9.1 Production of sulfur dioxide

Exposure Scenario Format (1) addressing uses carried out by workers	
1. Title	
Free short title	Production of sulfur dioxide (SO_2)
Systematic title based on use descriptor	SU3 (Industrial uses), SU8, SU9 PC19 (appropriate PROCs and ERCs are given in Section 2 below)
Processes, tasks and/or activities covered	Processes, tasks and/or activities covered are described in Section 2 below.
Assessment Method	Inhalation exposure assessment is based on measured data for furnace and filling operations and on MEASE for closed processes.

2. Operational conditions and risk management measures

Workplace	Involved tasks	Involved PROCs
Unloading of waste sulfuric acid/sulfur	discharging of waste H_2SO_4/sulfur from road and rail tank cars into closed system	8b
Furnace operations	spraying for decomposition in rotary furnace, operations in the post-combustion chamber and/or burning of sulfur	22
Adsorption / Desorption	cooling, absorption, desorption, drying, compression, condensation	1
Filling of flasks/barrels	connecting and disconnecting operations	8b
Filling of road or rail tank cars	connecting and disconnecting operations	8b

ERC 1	Manufacture of substances

2.1 Control of workers 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
Unloading of waste sulfuric acid/sulfur	not restricted		aqueous solution, liquid, massive	very low
Furnace operations	not restricted		gaseous	high
Adsorption / Desorption	not restricted		liquefied gas / gaseous	high
Filling of flasks/barrels	not restricted		liquefied gas	high
Filling of road or rail tank cars	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 use/exposure

Workplace	Duration of exposure
Unloading of waste sulfuric acid/sulfur	480 minutes (not restricted)
Furnace operations	480 minutes (not restricted)
Adsorption / Desorption	480 minutes (not restricted)
Filling of flasks/barrels	480 minutes (not restricted)
Filling of road or rail tank cars	480 minutes (not restricted)

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	Room volume	Outdoors or indoors	Process temperature	Process pressure
Unloading of waste sulfuric acid/sulfur	not considered relevant for occupational exposure assessment of the conducted processes	delivery and storage in roofed outdoor workplace	ambient	not considered relevant for occupational exposure assessment of the conducted processes
Furnace operations		not considered relevant for occupational exposure assessment of the conducted processes	< 1,500°C	
Adsorption / Desorption			up to 100°C	
Filling of flasks/barrels			ambient	3,000 – 4,000 hPa
Filling of road or rail tank cars			ambient	3,000 – 4,000 hPa

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

Workplace	Level of containment	Level of segregation
Unloading of waste sulfuric acid/sulfur	tight fitting connections	segregation of the emission source is generally not required in the processes
Furnace operations	closed system (furnace)	
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 the mode of operation. As far as technically feasible, use should be made of automated filling stations.
Filling of road or rail tank cars	extracted (< 100 mbar) and tight fitting connections	

Technical conditions and measures to control dispersion from source towards the worker

Workplace	Level of separation	Localised controls (LC)	Specification of LC	Further information
Unloading of waste sulfuric acid/sulfur	separation of workers is generally not required in the processes	not required	na	-
Furnace operations		furnace extraction device	10 mbar	-
Adsorption / Desorption		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 to prevent /limit releases, dispersion and exposure

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.

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.

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)**
Unloading of waste sulfuric acid/sulfur	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.
Furnace operations	not required	na		
Adsorption / Desorption	not required	na		
Filling of flasks/barrels	not required	na		
Filling of road or rail tank cars	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 environmental exposure

Product characteristics

Gas

Amounts used

864,715 tonnes/year EU production volume

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 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 dioxide is not yet produced		Since sulfur dioxide has corrosive properties, dermal exposure has to be minimised as far as technically feasible. A DNEL for dermal effects has not been derived. Thus, dermal exposure is not assessed in this exposure scenario.	
Furnace operations	measured data	0.2 ppm (0.4)		
Adsorption / Desorption	MEASE	0.01 ppm (0.02)		
Filling of flasks/barrels	measured data	0.2 ppm (0.4)		
Filling of road or rail tank cars	measured data	0.03 ppm (0.07)		

Environmental emissions

The predicted no effect concentration PNEC of SO_2 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 SO_2 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 ppm (1.3 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

The downstream user (DU) works inside the boundaries set by the ES if emission to air < 7 tonnes/year. If emission to air > 7 tonnes/year, air emission abatement system should be used (wet or dry scrubber…).

9.1.1 Indirect exposure of humans via the environment (local)

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

Concentration for local exposure of humans via the environment					
	Estimated exposure concentrations		**Measured exposure concentrations**		**Explanation / source of measured data**
	value	**unit**	**value**	**unit**	
Air	5.28	µg SO_2/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 environment (mg/kg bw/d)					
µg SO_2/d	**mg SO_2/kg bw/d**		**Justification**		
-	-		Route of exposure is not relevant, since sulfur dioxide is a gas.		
Quantitative risk characterisation for humans exposed via the environment					
Route	**exposure concentrations (EC)**		**DNEL**		**Risk characterisation ratio**
Inhalation- local effects (long term)	5.28 µg SO_2/m^3		520 µg/m³		0.01
Oral- systemic (long term)	-		-		-
Combined routes					RCR Inhalation- systemic + RCR Oral- systemic

9.2 Discharging and filling operations for trading and distributing purposes

Exposure Scenario Format (1) addressing uses carried out by workers				
1. Title				
Free short title	Discharging and filling operations for trading and distributing purposes of sulfur dioxide (SO_2)			
Systematic title based on use descriptor	SU3 (Industrial uses), SU10 PC19, PC21 (appropriate PROCs and ERCs are given in Section 2 below)			
Processes, tasks and/or activities covered	Processes, tasks and/or activities covered are described in Section 2 below.			
Assessment Method	The assessment of inhalation exposure is based on analogous data from the production of SO_2.			
2. Operational conditions and risk management measures				
Workplace	**Involved tasks**	**Involved PROCs**		
Connecting and disconnecting of flasks/barrels	discharging and filling operations (including formulation steps in closed systems)	1, 8a, 8b, 9		
Discharging and filling of road/rail tank cars	discharging and filling operations (including formulation steps in closed systems)	1, 8a, 8b, 9		
ERC 2	Formulation of preparations			
2.1 Control of workers 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				
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 use/exposure				
Workplace	**Duration of exposure**			
All relevant workplaces	480 minutes (not restricted)			
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	**Room volume**	**Outdoors or indoors**	**Process temperature**	**Process pressure**
All relevant workplaces	not considered relevant for occupational exposure assessment of the conducted processes		ambient	< 4,000 hPa
Technical conditions and measures at process level (source) to prevent release				
Workplace	**Level of containment**		**Level of segregation**	
All relevant workplaces	extracted (< 100 mbar) and tight fitting connections, closed system		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.	

Technical conditions and measures to control dispersion from source towards 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

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 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 and filling of road/rail tank cars	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 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, 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 has not been derived. Thus, dermal exposure is not assessed in this exposure scenario.	
Discharging and filling of road/rail tank cars	analogous data	0.03 ppm (0.07)		

Environmental emissions

The predicted no effect concentration PNEC of SO_2 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 SO_2 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 ppm (1.3 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

The downstream user (DU) works inside the boundaries set by the ES if emission to air < 7 tonnes/year. If emission to air > 7 tonnes/year, air emission abatement system should be used (wet or dry scrubber…)

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

Exposure Scenario Format (1) addressing uses carried out by workers	
1. Title	
Free short title	Industrial use of sulfur dioxide (SO_2) in the production of foundry cores (semi-closed process)
Systematic title based on use descriptor	SU3 (Industrial uses), SU14 PC19 (appropriate PROCs and ERCs are given in Section 2 below)
Processes, tasks and/or activities covered	Processes, tasks and/or activities covered are described in Section 2 below.
Assessment Method	Inhalation exposure assessment is based on analogous data from the production of sulfur dioxide for discharging operations and on measured data for the manufacture of foundry cores (semi-closed process).

2. Operational conditions and risk management measures		
Workplace	**Involved tasks**	**Involved PROCs**
Connecting and disconnecting of flasks/barrels	discharging operations (including formulation and processing steps in closed systems)	1, 8a, 8b, 9
Discharging of road/rail tank cars	discharging operations (including formulation and processing steps in closed systems)	1, 8a, 8b, 9
Manufacture of foundry cores (semi-closed process)	manual operations at core shooting machines, and finishing of foundry cores	2, 3, 8b
ERC 2 **ERC 6d**	Formulation of preparation Industrial use of process regulators for polymerisation processes in produc-tion of resins, rubbers, polymers	

2.1 Control of workers 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**
Connecting and disconnecting of flasks/barrels	not restricted		liquefied gas	high
Discharging of road/rail tank cars			liquefied gas	high
Manufacture of foundry cores (semi-closed process)			liquefied gas / gaseous	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 use/exposure

Workplace	**Duration of exposure**
All workplaces	480 minutes (not restricted)

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	Room volume	Outdoors or indoors	Process temperature	Process pressure
Connecting and disconnecting of flasks/barrels	not considered relevant for occupational exposure assessment of the conducted processes		ambient	< 4,000 hPa
Discharging of road/rail tank cars			ambient	< 4,000 hPa
Manufacture of foundry cores (semi-closed process)			not restricted	ambient

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

Workplace	Level of containment	Level of segregation
Connecting and disconnecting of flasks/barrels	extracted (< 100 mbar) and tight fitting connections, closed system	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.
Discharging of road/rail tank cars		
Manufacture of foundry cores (semi-closed process)	not required	segregation of the emission source is not required at this workplace

Technical conditions and measures to control dispersion from source towards 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	-
Manufacture of foundry cores (semi-closed process)		local exhaust ventilation	90 % (ECETOC efficiency for PROC 2 & PROC 3)	-

Organisational measures to prevent /limit releases, dispersion and exposure

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 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		
Manufacture of foundry cores (semi-closed process)	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 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, dermal exposure has to be minimised as far as technically feasible. A DNEL for dermal effects has not been derived. Thus, dermal exposure is not assessed in this exposure scenario.	
Discharging of road/rail tank cars	analogous data	0.03 ppm (0.07)		
Manufacture of foundry cores (semi-closed process)	measured data	0.41 ppm (0.82)		

Environmental emissions

The predicted no effect concentration PNEC of SO_2 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 SO_2 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 ppm (1.3 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/m^3). 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

The downstream user (DU) works inside the boundaries set by the ES if emission to air < 7 tonnes/year. If emission to air > 7 tonnes/year, air emission abatement system should be used (wet or dry scrubber…)

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

Exposure Scenario Format (1) addressing uses carried out by workers	
1. Title	
Free short title	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	SU3 (Industrial uses), SU4, SU6b, SU8, SU9, SU10, SU13, SU14, SU15 PC14, PC15, PC19, PC20, PC26, PC29, PC37 (appropriate PROCs and ERCs are given in Section 2 below)
Processes, tasks and/or activities covered	Processes, tasks and/or activities covered are described in Section 2 below.
Assessment Method	Inhalation exposure assessment is based on analogous data from the production of sulfur dioxide for discharging operations, for semi-closed processes on analogous data from the manufacture of foundry cores (semi-closed process) and on MEASE for closed processes.

2. Operational conditions and risk management measures

Workplace	Involved tasks	Involved PROCs
Connecting and disconnecting of flasks/barrels	discharging operations	1, 8a, 8b, 9
Discharging of road/rail tank cars	discharging operations	1, 8a, 8b, 9
Use of sulfur dioxide in closed processes	maintenance and supervision activities at closed systems	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	2, 3, 4, 5, 8b, 22, 23

ERC 2	Formulation of preparation
ERC 4	Industrial use of processing aids in processes and products, not becoming part of articles
ERC 6a	Industrial use resulting in manufacture of another substance (use of intermediates)
ERC 6b	Industrial use of reactive processing aids

2.1 Control of workers 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
Connecting and disconnecting of flasks/barrels	not restricted		liquefied gas	high
Discharging of road/rail tank cars			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 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 use/exposure

Workplace	Duration of exposure
All workplaces	480 minutes (not restricted)

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	**Room volume**	**Outdoors or indoors**	**Process temperature**	**Process pressure**
Connecting and disconnecting of flasks/barrels	not considered relevant for occupational exposure assessment of the conducted processes		ambient	< 4,000 hPa
Discharging of road/rail tank cars			ambient	< 4,000 hPa
Use of sulfur dioxide in closed processes			not restricted	not restricted
Use of sulfur dioxide in semi-closed processes			not restricted	ambient

Technical conditions and measures at process level (source) to prevent release		
Workplace	**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.
Discharging of road/rail tank cars		
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 measures to control dispersion from source towards 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
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 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 environmental exposure

Product characteristics

Gas, aqueous solution

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, analogous data from the manufacture of foundry cores (semi-closed process), analogous data from the production of SO_2, 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)	Since sulfur dioxide has corrosive properties, dermal exposure has to be minimised as far as technically feasible. A DNEL for dermal effects has not been derived. Thus, dermal exposure is not assessed in this exposure scenario.	
Discharging of road/rail tank cars	analogous data	0.03 ppm (0.07)		
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

The predicted no effect concentration PNEC of SO_2 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 SO_2 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 ppm (1.3 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

The downstream user (DU) works inside the boundaries set by the ES if emission to air < 7 tonnes/year. If emission to air > 7 tonnes/year, air emission abatement system should be used (wet or dry scrubber…)

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

Exposure Scenario Format (1) addressing uses carried out by workers	
1. Title	
Free short title	Professional use of sulfur dioxide (SO_2) in winemaking/refilling of refrigeration 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	Processes, tasks and/or activities covered are described in Section 2 below.
Assessment Method	Inhalation exposure assessment is based on analogous data from the production of sulfur dioxide.

2. Operational conditions and risk management measures	
Workplace/Involved tasks	**Involved PROCs**
Connecting and disconnecting of flasks/barrels	8a, 8b, 9
Manual dosing of sulfur dioxide from flasks into wine casks/refrigeration equipment	8a, 8b, 9, 19 (dosing by the use of special sulfur dioxide dosing tools)
ERC 6a **ERC 7**	Industrial use resulting in manufacture of another substance (use of interme-diates) Industrial use of substances in closed systems

2.1 Control of workers 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/Involved tasks	**Use in preparation**	**Content in preparation**	**Physical form**	**Emission potential**
Connecting and disconnecting of flasks/barrels	not restricted		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 use/exposure

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	not considered relevant for occupational exposure assessment of the conducted processes		ambient	< 4,000 hPa
Manual dosing of sulfur dioxide from flasks into wine casks/refrigeration	wine cellars/refrigerating facilities	not restricted	ambient	< 4,000 hPa

equipment				

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

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 measures to control dispersion from source towards 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 generally not required in the processes	integrated extraction devices	< 100 mbar	-
Manual dosing of sulfur dioxide from flasks into wine casks/refrigeration equipment		not required	na	-

Organisational measures to prevent /limit releases, dispersion and exposure

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 related to personal protection, 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		

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 environmental exposure

Product characteristics

Gas, aqueous solution

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, 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 technically feasible. A DNEL for dermal effects has not been derived. Thus, dermal exposure is not assessed in this exposure scenario.	
Manual dosing of sulfur dioxide from flasks into wine casks/refrigeration equipment	analogous data	0.4 ppm (0.8)		

Environmental emissions

The predicted no effect concentration PNEC of SO_2 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 SO_2 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 ppm (1.3 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

The downstream user (DU) works inside the boundaries set by the ES if emission to air < 7 tonnes/year. If emission to air > 7 tonnes/year, air emission abatement system should be used (wet or dry scrubber…)