Safety Data Sheet

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

1.1 Product Identifier

Material Name:	**Fuel oil, residual CAS 68476-33-5**
REACH Registration No.:	01-2119474894-22
Synonyms:	Heavy fuel oil, Long residue LS, Fuel 77, Fuel 45, Colorline 180, LSFO, RMG 380, RME 180, B38H

1.2 Relevant identified uses of the substance or mixture and uses advised against

Product Use: Fuel for use in off-road diesel engines, boilers, furnaces and other combustion equipment.
Use as an intermediate, industrial
Distribution of substance, industrial
Formulation & (re) packing of the substance and its mixtures, industrial
Use as a fuel, industrial
Use as a fuel, professional

Uses Advised Against: Applications that are not registered and risk assessed.

1.3 Details of the supplier of the substance or mixture

Manufacturer/Supplier: St1 Refinery AB
Box 8889
402 72 Gothenburg, Sweden

Telephone: +46 (0) 31 744 6000

Email Contact for MSDS: bransle@st1.se or Supply-Sweden@st1.se

1.4 Emergency Telephone Number:

112 SOS Alarm
Swedish Poisons Information Centre: +46 (0)8 331231

2. HAZARDS IDENTIFICATION

2.1 Classification of substance or mixture

Product definition : Substance

Regulation (EC) No 1272/2008 (CLP)	
Hazard classes / Hazard categories	**Hazard Statement**
Acute toxicity, Category 4; Inhalation	H332
Carcinogenicity, Category 1B	H350
Toxic to reproduction, Category 2	H361d
Specific target organ toxicity – repeated exposure, Category 2; Blood; Liver; Thymus.	H373
Acute hazards to the aquatic environment, Category 1	H400
Chronic hazards to the aquatic environment, Category 1	H410
Repeated exposure may cause skin dryness or cracking	H-EUH066

2.2 Label Elements

Labeling according to Regulation (EC) No 1272/2008

Symbol(s) :

Signal Words: Danger

CLP Hazard Statements:

HEALTH HAZARDS:
H332: Harmful if inhaled.
H350: May cause cancer.
H361d: Suspected of damaging the unborn child.
H373: May cause damage to organs through prolonged or repeated exposure, Blood, Liver, Thymus.

H-EUH066: Repeated exposure may cause skin dryness or cracking.

ENVIRONMENTAL HAZARDS:
H400: Very toxic to aquatic life.
H410: Very toxic to aquatic life with long lasting effects.

CLP Precautionary statements
Prevention:

PREVENTION:
P201; P202; P261; P271; P273; P280

RESPONSE:
P301+P310; P304+P340; P308+P313; P312; P331; P391

STORAGE:
P405

DISPOSAL:
P501

For more information regarding CLP Precautionary statements, see chapter 16.

2.3 Other Hazards

Health Hazards: Hydrogen sulphide is highly toxic and may be fatal if inhaled. Hydrogen sulphide (H2S), an extremely flammable and toxic gas and other hazardous vapours may evolve and collect in the headspace of storage tanks, transport vessels and other enclosed containers.
May dull the sense of smell and has a high odour threshold, so do not rely on odour as an indication of hazard.
Contact with hot material can cause thermal burns which may result in permanent skin damage.

Safety Hazards: Not classified as flammable but will burn. Flammable vapours may be present even at temperatures below the flash point. Therefore it should be treated as a potentially flammable liquid. May ignite on surfaces at temperatures above auto-ignition temperature. Electrostatic charges may be generated during pumping. Electrostatic discharge may cause fire.

The substance does not fulfil all screening criteria for persistence, bioaccumulation and toxicity and hence is not considered to be PBT or vPvB.

Other Information: This product is intended for use in closed systems only.

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substance

CAS No. : 68476-33-5

Preparation Description: Streams obtained from distillation and cracking processes and containing a mixture of saturated, aromatic and olefinic hydrocarbons with carbon numbers predominantly in the C9 to C50 range. Contains cracked components in which polycyclic aromatic compounds, mainly 3-ring but some 4 to 6 ring species, are present. Contains sulphur, oxygen, nitrogen compounds, vanadium and other metals at >10 ppm w/w.

Product is not a mixture according regulation 1907/2006/EC.

Hazardous Components

Classification of components according to Regulation (EC) No 1272/2008

Chemical Name	CAS No.	EINECS	REACH Registration No.	Conc. vol%
Fuel oil, residual	68476-33-5	270-675-6	01-2119474894-22	≤ 100

Chemical Name	Hazard Class & Category	Hazard Statement
Fuel oil, residual	Carc., 1B; Acute Tox., 4; Repr., 2; STOT RE, 2; Aquatic Chronic, 1; Aquatic Acute, 1	H332; H350; H361d; H373; H400; H410; H-EUH066

3.2 Mixtures : Not applicable.

Additional Information: Contains hydrogen sulphide, CAS # 7783-06-4.
Hydrogen sulphide may be present both in the liquid and the vapour. Composition is complex and varies with the source of the crude oil. Heavy Fuel Oils are blends of residual fuels and distillate streams which always require heating before use.

4. FIRST AID MEASURES

4.1 Description of First Aid Measures

General Information: Vaporisation of H2S that has been trapped in clothing can be dangerous to rescuers. Maintain respiratory protection to avoid contamination from the victim to rescuer. Mechanical ventilation should be used to resuscitate if at all possible.

Inhalation:	Remove to fresh air. Do not attempt to rescue the victim unless proper respiratory protection is worn. If the victim has difficulty breathing or tightness of the chest, is dizzy, vomiting, or unresponsive, give 100% oxygen with rescue breathing or CPR as required and transport to the nearest medical facility.
Skin contact:	Cold product - Remove contaminated clothing. Flush exposed area with water and follow by washing with soap if available. If persistent irritation occurs, obtain medical attention. Hot product - If contact with hot product, cool the burn area by flushing with large amounts of water. Do not attempt to remove anything from the burn area or apply burn creams or ointments. Cover the burn area loosely with a sterile dressing, if available. Transport to the nearest medical facility for additional treatment.
Eye contact:	Cold product - Flush eye with copious quantities of water. If persistent irritation occurs, obtain medical attention. Hot product - If contact with hot product, cool the burn area by flushing with large amounts of water. Do not attempt to remove anything from the burn area or apply burn creams or ointments. Cover the burn area loosely with a sterile dressing, if available. Transport to the nearest medical facility for additional treatment.
Ingestion:	If vomiting occurs spontaneously, keep head below hips to prevent aspiration. Give nothing by mouth.
4.2 Most important symptoms/effects, acute & delayed:	H2S has a broad range of effects dependent on the airborne concentration and length of exposure: 0.02 ppm odour threshold, smell of rotten eggs; 10 ppm eye and respiratory tract irritation; 100 ppm coughing, headache, dizziness, nausea, eye irritation, loss of sense of smell in minutes; 200 ppm potential for pulmonary oedema after >20-30 minutes; 500 ppm loss of consciousness after short exposures, potential for respiratory arrest; >1000 ppm immediate loss of consciousness may lead rapidly to death, prompt cardiopulmonary resuscitation may be required. Do not depend on sense of smell for warning. H2S causes rapid olfactory fatigue (deadens sense of smell). There is no evidence that H2S will accumulate in the body tissue after repeated exposure. Defatting dermatitis signs and symptoms may include a burning sensation and/or a dried/cracked appearance
4.3 Indication of immediate medical	Hydrogen sulphide (H2S) - CNS asphyxiant. May cause rhinitis,

attention and special treatment needed:	bronchitis and occasionally pulmonary oedema after severe exposure. CONSIDER: Oxygen therapy. Consult a Poison Control Center for guidance. Exposure to hydrogen sulphide at concentrations above the recommended occupational exposure standard may cause headache, dizziness, irritation of the eyes, upper respiratory tract, mouth and digestive tract, convulsions, respiratory paralysis, unconsciousness and even death. Call a doctor or poison control center for guidance.

5. FIRE FIGHTING MEASURES

Clear fire area of all non-emergency personnel.

5.1 Extinguishing Media:	Foam, water spray or fog. Dry chemical powder, carbon dioxide, sand or earth may be used for small fires only.
Unsuitable Extinguishing Media:	Do not use direct water jets on the burning product as they could cause a steam explosion and spread of the fire. Simultaneous use of foam and water on the same surface is to be avoided as water destroys the foam
5.2 Special hazards arising from substance or mixture:	Hazardous combustion products may include: A complex mixture of airborne solid and liquid particulates and gases (smoke), carbon monoxide, oxides of nitrogen, oxides of sulphur, unidentified organic and inorganic compounds. Flammable vapours may be present even at temperatures below the flash point. The vapour is heavier than air, spreads along the ground and distant ignition is possible. Sinks in fresh water, floats on sea water and may reignite on water surface. Hydrogen sulphide (H2S) and toxic sulphur oxides may be given off when this material is heated. Do not depend on sense of smell for warning.
5.3 Advice for fire-fighters:	Wear full protective clothing and self-contained breathing apparatus.
Additional Advice:	Keep adjacent containers cool by spraying with water. If possible remove containers from the danger zone. If the fire cannot be extinguished the only course of action is to evacuate immediately.

6. ACCIDENTAL RELEASE MEASURES

Avoid contact with spilled or released material. For guidance on selection of personal protective equipment see Chapter 8 of this Material Safety Data Sheet. See Chapter 13 for information on disposal. Observe the relevant local and international regulations. Remove contaminated clothing. Evacuate the area of all non-essential personnel. Avoid contact with skin, eyes and clothing. Ventilate contaminated area thoroughly.

6.1 Personal Precautions, Protective Equipment and Emergency Procedures:	May ignite on surfaces at temperatures above auto-ignition temperature. Do not breathe fumes, vapour. Shut off all ignition sources, such as flames, sparks, electricity.
6.2 Environmental Precautions:	Shut off leaks, if possible without personal risks. Remove all possible sources of ignition in the surrounding area. Use appropriate containment (of product and firefighting water) to avoid environmental contamination. Prevent from spreading or entering drains, ditches or rivers by using sand, earth, or other appropriate barriers. Attempt to disperse the vapour or to direct its flow to a safe location for example by using fog sprays. Take precautionary measures against static discharge. Ensure electrical continuity by bonding and grounding (earthing) all equipment.
6.3 Methods and Material for Containment and Clean Up:	For small liquid spills (< 1 drum), transfer by mechanical means to a labelled, sealable container for product recovery or safe disposal. Allow residues to evaporate or soak up with an appropriate absorbent material and dispose of safely. Remove contaminated soil and dispose of safely. For large liquid spills (> 1 drum), transfer by mechanical means such as vacuum truck to a salvage tank for recovery or safe disposal. Do not flush away residues with water. Retain as contaminated waste. Allow residues to evaporate or soak up with an appropriate absorbent material and dispose of safely. Remove contaminated soil and dispose of safely. Shovel into a suitable clearly marked container for disposal or reclamation in accordance with local regulations.
Additional Advice:	Notify authorities if any exposure to the general public or the environment occurs or is likely to occur. Local authorities should be advised if significant spillages cannot be contained. Maritime spillages should be dealt with using a Shipboard Oil Pollution Emergency Plan (SOPEP),

as required by MARPOL Annex 1 Regulation 26.

7. HANDLING AND STORAGE

7.1 Precautions for Safe Handling:

Avoid breathing vapours or contact with material. Only use In well ventilated areas. Wash thoroughly after handling. For guidance on selection of personal protective equipment see Chapter 8 of this Material Safety Data Sheet. Use the information in this data sheet as input to a risk assessment of local circumstances to help determine appropriate controls for safe handling, storage and disposal of this material. Properly dispose of any contaminated rags or cleaning materials in order to prevent fires. Prevent spillages. Use local exhaust ventilation if there is risk of inhalation of vapours, mists or aerosols. Maintenance and Fuelling Activities - Avoid inhalation of vapours and contact with skin.
The inherent toxic and olfactory (sense of smell) fatiguing properties of hydrogen sulphide require that air monitoring alarms are used if concentrations are expected to reach harmful levels such as in enclosed spaces, heated transport vessels and spill or leak situations. If the air concentration exceeds 50 ppm, the area should be evacuated unless respiratory protection is in use. Avoid prolonged or repeated contact with skin. When using the product do not eat or drink. Extinguish any naked flames. Do not smoke. Remove ignition sources. Avoid sparks. Electrostatic charges may be generated during pumping. Electrostatic discharge may cause fire. Earth all equipment.

7.2 Conditions for safe storage, including any incompatibilities:

Drum and small container storage: Drums should be stacked to a maximum of 3 high. Use properly labelled and closable containers. Prevent ingress of water. Tank storage: Tanks must be specifically designed for use with this product. Bulk storage tanks should be diked (bunded). Locate tanks away from heat and other sources of ignition. Tanks should be fitted with heating coils. Ensure heating coils are always covered with product (minimum 15 cm).

7.3 Specific End Uses:

Please refer to Ch16 and/or the annexes for the registered uses under REACH.

Additional Information:	Exposure to this product should be reduced as low as reasonably practicable. Reference should be made to the Health and Safety Executive's publication "COSHH Essentials". Ensure that all local regulations regarding handling and storage facilities are followed.
Product Transfer:	Avoid splash filling. Wait 2 minutes after tank filling (for tanks such as those on road tanker vehicles) before opening hatches or manholes. Wait 30 minutes after tank filling (for large storage tanks) before opening hatches or manholes. Keep containers closed when not in use. Do not use compressed air for filling, discharging or handling.
Recommended Materials:	For containers, or container linings use mild steel, stainless steel. Aluminium may also be used for applications where it does not present an unnecessary fire hazard. Examples of suitable materials are: high density polyethylene (HDPE) and Viton (FKM), which have been specifically tested for compatibility with this product. For container linings, use amine-adduct cured epoxy paint. For seals and gaskets use: graphite, PTFE, Viton A, Viton B.
Unsuitable Materials:	Some synthetic materials may be unsuitable for containers or container linings depending on the material specification and intended use. Examples of materials to avoid are: natural rubber (NR), nitrile rubber (NBR), ethylene propylene rubber (EPDM), polymethyl methacrylate (PMMA), polystyrene, polyvinyl chloride (PVC), polyisobutylene. However, some may be suitable for glove materials.
Container Advice:	Containers, even those that have been emptied, can contain explosive vapours. Do not cut, drill, grind, weld or perform similar operations on or near containers.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Read in conjunction with the Exposure Scenario for your specific use contained in the Annex.

8.1 Control Parameters

Occupational Exposure Limits

Chemical name	Source	Limit level mg/m3	Limit level ppm	Short-time value mg/m3	Short-time value ppm
Hydrogen sulphide	AFS 2015:7	7	5	14	10

Biological Exposure Index (BEI)

No biological limit allocated.

Derived No Effect Levels (DNEL)

Component	Exposure Route	Exposure Type (long/short)	Application Area	Value
Fuel oil, residual	Inhalation	acute, systemic effects	Worker	4700 mg/m3 15 min (aerosol)
	Dermal	long term, systemic effects	Worker	0,065 mg/kg 8h
	Inhalation	long term, systemic effects	Worker	0,12 mg/m3 8h (aerosol)
	Oral	long term, systemic effects	Consumer	0,015 mg/kg 24h

PNEC related information: Substance is a hydrocarbon with a complex, unknown or variable composition. Conventional methods of deriving PNECs are not appropriate and it is not possible to identify a single representative PNEC for such substances.

8.2 Exposure Controls General Information: The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Select controls based on a risk assessment of local circumstances. Appropriate measures include: Use sealed systems as far as possible. Adequate ventilation to control airborne concentrations below the exposure guidelines/limits. Local exhaust ventilation is recommended. Eye washes and showers for emergency use.

Occupational Exposure Controls

Personal Protective Equipment: Personal protective equipment (PPE) should meet recommended national standards. Check with PPE suppliers.

Eye Protection: Chemical splash goggles (chemical monogoggles),

	approved to EU Standard EN166.
Hand Protection:	Personal hygiene is a key element of effective hand care. Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturizer is recommended. Suitability and durability of a glove is dependent on usage, e.g. frequency and duration of contact, chemical resistance of glove material, glove thickness, and dexterity. Always seek advice from glove suppliers. Contaminated gloves should be replaced. Select gloves tested to a relevant standard (e.g. Europe EN374, US F739). When prolonged or frequent repeated contact occurs, Nitrile gloves may be suitable. (Breakthrough time of > 240 minutes.) For incidental contact/splash protection Neoprene, PVC gloves may be suitable.
Body protection:	Chemical resistant gloves/gauntlets, boots, and apron (where risk of splashing).
Respiratory Protection:	If engineering controls do not maintain airborne concentrations to a level which is adequate to protect worker health, select respiratory protection equipment suitable for the specific conditions of use and meeting relevant legislation. Check with respiratory protective equipment suppliers. Where air-filtering respirators are suitable, select an appropriate combination of mask and filter. Where air-filtering respirators are unsuitable (e.g. airborne concentrations are high, risk of oxygen deficiency, confined space) use appropriate positive pressure breathing apparatus. All respiratory protection equipment and use must be in accordance with local regulations. Select a filter suitable for combined particulate/organic gases and vapours [boiling point >65 °C (149 °F)] meeting EN14387.
Thermal Hazards:	When handling heated product, wear heat resistant gloves, safety hat with visor, and heat resistant coveralls (with cuffs over gloves and legs over boots), and heavy-duty boots, e.g. leather for heat resistance.
Monitoring Methods:	Monitoring of the concentration of substances in the breathing zone of workers or in the general workplace may be required to confirm compliance with an OEL and adequacy of exposure controls. For some substances

	biological monitoring may also be appropriate.
Environmental Exposure Controls **Environmental exposure control measures:**	Local guidelines on emission limits for volatile substances must be observed for the discharge of exhaust air containing vapour.
Consumer Exposure Controls **Exposure Control Measures for Consumers:**	If repeated and/or prolonged skin exposure to the substance is likely, then wear suitable gloves tested to EN374 and provide employee skin care programmes.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

Appearance:	Brown to black. Viscous liquid
Odour:	Hydrocarbon
Odour threshold:	-
pH:	Not applicable
Melting point/freezing point:	<30 °C
Initial boiling point and boiling range:	150 - 750°C
Flash point:	>60 °C
Evaporation rate:	-
Flammability (solid, gas)	-
Upper/lower flammability or explosive limits:	0,50 – 5,0 % (V)
Vapour pressure, at 37,8 °C:	0,2 to 7,91 hPa
Vapour density:	-
Relative density:	Max 991 kg/m3
Solubility(ies):	Negligible
Partition coefficient: n-octanol/water:	-
Auto-ignition temperature:	> 220^{o}C
Decomposition temperature:	-
Kinematics Viscosity, 40oC	>20,5 mm2/s
Explosive properties:	Not considered to be explosive
Oxidising properties:	Not considered to oxidase

9.2 Other Information: Not applicable.

10. STABILITY AND REACTIVITY

10.1 Reactivity: Fuel oil, residual is not considered to be reactive

10.2 Chemical Stability Stable under normal conditions of use.

10.3 Possibility of Hazardous Reactions:	Oxidises on contact of air.
10.4 Conditions to Avoid:	Avoid heat, sparks, open flames and other ignition sources.
10.5 Incompatible Materials:	Strong oxidising agents.
10.6 Hazardous Decomposition Products:	Hazardous decomposition products are not expected to form during normal storage. Thermal decomposition is highly dependent on conditions. A complex mixture of airborne solids, liquids and gases, including carbon monoxide, carbon dioxide and other organic compounds will be evolved when this material undergoes combustion or thermal or oxidative degradation.

11. TOXICOLOGICAL INFORMATION

11.1 Information on Toxicological effects

Basis for Assessment:	Information given is based on product data, knowledge of the components and the toxicology of similar products.
Likely Routes of Exposure:	Skin and eye contact are the primary routes of exposure although exposure may occur through inhalation or following accidental ingestion.
Acute Oral Toxicity:	Low toxicity: LD50 > 5000 mg/kg, Rat
Acute Dermal Toxicity:	Low toxicity: LD50 >2000 mg/kg, Rabbit
Acute Inhalation Toxicity:	Harmful if inhaled. LC50 > 1.0 - ≤ 5.0 mg/l / 4 h, Rat
Skin Corrosion/Irritation:	Expected to be slightly irritating. Prolonged/repeated contact may cause defatting of the skin which can lead to dermatitis. Contact with hot material can cause thermal burns which may result in permanent skin damage.
Serious Eye Damage/Irritation:	Expected to be slightly irritating. Hot product may cause severe eye burns and/or blindness.
Respiratory Irritation:	Inhalation of vapours or mists may cause irritation to the respiratory system.
Respiratory or Skin Sensitisation	Not expected to be a sensitizer.
Aspiration Hazard:	Not considered an aspiration hazard.

Germ Cell Mutagenicity:	Positive in in-vitro, but negative in in-vivo mutagenicity assays.
Carcinogenicity:	Causes cancer in laboratory animals.
Reproductive and Developmental Toxicity:	Causes foetotoxicity at doses which are maternally toxic.
Specific target organ toxicity- single exposure:	Not expected to be a hazard.
Specific target organ toxicity - repeated exposure:	May cause damage to organs or organ systems through prolonged or repeated exposure, blood, liver, thymus.

12. ECOLOGICAL INFORMATION

Basis for Assessment:	Fuels are typically made from blending several refinery streams. Ecotoxicological studies have been carried out on a variety of hydrocarbon blends and streams but not those containing additives. Information given is based on knowledge of the components and the ecotoxicology of similar products.

12.1 Toxicity

Acute Toxicity:	Expected to be very toxic: LL/EL/IL50 < 1 mg/l (LL/EL50 expressed as the nominal amount of product required to prepare aqueous test extract).
Fish:	Harmful: LL/EL/IL50 10-100 mg/l
Aquatic Invertebrates:	Toxic: LL/EL/IL50 1-10 mg/l
Algae:	Very toxic: LL/EL/IL50 < 1 mg/l
Microorganisms:	Expected to be practically non-toxic: LL/EL/IL50 > 100 mg/l

Chronic Toxicity

Fish:	NOEC/NOEL expected to be > 0,01 - ≤ 0,1 mg/l (based on test data)
Aquatic Invertebrates:	NOEC/NOEL expected to be > 0,1 - ≤ 1,0 mg/l (based on test data)
12.2 Persistence and Degradability:	The volatile constituents will oxidize rapidly by Photochemical reactions in air. Major constituents are inherently biodegradable.
12.3 Bioaccumulative Potential:	Contains constituents with the potential to bioaccumulate.
12.4 Mobility:	Partly evaporates from water or soil surfaces, but a significant proportion will remain after one day. Large volumes may penetrate soil and could contaminate groundwater. Sinks in

	fresh water, but will float on sea water and form a slick. Contains volatile constituents.
12.5 Result of the PBT and vPvB assessment:	The substance does not fulfill all screening criteria for persistence, bioaccumulation and toxicity and hence is not considered to be PBT or vPvB.
12.6 Other Adverse Effects:	Films formed on water may affect oxygen transfer and damage organisms.

13. DISPOSAL CONSIDERATIONS

13.1 Waste Treatment Methods

Material Disposal:	Recover or recycle if possible. It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste classification and disposal methods in compliance with applicable regulations. Do not dispose into the environment, in drains or in water courses. Do not dispose of tank water bottoms by allowing them to drain into the ground. This will result in soil and groundwater contamination. Waste arising from a spillage or tank cleaning should be disposed of in accordance with prevailing regulations, preferably to a recognised collector or contractor. The competence of the collector or contractor should be established beforehand.
Container Disposal:	Send to drum recoverer or metal reclaimer. Drain container thoroughly. After draining, vent in a safe place away from sparks and fire. Residues may cause an explosion hazard if heated above the flash point. Do not puncture, cut or weld uncleaned drums. Do not pollute the soil, water or environment with the waste container. Comply with any local recovery or waste disposal regulations.
Local Legislation:	EU Waste Disposal Code (EWC): 13 07 01 fuel oil and diesel. The number given to waste is associated with the appropriate usage. The user must decide if their particular use results in another waste code being assigned. Disposal should be in accordance with applicable regional, national, and local laws and regulations. Local regulations may be more stringent than regional or national requirements and must be complied with.

14. TRANSPORT INFORMATION

Land transport (ADR/RID):

ADR/RID

UN No.:	3082
UN Proper Shipping Name:	Environmentally hazardous substance, liquid, n.o.s. (Fuel oil, residual)
Transport Hazard Class:	9
Packing group:	III
Danger label (primary risk):	9
Environmental Hazard:	Environmentally Hazardous

Inland waterways transport (ADN):

UN No.:	3082
UN Proper Shipping Name:	Environmentally hazardous substance, liquid, n.o.s. (Fuel oil, residual)
Transport Hazard Class:	9
Packing group:	III
Danger label (primary risk):	9
Danger label (subsidiary risk):	N1, CMR, F, S
Environmental Hazard:	Environmentally Hazardous

Sea transport (IMDG Code):

UN No.:	UN 3082
UN Proper Shipping Name:	Environmentally hazardous substance, liquid, n.o.s.
Technical name:	Fuel oil, residual
Transport Hazard Class:	9
Packing group:	III
Marine pollutant:	Yes

Air transport (IATA):

UN No.:	3082
UN Proper Shipping Name:	Environmentally hazardous substance, liquid, n.o.s.
Technical name:	Fuel oil, residual
Transport Hazard Class:	9
Packing group:	III
Marine pollutant:	Yes

Sea (Annex II of MARPOL 73/78 and the IBC code)

Pollution Category	:	Not applicable
Ship Type	:	Not applicable
Product Name	:	Not applicable
Special Precaution	:	Not applicable

Additional Information : MARPOL Annex I rules apply for bulk shipments by sea.

15. REGULATORY INFORMATION

The regulatory information is not intended to be comprehensive. Other regulations may apply to this material.

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture	EU Regulation (EC) No 1907/2006 (REACH). EU Regulation (EC) No 1272/2008 Classification, labelling and packaging of chemical substances and mixtures (CLP).
15.2 Chemical Safety Assessment	A Chemical Safety Assessment was performed for this substance.

16. OTHER INFORMATION

CLP Hazard Statements

H332: Harmful if inhaled.
H350: May cause cancer.
H361d: Suspected of damaging fertility or the unborn child
H373: May cause damage to organs through prolonged or repeated exposure.
H-EUH066: Repeated exposure may cause skin dryness or cracking.
H400: Very toxic to aquatic life
H410: Very toxic to aquatic life with long lasting effects.

CLP Precautionary statements:

P201: Obtain special instructions before use
P202: Do not handle until all safety precautions have been read and understood.
P261: Avoid breathing dust/fume/gas/mist/vapours/spray.
P271: Use only outdoors or in a well-ventilated area.
P273: Avoid release to the environment.
P280: Wear protective gloves/clothing/eye protection
P301+P310: IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician
P304+P340: IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
P308+P313: IF exposed or concerned: Get medical advice/attention
P312: Call a POISON CENTER or doctor/physician if you feel unwell
P331: Do NOT induce vomiting
P391: Collect spillage
P405: Store locked up
P501: Dispose of contents/container in accordance with local/regional/national/international regulation

Recommended Restrictions on Use (Advice Against):	This product must not be used in applications other than those recommended in Section 1, without first seeking the advice of the supplier.
Additional Information:	This document contains important information to ensure the safe storage, handling and use of this product. The information in this document should be brought to the attention of the person in your organisation responsible for advising on safety matters.
Other Information:	This product is intended for use in closed systems only.
MSDS Distribution	The information in this document should be made available to all who may handle the product.
MSDS Version Number	1.3
MSDS Effective Date:	24.05.2016
Disclaimer:	This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.

Table of Contents exposure scenarios

Identified Uses according to the Use Descriptor System

Uses - Worker		
Title	:	1. Manufacture of substance - Industrial
Uses - Worker		
Title	:	2. Use as an intermediate - Industrial
Uses - Worker		
Title	:	3. Distribution of substance - Industrial
Uses - Worker		
Title	:	4. Formulation & (re)packing of substances and mixtures - Industrial
Uses - Worker		
Title	:	5. Use as a fuel - Industrial
Uses - Worker		
Title	:	6. Use as a fuel - Professional

Abbreviation:

SU 3 - Industrial uses: Uses of substances as such or in preparations at industrial sites
SU8- Manufacture of bulk, large scale chemicals (including petroleum products)
SU9 - Manufacture of fine chemicals
SU 10 - Formulation [mixing] of preparations and/or re-packaging (excluding alloys)
SU 22 - Professional uses: Public domain (administration, education, entertainment, services, craftsmen)

PROC1 - Use in closed process, no likelihood of exposure
PROC2 - Use in closed, continuous process with occasional controlled exposure
PROC3 - Use in closed batch process (synthesis or formulation)
PROC8a - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities
PROC8b - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities
PROC15 - Use as laboratory reagent
PROC16 - Using material as fuel sources, limited exposure to unburned product to be expected

ERC1 - Manufacture of substances
ERC2 - Formulation of preparations
ERC3 - Formulation in materials
ERC4 - Industrial use of processing aids in processes and products, not becoming part of articles
ERC5 - Industrial use resulting in inclusion into or onto a matrix
ERC6a - Industrial use resulting in manufacture of another substance (use of intermediates)
ERC6b - Industrial use of reactive processing aids
ERC6c - Industrial use of monomers for manufacture of thermo-plastics
ERC6d - Industrial use of process regulators for polymerisation processes in production of resins, rubbers, polymers
ERC7 - Industrial use of sub-stances in closed systems
ERC9a - Wide dispersive indoor use of substances in closed systems
ERC9b - Wide dispersive outdoor use of substances in closed systems

Exposure Scenario – Worker

SECTION 1	**EXPOSURE SCENARIO TITLE**
Title	1. Manufacture of substance - Industrial
Use Descriptor	**Sector of Use**: SU3, SU8, SU9 **Process Categories**: PROC1, PROC2, PROC3, PROC8a, PROC8b, PROC15 **Environmental Release Categories**: ERC1, ERC4, ESVOC SpERC 1.1.v1
Scope of process	Manufacture of the substance or use as a process chemical or extraction agent within closed or contained systems. Includes incidental exposures during recycling/ recovery, material transfers, storage, sampling, associated laboratory activities, maintenance and loading (including marine vessel/barge, road/rail car and bulk container).

SECTION 2	**OPERATIONAL CONDITIONS AND RISK MANAGEMENT MEASURES**

Section 2.1	**Control of Worker Exposure**
Product Characteristics	
Physical form of product	Liquid, vapour pressure < 0.5 kPa at STP
Concentration of substance in product.	Covers percentage substance in the product up to 100% (unless stated differently)
Frequency and Duration of Use	
Covers daily exposures up to 8 hours (unless stated differently)	
Other Operational Conditions affecting Exposure	
Operation is carried out at elevated temperature (> 20°C above ambient temperature). Assumes a good basic standard of occupational hygiene has been implemented.	

Contributing Scenarios	**Risk Management Measures**
General measures (carcinogens).	Consider technical advances and process upgrades (including automation) for the elimination of releases. Minimise exposure using measures such as closed systems, dedicated facilities and suitable general/local exhaust ventilation. Drain down systems and clear transfer lines prior to breaking containment. Clean/flush equipment, where possible, prior to maintenance. Where there is potential for exposure: restrict access to authorised persons; provide specific activity training to operators to minimise exposures; wear suitable gloves and coveralls to prevent skin contamination; wear respiratory protection when its use is identified for certain contributing scenarios; clear up spills immediately and dispose of wastes safely. Ensure safe systems of work or equivalent arrangements are in place to manage risks. Regularly inspect, test and maintain all control

	measures. Consider the need for risk based health surveillance.
General exposures (closed systems)	Handle substance within a closed system. Wear chemically resistant gloves tested to EN374 (nitrile gloves have the best protection for fuel oil) in combination with 'basic' employee training.
Process sampling. Outdoor	Sample via a closed loop or other system to avoid exposure. Avoid carrying out activities involving exposure for more than 15 minutes. Wear chemically resistant gloves (nitrile) in combination with 'basic' employee training.
Laboratory activities	Handle within a fume cupboard or implement suitable equivalent methods to minimise exposure. Wear suitable gloves tested to EN374 (nitrile).
Marine vessel/barge (un)loading	Avoid carrying out activities involving exposure for more than 4 hours. Transfer via enclosed lines. Clear transfer lines prior to de-coupling. Retain drain downs in sealed storage pending disposal or for subsequent recycle. Wear chemically resistant gloves (nitrile) in combination with 'basic' employee training.
Road tanker/rail car loading	Ensure material transfers are under containment or extract ventilation, or: Avoid carrying out activities involving exposure for more than 1 hour. Wear chemically resistant gloves (nitrile) in combination with 'basic' employee training.
Equipment cleaning and maintenance	Drain down and flush system prior to equipment break-in or maintenance. Retain drain downs in sealed storage pending disposal or for subsequent recycle. Wear chemically resistant gloves (nitrile) in combination with specific activity training.
Bulk product storage	Store substance within a closed system. Avoid carrying out activities involving exposure for more than 4 hours. Wear chemically resistant gloves (nitrile) in combination with 'basic' employee training.

Section 2.2	**Control of Environmental Exposure**
Substance is complex UVCB.	
Predominantly hydrophobic.	
Amounts Used	
Fraction of EU tonnage used in region:	0.1
Regional use tonnage (tonnes/year):	1.1E+07
Fraction of Regional tonnage used locally:	5.2E-02
Annual site tonnage (tonnes/year):	6.0E+05
Maximum daily site tonnage (kg/day):	2.0E+06
Frequency and Duration of Use	

Continuous release.	
Emission Days (days/year):	300
Environmental factors not influenced by risk management	
Local freshwater dilution factor:	10
Local marine water dilution factor:	100
Other Operational Conditions affecting Environmental Exposure	
Release fraction to air from process (initial release prior to RMM):	1.0E+04
Release fraction to wastewater from process (initial release prior to RMM):	3.0E-06
Release fraction to soil from process (initial release prior to RMM):	1.0E-04
Technical conditions and measures at process level (source) to prevent release	
Common practices vary across sites thus conservative process release estimates used.	
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	
Risk from environmental exposure is driven by humans via indirect exposure (primarily ingestion).	
Prevent discharge of undissolved substance to or recover from onsite wastewater.	
If discharging to domestic sewage treatment plant, no secondary wastewater treatment required.	
Treat air emission to provide a typical removal efficiency of (%)	90
Treat onsite wastewater (prior to receiving water discharge) to provide the required removal efficiency of >= (%)	85.9
If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of (%)	0
Organisational measures to prevent/limit release from site	
Do not apply industrial sludge to natural soils. Sludge should be incinerated, contained or reclaimed.	
Conditions and Measures related to municipal sewage treatment plant	
Estimated substance removal from wastewater via domestic sewage treatment (%)	88.8
Total efficiency of removal from wastewater after onsite and offsite (domestic treatment plant) RMMs (%)	88.8
Maximum allowable site tonnage (MSafe) based on release following total wastewater treatment removal (kg/d):	2.3E+06
Assumed domestic sewage treatment plant flow (m3/d)	10000
Conditions and Measures related to external treatment of waste for disposal	
During manufacturing no waste of the substance is generated.	
Conditions and measures related to external recovery of waste	
During manufacturing no waste of the substance is generated.	

SECTION 3	EXPOSURE ESTIMATION
Section 3.1 - Health	
The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated.	

Section 3.2 - Environment
The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model.

SECTION 4	GUIDANCE TO CHECK COMPLIANCE WITH THE EXPOSURE SCENARIO
Section 4.1 - Health	
Predicted exposures are not expected to exceed the DN(M)EL when the Risk Management Measures/Operational Conditions outlined in Section 2 are implemented. Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. Available hazard data do not enable the derivation of a DNEL for carcinogenic effects. Risk Management Measures are based on qualitative risk characterisation.	

Section 4.2 -Environment
Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures.
Required removal efficiency for wastewater can be achieved using onsite/offsite technologies, either alone or in combination.
Required removal efficiency for air can be achieved using on-site technologies, either alone or in combination.
Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org/en/reach-for-industries-libraries.html).

Exposure Scenario – Worker

SECTION 1	**EXPOSURE SCENARIO TITLE**
Title	2. Use as an intermediate - Industrial
Use Descriptor	**Sector of Use**: SU3, SU8, SU9 **Process Categories**: PROC1, PROC2, PROC3, PROC8a, PROC8b, PROC15 **Environmental Release Categories**: ERC6A, ESVOC SpERC 6.1a.v1
Scope of process	Use of substance as an intermediate within closed or contained systems (not related to Strictly Controlled Conditions). Includes incidental exposures during recycling/ recovery, material transfers, storage, sampling, associated laboratory activities, maintenance and loading (including marine vessel/barge, road/rail car and bulk container).

SECTION 2	**OPERATIONAL CONDITIONS AND RISK MANAGEMENT MEASURES**

Section 2.1	**Control of Worker Exposure**
Physical form of product	Liquid, vapour pressure > 0,5 kPa at STP
Concentration of substance in product.	Covers percentage substance in the product up to 100% (unless stated differently)
Frequency and Duration of Use	
Covers daily exposures up to 8 hours (unless stated differently).	
Other Operational Conditions affecting Exposure	
Operation is carried out at elevated temperature (> 20°C above ambient temperature). Assumes a good basic standard of occupational hygiene has been implemented.	

Contributing Scenarios	**Risk Management Measures**
General measures (carcinogens).	Consider technical advances and process upgrades (including automation) for the elimination of releases. Minimise exposure using measures such as closed systems, dedicated facilities and suitable general/local exhaust ventilation. Drain down systems and clear transfer lines prior to breaking containment. Clean/flush equipment, where possible, prior to maintenance. Where there is potential for exposure: restrict access to authorised persons; provide specific activity training to operators to minimise exposures; wear suitable gloves and coveralls to prevent skin contamination; wear respiratory protection when its use is identified for certain contributing scenarios; clear up spills immediately and dispose of wastes safely. Ensure safe systems of work or equivalent arrangements are in place to manage risks. Regularly inspect, test and maintain all control measures. Consider the need for risk based health surveillance.

General exposures (closed systems)	Handle substance within a closed system. Wear chemically resistant gloves tested to EN374 (nitrile gloves have the best protection for fuel oil) in combination with 'basic' employee training.
General exposures (closed systems). Process sampling outdoor.	Handle substance within a closed system. Sample via a closed loop or other system to avoid exposure. Avoid carrying out activities involving exposure for more than 15 minutes. Wear chemically resistant gloves (nitrile) in combination with 'basic' employee training.
Laboratory activities	Handle within a fume cupboard or implement suitable equivalent methods to minimise exposure. Wear suitable gloves tested to EN374 (nitrile).
Marine vessel/barge (un)loading	Transfer via enclosed lines. Clear transfer lines prior to de-coupling. Avoid carrying out activities involving exposure for more than 4 hours. Retain drain downs in sealed storage pending disposal or for subsequent recycle. Wear chemically resistant gloves (nitrile)) in combination with 'basic' employee training.
Road tanker/rail car loading	Ensure material transfers are under containment or extract ventilation, or: Avoid carrying out activities involving exposure for more than 1 hour. Wear chemically resistant gloves (nitrile) in combination with 'basic' employee training.
Equipment cleaning and maintenance	Drain down and flush system prior to equipment break-in or maintenance. Retain drain downs in sealed storage pending disposal or for subsequent recycle. Wear chemically resistant gloves (nitrile) in combination with specific activity training.
Bulk product storage	Store substance within a closed system. Avoid carrying out activities involving exposure for more than 4 hours. Wear chemically resistant gloves (nitrile) in combination with 'basic' employee training.

Section 2.2	**Control of Environmental Exposure**
Substance is complex UVCB.	
Predominantly hydrophobic.	
Amounts Used	
Fraction of EU tonnage used in region:	0.1
Regional use tonnage (tonnes/year):	1.3E+05
Fraction of Regional tonnage used locally:	1.2E-01
Annual site tonnage (tonnes/year):	1.5E+04
Maximum daily site tonnage (kg/day):	5.0E+04
Frequency and Duration of Use	
Continuous release.	
Emission Days (days/year):	300

Environmental factors not influenced by risk management	
Local freshwater dilution factor:	10
Local marine water dilution factor:	100
Other Operational Conditions affecting Environmental Exposure	
Release fraction to air from process (initial release prior to RMM):	1.0E-05
Release fraction to wastewater from process (initial release prior to RMM):	1.0E-05
Release fraction to soil from process (initial release prior to RMM):	1.0E-03
Technical conditions and measures at process level (source) to prevent release	
Common practices vary across sites thus conservative process release estimates used.	
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	
Risk from environmental exposure is driven by freshwater sediment.	
Treat air emission to provide a typical removal efficiency of (%)	80
Treat onsite wastewater (prior to receiving water discharge) to provide the required removal efficiency of >= (%)	54.0
If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of (%)	0
If discharging to domestic sewage treatment plant, no secondary wastewater treatment required.	
Prevent discharge of undissolved substance to or recover from onsite wastewater.	
Organisational measures to prevent/limit release from site	
Do not apply industrial sludge to natural soils. Sludge should be incinerated, contained or reclaimed.	
Conditions and Measures related to municipal sewage treatment plant	
Estimated substance removal from wastewater via domestic sewage treatment (%)	88.8
Total efficiency of removal from wastewater after onsite and offsite (domestic treatment plant) RMMs (%)	88.8
Maximum allowable site tonnage (MSafe) based on release following total wastewater treatment removal (kg/d)	1.9E+05
Assumed domestic sewage treatment plant flow (m3/d)	2000
Conditions and Measures related to external treatment of waste for disposal	
This substance is consumed during use and no waste of substance is generated.	
Conditions and measures related to external recovery of waste	
This substance is consumed during use and no waste of substance is generated.	

SECTION 3	EXPOSURE ESTIMATION
Section 3.1 - Health	
The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated.	
Section 3.2 - Environment	
The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model.	

SECTION 4	GUIDANCE TO CHECK COMPLIANCE WITH THE EXPOSURE SCENARIO
Section 4.1 - Health	
Predicted exposures are not expected to exceed the DN(M)EL when the Risk Management Measures/Operational Conditions outlined in Section 2 are implemented. Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. Available hazard data do not enable the derivation of a DNEL for carcinogenic effects. Risk Management Measures are based on qualitative risk characterisation.	

Section 4.2 -Environment
Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures.
Required removal efficiency for wastewater can be achieved using onsite/offsite technologies, either alone or in combination.
Required removal efficiency for air can be achieved using on-site technologies, either alone or in combination.
Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org/en/reach-for-industries-libraries.html).

Exposure Scenario – Worker

SECTION 1	**EXPOSURE SCENARIO TITLE**
Title	3. Distribution of substance - Industrial
Use Descriptor	**Sector of Use**: SU3 **Process Categories**: PROC1, PROC2, PROC3, PROC 8a, PROC8b, PROC15 **Environmental Release Categories**: ERC1, ERC2, ERC3, ERC4, ER 5, ERC6A, ERC6B, ERC6C, ERC6D, ERC7, ESVOC SpERC 1.1b.v1
Scope of process	Bulk loading (including marine vessel/barge, rail/road car and IBC loading) of substance within closed or contained systems, including incidental exposures during its sampling, storage, unloading, maintenance and associated laboratory activities.

SECTION 2	**OPERATIONAL CONDITIONS AND RISK MANAGEMENT MEASURES**

Section 2.1	**Control of Worker Exposure**
Physical form of product	Liquid, vapour pressure > 0.5 kPa at STP
Concentration of substance in product.	Covers percentage substance in the product up to 100% (unless stated differently)
Frequency and Duration of Use	
Covers daily exposures up to 8 hours (unless stated differently).	
Other Operational Conditions affecting Exposure	
Assumes use at not more than 20°C above ambient temperature (unless stated differently). Assumes a good basic standard of occupational hygiene has been implemented.	

Contributing Scenarios	**Risk Management Measures**
General measures (carcinogens)	Consider technical advances and process upgrades (including automation) for the elimination of releases. Minimise exposure using measures such as closed systems, dedicated facilities and suitable general/local exhaust ventilation. Drain down systems and clear transfer lines prior to breaking containment. Clean/flush equipment, where possible, prior to maintenance. Where there is potential for exposure: restrict access to authorised persons; provide specific activity training to operators to minimise exposures; wear suitable gloves and coveralls to prevent skin contamination; wear respiratory protection when its use is identified for certain contributing scenarios; clear up spills immediately and dispose of wastes safely. Ensure safe systems of work or equivalent arrangements are in place to manage risks. Regularly inspect, test and maintain all control measures. Consider the need for risk based health surveillance.

General exposures (closed systems).	Handle substance within a closed system. Avoid carrying out activities involving exposure for more than 4 hours. Sample via a closed loop or other system to avoid exposure. Wear chemically resistant gloves tested to EN374 (nitrile gloves have the best protection for fuel oil) in combination with 'basic' employee training.
Process sampling. Outdoor	Sample via a closed loop or other system to avoid exposure. Avoid carrying out activities involving exposure for more than 15 minutes. Wear chemically resistant gloves (nitrile) in combination with 'basic' employee training.
Laboratory activities	Handle within a fume cupboard or implement suitable equivalent methods to minimise exposure. Wear suitable gloves tested to EN374 (nitrile).
Bulk closed loading and unloading.	Ensure material transfers are under containment or extract ventilation. Wear chemically resistant gloves (nitrile) in combination with specific activity training.
Marine vessel/barge (un)loading	Transfer via enclosed lines. Clear transfer lines prior to de-coupling. Retain drain downs in sealed storage pending disposal or for subsequent recycle. Avoid carrying out activities involving exposure for more than 4 hours. Wear chemically resistant gloves (nitrile) in combination with 'basic' employee training.
Road tanker/rail car loading	Ensure material transfers are under containment or extract ventilation, or: Avoid carrying out activities involving exposure for more than 1 hour. Wear chemically resistant gloves (nitrile) in combination with 'basic' employee training.
Equipment cleaning and maintenance	Drain down and flush system prior to equipment break-in or maintenance. Wear chemically resistant gloves (nitrile) in combination with specific activity training. Retain drain downs in sealed storage pending disposal or for subsequent recycle.
Bulk product storage	Store substance within a closed system. Avoid carrying out activities involving exposure for more than 4 hours. Wear chemically resistant gloves (nitrile) in combination with 'basic' employee training.
Product sampling	Sample via a closed loop or other system to avoid exposure. Avoid carrying out activities involving exposure for more than 15 minutes. Wear chemically resistant gloves (nitrile) in combination with 'basic' employee training.

Section 2.2	**Control of Environmental Exposure**
Substance is complex UVCB.	
Predominantly hydrophobic.	
Amounts Used	
Fraction of EU tonnage used in region:	0.1
Regional use tonnage (tonnes/year):	1.1E+07
Fraction of Regional tonnage used locally:	2.0E-03
Annual site tonnage (tonnes/year):	2.3E+04
Maximum daily site tonnage (kg/day):	7.7E+04
Frequency and Duration of Use	
Continuous release.	
Emission Days (days/year):	300
Environmental factors not influenced by risk management	
Local freshwater dilution factor:	10
Local marine water dilution factor:	100
Other Operational Conditions affecting Environmental Exposure	
Release fraction to air from process (initial release prior to RMM):	1.0E-04
Release fraction to wastewater from process (initial release prior to RMM):	1.0E-07
Release fraction to soil from process (initial release prior to RMM):	1.0E-05
Technical conditions and measures at process level (source) to prevent release	
Common practices vary across sites thus conservative process release estimates used.	
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	
Risk from environmental exposure is driven by humans via indirect exposure (primarily inhalation).	
No wastewater treatment required.	
Prevent discharge of undissolved substance to or recover from onsite wastewater.	
Treat air emission to provide a typical removal efficiency of (%)	90
Treat onsite wastewater (prior to receiving water discharge) to provide the required removal efficiency of >= (%)	0
If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of (%)	0
Organisational measures to prevent/limit release from site	
Do not apply industrial sludge to natural soils. Sludge should be incinerated, contained or reclaimed.	
Conditions and Measures related to municipal sewage treatment plant	
Estimated substance removal from wastewater via domestic sewage treatment (%)	88.8
Total efficiency of removal from wastewater after onsite and offsite (domestic treatment plant) RMMs (%)	88.8
Maximum allowable site tonnage (MSafe) based on release following total wastewater treatment removal (kg/d)	3.8E+05
Assumed domestic sewage treatment plant flow (m3/d)	2000
Conditions and Measures related to external treatment of waste for disposal	

External treatment and disposal of waste should comply with applicable local and/or regional regulations.
Conditions and measures related to external recovery of waste
External recovery and recycling of waste should comply with applicable local and/or regional regulations.

SECTION 3	**EXPOSURE ESTIMATION**
Section 3.1 - Health	
The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated.	

Section 3.2 - Environment
The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model.

SECTION 4	**GUIDANCE TO CHECK COMPLIANCE WITH THE EXPOSURE SCENARIO**
Section 4.1 - Health	
Predicted exposures are not expected to exceed the DN(M)EL when the Risk Management Measures/Operational Conditions outlined in Section 2 are implemented. Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. Available hazard data do not enable the derivation of a DNEL for carcinogenic effects. Risk Management Measures are based on qualitative risk characterisation.	

Section 4.2 -Environment
Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures.
Required removal efficiency for wastewater can be achieved using onsite/offsite technologies, either alone or in combination.
Required removal efficiency for air can be achieved using on-site technologies, either alone or in combination.
Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org/en/reach-for-industries-libraries.html).

Exposure Scenario – Worker

SECTION 1	**EXPOSURE SCENARIO TITLE**
Title	4. Formulation & (re)packing of substances and mixtures - Industrial
Use Descriptor	**Sector of Use**: SU3, SU10 **Process Categories**: PROC1, PROC2, PROC3, PROC8a, PROC8b, PROC15 **Environmental Release Categories**: ERC2, ESVOC SpERC 2.2.v1
Scope of process	Formulation of the substance and its mixtures in batch or continuous operations within closed or contained systems, including incidental exposures during storage, materials transfers, mixing, maintenance, sampling and associated laboratory activities.

SECTION 2	**OPERATIONAL CONDITIONS AND RISK MANAGEMENT MEASURES**

Section 2.1	**Control of Worker Exposure**
Physical form of product	Liquid, vapour pressure > 0.5 kPa at STP
Concentration of substance in product.	Covers percentage substance in the product up to 100% (unless stated differently).
Frequency and Duration of Use	
Covers daily exposures up to 8 hours (unless stated differently).	
Other Operational Conditions affecting Exposure	
Assumes use at not more than 20°C above ambient temperature (unless stated differently). Assumes a good basic standard of occupational hygiene has been implemented.	

Contributing Scenarios	**Risk Management Measures**
General measures (carcinogens)	Consider technical advances and process upgrades (including automation) for the elimination of releases. Minimise exposure using measures such as closed systems, dedicated facilities and suitable general/local exhaust ventilation. Drain down systems and clear transfer lines prior to breaking containment. Clean/flush equipment, where possible, prior to maintenance. Where there is potential for exposure: restrict access to authorised persons; provide specific activity training to operators to minimise exposures; wear suitable gloves and coveralls to prevent skin contamination; wear respiratory protection when its use is identified for certain contributing scenarios; clear up spills immediately and dispose of wastes safely. Ensure safe systems of work or equivalent arrangements are in place to manage risks. Regularly inspect, test and maintain all control measures. Consider the need for risk based health surveillance.

General exposures (closed systems)	Handle substance within a closed system. Avoid carrying out activities involving exposure for more than 4 hours. Wear chemically resistant gloves tested to EN374 (nitrile gloves have the best protection for fuel oil) in combination with 'basic' employee training.
Process sampling	Handle substance within a closed system. Sample via a closed loop or other system to avoid exposure. Avoid carrying out activities involving exposure for more than 15 minutes. Wear chemically resistant gloves (nitrile) in combination with 'basic' employee training.
Laboratory activities	Handle within a fume cupboard or implement suitable equivalent methods to minimise exposure. Wear suitable gloves tested to EN374 (nitrile).
Marine vessel/barge (un)loading	Transfer via enclosed lines. Clear transfer lines prior to de-coupling. Retain drain downs in sealed storage pending disposal or for subsequent recycle. Avoid carrying out activities involving exposure for more than 4 hours. Wear chemically resistant gloves (nitrile) in combination with 'basic' employee training.
Road tanker/rail car loading	Ensure material transfers are under containment or extract ventilation, or: Avoid carrying out activities involving exposure for more than 1 hour. Wear chemically resistant gloves (nitrile) in combination with 'basic' employee training.
Drum/batch transfers	Ensure material transfers are under containment or extract ventilation. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour), or: Ensure operation is undertaken outdoors. Avoid carrying out activities involving exposure for more than 1 hour. Wear chemically resistant gloves (nitrile) in combination with 'basic' employee training.
Equipment cleaning and maintenance	Drain down and flush system prior to equipment break-in or maintenance. Retain drain downs in sealed storage pending disposal or for subsequent recycle. Wear chemically resistant gloves (nitrile) in combination with specific activity training.
Bulk product storage	Store substance within a closed system. Avoid carrying out activities involving exposure for more than 4 hours. Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training.
Product sampling	Sample via a closed loop or other system to avoid exposure. Avoid carrying out activities involving exposure for more than 15 minutes. Wear chemically resistant gloves (nitrile) in combination with 'basic' employee training.

Section 2.2	**Control of Environmental Exposure**
Substance is complex UVCB.	
Predominantly hydrophobic.	
Amounts Used	
Fraction of EU tonnage used in region:	0.1
Regional use tonnage (tonnes/year):	1.1E+07
Fraction of Regional tonnage used locally:	2.6E-03
Annual site tonnage (tonnes/year):	3.0E+04
Maximum daily site tonnage (kg/day):	1.0E+05
Frequency and Duration of Use	
Continuous release.	
Emission Days (days/year):	300
Environmental factors not influenced by risk management	
Local freshwater dilution factor:	10
Local marine water dilution factor:	100
Other Operational Conditions affecting Environmental Exposure	
Release fraction to air from process (after typical onsite RMMs consistent with EU Solvent Emissions Directive requirements):	2.2E-03
Release fraction to wastewater from process (initial release prior to RMM):	5.0E-06
Release fraction to soil from process (initial release prior to RMM):	1.0E-04
Technical conditions and measures at process level (source) to prevent release	
Common practices vary across sites thus conservative process release estimates used.	
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	
Risk from environmental exposure is driven by humans via indirect exposure (primarily inhalation).	
If discharging to domestic sewage treatment plant, no secondary wastewater treatment required.	
Prevent discharge of undissolved substance to or recover from onsite wastewater.	
Treat air emission to provide a typical removal efficiency of (%)	0
Treat onsite wastewater (prior to receiving water discharge) to provide the required removal efficiency of ≥ (%)	54.0
If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of (%)	0
Organisational measures to prevent/limit release from site	
Do not apply industrial sludge to natural soils. Sludge should be incinerated, contained or reclaimed.	
Conditions and Measures related to municipal sewage treatment plant	
Estimated substance removal from wastewater via domestic sewage treatment (%)	88.8
Total efficiency of removal from wastewater after onsite and offsite (domestic treatment plant) RMMs (%)	88.8
Maximum allowable site tonnage (MSafe) based on release following total wastewater treatment removal (kg/d)	1.1E+05
Assumed domestic sewage treatment plant flow (m3/d)	2000

Conditions and Measures related to external treatment of waste for disposal
External treatment and disposal of waste should comply with applicable local and/or regional regulations.
Conditions and measures related to external recovery of waste
External recovery and recycling of waste should comply with applicable local and/or regional regulations.

SECTION 3	**EXPOSURE ESTIMATION**
Section 3.1 - Health	
The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated.	

Section 3.2 - Environment
The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model.

SECTION 4	**GUIDANCE TO CHECK COMPLIANCE WITH THE EXPOSURE SCENARIO**
Section 4.1 - Health	
Predicted exposures are not expected to exceed the DN(M)EL when the Risk Management Measures/Operational Conditions outlined in Section 2 are implemented. Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. Available hazard data do not enable the derivation of a DNEL for carcinogenic effects. Risk Management Measures are based on qualitative risk characterisation.	

Section 4.2 -Environment
Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures.
Required removal efficiency for wastewater can be achieved using onsite/offsite technologies, either alone or in combination.
Required removal efficiency for air can be achieved using on-site technologies, either alone or in combination.
Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org/en/reach-for-industries-libraries.html).

Exposure Scenario – Worker

SECTION 1	**EXPOSURE SCENARIO TITLE**
Title	5. Use as a fuel - Industrial
Use Descriptor	**Sector of Use**: SU3 **Process Categories**: PROC1, PROC2, PROC3, PROC8a, PROC8b, PROC16 **Environmental Release Categories**: ERC7, ESVOC SpERC 7.12a.v1
Scope of process	Covers the use as a fuel (or fuel additives and additive components) within closed or contained systems, including incidental exposures during activities associated with its transfer, use, equipment maintenance and handling of waste.

SECTION 2	**OPERATIONAL CONDITIONS AND RISK MANAGEMENT MEASURES**

Section 2.1	**Control of Worker Exposure**
Physical form of product	Liquid, vapour pressure > 0.5 kPa at STP
Concentration of substance in product.	Covers percentage substance in the product up to 100% (unless stated differently)
Frequency and Duration of Use	
Covers daily exposures up to 8 hours (unless stated differently).	
Other Operational Conditions affecting Exposure	
Assumes use at not more than 20°C above ambient temperature (unless stated differently). Assumes a good basic standard of occupational hygiene has been implemented.	

Contributing Scenarios	**Risk Management Measures**
General measures (carcinogens)	Consider technical advances and process upgrades (including automation) for the elimination of releases. Minimise exposure using measures such as closed systems, dedicated facilities and suitable general/local exhaust ventilation. Drain down systems and clear transfer lines prior to breaking containment. Clean/flush equipment, where possible, prior to maintenance. Where there is potential for exposure: restrict access to authorised persons; provide specific activity training to operators to minimise exposures; wear suitable gloves and coveralls to prevent skin contamination; wear respiratory protection when its use is identified for certain contributing scenarios; clear up spills immediately and dispose of wastes safely. Ensure safe systems of work or equivalent arrangements are in place to manage risks. Regularly inspect, test and maintain all control measures. Consider the need for risk based health surveillance.

General exposures (closed systems).	Handle substance within a closed system. Sample via a closed loop or other system to avoid exposure. Avoid carrying out activities involving exposure for more than 4 hours. Wear chemically resistant gloves tested to EN374 (nitrile gloves have the best protection for fuel oil) in combination with 'basic' employee training.
Product sampling	Handle substance within a closed system. Sample via a closed loop or other system to avoid exposure. Avoid carrying out activities involving exposure for more than 1 hour. Provide a good standard of controlled ventilation (10 to 15 air changes per hour). Wear chemically resistant gloves (nitrile) in combination with 'basic' employee training.
Bulk closed unloading. Outdoor	Transfer via enclosed lines. Avoid carrying out activities involving exposure for more than 4 hours. Wear chemically resistant gloves (nitrile) in combination with 'basic' employee training.
Drum/batch transfers	Ensure material transfers are under containment or extract ventilation, or: Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). Avoid carrying out activities involving exposure for more than 1 hour. Wear chemically resistant gloves (nitrile) in combination with 'basic' employee training.
Operation of solids filtering equipment	Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). Avoid carrying out activities involving exposure for more than 4 hours. Wear chemically resistant gloves (nitrile) in combination with 'basic' employee training.
Use as a fuel (closed systems)	Wear chemically resistant gloves (nitrile) in combination with 'basic' employee training.
Equipment cleaning and maintenance	Drain down and flush system prior to equipment break-in or maintenance. Retain drain downs in sealed storage pending disposal or for subsequent recycle. Wear chemically resistant gloves (nitrile) in combination with specific activity training.
Bulk product storage	Store substance within a closed system. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). Avoid carrying out activities involving exposure for more than 4 hours. Wear chemically resistant gloves (nitrile) in combination with 'basic' employee training.

Section 2.2	**Control of Environmental Exposure**
Substance is complex UVCB.	
Predominantly hydrophobic.	
Amounts Used	
Fraction of EU tonnage used in region:	0.1
Regional use tonnage (tonnes/year):	1.1E+07
Fraction of Regional tonnage used locally:	1.4E-01
Annual site tonnage (tonnes/year):	1.5E+06
Maximum daily site tonnage (kg/day):	5.0E+06
Frequency and Duration of Use	
Continuous release.	
Emission Days (days/year):	300
Environmental factors not influenced by risk management	
Local freshwater dilution factor:	10
Local marine water dilution factor:	100
Other Operational Conditions affecting Environmental Exposure	
Release fraction to air from process (after typical onsite RMMs consistent with EU Solvent Emissions Directive requirements):	7.0E-04
Release fraction to wastewater from process (initial release prior to RMM):	4.4E-07
Release fraction to soil from process (initial release prior to RMM):	0
Technical conditions and measures at process level (source) to prevent release	
Common practices vary across sites thus conservative process release estimates used.	
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	
Risk from environmental exposure is driven by humans via indirect exposure (primarily inhalation).	
If discharging to domestic sewage treatment plant, no secondary wastewater treatment required.	
Prevent discharge of undissolved substance to or recover from onsite wastewater.	
Treat air emission to provide a typical removal efficiency of (%)	95
Treat onsite wastewater (prior to receiving water discharge) to provide the required removal efficiency of >= (%)	87.7
If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of (%)	0
Organisational measures to prevent/limit release from site	
Do not apply industrial sludge to natural soils. Sludge should be incinerated, contained or reclaimed.	
Conditions and Measures related to municipal sewage treatment plant	
Estimated substance removal from wastewater via domestic sewage treatment (%)	88.8
Total efficiency of removal from wastewater after onsite and offsite (domestic treatment plant) RMMs (%)	88.8
Maximum allowable site tonnage (MSafe) based on release following total wastewater treatment removal (kg/d)	5.2E+06
Assumed domestic sewage treatment plant flow (m3/d)	2000

Conditions and Measures related to external treatment of waste for disposal
Combustion emissions limited by required exhaust emission controls. Waste combustion emissions considered in regional exposure assessment.
Conditions and measures related to external recovery of waste
This substance is consumed during use and no waste of substance is generated.

SECTION 3	**EXPOSURE ESTIMATION**
Section 3.1 - Health	

Section 3.2 - Environment
The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model.

SECTION 4	**GUIDANCE TO CHECK COMPLIANCE WITH THE EXPOSURE SCENARIO**
Section 4.1 - Health	
Predicted exposures are not expected to exceed the DN(M)EL when the Risk Management Measures/Operational Conditions outlined in Section 2 are implemented. Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. Available hazard data do not enable the derivation of a DNEL for carcinogenic effects. Risk Management Measures are based on qualitative risk characterisation.	

Section 4.2 -Environment
Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures.
Required removal efficiency for wastewater can be achieved using onsite/offsite technologies, either alone or in combination.
Required removal efficiency for air can be achieved using on-site technologies, either alone or in combination.
Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org/en/reach-for-industries-libraries.html).

Exposure Scenario – Worker

SECTION 1	**EXPOSURE SCENARIO TITLE**
Title	6. Use as a fuel - Professional
Use Descriptor	**Sector of Use**: SU22 **Process Categories**: PROC1, PROC2, PROC3, PROC8a, PROC8b, PROC16 **Environmental Release Categories**: ERA9A, ERC9B, ESVOC SpERC 9.12b.v1
Scope of process	Covers the use as a fuel (or fuel additives and additive components) within closed or contained systems, including incidental exposures during activities associated with its transfer, use, equipment maintenance and handling of waste.

SECTION 2	**OPERATIONAL CONDITIONS AND RISK MANAGEMENT MEASURES**

Section 2.1	**Control of Worker Exposure**
Physical form of product	Liquid, vapour pressure > 0.5 kPa at STP
Concentration of substance in product.	Covers percentage substance in the product up to 100% (unless stated differently)
Frequency and Duration of Use	
Covers daily exposures up to 8 hours (unless stated differently).	
Other Operational Conditions affecting Exposure	
Assumes use at not more than 20°C above ambient temperature (unless stated differently). Assumes a good basic standard of occupational hygiene has been implemented.	

Contributing Scenarios	**Risk Management Measures**
General measures (carcinogens)	Consider technical advances and process upgrades (including automation) for the elimination of releases. Minimise exposure using measures such as closed systems, dedicated facilities and suitable general/local exhaust ventilation. Drain down systems and clear transfer lines prior to breaking containment. Clean/flush equipment, where possible, prior to maintenance. Where there is potential for exposure: restrict access to authorised persons; provide specific activity training to operators to minimise exposures; wear suitable gloves and coveralls to prevent skin contamination; wear respiratory protection when its use is identified for certain contributing scenarios; clear up spills immediately and dispose of wastes safely. Ensure safe systems of work or equivalent arrangements are in place to manage risks. Regularly inspect, test and maintain all control measures. Consider the need for risk based health surveillance.

General exposures (closed systems)	Handle substance within a closed system. Avoid carrying out activities involving exposure for more than 1 hour. Provide a good standard of controlled ventilation (10 to 15 air changes per hour). Wear chemically resistant gloves tested to EN374 (nitrile gloves have the best protection for fuel oil) in combination with 'basic' employee training.
Product sampling	Handle substance within a closed system. Sample via a closed loop or other system to avoid exposure. Avoid carrying out activities involving exposure for more than 1 hour. Provide a good standard of controlled ventilation (10 to 15 air changes per hour). Wear chemically resistant gloves (nitrile) in combination with specific activity training.
Bulk closed unloading	Provide a good standard of controlled ventilation (10 to 15 air changes per hour). Ensure material transfers are under containment or extract ventilation, or avoid carrying out activities involving exposure for more than 1 hour. Wear chemically resistant gloves (nitrile) in combination with 'basic' employee training.
Drum/batch transfers	Provide a good standard of controlled ventilation (10 to 15 air changes per hour). Ensure material transfers are under containment or extract ventilation, or avoid carrying out activities involving exposure for more than 1 hour. Wear chemically resistant gloves (nitrile) in combination with 'basic' employee training.
Refuelling	Ensure material transfers are under containment or extract ventilation. Avoid carrying out activities involving exposure for more than 1 hour. Wear chemically resistant gloves (nitrile) in combination with 'basic' employee training.
Use as a fuel (closed systems)	Wear chemically resistant gloves (nitrile) in combination with 'basic' employee training.
Equipment cleaning and maintenance	Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). Drain down system prior to equipment break-in or maintenance. Retain drain downs in sealed storage pending disposal or for subsequent recycle. Clear spills immediately. Wear chemically resistant gloves (nitrile) in combination with specific activity training.

Section 2.2	**Control of Environmental Exposure**
Substance is complex UVCB.	
Predominantly hydrophobic.	
Amounts Used	
Fraction of EU tonnage used in region:	0.1
Regional use tonnage (tonnes/year):	3.3E+05
Fraction of Regional tonnage used locally:	5.0E-04
Annual site tonnage (tonnes/year):	1.7E+02
Maximum daily site tonnage (kg/day):	4.6E+02
Frequency and Duration of Use	
Continuous release.	
Emission Days (days/year):	365
Environmental factors not influenced by risk management	
Local freshwater dilution factor:	10
Local marine water dilution factor:	100
Other Operational Conditions affecting Environmental Exposure	
Release fraction to air from wide dispersive use (regional only):	1.0E-04
Release fraction to wastewater from wide dispersive use:	1.0E-05
Release fraction to soil from wide dispersive use (regional only):	1.0E-05
Technical conditions and measures at process level (source) to prevent release	
Common practices vary across sites thus conservative process release estimates used.	
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	
Risk from environmental exposure is driven by humans via indirect exposure (primarily inhalation).	
No wastewater treatment required.	
Prevent discharge of undissolved substance to or recover from onsite wastewater.	
Treat air emission to provide a typical removal efficiency of (%)	
Treat onsite wastewater (prior to receiving water discharge) to provide the required removal efficiency of >= (%)	0
If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of (%)	0
Organisational measures to prevent/limit release from site	
Do not apply industrial sludge to natural soils. Sludge should be incinerated, contained or reclaimed.	
Conditions and Measures related to municipal sewage treatment plant	
Estimated substance removal from wastewater via domestic sewage treatment (%)	88.8
Total efficiency of removal from wastewater after onsite and offsite (domestic treatment plant) RMMs (%)	88.8
Maximum allowable site tonnage (MSafe) based on release following total wastewater treatment removal (kg/d)	2.3E+03
Assumed domestic sewage treatment plant flow (m3/d)	2000
Conditions and Measures related to external treatment of waste for disposal	
Combustion emissions limited by required exhaust emission controls. Waste combustion emissions considered in regional exposure assessment.	

Conditions and measures related to external recovery of waste
This substance is consumed during use and no waste of substance is generated.

SECTION 3	**EXPOSURE ESTIMATION**
Section 3.1 - Health	
The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated.	

Section 3.2 - Environment
The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model.

SECTION 4	**GUIDANCE TO CHECK COMPLIANCE WITH THE EXPOSURE SCENARIO**
Section 4.1 - Health	
Predicted exposures are not expected to exceed the DN(M)EL when the Risk Management Measures/Operational Conditions outlined in Section 2 are implemented. Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. Available hazard data do not enable the derivation of a DNEL for carcinogenic effects. Risk Management Measures are based on qualitative risk characterisation.	

Section 4.2 -Environment
Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures.
Required removal efficiency for wastewater can be achieved using onsite/offsite technologies, either alone or in combination.
Required removal efficiency for air can be achieved using on-site technologies, either alone or in combination.
Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org/en/reach-for-industries-libraries.html).