly (i.e. RF for emissions to waste-water reduced from 0.5 to 0.05% and RF for emissions to air reduced from 0.2 to 0.02%).

Risk assessment is not currently detailed for the sediment compartment as the PNEC is pending the outcome of sediment ecotoxicity testing. Risk characterisation for freshwater and marine sediments will be added following completion of the sediment test programme.

9.0.3 Methodology – indirect exposure via the environment

Assessment of the risk posed to man via environmental emissions is focussed on inhalation exposure following stack emissions to the atmosphere and their subsequent dispersal, which may lead to exposure of the general population living downwind of emissions. Releases to the atmosphere during the manufacture of DDP and its use as chemical intermediate are estimated based on the emission factor detailed in the SpERC for 'Manufacture of metal compounds' and its application to the Msafe tonnage (use of the emission factor detailed in the SpERC is supported by a limited amount of data on measured stack emissions). Exposure to the general population is estimated based on the quantity emitted to the atmosphere and use of an algorithm taken from ECHA technical guidance. Risk characterisation is performed by comparison of the estimated airborne concentration to a 'derived no effect level' (DNEL) for the general population.

9.1. Exposure scenario 1: Manufacture of diamminedichloropalladium

9.1.1. Environmental contributing scenario 1:

9.1.1.1. Conditions of use

The conditions of use are as described in the generic exposure scenario (GES) below.

9.1.1.2. Releases

The GES and associated risk assessment are concerned with releases of palladium to waste-water and air. This waste-water is either discharged directly to freshwater or treated at a municipal STP before discharge to fresh or marine waters; the three potential exposure scenarios are considered by the sub-scenarios ES 1.1-1.3. Exposure assessment for the aquatic environment is based on representative exposure characteristics from the palladium manufacturing sector and calculation of the maximum safe tonnage (Msafe) of DDP that can be manufactured without risk to the environment. Msafe is calculated using release factors determined from palladium emissions measured in waste-water in relation to the tonnage of palladium processed at sites producing DDP and other palladium compounds[4].

9.1.1.3. Exposure and risks for man via the environment

Assessment of risks for man via the environment is based on inhalation exposure to airborne particulates containing palladium released to the atmosphere during the manufacture of DDP and other palladium compounds[2].

Annual emission to air (kg Pd)	Emission days per year	Concentration in local air (µg Pd/m³)	Annual average concentration in air (µg Pd/m³)	DNEL (µg Pd/m³)	RCR
1.7	300	1.53×10^{-3}	1.3×10^{-3}	0.5	3.1×10^{-3}

1. Title **ES1: Manufacture of diamminedichloropalladium**	
Life cycle	Manufacture of diamminedichloropalladium
Systematic title based on use descriptor	**ERC:** ERC 1 Manufacture of substances
2. Operational conditions and risk management measures	
2.1 Control of environmental exposure	
Environmental related free short title	Production of diamminedichloropalladium
Systematic title based on use descriptor (environment)	ERC 1 Manufacture of substances
Processes, tasks, activities covered (environment)	Production of diamminedichloropalladium: Raw material delivery and handling, production and processing of DDP, packaging of DDP, cleaning & maintenance.
Environmental Assessment Method	Estimates based on monitoring data of emissions are used for calculation of maximum tonnage that can be manufactured safely without risk to the

[4] The emissions to waste-water and air from sites producing DDP and other palladium compounds are measured as total Pd and cannot be attributed to the manufacture or subsequent use of specific palladium compounds.

	environment
Product characteristics Diamminedichloropalladium as solid or aqueous solution. Environmental assessment is based on the measured emission of Pd in waste-water discharge and total Pd emissions to air.	
Amounts used	
Maximum annual safe use at a site (Msafe)	11 tonnes DDP (5.5 tonnes Pd metal equivalent)
Frequency and duration of use	
Pattern of release to the environment	250 days per year per site (50th %)
Environment factors not influenced by risk management	
Receiving surface water flow rate	ES 1.1 Discharge to STP: 3,000 m^3/d (10th %) ES 1.2 Direct discharge: 120,000 m^3/d
Dilution capacity, freshwater	Env ES 1.1 Discharge to freshwater via STP: DF = 10 (default) Env ES 1.2 Direct discharge to freshwater: DF = 1000 (max)
Dilution capacity, marine	Env ES 1.3 Discharge to seawater via STP: DF = 100 (default)
Other given operational conditions affecting environmental exposure	
None	
Technical conditions and measures at process level (source) to prevent release	
Appropriate process control systems shall be implemented.	
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	
Waste water: ES 1.1 & 1.3 Discharge to STP: On-site wastewater treatment by chemical precipitation, sedimentation and/or filtration. Efficiency 99.9 % (50th %) and off-site wastewater treatment plant, municipal STP Efficiency 80% (based on standard TGD parameters & known Pd partition coefficient for SPM) Release factor after on-site treatment: 68.2 g/T (50th %) ES 1.2 Direct discharge: On-site wastewater treatment by chemical precipitation, sedimentation and/or filtration. Efficiency 99.9 % Release factor after on-site treatment: 68.2 g/T (50th %) **Air:** All ES: Treatment of air emissions by filters (e.g. fabric, bag, HEPA) and/or wet scrubbers. Release factor after on-site treatment: 300 g/T (SpERC for 'Manufacture of metal compounds'[5])	
Organizational measures to prevent/limit release from site	
Regular operator training.	

[5] ARCHE (2013) Manufacture of metal compounds. spERC code Eurometaux 1.2.v2.1. Available online at http://www.arche-consulting.be/metal-csa-toolbox/SPERCs-tool-for-metals/

Conditions and measures related to municipal sewage treatment plant (if applicable)	
Municipal Sewage Treatment Plant (STP)	Yes for ES 1.1 and ES 1.3 Discharge to STP
Discharge rate of the Municipal STP	3 000 m^3/d (10th %)
Incineration of the sludge of the Municipal STP	The sludge is incinerated (with ash going to landfill)
Conditions and measures related to external treatment of waste for disposal	
DDP- and other Pd-containing waste is filled into containers and transported to licensed recycling facilities for recovery or disposed of at landfill.	
Conditions and measures related to external recovery of waste	
DDP- and other Pd-containing waste suitable for recycling may be recycled either internally or at licensed recycling facility. The sludge from the on-site treatment plant is processed for metal reclamation (recycling).	

3. Exposure and risk estimation

Environment [based on total Pd emissions]

ERC 1

ES Production of DDP

Compartment	Unit	PNEC	$PEC_{regional}$	C_{local}	PEC	RCR	Methods for calculation of environmental concentrations
Discharge to STP (ES 1.1 & 1.3)	mg Pd/L	1.46 mg/L as Pd(II)	6.54 x10^{-7} mg/L as Pd(II)	9.9 x 10^{-5} mg/L as Pd(II)	9.9 x 10^{-5} mg/L as Pd(II)	6.8 x 10^{-5}	Sector-specific measured values for emission factors applied to Msafe tonnage and dilution factor at municipal sewage works
ES 1.1 Freshwater via STP	mg Pd/L	1.33 x10^{-5} mg/L as Pd(II)	6.54 x10^{-7} mg/L as Pd(II)	9.21 x10^{-6} mg/L as Pd(II)	9.87 x10^{6} mg/L as Pd(II)	0.74	Sector-specific measured values for emission factors applied to Msafe tonnage and Pd-specific values for STP removal efficiency and dilution in ultimate receiving water body
ES 1.2 Freshwater following direct discharge	mg Pd/L	1.33 x10^{-5} mg/L as Pd(II)	6.54 x10^{-7} mg/L as Pd(II)	1.16 x10^{-5} mg/L as Pd(II)	1.23 x10^{-5} mg/L as Pd(II)	0.92	Sector-specific measured values for emission factors applied to Msafe tonnage and maximum level dilution in receiving water body
ES 1.3 Marine water via STP	mg Pd/L	1.33 x10^{-6} mg/L as Pd(II)	4.68 x10^{-8} mg/L as Pd(II)	7.96 x10^{-7} mg/L as Pd(II)	8.42 x10^{-7} mg/L as Pd(II)	0.65	Sector-specific measured values for emission factors applied to Msafe tonnage and Pd-specific values for STP removal efficiency and default dilution in marine surface water
Terrestrial (all scenarios)	mg/kg	0.0117 mg/kg as Pd(II)	1.89 x10^{-3} mg/kg as Pd(II)	3.3 x10^{-6} mg/kg as Pd(II)	1.89 x10^{-3} mg/kg as Pd(II)	0.16	Modelled increase in soil concentrations due to deposition from atmospheric emissions (i.e. assuming no

							application of sewage sludge to land)

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

Environment

Scaling tool: Metals EUSES IT tool (free download: http://www.arche-consulting.be/Metal-CSA-toolbox/du-scaling-tool)

Scaling of the release to air and water environment includes:

- Refining of the release factor to air and waste water and/or and the efficiency of the air filter and wastewater treatment facility.
- Adjustment of the flow rate for the receiving water body and subsequent dilution factor.

9.2. Exposure scenario 2:
Industrial use of diamminedichloropalladium as an intermediate in the manufacture of other substances

9.2.1. Environmental contributing scenario 2:

9.2.1.1. Conditions of use

The conditions of use are as described in the generic exposure scenario (GES) below.

9.2.1.2. Releases

The GES and associated risk assessment are concerned with releases of palladium (II) to waste-water and air. This waste-water is either discharged directly to freshwater or subsequently treated at a municipal STP before discharge to fresh or marine waters; the three potential exposure scenarios are considered by the sub-scenarios ES 2.1-2.3. Exposure assessment for the aquatic environment is based on representative exposure characteristics from the palladium manufacturing sector and calculation of the maximum safe tonnage (Msafe) of DDP that can be manufactured. Msafe is calculated using release factors determined from palladium emissions measured in waste-water in relation to the volume of palladium processed at sites producing DDP and other palladium compounds[6].

9.2.1.3. Exposure and risks for man via the environment

Assessment of risks for man via the environment is based on inhalation exposure to airborne particulates containing palladium released to the atmosphere during the manufacture of DDP and other palladium compounds[2].

Annual emission to air (kg Pd)	Emission days per year	Concentration in local air (µg Pd/m³)	Annual average concentration in air (µg Pd/m³)	DNEL (µg Pd/m³)	RCR
1.7	300	1.53×10^{-3}	1.3×10^{-3}	0.5	3.1×10^{-3}

1. Title **ES2: Industrial use of diamminedichloropalladium as intermediate in the manufacture of other substances**	
Life cycle	Industrial use of diamminedichloropalladium as chemical intermediate
Systematic title based on use descriptor	**ERC:** ERC 1 Manufacture of substances ERC 6A Industrial use resulting in manufacture of another substance (use of intermediates)
2. Operational conditions and risk management measures	
2.1 Control of environmental exposure	
Environmental related free short title	Production of diamminedichloropalladium
Systematic title based on use descriptor (environment)	ERC 1 Manufacture of substances ERC 6A Industrial use resulting in manufacture of another substance (use of intermediates)

[6] The emissions to waste-water and air from sites producing DDP and other palladium compounds are measured as total Pd and cannot be attributed to the manufacture or subsequent use of specific palladium compounds.

Processes, tasks, activities covered (environment)	Industrial use of diamminedichloropalladium as a chemical intermediate:
Environmental Assessment Method	Estimates based on monitoring data of emissions are used for calculation of maximum tonnage that can be safely used without risk to the environment
Product characteristics Diamminedichloropalladium as solid or aqueous solution. Environmental assessment is based on the measured emission of Pd in waste-water discharge and total Pd emissions to air.	
Amounts used	
Maximum annual safe use at a site (Msafe)	11 tonnes DDP (5.5 tonnes Pd metal equivalent)
Frequency and duration of use	
Pattern of release to the environment	250 days per year per site (50th %)
Environment factors not influenced by risk management	
Receiving surface water flow rate	ES 2.1 Discharge to STP: 3,000 m^3/d (10th %) ES 2.2 Direct discharge: 120,000 m^3/d
Dilution capacity, freshwater	Env ES 2.1 Discharge to freshwater via STP: DF = 10 (default) Env ES 2.2 Direct discharge to freshwater: DF = 1000 (max)
Dilution capacity, marine	Env ES 2.3 Discharge to seawater via STP: DF = 100 (default)
Other given operational conditions affecting environmental exposure	
None	
Technical conditions and measures at process level (source) to prevent release	
Appropriate process control systems shall be implemented.	
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	
Waste water: ES 2.1 & 2.3 Discharge to STP: On-site wastewater treatment by chemical precipitation, sedimentation and/or filtration. Efficiency 99.9 % (50th %) and off-site wastewater treatment plant, municipal STP Efficiency 80% (based on standard TGD parameters & known Pd partition coefficient for SPM) Release factor after on-site treatment: 68.2 g/T (50th %) ES 2.2 Direct discharge: On-site wastewater treatment by chemical precipitation, sedimentation and/or filtration. Efficiency 99.9 % Release factor after on-site treatment: 68.2 g/T (50th %) **Air:** All ES: Treatment of air emissions by filters (e.g. fabric, bag, HEPA) and/or wet scrubbers. Release factor after on-site treatment: 300 g/T (SpERC for 'Manufacture of metal compounds')	
Organizational measures to prevent/limit release from site	

Regular operator training.	
Conditions and measures related to municipal sewage treatment plant (if applicable)	
Municipal Sewage Treatment Plant (STP)	Yes for ES 2.1 and ES 2.3 Discharge to STP
Discharge rate of the Municipal STP	3 000 m^3/d
Incineration of the sludge of the Municipal STP	The sludge is incinerated (with ash going to landfill)
Conditions and measures related to external treatment of waste for disposal	
DDP- and other Pd-containing waste is filled into containers and transported to licensed recycling facilities for recovery or disposed of at landfill.	
Conditions and measures related to external recovery of waste	
DDP- and other Pd-containing waste suitable for recycling may be recycled either internally or at licensed recycling facility. The sludge from the on-site treatment plant is processed for metal reclamation (recycling).	

3. Exposure and risk estimation

Environment [based on total Pd emissions]

ERC 1, ERC 6A

ES Production of DDP

Compartment	Unit	PNEC	$PEC_{regional}$	C_{local}	PEC	RCR	Methods for calculation of environmental concentrations
Discharge to STP (ES 2.1 and 2.3)	mg Pd/L	1.46 mg/L as Pd(II)	6.54×10^{-7} mg/L as Pd(II)	9.9×10^{-5} mg/L as Pd(II)	9.9×10^{-5} mg/L as Pd(II)	6.8×10^{-5}	Sector-specific measured values for emission factors applied to Msafe tonnage and dilution factor at municipal sewage works
ES 2.1 Freshwater via STP	mg Pd/L	1.33×10^{-5} mg/L as Pd(II)	6.54×10^{-7} mg/L as Pd(II)	9.21×10^{-6} mg/L as Pd(II)	9.87×10^{-6} mg/L as Pd(II)	0.74	Sector-specific measured values for emission factors applied to Msafe tonnage and Pd-specific values for STP removal efficiency and dilution in ultimate receiving water body
ES 2.2 Freshwater following direct discharge	mg Pd/L	1.33×10^{-5} mg/L as Pd(II)	6.54×10^{-7} mg/L as Pd(II)	1.16×10^{-5} mg/L as Pd(II)	1.23×10^{-5} mg/L as Pd(II)	0.92	Sector-specific measured values for emission factors applied to Msafe tonnage and maximum level dilution in receiving water body
ES 2.3 Marine water via STP	mg Pd/L	1.33×10^{-6} mg/L as Pd(II)	4.68×10^{-8} mg/L as Pd(II)	7.96×10^{-7} mg/L as Pd(II)	8.42×10^{-7} mg/L as Pd(II)	0.65	Sector-specific measured values for emission factors applied to Msafe tonnage and Pd-specific values for STP removal efficiency and default dilution in marine surface water
Terrestrial (all scenarios)	mg/kg	0.0117 mg/kg as Pd(II)	1.89×10^{-3} mg/kg as Pd(II)	3.3×10^{-6} mg/kg as Pd(II)	1.89×10^{-3} mg/kg as Pd(II)	0.16	Modelled increase in soil concentrations due to deposition from atmospheric emissions (i.e. assuming no application of sewage sludge to land)

4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES
Environment Scaling tool: Metals EUSES IT tool (free download: http://www.arche-consulting.be/Metal-CSA-toolbox/du-scaling-tool) Scaling of the release to air and water environment includes: • Refining of the release factor to air and waste water and/or and the efficiency of the air filter and wastewater treatment facility. • Adjustment of the flow rate for the receiving water body and subsequent dilution factor.

9.3. Exposure scenario 3: Industrial use of diamminedichloropalladium for electroplating of massive objects

9.3.1. Environmental contributing scenario 3:

9.3.1.1. Conditions of use

The conditions of use are as described in the generic exposure scenario (GES) below.

9.3.1.2. Releases

The GES and associated risk assessment are concerned with releases of palladium (II) to waste-water and air during the use of DDP in electroplating of massive objects. This waste-water is assumed to be treated at a municipal STP before discharge to freshwater. Exposure assessment for the aquatic environment is based on calculation of the maximum safe tonnage (Msafe) of DDP that can be used for electroplating; modelling of environmental exposure is based on release factors detailed in the SpERC for 'Industrial use of metals and metal compounds in metallic coating'[7].

9.2.1.3. Exposure and risks for man via the environment

Assessment of risks for man via the environment is based on inhalation exposure to airborne particulates containing palladium released to the atmosphere during the use of DDP in the electroplating of massive objects.

Annual emission to air (kg Pd)	Emission days per year	Concentration in local air (µg Pd/m³)	Annual average concentration in air (µg Pd/m³)	DNEL (µg Pd/m³)	RCR
0.1	220	1.3×10^{-4}	7.6×10^{-5}	0.5	1.9×10^{-4}

1. Title **ES3: Industrial use of diamminedichloropalladium for electroplating of massive objects**	
Life cycle	Use of diamminedichloropalladium in surface treatment
Systematic title based on use descriptor	**ERC:** ERC 5
2. Operational conditions and risk management measures	
2.1 Control of environmental exposure	
Environmental related free short title	Industrial use of diamminedichloropalladium for electroplating of massive objects
Systematic title based on use descriptor (environment)	ERC 5 (Industrial use resulting in inclusion into or onto a matrix)
Processes, tasks, activities covered (environment)	Industrial use of diamminedichloropalladium for electroplating: As defined by SpERC for 'Industrial use of metals and metal compounds in metallic coating'[5]
Environmental Assessment Method	Estimates based on monitoring data of emissions are used for calculation of

[7] ARCHE (2013) Industrial use of metals and metal compounds in metallic coating. spERC code Eurometaux 5.1 v2.1. Available online at http://www.arche-consulting.be/metal-csa-toolbox/SPERCs-tool-for-metals/

	maximum tonnage that can be used safely without risk to the environment
Product characteristics Diamminedichloropalladium as solid or aqueous solution. Environmental assessment is based on the measured release factors detailed in the SpERC for 'Industrial use of metals and metal compounds in metallic coating' and default characteristics for environmental compartments detailed in the ECHA technical guidance and EUSES model.	
Amounts used	
Maximum annual safe use at a site (Msafe)	1 tonne DDP (500 kg Pd metal equivalent)
Frequency and duration of use	
Pattern of release to the environment	220 days per year per site (SpERC for 'Industrial use of metals and metal compounds in metallic coating)
Environment factors not influenced by risk management	
Receiving surface water flow rate	ES: Discharge to STP: 2,000 m^3/d (default)
Dilution capacity, freshwater	Env ES: Discharge to freshwater via STP: DF = 10 (default)
Dilution capacity, marine	NR
Other given operational conditions affecting environmental exposure	
None	
Technical conditions and measures at process level (source) to prevent release	
Appropriate process control systems shall be implemented.	
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	
Waste water: ES Discharge to freshwater via STP: On-site wastewater treatment by chemical precipitation, sedimentation, electrolysis, reverse osmosis, ion exchange and/or filtration. Efficiency >99% (typical values reported in SpERC for 'Industrial use of metals and metal compounds in metallic coating) and off-site wastewater treatment plant, municipal STP Efficiency 80% (based on standard TGD parameters & known Pd partition coefficient for SPM) Release factor after on-site treatment: 500 g/T (modified SpERC)[8] **Air:** ES: Treatment of air emissions by cyclones, filters (e.g. fabric, bag, HEPA or ceramic), electrostatic precipitators and/or wet scrubbers. Efficiency 95 to >99% (typical values reported in SpERC for 'Industrial use of metals and metal compounds in metallic coating') Release factor after on-site treatment: 200 g/T (modified SpERC)	
Organizational measures to prevent/limit release from site	

[8] The release factors detailed in the SpERC for 'Industrial use of metals and metal compounds in metallic coating' are considered to be unrealistic for high value palladium compounds for DDP as the SpERC is based on emission data from the surface treatment industry's use of base metals such as zinc and nickel. Release factors have therefore been reduced by an order of magnitude. It is recommended to measure/monitor the site-specific air and/or water releases as a further refinement step.

Regular operator training.	
Conditions and measures related to municipal sewage treatment plant (if applicable)	
Municipal Sewage Treatment Plant (STP)	Yes
Discharge rate of the Municipal STP	2 000 m^3/d (default)
Incineration of the sludge of the Municipal STP	The sludge is incinerated (with ash going to landfill)
Conditions and measures related to external treatment of waste for disposal	
DDP- and other Pd-containing waste is filled into containers and transported to licensed recycling facilities for recovery or disposed of at landfill.	
Conditions and measures related to external recovery of waste	
DDP- and other Pd-containing waste suitable for recycling may be recycled either internally or at licensed recycling facility.	

3. Exposure and risk estimation

Environment [based on total Pd emissions]

ERC 5

ES Industrial use of diamminedichloropalladium for electroplating of massive objects

Compartment	Unit	PNEC	$PEC_{regional}$	C_{local}	PEC	RCR	Methods for calculation of environmental concentrations
ES Discharge to STP	mg Pd/L	1.46 mg/L as Pd(II)	6.54×10^{-7} mg/L as Pd(II)	1.13×10^{-4} mg/L as Pd(II)	1.13×10^{-4} mg/L as Pd(II)	7.7×10^{-5}	Modified SpERC emission factors applied to Msafe tonnage and default flow rate at municipal sewage works
ES Freshwater via STP	mg Pd/L	1.33×10^{-5} mg/L as Pd(II)	6.54×10^{-7} mg/L as Pd(II)	1.05×10^{-5} mg/L as Pd(II)	1.11×10^{-5} mg/L as Pd(II)	0.84	Modified SpERC emission factors applied to Msafe tonnage and Pd-specific values for STP removal efficiency and default dilution in ultimate receiving water body
Terrestrial	mg/kg	0.0117 mg/kg as Pd(II)	1.89×10^{-3} mg/kg as Pd(II)	2.0×10^{-7} mg/kg as Pd(II)	1.89×10^{-3} mg/kg as Pd(II)	0.16	Modelled increase in soil concentrations due to deposition from atmospheric emissions (i.e. assuming no application of sewage sludge to land)

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

Environment

Scaling tool: Metals EUSES IT tool (free download: http://www.arche-consulting.be/Metal-CSA-toolbox/du-scaling-tool)

Scaling of the release to air and water environment includes:

- Refining of the release factor to air and waste water and/or and the efficiency of the air filter and wastewater treatment facility.
- Adjustment of the flow rate for the receiving water body and subsequent dilution factor.