044- Recommended guidelines for discharge and emission reporting, Rev. 25

Annex B- VOC emissions handbook

Handbook for quantification of direct methane and nmVOC emissions

June 2026

Table of contents

1. Introduction

This handbook is a summary of proposed models for calculating direct methane and nmVOC emissions from facilities on the Norwegian continental shelf.

The handbook is intended as an aid to operator companies in their work to facilitate reporting of the emissions. It provides a description of the calculation methodology that should be used for the individual sources of direct emissions of methane and nmVOC for which emissions are to be reported in connection with the annual report to the Norwegian Environment Agency.

2. Emission sources

Pursuant to the new reporting format, 32 sources have been defined 2from which emissions of methane and nmVOC may potentially occur on a facility. In addition, there are some minor sources that are added as a percentage supplement. For practical reasons, the sources are organised into **Main sources** and **Sub-sources**.

Table 1 - Overview of emission sources

Source ID	Main sources	Sub-sources
1.1	Measured emission	Measured common vent
10.1	Triethylene glycol (TEG) regeneration	TEG flash tank
10.2	Triethylene glycol (TEG) regeneration	TEG regenerator
10.3	Triethylene glycol (TEG) regeneration	Stripping gas
20.1	Monoethylene glycol (MEG) regeneration	MEG flash tank
20.2	Monoethylene glycol (MEG) regeneration	MEG regenerator
20.3	Monoethylene glycol (MEG) regeneration	Stripping gas
30.1	Amine regeneration	Amine flash tank
30.2	Amine regeneration	Amine regenerator
40.1	Produced water handling	Produced water flash tank
40.2	Produced water handling	Flotation tank / CFU
40.3	Produced water handling	Flotation gas
40.4	Produced water handling	Discharge caisson
50.1	Centrifugal compressor seal oil	Degassing pots
50.2	Centrifugal compressor seal oil	Seal oil retention tank
50.3	Centrifugal compressor seal oil	Seal oil storage tank
60.1	Reciprocating compressor	Separator chamber
60.2	Reciprocating compressor	Crankcase
70.1	Dry compressor seals	Primary seal gas
70.2	Dry compressor seals	Secondary seal gas
70.3	Dry compressor seals	Leakage of primary seal gas to secondary vent
80.1	Unburnt flare gas	Extinguished flare and flare ignition
80.2	Unburnt flare gas	Non-combustible flare gas
80.3	Unburnt flare gas	Inert gas-purged open flare
90.1	Process leaks	Major gas leaks
90.2	Process leaks	Minor gas leaks
100.1	Purge and blanket gas	Purge and blanket gas
110.1	Gas analysers and sampling stations	Gas analysers and sampling stations
120.1	Drilling	Drilling
130.1	Crude oil storage tanks on FPSO	Gas-freeing in connection with tank inspection
130.2	Crude oil storage tanks on FPSO	Abnormal operating situation
140.1	Gas-freeing of process systems	Gas-freeing of process systems
160. 1	Cold venting from turbines	Cold venting during start-up, operation and shutdown of turbines
900.1	General supplement	FPSO
910.1	General supplement	Fixed facilities

3. Methods for emission calculations

3.1 General

The emissions are calculated for the individual sources and sub-sources. Recommended calculation methods vary from sub-source to sub-source. For most sources, the waste gas may be routed to discharge, to flaring or to recovery. Only the waste gas routed to discharge shall be reported. In Footprint, the method used to calculate emissions for each individual source shall be specified. The predefined calculation methods that can be selected in Footprint are given in Table 2.

Table 2 – Predefined calculation methods in Footprint.

Calculation methods
Direct measurements
Indirect measurements
Mass balance
Not on the installation
GRI-GLYCalc (only for the 10 and 20 series)
MultiProScale (only for the 10 and 20 series)
Emission factor
1% general supplement (only for 910.1)
3% general supplement (only for 900.1)
Supplier data
Henry's law (only for the 40 series)*
Routed to flare
Recovery
Included in measured common vent
Other installation-specific method
Flow rate of stripping gas
Calculated from upstream pressure and water quantity
Registration of time with unlit flare
OGI leak/no leak
Calculation of flow rate
Annual gas-freed storage tank volume
Volume of gas-freed process plant

*Not a relevant method

3.2 Measured emission from common vent - sub-source 1.1

General quantification method.

For installations that have a flow meter on the common vent, these measurements may be used as the basis for reporting, instead of quantifying the individual contributing sources/sub-sources, provided that this gives equally accurate or better emission data. If the emission gas through the common vent contains larger proportions of inert gases, the proportion of these should be calculated/measured and deducted.

In cases where the contribution from some of the contributing sources can be well quantified using the methods given in these guidelines, these should be deducted from the emissions from the common vent and reported under the relevant emission source(s). The emissions may be calculated in a two-step operation:

Step 1. Calculation of waste gas quantity.

$V_{NG} = V_{MEASURED} – (V_{N2} + V_{H2O} + V_{CO2}) – (V_{HC\_SOURCE\ 1} + V_{HC\_SOURCE\ 2} + .. V_{HC\_SOURCE\ N})$

Table 3 - Explanation of the components in the equation for calculating emission quantity based on measurement from the common vent.

Component	Unit	Explanation
V_{NG}	Sm^3	Volume of natural gas used as the basis for calculating methane and nmVOC emissions
$V_{MEASURED}$	Sm^3	Accumulated measured emissions during the reporting period
V_{N2}	Sm^3	Quantified volume of N_2 in the waste gas
V_{H2O}	Sm^3	Quantified volume of H_2O (water vapour) in the waste gas
V_{CO2}	Sm^3	Quantified volume of CO_2 in the waste gas
$V_{HC\_SOURCE\ 1}$	Sm^3	Volume of waste gas from source quantified by source quantification
$V_{HC\_SOURCE\ 2}$	Sm^3	Volume of waste gas from source quantified by source quantification
$V_{HC\_SOURCE\ N}$	Sm^3	Volume of waste gas from source quantified by source quantification

If it is difficult to quantify the quantities of inert gas in the waste gas (for example N_2, H_2O and CO_2), conservative (low) estimates are better than no deduction. It should be possible to justify the estimate. For small quantities of inert gas, the deduction may be disregarded.

Step 2. Calculation of methane and nmVOC emissions.

Methane emissions: $U_{CH4} = V_{NG} * Mol\%_{CH4} * \rho_{CH4} * 10^{-5}$

nmVOC emissions: $U_{nmVOC} = V_{NG} * Mol\%_{nmVOC} * \rho_{nmVOC} * 10^{-5}$

Table 4 - Explanation of the components in the equation for calculating emissions from the common vent.

Component	Unit	Explanation
U_{CH4}	tonnes	Methane emissions during the reporting period
U_{nmVOC}	tonnes	nmVOC emissions during the reporting period
V_{NG}	Sm^3	Volume of natural gas used as the basis for calculating methane and nmVOC emissions. See Step 1.
$Mol\%_{CH4}$	%	Mol% or volume% methane in the seal gas
$Mol\%_{nmVOC}$	%	Mol% or volume% nmVOC in the seal gas
ρ_{CH4}	kg/Sm^3	Density of CH_4. This is approximately 0.68 kg/Sm^3
ρ_{nmVOC}	Kg/Sm^3	Density of nmVOC. May be set equal to 2.0 kg/Sm^3

3.3 Calculation of emissions from TEG regeneration – sub-sources 10.1, 10.2 and 10.3

Three sub-sources from TEG regeneration generate waste gases that may be routed to discharge:

- Waste gas from the TEG flash tank
- Waste gas from the TEG regenerator
- HC stripping gas (used gas is mixed with waste gas from the TEG regenerator before any discharge)

3.3.1 TEG flash tank - sub-source 10.1

General quantification method.

In the event of any discharge from the sub-source, the emission quantity is calculated as for TEG regeneration (see Section 3.3.2).

3.3.2 TEG regenerator - sub-source 10.2

General quantification method.

There are two alternatives for quantifying waste gas (boiled-off gas) from the TEG regenerator:

Alternative 1:
Use of the GRI-GLYCalc software system (a US-developed Windows-based calculation program, specially developed to calculate the quantity and composition of waste gases from the various waste-gas sources in glycol systems, accepted and used by the U.S. EPA).

The required installation-specific input parameters are:

- Volumetric flow rate of natural gas through the absorption column
- Gas composition of the natural gas
- Pressure and temperature in the absorption column
- Pressure and temperature in the flash tank
- Pressure and temperature in the regenerator (boiler)
- TEG circulation rate

The software system calculates emissions of methane and the individual hydrocarbon components in nmVOC (these are added together to arrive at total nmVOC emissions).

Alternative 2:
As GRI-GLYCalc is a commercial program, an alternative method may also be used. The content of methane and nmVOC (C_2+) in the TEG solution, measured as mass per unit volume of TEG solution, is determined by sampling and analysis of TEG downstream of the flash tank.

Methane emissions: $U_{CH4} = V_{TEG} * k_{CH4} * t$
nmVOC emissions: $U_{nmVOC} = V_{TEG} * k_{nmVOC} * t$

Table 5 - Explanation of the components in the equation for calculating emissions from the TEG regenerator.

Component	Unit	Explanation
U_{CH4}	tonnes	Methane emissions from the TEG regenerator during the reporting period
U_{nmVOC}	tonnes	nmVOC emissions from the TEG regenerator during the reporting period
k_{CH4}	tonnes CH_4/m^3 TEG	Concentration of CH_4 in the TEG solution
k_{nmVOC}	tonnes nmVOC/m^3 TEG	Concentration of nmVOC in the TEG solution
V_{TEG}	m^3/hour	Circulation rate of the TEG solution
t	hours	Number of operating hours in the reporting period

3.3.3 Stripping gas - sub-source 10.3

General quantification method.

Some installations use HC stripping gas to accelerate the removal of water from the TEG solution. Measurement or other reliable quantification of the stripping gas quantity entering the regenerator will be necessary in order to quantify the emissions. The composition of the waste gas is the same as the composition of the stripping gas entering the installation.

The emissions may, in simplified form, be calculated as follows:

Methane emissions: $U_{CH4} = V_{NG} * Mol\%_{CH4} * \rho_{CH4} * t * 10^{-5}$
nmVOC emissions: $U_{nmVOC} = V_{NG} * Mol\%_{nmVOC} * \rho_{nmVOC} * t * 10^{-5}$

Table 6 - Explanation of the components in the equation for calculating emissions from the TEG regenerator.

Component	Unit	Explanation
U_{CH4}	tonnes	Methane emissions from the TEG regenerator during the reporting period
U_{nmVOC}	tonnes	nmVOC emissions from the TEG regenerator during the reporting period
V_{NG}	Sm^3/hour	Flow rate of natural gas into the regenerator
$Mol\%_{CH4}$	%	Mol% or volume% methane in the seal gas
$Mol\%_{nmVOC}$	%	Mol% or volume% nmVOC in the seal gas
ρ_{CH4}	kg/Sm^3	Density of methane (= 0.68 kg/Sm^3)
ρ_{nmVOC}	kg/Sm^3	Density of nmVOC (may be set equal to 2.0 kg/Sm^3 if the composition of the nmVOC is unknown; otherwise, it may be calculated from laboratory analyses of the fuel gas)
t	hours	Number of operating hours in the reporting period

3.4 Calculation of emissions from MEG regeneration - sub-sources 20.1, 20.2 and 20.3

General quantification method.

Use of specially developed calculation tools to quantify the emissions. Alternatives:

- **GRI-GLYCalc**: calculation program described in more detail in the chapter on TEG regeneration
- **MultiProScale**: process simulation program specially developed to simulate chemistry, thermodynamics and equilibrium in oil-gas-water and MEG systems

Emissions of methane and nmVOC from any stripping gas are calculated in the same way as for stripping gas in TEG regeneration (see Section 3.3.3).

3.5 Calculation of emissions from amine regeneration - sub-sources 30.1 and 30.2

Installation-specific quantification method

Established by the operator company of the installation. The accuracy of the method should be documentable.

3.6 Calculation of emissions from produced water handling – sub-sources 40.1, 40.2, 40.3 and 40.4

Emissions may normally occur if waste gas from the following sources is routed to discharge:

- Produced water flash tank
- Flotation tank/CFU[1] (for installations that have such a system)
- Supplied flotation gas (if HC gas is used)
- Discharge caisson

3.6.1 Degassing tank, flotation tank and discharge caisson - sub-sources 40.1, 40.2, 40.4

General quantification method.

The waste gas quantity is a result of pressure reduction of the produced water and may be calculated using the following general quantification method:

Methane emissions: $U_{CH4} = f_{CH4} * V_{pw} * \Delta p$
nmVOC emissions: $U_{nmVOC} = f_{nmVOC} * V_{pw} * \Delta p$

Table 7 - Explanation of the components in the equation for calculating direct emissions from produced water.

Component	Unit	Explanation
U_{CH4}	tonnes	Methane emissions from produced water during the reporting period
U_{nmVOC}	tonnes	nmVOC emissions from produced water during the reporting period
f_{CH4}	**14** tonnes CH_4/(10^6 m^3 produced water*bar)	Emission factor for CH_4. Tonnes of methane per million m^3 of produced water through the degassing point and per bar pressure drop from the nearest upstream degassing point.
f_{nmVOC}	**3.5** tonnes nmVOC/(10^6 m^3 produced water*bar)	Emission factor for nmVOC. Tonnes of nmVOC per million m^3 of produced water through the degassing point and per bar pressure drop from the nearest upstream degassing point*.
V_{PW}	m^3	Accumulated quantity of produced water through the degassing point during the reporting period
Δp	bar	Operating pressure difference between the degassing point and the nearest upstream degassing point
t	hours	Number of operating hours in the reporting period

*If the pressure and temperature of the produced water indicate the use of other factors pursuant to the report "Kaldventilering og diffuse utslipp fra petroleumsvirksomheten på norsk sokkel - Delrapport 2 Utslippsmengder og kvantifiseringsmetodikk", prepared by Add Novatech AS for the Norwegian Environment Agency, 2016, the operator is free to choose this if relevant documentation is available.

[1] CFU = Compact Flotation Unit

If the produced water system has more than one degassing point, e.g. both from the CFU and from the discharge caisson, the waste gas quantity from each degassing point is calculated and added together.

The produced water quantity V_{PW} is the quantity of produced water passing the degassing point. For emissions from the discharge caisson, this will be the quantity of produced water discharged to sea. Emissions from the degassing tank and flotation unit may also include produced water that is reinjected.

3.6.2 HC gas as flotation gas in flotation tank/CFU - sub-source 40.3

General quantification method.

Emissions of flotation gas are determined by measuring the quantity of flotation gas entering the installation, or by quantifying it in another reliable manner. The operator should be able to document how the flotation gas quantity has been established.

Methane emissions: $U_{CH4} = V_{NG} * Mol\%_{CH4} * \rho_{CH4} * t * 10^{-5}$

nmVOC emissions: $U_{nmVOC} = V_{NG} * Mol\%_{nmVOC} * \rho_{nmVOC} * t * 10^{-5}$

Table 8 - Explanation of the components in the equation for calculating emissions from flotation tank/CFU.

Component	Unit	Explanation
U_{CH4}	tonnes	Methane emissions from flotation tank/CFU during the reporting period
U_{nmVOC}	tonnes	nmVOC emissions from flotation tank/CFU during the reporting period
V_{NG}	Sm^3/hour	Flow rate of natural gas (flotation gas) into the flotation tank/CFU
$Mol\%_{CH4}$	%	Mol% or volume% methane in the seal gas
$Mol\%_{nmVOC}$	%	Mol% or volume% nmVOC in the seal gas
ρ_{CH4}	kg/Sm^3	Density of methane (= 0.68 kg/Sm^3)
ρ_{nmVOC}	kg/Sm^3	Density of nmVOC (may be set equal to 2.0 kg/Sm^3 if the composition of the nmVOC is unknown; otherwise, it may be calculated from laboratory analyses of the fuel gas)
t	hours	Number of operating hours in the reporting period

3.7 Calculation of emissions from centrifugal compressor seal oil - sub-sources 50.1, 50.2, 50.3

Installation-specific method

Seal oil used in centrifugal compressors absorbs gas from the compressor. The gas is released as waste gas from up to three sub-sources:

- Degassing pots (sub-source 50.1). There are normally one to two pots per compression stage
- Seal oil retention tank (sub-source 50.2). This may be common to all compressors.
- Seal oil storage tank (sub-source 50.3). Common to all compressors.

On some installations, the retention tank and storage tank are combined in one tank.
The emissions are determined in accordance with installation-specific method(s) established by the operator company. The relevance and accuracy of the method should be documented.

3.8 Calculation of emissions from reciprocating compressor - sub-sources 60.1, 60.2

Installation-specific method

The number of installations with reciprocating compressors is low, and they use different sealing systems. The emissions are determined in accordance with installation-specific methods established by the operator company. The relevance and accuracy of the method should be documentable.

3.9 Calculation of emissions from dry compressor seals – sub-sources 70.1, 70.2 and 70.3

Installation-specific methods

Centrifugal compressors with dry seals result in emissions if HC-containing seal gas is not recovered or flared. Three (3) potential sub-sources may give rise to emissions.

1. Used primary seal gas.
2. Used secondary seal gas (if HC gas is used).
3. Leakage of primary seal gas to secondary vent.

The emissions are calculated for each individual compressor stage (two seals per compression stage) and added together.

3.9.1 Primary seal gas - sub-source 70.1

General quantification method.

Depending on available information, three general quantification methods are recommended:

Primary method:

Measurement of the quantity of seal gas (barrier gas) out of the "Primary Vent". Some compressors are fitted with a flow meter on the gas from the primary vent. The emissions from each of the two seals per compressor are calculated using the following formula:

Methane emissions: $U_{CH4} = V_{PTout} * Mol\%_{CH4} * \rho_{CH4} * t * 10^{-5}$

nmVOC emissions: $U_{nmVOC} = V_{PTout} * Mol\%_{nmVOC} * \rho_{nmVOC} * t * 10^{-5}$

Table 9 - Explanation of the components in the equation for calculating emissions of primary seal gas.

Component	Unit	Explanation
U_{CH4}	tonnes	Methane emissions from primary seal gas per seal per compressor during the reporting period
U_{nmVOC}	tonnes	nmVOC emissions from primary seal gas per seal per compressor during the reporting period
V_{PTout}	Sm^3/hour	Flow rate of primary seal gas out of the primary vent.
$Mol\%_{CH4}$	%	Mol% or volume% methane in the seal gas
$Mol\%_{nmVOC}$	%	Mol% or volume% nmVOC in the seal gas
ρ_{CH4}	kg/Sm^3	Density of methane (= 0.68 kg/Sm^3)
ρ_{nmVOC}	kg/Sm^3	Density of nmVOC (may be set equal to 2.0 kg/Sm^3 if the composition of the nmVOC is unknown; otherwise, it may be calculated from laboratory analyses of the export gas/fuel gas)
t	hours	Number of operating hours in the reporting period

The total emissions of primary seal gas are then:

Methane: $(U^1_{CH4} + U^2_{CH4})_{compressor1} + (U^1_{CH4} + U^2_{CH4})_{compressor2} + \ldots + (U^1_{CH4} + U^2_{CH4})_{compressor\ n}$

nmVOC: $(U^1_{nmVOC} + U^2_{nmVOC})_{compressor1} + (U^1_{nmVOC} + U^2_{nmVOC})_{compressor2} + \ldots + (U^1_{nmVOC} + U^2_{nmVOC})_{compressor\ n}$

Where:

U^1 = emissions from seal 1 on the compressor

U^2 = emissions from seal 2 on the compressor

Secondary method:

For compressors where the flow rate of primary seal gas out of the primary vent is not measured. On all compressors with dry seals, the quantity of seal gas into the primary seal is measured. By default, it is assumed that 10% of the seal gas entering the seal is discharged as waste gas. The formula set is then:

Methane emissions: $U_{CH4} = k * V_{PTin} * Mol\%_{CH4} * \rho_{CH4} * t * 10^{-7}$

nmVOC emissions: $U_{nmVOC} = k * V_{PTin} * Mol\%_{nmVOC} * \rho_{nmVOC} * t * 10^{-7}$

Table 10 - Explanation of the components in the equation for calculating emissions of primary seal gas.

Component	Unit	Explanation
k	%	Percentage of primary seal gas that exits through the primary vent. 10% is often recommended by the supplier.
V_{PTin}	Sm^3/hour	Flow rate of primary seal gas into the seal
$Mol\%_{CH4}$	%	Mol% or volume% methane in the seal gas
$Mol\%_{nmVOC}$	%	Mol% or volume% nmVOC in the seal gas
ρ_{CH4}	kg/Sm^3	Density of methane (= 0.68 kg/Sm^3)
ρ_{nmVOC}	kg/Sm^3	Density of nmVOC (may be set equal to 2.0 kg/Sm^3 if the composition of the nmVOC is unknown; otherwise, it may be calculated from laboratory analyses of the export gas/fuel gas)
t	hours	Number of operating hours in the reporting period

The total emissions from the compressors are summed in the same way as for the primary method.

Tertiary method:
If measurement data into the seal are not available, data are obtained from the seal supplier.

3.9.2 Secondary seal gas - sub-source 70.2

This sub-source is only relevant in cases where fuel gas or another HC gas is used as seal gas.

General quantification method.

Seal gas entering the seal is measured, or quantified in another satisfactory manner. The quantity of gas entering equals the quantity of gas exiting through the "secondary vent". The emissions per seal are calculated as follows:

Methane emissions: $U_{CH4} = V_{STin} * Mol\%_{CH4} * \rho_{CH4} * t * 10^{-5}$
nmVOC emissions: $U_{nmVOC} = V_{STin} * Mol\%_{nmVOC} * \rho_{nmVOC} * t * 10^{-5}$

Table 11 - Explanation of the components in the equation for calculating emissions of secondary seal gas.

Component	Unit	Explanation
U_{CH4}	tonnes	Methane emissions from secondary seal gas per seal per compressor during the reporting period
U_{nmVOC}	tonnes	nmVOC emissions from secondary seal gas per seal per compressor during the reporting period
V_{STin}	Sm^3/hour	Flow rate of secondary seal gas into the secondary seal
$Mol\%_{CH4}$	%	Mol% or volume% methane in the seal gas
$Mol\%_{nmVOC}$	%	Mol% or volume% nmVOC in the seal gas
ρ_{CH4}	kg/Sm^3	Density of methane (= 0.68 kg/Sm^3)
ρ_{nmVOC}	kg/Sm^3	Density of nmVOC (may be set equal to 2.0 kg/Sm^3 if the composition of the nmVOC is unknown; otherwise, it may be calculated from laboratory analyses of the export gas/fuel gas)
t	hours	Number of operating hours in the reporting period

The total emissions from the compressors' secondary seal gas are summed in the same way as for primary seal gas.

3.9.3 Leakage of primary seal gas to secondary vent - sub-source 70.3

This is only relevant to quantify if

- the gas from the primary vent is recovered or routed to flare, and
- the seal does not have a mechanical design that prevents such leakage (e.g. internal labyrinth), while secondary seal gas is not used (an internal labyrinth alone does not necessarily prevent small leaks).

General quantification method.

The emissions are calculated as 10% leakage into the secondary vent of waste gas from primary seal gas. This corresponds to 1% of the quantity of primary seal gas entering the primary seal. The emissions per relevant compressor stage are as follows (if the basis is measured quantity of primary seal gas out of the primary vent):

Methane emissions: $U_{CH4} = 0.1 * V_{PTout} * Mol\%_{CH4} * \rho_{CH4} * t * 10^{-5}$

nmVOC emissions: $U_{nmVOC} = 0.1 * V_{PTout} * Mol\%_{nmVOC} * \rho_{nmVOC} * t * 10^{-5}$

Table 12 - Explanation of the components in the equation for calculating emissions of primary seal gas.

Component	Unit	Explanation
V_{PTout}	Sm^3/hour	Flow rate of primary seal gas out of each primary vent
$Mol\%_{CH4}$	%	Mol% or volume% methane in the seal gas
$Mol\%_{nmVOC}$	%	Mol% or volume% nmVOC in the seal gas
ρ_{CH4}	kg/Sm^3	Density of methane (= 0.68 kg/Sm^3)
ρ_{nmVOC}	kg/Sm^3	Density of nmVOC (may be set equal to 2.0 kg/Sm^3 if the composition of the nmVOC is unknown; otherwise, it may be calculated from laboratory analyses of the export gas/fuel gas)
t	hours	Number of operating hours in the reporting period

If the compressor is not fitted with a meter that records the quantity of primary seal gas out of the primary vent, V_{PTout} is replaced by V_{PTin} and the factor 0.1 is replaced by 0.01.

Total emissions from the sub-source are obtained by summing the emissions from each of the seals on all relevant compressors, in the same way as for emissions of primary seal gas.

3.10 Calculation of emissions from unburnt flare gas – sub-sources 80.1, 80.2 and 80.3

Direct emissions of unburnt flare gas may occur in the following situations:

- If the flare is extinguished and during the period between admission of flare gas (opening for discharge of the flare gas) and ignition of the flare. The latter is particularly relevant for installations with a closed flare.
- Non-combustible flare gas (i.e. the flare gas has too low a hydrocarbon content to burn)
- Inert gas-purged open flare (cold flare).

In connection with reporting, the operator should select the sub-source below (80.1, 80.2 or 80.3) that is considered most representative of the emission situation.

3.10.1 Extinguished flare and flare ignition - sub-source 80.1

General quantification method.

The emissions are quantified by introducing a log recording the time from when the flare is extinguished or the flare valve opens until the flare is ignited. In simplified form, the emissions may be calculated as follows:

Methane emissions: $U_{CH4} = V_{FG} * Mol\%_{CH4} * \rho_{CH4} * 10^{-5}$

nmVOC emissions: $U_{nmVOC} = V_{FG} * Mol\%_{nmVOC} * \rho_{nmVOC} * 10^{-5}$

Table 13 - Explanation of the components in the equation for calculating emissions from extinguished flare/flare ignition.

Component	Unit	Explanation
U_{CH4}	tonnes	Methane emissions from extinguished flare / delayed flare ignition during the reporting period
U_{nmVOC}	tonnes	nmVOC emissions from extinguished flare / delayed flare ignition during the reporting period
V_{FG}	Sm^3	Volume of directly discharged unburnt flare gas during the reporting period
$Mol\%_{CH4}$	%	Mol% or volume% methane in the flare gas
$Mol\%_{nmVOC}$	%	Mol% or volume% nmVOC in the flare gas
ρ_{CH4}	kg/Sm^3	Density of methane (= 0.68 kg/Sm^3)
ρ_{nmVOC}	kg/Sm^3	Density of nmVOC (may be set equal to 2.0 kg/Sm^3 if the composition of the nmVOC is unknown; otherwise, it may be calculated from the assumed/calculated composition of the flare gas)

3.10.2 Non-combustible flare gas - sub-source 80.2

Installation-specific quantification method.

This applies to a small number of flares on the continental shelf that are characterised by having too low a content of HC gases to be able to burn. The flare therefore functions as a cold vent equipped with a flare gas meter. Since the flare gas meter measures all gas, not only HC gas, the challenge is to estimate the fraction of HC gases.

If the flare gas is never ignited, the emissions are quantified according to the total registered flare gas quantity multiplied by the fraction of HC gases.

If the flare is ignited during periods, for example because it is located close to a neighbouring flare that is ignited under special conditions, this is compensated for using the flaring log.

On this basis, the operator establishes an installation-specific quantification method for the relevant installation.

3.10.3 Inert gas-purged open flare - sub-source 80.3

General quantification method.

This applies to a very limited number of flares on the Norwegian continental shelf. These are inert gas-purged flares that do not have emissions during normal operation. The flares are equipped with flare gas meters and are only in operation for short periods during special situations:

a. During depressurisation of smaller equipment units or pipe sections in connection with maintenance or emergency blowdown. If the discharge occurs without the flare being ignited, all of it is reported as methane and nmVOC emissions. If the flare is ignited, methane and nmVOC emissions are not reported, except for emissions during the ignition period, as recorded by the flaring log.

b. During depressurisation of large volumes, e.g. piping systems (very rare), the flare is normally ignited. Methane and nmVOC emissions are only calculated for the short period during which the flare is unlit in connection with the start of flaring.

The emissions are calculated based on flare gas measurements. The flare gas quantity is stated in Sm^3. The distribution between methane and nmVOC is given by the composition of the flare gas, for example determined using the CMR method.

3.11 Calculation of emissions from process leaks – sub-sources 90.1 and 90.2

These emissions are divided into two groups that are quantified using different general methods:

- Sub-source 90.1 – Major gas leaks (hydrocarbon leaks with a rate above 0.1 kg/second)
- Sub-source 90.2 – Minor gas leaks/diffuse emissions

3.11.1 Major gas leaks - sub-source 90.1

General quantification method.

Major emission leaks include:

- Leaks reported in Chapter 8 of the emissions report. These are leaks that are quantified and reported in accordance with the HSE regulations and prioritised for mitigation.
- Any other large individual leaks from valves/flanges, couplings, etc. where the leak quantity is quantified separately for each leak.

The emissions are calculated as follows:

Methane emissions: $U_{CH4} = U_{UGL} * Weight\%_{CH4} * 10^{-2}$
nmVOC emissions: $U_{nmVOC} = U_{UGL} * Weight\%_{nmVOC} * 10^{-2}$

For such leaks, the gas composition will normally not be known. It may then be assumed that the emitted gas consists of 50 weight% methane and 50 weight% nmVOC (corresponding to 75 mol% methane and 25 mol% nmVOC and an nmVOC density of 2.0 kg/Sm^3). In such cases, the formula set above may be used.

If the composition is given in mol%, methane and nmVOC emissions may be calculated as follows:

Methane emissions: $U_{CH4} = U_{UGL} * (\rho_{CH4} * mol\%_{CH4})/(\rho_{CH4} * mol\%_{CH4}+\rho_{nmVOC} * mol\%_{nmVOC})$
nmVOC emissions: $U_{nmVOC} = U_{UGL} * (\rho_{nmVOC} * mol\%_{nmVOC})/(\rho_{CH4} * mol\%_{CH4}+\rho_{nmVOC} * mol\%_{nmVOC})$

(If the composition is given in vol%, then mol% is replaced by vol% in the equations, i.e. it is assumed that the gas is approximately ideal.)

For major gas leaks (> 10 tonnes), an attempt should be made to calculate/estimate the distribution between methane and nmVOC based on the leak location and the gas composition at that location.

Table 14 - Explanation of the components in the equation for calculating emissions from major gas leaks.

Component	Unit	Explanation
U_{CH4}	tonnes	Methane emissions from major gas leaks during the reporting period
U_{nmVOC}	tonnes	nmVOC emissions from major gas leaks during the reporting period
U_{UGL}	tonnes	Total emission quantity from major gas leaks during the reporting period (natural gas)
$Weight\%_{CH4}$	%	Weight% methane in the leak emissions
$Weight\%_{nmVOC}$	%	Weight% nmVOC in the leak emissions
$Mol\%_{CH4}$	%	Mol% or volume% methane in the leak gas
$Mol\%_{nmVOC}$	%	Mol% or volume% nmVOC in the leak gas
ρ_{CH4}	tonnes/Sm^3	Density of methane (= 0.68 kg/Sm^3)
ρ_{nmVOC}	tonnes/Sm^3	Density of nmVOC (may be set equal to 2.0 kg/Sm^3 if the composition of the nmVOC is unknown; otherwise, it may be calculated from the assumed/calculated composition of the flare gas)

Emissions from major gas leaks shall also be reported in Chapter 8 “Accidental releases”. There, the total quantity of released HC gas is reported (methane + nmVOC).

3.11.2 Minor gas leaks/diffuse emissions - sub-source 90.2

General quantification method.

The OGI “leak/no leak” method is used. The method is based on the following:

- A database of the installation’s components with leakage potential. This should be updated following updates to the Quantitative Risk Assessment (QRA).
- Use of an IR camera to detect leaks from the components. The camera should have an established lower detection limit.
- Statistically established “standard” leak rates from API for components with detected leakage and components with no detected leakage.

The emission quantities of natural gas are calculated as follows:

$U = k_{leak} * f_{leak} * 1/A * t_1 /1\,000\,000 + k_{noleak} * f_{noleak} * t_2 /1\,000\,000$ (tonnes/year)

Table 15 - Explanation of the components in the equation for calculating emissions from minor gas leaks.

Component	Unit	Explanation
U	tonnes	Emissions of HC gas (methane + nmVOC) from minor gas leaks during the reporting period
k_{leak}	Number	Number of components with detected leakage
$k_{no\text{-}leak}$	Number	Number of components where leakage was not detected
f_{leak}	g/hour/component	Emission factor for components with detected leakage

Component	Unit	Explanation
$f_{no\text{-}leak}$	g/hour/component	Emission factor for components where leakage was not detected
t_1	hours	Number of operating hours in the reporting period
t_2	hours	hours in the reporting period (8760 hours)
A	-	Fraction of hydrocarbon-containing systems covered by the IR scan (e.g. if 70% was covered, A equals 0.7).

Because the composition of the emission gas will not be known, it is recommended to assume 50 weight% methane and 50 weight% nmVOC (this corresponds to 75 mol% methane and 25 mol% nmVOC, which is considered to be sufficiently representative of this emission gas).

The emission factors used will depend on the detection limit of the IR camera. The emission factors are shown in Table 16.

If the detection limit of the IR camera is not known and there is no reasonable basis for another choice, emission factors specified for a 60 g/hour detection limit are used.

Table 16 - Overview of emission factors used in the OGI "leak/no leak" method

Component type	Type of emission factor	Emission factors *f* (g/hour/component)			
		Detection limit 3g/hour	Detection limit 6g/hour	Detection limit 30g/hour	Detection limit 60g/hour
Valves	no-leak	0,019	0,043	0,17	0,27
	leak	55	73	140	200
Connectors (flanges/threaded connections)	no-leak	0,0026	0,0041	0,01	0,014
	leak	29	45	88	120
Pumps	no-leak	0,096	0,13	0,59	0,75
	leak	140	160	310	350
Other components	no-leak	0,007	0,0140	0,0510	0,0810
	leak	56	75	150	210

The measurements shall be carried out using an approved IR camera. The FLIR Optical Imaging Camera GF320 and the OPGAL EyeCGas Camera are the most commonly used cameras. If these cameras, or cameras with equivalent resolution, are used, the emission factors for a detection limit of 3 g/hour shall be applied.

The OGI measurements should be carried out in accordance with Offshore Norge's industry template – *OGI "leak/no-leak" method for quantification of small leaks and fugitive emissions*, which provides further information and details on the methodology for measuring these emissions. The basis for this is that extensive measurements at Kårstø, Kollsnes, Mongstad and Sture using the "High Flow Sampling" method show that emissions per detected leak are, on average, lower than those shown in Table 16 for a detection limit of 3 g/hour.

OGI measurements on the same facility should preferably be coordinated with the update of the QRA and carried out with sufficient frequency. It is recommended that emissions be calculated on the basis of the measurement results until the next measurement. Thereafter, the new measurement results should be applied until a new measurement is carried out. If more than one OGI measurement campaign is carried out within a reporting year, the arithmetic mean of the measurements shall be used as the basis for reporting.

3.12 Calculation of emissions from purge and blanket gas - sub-source 100.1

General quantification method.

There are two general ways of quantifying the emissions:

1. **Measurement or another reliable quantification method for the flow rate in the supply pipe for purge/blanket gas from the fuel gas system.** If the measured purge/blanket gas goes to different consumers that route the waste gas to different recipients, such as recovery, flare and discharge (vent), the fraction routed to discharge should be quantifiable in a manner that is as reliable as the supply rate.

   The emissions are calculated using the following formulae:

   Methane emissions: $U_{CH4} = (V_{STG} - V_{ab}) * Mol\%_{CH4} * \rho_{CH4} * t * 10^{-5}$
   nmVOC emissions: $U_{nmVOC} = (V_{STG} - V_{ab}) * Mol\%_{nmVOC} * \rho_{nmVOC} * t * 10^{-5}$

   Table 17 - Explanation of the components in the equation for calculating emissions from purge and blanket gas.

Component	Unit	Explanation
U_{CH4}	tonnes	Methane emissions from purge and blanket gas during the reporting period
U_{nmVOC}	Tonnes	nmVOC emissions from purge and blanket gas during the reporting period
V_{STG}	Sm^3/hour	Total consumption (flow rate) of purge and blanket gas
V_{ab}	Sm^3/hour	Flow rate to users of purge and blanket gas where the waste gas is recycled or flared
$Mol\%_{CH4}$	%	Mol% or volume% methane in the seal gas
$Mol\%_{nmVOC}$	%	Mol% or volume% nmVOC in the seal gas
ρ_{CH4}	kg/Sm^3	Density of methane (= 0,68 kg/Sm^3)
ρ_{nmVOC}	kg/Sm^3	Density of nmVOC (may be set equal to 2.0 kg/Sm^3 if the composition of the nmVOC is unknown; otherwise, it may be calculated from laboratory analyses of the fuel gas)
t	hours	Number of operating hours in the reporting period

2. **By measuring and categorising the emission gas, where purge/blanket gas may be discharged together with gas from other sources.** This will require a flow meter in the discharge pipe and, if relevant, analyses of the waste gas.

   The distribution of the waste gas between methane and nmVOC is, in principle, carried out in the same way as for method 1 above.

If alternative 2 is in place, then alternative 1 is not relevant. The operator selects the quantification method based on what is best for the relevant facility.

The distribution between methane and nmVOC is determined by the composition of the fuel gas.

3.13 Calculation of emissions from gas analysers and sampling stations - sub-source 110.1

Calculated for installations where:

a) the analyser gas is taken from a side stream ("slip stream") to the main pipe, combined with
b) the side stream running continuously with discharge to the atmosphere.

The contribution from the other sub-sources to emissions from gas analysers and sampling stations is so small that it is included in the general supplement (See Section 3.17).

General quantification method:

Two alternative methods may be used:

1. By establishing the flow rate through the side stream by measurement or another reliable method. In this case, the emissions are calculated using the following formulae:

   Metane emissions: $U_{CH4} = V_G * Mol\%_{CH4} * \rho_{CH4} * t * 10^{-5}$
   nmVOC emissions: $U_{nmVOC} = V_G * Mol\%_{nmVOC} * \rho_{nmVOC} * t * 10^{-5}$

Table 18 - Explanation of the components in the equation for calculating emissions from gas analysers.

Component	Unit	Explanation
U_{CH4}	tonnes	Methane emissions from the side stream feeding the gas analyser during the reporting period
U_{nmVOC}	tonnes	nmVOC emissions from the side stream feeding the gas analyser during the reporting period
V_G	Sm^3/hour	Measured flow rate through the side stream
$Mol\%_{CH4}$	%	Mol% or volume% methane in the seal gas
$Mol\%_{nmVOC}$	%	Mol% or volume% nmVOC in the seal gas
ρ_{CH4}	kg/Sm^3	Density of methane (= 0.68 kg/Sm^3)
ρ_{nmVOC}	kg/Sm^3	Density of nmVOC (may be set equal to 2.0 kg/Sm^3 if the composition of the nmVOC is unknown; otherwise, it may be calculated from laboratory analyses of the gas)
t	hours	Number of operating hours in the reporting period

For analysers that categorise the entire gas stream, the mol% shown by the analysis is used. For other analysers, the operator selects the composition considered most representative (fuel gas, export gas or another composition). Average data over the reporting period should be acceptable.

2. If the side stream is routed to a common vent with a meter, the quantity of emission gas will be measured through the common vent metering station (see Section 3.2).

3.14 Calculation of emissions from drilling - sub-source 120.1

General quantification method.

Methane emissions: $U_{CH4} = a * f_{CH4}$
nmVOC emissions: $U_{nmVOC} = a * f_{nmVOC}$

The emission factors cover both emissions released in connection with cuttings handling and screening and emissions of gas from the mud separator.

Table 19 - Explanation of the components in the equation for calculating direct emissions from drilling.

Component	Unit	Explanation
U_{CH4}	tonnes	Methane emissions during the reporting period
U_{nmVOC}	tonnes	nmVOC emissions during the reporting period
a	number	Number of wellbores completed or recompleted during the reporting period
f_{CH4}	**0.25** tonnes/wellbore	Emission factor for CH_4
f_{nmVOC}	**0.25** tonnes/wellbore	Emission factor for nmVOC

Note that the activity factor is the number of wellbores completed or recompleted (not the number of wells).

3.15 Calculation of emissions from crude oil storage tanks on FPSO – sub-sources 130.1 and 130.2

This applies to emissions from floating combined production and storage units (FPSOs) where the tank atmosphere is natural gas.

3.15.2 Gas-freeing in connection with tank inspection - sub-source 130.1

General quantification method.

Methane emissions: $U_{CH4} = V_{tanks} * Mol\%_{CH4} * \rho_{CH4} * 10^{-5}$
nmVOC emissions: $U_{nmVOC} = V_{tanks} * Mol\%_{nmVOC} * \rho_{nmVOC} * 10^{-5}$

If compositions are only known in volume%, Mol% is replaced by volume% in the equations, as the difference is small compared with the other uncertainties.

Table 20 - Explanation of the components in the equation for calculating direct emissions from gas-freeing of crude oil storage tanks on FPSO.

Component	Unit	Explanation
U_{CH4}	tonnes	Methane emissions during the reporting period
U_{nmVOC}	tonnes	nmVOC emissions during the reporting period
$Mol\%_{CH4}$	%	Mol% or volume% methane in the seal gas
$Mol\%_{nmVOC}$	%	Mol% or volume% nmVOC in the seal gas
ρ_{CH4}	kg/Sm^3	Density of CH_4. This is approximately 0.68 kg/Sm^3
ρ_{nmVOC}	kg/Sm^3	Density of nmVOC. May be set equal to 2.0 kg/Sm^3
V_{tanks}	m^3	Total volume of all crude oil storage tanks that have been gas-freed during the reporting period

The density of nmVOC will depend on the composition of the VOC components. Normally, this is not known. A density of 2 kg/Sm^3 should be an acceptable approximation. Mol% is calculated based on the composition of the waste gas.

The composition of the waste gas may be set equal to the fuel gas composition on the installation if fuel gas is used as cover gas/blanket gas in connection with the final tank emptying.

If the installation is an FPSO with crude oil storage and inert gas (neutral gas) is used as cover gas after the final tank offloading before tank inspection, the general supplement is increased to 3% (sub-source 900.1).

3.15.3 Abnormal operating situation - sub-source 130.2

Installation-specific quantification method.

These are emissions from the storage tanks on an FPSO that may occur as a result of special, non-normal operating situations. The operator company establishes an installation-specific quantification method that takes the emission situation into account. The method should be documentable.

3.16 Calculation of emissions from gas-freeing of process systems - sub-source 140.1

General quantification method.

This source applies only if all or parts of the process plant are gas-freed during the reporting year. The emissions are calculated using a conservative approach, assuming that all HC gas in the depressurised process plant is discharged to air when gas-freeing starts.

If good documentation is available for which systems were gas-freed, the volume of these systems may be used as the basis for reporting, rather than the entire process plant.

Methane emissions: $U_{CH4} = V_{process\ plant} * a * Mol\%_{CH4} * \rho_{CH4} * 10^{-5}$

nmVOC emissions: $U_{nmVOC} = V_{process\ plant} * a * Mol\%_{nmVOC} * \rho_{nmVOC} * 10^{-5}$

Table 21 - Explanation of the components in the equation for calculating direct emissions from depressurisation and gas-freeing of process plants.

Component	Unit	Explanation
U_{CH4}	tonnes	Methane emissions during the reporting period
U_{nmVOC}	tonnes	nmVOC emissions during the reporting period
$Mol\%_{CH4}$	%	Mol% or volume% methane in the seal gas
$Mol\%_{nmVOC}$	%	Mol% or volume% nmVOC in the seal gas
ρ_{CH4}	kg/Sm^3	Density of CH_4. This is approximately 0.68 kg/Sm^3
ρ_{nmVOC}	kg/Sm^3	Density of nmVOC. May be set equal to 2.0 kg/Sm^3
$V_{Process\ plant}$	Sm^3	Total volume of process plant gas-freed per gas-freeing operation
a	number	Number of gas-freeing operations during the reporting period

Emissions are reported only for reporting periods in which gas-freeing has taken place.

The fuel gas composition may be used as the basis for determining the weight ratio between methane emissions and nmVOC emissions.

3.17 Cold venting in connection with turbine operation – sub-source 160.1

This sub-source covers venting during start-up, operation or shutdown of turbines. Venting must not be confused with unburnt natural gas in the exhaust gas from combustion (not direct VOC emissions). It is recommended that operators carry out a technical review of burner and seal design in turbines in consultation with the supplier in order to assess the potential for cold venting during operation. This also includes cold venting during turbine shutdown and fuel changeover from gas to diesel. A turbine-specific leakage rate established from supplier measurements may be used if available. Emissions from cold venting may generally be quantified based on a leakage rate or a known emission volume.

General quantification method.

There are two general ways of quantifying the emissions:

1. Calculation with known leakage rate:
   Methane emissions: $U_{CH4} = t * V_L * Mol\%_{CH4} * 10^{-5}$
   nmVOC emissions: $U_{nmVOC} = t * V_L * Mol\%_{nmVOC} * 10^{-5}$

2. Calculation with known emission volume:
   Methane emissions: $U_{CH4} = V_v * a * Mol\%_{CH4} * \rho_{CH4} * 10^{-5}$
   nmVOC emissions: $U_{nmVOC} = V_v * a * Mol\%_{nmVOC} * \rho_{nmVOC} * 10^{-5}$

The fuel gas composition is used as the basis for determining the molar/weight ratio between methane and nmVOC emissions. Density for methane and nmVOC (ρ) may be used to convert to vented volume in the unit Sm^3.

Table 22 - Explanation of the components in the equation for calculating direct emissions from cold venting of turbines in operation

Component	Unit	Explanation
U_{CH4}	tonnes	Methane emissions during the reporting period
U_{nmVOC}	tonnes	nmVOC emissions during the reporting period
$Mol\%_{CH4}$	%	Mol% or volume% methane in the fuel gas
$Mol\%_{nmVOC}$	%	Mol% or volume% nmVOC in the fuel gas
ρ_{CH4}	kg/Sm^3	Density of methane (= 0.68 kg/Sm^3)
ρ_{nmVOC}	kg/Sm^3	Density of nmVOC (may be set equal to 2.0 kg/Sm^3 if the composition of the nmVOC is unknown; otherwise, it may be calculated from laboratory analyses of the fuel gas)
t	hours	Number of operating hours of turbines on fuel gas during the reporting period
V_L	kg/hour	Leakage rate from turbines
V_v	Sm^3	Leakage volume
a	number	Number of emissions during the reporting period

3.18 General supplement - sub-sources 900.1 and 910.1

A general supplement shall be added to cover emissions from various sources with minor emission contributions. The operator adds 1% to the sum of the other emissions (mandatory). If the installation is an FPSO with crude oil storage and inert gas (neutral gas) or HC gas is used as cover gas after the final tank offloading before tank inspection, the supplement is increased to 3%.

Sources with minor emission contributions that may be included in the general supplement:

- Low-pressure liquid separator
- Seals on screw compressors
- Depressurisation/gas-freeing of instruments and instrument manifolds
- Bleeding of gas from production risers
- Pig traps
- Retrieval of corrosion coupons
- Gas diffusion through flexible risers and subsea jumpers through GRVs (gas relief valves).
- Storage tanks for diesel and other consumable oils
- Double block and bleed valves

4. DISTRIBUTION OF EMISSION GAS INTO METHANE AND NMVOC

In some cases, the distribution of the emission gas is known as mol% or volume%. The emissions shall be reported in mass units. It is therefore important to convert volume% and mol% to weight%. Methane has a density of approximately 0.68 kg/Sm^3. The density of nmVOC will vary with the composition. If this is not available, 2.0 kg/Sm^3 may provide an acceptable approximation.

5. CHANGES DURING THE REPORTING PERIOD

The emission conditions may change during the reporting period, for example through mitigation measures on an emission source. For example, mitigation measures on a source may mean that waste gas routed to direct discharge is recovered within the same reporting period. In such cases, this must be commented on.

6. REVISION JUNE 2026

The following changes have been made in the current version:

1. Source 150.1 – vented CO_2 from activity related to CO_2 handling has been removed, as this does not concern emissions of methane or nmVOC.
2. A new source 160.1 – cold venting in connection with turbine operation – is introduced, which, in addition to venting during operation, also includes venting during start-up or shutdown of turbines.
3. The unit for f_{CH4} and f_{nmVOC} in Table 7 was changed to be consistent with the module 2 report to NEMS.
4. A clarification has been made in the introduction to 3.9.3 – leakage of primary seal gas to secondary vent – sub-source 70.3.
5. A clarification has been added in the introduction to 3.10 – Calculation of emissions from unburnt flare gas – sub-sources 80.1, 80.2 and 80.3.
6. Explanation of components that are *not* included in the equation for calculating emissions from minor gas leaks has been removed from Table 15.
7. In Table 16, *other/all components* has been changed to *other components*.
8. The first paragraph after Table 16 has been removed.
9. In Table 19, it is clarified that the number of wellbores completed during the reporting period also includes recompleted wells.
10. In Table 21, the unit for $V_{Process\ plant}$ is changed from m^3 to Sm^3.
11. In 3.19 – general supplement - sub-sources 900.1 and 910.1 – it is clarified that the 3% supplement for FPSOs with oil storage also applies if HC gas is used, and the source *flexible risers* is expanded to include emission contributions from hydrocarbon-carrying flexible pipes, not only risers.