SECTION 1: IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

1.1 Product identifier

Product Name	Fuel oil, residual
Product Description	V2006-HIGH SULPHUR FUEL OIL-Fuel oil, residual
Trade Name	HIGH SULPHUR FUEL OIL
Product code	HSFO, V2006
CAS No.	68476-33-5
EC No.	270-675-6
REACH Registration No.	-

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

Identified Use(s)

No.	Exposure Scenario	Page:
1	Distribution of Fuel oil, residual	11
2	Formulation and (re)packing of Fuel oil, residual	15
3	Use of Fuel oil, residual as a Fuel (Industrial)	19
4	Use of Fuel oil, residual as a Fuel (Professional)	22

Uses Advised Against: Anything other than the above.

1.3 Details of the supplier of the safety data sheet

Company Identification:
Vitol SA
Place des Bergues 3
P.O. Box 2056
1211 Geneva 1
Switzerland

Telephone	+31 10 498 7200
Fax	+31 10 452 9545
E-Mail (competent person)	xreach@vitol.com

1.4 Emergency telephone number

Emergency Phone No.	+44 (0) 1235 239 670, 24/7
Languages spoken	All official European languages.

SECTION 2: HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

2.1.1 Regulation (EC) No. 1272/2008 (CLP)

Asp. Tox. 1; H304
Acute Tox. 4; H332
Carc. 1B; H350
Repr. 2; H361d
STOT RE 2; H373 (Thymus, Liver, blood effects)
Aquatic Acute 1; H400
Aquatic Chronic 1; H410

2.2 Label elements

According to Regulation (EC) No. 1272/2008 (CLP)

Product Description: V2006-HIGH SULPHUR FUEL OIL-Fuel oil, residual

Hazard Pictogram(s)

Signal Word(s): Danger

Hazard Statement(s)	H304: May be fatal if swallowed and enters airways. 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: Thymus, Liver, blood effects H410: Very toxic to aquatic life with long lasting effects.
Precautionary Statement(s)	P201: Obtain special instructions before use. P260: Do not breathe dust/fume/gas/mist/vapours/spray. P281: Use personal protective equipment as required. P301+P310: IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician. P331: Do NOT induce vomiting. P273: Avoid release to the environment.
Supplemental information	EUH066: Repeated exposure may cause skin dryness or cracking.

2.3 Other hazards

Product may release Hydrogen Sulphide: A specific assessment of inhalation risks from the presence of hydrogen sulphide in tank headspaces, confined spaces, product residue, tank waste and waste water, and unintentional releases should be made to help determine controls appropriate to local circumstances. Remove contaminated clothing and wash clothing before reuse. Vapour may create explosive atmosphere.The vapour is heavier than air; beware of pits and confined spaces.

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

SUBSTANCE	CAS No.	EC No.	REACH Registration No.	%W/W
Fuel oil, residual	68476-33-5	270-675-6	-	100

SECTION 4: FIRST AID MEASURES

4.1 Description of first aid measures

Self-protection of the first aider	The vapour is heavier than air; beware of pits and confined spaces. If it is suspected that fumes are still present, the responder should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Avoid all contact. Do not ingest. If swallowed then seek immediate medical assistance.
H2S Warning:	Hydrogen sulphide (H2S) can accumulate in the headspace of storage tanks and reach potentially hazardous concentrations. If there is any suspicion of inhalation: A self contained breathing apparatus should be worn. Remove to fresh air immediately.
Inhalation	IF INHALED: If breathing is difficult, remove victim to fresh air and keep at rest in a position comfortable for breathing. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband. If symptoms persist, obtain medical attention.
Skin Contact	IF ON SKIN (or hair): Remove contaminated clothing immediately and drench affected skin with plenty of water, then wash with soap and water. If irritation (redness, rash, blistering) develops, get medical attention.
Eye Contact	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists, get medical advice/attention.
Ingestion	IF SWALLOWED: Do not induce vomiting because of risk of aspiration into the lungs. If vomiting occurs spontaneously, keep head below hips to prevent

		aspiration into the lungs. If unconscious, place in recovery position and get medical attention immediately. Do not give anything by mouth to an unconscious person. Get medical attention immediately. Do not wait for symptoms to appear.
4.2	**Most important symptoms and effects, both acute and delayed**	Inhalation: Vapour may be irritant to the respiratory tract. Skin Contact: Repeated and/or prolonged skin contact may cause irritation. Eye Contact: May cause eye irritation. Ingestion: Aspiration hazard. Aspiration into the lungs may cause chemical pneumonitis, which can be fatal.
4.3	**Indication of any immediate medical attention and special treatment needed**	If breathing is laboured, oxygen should be administered by qualified personnel. In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).
	Notes to a physician:	IF INHALED: If unconscious, place in recovery position and get medical attention immediately. Administer oxygen if available and artificial respiration if necessary. IF SWALLOWED: Do not induce vomiting because of risk of aspiration into the lungs. If aspiration is suspected obtain immediate medical attention. If vomiting occurs spontaneously, keep head below hips to prevent aspiration into the lungs.

SECTION 5: FIREFIGHTING MEASURES

5.1	**Extinguishing media**	
	Suitable Extinguishing media	Foam, Carbon dioxide, Water fog or dry powder.
	Unsuitable extinguishing media	Do not use water jet. Direct water jet may spread the fire.
5.2	**Special hazards arising from the substance or mixture**	Not flammable but will support combustion. The vapour is heavier than air; beware of pits and confined spaces. Will float and can be reignited on surface water. Decomposes in a fire giving off toxic fumes: A mixture of solid and liquid particulates and gases including unidentified organic and inorganic compounds. If sulphur compounds are present in appreciable amounts, combustion products may include also H2S and SOx (sulfur oxides) or sulfuric acid
5.3	**Advice for fire-fighters**	Fight fire with normal precautions from a reasonable distance. Fire fighters should wear complete protective clothing including self-contained breathing apparatus. Keep containers cool by spraying with water if exposed to fire. Avoid release to the environment. Dike fire control water for later disposal.

SECTION 6: ACCIDENTAL RELEASE MEASURES

6.1	**Personal precautions, protective equipment and emergency procedures**	Caution - spillages may be slippery. Ensure operatives are trained to minimise exposures. Ensure suitable personal protection during removal of spillages. Eliminate sources of ignition. Shut off leaks if without risk. Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Avoid all contact with substance. Ensure adequate ventilation. Do not breathe vapour. Do not ingest. If swallowed then seek immediate medical assistance. Do not use sparking tools.
	H2S Warning:	Product may release Hydrogen Sulphide. Exposure controls - These controls may include: Segregation of areas, Access only to authorised persons, Permit to work systems, Confined space working procedures, Area H2S alarms, Personal H2S alarms, Personal escape sets, H2S awareness training. Please see section 8 for appropriate personal protection equipment
	Small spillages:	Wear flame-resistant antistatic protective clothing.
	Large spillages:	Evacuate the area and keep personnel upwind. Drench contaminated clothing with water before removing to avoid risk of sparks from static electricity. Avoid all contact. Wear chemical protection suit and breathing apparatus. See Also Section: 8.
6.2	**Environmental precautions**	Avoid release to the environment. Do not allow to enter drains, sewers or watercourses. Spillages or uncontrolled discharges into watercourses must be alerted to the Environment Agency or other appropriate regulatory body. If necessary: Dike area to contain the spill and prevent releases to sewers, drains, or other waterways.
6.3	**Methods and material for containment and cleaning**	Provided it is safe to do so, isolate the source of the leak. The vapour is heavier

	up	than air; beware of pits and confined spaces. Ensure that the equipment is adequately grounded. Allow small spillages to evaporate provided there is adequate ventilation.
	Spillages onto land:	In case of soil contamination, remove contaminated soil and treat in accordance with local regulations. Adsorb spillages onto sand, earth or any suitable adsorbent material. Transfer to a lidded container for disposal or recovery. Dispose of this material and its container as hazardous waste. **Small spillages:** Allow small spillages to evaporate provided there is adequate ventilation. Wear flame-resistant antistatic protective clothing. **Large spillages:** Cover spillage with foam to reduce evaporation. Do not use water jet.
	Spillages on water or at sea:	Collect as much as possible in clean container for reuse or disposal. **Small spillages:** Contain product with floating barriers or other equipment. Collect spilled product by absorbing with specific floating absorbents. **Large spillages:** Open waters should be contained with floating barriers or other mechanical means and recovered, only if this is strictly necessary and if fire/explosion risks can be adequately prevented. Otherwise control the spreading of the spillage, and let the substance evaporate naturally.
6.4	**Reference to other sections**	See Section: 8,13

SECTION 7: HANDLING AND STORAGE

7.1	**Precautions for safe handling**	Obtain special instructions before use. Keep away from sources of ignition - No smoking. Use only outdoors or in a well-ventilated area. Prevent vapour build up by providing adequate ventilation during and after use. Take action to prevent static discharges. Use non-sparking tools. All parts of the plant and equipment should be electrically bonded together and connected to earth. Electrical continuity should be checked at regular intervals. Antistatic clothing and footwear should be used. The vapour is heavier than air; beware of pits and confined spaces. Avoid all contact with substance. Do not ingest. If swallowed then seek immediate medical assistance. Do not breathe vapour. See Section: 8. Keep good industrial hygiene. Wash hands thoroughly after handling. Contaminated clothing should be thoroughly cleaned.
	H2S Warning:	Product may release Hydrogen Sulphide: A specific assessment of inhalation risks from the presence of hydrogen sulphide in tank headspaces, confined spaces, product residue, tank waste and waste water, and unintentional releases should be made to help determine controls appropriate to local circumstances. These controls may include: Segregation of areas, Access only to authorised persons, Permit to work systems, Confined space working procedures, Area H2S alarms, Personal H2S alarms, Personal escape sets, H2S awareness training.
7.2	**Conditions for safe storage, including any incompatibilities**	Light hydrocarbon vapours can build up in the headspace of containers. These can cause flammability / explosion hazards. Bund storage facilities to prevent soil and water pollution in the event of spillage. Keep only in original packaging. Keep containers properly sealed when not in use. Protect from sunlight. Containers of this material may be hazardous when empty since they retain product residue. Empty container may contain product residue which may result in flammable or explosive vapours inside the container.
	Storage temperature	Stable at ambient temperatures.
	Storage measures	Suitable containers: Stainless steel, Mild steel Unsuitable containers: Synthetic materials
	Incompatible materials	Keep away from oxidising agents.
7.3	**Specific end use(s)**	See Section: 1.2 and/or Exposure Scenario.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1	**Control parameters**	
8.1.1	**Occupational Exposure Limits**	No Occupational Exposure Limit assigned. Users are advised to consider national Occupational Exposure Limits or other equivalent values.

8.1.2 Biological limit value

Not established.

8.1.3 PNECs and DNELs

PNEC: Fuel Oil, Residual is a hydrocarbon UVCB. The hydrocarbon block method is used in PETRORISK to calculate the environmental toxicity (HC5) of each group of components in the substance. These are used to estimate the environmental risk for the substance. Therefore individual environmental compartments PNECs are not available for this product.

Fuel Oil, Residual Derived No Effect Level	Oral	Inhalation	Dermal
Worker - Long Term - Systemic effects	0.015 mg/kg bw/day	0.18 mg/m³	0.065 mg/kg bw/day
Worker - Short term - Systemic effects	-	4700 mg/m³	-

8.2 Exposure controls

8.2.1 Appropriate engineering controls

Provide adequate ventilation, including appropriate local extraction if dusts, fumes or vapours are likely to be evolved. Store in a cool/low-temperature, well-ventilated (dry) place away from heat and ignition sources. Guarantee that the eye flushing systems and safety showers are located close to the working place.

8.2.2 Individual protection measures, such as personal protective equipment (PPE)

Protective clothing should be selected specifically for the working place, depending on concentration and quantity of the hazardous substances handled. The resistance of the protective clothing to chemicals should be ascertained with the respective supplier.
Fuels are typically used, transferred and transported in closed systems. If exposure is likely (i.e. during sampling) the following advice may be appropriate. Keep good industrial hygiene. Always wash hands before smoking, eating and drinking. Do not eat, drink or smoke at the work place.

Refer to annexes for exposure scenarios detailing use specific exposure controls

Eye/ face protection

Use eye protection according to EN 166, designed to protect against liquid splashes.

Skin protection

Hand protection: Wear impervious gloves (EN374). Gloves should be changed regularly to avoid permeation problems. Breakthrough time of the glove material: refer to the information provided by the gloves' producer.
Recommended: Nitrile rubber.

Body protection: Wear anti-static clothing and shoes.
small scale: Wear suitable coveralls to prevent exposure to the skin.
large scale: Chemical protection suit.

Respiratory protection

When the product is heated /In case of inadequate ventilation wear respiratory protection. The use of a high efficiency filter (EN143) is recommended. Filter type A2

Closed system(s): Not normally required.

Thermal hazards

Not applicable.

8.2.3 Environmental Exposure Controls

Avoid release to the environment.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

Appearance	Liquid, Viscous, May be coloured.
Odour	Fuel oil-like
Odour threshold	Not established.

pH	Not established.
Melting point/freezing point	< 30 °C
Initial boiling point and boiling range	> 350 °C
Flash point	> 60 °C
Evaporation rate	Not established .
Flammability (solid, gas)	Not applicable - Liquid
Upper/lower flammability or explosive limits	Not established.
Vapour pressure	0.5 kPa @ 20°C
Vapour density	>1 (Air=1)
Relative density	0.80 - 0.99 g/cm³ @ 15 °C
Solubility(ies)	Water: 0.4 mg/l @ 22 °C Slightly soluble.
Partition coefficient: n-octanol/water	2.7 – 6 log P
Auto-ignition temperature	> 225 °C
Decomposition Temperature	Not established.
Viscosity	7 – 20.5 mm²/s @ 40 °C (<60 mm²/s @ 100 °C)
Explosive properties	Not explosive. (Vapour may create explosive atmosphere.)
Oxidising properties	Not oxidising.

9.2 Other information None known.

SECTION 10: STABILITY AND REACTIVITY

10.1	**Stability and reactivity**	Stable under normal conditions. Reacts with - Strong oxidising agents
10.2	**Chemical stability**	Stable under normal conditions. Hazardous polymerisation will not occur. Product may release Hydrogen Sulphide.
10.3	**Possibility of hazardous reactions**	Vapours are heavier than air and may travel considerable distances to a source of ignition and flashback. Product may release Hydrogen Sulphide.
10.4	**Conditions to avoid**	Elevated temperature: > 50 °C Keep away from heat, sources of ignition and direct sunlight.
10.5	**Incompatible materials**	Keep away from oxidising agents. Strong Acids and Alkalis.
10.6	**Hazardous decomposition product(s)**	A mixture of solid and liquid particulates and gases including unidentified organic and inorganic compounds. Decomposes in a fire giving off toxic fumes: COx, H2S, SOx,

SECTION 11: TOXICOLOGICAL INFORMATION

11.1	**Information on toxicological effects**	All test data taken from existing ECHA registrations for the substances mentioned.
	Acute toxicity - Ingestion	Based upon the available data, the classification criteria are not met. LD50 (oral,rat) mg/kg: >2000 (OECD 401)
	Acute toxicity - Inhalation	Acute Tox. 4; Harmful if inhaled. LC50 (inhalation,rat) mg/l/4h: 4.1 (EPA OTS 798.1150)
	Acute toxicity - Skin Contact	Based upon the available data, the classification criteria are not met. LD50 (skin,rabbit) mg/kg: >2000 (OECD 434)
	Skin corrosion/irritation	Based upon the available data, the classification criteria are not met. Not irritating to skin. (rabbit) (OECD 404) EUH066: Repeated exposure may cause skin dryness or cracking. (rat) (OECD 410)
	Serious eye damage/irritation	Based upon the available data, the classification criteria are not met. Not irritating to eyes. (rabbit) (EU Method B.5)
	Respiratory or skin sensitization	Based upon the available data, the classification criteria are not met. Sensitisation (guinea pig) - Negative (OECD 406)
	Germ cell mutagenicity	Based upon the available data, the classification criteria are not met. ECHA Registration Endpoint summary: Not classified. Studies showed no consistent evidence of mutagenic activity.
	Carcinogenicity	Carc. 1B; May cause cancer. ECHA Registration Endpoint summary: Positive (mouse)
	Reproductive toxicity	Repr. 2; H361d: Suspected of damaging the unborn child. ECHA Registration Endpoint summary:

		Reproductive toxicity: Negative Developmental toxicity: Positive
	STOT - single exposure	Based upon the available data, the classification criteria are not met. Weight of evidence approach
	STOT - repeated exposure	STOT RE 2; May cause damage to organs through prolonged or repeated exposure.
	Oral:	No data
	Inhalation:	No data
	Dermal:	NOAEL 1.06 mg/kg bw/day (rat) (OECD 410)
	Aspiration hazard	Asp. Tox. 1; May be fatal if swallowed and enters airways. Viscosity: 7 – 20.5 mm²/s @ 40 °C (<60 mm²/s @ 100 °C)
11.2	**Other information**	None.

SECTION 12: ECOLOGICAL INFORMATION

12.1	**Toxicity**	Aquatic Acute 1; Very toxic to aquatic life. Aquatic Chronic 1; Very toxic to aquatic life with long lasting effects.
	Short Term (acute):	EL50 48hr (Daphnia magna) 0.22 mg/l (OECD 202)
	Long Term (Chronic):	The aquatic toxicity was estimated using the PETROTOX computer model. Estimated: 0.1 mg/l (Fish)
12.2	**Persistence and degradibility**	Substance is complex UVCB. Standard tests for this endpoint are intended for single substances and are not appropriate for this complex substance.
12.3	**Bioaccumulative potential**	Substance is complex UVCB. Standard tests for this endpoint are intended for single substances and are not appropriate for this complex substance.
12.4	**Mobility in soil**	Substance is complex UVCB. Standard tests for this endpoint are intended for single substances and are not appropriate for this complex substance.
12.5	**Results of PBT and vPvB assessment**	Not classified as PBT or vPvB.
12.6	**Other adverse effects**	None known.

SECTION 13: DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Do not empty into drains, dispose of this material and its container at hazardous or special waste collection point. Disposal should be in accordance with local, state or national legislation. Containers of this material may be hazardous when empty since they retain product residue. Containers must not be punctured or destroyed by burning, even when empty. Allocation of a waste code number, according to the European Waste Catalogue, should be carried out in agreement with the regional waste disposal company. Waste code: Fuel Oil (13 07 01)

SECTION 14: TRANSPORT INFORMATION

		ADR/RID	**IMDG/ADN**
14.1	**UN number**	UN 3082	UN 3082
14.2	**Proper Shipping Name**	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, FUEL OIL, RESIDUAL	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, FUEL OIL, RESIDUAL
14.3	**Transport hazard class(es)**	9	9 (N1, CMR, F)
14.4	**Packing group**	III	III
14.5	**Environmental hazards**	MILIEUGEVAARLIJK / ENVIRONMENTALLY HAZARDOUS/ UMWELTGEFÄHREND /DANGEREUX POUR/ L'ENVIRONNEMENT	
14.6	**Special precautions for user**	See Section: 2	
14.7	**Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code**	This product is being carried under the scope of MARPOL Annex 1. Special Precautions: Refer to Chapter 7 'Handling and Storage' for special precautions which a user needs to be aware of, or needs to comply with, in connection with transport.	
14.8	**Additional Information**	ADR HIN: 90 Tunnel Restriction Code: 3 E Limited Quantity: 5L	EmS: F-A, S-F Limited Quantity: 5L

SECTION 15: REGULATORY INFORMATION

15.1	**Safety, health and environmental regulations/legislation specific for the substance or mixture**	
15.1.1	**EU regulations**	Authorisations and/or Restrictions On Use
	Annex XVII (Restrictions)	In accordance with REACH Annex XVII entry 30 (c) this substance is exempt from Entry 28 and 29 of REACH Annex XVII as it is to be sold as a fuel in a closed system.
	Seveso	Upper Tier: 25000 tonnes Lower Tier: 2500 tonnes
15.1.2	**National regulations**	
	Germany	Wassergefährdungsklasse (Germany). WGK number: 3
15.2	**Chemical Safety Assessment**	A REACH chemical safety assessment (CSA) has been carried out. Refer to annexes for exposure scenarios detailing use specific exposure controls.

SECTION 16: OTHER INFORMATION

Sections indicated with the following have been revised
Header and Section 1.3

Updated version and date. Please review SDS with care.

References:
Existing ECHA registration(s) for Fuel Oil, Residual (CAS No. 68476-33-5) and Chemical Safety Report.

This Safety Data Sheet was prepared in accordance with EC Regulation (EC) 1907/2006 (REACH), 1272/2008 (CLP) & 2015/830.

LEGEND

LTEL	Long Term Exposure Limit
STEL	Short Term Exposure Limit
DNEL	Derived No Effect Level
PNEC	Predicted No Effect Concentration
PBT	PBT: Persistent, Bioaccumulative and Toxic
vPvB	very Persistent and very Bioaccumulative
OECD	Organisation for Economic Cooperation and Development

Training advice: Consideration should be given to the work procedures involved and the potential extent of exposure as they may determine whether a higher level of protection is required.

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Annex to the extended Safety Data Sheet (eSDS)
See below -

Fuel oil, residual

CAS No. 68476-33-5
EINECS No. 270-675-6

Summary of Parameters

Physical parameters			
Vapour pressure (Pa)			Value used for exposure assessment = 2.0E+02
Partition coefficient (log K_{OW})			1.99 – 18.02
Aqueous solubility (mg/l)			2.7E-12 – 2.0E+03 Value used for environmental exposure assessment = 7.3E+00
Molecular weight			Not applicable
Biodegradability			Standard tests for this endpoint are intended for single substances and are not appropriate for this complex substance.
Human Health (DNEL)			
Workers	Short term	Inhalation (mg/m³)	4700
		Dermal (mg/kg bw/day)	Not defined
	Long Term	Inhalation (mg/m³)	0.18
		Dermal (mg/kg bw/day)	0.065
Consumer		Inhalation (mg/m³)	Not defined
		Dermal (mg/kg bw/day)	Not defined
		Oral (mg/kg bw/day)	0.015
Environmental Parameters (PNECs)			
Fuel oil, residual is a hydrocarbon UVCB. The hydrocarbon block method is used in PETRORISK to calculate the environmental toxicity (HC5) of each group of components in the substance. These are used to estimate the environmental risk for the substance. Therefore individual environmental compartments PNECs are not available for this product.			

Contents

Contributing Scenarios

Workers

PROC1 Use in closed process, no likelihood of exposure
PROC2 Use in closed, continuous process with occasional controlled exposure
(Storage) Bulk product storage.
(Sampling) Product sampling.
(Fuel filtering) Operation of solids filtering equipment.
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
(Maintenance) Equipment cleaning and maintenance.
PROC8b Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities
(Marine) Marine vessel or barge loading.
(Road/Rail) Road tanker/rail car loading.
(Drum) Drum or batch transfers.
(Bulk) Bulk closed loading and unloading.
(Refuelling) Refuelling.
PROC15 Use as laboratory reagent.
PROC16 Using material as fuel sources, limited exposure to unburned product to be expected

Environment

ERC2 Formulation of preparations
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 substances 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 1 – Distribution of Fuel oil, residual

1.0 Contributing scenarios	
Sector of Use [SU]	SU3 Industrial uses: Uses of substances as such or in preparations at industrial sites
Process Category [PROC]	PROC1 PROC2 PROC2 (Storage) PROC2 (Sampling) PROC3 PROC8a (Maintenance) PROC8b (Marine) PROC8b (Road/Rail) PROC15
Chemical Product Category [PC]	Not applicable
Article Categories [AC]	Not applicable
Environmental Release Categories [ERC]	ERC4 ERC5 ERC6a ERC6b ERC6c ERC6d ERC7
Specific Environmental Release Categories [SPERC]	ESVOC SpERC 1.1b.v1

2.0 Operational conditions and risk management measures		
2.1 Control of worker exposure		
Product characteristics		
Physical form of product	Liquid	
Vapour pressure	<0.5 kPa @ STP	
Concentration of substance in product	Covers percentage substance in the product up to 100 % (unless stated differently).	
Human factors not influenced by risk management		
Potential exposure area	Not defined	
Frequency and duration of use		
Exposure duration per day	PROC1, PROC8a (Maintenance), PROC15	Covers daily exposures up to 8 hours (unless stated differently).
	PROC2 (Storage), PROC3, PROC8b (Marine)	Covers exposure up to 1 - 4 hour(s)
	PROC8b (Road/Rail)	Covers exposure up to 15 min - 1 hour(s)
	PROC2, PROC2 (Sampling)	Covers exposure up to 15 min
Emission days (days/year):	300	
Other operational conditions affecting worker exposure		
Area of use	PROC2 (Sampling)	Outdoor
	All other PROC's	Not defined (default = Indoor)
Characteristics of the surroundings	Not defined	
General measures applicable to all activities Assumes a good basic standard of occupational hygiene is implemented. Assumes activities are at ambient temperature (unless stated differently).		
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 scenario; clear up spills immediately and dispose of waste 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.		
Technical conditions of use		
PROC1, PROC2, PROC2 (Storage),	Handle substance within a closed system.	

PROC3		
PROC8b (Road/Rail)	Ensure material transfers are under containment or extract ventilation (Efficiency of at least 80%)	
PROC15	Handle in a fume cupboard or under extract ventilation. (Efficiency of at least 90 %).	
Organisational measures		
PROC2; PROC3	Sample via a closed loop or other system to avoid exposure.	
PROC8b (Marine)	Transfer via enclosed lines. Clear transfer lines prior to de-coupling.	
PROC8a (Maintenance)	Drain down and flush system prior to equipment break-in or maintenance.	
PROC8a (Maintenance), PROC8b (Marine)	Retain drain downs in sealed storage pending disposal or for subsequent recycle.	
PROC8b (Road/Rail)	Ensure material transfers are under containment or extract ventilation	
Risk management measures related to human health		
Respiratory protection	No special measures are required.	
Hand and/or Skin protection	PROC1, PROC2, PROC2 (Storage), PROC2 (Sampling), PROC3, PROC8b (Marine), PROC8b (Road/Rail)	Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training.(Efficiency of at least 90 %).
	PROC15	Wear suitable gloves tested to EN374. (Efficiency of at least 80 %).
	PROC8a (Maintenance)	Wear chemically resistant gloves (tested to EN374) in combination with specific activity training. (Efficiency of at least 75%)
Eye Protection	No special measures are required.	

2.2 Control of environmental exposure	
Amounts used	
Fraction of EU tonnage used in region:	0.1
Regional use tonnage (tons/year):	9.3E+06
Fraction of Regional tonnage used locally (tons/year):	2.0E-03
Annual site tonnage (tons/year):	1.9E+04
Maximum daily site tonnage (kg/day):	6.2E+04
Environment factors not influenced by risk management	
Flow rate of receiving surface water (m^3/d):	Not defined (default = 18,000)
Local freshwater dilution factor:	10
Local marine water dilution factor:	100
Operational conditions	
Emission days (days/year):	300
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-06
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 ingestion). No 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 (%):	0
If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of (%):	0
Treat soil emission to provide a typical removal efficiency of (%):	Not defined
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	
Size of municipal sewage system/treatment plant (m^3/d):	2.0E+03
Degradation effectiveness (%):	94.2
Conditions and measures related to external treatment of waste for disposal	
External treatment and disposal of waste should comply with applicable local and/or national regulations.	
Conditions and measures related to external recovery of waste	
External recovery and recycling of waste should comply with applicable local and/or national regulations.	
Substance release quantities after risk management measures	

Release to waste water from process (mg/l):	Not defined
Maximum allowable site tonnage (MSafe) based on release following total wastewater treatment removal (kg/d):	8.0E+04

3. Exposure estimation and reference to its source

3.1 Human exposure prediction

Exposure assessment (method/calculation model)	The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated. (PROC1, PROC2, PROC2 (Sampling), PROC15) The Advanced REACH Tool (ART) has been used to estimate workplace exposures unless otherwise indicated. (PROC2 (Storage), PROC3, PROC8a (Maintenance), PROC8b (Marine), PROC8b (Road/Rail)).

	Inhalation		Dermal		Combined
Process Category [PROC]	**Inhalation exposure (mg/m³)**	**Risk characterisation ratio (RCR)**	**Dermal exposure (mg/kg bw/day)**	**Risk characterisation ratio (RCR)**	**Risk characterisation ratio (RCR)**
PROC1	0.01	0.04	0.03	0.57	0.61
PROC2	0.04	0.19	0.03	0.57	0.76
PROC2 (Storage)	0.04	0.21	0.03	0.57	0.78
PROC2 (Sampling)	0.04	0.19	0.03	0.57	0.76
PROC3	0.04	0.21	0.03	0.57	0.78
PROC8a (Maintenance)	0.00	0.01	0.05	0.83	0.85
PROC8b (Marine)	0.06	0.35	0.03	0.57	0.92
PROC8b (Road/Rail)	0.03	0.19	0.03	0.57	0.76
PROC15	0.05	0.28	0.01	0.10	0.38

3.2 Environmental exposure prediction

Exposure assessment (method/calculation model)	The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model.

Fuel oil, residual is a hydrocarbon UVCB. The hydrocarbon block method is used in PETRORISK to calculate the environmental toxicity (HC5) of each group of components in the substance. These are used to estimate the environmental risk for the substance. Therefore individual environmental compartments PNECs are not available for this product.

Environmental exposure	STP	Freshwater	Marine water	Soil	Freshwater sediment	Marine sediment
Predicted Environmental Exposure (PEC)	1.9E-03 mg/l	1.9E-04 mg/l	1.9E-05 mg/l	6.2E-02 mg/kg ww	1.4E+00 mg/kg ww	3.7E-02 mg/kg ww
Risk characterisation ratio (RCR)	2.0E-03	7.6E-03	7.6E-04	3.3E-05	1.3E-02	9.9E-04

Human exposure prediction:

Route of Exposure	Exposure (µg/kg/Day)	Risk characterisation ratio (RCR)
Oral	2.0E+01	7.7E-01
Inhalation	1.6E-01	3.2E-03

4. Evaluation guidance to downstream user

For scaling see	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 support the need for a DNEL to be established for other health effects. Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org/en/reach-for-industries-libraries.html).	
Exposure assessment	Worker	The ECETOC TRA tool has been used to estimate workplace exposures unless

instrument/tool/method		otherwise indicated. (PROC1, PROC2, PROC2 (Sampling), PROC15) The Advanced REACH Tool (ART) has been used to estimate workplace exposures unless otherwise indicated. (PROC2 (Storage), PROC3, PROC8a (Maintenance), PROC8b (Marine), PROC8b (Road/Rail)).
	Environment	The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model.

Exposure Scenario 2 – Formulation and (re)packing of Fuel oil, residual

1.0 Contributing scenarios	
Sector of Use [SU]	SU3 Industrial uses: Uses of substances as such or in preparations at industrial sites SU10 Formulation [mixing] of preparations and/or re-packaging (excluding alloys)
Process Category [PROC]	PROC1 PROC2 PROC2 (Storage) PROC2 (Sampling) PROC3 PROC8a (Maintenance) PROC8b (Marine) PROC8b (Road/Rail) PROC8b (Drum) PROC15
Chemical Product Category [PC]	Not applicable
Article Categories [AC]	Not applicable
Environmental Release Categories [ERC]	ERC2
Specific Environmental Release Categories [SPERC]	ESVOC SpERC 2.2.v1

2.0 Operational conditions and risk management measures		
2.1 Control of worker exposure		
Product characteristics		
Physical form of product	Liquid	
Vapour pressure	<0.5 kPa @ STP	
Concentration of substance in product	Covers percentage substance in the product up to 100 % (unless stated differently).	
Human factors not influenced by risk management		
Potential exposure area	Not defined	
Frequency and duration of use		
Exposure duration per day	PROC1, PROC8a (Maintenance), PROC15	Covers daily exposures up to 8 hours (unless stated differently).
	PROC2 (Storage), PROC3, PROC8b (Marine)	Covers exposure up to 1 - 4 hour(s)
	PROC8b (Road/Rail), PROC8b (Drum)	Covers exposure up to 15 min - 1 hour(s)
	PROC2, PROC2 (Sampling)	Covers exposure up to 15 min
Emission days (days/year):	300	
Other operational conditions affecting worker exposure		
Area of use	All contributing scenarios	Not defined (default = Indoor)
Characteristics of the surroundings	Not defined	
General measures applicable to all activities Assumes a good basic standard of occupational hygiene is implemented. Assumes activities are at ambient temperature (unless stated differently).		
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 scenario; clear up spills immediately and dispose of waste 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.		
Technical conditions of use		
PROC1, PROC2, PROC3	Handle substance within a closed system.	
PROC8b (Drum)	Ensure material transfers are under containment or extract ventilation. (Efficiency of at least 97%).	
PROC15	Handle in a fume cupboard or under extract ventilation. (Efficiency of at least 90 %).	
Organisational measures		
PROC2, PROC2 (Sampling)	Minimise the volume and frequency of sampling. Ensure dedicated sample points are provided.	

PROC8b (Marine)	Transfer via enclosed lines. Clear transfer lines prior to de-coupling.	
PROC8a (Maintenance)	Drain down and flush system prior to equipment break-in or maintenance.	
PROC8a (Maintenance), PROC8b (Marine)	Retain drain downs in sealed storage pending disposal or for subsequent recycle.	
PROC8b (Road/Rail), PROC8b (Drum)	Ensure material transfers are under containment or extract ventilation	
Risk management measures related to human health		
Respiratory protection	No special measures are required.	
Hand and/or Skin protection	PROC1, PROC2, PROC2 (Storage), PROC2 (Sampling), PROC3, PROC8b (Marine), PROC8b (Road/Rail), PROC8b (Drum)	Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training.(Efficiency of at least 90 %).
	PROC8a (Maintenance)	Wear chemically resistant gloves (tested to EN374) in combination with specific activity training. (Efficiency of at least 75%)
	PROC15	Wear suitable gloves tested to EN374. (Efficiency of at least 80 %).
Eye Protection	No special measures are required.	

2.2 Control of environmental exposure

Amounts used	
Fraction of EU tonnage used in region:	0.1
Regional use tonnage (tons/year):	7.5E+06
Fraction of Regional tonnage used locally (tons/year):	4.0E-03
Annual site tonnage (tons/year):	3.0E+04
Maximum daily site tonnage (kg/day):	1.0E+05
Environment factors not influenced by risk management	
Flow rate of receiving surface water (m^3/d):	Not defined (default = 18,000)
Local freshwater dilution factor:	10
Local marine water dilution factor:	100
Operational conditions	
Emission days (days/year):	300
Release fraction to air from process (after typical onsite RMMs consistent with EU Solvent Emissions Directive requirements):	1.0E-03
Release fraction to wastewater from process (initial release prior to RMM):	2.0E-05
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). No wastewater treatment required.	
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 (%):	81.3
If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of (%):	0
Treat soil emission to provide a typical removal efficiency of (%):	Not defined
Common practices vary across sites thus conservative process release estimates used.	
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	
Size of municipal sewage system/treatment plant (m^3/d):	2.0E+03
Degradation effectiveness (%):	94.2
Conditions and measures related to external treatment of waste for disposal	
External treatment and disposal of waste should comply with applicable local and/or national regulations.	
Conditions and measures related to external recovery of waste	
External recovery and recycling of waste should comply with applicable local and/or national regulations.	
Substance release quantities after risk management measures	
Release to waste water from process (mg/l):	Not defined
Maximum allowable site tonnage (MSafe) based on release following total wastewater treatment removal (kg/d):	1.1E+05

3. Exposure estimation and reference to its source

3.1 Human exposure prediction

Exposure assessment (method/calculation model)	The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated. (PROC1, PROC2, PROC2 (Sampling), PROC8b (Drum), PROC15) The Advanced REACH Tool (ART) has been used to estimate workplace exposures unless otherwise indicated. (PROC2 (Storage), PROC3, PROC8a (Maintenance), PROC8b (Marine), PROC8b (Road/Rail)).

	Inhalation		Dermal		Combined
Process Category [PROC]	**Inhalation exposure (mg/m³)**	**Risk characterisation ratio (RCR)**	**Dermal exposure (mg/kg bw/day)**	**Risk characterisation ratio (RCR)**	**Risk characterisation ratio (RCR)**
PROC1	0.01	0.04	0.03	0.57	0.61
PROC2	0.04	0.19	0.03	0.57	0.76
PROC2 (Storage)	0.04	0.21	0.03	0.57	0.78
PROC2 (Sampling)	0.04	0.19	0.03	0.57	0.76
PROC3	0.04	0.21	0.03	0.57	0.78
PROC8a (Maintenance)	0.00	0.01	0.05	0.83	0.85
PROC8b (Marine)	0.06	0.36	0.03	0.57	0.92
PROC8b (Road/Rail)	0.03	0.20	0.03	0.57	0.76
PROC8b (Drum)	0.02	0.12	0.03	0.57	0.68
PROC15	0.05	0.28	0.01	0.10	0.38

3.2 Environmental exposure prediction

Exposure assessment (method/calculation model)	The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model.

Fuel oil, residual is a hydrocarbon UVCB. The hydrocarbon block method is used in PETRORISK to calculate the environmental toxicity (HC5) of each group of components in the substance. These are used to estimate the environmental risk for the substance. Therefore individual environmental compartments PNECs are not available for this product.

Environmental exposure	STP	Freshwater	Marine water	Soil	Freshwater sediment	Marine sediment
Predicted Environmental Exposure (PEC)	6.1E-02 mg/l	6.1E-03 mg/l	6.1E-04 mg/l	6.3E-02 mg/kg ww	1.5E+00 mg/kg ww	5.5E-02 mg/kg ww
Risk characterisation ratio (RCR)	6.4E-02	2.4E-01	2.4E-02	5.3E-04	3.1E-01	3.1E-02

Human exposure prediction:

Route of Exposure	Exposure (µg/kg/Day)	Risk characterisation ratio (RCR)
Oral	2.1E+01	8.1E-01
Inhalation	6.6E+00	1.3E-01

4. Evaluation guidance to downstream user

For scaling see	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 support the need for a DNEL to be established for other health effects. Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org/en/reach-for-industries-libraries.html).	
Exposure assessment	Worker	The ECETOC TRA tool has been used to estimate workplace exposures unless

instrument/tool/method		otherwise indicated. (PROC1, PROC2, PROC2 (Sampling), PROC8b (Drum), PROC15) The Advanced REACH Tool (ART) has been used to estimate workplace exposures unless otherwise indicated. (PROC2 (Storage), PROC3, PROC8a (Maintenance), PROC8b (Marine), PROC8b (Road/Rail)).
	Environment	The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model.

Exposure Scenario 3 – Use of Fuel oil, residual as a Fuel (Industrial)

1.0 Contributing scenarios	
Sector of Use [SU]	SU3 Industrial uses: Uses of substances as such or in preparations at industrial sites
Process Category [PROC]	PROC1 PROC2 PROC2 (Fuel filtering) PROC2 (Storage) PROC3 PROC8a (Maintenance) PROC8b (Bulk) PROC8b (Drum) PROC16
Chemical Product Category [PC]	Not applicable
Article Categories [AC]	Not applicable
Environmental Release Categories [ERC]	ERC7
Specific Environmental Release Categories [SPERC]	ESVOC SpERC 7.12a.v1

2.0 Operational conditions and risk management measures		
2.1 Control of worker exposure		
Product characteristics		
Physical form of product	Liquid	
Vapour pressure	<0.5 kPa @ STP	
Concentration of substance in product	Covers percentage substance in the product up to 100 % (unless stated differently).	
Human factors not influenced by risk management		
Potential exposure area	Not defined	
Frequency and duration of use		
Exposure duration per day	PROC1, PROC8a (Maintenance), PROC8b (Bulk), PROC16	Covers daily exposures up to 8 hours (unless stated differently).
	PROC2 (Fuel filtering), PROC2 (Storage), PROC3	Covers exposure up to 1 - 4 hour(s)
	PROC2, PROC8b (Drum)	Covers exposure up to 15 min - 1 hour(s)
Emission days (days/year):	300	
Other operational conditions affecting worker exposure		
Area of use	PROC8b (Bulk)	Outdoor
	All other PROC's	Not defined (default = Indoor)
Characteristics of the surroundings	Not defined	
General measures applicable to all activities Assumes a good basic standard of occupational hygiene is implemented. Assumes activities are at ambient temperature (unless stated differently).		
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 scenario; clear up spills immediately and dispose of waste 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.		
Technical conditions of use		
PROC1, PROC2, PROC3	Handle substance within a closed system.	
Organisational measures		
PROC2	Provide a good standard of controlled ventilation (10 to 15 air changes per hour).	
PROC8b (Bulk)	Transfer via enclosed lines.	
PROC8b (Drum), PROC2 (Fuel filtering), PROC2 (Storage), PROC16	Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).	

PROC8a (Maintenance)	Retain drain downs in sealed storage pending disposal or for subsequent re	
Risk management measures related to human health		
Respiratory protection	No special measures are required.	
Hand and/or Skin protection	PROC1, PROC2, PROC2 (Fuel filtering), PROC2 (Storage), PROC3, PROC8b (Bulk), PROC8b (Drum), PROC16	Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training (Efficiency of at least 90 %).
	PROC8a (Maintenance)	Wear chemically resistant gloves (tested to EN374) in combination with specific activity training (Efficiency of at least 75 %).
Eye Protection	No special measures are required.	

2.2 Control of environmental exposure	
Amounts used	
Fraction of EU tonnage used in region:	0.1
Regional use tonnage (tons/year):	5.9E+06
Fraction of Regional tonnage used locally (tons/year):	2.6E-01
Annual site tonnage (tons/year):	1.5E+06
Maximum daily site tonnage (kg/day):	5.0E+06
Environment factors not influenced by risk management	
Flow rate of receiving surface water (m^3/d):	Not defined (default = 18,000)
Local freshwater dilution factor:	10
Local marine water dilution factor:	100
Operational conditions	
Emission days (days/year):	300
Release fraction to air from process (initial release prior to RMM):	2.0E-04
Release fraction to wastewater from process (initial release prior to RMM):	1.0E-06
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 ingestion). No wastewater treatment required.	
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 (%):	92.5
If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of (%):	0
Treat soil emission to provide a typical removal efficiency of (%):	Not defined
Common practices vary across sites thus conservative process release estimates used.	
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	
Size of municipal sewage system/treatment plant (m^3/d)	2.0E+03
Degradation effectiveness (%)	94.2
Conditions and measures related to external treatment of waste for disposal	
Combustion emissions limited by required exhaust emission controls. Combustion emissions considered in regional exposure assessment. External treatment and disposal of waste should comply with applicable local and/or national regulations.	
Substance release quantities after risk management measures	
Release to waste water from process (mg/l)	Not defined
Maximum allowable site tonnage (MSafe) based on release following total wastewater treatment removal (kg/d):	5.4E+06

3. Exposure estimation and reference to its source

3.1 Human exposure prediction

Exposure assessment (method/calculation model)	The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated. (PROC1, PROC2, PROC16) The Advanced REACH Tool (ART) has been used to estimate workplace

	exposures unless otherwise indicated. (PROC2 (Storage), PROC2 (Fuel filtering), PROC3, PROC8a (Maintenance), PROC8b (Bulk), PROC8b (Drum))

	Inhalation		Dermal		Combined
Process Category [PROC]	**Inhalation exposure (mg/m³)**	**Risk characterisation ratio (RCR)**	**Dermal exposure (mg/kg bw/day)**	**Risk characterisation ratio (RCR)**	**Risk characterisation ratio (RCR)**
PROC1	0.01	0.04	0.03	0.57	0.61
PROC2	0.03	0.17	0.03	0.57	0.73
PROC2 (Fuel filtering)	0.04	0.21	0.03	0.57	0.78
PROC2 (Storage)	0.04	0.21	0.03	0.57	0.78
PROC3	0.04	0.21	0.03	0.57	0.78
PROC8a (Maintenance)	0.00	0.01	0.05	0.83	0.85
PROC8b (Bulk)	0.06	0.36	0.03	0.57	0.92
PROC8b (Drum)	0.03	0.19	0.03	0.57	0.76
PROC16	0.01	0.06	0.03	0.57	0.62

3.2 Environmental exposure prediction

Exposure assessment (method/calculation model)	The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model.

Fuel oil, residual is a hydrocarbon UVCB. The hydrocarbon block method is used in PETRORISK to calculate the environmental toxicity (HC5) of each group of components in the substance. These are used to estimate the environmental risk for the substance. Therefore individual environmental compartments PNECs are not available for this product.

Environmental exposure	STP	Freshwater	Marine water	Soil	Freshwater sediment	Marine sediment
Predicted Environmental Exposure (PEC)	1.5E-01 mg/l	1.5E-02 mg/l	1.5E-03 mg/l	6.3E-02 mg/kg ww	1.8E+00 mg/kg ww	4.6E-02 mg/kg ww
Risk characterisation ratio (RCR)	1.6E-01	6.1E-01	6.1E-02	3.0E-04	7.7E-01	7.7E-02

Human exposure prediction:

Route of Exposure	Exposure (µg/kg/Day)	Risk characterisation ratio (RCR)
Oral	2.2E+01	8.7E-01
Inhalation	3.4E+00	6.6E-02

4. Evaluation guidance to downstream user

For scaling see	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 support the need for a DNEL to be established for other health effects. Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org/en/reach-for-industries-libraries.html).	
Exposure assessment instrument/tool/method	Worker	The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated. (PROC1, PROC2, PROC16) The Advanced REACH Tool (ART) has been used to estimate workplace exposures unless otherwise indicated. (PROC2 (Storage), PROC2 (Fuel filtering), PROC3, PROC8a (Maintenance), PROC8b (Bulk), PROC8b (Drum))
	Environment	The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model.

Exposure Scenario 4 – Use of Fuel oil, residual as a Fuel (Professional)

1.0 Contributing scenarios	
Sector of Use [SU]	SU22 Professional uses: Public domain (administration, education, entertainment, services, craftsmen)
Process Category [PROC]	PROC1 PROC2 PROC2 (Storage) PROC3 PROC8a (Maintenance) PROC8b (Bulk) PROC8b (Drum/batch transfers) PROC8b (Refuelling) PROC16
Chemical Product Category [PC]	Not applicable
Article Categories [AC]	Not applicable
Environmental Release Categories [ERC]	ERC9a ERC9b
Specific Environmental Release Categories [SPERC]	ESVOC SpERC 9.12b.v1

2.0 Operational conditions and risk management measures		
2.1 Control of worker exposure		
Product characteristics		
Physical form of product	Liquid	
Vapour pressure	<0.5 kPa @ STP	
Concentration of substance in product	Covers percentage substance in the product up to 100 % (unless stated differently).	
Human factors not influenced by risk management		
Potential exposure area	Not defined	
Frequency and duration of use		
Exposure duration per day	PROC1, PROC8a (Maintenance), PROC16	Covers daily exposures up to 8 hours (unless stated differently).
	PROC2 (Storage)	Covers exposure up to 1 - 4 hour(s)
	PROC2, PROC8b (Bulk), PROC8b (Drum), PROC8b (Refuelling)	Covers exposure up to 15 min - 1 hour(s)
	PROC3	Covers exposure up to 15 min
Exposure duration (days/year)	365	
Other operational conditions affecting worker exposure		
Area of use	All PROC's	Not defined (default = Indoor)
Characteristics of the surroundings	Not defined	
General measures applicable to all activities Assumes a good basic standard of occupational hygiene is implemented. Assumes activities are at ambient temperature (unless stated differently).		
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 scenario; clear up spills immediately and dispose of waste 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.		
Technical conditions of use		
PROC1, PROC2, PROC3	Handle substance within a closed system.	
Organisational measures		
PROC2, PROC3, PROC8b (Bulk), PROC8b (Drum)	Provide a good standard of controlled ventilation (10 to 15 air changes per hour).	
PROC2 (Storage), PROC8a (Maintenance), PROC16	Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).	

PROC8b (Bulk), PROC8b (Drum)	Ensure material transfers are under containment or extract ventilation. Clear transfer lines prior to de-coupling.	
PROC8b (Bulk), PROC8b (Drum), PROC8a (Maintenance)	Retain drain downs in sealed storage pending disposal or for subsequent recycle.	
Risk management measures related to human health		
Respiratory protection	No special measures are required.	
Hand and/or Skin protection	PROC1, PROC2 (Storage), PROC3, PROC8b (Bulk), PROC8b (Drum), PROC8b (Refuelling),	Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training (Efficiency of at least 90 %).
	PROC2, PROC8a (Maintenance)	Wear chemically resistant gloves (tested to EN374) in combination with specific activity training (Efficiency of at least 95 %).
Eye Protection	No special measures are required.	

2.2 Control of environmental exposure	
Amounts used	
Fraction of EU tonnage used in region:	0.1
Regional use tonnage (tons/year):	1.7E+06
Fraction of Regional tonnage used locally (tons/year):	5.0E-04
Annual site tonnage (tons/year):	8.5E+02
Maximum daily site tonnage (kg/day):	2.3E+03
Environment factors not influenced by risk management	
Flow rate of receiving surface water (m^3/d):	Not defined (default = 18,000)
Local freshwater dilution factor:	10
Local marine water dilution factor:	100
Operational conditions	
Emission days (days/year):	365
Release fraction to air from wide dispersive use (regional only):	1.0E-05
Release fraction to wastewater from wide dispersive use:	1.0E-07
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 ingestion). No wastewater treatment required.	
Treat air emission to provide a typical removal efficiency of (%):	Not applicable
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
Treat soil emission to provide a typical removal efficiency of (%):	Not defined
Common practices vary across sites thus conservative process release estimates used.	
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	
Size of municipal sewage system/treatment plant (m^3/d):	2.0E+03
Degradation effectiveness (%):	94.2
Conditions and measures related to external treatment of waste for disposal	
Combustion emissions limited by required exhaust emission controls. Combustion emissions considered in regional exposure assessment. External treatment and disposal of waste should comply with applicable local and/or national regulations.	
Conditions and measures related to external treatment of waste for disposal	
This substance is consumed during use and no waste of the substance is generated.	
Substance release quantities after risk management measures	
Release to waste water from process (mg/l):	Not defined
Maximum allowable site tonnage (MSafe) based on release following total wastewater treatment removal (kg/d):	3.0E+03

3. Exposure estimation and reference to its source

3.1 Human exposure prediction	
Exposure assessment (method/calculation model)	The ECETOC TRA tool has been used to estimate workplace exposures unless

	otherwise indicated. (PROC1, PROC2, PROC3, PROC16). The Advanced REACH Tool (ART) has been used to estimate workplace exposures unless otherwise indicated. (PROC2 (Storage), PROC8a (Maintenance), PROC8b (Bulk), PROC8b (Drum) and PROC8b (Refuelling))

	Inhalation		Dermal		Combined
Process Category [PROC]	**Inhalation exposure (mg/m³)**	**Risk characterisation ratio (RCR)**	**Dermal exposure (mg/kg bw/day)**	**Risk characterisation ratio (RCR)**	**Risk characterisation ratio (RCR)**
PROC1	0.01	0.06	0.03	0.57	0.62
PROC2	0.06	0.33	0.02	0.28	0.62
PROC2 (Storage)	0.04	0.21	0.03	0.57	0.78
PROC3	0.03	0.17	0.03	0.57	0.73
PROC8a (Maintenance)	0.01	0.05	0.05	0.83	0.88
PROC8b (Bulk)	0.03	0.19	0.03	0.57	0.76
PROC8b (Drum)	0.03	0.19	0.03	0.57	0.76
PROC8b (Refuelling)	0.03	0.19	0.03	0.57	0.76
PROC16	0.01	0.06	0.03	0.57	0.62

3.2 Environmental exposure prediction

Exposure assessment (method/calculation model)	The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model.

Fuel oil, residual is a hydrocarbon UVCB. The hydrocarbon block method is used in PETRORISK to calculate the environmental toxicity (HC5) of each group of components in the substance. These are used to estimate the environmental risk for the substance. Therefore individual environmental compartments PNECs are not available for this product.

Environmental exposure	STP	Freshwater	Marine water	Soil	Freshwater sediment	Marine sediment
Predicted Environmental Exposure (PEC)	7.2E-06 mg/l	1.1E-04 mg/l	7.3E-07 mg/l	6.2E-02 mg/kg ww	1.4E+00 mg/kg ww	3.6E-02 mg/kg ww
Risk characterisation ratio (RCR)	7.5E-06	4.7E-03	6.2E-05	5.7E-05	3.5E-03	4.1E-05

Human exposure prediction:

Route of Exposure	Exposure (µg/kg/Day)	Risk characterisation ratio (RCR)
Oral	2.0E+01	7.7E-01
Inhalation	1.2E-01	2.3E-03

4. Evaluation guidance to downstream user

For scaling see	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 support the need for a DNEL to be established for other health effects. Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org/en/reach-for-industries-libraries.html).	
Exposure assessment instrument/tool/method	Worker	The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated. (PROC1, PROC2, PROC3, PROC16). The Advanced REACH Tool (ART) has been used to estimate workplace exposures unless otherwise indicated. (PROC2 (Storage), PROC8a (Maintenance), PROC8b (Bulk), PROC8b (Drum) and PROC8b (Refuelling))
	Environment	The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model.