

CHEMICAL SAFETY REPORT

Part B

Heavy Fuel Oil Components

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9. EXPOSURE ASSESSMENT

Table 9.1. Identified Use Description and Exposure Scenario Number Key

IU	Category	Identified Use Name	Sector	ES Number	Sector of Use (SU)	Product Category (PC)	Process Category (PROC)	Article Category (AC)	Environmental Release Category (ERC)	Specific Environmental Release Category (SpERC)
1	Heavy Fuel Oil Components	01 – Manufacture of Substance	Industrial	ES 9.1.1	3, 8, 9	NA	1, 2, 3, 8a, 8b, 15	NA	1, 4	ESVOC SpERC 1.1.v1
2	Heavy Fuel Oil Components	01b – Use of Substance as Intermediate	Industrial	ES 9.2.1	3, 8, 9	NA	1, 2, 3, 8a, 8b, 15	NA	6a	ESVOC SpERC 6.1a.v1
3	Heavy Fuel Oil Components	01a – Distribution of Substance	Industrial	ES 9.3.1	3	NA	1, 2, 3, 8a, 8b, 15	NA	1, 2, 3, 4, 5, 6a, 6b, 6c, 6d, 7	ESVOC SpERC 1.1b.v1
4	Heavy Fuel Oil Components	02 – Formulation & (Re)packing of Substances and Mixtures	Industrial	ES 9.4.1	3, 10	NA	1, 2, 3, 8a, 8b, 15	NA	2	ESVOC SpERC 2.2.v1
5	Heavy Fuel Oil Components	03a – Uses in Coatings: Industrial	Industrial	ES 9.5.1	3	NA	1, 2, 3, 8a, 8b, 15	NA	4	ESVOC SpERC 4.3a.v1
6	Heavy Fuel Oil Components	03b – Uses in Coatings: Professional	Professional	ES 9.6.1	22	NA	1, 2, 3, 8a, 8b, 15	NA	8a, 8d	ESVOC SpERC 8.3b.v1
7	Heavy Fuel Oil Components	12a – Use as a Fuel: Industrial	Industrial	ES 9.7.1	3	NA	1, 2, 3, 8a, 8b, 16	NA	7	ESVOC SpERC 7.12a.v1
8	Heavy Fuel Oil Components	12b – Use as a Fuel: Professional	Professional	ES 9.8.1	22	NA	1, 2, 3, 8a, 8b, 16	NA	9a, 9b	ESVOC SpERC 9.12b.v1

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9	Heavy Fuel Oil Components	15 – Use in Road and Construction Applications: Professional	Professional	ES 9.9.1	22	NA	8a, 8b	NA	8d, 8f	ESVOC SpERC 8.15.v1
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The process of mapping uses and characterising risks has often identified a series of supporting measures that may further contribute to the management of exposure. The measures are identified in *blue* text in the Appendices contained in section 10. These measures are not contained within the Exposure Scenarios (ES) as they do not need to be implemented in order to achieve satisfactory exposure control. However, they are identified within the CSA in order that stakeholders are able to benefit from access to other exposure control information that has been obtained during the process of CSA/ES development.

9.1. Manufacture of Heavy Fuel Oil – Industrial

9.1.1. Exposure Scenario

Section 1 Exposure Scenario Title Heavy Fuel Oil	
Title	
Manufacture of Substance	
Use Descriptor	
Sector(s) of Use	3, 8, 9
Process Categories	1, 2, 3, 8a, 8b, 15 <i>Further information on the mapping and allocation of PROC codes is contained in Table 9.1</i>
Environmental Release Categories	1, 4
Specific Environmental Release Category	ESVOC SpERC 1.1.v1
Processes, tasks, activities covered	
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).	
Assessment Method	
See Section 3.	
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. OC3 .
Concentration of substance in product	Covers percentage substance in the product up to 100 % (unless stated differently) G13
Amount used	Not applicable
Frequency and duration of use/exposure	Covers daily exposures up to 8 hours (unless stated differently) G2
Human factors not influenced by risk management	Not applicable
Other Operational Conditions affecting exposure	Operation is carried out at elevated temperature (> 20°C above ambient temperature). OC7 . Assumes a good basic standard of occupational hygiene is implemented G1 .
Contributing Scenarios	Specific Risk Management Measures and Operating Conditions
General measures (carcinogens) G18	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. G20
CS15 General exposures (closed systems).	Handle substance within a closed system E47 . Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training

	PPE16.
CS2 Process sampling. +OC9 Outdoor	Sample via a closed loop or other system to avoid exposure E8. Avoid carrying out activities involving exposure for more than 15 minutes OC26. Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16.
CS85 Bulk product storage.	Store substance within a closed system E84. Avoid carrying out activities involving exposure for more than 4 hours OC28. Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16.
CS36 Laboratory activities	Handle within a fume cupboard or implement suitable equivalent methods to minimise exposure E12. Wear suitable gloves tested to EN374 PPE15.
CS510 Marine vessel/barge (un)loading	Avoid carrying out activities involving exposure for more than 4 hours OC28. Transfer via enclosed lines E52. Clear transfer lines prior to de-coupling E39. Retain drain downs in sealed storage pending disposal or for subsequent recycle ENVT4. Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16.
CS511 Road tanker/Railcar loading	Ensure material transfers are under containment or extract ventilation E66. Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16.
CS39 Equipment cleaning and maintenance	Drain down and flush system prior to equipment break-in or maintenance E55. Wear chemically resistant gloves (tested to EN374) in combination with specific activity training PPE17. Retain drain downs in sealed storage pending disposal or for subsequent recycle ENVT4.
Additional information on the basis for the allocation of the identified OCs and RMMs is contained in Appendices 2 to 3	
Section 2.2 Control of environmental exposure	
Product characteristics	
Substance is complex UVCB [PrC3]. Predominantly hydrophobic [PrC4a].	
Amounts used	
Fraction of EU tonnage used in region	0.1
Regional use tonnage (tonnes/year)	1.1e7
Fraction of Regional tonnage used locally	5.2e-2
Annual site tonnage (tonnes/year)	6.0e5
Maximum daily site tonnage (kg/day)	2.0e6
Frequency and duration of use	
Continuous release [FD2].	
Emission days (days/year)	300
Environmental factors not influenced by risk management	
Local freshwater dilution factor	10
Local marine water dilution factor	100
Other given operational conditions affecting environmental exposure	
Release fraction to air from process (initial release prior to RMM)	1.0e-4
Release fraction to wastewater from process (initial release prior to RMM)	3.0e-6
Release fraction to soil from process (initial release prior to RMM)	0.0001
Technical conditions and measures at process level (source) to prevent release	
Common practices vary across sites thus conservative process release estimates used [TCS1].	
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 [TCR1]. Onsite wastewater treatment required [TCR13]. Prevent discharge of undissolved substance to or recover from onsite wastewater [TRC14].	
Treat air emission to provide a typical removal efficiency of (%)	90
Treat onsite wastewater (prior to receiving water discharge) to provide	85.9

the required removal efficiency \geq (%)	
If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of \geq (%)	0.0
Organisation measures to prevent/limit release from site	
Do not apply industrial sludge to natural soils [OMS2]. Sludge should be incinerated, contained or reclaimed [OMS3].	
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 (M_{Safe}) based on release following total wastewater treatment removal (kg/d)	2.3e6
Assumed domestic sewage treatment plant flow (m^3/d)	10000
Conditions and measures related to external treatment of waste for disposal	
During manufacturing no waste of the substance is generated to treat [ETW4].	
Conditions and measures related to external recovery of waste	
During manufacturing no waste of the substance is generated to recover [ERW2].	
Additional information on the basis for the allocation of the identified OCs and RMMs is contained in PETRORISK file in IUCLID Section 13.	
Section 3 Exposure Estimation	
3.1. Health	
The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated. G21.	
3.2. Environment	
The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model [EE2].	
Section 4 Guidance to check compliance with the Exposure Scenario	
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. G22.	
Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. G23.	
Available hazard data do not enable the derivation of a DNEL for carcinogenic effects. G33. Available hazard data do not support the need for a DNEL to be established for other health effects. G36. Risk Management Measures are based on qualitative risk characterisation. G37.	
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 [DSU1]. Required removal efficiency for wastewater can be achieved using onsite/offsite technologies, either alone or in combination [DSU2]. Required removal efficiency for air can be achieved using onsite technologies, either alone or in combination [DSU3]. Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org/en/reach-for-industries-libraries.html) [DSU4]. Scaled assessments for EU refineries have been performed using site-specific data and are attached in PETRORISK file in IUCLID Section 13 – “Site-Specific Production” worksheet [DSU6]. For refinery sites where scaling revealed a condition of unsafe use (i.e., RCRs > 1), a site-specific chemical safety assessment was required [DSU8]. Consequently a Tier 2 assessment was performed in an attempt to refine conservative exposure assumptions and improve risk estimates. The Tier 2 analysis demonstrates that no refineries have RCRs>1 (see Appendix 4 and PETRORISK file in IUCLID section 13 – “Tier 2 Site Specific Production worksheet”).	

9.1.2. Exposure Estimation

9.1.2.1. Human Health

See Appendix 2.a and 2.b.

9.1.2.2. Environment

See *PETRORISK* file in *IUCLID* Section 13 – “LocalCSR” worksheet

9.2. Use of Heavy Fuel Oil as Intermediate – Industrial

9.2.1. Exposure Scenario

Section 1 Exposure Scenario Title Heavy Fuel Oil	
Title	
Use as Substance as Intermediate	
Use Descriptor	
Sector(s) of Use	3, 8, 9
Process Categories	1, 2, 3, 8a, 8b, 15 Further information on the mapping and allocation of PROC codes is contained in Table 9.1
Environmental Release Categories	6a
Specific Environmental Release Category	ESVOC SpERC 6.1a.v1
Processes, tasks, activities covered	
Use of substance as an intermediate 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).	
Assessment Method	
See Section 3.	
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. OC3 .
Concentration of substance in product	Covers percentage substance in the product up to 100 % (unless stated differently) G13
Amount used	Not applicable
Frequency and duration of use/exposure	Covers daily exposures up to 8 hours (unless stated differently) G2
Human factors not influenced by risk management	Not applicable
Other Operational Conditions affecting exposure	Operation is carried out at elevated temperature (> 20°C above ambient temperature). OC7 . Assumes a good basic standard of occupational hygiene is implemented G1 .
Contributing Scenarios	Specific Risk Management Measures and Operating Conditions
General measures (carcinogens) G18	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. G20
CS15 General exposures (closed systems).	Handle substance within a closed system E47 . Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16 .

CS15 General exposures (closed systems). + CS2 Process sampling. +OC9 Outdoor	Handle substance within a closed system E47. Sample via a closed loop or other system to avoid exposure E8. Avoid carrying out activities involving exposure for more than 15 minutes OC26. Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16.
CS85 Bulk product storage.	Store substance within a closed system E84. Avoid carrying out activities involving exposure for more than 4 hours OC28. Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16.
CS36 Laboratory activities	Handle within a fume cupboard or implement suitable equivalent methods to minimise exposure E12. Wear suitable gloves tested to EN374 PPE15.
CS510 Marine vessel/barge (un)loading	Avoid carrying out activities involving exposure for more than 4 hours OC28. Transfer via enclosed lines E52. Clear transfer lines prior to de-coupling E39. Retain drain downs in sealed storage pending disposal or for subsequent recycle ENVT4. Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16.
CS511 Road tanker/Railcar loading	Avoid carrying out activities involving exposure for more than 1 hour OC27, or: G9 Ensure material transfers are under containment or extract ventilation E66. Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16.
CS39 Equipment cleaning and maintenance	Drain down and flush system prior to equipment break-in or maintenance E55. Wear chemically resistant gloves (tested to EN374) in combination with specific activity training PPE17. Retain drain downs in sealed storage pending disposal or for subsequent recycle ENVT4.
Additional information on the basis for the allocation of the identified OCs and RMMs is contained in Appendices 2 to 3	
Section 2.2 Control of environmental exposure	
Product characteristics	
Substance is complex UVCB [PrC3]. Predominantly hydrophobic [PrC4a].	
Amounts used	
Fraction of EU tonnage used in region	0.1
Regional use tonnage (tonnes/year)	1.3e5
Fraction of Regional tonnage used locally	1.2e-1
Annual site tonnage (tonnes/year)	1.5e4
Maximum daily site tonnage (kg/day)	5.0e4
Frequency and duration of use	
Continuous release [FD2].	
Emission days (days/year)	300
Environmental factors not influenced by risk management	
Local freshwater dilution factor	10
Local marine water dilution factor	100
Other given operational conditions affecting environmental exposure	
Release fraction to air from process (initial release prior to RMM)	1.0e-5
Release fraction to wastewater from process (initial release prior to RMM)	1.0e-5
Release fraction to soil from process (initial release prior to RMM)	0.001
Technical conditions and measures at process level (source) to prevent release	
Common practices vary across sites thus conservative process release estimates used [TCS1].	
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 [TCR1b]. If discharging to domestic sewage treatment plant, no onsite wastewater treatment required [TCR9]. Prevent discharge of undissolved substance to or recover from onsite wastewater [TRC14].	
Treat air emission to provide a typical removal efficiency of (%)	80
Treat onsite wastewater (prior to receiving water discharge) to provide	54.0

the required removal efficiency \geq (%)	
If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of \geq (%)	0
Organisation measures to prevent/limit release from site	
Do not apply industrial sludge to natural soils [OMS2]. Sludge should be incinerated, contained or reclaimed [OMS3].	
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 (M_{Safe}) based on release following total wastewater treatment removal (kg/d)	1.9e5
Assumed domestic sewage treatment plant flow (m^3/d)	2000
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 to treat [ETW5].	
Conditions and measures related to external recovery of waste	
This substance is consumed during use and no waste of the substance is generated to recover [ERW3].	
Additional information on the basis for the allocation of the identified OCs and RMMs is contained in PETRORISK file in IUCLID Section 13	
Section 3 Exposure Estimation	
3.1. Health	
The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated. G21.	
3.2. Environment	
The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model [EE2].	
Section 4 Guidance to check compliance with the Exposure Scenario	
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. G22.	
Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. G23.	
Available hazard data do not enable the derivation of a DNEL for carcinogenic effects. G33. Available hazard data do not support the need for a DNEL to be established for other health effects. G36. Risk Management Measures are based on qualitative risk characterisation. G37.	
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 [DSU1]. Required removal efficiency for wastewater can be achieved using onsite/offsite technologies, either alone or in combination [DSU2]. Required removal efficiency for air can be achieved using onsite technologies, either alone or in combination [DSU3]. Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org/en/reach-for-industries-libraries.html)	

9.2.2. Exposure Estimation

9.2.2.1. Human Health

See Appendix 2.a and 2.b.

9.2.2.2. Environment

See *PETRORISK file in IUCLID Section 13* – “LocalCSR” worksheet

9.3. Distribution of Heavy Fuel Oil – Industrial

9.3.1. Exposure Scenario

Section 1 Exposure Scenario Title Heavy Fuel Oil	
Title	
Distribution of Substance	
Use Descriptor	
Sector(s) of Use	3
Process Categories	1, 2, 3, 8a, 8b, 15 <i>Further information on the mapping and allocation of PROC codes is contained in Table 9.1</i>
Environmental Release Categories	1, 2, 3, 4, 5, 6a, 6b, 6c, 6d, 7
Specific Environmental Release Category	ESVOC SpERC 1.1b.v1
Processes, tasks, activities covered	
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.	
Assessment Method	
See Section 3.	
Section 2 Operational conditions and risk management measures	
Section 2.1 Control of worker exposure	
Product characteristics	
Physical form of product	Liquid
Vapour pressure (kPa)	Liquid, vapour pressure <0.5 kPa at STP. OC3 .
Concentration of substance in product	Covers percentage substance in the product up to 100 % (unless stated differently) G13
Frequency and duration of use/exposure	Covers daily exposures up to 8 hours (unless stated differently) G2
Other Operational Conditions affecting exposure	Assumes use at not more than 20°C above ambient temperatures, unless stated differently. G15 . Assumes a good basic standard of occupational hygiene is implemented G1
Contributing Scenarios	Specific Risk Management Measures and Operating Conditions
General measures (carcinogens) G18	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. G20
CS2 Process sampling. + OC9 Outdoor	Sample via a closed loop or other system to avoid exposure E8 . Avoid carrying out activities involving exposure for more than 15 minutes OC26 . Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16 .
CS15 General exposures (closed systems).	Handle substance within a closed system E47 . Avoid carrying out activities involving exposure for more than 4 hours OC28 . Sample via a

	closed loop or other system to avoid exposure E8 . Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16 .
CS85 Bulk product storage.	Store substance within a closed system E84 . Avoid carrying out activities involving exposure for more than 4 hours OC28 . Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16 .
CS137 Product sampling	Sample via a closed loop or other system to avoid exposure E8 . Avoid carrying out activities involving exposure for more than 15 minutes OC26 . Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16 .
CS36 Laboratory activities	Handle within a fume cupboard or implement suitable equivalent methods to minimise exposure E12 . Wear suitable gloves tested to EN374 PPE15 .
CS510_Marine vessel/barge (un)loading	Avoid carrying out activities involving exposure for more than 4 hours OC28 . Transfer via enclosed lines E52 . Clear transfer lines prior to de-coupling E39 . Retain drain downs in sealed storage pending disposal or for subsequent recycle ENVT4 . Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16 .
CS511 Road tanker/Railcar loading	Ensure material transfers are under containment or extract ventilation E66 . Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16 .
CS39 Equipment cleaning and maintenance	Drain down and flush system prior to equipment break-in or maintenance E55 . Wear chemically resistant gloves (tested to EN374) in combination with specific activity training PPE17 . Retain drain downs in sealed storage pending disposal or for subsequent recycle ENVT4 .
Additional information on the basis for the allocation of the identified OCs and RMMs is contained in Appendices 2 to 3	
Section 2.2 Control of environmental exposure	
Product characteristics	
Substance is complex UVCB [PrC3]. Predominantly hydrophobic [PrC4a].	
Amounts used	
Fraction of EU tonnage used in region	0.1
Regional use tonnage (tonnes/year)	1.1e7
Fraction of Regional tonnage used locally	2.0e-3
Annual site tonnage (tonnes/year)	2.3e4
Maximum daily site tonnage (kg/day)	7.7e4
Frequency and duration of use	
Continuous release [FD2].	
Emission days (days/year)	300
Environmental factors not influenced by risk management	
Local freshwater dilution factor	10
Local marine water dilution factor	100
Other given operational conditions affecting environmental exposure	
Release fraction to air from process (initial release prior to RMM)	1.0e-4
Release fraction to wastewater from process (initial release prior to RMM)	1.0e-7
Release fraction to soil from process (initial release prior to RMM)	0.00001
Technical conditions and measures at process level (source) to prevent release	
Common practices vary across sites thus conservative process release estimates used [TCS1].	
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 [TCR1]]. No wastewater treatment required [TCR6].	
Treat air emission to provide a typical removal efficiency of (%)	90
Treat onsite wastewater (prior to receiving water discharge) to provide	0

the required removal efficiency \geq (%)	
If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of \geq (%)	0
Organisation measures to prevent/limit release from site	
Do not apply industrial sludge to natural soils [OMS2]. Sludge should be incinerated, contained or reclaimed [OMS3].	
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 (M_{Safe}) based on release following total wastewater treatment removal (kg/d)	3.8e5
Assumed domestic sewage treatment plant flow (m^3/d)	2000
Conditions and measures related to external treatment of waste for disposal	
External treatment and disposal of waste should comply with applicable regulations [ETW3].	
Conditions and measures related to external recovery of waste	
External recovery and recycling of waste should comply with applicable regulations [ERW1].	
Additional information on the basis for the allocation of the identified OCs and RMMs is contained in PETRORISK file in IUCLID Section 13	
Section 3 Exposure Estimation	
3.1. Health	
The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated. G21.	
3.2. Environment	
The Hydrocarbon Block Method has been used to calculate environmental exposure with the PETRORISK model [EE2].	
Section 4 Guidance to check compliance with the Exposure Scenario	
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. G22.	
Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. G23.	
Available hazard data do not enable the derivation of a DNEL for carcinogenic effects. G33. Available hazard data do not support the need for a DNEL to be established for other health effects. G36. Risk Management Measures are based on qualitative risk characterisation. G37.	
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 [DSU1]. Required removal efficiency for wastewater can be achieved using onsite/offsite technologies, either alone or in combination [DSU2]. Required removal efficiency for air can be achieved using onsite technologies, either alone or in combination [DSU3]. Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org/en/reach-for-industries-libraries.html) [DSU4].	

9.3.2. Exposure Estimation

9.3.2.1. Human Health

See Appendix 2.a and 2.b.

9.3.2.2. Environment

See *PETRORISK file in IUCLID Section 13* – “LocalCSR” worksheet

9.4. Formulation & (Re)packing of Heavy Fuel Oil – Industrial

9.4.1. Exposure Scenario

Section 1 Exposure Scenario Title Heavy Fuel Oil	
Title	
Formulation & (Re)packing of Substances and Mixtures	
Use Descriptor	
Sector(s) of Use	3, 10
Process Categories	1, 2, 3, 8a, 8b, 15 <i>Further information on the mapping and allocation of PROC codes is contained in Table 9.1</i>
Environmental Release Categories	2
Specific Environmental Release Category	ESVOC SpERC 2.2.v1
Processes, tasks, activities covered	
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.	
Assessment Method	
See Section 3.	
Section 2 Operational conditions and risk management measures	
Section 2.1 Control of worker exposure	
Product characteristics	
Physical form of product	Liquid
Vapour pressure (kPa)	Liquid, vapour pressure <0.5 kPa at STP. OC3 .
Concentration of substance in product	Covers percentage substance in the product up to 100 % (unless stated differently) G13
Frequency and duration of use/exposure	Covers daily exposures up to 8 hours (unless stated differently) G2
Other Operational Conditions affecting exposure	Assumes use at not more than 20°C above ambient temperatures, unless stated differently. G15 . Assumes a good basic standard of occupational hygiene is implemented G1
Contributing Scenarios	Specific Risk Management Measures and Operating Conditions
General measures (carcinogens) G18	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. G20
CS15 General exposures (closed systems). + CS2 Process sampling.	Handle substance within a closed system E47 . Sample via a closed loop or other system to avoid exposure E8 . Avoid carrying out activities involving exposure for more than 15 minutes OC26 . Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16 .
CS15 General exposures	Handle substance within a closed system E47 . Sample via a closed loop

(closed systems).	or other system to avoid exposure E8. Avoid carrying out activities involving exposure for more than 4 hours OC28. Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16.
CS85 Bulk product storage.	Store substance within a closed system E84. Avoid carrying out activities involving exposure for more than 4 hours OC28. Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16.
CS137 Product sampling	Sample via a closed loop or other system to avoid exposure E8. Avoid carrying out activities involving exposure for more than 15 minutes OC26. Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16.
CS36 Laboratory activities	Handle within a fume cupboard or implement suitable equivalent methods to minimise exposure E12. Wear suitable gloves tested to EN374 PPE15.
CS510 Marine vessel/barge (un)loading	Transfer via enclosed lines E52 Avoid carrying out activities involving exposure for more than 4 hours OC28. Clear transfer lines prior to de-coupling E39. Retain drain downs in sealed storage pending disposal or for subsequent recycle ENVT4. Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16.
CS511 Road tanker/Railcar loading	Ensure material transfers are under containment or extract ventilation E66. Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16.
CS8 Drum/batch transfers	Ensure material transfers are under containment or extract ventilation E66. Provide a general ventilation (not less than 3 to 5 air changes per hour) E11, or G9; Ensure operation is undertaken outdoors. E69. Avoid carrying out activities involving exposure for more than 1 hour OC27. Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16.
CS39 Equipment cleaning and maintenance	Drain down and flush system prior to equipment break-in or maintenance E55. Wear chemically resistant gloves (tested to EN374) in combination with specific activity training PPE17. Retain drain downs in sealed storage pending disposal or for subsequent recycle ENVT4.
Additional information on the basis for the allocation of the identified OCs and RMMs is contained in Appendices 2 to 3	
Section 2.2 Control of environmental exposure	
Product characteristics	
Substance is complex UVCB [PrC3]. Predominantly hydrophobic [PrC4a].	
Amounts used	
Fraction of EU tonnage used in region	0.1
Regional use tonnage (tonnes/year)	1.1e7
Fraction of Regional tonnage used locally	2.6e-3
Annual site tonnage (tonnes/year)	3.0e4
Maximum daily site tonnage (kg/day)	1.0e5
Frequency and duration of use	
Continuous release [FD2].	
Emission days (days/year)	300
Environmental factors not influenced by risk management	
Local freshwater dilution factor	10
Local marine water dilution factor	100
Other given operational conditions affecting environmental exposure	
Release fraction to air from process (after typical onsite RMMs, consistent with EU Solvent Emissions Directive requirements)	2.2e-3
Release fraction to wastewater from process (initial release prior to RMM)	5.0e-6
Release fraction to soil from process (initial release prior to RMM)	0.0001
Technical conditions and measures at process level (source) to prevent release	

Common practices vary across sites thus conservative process release estimates used [TCS1].	
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 [TCR1j]. If discharging to domestic sewage treatment plant, no onsite wastewater treatment required [TCR9]. Prevent discharge of undissolved substance to or recover from onsite wastewater [TRC14].	
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 \geq (%)	54.0
If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of \geq (%)	0
Organisation measures to prevent/limit release from site	
Do not apply industrial sludge to natural soils [OMS2]. Sludge should be incinerated, contained or reclaimed [OMS3].	
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 (M_{Safe}) based on release following total wastewater treatment removal (kg/d)	1.1e5
Assumed domestic sewage treatment plant flow (m^3/d)	2000
Conditions and measures related to external treatment of waste for disposal	
External treatment and disposal of waste should comply with applicable regulations [ETW3].	
Conditions and measures related to external recovery of waste	
External recovery and recycling of waste should comply with applicable regulations [ERW1].	
Additional information on the basis for the allocation of the indentified OCs and RMMs is contained in PETRORISK file in IUCLID Section 13	
Section 3 Exposure Estimation	
3.1. Health	
The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated. G21.	
3.2. Environment	
The Hydrocarbon Block Method has been used to calculate environmental exposure with the PETRORISK model [EE2].	
Section 4 Guidance to check compliance with the Exposure Scenario	
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. G22.	
Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. G23.	
Available hazard data do not enable the derivation of a DNEL for carcinogenic effects. G33. Available hazard data do not support the need for a DNEL to be established for other health effects. G36. Risk Management Measures are based on qualitative risk characterisation. G37.	
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 [DSU1]. Required removal efficiency for wastewater can be achieved using onsite/offsite technologies, either alone or in combination [DSU2]. Required removal efficiency for air can be achieved using onsite technologies, either alone or in combination [DSU3]. Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org/en/reach-for-industries-libraries.html) [DSU4].	

9.4.2. Exposure Estimation

9.4.2.1. Human Health

See Appendix 2.a and 2.b.

9.4.2.2. Environment

See *PETRORISK* file in *IUCLID* Section 13 – “LocalCSR” worksheet

9.5. Uses of Heavy Fuel Oil in Coatings – Industrial

9.5.1. Exposure Scenario

Section 1 Exposure Scenario Title Heavy Fuel Oil	
Title	
Uses in Coatings	
Use Descriptor	
Sector(s) of Use	3
Process Categories	1, 2, 3, 8a, 8b, 15 <i>Further information on the mapping and allocation of PROC codes is contained in Table 9.1</i>
Environmental Release Categories	4
Specific Environmental Release Category	ESVOC SpERC 4.3a.v1
Processes, tasks, activities covered	
Covers the use in coatings (paints, inks, adhesives, etc) within closed or contained systems including incidental exposures during use (including materials receipt, storage, preparation and transfer from bulk and semi-bulk, application activities and film formation) and equipment cleaning, maintenance and associated laboratory activities.	
Assessment Method	
See Section 3.	
Section 2 Operational conditions and risk management measures	
Section 2.1 Control of worker exposure	
Product characteristics	
Physical form of product	Liquid
Vapour pressure (kPa)	Liquid, vapour pressure <0.5 kPa at STP. OC3 .
Concentration of substance in product	Covers percentage substance in the product up to 100 % (unless stated differently) G13
Frequency and duration of use/exposure	Covers daily exposures up to 8 hours (unless stated differently) G2
Other Operational Conditions affecting exposure	Assumes use at not more than 20°C above ambient temperatures, unless stated differently. G15 . Assumes a good basic standard of occupational hygiene is implemented G1
Contributing Scenarios	Specific Risk Management Measures and Operating Conditions
General measures (carcinogens) G18	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. G20
CS99 Film formation - force drying, stoving and other technologies.	Provide extract ventilation to points where emissions occur E54 . Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16 .
CS15 General exposures (closed systems).	Handle substance within a closed system E47 . Provide extract ventilation to points where emissions occur E54 . Provide a good standard of

	controlled ventilation (10 to 15 air changes per hour) E40 . Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16 .
CS3 Material transfers	Provide a good standard of controlled ventilation (10 to 15 air changes per hour) E40 . Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16 . Ensure material transfers are under containment or extract ventilation E66 .
CS36 Laboratory activities.	Handle within a fume cupboard or implement suitable equivalent methods to minimise exposure E12 . Wear suitable gloves tested to EN374 PPE15 .
CS39 Equipment cleaning and maintenance	Drain down and flush system prior to equipment break-in or maintenance E55 . Wear chemically resistant gloves (tested to EN374) in combination with specific activity training PPE17 . Retain drain downs in sealed storage pending disposal or for subsequent recycle ENV4 .
CS67 Storage.	Store substance within a closed system E84 . Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16 .
Additional information on the basis for the allocation of the identified OCs and RMMs is contained in Appendices 2 to 3	
Section 2.2 Control of environmental exposure	
Product characteristics	
Substance is complex UVCB [PrC3]. Predominantly hydrophobic [PrC4a].	
Amounts used	
Fraction of EU tonnage used in region	0.1
Regional use tonnage (tonnes/year)	1.0e2
Fraction of Regional tonnage used locally	1
Annual site tonnage (tonnes/year)	1.0e2
Maximum daily site tonnage (kg/day)	5.0e3
Frequency and duration of use	
Continuous release [FD2].	
Emission days (days/year)	20
Environmental factors not influenced by risk management	
Local freshwater dilution factor	10
Local marine water dilution factor	100
Other given operational conditions affecting environmental exposure	
Release fraction to air from process (initial release prior to RMM)	
	0.98
Release fraction to wastewater from process (initial release prior to RMM)	
	2.0e-5
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 [TCS1].	
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 [TCR1j]. No wastewater treatment required [TCR6]. Prevent discharge of undissolved substance to or recover from onsite wastewater [TRC14].	
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 \geq (%)	0
If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of \geq (%)	0
Organisation measures to prevent/limit release from site	
Do not apply industrial sludge to natural soils [OMS2]. Sludge should be incinerated, contained or reclaimed [OMS3].	
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 (M_{Safe}) based on release following total wastewater treatment removal (kg/d)	1.1e5
Assumed domestic sewage treatment plant flow (m^3/d)	2000
Conditions and measures related to external treatment of waste for disposal	
External treatment and disposal of waste should comply with applicable regulations [ETW3].	
Conditions and measures related to external recovery of waste	
External recovery and recycling of waste should comply with applicable regulations [ERW1].	
Additional information on the basis for the allocation of the identified OCs and RMMs is contained in PETRORISK file in IUCLID Section 13	
Section 3 Exposure Estimation	
3.1. Health	
The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated. G21.	
3.2. Environment	
The Hydrocarbon Block Method has been used to calculate environmental exposure with the PETRORISK model [EE2].	
Section 4 Guidance to check compliance with the Exposure Scenario	
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. G22.	
Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. G23.	
Available hazard data do not enable the derivation of a DNEL for carcinogenic effects. G33. Available hazard data do not support the need for a DNEL to be established for other health effects. G36. Risk Management Measures are based on qualitative risk characterisation. G37.	
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 [DSU1]. Required removal efficiency for wastewater can be achieved using onsite/offsite technologies, either alone or in combination [DSU2]. Required removal efficiency for air can be achieved using onsite technologies, either alone or in combination [DSU3]. Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org/en/reach-for-industries-libraries.html) [DSU4].	

9.5.2. Exposure Estimation

9.5.2.1. Human Health

See Appendix 2.a and 2.b.

9.5.2.2. Environment

See *PETRORISK file in IUCLID Section 13* – “LocalCSR” worksheet

9.6. Uses of Heavy Fuel Oil in Coatings – Professional

9.6.1. Exposure Scenario

Section 1 Exposure Scenario Title Heavy Fuel Oil	
Title	
Uses in Coatings	
Use Descriptor	
Sector(s) of Use	22
Process Categories	1, 2, 3, 8a, 8b, 15 <i>Further information on the mapping and allocation of PROC codes is contained in Table 9.1</i>
Environmental Release Categories	8a, 8d
Specific Environmental Release Category	ESVOC SpERC 8.3b.v1
Processes, tasks, activities covered	
Covers the use in coatings (paints, inks, adhesives, etc) within closed or contained systems including incidental exposures during use (including materials receipt, storage, preparation and transfer from bulk and semi-bulk, application activities and film formation) and equipment cleaning, maintenance and associated laboratory activities.	
Assessment Method	
See Section 3.	
Section 2 Operational conditions and risk management measures	
Section 2.1 Control of worker exposure	
Product characteristics	
Physical form of product	Liquid
Vapour pressure (kPa)	Liquid, vapour pressure <0.5 kPa at STP. OC3 .
Concentration of substance in product	Covers percentage substance in the product up to 100 % (unless stated differently) G13
Frequency and duration of use/exposure	Covers daily exposures up to 8 hours (unless stated differently) G2
Other Operational Conditions affecting exposure	Assumes use at not more than 20°C above ambient temperatures, unless stated differently. G15 . Assumes a good basic standard of occupational hygiene is implemented G1
Contributing Scenarios	Specific Risk Management Measures and Operating Conditions
General measures (carcinogens) G18	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. G20
Film formation - force drying, stoving and other technologies CS99.	Handle substance within closed systems E47 Limit the substance content in the product to 5 % OC17 . Provide extract ventilation to points where emissions occur. E54 .
CS15 General exposures (closed systems).	Handle substance within closed systems E47 Limit the substance content in the product to 5 % OC17 . Provide extract ventilation to points where

	emissions occur E54.
CS3 Material transfers	Ensure material transfers are under containment or extract ventilation E66 Avoid carrying out activities involving exposure for more than 15 minutes OC26. Limit the substance content in the product to 1 % OC16. Wear chemically resistant gloves (tested to EN374) in combination with intensive management supervision controls PPE18.
CS36 Laboratory activities.	Handle within a fume cupboard or implement suitable equivalent methods to minimise exposure. E12.
CS39 Equipment cleaning and maintenance	Drain down and flush system prior to equipment break-in or maintenance E55 Retain drain down in sealed storage pending disposal or for subsequent recycle ENVT4. Deal with spills immediately. C&H13. Avoid carrying out activities involving exposure for more than 15 minutes OC26. Limit the substance content in the product to 1 % OC16. Wear chemically resistant gloves (tested to EN374) in combination with intensive management supervision controls PPE18. Retain drain downs in sealed storage pending disposal or for subsequent recycle ENVT4.
CS67 Storage.	Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16. Store substance within a closed system. E84
Additional information on the basis for the allocation of the identified OCs and RMMs is contained in Appendices 2 to 3	
Section 2.2 Control of environmental exposure	
Product characteristics	
Substance is complex UVCB [PrC3]. Predominantly hydrophobic [PrC4a].	
Amounts used	
Fraction of EU tonnage used in region	0.1
Regional use tonnage (tonnes/year)	1.0e2
Fraction of Regional tonnage used locally	5.0e-4
Annual site tonnage (tonnes/year)	5.0e-2
Maximum daily site tonnage (kg/day)	1.4e-1
Frequency and duration of use	
Continuous release [FD2].	
Emission days (days/year)	365
Environmental factors not influenced by risk management	
Local freshwater dilution factor	10
Local marine water dilution factor	100
Other given operational conditions affecting environmental exposure	
Release fraction to air from wide dispersive use (regional only)	0.98
Release fraction to wastewater from wide dispersive use	0.01
Release fraction to soil from wide dispersive use (regional only)	0.01
Technical conditions and measures at process level (source) to prevent release	
Common practices vary across sites thus conservative process release estimates used [TCS1].	
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 [TCR1j].	
No wastewater treatment required [TCR6].	
Treat air emission to provide a typical removal efficiency of (%)	N/A
Treat onsite wastewater (prior to receiving water discharge) to provide the required removal efficiency \geq (%)	0
If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of \geq (%)	0
Organisation measures to prevent/limit release from site	
Do not apply industrial sludge to natural soils [OMS2]. Sludge should be incinerated, contained or	

reclaimed [OMS3].	
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 (M_{Safe}) based on release following total wastewater treatment removal (kg/d)	7.0e-1
Assumed domestic sewage treatment plant flow (m^3/d)	2000
Conditions and measures related to external treatment of waste for disposal	
External treatment and disposal of waste should comply with applicable regulations [ETW3].	
Conditions and measures related to external recovery of waste	
External recovery and recycling of waste should comply with applicable regulations [ERW1].	
Additional information on the basis for the allocation of the identified OCs and RMMs is contained in PETRORISK file in IUCLID Section 13	
Section 3 Exposure Estimation	
3.1. Health	
The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated. G21.	
3.2. Environment	
The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model [EE2].	
Section 4 Guidance to check compliance with the Exposure Scenario	
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. G22.	
Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. G23.	
Available hazard data do not enable the derivation of a DNEL for carcinogenic effects. G33. Available hazard data do not support the need for a DNEL to be established for other health effects. G36. Risk Management Measures are based on qualitative risk characterisation. G37.	
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 [DSU1]. Required removal efficiency for wastewater can be achieved using onsite/offsite technologies, either alone or in combination [DSU2]. Required removal efficiency for air can be achieved using onsite technologies, either alone or in combination [DSU3]. Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org/en/reach-for-industries-libraries.html) [DSU4].	

9.6.2. Exposure Estimation

9.6.2.1. Human Health

See Appendix 2.a and 2.b.

9.6.2.2. Environment

See *PETRORISK file in IUCLID Section 13* – “LocalCSR” worksheet

9.7. Use of Heavy Fuel Oil as a Fuel – Industrial

9.7.1. Exposure Scenario

Section 1 Exposure Scenario Title Heavy Fuel Oil	
Title	
Use as a Fuel	
Use Descriptor	
Sector(s) of Use	3
Process Categories	1, 2, 3, 8a, 8b, 16 <i>Further information on the mapping and allocation of PROC codes is contained in Table 9.1</i>
Environmental Release Categories	7
Specific Environmental Release Category	ESVOC SpERC 7.12a.v1
Processes, tasks, activities covered	
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.	
Assessment Method	
See Section 3.	
Section 2 Operational conditions and risk management measures	
Section 2.1 Control of worker exposure	
Product characteristics	
Physical form of product	Liquid
Vapour pressure (kPa)	Liquid, vapour pressure <0.5 kPa at STP. OC3 .
Concentration of substance in product	Covers percentage substance in the product up to 100 % (unless stated differently) G13
Frequency and duration of use/exposure	Covers daily exposures up to 8 hours (unless stated differently) G2
Other Operational Conditions affecting exposure	Assumes use at not more than 20°C above ambient temperatures, unless stated differently. G15 . Assumes a good basic standard of occupational hygiene is implemented G1
Contributing Scenarios	Specific Risk Management Measures and Operating Conditions
General measures (carcinogens) G18	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. G20
CS15 General exposures (closed systems).	Handle substance within a closed system E47 . Sample via a closed loop or other system to avoid exposure E8 . Avoid carrying out activities involving exposure for more than 4 hours OC28 . Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16 .
CS15 General exposures	Handle substance within a closed system E47 . Sample via a closed loop

(closed systems). + CS137 Product sampling.	or other system to avoid exposure E8. Avoid carrying out activities involving exposure for more than 1 hour OC27. Provide a good standard of controlled ventilation (10 to 15 air changes per hour) E40. Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16.
CS502 Bulk closed unloading + OC9 Outdoor	Transfer via enclosed lines E52. Avoid carrying out activities involving exposure for more than 4 hours OC28. Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16.
CS8 Drum/batch transfers	Ensure material transfers are under containment or extract ventilation E66. , or (G9): Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour) E11. Avoid carrying out activities involving exposure for more than 1 hour OC27. Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16.
CS 117 Operation of solids filtering equipment	Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour) E11. Avoid carrying out activities involving exposure for more than 4 hours OC28. Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16.
CS85 Bulk product storage.	Store substance within a closed system E84. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour) E11. Avoid carrying out activities involving exposure for more than 4 hours OC28. Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16.
GEST_12I Use as a fuel. CS 107 (closed system)	Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16.
CS39 Equipment cleaning and maintenance	Drain down and flush system prior to equipment break-in or maintenance E55. Wear chemically resistant gloves (tested to EN374) in combination with specific activity training PPE17. Retain drain downs in sealed storage pending disposal or for subsequent recycle ENVT4.
Additional information on the basis for the allocation of the identified OCs and RMMs is contained in Appendices 2 to 3	
Section 2.2 Control of environmental exposure	
Product characteristics	
Substance is complex UVCB [PrC3]. Predominantly hydrophobic [PrC4a].	
Amounts used	
Fraction of EU tonnage used in region	0.1
Regional use tonnage (tonnes/year)	1.1e7
Fraction of Regional tonnage used locally	1.4e-1
Annual site tonnage (tonnes/year)	1.5e6
Maximum daily site tonnage (kg/day)	5.0e6
Frequency and duration of use	
Continuous release [FD2].	
Emission days (days/year)	300
Environmental factors not influenced by risk management	
Local freshwater dilution factor	10
Local marine water dilution factor	100
Other given operational conditions affecting environmental exposure	
Release fraction to air from process (initial release prior to RMM)	7.0e-4
Release fraction to wastewater from process (initial release prior to RMM)	4.4e-7
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 [TCS1].	
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 [TCR1b]. Additional onsite wastewater treatment required [TCR13]. Prevent discharge of undissolved substance to or recover from onsite wastewater [TRC14].	
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 \geq (%)	87.7
If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of \geq (%)	0
Organisation measures to prevent/limit release from site	
Do not apply industrial sludge to natural soils [OMS2]. Sludge should be incinerated, contained or reclaimed [OMS3].	
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 (M_{Safe}) based on release following total wastewater treatment removal (kg/d)	5.2e6
Assumed domestic sewage treatment plant flow (m^3/d)	2000
Conditions and measures related to external treatment of waste for disposal	
Combustion emissions limited by required exhaust emission controls [ETW1]. Combustion emissions considered in regional exposure assessment [ETW2].	
Conditions and measures related to external recovery of waste	
This substance is consumed during use and no waste of the substance is generated to recover [ERW3].	
Additional information on the basis for the allocation of the identified OCs and RMMs is contained in PETRORISK file in IUCLID Section 13	
Section 3 Exposure Estimation	
3.1. Health	
3.2. Environment	
The Hydrocarbon Block Method has been used to calculate environmental exposure with the PETRORISK model [EE2].	
Section 4 Guidance to check compliance with the Exposure Scenario	
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. G22.	
Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. G23.	
Available hazard data do not enable the derivation of a DNEL for carcinogenic effects. G33. Available hazard data do not support the need for a DNEL to be established for other health effects. G36. Risk Management Measures are based on qualitative risk characterisation. G37.	
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 [DSU1]. Required removal efficiency for wastewater can be achieved using onsite/offsite technologies, either alone or in combination [DSU2]. Required removal efficiency for air can be achieved using onsite technologies, either alone or in combination [DSU3]. Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org/en/reach-for-industries-libraries.html) [DSU4].	

9.7.2. Exposure Estimation

9.7.2.1. Human Health

See Appendix 2.a and 2.b.

9.7.2.2. Environment

See *PETRORISK* file in *IUCLID* Section 13 – “LocalCSR” worksheet

9.8. Use of Heavy Fuel Oil as a Fuel – Professional

9.8.1. Exposure Scenario

Section 1 Exposure Scenario Title Heavy Fuel Oil	
Title	
Use as a Fuel	
Use Descriptor	
Sector(s) of Use	22
Process Categories	1, 2, 3, 8a, 8b, 16 <i>Further information on the mapping and allocation of PROC codes is contained in Table 9.1</i>
Environmental Release Categories	9a, 9b
Specific Environmental Release Category	ESVOC SpERC 9.12b.v1
Processes, tasks, activities covered	
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.	
Assessment Method	
See Section 3.	
Section 2 Operational conditions and risk management measures	
Section 2.1 Control of worker exposure	
Product characteristics	
Physical form of product	Liquid
Vapour pressure (kPa)	Liquid, vapour pressure <0.5 kPa at STP. OC3 .
Concentration of substance in product	Covers percentage substance in the product up to 100 % (unless stated differently) G13
Frequency and duration of use/exposure	Covers daily exposures up to 8 hours (unless stated differently) G2
Other Operational Conditions affecting exposure	Assumes use at not more than 20°C above ambient temperatures, unless stated differently. G15 . Assumes a good basic standard of occupational hygiene is implemented G1
Contributing Scenarios	Specific Risk Management Measures and Operating Conditions
General measures (carcinogens) G18	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. G20
CS15 General exposures (closed systems). + CS137 Product sampling.	Handle substance within a closed system E47 . Sample via a closed loop or other system to avoid exposure E8 . Avoid carrying out activities involving exposure for more than 1 hour OC27 . Provide a good standard of controlled ventilation (10 to 15 air changes per hour) E40 . Wear chemically resistant gloves (tested to EN374) in combination with specific activity training PPE17 .

CS15 General exposures (closed systems).	Handle substance within a closed system E47. Sample via a closed loop or other system to avoid exposure E8. Avoid carrying out activities involving exposure for more than 1 hour OC27. Provide a good standard of controlled ventilation (10 to 15 air changes per hour) E40. Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16.
CS502 Bulk closed unloading	Provide a good standard of controlled ventilation (10 to 15 air changes per hour) E40. Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16. Avoid carrying out activities involving exposure for more than 1 hour OC27. , or G9: Ensure material transfers are under containment or extract ventilation E66.
CS8 Drum/batch transfers	Provide a good standard of controlled ventilation (10 to 15 air changes per hour) E40. Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16. Avoid carrying out activities involving exposure for more than 1 hour OC27. , or G9: Ensure material transfers are under containment or extract ventilation E66.
CS507 Refuelling	Ensure material transfers are under containment or extract ventilation E66. Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16. Avoid carrying out activities involving exposure for more than 1 hour OC27.
GEST_12I Use as a fuel. CS 107 (closed system)	Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training PPE16.
CS39 Equipment cleaning and maintenance	Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour) E11. Wear chemically resistant gloves (tested to EN374) in combination with specific activity training PPE17. Drain down system prior to equipment break-in or maintenance E65. Retain drain downs in sealed storage pending disposal or for subsequent recycle ENVT4. Clear spills immediately C&H13.
Additional information on the basis for the allocation of the identified OCs and RMMs is contained in Appendices 2 to 3	
Section 2.2 Control of environmental exposure	
Product characteristics	
Substance is complex UVCB [PrC3]. Predominantly hydrophobic [PrC4a].	
Amounts used	
Fraction of EU tonnage used in region	0.1
Regional use tonnage (tonnes/year)	3.3e5
Fraction of Regional tonnage used locally	5.0e-4
Annual site tonnage (tonnes/year)	1.7e2
Maximum daily site tonnage (kg/day)	4.6e2
Frequency and duration of use	
Continuous release [FD2].	
Emission days (days/year)	365
Environmental factors not influenced by risk management	
Local freshwater dilution factor	10
Local marine water dilution factor	100
Other given operational conditions affecting environmental exposure	
Release fraction to air from wide dispersive use (regional only)	1.0e-4
Release fraction to wastewater from wide dispersive use	0.00001
Release fraction to soil from wide dispersive use (regional only)	0.00001
Technical conditions and measures at process level (source) to prevent release	
Common practices vary across sites thus conservative process release estimates used [TCS1].	
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 [TCR1j].	

No wastewater treatment required [TCR6].	
Treat air emission to provide a typical removal efficiency of (%)	N/A
Treat onsite wastewater (prior to receiving water discharge) to provide the required removal efficiency \geq (%)	0
If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of \geq (%)	0
Organisation measures to prevent/limit release from site	
Do not apply industrial sludge to natural soils [OMS2]. Sludge should be incinerated, contained or reclaimed [OMS3].	
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 (M_{Safe}) based on release following total wastewater treatment removal (kg/d)	2.3e3
Assumed domestic sewage treatment plant flow (m^3/d)	2000
Conditions and measures related to external treatment of waste for disposal	
Combustion emissions limited by required exhaust emission controls [ETW1]. Combustion emissions considered in regional exposure assessment [ETW2].	
Conditions and measures related to external recovery of waste	
This substance is consumed during use and no waste of the substance is generated to recover [ERW3].	
Additional information on the basis for the allocation of the identified OCs and RMMs is contained in PETRORISK file in IUCLID Section 13.	
Section 3 Exposure Estimation	
3.1. Health	
The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated. G21.	
3.2. Environment	
The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model [EE2].	
Section 4 Guidance to check compliance with the Exposure Scenario	
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. G22.	
Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. G23.	
Available hazard data do not enable the derivation of a DNEL for carcinogenic effects. G33. Available hazard data do not support the need for a DNEL to be established for other health effects. G36. Risk Management Measures are based on qualitative risk characterisation. G37.	
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 [DSU1]. Required removal efficiency for wastewater can be achieved using onsite/offsite technologies, either alone or in combination [DSU2]. Required removal efficiency for air can be achieved using onsite technologies, either alone or in combination [DSU3]. Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org/en/reach-for-industries-libraries.html) [DSU4].	

9.8.2. Exposure Estimation

9.8.2.1. Human Health

See Appendix 2.a and 2.b.

9.8.2.2. Environment

See *PETRORISK* file in *IUCLID* Section 13 – “LocalCSR” worksheet

9.9. Use of Heavy Fuel Oil in Road and Construction Applications – Professional

9.9.1. Exposure Scenario

Section 1 Exposure Scenario Title Heavy Fuel Oils	
Title	
Use in Road and Construction Applications	
Use Descriptor	
Sector(s) of Use	22
Process Categories	8a, 8b <i>Further information on the mapping and allocation of PROC codes is contained in Table 9.1</i>
Environmental Release Categories	8d, 8f
Specific Environmental Release Category	ESVOC SpERC 8.15.v1
Processes, tasks, activities covered	
Covers the use of surface coatings and binders within closed or contained systems, including incidental exposures during material transfers and filling operations.	
Assessment Method	
See Section 3.	
Section 2 Operational conditions and risk management measures	
Section 2.1 Control of worker exposure	
Product characteristics	
Physical form of product	Liquid
Vapour pressure (kPa)	Liquid, vapour pressure <0.5 kPa at STP. OC3.
Concentration of substance in product	Covers percentage substance in the product up to 100 % (unless stated differently) G13
Frequency and duration of use/exposure	Covers daily exposures up to 8 hours (unless stated differently) G2
Other Operational Conditions affecting exposure	Operation is carried out at elevated temperature (> 20°C above ambient temperature). OC7. Assumes a good basic standard of occupational hygiene is implemented G1.
Contributing Scenarios	Specific Risk Management Measures and Operating Conditions
General measures (carcinogens) G18	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. G20
CS3 Material transfers	Ensure material transfers are under containment or extract ventilation E66 Avoid carrying out activities involving exposure for more than 15 minutes OC26. Limit the substance content in the product to 1 % OC16. Wear chemically resistant gloves (tested to EN374) in combination with intensive management supervision controls PPE18.
CS39 Equipment cleaning	Drain down and flush system prior to equipment break-in or maintenance

and maintenance	E55 Retain drain down in sealed storage pending disposal or for subsequent recycle ENVT4. Deal with spills immediately. C&H13. Avoid carrying out activities involving exposure for more than 15 minutes OC26. Limit the substance content in the product to 1 % OC16. Wear chemically resistant gloves (tested to EN374) in combination with intensive management supervision controls PPE18. Retain drain downs in sealed storage pending disposal or for subsequent recycle ENVT4.
Additional information on the basis for the allocation of the identified OCs and RMMs is contained in Appendices 2 to 3	
Section 2.2 Control of environmental exposure	
Product characteristics	
Substance is complex UVCB [PrC3]. Predominantly hydrophobic [PrC4a].	
Amounts used	
Fraction of EU tonnage used in region	0.1
Regional use tonnage (tonnes/year)	2.2e4
Fraction of Regional tonnage used locally	5.0e-4
Annual site tonnage (tonnes/year)	1.1e1
Maximum daily site tonnage (kg/day)	3.0e1
Frequency and duration of use	
Continuous release [FD2].	
Emission days (days/year)	365
Environmental factors not influenced by risk management	
Local freshwater dilution factor	10
Local marine water dilution factor	100
Other given operational conditions affecting environmental exposure	
Release fraction to air from wide dispersive use (regional only)	
	0.95
Release fraction to wastewater from wide dispersive use	
	0.01
Release fraction to soil from wide dispersive use (regional only)	
	0.04
Technical conditions and measures at process level (source) to prevent release	
Common practices vary across sites thus conservative process release estimates used [TCS1].	
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 [TCR1]].	
If discharging to domestic sewage treatment plant, no onsite wastewater treatment required [TCR9].	
Treat air emission to provide a typical removal efficiency of (%)	N/A
Treat onsite wastewater (prior to receiving water discharge) to provide the required removal efficiency \geq (%)	30.2
If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of \geq (%)	0
Organisation measures to prevent/limit release from site	
Do not apply industrial sludge to natural soils [OMS2]. Sludge should be incinerated, contained or reclaimed [OMS3].	
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 (M_{Safe}) based on release following total wastewater treatment removal (kg/d)	1.1e2
Assumed domestic sewage treatment plant flow (m^3/d)	2000
Conditions and measures related to external treatment of waste for disposal	
External treatment and disposal of waste should comply with applicable regulations [ETW3].	
Conditions and measures related to external recovery of waste	

External recovery and recycling of waste should comply with applicable regulations [ERW1].
Additional information on the basis for the allocation of the indentified OCs and RMMs is contained in PETRORISK file in IUCLID Section 13
Section 3 Exposure Estimation
3.1. Health
The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated. G21.
3.2. Environment
The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model [EE2].
Section 4 Guidance to check compliance with the Exposure Scenario
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. G22.
Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. G23.
Available hazard data do not enable the derivation of a DNEL for carcinogenic effects. G33. Available hazard data do not support the need for a DNEL to be established for other health effects. G36. Risk Management Measures are based on qualitative risk characterisation. G37.
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 [DSU1]. Required removal efficiency for wastewater can be achieved using onsite/offsite technologies, either alone or in combination [DSU2]. Required removal efficiency for air can be achieved using onsite technologies, either alone or in combination [DSU3]. Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org/en/reach-for-industries-libraries.html) [DSU4].

9.9.2. Exposure Estimation

9.9.2.1. Human Health

See Appendix 2.a and 2.b.

9.9.2.2. Environment

See *PETRORISK file in IUCLID Section 13* – “LocalCSR” worksheet

9.10. Regional Environment Exposure Estimation

See *PETRORISK* file in *IUCLID* Section 13 – “RegionalCSR” worksheet

10. RISK CHARACTERISATION

10.1. Manufacture of Heavy Fuel Oil – Industrial

10.1.1. Human Health

See Appendix 3.a and 3.b.

10.1.2. Environment

See *PETRORISK file in IUCLID Section 13* – “LocalCSR” worksheet

10.2. Use of Heavy Fuel Oil as Intermediate – Industrial

10.2.1. Human Health

See Appendix 3.a and 3.b.

10.2.2. Environment

See *PETRORISK file in IUCLID Section 13* – “LocalCSR” worksheet

10.3. Distribution of Heavy Fuel Oil – Industrial

10.3.1. Human Health

See Appendix 3.a and 3.b.

10.3.2. Environment

See *PETRORISK file in IUCLID Section 13* – “LocalCSR” worksheet

10.4. Formulation & (Re)packing of Heavy Fuel Oil – Industrial

10.4.1. Human Health

See Appendix 3.a and 3.b.

10.4.2. Environment

See *PETRORISK file in IUCLID Section 13* – “LocalCSR” worksheet

10.5. Uses of Heavy Fuel Oil in Coatings – Industrial

10.5.1. Human Health

See Appendix 3.a and 3.b.

10.5.2. Environment

See *PETRORISK file in IUCLID Section 13* – “LocalCSR” worksheet

10.6. Uses of Heavy Fuel Oil in Coatings – Professional

10.6.1. Human Health

See Appendix 3.a and 3.b.

10.6.2. Environment

See *PETRORISK file in IUCLID Section 13* – “LocalCSR” worksheet

10.7. Uses of Heavy Fuel Oil as a Fuel – Industrial

10.7.1. Human Health

See Appendix 3.a and 3.b.

10.7.2. Environment

See *PETRORISK file in IUCLID Section 13* – “LocalCSR” worksheet

10.8. Uses of Heavy Fuel Oil as a Fuel – Professional

10.8.1. Human Health

See Appendix 3.a and 3.b.

10.8.2. Environment

See *PETRORISK file in IUCLID Section 13* – “LocalCSR” worksheet

10.9. Uses of Heavy Fuel Oil in Road and Construction Applications – Professional

10.9.1. Human Health

See Appendix 3.a and 3.b.

10.9.2. Environment

See *PETRORISK file in IUCLID Section 13* – “LocalCSR” worksheet

10.10. Overall exposure (combined for all relevant emission/release sources)

10.10.1. Human health (combined for all exposure routes)

See Appendix 3.a & 3.b.

10.10.2. Environment (combined for all exposure routes)

Combined exposures can be calculated with information provided on the individual exposure scenarios presented in section 9. However, it is unclear how to define risk management measures resulting from this analysis.

10.11. Regional Environment

See *PETRORISK file in IUCLID Section 13* – “RegionalCSR” worksheet

APPENDIX 2: Exposure Estimations

**Appendix 2.a.
Exposure Estimation**

Appendix 2.b. Qualitative Exposure Estimation

Qualitative Exposure Estimation for R20 substances

There is a difference of at least a factor of 30 between the short-term (when expressed over 15 minutes) and the long term DNELs (when expressed over 8 hours), i.e. the long-term DNEL is lower by at least 30x. In these circumstances a quantitative assessment of short-term exposure assessment has not be undertaken based on the following rationale:

- For any single short term (ST) event to adversely influence the implementation of the long term (LT) reference value (DNEL when available) in the CSA, then the single ST exposure must be ~30x greater than the LT DNEL. Where the ST exposure might be repeated during the course of an activity, then the contribution made by the ST exposures to the LT average would clearly be greater. Hence, provided daily average exposures are controlled to within the LT reference value, then this will also account for any potential risks arising from ST exposure.

Qualitative Exposure Estimation for R45 substances

The R45 risk phrase (may cause cancer) relates to the strength of evidence to indicate that the substance may cause cancer in humans. When a carcinogenic substance is considered a threshold carcinogen and/or if appropriate dose-response data from epidemiological and/or animal studies are available, it may be possible to derive a DMEL which should then be used in quantitative risk characterisation to define the appropriate RMMs... However, when a carcinogenic substance is considered a non-threshold carcinogen and/or if appropriate dose-response data from epidemiological and/or animal studies are not available, it is not possible to derive a DMEL, and hence a qualitative approach to the CSA will be required.

This general qualitative CSA approach aims to reduce/avoid exposure or incidents with the substance consistent with the expectations of Directive 2004/37/EC. The general philosophy is twofold:

1. that the uses of any R45 substance are limited to suitably equipped industrial or professional settings and will only be supported in circumstances where exposure potential is limited (PROCs 1, 2, 3, 8a (*maintenance only*), 8b, 9, 15, and 16) and will not cover those situations where exposure to the substance might be expected to be significant (such as PROCs 7, 11, 17, 18, etc). This limitation on use is consistent with the current expectations of Directive 2004/37/EC.
2. That a stringent set of RMMs will be applied. Firstly, exposures should be controlled to at least the levels that represent an acceptable level of risk (i.e. represent a RCR of <1 for the DMEL or the otherwise critical non-carcinogenic adverse effect associated with exposure to the substance (the lowest DNEL is used for a quantitative CSA)). Secondly, that rigorous systems of control are implemented to manage exposures in addition to and independent of the risk measures required to manage non-cancer endpoints (and which are described via the use of standard phrases linked to defined circumstances of use), with the aim that the net outcome is the description of the RMMs that when implemented ensure that the likelihood of cancer occurring is minimised, and the risk is considered to be controlled.

Qualitative Exposure Estimation for R66 substances

For substances and preparations that do not meet the criteria for R38 but which may cause concern as a result of skin dryness, flaking or cracking, the risk phrase R66 (Repeated exposure may cause skin dryness or cracking) shall be used. Decisions for applying this phrase are derived either from practical observation after normal handling and use or from other relevant information used to predict effects on the skin.

The R66 risk phrase is generally applied to petroleum substances and solvents that have the capacity to extract lipids from the skin and that are not classified as skin irritant. R66 does not relate to a classifiable endpoint, and there is no standardized test method to quantify the effect. Thus, a DNEL cannot be derived.

Note that R66 is an "additional" risk phrase which means that it shall be applied only to substances or preparations that are already classified whilst assignment of the risk phrase R66 does not, in itself, have any impact on the formal classification of the substance.

This general qualitative CSA approach aims to reduce/avoid contact or incidents with the substance. However, implementation of risk management measures (RMMs) and operational conditions (OCs) need to be proportional to the degree of concern for the health hazard presented by the substance.

Exposures should be controlled to at least the levels that represent an acceptable level of risk such that the implementation of the chosen RMMs will ensure that the likelihood of an event occurring due to the substance hazard is negligible, and the risk is considered to be controlled to a level of no concern.

For skin defatting a qualitative risk characterisation has been conducted. Handling and storage risk management measures that are generally identified for skin defatting risks are outlined in Appendix 3.b. A review of these RMMs indicates that if the user complies with the following generic statement, risks due to skin defatting are considered to be controlled. For any substance, classified as R66, these measures should be communicated via the safety data sheet by use of the following phrase:

- PPE20: 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

APPENDIX 3: Risk Characterisations

**Appendix 3.a.
Risk Characterisation**

Appendix 3.b. Qualitative Risk Characterisation

Qualitative Risk Characterisation for R20 substances

A quantitative assessment of short term exposure has not been undertaken as there is a difference of at least a factor of 30 between the short term (when expressed over 15 minutes) and the long term DNEL (when expressed over 8 hours) DNELs.

Qualitative Risk Characterisation for R45 substances

In the case of carcinogens (substances classified as R45), comprehensive EU legislation already exists that establishes a framework of expectations that can be used as the basis for applying a qualitative approach for any CSA. Specifically Directive 2004/37/EC of the European Parliament and the Council of 29 April 2004 on the protection of workers from the risks related to exposure to carcinogens or mutagens at work (Sixth individual Directive within the meaning of Article 16(1) of Council Directive 89/391/EEC) sets out the minimum requirements for protecting workers who may be exposed to carcinogens and mutagens during work activities. Preventive measures must be taken for the protection of the health and safety of workers exposed to carcinogens or mutagens. The implementation of following RMMs, which build from the existing legal provisions, is intended to ensure that the likelihood of cancer occurring is minimised.

For the cancer hazard a qualitative risk characterisation has been conducted consistent with the considerations and risk management measures identified in the Table below.

Hazard	Material	Risk / Hazard Phrase	Examples of Relevant S Phrases and P Statements	Components of the Qualitative Risk Assessment
Cancer (R45)	• Liquid	R45 / H350	<ul style="list-style-type: none"> • S23: Do not breathe gas/fumes/vapour/spray • S24: Avoid contact with skin • S51: Use only in well-ventilated areas • S36/37: Wear suitable protective clothing and gloves. • S45: In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible). • S53: Avoid exposure – obtain special instructions before use. <p>Prevention:</p> <ul style="list-style-type: none"> • P201: Obtain special instructions before use. • P202: Do not handle until all safety precautions have been read and understood. • P260: Do not breathe dust/fume/gas/mist/vapours/spray. • P281: Use personal protective equipment as required. <p>Response:</p> <ul style="list-style-type: none"> • P308 + P313: If exposed or 	<p>Worker</p> <ul style="list-style-type: none"> • Implement good standards of occupational hygiene • Consider technical advances and process upgrades • Minimise exposure using measures such as closed systems • Management/supervision to check that the RMMs in place are being used correctly and OCs followed • Restrict access to authorised persons; • Provide specific activity training • Regularly inspect, test and maintain all control measures • Consider the need for risk based health surveillance <p>Consumer</p> <ul style="list-style-type: none"> - Not supported unless marketed in a manner consistent with Article 56 of REACH

Hazard	Material	Risk / Hazard Phrase	Examples of Relevant S Phrases and P Statements	Components of the Qualitative Risk Assessment
			<p>concerned: Get medical advice/attention.</p> <p>Storage:</p> <ul style="list-style-type: none"> • P405: Store locked up. <p>Disposal:</p> <ul style="list-style-type: none"> • P501 : Dispose of contents/container to.... in accordance with local/regional/national/international regulations (to be specified) 	

For any substance, classified as R45, these risk management measures will be communicated via the Exposure Scenario by use of the following phrases:

For every exposure scenario, the following general phrase will be included

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. G20.

In addition the following specific phrases will also be applied, where the identified contributing scenarios are relevant within any Exposure Scenario

Contributing Scenarios (examples)	Risk Management Measures (all included in Exposure Scenarios – for R45 substances)
CS2 Process sampling	Sample via a closed loop or other system to avoid exposure. E8.
CS14 Bulk transfers (incl. CS501) <i>And related phrases such as CS6, CS8.</i>	Ensure material transfers are under containment or extract ventilation. E66.
CS15 General exposures (closed systems) <i>And related phrases...</i>	Handle substance within a closed system. E47.
CS507 Refuelling	Ensure material transfers are under containment or extract ventilation. E66.
CS36 Laboratory activities	Handle within a fume cupboard or implement suitable equivalent methods to minimise exposure. E12.
CS5 Equipment maintenance AND CS39 Equipment cleaning and maintenance	<p>Either: Drain down and flush system prior to equipment break-in or maintenance. E55;</p> <p>Or; Drain down system prior to equipment break-in or maintenance. E65.</p> <p>And; Retain drain downs in sealed storage pending disposal or</p>

	for subsequent recycle. ENVT4. Clear spills immediately. C&H13.
CS67 Storage	Store substance within a closed system. E84.

Qualitative Risk Characterisation for R66 substances

The implementation of relevant RMMs will ensure that the likelihood of an event occurring due to the substance hazard of skin defatting is negligible and the risk is considered to be controlled to a level of no concern.

For skin defatting a qualitative risk characterisation has been conducted consistent with the considerations and risk management measures identified in the Table below.

Hazard	Material	Risk / Hazard Phrase	Examples of Relevant S Phrases and P Statements	Components of the Qualitative Risk Assessment
Skin defatting (R66)	• Liquid	R66 / EUH066 Repeated exposure may cause skin dryness or cracking	No designated S and P phrases are assigned, though the following phrase may be appropriate: S24 Avoid contact with skin Response: <ul style="list-style-type: none"> • P280: Wear protective gloves/protective clothing/eye protection/face protection. • P281: Use personal protective equipment as required. 	<ul style="list-style-type: none"> • Implementation of basic standards of occupational hygiene; • Avoid repeated and/or prolonged skin contact with product; • Wear gloves (tested to EN374) if hand contamination likely, wash off any skin contamination promptly; • Avoid splashes and spills; • Avoidance of contact with contaminated tools and objects; • Clean up contamination/spills; • Regular cleaning of equipment and work area; • Management/supervision to check that the RMMs in place are being used correctly and OCs followed; • Training for staff on good practice to prevent / minimise exposures and to report any skin effects that may develop; • Good standard of personal hygiene.

For any substance, classified as R66, these measures should be communicated via the safety data sheet by use of the following phrase:

- PPE20: 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

**APPENDIX 4: REACH Tier II Environmental Risk
Assessment of Heavy Fuel Oil Components
Manufactured at European Refineries**

Tier II Environmental Risk Assessment of Heavy Fuel Oil Components Manufactured at European Refineries

The Petrorisk model has been applied to assess the risks of Heavy Fuel Oil (HFO) manufacture in the framework of REACH. The model first calculates the risk characterization ratios (RCRs) for a generic refinery scenario and then scales these results to characterize risks for specific refineries using site-specific data.

To develop initial exposure estimates, the Sector Specific Environmental Release Category (SpERC) for the manufacturing generic exposure scenario is used. This SpERC provides a number of key default parameters such as the site tonnage, release fraction to wastewater, wastewater flow and the receiving water dilution factor that are required inputs for generic exposure calculations.

Since HFO is a complex substances (i.e. UVCB), assumptions must also be invoked regarding the composition of the substance and associated emissions. Substance composition is characterized based on analysis of multiple HFO samples using two-dimensional gas chromatography. These analytical results are used to determine a typical HFO composition that is defined in terms of the weight percent of various structural classes and carbon numbers, i.e. hydrocarbon blocks. To simulate the HFO substance composition this distribution is then mapped to a library of 1500 representative hydrocarbon structures that are included in the Petrorisk model. The composition of HFO wastewater emissions is then estimated from the simulated substance composition by applying Raoult's Law. This ensures that the water solubility of the representative hydrocarbons is taken into account in emissions estimation.

Given the SpERC site tonnage and wastewater release fraction coupled with the simulated wastewater composition described above, wastewater emissions of each HFO structure are determined. The corresponding predicted wastewater influent concentrations are then calculated by dividing the structure-specific emission by the generic wastewater treatment flow. These predicted influent concentrations are then reduced by the structure-specific wastewater treatment removal that is obtained using the SimpleTreat model. The resulting predicted effluent concentrations for each HFO structure is then used to calculate surface or marine water concentrations by dividing by the default dilution factor. Sediment concentrations are calculated from predicted water concentrations using equilibrium partitioning theory. Risks associated with concentrations of each structure in effluent, water and sediment are then calculated using an additive toxicity model. The effect concentrations for each structure are calculated using the target lipid model that is incorporated into Petrorisk. Finally, risks associated with specific refineries are determined by scaling the generic refinery scenario results.

The first step in scaling generic results to a specific refinery is to estimate the concentration of HFO associated hydrocarbons in the refinery effluent. This is accomplished by multiplying site measurements of total petroleum hydrocarbons (TPH) in refinery effluent by the ratio of HFO production to crude throughput.

$$P_{HFO,i} = TPH_{Effluent,i} \times P_{HFO,i} / T_{Crude,i} \quad (1)$$

where i refers to refinery i

To calculate a refinery specific RCR for wastewater treatment plant microbes, the following equation is applied:

$$RCR_{WWTP,i} = RCR_{WWTP,generic} \times P_{HFO,i} / P_{HFO,generic} \quad (2)$$

where $RCR_{WWTP,generic}$ and $P_{HFO,generic}$ are the predicted risk characterization ratio and total effluent concentration of HFO associated hydrocarbons obtained from the generic refinery scenario described above.

To calculate a refinery specific RCR for surface/marine waters or sediments, the site-specific dilution factor must also be incorporated into scaling:

$$RCR_{Water,i} = RCR_{Water,generic} \times P_{HFO,i} / P_{HFO,generic} \times DF_{HFO,generic} / DF_{HFO,i} \quad (3)$$

$$RCR_{Sediment,i} = RCR_{Sediment,generic} \times P_{HFO,i} / P_{HFO,generic} \times DF_{HFO,generic} / DF_{HFO,i} \quad (4)$$

The above procedure has been applied to assess the environmental risk of 117 European refineries that manufacture HFO. Results indicate that only 8 refineries exhibited RCRs for at least one compartment greater than one (Table 1). Consequently a Tier II assessment was performed in an attempt to refine conservative exposure assumptions and improve risk estimates.

Table 1. Refineries manufacturing HFO with predicted RCRs calculated in Petrorisk based on site-specific scaling with RCRs > 1

Refinery code	Effluent	Fresh Water	Fresh Water Sediment	Marine Water	Marine Sediment
7.02				1.39	1.57
8.00	1.29			0.19	0.21
8.15	1.08			0.16	0.18
11.01				1.90	2.20
11.02				1.12	1.26
15.02	1.71			0.25	0.28
24.02	1.38	0.50	0.57		
27.02		1.13	1.28		

A critical assumption in the site specific scaling approach is the estimation of HFO constituents in refinery effluent based on site-specific HFO production and crude throughput volumes and effluent TPH data (Eqn 1). This equation has been applied to all the major marketed petroleum substances in an attempt to develop a general allocation of refinery effluent TPH to each substance. Since other petroleum substances share some of the same hydrocarbon blocks that comprise HFO and are produced in higher volume, manufacture of these substances are also expected to contribute HFO related blocks to refinery effluent (Table 2). If the percentage of HFO blocks that comprise each substance is weighted by the percentage that the substance contributes to the effluent TPH, the percentage of HFO blocks in a generic refinery effluent can be calculated. If the contribution for each substance is summed the total percentage of HFO blocks is predicted to be 51.6% (Table 2). Thus, using the approach incorporated into Petrorisk approximately half of the TPH in effluent is predicted to be attributable to HFO related blocks.

Table 2. Allocation of TPH and HFO Block Composition to Substances and Implications for HFO Refinery Effluent Composition

Substance	% TPH Allocation	% HFO Blocks in Composition	% HFO Blocks in Effluent
Naphthas	26.2	1.7	0.5
Kerosines	7.5	39.8	3.2
MK-1	0.5	87.2	0.5
Straight run gas oils	1.1	52.4	0.6
Vacuum gas oils	39.2	66.0	27.6
Cracked gas oils	0.4	82.1	0.4
Other gas oils	2.7	60.8	1.8
Other substances	6.4	0.0	0.0
HFO	16	100.0	17.1
Total			51.6

To determine how predictions compare with actual TPH composition in EU refinery effluents, an

analysis of the Effluent Speciation Project (ESP) that was carried out by CONCAWE in 2008 and 2009 (CONCAWE Report 3/10, in press) has been performed. In this project, 111 effluent samples from 105 refineries were analysed by 2d-GC to obtain an impression of the hydrocarbon speciation across EU refineries. Table 3 provides a statistical summary by receiving water type of the measured TPH concentrations as well as the % contribution from HFO related blocks.

Table 3. Statistical Summary of CONCAWE Effluent Speciation Project

Receiving medium	Parameter	TPH (mg/l)	HFO Blocks %
Fresh water	Median	0.14	17
	Average	2.85	12
	95 %-tile	9.46	16
Marine	Median	0.16	18
	Average	1.73	14
	95 %-tile	6.86	15
External WWTP	Median	3.51	14
	Average	9.34	4
	95 %-tile	16.76	10

This analysis indicates that the actual contribution of HFO blocks to TPH ranges from 4 to 18% in contrast the much higher predictions obtained via the scaling approach presented in Table 2. Consequently, the scaling approach overestimates the amount of HFO blocks in refinery effluent by at least a factor of 2.9 (i.e. 51.6/18). Given the conservatism introduced by the assumptions used to estimate effluent speciation in the Petrisk model, estimated RCRs obtained for the eight refineries ranging from 1.08 to 2.20 (Table 1) can be refined by dividing by 2.9. The revised RCRs are provided in Table 4. Results indicate all refineries have RCRs below one indicating no unacceptable risks.

Table 4. Tier 2 Risk Characterization for Refineries in Table 1 Using Recent Measured Effluent TPH Speciation Data

Refinery code	Effluent	Fresh Water	Fresh Water Sediment	Marine Water	Marine Sediment
7.02				0.48	0.54
8.00	0.44			0.19	0.21
8.15	0.37			0.16	0.18
11.01				0.66	0.74
11.02				0.39	0.44
15.02	0.59			0.25	0.28
24.02	0.48	0.25	0.57		
27.02		0.39	0.44		