9.1 Production of sulfur dioxide

	Format (1) addressin	g uses carried out b	y workers			
1. Title						
Free short title		Production of sul	fur dioxide (S	SO ₂)		
Systematic title based		SU3 (Industrial u		SU9		
on use descriptor	(ap	PC propriate PROCs and ERCs		Section 2 belo	w)	
Processes, tasks		Processes, tasks and/or activities covered are described in Section 2 below.				
and/or activities covered	Processes,	tasks and/or activities cove	ered are desc	cribed in Section	1 2 Delow.	
Assessment Method	Inhalation exposure ass	sessment is based on meas MEASE for close			ling operations and on	
2. Operational cond	itions and risk mana	gement measures				
Workplace	In	volved tasks		Inve	olved PROCs	
Unloading of waste sulfuric acid/sulfur		O₄/sulfur from road and rail closed system	tank cars		8b	
Furnace operations		on in rotary furnace, operati namber and/or burning of su			22	
Adsorption / Desorption	cooling, absorption, o	desorption, drying, compres			1	
Filling of flasks/barrels	connecting and	d disconnecting operations			8b	
Filling of road or rail tank cars	connecting and	d disconnecting operations			8b	
ERC 1		Manufacture	of substance	6		
2.1 Control of worke	ers exposure					
Product characteristic						
reflected by an assignme	approach, the substance-i ent of a so-called fugacity based on the vapour pressu	class in the MEASE too				
Workplace	Use in preparation	Content in preparation	Physic	cal form	Emission potential	
Unloading of waste sulfuric acid/sulfur						
		tricted		olution, liquid, ssive	very low	
Furnace operations	not res		. ma		very low high	
		tricted	. ma gas	ssive		
Furnace operations Adsorption /	not res	tricted	ma gas liquefied g	ssive	high	
Furnace operations Adsorption / Desorption	not res	tricted tricted tricted	ma gas liquefied g liquef	ssive seous as / gaseous	high	
Furnace operations Adsorption / Desorption Filling of flasks/barrels Filling of road or rail	not res not res not res	tricted tricted tricted	ma gas liquefied g liquef	ssive seous as / gaseous ied gas	high high high	
Furnace operations Adsorption / Desorption Filling of flasks/barrels Filling of road or rail tank cars Amounts used The actual tonnage handle the scale of operation (in	not res not res not res	tricted tricted tricted tricted d to influence the exposure nd level of containment/au	ma gas liquefied g liquef liquef as such for t	ssive seous as / gaseous ied gas ied gas his scenario. In	high high high high stead, the combination of	
Furnace operations Adsorption / Desorption Filling of flasks/barrels Filling of road or rail tank cars Amounts used The actual tonnage handle the scale of operation (in	not res not res not res not res not res dustrial vs. professional) a erminant of the process-intri	tricted tricted tricted tricted d to influence the exposure nd level of containment/au	ma gas liquefied g liquef liquef as such for t	ssive seous as / gaseous ied gas ied gas his scenario. In	high high high high stead, the combination of	
Furnace operations Adsorption / Desorption Filling of flasks/barrels Filling of road or rail tank cars Amounts used The actual tonnage handle the scale of operation (in conditions) is the main dete Frequency and duration Workplace	not res not res not res not res not res dustrial vs. professional) a erminant of the process-intri	tricted tricted tricted tricted d to influence the exposure nd level of containment/au	ma gas liquefied g liquef liquef as such for t utomation (as	ssive seous as / gaseous ied gas ied gas his scenario. In	high high high high stead, the combination of	
Furnace operations Adsorption / Desorption Filling of flasks/barrels Filling of road or rail tank cars Amounts used The actual tonnage handle the scale of operation (in conditions) is the main dete Frequency and duration	not res not res not res not res not res dustrial vs. professional) a erminant of the process-intri	tricted tricted tricted tricted d to influence the exposure nd level of containment/au insic emission potential.	ma gas liquefied g liquef liquef as such for t utomation (as f exposure	ssive seous as / gaseous ied gas ied gas his scenario. In s reflected in th	high high high high stead, the combination of	
Furnace operations Adsorption / Desorption Filling of flasks/barrels Filling of road or rail tank cars Amounts used The actual tonnage handle the scale of operation (inconditions) is the main dete Frequency and duration Workplace Unloading of waste sulfuric acid/sulfur Furnace operations	not res not res not res not res not res dustrial vs. professional) a erminant of the process-intri	tricted tricted tricted tricted d to influence the exposure nd level of containment/au insic emission potential. Duration o	ma gas liquefied g liquef liquef as such for t utomation (as f exposure not restricted	ssive eous as / gaseous ied gas ied gas his scenario. In s reflected in th	high high high high stead, the combination of	
Furnace operations Adsorption / Desorption Filling of flasks/barrels Filling of road or rail tank cars Amounts used The actual tonnage handlet the scale of operation (in conditions) is the main dete Frequency and duration Workplace Unloading of waste sulfuric acid/sulfur	not res not res not res not res not res dustrial vs. professional) a erminant of the process-intri	tricted tricted tricted tricted d to influence the exposure nd level of containment/au insic emission potential. Duration o 480 minutes (ma gas liquefied g liquef liquef as such for t utomation (as f exposure not restricted	ssive seous as / gaseous ied gas ied gas his scenario. In s reflected in th)	high high high high stead, the combination of	
Furnace operations Adsorption / Desorption Filling of flasks/barrels Filling of road or rail tank cars Amounts used The actual tonnage handle the scale of operation (inconditions) is the main dete Frequency and duration Workplace Unloading of waste sulfuric acid/sulfur Furnace operations Adsorption /	not res not res not res not res not res dustrial vs. professional) a erminant of the process-intri	tricted tricted tricted tricted tricted tricted tricted Duration o 480 minutes (480 minutes (ma gas liquefied g liquef liquef as such for t utomation (as f exposure not restricted not restricted	ssive seous as / gaseous ied gas ied gas his scenario. In s reflected in th))	high high high high stead, the combination of	

	enced by risk managemen				
The shift breathing volume	e during all process steps is	assumed to be 10 m ³ /shift ((8 hours).		
Other given operational	conditions affecting work	ers exposure			
Workplace	Room volume	Outdoors or indoors	Process temperature	Process pressure	
Unloading of waste sulfuric acid/sulfur		delivery and storage in roofed outdoor workplace	ambient	not considered relevant for occupational	
Furnace operations	not considered relevant		< 1,500°C	exposure assessment o the conducted	
Adsorption / Desorption	for occupational exposure assessment of the conducted processes	not considered relevant for occupational	up to 100°C	processes	
Filling of flasks/barrels		exposure assessment of the conducted processes	ambient	3,000 – 4,000 hPa	
Filling of road or rail tank cars		·	ambient	3,000 – 4,000 hPa	
Technical conditions and	d measures at process lev	vel (source) to prevent rele	ease		
Workplace	Level of co	ontainment	Level of s	egregation	
Unloading of waste sulfuric acid/sulfur	tight fitting o	connections			
Furnace operations	closed system (furnace)		segregation of the emission source is generally n required in the processes		
Adsorption / Desorption	closed system				
Filling of flasks/barrels	extracted (< 100 mbar) and tight fitting connections		For pre-cautionary reasons, it is suggested that workers leave the workplace after connecting/disconnecting if appropriate according		
Filling of road or rail tank cars	extracted (< 100 mbar) ar	nd tight fitting connections	the mode of operation. As far as technically feasible use should be made of automated filling stations.		
Technical conditions and	d measures to control dis	persion from source towa	rds the worker		
Workplace	Level of separation	Localised controls (LC)	Specification of LC	Further information	
Unloading of waste sulfuric acid/sulfur		not required	na	-	
Furnace operations		furnace extraction device	10 mbar	-	
Adsorption / Desorption	separation of workers is generally not required in the processes	not required	na	-	
Filling of flasks/barrels		integrated extraction devices	< 100 mbar	-	
Filling of road or rail tank cars		integrated extraction devices	< 100 mbar	-	
Organisational measures	s to prevent /limit releases	s, dispersion and exposur	e		
8	personal hygiene practices,	ygiene measures are requir no eating and smoking a		0	

It is noted that this exposure scenario does exclusively cover exposure to sulfur dioxide. However, during raw material handling, exposure to sulfuric acid may occur. Any existing occupational exposure level has to be maintained in parallel to this exposure scenario.

Workplace	Specification of respiratory protective equipment (RPE)	RPE efficiency (assigned protection factor, APF)	Specification of gloves	Further personal protective equipment (PPE)
Unloading of waste sulfuric acid/sulfur	not required	na		Eye protection equipment (e.g. goggles or visors) must be worn
Furnace operations	not required	na	Since sulfur dioxide has	unless potential contac with the eye can be
Adsorption / Desorption	not required	na	corrosive properties, the use of protective gloves is mandatory for all	excluded by the nature and type of application (i.e. closed process).
Filling of flasks/barrels	not required	na	process steps.	Additionally, face protection, protective clothing and safety
Filling of road or rail tank cars	ABEK1	30		shoes are required to be worn as appropriate.
capability of using tools an For reasons as given abov of RPE), (ii) have suitable recommended devices ab face properly and securely The employer and self-err and the management of	d of communicating are rec ve, the worker should there e facial characteristics redu ove which rely on a tight fa ployed persons have lega	duced during the wearing of fore be (i) healthy (especial ucing leakages between fa ce seal will not provide the I responsibilities for the ma orkplace. Therefore, they	ad. In addition, it shall be co RPE. Ily in view of medical problem ace and mask (in view of s required protection unless intenance and issue of resp should define and docume	ns that may affect the us cars and facial hair). Th they fit the contours of th piratory protective device
2.2 Control of enviro	onmental exposure			
Product characteristics				
Gas				
Amounts used				
-	lownstream use volume (lo ause it can reasonably be	•	et equal to regional tonnage am use industrial sites usir	
Frequency and duration	of use			
365 days				
Technical conditions and	d measures at process lev	vel (source) to prevent rel	ease	
All processes are strictly c	losed.			
Technical onsite condition	ons and measures to redu	ice or limit discharges, ai	r emissions and releases t	o soil
dry scrubber)			nission abatement system s ring water should be avoide	
	s related to municipal sev	vage treatment plant		
Not applicable	•			
	s related to external treat	ment of waste for disposa	al	
No solid waste				
••••••••••••••••••••••••••••••••••••••		and sector		
Conditions and measure	s related to external reco	very of waste		

3. Exposure estimation and reference to its source

Occupational exposure

For the assessment of inhalation exposure, measured data from the production of SO_2 and the exposure estimated from the MEASE tool were used. The risk characterisation ratio (RCR) is the quotient of the refined exposure estimate and the respective DNEL (derived no-effect level) and has to be below 1 to demonstrate a safe use. For inhalation exposure, the RCR is based on the DNEL for sulfur dioxide of 0.5 ppm (1.3 mg/m³).

Workplace	Method used for inhalation exposure assessment (refer to introduction)	Inhalation exposure estimate (RCR)	Method used for dermal exposure assessment	Dermal exposure estimate (RCR)		
Unloading of waste sulfuric acid/sulfur	not assessed as sulfur di	oxide is not yet produced				
Furnace operations	measured data	0.2 ppm (0.4)	Since sulfur dioxide has corrosive properties, der exposure has to be minimised as far as technica feasible. A DNEL for dermal effects has not bee derived. Thus, dermal exposure is not assessed			
Adsorption / Desorption	MEASE	0.01 ppm (0.02)				
Filling of flasks/barrels	measured data	0.2 ppm (0.4)	this exposure scenario.			
Filling of road or rail tank cars	measured data	0.03 ppm (0.07)]			

Environmental emissions

The predicted no effect concentration PNEC of SO₂ in air is 6.65 μ g/m3.

Following a PECregional air of 1.035 µg/m3 and a maximum RCR of 0.95, 7 tonnes/year (PEC 5.28 µg/m3) is the maximum amount of SO2 that can be released.

Consequently safe use can be demonstrated when emissions to air of SO₂ do not exceed 7 tonnes/year.

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

Occupational exposure

The downstream user (DU) works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the DU can demonstrate on his own that his operational conditions and implemented risk management measures are adequate. This has to be done by showing that they limit the inhalation and dermal exposure to a level below the respective DNEL (given that the processes and activities in question are covered by the PROCs listed above) as given below. If measured data are not available, the DU may make use of an appropriate scaling tool such as MEASE (www.ebrc.de/mease.html) to estimate the associated exposure. It is noted that any given RPE and corresponding APFs in MEASE are related to their efficiency for protection against particles. Thus, for the current scenarios, the specific protection factor of an ABEK1 respiratory mask of 30 has to be applied manually by the user.

DNEL_{inhalation}: $0.5 \text{ ppm} (1.3 \text{ mg/m}^3)$

<u>Important note:</u> The DU has to be aware of the fact that apart from the long-term DNEL given above, a DNEL for acute effects exists at a level of 1 ppm (2.7 mg/m³). By demonstrating a safe use when comparing exposure estimates with the long-term DNEL, the acute DNEL is therefore also covered (according to R.14 guidance, acute exposure levels can be derived by multiplying long-term exposure estimates by a factor of 2). When using MEASE for the derivation of exposure estimates, it is noted that the exposure duration <u>may not</u> be reduced.

Environmental emissions

9.1.1 Indirect exposure of humans via the environment (local)

Concentration for local e	xposure of huma	ns via the environ	nent		
		Estimated exposure concentrations		osure S	Explanation / source of
	value	unit	value	unit	measured data
Air	5.28	µg SO₂/m³	-	-	Local PEC has been calculated using EUSES 2.1 based on a worst-case assessment.
Drinking water	-	-	-	-	Route of exposure is not relevant, since sulfur dioxide is a gas.
Total daily dose for oral	exposure via the e	environment (mg/k	g bw/d)		
µg SO₂/d	mg SO ₂ /kg bw/	d	Justification		
-	-		Route of exposure is not relevant, since sulfur dioxide is a gas.		
Quantitative risk charact	erisation for huma	ans exposed via th	e environment		
Route	exposure conc	entrations (EC)	DNEL		Risk characterisation ratio
Inhalation- local effects (long term)	5.28 µg SO ₂ /m ³	5.28 μg SO₂/m³			0.01
Oral- systemic (long term)	-		-		-
Combined routes					RCR Inhalation- systemic + RCR Oral- systemic

Table 6: Concentration and risk characterization for local exposure of humans via the environment

9.2 Discharging and filling operations for trading and distributing purposes

Exposure Scenario	Format (1) addressin	g uses carried out by	v workers	
1. Title		<u> </u>	·	
Free short title	Discharging and fill	ing operations for trading an	nd distributing purposes of s	ulfur dioxide (SO ₂)
Systematic title based on use descriptor	(ap	SU3 (Industrial PC19, propriate PROCs and ERCs	PC21	w)
Processes, tasks and/or activities covered	Processes	, tasks and/or activities cove	ered are described in Section	n 2 below.
Assessment Method	The assessment of i	nhalation exposure is based	on analogous data from the	e production of SO ₂ .
2. Operational condi	tions and risk mana	gement measures		
Workplace	Involv	ed tasks	Involved	I PROCs
Connecting and disconnecting of flasks/barrels		g operations (including in closed systems)	1, 8a,	8b, 9
Discharging and filling of road/rail tank cars		g operations (including in closed systems)	1, 8a,	8b, 9
ERC 2		Formulation of	preparations	
2.1 Control of worke	rs exposure			
Product characteristic				
According to the MEASE approach, the substance-intrinsic emission potential is one of the main exposure determinants. This is reflected by an assignment of a so-called fugacity class in the MEASE tool. For operations conducted with liquid or gaseous substances the fugacity is based on the vapour pressure of that substance.				
Workplace	Use in preparation	Content in preparation	Physical form	Emission potential
All relevant workplaces	not restricted		liquefied gas	high
Amounts used				
	dustrial vs. professional) a	d to influence the exposure a nd level of containment/aut insic emission potential.		
Frequency and duration of	of use/exposure			
Workplace		Duration of	exposure	
All relevant workplaces		480 minutes (r	not restricted)	
Human factors not influe	nced by risk management	t		
The shift breathing volume	during all process steps is	assumed to be 10 m ³ /shift (8	3 hours).	
Other given operational of	onditions affecting worke	ers exposure		
Workplace	Room volume	Outdoors or indoors	Process temperature	Process pressure
All relevant workplaces		for occupational exposure conducted processes	ambient	< 4,000 hPa
Technical conditions and	measures at process lev	el (source) to prevent relea	ase	
Workplace	Level of co	ontainment	Level of se	
All relevant workplaces	extracted (< 100 mbar) and tight fitting connections, closed system			e workplace after if appropriate according . As far as technically e made of automated

Technical conditions and	measures to control disp	ersion from source towar	ds the worker				
Workplace	Level of separation	Localised controls (LC)	Specification of LC	Further information			
All relevant workplaces	separation of workers is generally not required in the processes	integrated extraction devices	< 100 mbar	-			
Organisational measures	to prevent /limit releases	, dispersion and exposure	•				
measures involve good pe	Avoid inhalation or ingestion. General occupational hygiene measures are required to ensure a safe handling of the substance. These measures involve good personal hygiene practices, no eating and smoking at the workplace, unless otherwise stated below the wearing of standard working clothes and shoes.						
Conditions and measures	s related to personal prote	ection, hygiene and health	evaluation				
Workplace	Specification of respiratory protective equipment (RPE)	RPE efficiency (assigned protection factor, APF)	Specification of gloves	Further personal protective equipment (PPE)			
Connecting and disconnecting of flasks/barrels	not required	na	Since sulfur dioxide has corrosive properties, the use of protective gloves	Eye protection equipment (e.g. goggles or visors) must be worn, unless potential contact with the eye can be excluded by the nature and type of application			
Discharging and filling of road/rail tank cars	ABEK1	30	is mandatory for all process steps.	(i.e. closed process). Additionally, face protection, protective clothing and safety shoes are required to be worn as appropriate.			
Any RPE as defined above shall only be worn if the following principles are implemented in parallel: The duration of work (compare with "duration of exposure" above) should reflect the additional physiological stress for the worker due to the breathing resistance and mass of the RPE itself, due to the increased thermal stress by enclosing the head. In addition, it shall be considered that the worker's capability of using tools and of communicating are reduced during the wearing of RPE. For reasons as given above, the worker should therefore be (i) healthy (especially in view of medical problems that may affect the use of RPE), (ii) have suitable facial characteristics reducing leakages between face and mask (in view of scars and facial hair). The recommended devices above 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 maintenance and issue 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 training of the workers.							
2.2 Control of enviro	onmental exposure						
Product characteristics							
Gas							
Amounts used							
86,472 tonnes/year local do of total EU production beca wide-spread throughout the	ause it can reasonably be a	al worst-case tonnage is se assumed that the downstrea					
Frequency and duration of	of use						
365 days							
Technical conditions and	I measures at process leve	el (source) to prevent rele	ase				
All processes are strictly clo	osed.						
Technical onsite conditio	ns and measures to redu	ce or limit discharges, air	emissions and releases to	o soil			
dry scrubber)	-	air > 7 tonnes/year, air emi	-				
No emissions to water. In effluent.	No emissions to water. In case of emissions to water, pH impact on the receiving water should be avoided, e.g. by neutralizing the effluent.						
Conditions and measures related to municipal sewage treatment plant							
Not applicable							
Conditions and measures	s related to external treatm	nent of waste for disposal					
No solid waste							

Conditions and measures related to external recovery of waste

No solid waste

3. Exposure estimation and reference to its source

Occupational exposure

For the assessment of inhalation exposure, analogous data from the production of SO_2 were used. The risk characterisation ratio (RCR) is the quotient of the refined exposure estimate and the respective DNEL (derived no-effect level) and has to be below 1 to demonstrate a safe use. For inhalation exposure, the RCR is based on the DNEL for sulfur dioxide of 0.5 ppm (1.3 mg/m³).

Workplace	Method used for inhalation exposure assessment (refer to introduction)	Inhalation exposure estimate (RCR)	Method used for dermal exposure assessment	Dermal exposure estimate (RCR)		
Connecting and disconnecting of flasks/barrels	analogous data	0.2 ppm (0.4)	Since sulfur dioxide has corrosive properties, dermal exposure has to be minimised as far as technically feasible. A DNEL for dermal effects ha			
Discharging and filling of road/rail tank cars	analogous data	0.03 ppm (0.07)	not been derived. Thus, dermal exposure is r assessed in this exposure scenario.			

Environmental emissions

The predicted no effect concentration PNEC of SO₂ in air is 6.65 μ g/m3.

Following a PECregional air of 1.035 µg/m3 and a maximum RCR of 0.95, 7 tonnes/year (PEC 5.28 µg/m3) is the maximum amount of SO2 that can be released.

Consequently safe use can be demonstrated when emissions to air of SO₂ do not exceed 7 tonnes/year.

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

Occupational exposure

The downstream user (DU) works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the DU can demonstrate on his own that his operational conditions and implemented risk management measures are adequate. This has to be done by showing that they limit the inhalation and dermal exposure to a level below the respective DNEL (given that the processes and activities in question are covered by the PROCs listed above) as given below. If measured data are not available, the DU may make use of an appropriate scaling tool such as MEASE (www.ebrc.de/mease.html) to estimate the associated exposure. It is noted that any given RPE and corresponding APFs in MEASE are related to their efficiency for protection against particles. Thus, for the current scenarios, the specific protection factor of an ABEK1 respiratory mask of 30 has to be applied manually by the user.

DNEL_{inhalation}: $0.5 \text{ ppm} (1.3 \text{ mg/m}^3)$

<u>Important note:</u> The DU has to be aware of the fact that apart from the long-term DNEL given above, a DNEL for acute effects exists at a level of 1 ppm (2.7 mg/m³). By demonstrating a safe use when comparing exposure estimates with the long-term DNEL, the acute DNEL is therefore also covered (according to R.14 guidance, acute exposure levels can be derived by multiplying long-term exposure estimates by a factor of 2). When using MEASE for the derivation of exposure estimates, it is noted that the exposure duration <u>may not</u> be reduced.

Environmental emissions

9.3 Industrial use of sulfur dioxide in the production of foundry cores (semi-closed process)

Exposure Scenario	Format (1) addressin	g uses carried out by	y worl	kers		
1. Title						
Free short title	Industrial use of su	Ifur dioxide (SO ₂) in the proc	luction of	of foundry cores (ser	ni-closed process)	
Systematic title based		SU3 (Industrial uses), SU14				
on use descriptor	(ap	PC19 (appropriate PROCs and ERCs are given in Section 2 below)				
Processes, tasks and/or activities covered	Processes	, tasks and/or activities cove	ered are	described in Section	n 2 below.	
Assessment Method		sessment is based on analo d on measured data for the				
2. Operational condi	itions and risk mana	gement measures				
Workplace	Inv	olved tasks		Involv	ved PROCs	
Connecting and disconnecting of flasks/barrels		ns (including formulation and eps in closed systems)	d	1, 5	8a, 8b, 9	
Discharging of road/rail tank cars		ns (including formulation and eps in closed systems)	d	1, 5	8a, 8b, 9	
Manufacture of foundry cores (semi-closed process)		e shooting machines, and fin bundry cores	ishing	2	2, 3, 8b	
ERC 2 ERC 6d	Industrial use of process re	Formulation o egulators for polymerisation			resins, rubbers, polymers	
2.1 Control of worke	ers exposure					
Product characteristic						
reflected by an assignme	approach, the substance- ent of a so-called fugacity based on the vapour pressu	intrinsic emission potential class in the MEASE tool. ure of that substance.	is one For o	of the main exposu perations conducted	re determinants. This is with liquid or gaseous	
Workplace	Use in preparation	Content in preparation	P	Physical form	Emission potential	
Connecting and disconnecting of flasks/barrels		•		liquefied gas	high	
Discharging of road/rail tank cars	not re:	stricted		liquefied gas	high	
Manufacture of foundry cores (semi-closed process)			liquefied gas / gaseous		high	
Amounts used						
the scale of operation (in		d to influence the exposure and level of containment/autinisic emission potential.				
Frequency and duration	of use/exposure					
Workplace	Duration of exposure					
All workplaces		480 minutes (r	not restr	icted)		
Human factors not influe	nced by risk management	t				
The shift breathing volume	during all process steps is	assumed to be 10 m ³ /shift (8	3 hours)			

Workplace	Room volume	Outdoors or indoors	Process temperature	Process pressure
Connecting and	Room volume		Frocess temperature	Flocess plessure
disconnecting of flasks/barrels			ambient	< 4,000 hPa
Discharging of road/rail tank cars		or occupational exposure onducted processes	ambient	< 4,000 hPa
Manufacture of foundry cores (semi-closed process)			not restricted	ambient
•	d measures at process leve	el (source) to prevent relea	ase	
Workplace	Level of co	ontainment	Level of se	gregation
Connecting and disconnecting of flasks/barrels	extracted (< 100 mbar) ar	nd tight fitting connections,	For pre-cautionary reaso workers leave the connecting/disconnecting	workplace after
Discharging of road/rail tank cars		system	the mode of operation feasible, use should b discharging respect	e made of automated
Manufacture of foundry cores (semi-closed process)	not re	not required segregation of the emission at this work		
Technical conditions and	d measures to control disp	ersion from source towar	ds the worker	
Workplace	Level of separation	Localised controls (LC)	Specification / Efficiency of LC	Further information
Connecting and disconnecting of flasks/barrels		integrated extraction devices	< 100 mbar	-
Discharging of road/rail tank cars	separation of workers is generally not required in the processes	integrated extraction devices	< 100 mbar	-
Manufacture of foundry cores (semi-closed process)		local exhaust ventilation	90 % (ECETOC efficiency for PROC 2 & PROC 3)	-
Organisational measures	s to prevent /limit releases	, dispersion and exposure	1	
	on. General occupational hy ersonal hygiene practices, ng clothes and shoes.			
Conditions and measures	s related to personal prote	ection, hygiene and health	evaluation	
Workplace	Specification of respiratory protective equipment (RPE)	RPE efficiency (assigned protection factor, APF)	Specification of gloves	Further personal protective equipmen (PPE)
Connecting and disconnecting of flasks/barrels	not required	na		Eye protection equipment (e.g. goggle or visors) must be wor unless potential conta
Discharging of road/rail tank cars	ABEK1	30	Since sulfur dioxide has corrosive properties, the use of protective gloves is mandatory for all process steps.	with the eye can be excluded by the natur and type of applicatio (i.e. closed process) Additionally, face
Manufacture of foundry cores (semi-closed process)	ABEK1	30		protection, protective clothing and safety shoes are required to be worn as appropriat

mass of the RPE itself, due to the increased thermal stress by enclosing the head. In addition, it shall be considered that the worker's capability of using tools and of communicating are reduced during the wearing of RPE.

For reasons as given above, the worker should therefore be (i) healthy (especially in view of medical problems that may affect the use of RPE), (ii) have suitable facial characteristics reducing leakages between face and mask (in view of scars and facial hair). The recommended devices above 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 maintenance and issue 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 training of the workers.

2.2 Control of environmental exposure

Product characteristics

Gas

Amounts used

86,472 tonnes/year local downstream use volume (local worst-case tonnage is set equal to regional tonnage, regional tonnage = 10% of total EU production because it can reasonably be assumed that the downstream use industrial sites using SO2 are numerous and wide-spread throughout the EU)

Frequency and duration of use

365 days

Technical conditions and measures at process level (source) to prevent release

All processes are strictly closed.

Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil

None if emission to air < 7 tonnes/year. If emission to air > 7 tonnes/year, air emission abatement system should be used (e.g. wet or dry scrubber...)

No emissions to water. In case of emissions to water, pH impact on the receiving water should be avoided, e.g. by neutralizing the effluent.

Conditions and measures related to municipal sewage treatment plant

Not applicable

Conditions and measures related to external treatment of waste for disposal

No solid waste

Conditions and measures related to external recovery of waste

No solid waste

3. Exposure estimation and reference to its source

Occupational exposure

For the assessment of inhalation exposure, measured data from the manufacture of foundry cores (semi-closed process) and analogous data from the production of SO_2 were used. The risk characterisation ratio (RCR) is the quotient of the refined exposure estimate and the respective DNEL (derived no-effect level) and has to be below 1 to demonstrate a safe use. For inhalation exposure, the RCR is based on the DNEL for sulfur dioxide of 0.5 ppm (1.3 mg/m³).

Workplace	Method used for inhalation exposure assessment (refer to introduction)	Inhalation exposure estimate (RCR)	Method used for dermal exposure assessment	Dermal exposure estimate (RCR)		
Connecting and disconnecting of flasks/barrels	analogous data	0.2 ppm (0.4)	Since sulfur dioxide has corrosive properties,			
Discharging of road/rail tank cars	analogous data	0.03 ppm (0.07)	dermal exposure has to be minimised as far a technically feasible. A DNEL for dermal effects not been derived. Thus, dermal exposure is n			
Manufacture of foundry cores (semi-closed process)	measured data	0.41 ppm (0.82)	assessed in this ex			
Environmental emissions		-				

The predicted no effect concentration PNEC of SO₂ in air is 6.65 µg/m3.

Following a PECregional air of 1.035 µg/m3 and a maximum RCR of 0.95, 7 tonnes/year (PEC 5.28 µg/m3) is the maximum amount of SO2 that can be released.

Consequently safe use can be demonstrated when emissions to air of SO₂ do not exceed 7 tonnes/year.

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

Occupational exposure

The downstream user (DU) works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the DU can demonstrate on his own that his operational conditions and implemented risk management measures are adequate. This has to be done by showing that they limit the inhalation and dermal exposure to a level below the respective DNEL (given that the processes and activities in question are covered by the PROCs listed above) as given below. If measured data are not available, the DU may make use of an appropriate scaling tool such as MEASE (www.ebrc.de/mease.html) to estimate the associated exposure. It is noted that any given RPE and corresponding APFs in MEASE are related to their efficiency for protection against particles. Thus, for the current scenarios, the specific protection factor of an ABEK1 respiratory mask of 30 has to be applied manually by the user.

DNEL_{inhalation}: $0.5 \text{ ppm} (1.3 \text{ mg/m}^3)$

<u>Important note:</u> The DU has to be aware of the fact that apart from the long-term DNEL given above, a DNEL for acute effects exists at a level of 1 ppm (2.7 mg/m³). By demonstrating a safe use when comparing exposure estimates with the long-term DNEL, the acute DNEL is therefore also covered (according to R.14 guidance, acute exposure levels can be derived by multiplying long-term exposure estimates by a factor of 2). When using MEASE for the derivation of exposure estimates, it is noted that the exposure duration <u>may not</u> be reduced.

Environmental emissions

9.4 Industrial use of sulfur dioxide in closed or semi-closed processes

Exposure Scenario	Format (1) addressin	g uses carried out by	worker:	5		
1. Title						
Free short title	pharmaceutical products,	Industrial use of sulfur dioxide (SO ₂) in the paper, sugar and starch industry, the production of pharmaceutical products, in industrial water treatment, glass coating/lubricate rollers in glass manufacture, in metal casting/mining/purification and as refrigerant agent				
Systematic title based on use descriptor		ustrial uses), SU4, SU6b, SI PC14, PC15, PC19, PC propriate PROCs and ERCs	20, PC26, F	PC29, PC37		
Processes, tasks and/or activities covered	Processes,	tasks and/or activities cove	ered are des	cribed in Sectior	n 2 below.	
Assessment Method	discharging operations,	sessment is based on analo for semi-closed processes o (semi-closed process) and o	on analogou	s data from the i	manufacture of foundry	
2. Operational condi	tions and risk manag	gement measures				
Workplace	In	volved tasks		Invo	olved PROCs	
Connecting and disconnecting of flasks/barrels	disch	arging operations		1	, 8a, 8b, 9	
Discharging of road/rail tank cars	disch	arging operations		1	, 8a, 8b, 9	
Use of sulfur dioxide in closed processes	maintenance and supe	rvision activities at closed s	ystems		1	
Use of sulfur dioxide in semi-closed processes	such as: manual operations (e.g. sampling, additional dosing of fine chemicals), maintenance and use of sulfur dioxide as inert gas in metal alloy production and casting			4, 5, 8b, 22, 23		
ERC 2 ERC 4 ERC 6a ERC 6b	Formulation of preparation Industrial use of processing aids in processes and products, not becoming part of articles Industrial use resulting in manufacture of another substance (use of intermediates) Industrial use of reactive processing aids					
2.1 Control of worke	rs exposure					
Product characteristic						
reflected by an assignme	approach, the substance-in nt of a so-called fugacity based on the vapour pressu	class in the MEASE tool.	is one of t For opera	he main exposu tions conducted	re determinants. This is with liquid or gaseous	
Workplace	Use in preparation	Content in preparation	Phys	ical form	Emission potential	
Connecting and disconnecting of flasks/barrels			liquefied gas		high	
Discharging of road/rail tank cars	not res	stricted	liquefied gas		high	
Use of sulfur dioxide in closed processes			liquefied gas / gaseous		high	
Use of sulfur dioxide in semi-closed processes			liquefied	gas / gaseous	high	
Amounts used						
the scale of operation (inc	d per shift is not considered dustrial vs. professional) a erminant of the process-intri	nd level of containment/au				
Frequency and duration	of use/exposure					
Workplace		Duration of	exposure			
All workplaces		480 minutes (r	not restricte	d)		
Human factors not influe	nced by risk management					
The shift breathing volume	during all process steps is a	assumed to be 10 m ³ /shift (8	3 hours).			

Workplace	Room volume	Outdoors or indoors	Process temperature	Process pressure
Connecting and disconnecting of flasks/barrels			ambient	< 4,000 hPa
Discharging of road/rail tank cars		or occupational exposure	ambient	< 4,000 hPa
Use of sulfur dioxide in closed processes	assessment of the conducted processes		not restricted	not restricted
Use of sulfur dioxide in semi-closed processes			not restricted	ambient
Technical conditions and	I measures at process leve	el (source) to prevent relea	ase	
Workplace	Level of containment		Level of segregation	
Connecting and disconnecting of flasks/barrels Discharging of road/rail tank cars	extracted (< 100 mbar) and tight fitting connections		For pre-cautionary reasons, it is suggested that workers leave the workplace after connecting/disconnecting if appropriate according the mode of operation. As far as technically feasible, use should be made of automated discharging respectively filling stations.	
Use of sulfur dioxide in closed processes	closed system		not required	
Use of sulfur dioxide in semi-closed processes	not required		not required	
Technical conditions and	I measures to control disp	ersion from source towar	ds the worker	
Workplace	Level of separation	Localised controls (LC)	Specification / Efficiency of LC	Further information
Connecting and disconnecting of flasks/barrels	separation of workers is generally not required in the processes	integrated extraction devices	< 100 mbar	-
Discharging of road/rail tank cars		integrated extraction devices	< 100 mbar	-
Use of sulfur dioxide in closed processes		not required	na	-
Use of sulfur dioxide in semi-closed processes		local exhaust ventilation	90 % (ECETOC efficiency for PROC 2 & PROC 3)	-
Organisational measures	to prevent /limit releases	, dispersion and exposure		

measures involve good personal hygiene practices, no eating and smoking at the workplace, unless otherwise stated below the wearing of standard working clothes and shoes.

Conditions and measures related to personal protection, hygiene and health evaluation					
Workplace	Specification of respiratory protective equipment (RPE)	RPE efficiency (assigned protection factor, APF)	Specification of gloves	Further personal protective equipment (PPE)	
Connecting and disconnecting of flasks/barrels	not required	na	Since sulfur dioxide has corrosive properties, the use of protective gloves is mandatory for all process steps.	Eye protection equipment (e.g. goggles or visors) must be worn, unless potential contact with the eye can be excluded by the nature and type of application (i.e. closed process). Additionally, face protection, protective clothing and safety shoes are required to be worn as appropriate.	
Discharging of road/rail tank cars	ABEK1	30			
Use of sulfur dioxide in closed processes	not required	na			
Use of sulfur dioxide in semi-closed processes	ABEK1	30			
Any RPE as defined above shall only be worn if the following principles are implemented in parallel: The duration of work (compare with "duration of exposure" above) should reflect the additional physiological stress for the worker due to the breathing resistance and mass of the RPE itself, due to the increased thermal stress by enclosing the head. In addition, it shall be considered that the worker's capability of using tools and of communicating are reduced during the wearing of RPE. For reasons as given above, the worker should therefore be (i) healthy (especially in view of medical problems that may affect the use of RPE), (ii) have suitable facial characteristics reducing leakages between face and mask (in view of scars and facial hair). The recommended devices above 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 maintenance and issue 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 training of the workers.					
2.2 Control of enviro		5			
Product characteristics					
Gas, aqueous solution					
Amounts used					
	ause it can reasonably be a	al worst-case tonnage is se assumed that the downstrea			
Frequency and duration of	of use				
365 days					
Technical conditions and	measures at process leve	el (source) to prevent rele	ase		
All processes are strictly clo	osed.				
Technical onsite conditio	ns and measures to reduc	ce or limit discharges, air	emissions and releases to	soil	
dry scrubber)	-	air > 7 tonnes/year, air emi r, pH impact on the receivir	-		
Conditions and measures	s related to municipal sew	age treatment plant			
Not applicable					
Conditions and measures	s related to external treatn	nent of waste for disposal			
No solid waste					
Conditions and measures	s related to external recov	ery of waste			
No solid waste					

3. Exposure estimation and reference to its source

Occupational exposure

For the assessment of inhalation exposure, analogous data from the manufacture of foundry cores (semi-closed process), analogous data from the production of SO₂, and MEASE were used. The risk characterisation ratio (RCR) is the quotient of the refined exposure estimate and the respective DNEL (derived no-effect level) and has to be below 1 to demonstrate a safe use. For inhalation exposure, the RCR is based on the DNEL for sulfur dioxide of 0.5 ppm (1.3 mg/m³).

Workplace	Method used for inhalation exposure assessment (refer to introduction)	Inhalation exposure estimate (RCR)	Method used for dermal exposure assessment	Dermal exposure estimate (RCR)		
Connecting and disconnecting of flasks/barrels	analogous data	0.2 ppm (0.4)				
Discharging of road/rail tank cars	analogous data	0.03 ppm (0.07)	Since sulfur dioxide has corrosive properties dermal exposure has to be minimised as far a technically feasible. A DNEL for dermal effects not been derived. Thus, dermal exposure is n assessed in this exposure scenario.			
Use of sulfur dioxide in closed processes	MEASE	0.01 ppm (0.02)				
Use of sulfur dioxide in semi-closed processes	analogous data	0.41 ppm (0.82)				
Environmental emissions						

Environmental emissions

The predicted no effect concentration PNEC of SO₂ in air is 6.65 µg/m3.

Following a PECregional air of 1.035 µg/m3 and a maximum RCR of 0.95, 7 tonnes/year (PEC 5.28 µg/m3) is the maximum amount of SO2 that can be released.

Consequently safe use can be demonstrated when emissions to air of SO₂ do not exceed 7 tonnes/year.

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

Occupational exposure

The downstream user (DU) works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the DU can demonstrate on his own that his operational conditions and implemented risk management measures are adequate. This has to be done by showing that they limit the inhalation and dermal exposure to a level below the respective DNEL (given that the processes and activities in question are covered by the PROCs listed above) as given below. If measured data are not available, the DU may make use of an appropriate scaling tool such as MEASE (www.ebrc.de/mease.html) to estimate the associated exposure. It is noted that any given RPE and corresponding APFs in MEASE are related to their efficiency for protection against particles. Thus, for the current scenarios, the specific protection factor of an ABEK1 respiratory mask of 30 has to be applied manually by the user.

DNEL_{inhalation}: $0.5 \text{ ppm} (1.3 \text{ mg/m}^3)$

<u>Important note:</u> The DU has to be aware of the fact that apart from the long-term DNEL given above, a DNEL for acute effects exists at a level of 1 ppm (2.7 mg/m³). By demonstrating a safe use when comparing exposure estimates with the long-term DNEL, the acute DNEL is therefore also covered (according to R.14 guidance, acute exposure levels can be derived by multiplying long-term exposure estimates by a factor of 2). When using MEASE for the derivation of exposure estimates, it is noted that the exposure duration <u>may not</u> be reduced.

Environmental emissions

9.5 Professional use of sulfur dioxide in winemaking/refilling of refrigeration equipment

Exposure Scenario	Format (1) addressii	ng uses carried out by	/ workers			
1. Title		,	<u> </u>	·			
Free short title	Pr	ofessional use	e of sulfur dioxide (SO ₂) in wir	nemaking/refilling of refriger	ation equipment		
Systematic title based on use descriptor		SU22 (Professional uses) PC16, PC19 (appropriate PROCs and ERCs are given in Section 2 below)					
Processes, tasks and/or activities covered			s, tasks and/or activities cove				
Assessment Method	Inhalat	ion exposure a	assessment is based on anal	ogous data from the produc	tion of sulfur dioxide.		
2. Operational condi	2. Operational conditions and risk management measures						
Workplace/Involved tasks	S		Inv	olved PROCs			
Connecting and disconne flasks/barrels	ecting of			8a, 8b, 9			
Manual dosing of sulfur of from flasks into wine casks/refrigeration equip				3a, 8b, 9, 19 pecial sulfur dioxide dosing	tools)		
ERC 6a ERC 7		Industri	al use resulting in manufactu Industrial use of s	re of another substance (us ubstances in closed system			
2.1 Control of worke	ers expos	ure					
Product characteristic							
According to the MEASE approach, the substance-intrinsic emission potential is one of the main exposure determinants. This is reflected by an assignment of a so-called fugacity class in the MEASE tool. For operations conducted with liquid or gaseous substances the fugacity is based on the vapour pressure of that substance.							
Workplace/Involved tasks	Use in preparation		Content in preparation	Physical form	Emission potential		
Connecting and disconnecting of flasks/barrels		not re	estricted	liquefied gas	high		
Manual dosing of sulfur dioxide from flasks into wine casks/refrigeration equipment	not restricted			liquefied gas	high		
Amounts used							
The actual tonnage handled per shift is not considered to influence the exposure as such for this scenario. Instead, the combination of the scale of operation (industrial vs. professional) and level of containment/automation (as reflected in the PROCs and technical conditions) is the main determinant of the process-intrinsic emission potential.							
Frequency and duration of	of use/expo	sure					
Workplace/Involved tasks			Duration of	exposure			
Connecting and disconnecting of flasks/barrels	480 minutes (not restricted)						
Manual dosing of sulfur dioxide from flasks into wine casks/refrigeration equipment	< 15 minutes (not considered during exposure assessment because of existing acute effects of sulfur dioxide but pre- scribed for pre-cautionary reasons)						
Human factors not influenced by risk management							
The shift breathing volume during all process steps is assumed to be 10 m ³ /shift (8 hours).							
Other given operational conditions affecting workers exposure							
Workplace/Involved tasks	Room	volume	Outdoors or indoors	Process temperature	Process pressure		
Connecting and disconnecting of flasks/barrels			for occupational exposure conducted processes	ambient	< 4,000 hPa		
Manual dosing of sulfur dioxide from flasks into wine casks/refrigeration	cellars/re	ine frigerating ilities	not restricted	ambient	< 4,000 hPa		

equipment					
Technical conditions and	I measures at process lev	vel (source) to prevent rele	ase		
Workplace/Involved tasks	Level of containment Level of segregation				
Connecting and disconnecting of flasks/barrels	extracted (< 100 mbar) and tight fitting connections		For pre-cautionary reasons, it is suggested that workers leave the workplace after connecting/disconnecting if appropriate according the mode of operation. As far as technically feasible, use should be made of automated discharging respectively filling stations.		
Manual dosing of sulfur dioxide from flasks into wine casks/refrigeration equipment	not required		When not used, flasks should be safely stored (preferably in a separate room) according to manufacturer's instructions.		
Technical conditions and	I measures to control dis	persion from source towar	ds the worker		
Workplace/Involved tasks	Level of separation	Localised controls (LC)	Specification of LC	Further information	
Connecting and disconnecting of flasks/barrels	separation of workers is	integrated extraction devices	< 100 mbar	-	
Manual dosing of sulfur dioxide from flasks into wine casks/refrigeration equipment	generally not required in the processes	not required	na	-	
Organisational measures	to prevent /limit releases	s, dispersion and exposure	•		
	ersonal hygiene practices,	ygiene measures are require no eating and smoking at			
Conditions and measures	s related to personal prot	ection, hygiene and health	evaluation		
Workplace/Involved tasks	Specification of respiratory protective equipment (RPE)	RPE efficiency (assigned protection factor, APF)	Specification of gloves	Further personal protective equipment (PPE)	
Connecting and disconnecting of flasks/barrels	not required	na	Since sulfur dioxide has corrosive properties, the use of protective gloves is mandatory for all process steps.	Eye protection equipment (e.g. goggles or visors) must be worn, unless potential contact with the eye can be excluded by the nature and type of application (i.e. closed process). Additionally, face protection, protective clothing and safety shoes are required to be worn as appropriate.	
Manual dosing of sulfur dioxide from flasks into wine casks/refrigeration equipment	not required	na			
with "duration of exposure" mass of the RPE itself, due capability of using tools and For reasons as given abov	above) should reflect the to the increased thermal of communicating are rec e, the worker should there	following principles are imp additional physiological stress stress by enclosing the head luced during the wearing of F fore be (i) healthy (especially	ss for the worker due to the d. In addition, it shall be cor RPE. / in view of medical problem	uration of work (compare breathing resistance and isidered that the worker's is that may affect the use	
recommended devices abo face properly and securely. The employer and self-em	ove which rely on a tight fa ployed persons have lega	ucing leakages between fac ce seal will not provide the r I responsibilities for the main orkplace. Therefore, they s	required protection unless the ntenance and issue of resp	ney fit the contours of the iratory protective devices	
respiratory protective devic		ining of the workers.		-	
2.2 Control of environ Product characteristics					
Gas, aqueous solution					
Amounts used					
86,472 tonnes/year local d	ause it can reasonably be	cal worst-case tonnage is se assumed that the downstrea			
Frequency and duration	of use				

Technical conditions and measures at process level (source) to prevent release

All processes are strictly closed.

Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil

None if emission to air < 7 tonnes/year. If emission to air > 7 tonnes/year, air emission abatement system should be used (e.g. wet or dry scrubber...)

No emissions to water. In case of emissions to water, pH impact on the receiving water should be avoided, e.g. by neutralizing the effluent.

Conditions and measures related to municipal sewage treatment plant

Not applicable

Conditions and measures related to external treatment of waste for disposal

No solid waste

Conditions and measures related to external recovery of waste

No solid waste

3. Exposure estimation and reference to its source

Occupational exposure

For the assessment of inhalation exposure, analogous data from the production of SO_2 were used and doubled for pre-cautionary reasons. The risk characterisation ratio (RCR) is the quotient of the refined exposure estimate and the respective DNEL (derived no-effect level) and has to be below 1 to demonstrate a safe use. For inhalation exposure, the RCR is based on the DNEL for sulfur dioxide of 0.5 ppm (1.3 mg/m³).

Workplace/Involved tasks	Method used for inhalation exposure assessment (refer to introduction)	Inhalation exposure estimate (RCR)	Method used for dermal exposure assessment	Dermal exposure estimate (RCR)	
Connecting and disconnecting of flasks/barrels	analogous data	0.4 ppm (0.8)	Since sulfur dioxide has corrosive properties, dermal exposure has to be minimised as far as		
Manual dosing of sulfur dioxide from flasks into wine casks/refrigeration equipment	analogous data	0.4 ppm (0.8)	technically reasible. A DNEL for dermal effects h not been derived. Thus, dermal exposure is no assessed in this exposure scenario.		

Environmental emissions

The predicted no effect concentration PNEC of SO₂ in air is 6.65 µg/m3.

Following a PECregional air of 1.035 µg/m3 and a maximum RCR of 0.95, 7 tonnes/year (PEC 5.28 µg/m3) is the maximum amount of SO2 that can be released.

Consequently safe use can be demonstrated when emissions to air of SO₂ do not exceed 7 tonnes/year.

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

Occupational exposure

The downstream user (DU) works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the DU can demonstrate on his own that his operational conditions and implemented risk management measures are adequate. This has to be done by showing that they limit the inhalation and dermal exposure to a level below the respective DNEL (given that the processes and activities in question are covered by the PROCs listed above) as given below. If measured data are not available, the DU may make use of an appropriate scaling tool such as MEASE (<u>www.ebrc.de/mease.html</u>) to estimate the associated exposure. It is noted that any given RPE and corresponding APFs in MEASE are related to their efficiency for protection against particles. Thus, for the current scenarios, the specific protection factor of an ABEK1 respiratory mask of 30 has to be applied manually by the user.

DNEL_{inhalation}: $0.5 \text{ ppm} (1.3 \text{ mg/m}^3)$

Important note: The DU has to be aware of the fact that apart from the long-term DNEL given above, a DNEL for acute effects exists at a level of 1 ppm (2.7 mg/m³). By demonstrating a safe use when comparing exposure estimates with the long-term DNEL, the acute DNEL is therefore also covered (according to R.14 guidance, acute exposure levels can be derived by multiplying long-term exposure estimates by a factor of 2). When using MEASE for the derivation of exposure estimates, it is noted that the exposure duration may not be reduced.

Environmental emissions