

## ANNEX 08: CHEMICAL USE PLAN (IN ACCORDANCE WITH OFFSHORE PROTOCOL)

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## PRINOS OFFSHORE DEVELOPMENT PROJECT

Chemical Use Plan

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<b>PRINOS OFFSHORE DEVELOPMENT PROJECT</b> <b>CHEMICAL USE PLAN (IN ACCORDANCE WITH OFFSHORE PROTOCOL)</b>	
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## TABLE OF CONTENTS

<b><u>1</u></b>	<b><u>INTRODUCTION</u></b>	<b><u>1</u></b>
<b><u>2</u></b>	<b><u>LEGISLATION- BARCELONA PROTOCOL</u></b>	<b><u>3</u></b>
2.1.	DESCRIPTION OF THE CHEMICALS THAT THE OPERATOR INTENDS TO USE	3
2.1.1.	Existing offshore facilities	3
2.1.2.	Future Offshore facilities	9
<b><u>3</u></b>	<b><u>DESCRIPTION OF THE PURPOSE OF THE USE OF CHEMICALS</u></b>	<b><u>13</u></b>
3.1.	EXISTING OFFSHORE FACILITIES	13
3.2.	FUTURE OFFSHORE FACILITIES	13
<b><u>4</u></b>	<b><u>MAXIMUM CONCENTRATIONS OF THE CHEMICALS AND MAXIMUM AMOUNTS THAT ARE GOING TO BE USED IN ALL PERIODS</u></b>	<b><u>15</u></b>

### TABLES

Table 1: Description of chemicals in existing facilities.....	4
Table 2: Description of chemicals in future platforms (Lamda and Omicron) .....	10
Table 3: Chemical properties for the offshore facilities .....	15
Table 4: Expected dosage rates - Delta .....	17
Table 5: Expected dosage rates - Lamda.....	18
Table 6: Expected dosage rates - Omicron.....	18
Table 7: Annual chemical consumption rate for Lamda & Omicron (m <sup>3</sup> /annum) – except hydrate inhibitor (methanol).....	19

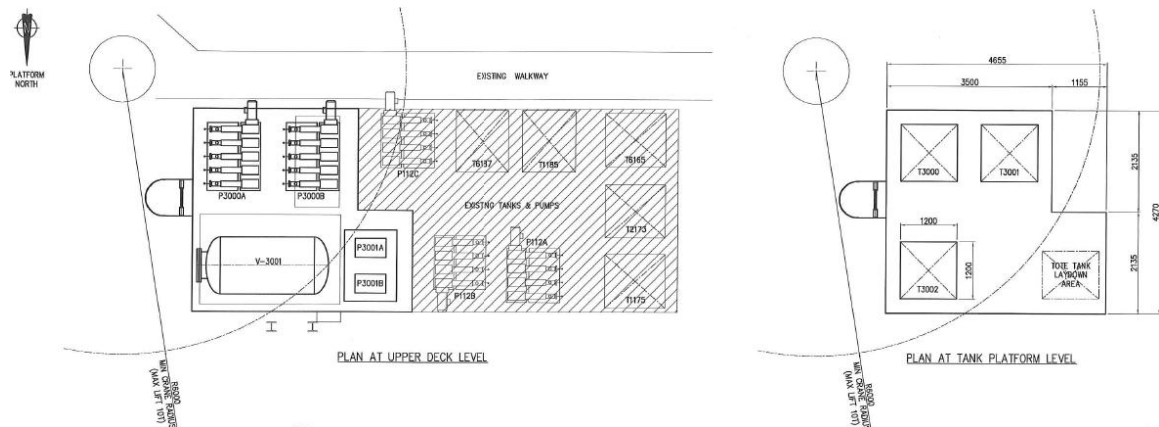
# 1 INTRODUCTION

The current Chemical Use Plan is in line with article 9 (1) and article 1 (k) of Offshore Protocol and meets the requirements of Annex 4.5 (par. 8.1.2) of MD 170225/14, for ESIA specifications. The Plan is applied in current offshore facilities (Delta platform) and in future platforms (Lamda and Omicron platforms).

The offshore processing on the Prinos complex that takes place in platform Delta consists basically of:

- 3- Phase (oil, gas and water) production separation
- Well production testing
- Crude dehydration
- Crude oil transfer to shore, with high pressure pump via 8” submarine pipeline
- Gas dehydration (BASF)
- Treatment of waste water for disposal (de oiling and stripping)
- Sea water injection

The chemical injection area of Delta platform will be upgraded to accommodate new chemical injection equipment (4 new pumps and 4 new chemical tanks as shown below)



Prinos Delta will supply chemicals to the Lamda and Omicron platforms maximizing the use of the umbilical and minimizing the need to send operators to the platforms. The only offshore processing that will take place in **platform Lamda and Omicron** consists basically of the use of chemicals for:

- Corrosion
- Demulsification

- Asphaltene precipitation
- Hydrates
- Antiscaling



## 2 LEGISLATION- BARCELONA PROTOCOL

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On 17 December 2012 the Council approved EU accession to the Offshore Protocol, thus underlining EU commitment to reducing environmental impacts of offshore activities in the Mediterranean through efficient regional cooperation. The legal consequence of this is that the Offshore Protocol now becomes part of EU legislation.

This protocol refers to the protection of Mediterranean Sea against pollution resulting from exploration and exploitation of the continental shelf and the seabed and its subsoil.

The Article 9 (1) of offshore protocol imposes an obligation on operators to obtain an approval from the Competent Authority to use and store chemicals for their activities (on basis of the Chemical Use Plan), which is not regulated in the Draft Regulation.

The offshore protocol According Article 1 (k) of the protocol for the protection of the Mediterranean Sea against pollution resulting from exploration and exploitation of the continental shelf and the seabed and its subsoil, imposes the need for a Chemical Use Plan. The Chemical Use Plan consists of the following requirements:

- a) Description of the chemicals that the operator intends to use
- b) Description of the purpose of the use of chemicals
- c) Maximum concentrations of the chemicals and maximum amounts that are going to be used in all periods.
- d) The area that the chemical may escape into the marine environment.

### 2.1. DESCRIPTION OF THE CHEMICALS THAT THE OPERATOR INTENDS TO USE

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#### 2.1.1. EXISTING OFFSHORE FACILITIES

The following chemicals are used in Delta platform:

- Demulsifier (EC-2173A)
- Scale inhibitor (EC-6165A and EC-6187A)
- Corrosion inhibitor (EC-1175A and EC-1185A)
- Antifouling-Biocide (EC-6201A and EC-6388A)

- Oxygen Scavenger (EC-6213A)
- Cationic polyelectrolyte (EC-6176A)
- Triethylene glycol (BASF)
- Methanol
- Citric acid

More specifically:

**Table 1: Description of chemicals in existing facilities**

Chemical	Nalco No.	Properties	Risks	Safety measures	Hazard symbol
Demulsifier	EC-2173A	Liquid with amber appearance, having an aromatic odor.  Stable under normal conditions	Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment  Repeated exposure may cause skin dryness or cracking  Vapours may cause drowsiness and dizziness	Do not breathe vapour  Avoid contact with skin and eye  Wear suitable gloves and eye/face protection  Use appropriate containment to avoid environmental contamination	(N)  Hazardous for the environment
Scale inhibitor	EC-6156A	Liquid with brown light appearance and mild odor.  Stable under normal conditions		Avoid contact with skin and eye  Wear suitable gloves and eye/face protection	
Scale inhibitor	EC-6187A	Liquid with clear light yellow		Avoid contact with skin and	

Chemical	Nalco No.	Properties	Risks	Safety measures	Hazard symbol
		appearance. Stable under normal conditions		eye Wear suitable gloves and eye/face protection	
Corrosion inhibitor	EC-1175A	Liquid with brown appearance and mild odor. Stable under normal conditions	Harmful if swallowed Causes burns Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment	Avoid contact with skin and eyes In case of contact with eyes, rinse immediately with plenty of water and seek medical advice Wear suitable protective clothing, gloves and eye/face protection In case of accident or if you feel unwell seek medical advice immediately (show the label where possible) Use appropriate containment to avoid environmental contamination	(C) Corrosive
Corrosion	EC-	Liquid with	Flammable	Do not breathe	(F)

Chemical	Nalco No.	Properties	Risks	Safety measures	Hazard symbol
inhibitor	1185A	clear brown appearance and aromatic odor.	<p>Causes burns</p> <p>Irritating to respiratory system</p> <p>Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment</p> <p>Harmful: may cause lung damage if swallowed</p> <p>Vapours may cause drowsiness and dizziness</p>	<p>vapour</p> <p>Avoid contact with skin / eyes</p> <p>In case of contact with eyes, rinse immediately with plenty of water and seek medical advice</p> <p>Wear suitable protective clothing, gloves and eye/face protection</p> <p>In case of accident or if you feel unwell seek medical advice immediately (show the label where possible)</p>	<p>Flammable (C)</p> <p>Corrosive (N)</p> <p>Hazardous for the environment</p>
Antifouling - Biocide	EC-6201A	<p>Liquid with clear water appearance and pungent odor.</p> <p>Stable</p>	<p>Harmful by inhalation and if swallowed</p> <p>Causes burns</p> <p>May cause sensitisation by inhalation</p> <p>May cause sensitisation by skin contact</p>	<p>Do not breathe vapour</p> <p>In case of contact with eyes, rinse immediately with plenty of water and seek medical advice</p> <p>Wear suitable protective clothing, gloves</p>	<p>(C) Corrosive</p> <p>(Xn) Harmful</p>

Chemical	Nalco No.	Properties	Risks	Safety measures	Hazard symbol
				<p>and eye/face protection</p> <p>In case of accident or if you feel unwell seek medical advice immediately (show the label where possible)</p> <p>Use only in well-ventilated areas</p>	
Antifouling-Biocide	EC-6388A	<p>Colorless liquid with pungent odor.</p> <p>Stable under normal conditions</p>	<p>The chemical has a low human risk and a moderate environmental risk</p>		(C) Corrosive
Oxygen scavenger	EC-6213A	<p>Clear yellow liquid with pungent odor.</p> <p>Stable</p>	<p>Contact with acids liberates toxic gas</p> <p>Irritating to eyes, respiratory system and skin</p>	<p>Keep away from acids</p> <p>Avoid contact with skin and eyes</p> <p>In case of contact with eyes, rinse immediately with plenty of water and seek medical advice</p> <p>If swallowed, seek medical advice</p>	(Xi) Irritant

Chemical	Nalco No.	Properties	Risks	Safety measures	Hazard symbol
				immediately and show this container or label	
Cationic polyelectrolyte	EC-6176A	Clear yellow liquid with ammoniacal odor. Stable under normal conditions	Irritating to eyes Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment	Avoid contact with skin and eyes In case of contact with eyes, rinse immediately with plenty of water and seek medical advice After contact with skin, wash immediately with plenty of water Wear suitable gloves and eye/face protection Use appropriate containment to avoid environmental contamination	(Xi) Irritant
Triethylene glycol	-	Hygroscopic liquid Stable	Risk of serious damage to eyes.		
Hydrate inhibitor (methanol)	-	Liquid with alcohol like odor or pungent odor	Highly flammable. Toxic by inhalation, in	Keep container tightly closed. Keep away from sources of	

Chemical	Nalco No.	Properties	Risks	Safety measures	Hazard symbol
		when crude Stable	contact with skin and if swallowed Danger of very serious irreversible effects Toxic: danger of very serious irreversible effects through inhalation, in contact with skin and if swallowed	ignition - No smoking Wear suitable protective clothing and gloves In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).	
Citric acid	-	Solid (crystalline powder) and odorless. Stable	Irritating to eyes, respiratory system and skin	In case of contact with eyes, rinse immediately with plenty of water and seek medical advice Wear suitable gloves and eye/face protection	

## 2.1.2. FUTURE OFFSHORE FACILITIES

### Lamda and Omicron Platforms

The chemical injection area of **Delta platform** will be upgraded to accommodate new chemical injection equipment. Chemicals will be injected with the wells and platform in flowing status. No chemical injection is required with the wells closed in thus limiting maximum pressures required to inject at Lamda platform. Subsequently, Omicron platform will be

installed south of the Prinós North field. The two platforms will be essentially identical.

The following chemicals will be used:

- Corrosion inhibitor (EC-1175A)
- Demulsifier (EC-2173A)
- Asphaltene inhibitor (EC-3019A)
- Hydrate inhibitor (methanol)
- Scale inhibitor (EC-6187A)

More specifically:

**Table 2: Description of chemicals in future platforms (Lamda and Omicron)**

Chemical	Nalco No.	Properties	Risks	Safety measures	Hazard symbol
Asphaltene inhibitor	EC-3019A				
Corrosion inhibitor	EC-1175A	Liquid with brown appearance and mild odor. Stable under normal conditions	Harmful if swallowed Causes burns Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment	Avoid contact with skin and eyes In case of contact with eyes, rinse immediately with plenty of water and seek medical advice Wear suitable protective clothing, gloves and eye/face protection In case of accident or if you feel unwell seek medical advice immediately (show the label where possible)	(C) Corrosive



Chemical	Nalco No.	Properties	Risks	Safety measures	Hazard symbol
				Use appropriate containment to avoid environmental contamination	
Demulsifier	EC-2173A	Liquid with amber appearance, having an aromatic odor.  Stable under normal conditions	Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment  Repeated exposure may cause skin dryness or cracking  Vapours may cause drowsiness and dizziness	Do not breathe vapour  Avoid contact with skin and eye  Wear suitable gloves and eye/face prtotection  Use appropriate containment to avoid environmental contamination	(N)  Hazardous for the environment
Scale inhibitor	EC-6187A	Liquid with clear light yellow appearance.  Stable under normal conditions		Avoid contact with skin and eye  Wear suitable gloves and eye/face prtotection	
Hydrate inhibitor (methanol)	-	Liquid with alcohol like odor or pungent odor when crude  Stable	Highly flammable.  Toxic by inhalation, in contact with skin and if swallowed	Keep container tightly closed.  Keep away from sources of ignition - No smoking  Wear suitable	Liquid with alcohol like odor or pungent odor when crude  Stable

Chemical	Nalco No.	Properties	Risks	Safety measures	Hazard symbol
			Danger of very serious Irreversible effects Toxic: danger of very serious irreversible effects through inhalation, in contact with skin and if swallowed	protective clothing and gloves In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).	

## 3 DESCRIPTION OF THE PURPOSE OF THE USE OF CHEMICALS

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### 3.1. EXISTING OFFSHORE FACILITIES

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As mentioned previously a number of process activities are taken place in Delta platform. For each stage a different chemical is used:

- Demulsifier (EC-2173A): A demulsifier is required to prevent the formation of emulsions within the overall production system
- Scale inhibitor (EC-6165A and EC-6187A): This chemicals are required in order to prevent scaling, due to the high salinity of formation of water.
- Corrosion inhibitors (EC-1175A and EC-1185A): For prevention of corrosion, inside the offshore flowlines and pipeline, two types of corrosion inhibitors are used.
- Antifouling (EC-6201A and EC-6388A): Antifouling agents are used for the protection of equipment from algae and bacteria growth.
- Oxygen Scavenger (EC-6213A): Oxygen is removed from the sea water, by the use of oxygen scavenger, for protection of corrosion by the growth of certain bacteria.
- Cationic polyelectrolyte (EC-6176A): This polyelectrolyte is used for flocculation of salts etc.
- Triethylene glycol (BASF): Triethylene glycol is used in order to remove the water from the sour gas and prevent corrosion of the 12" sour gas pipeline.
- Methanol: Methanol is to be used as the hydrate inhibitor.
- Citric acid: This type of acid is used for scaling cleaning.

### 3.2. FUTURE OFFSHORE FACILITIES

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The current Prinos Delta **corrosion protection** scheme will be adopted for use on the new platforms. The current scheme has proven that the use of carbon steel pipework with suitable corrosion inhibitor injection is acceptable. Corrosion inhibitor will be injected continuously at a point upstream of the relevant well choke valve.

**Demulsifier** will be injected continuously at the inlet to the export pipeline on both satellites.

Demulsifier is required to prevent the formation of emulsions within the overall production system. An additional demulsifier injection point will be installed at the test manifold

**Asphaltene** precipitation problems are expected in the Epsilon wells and potentially on wells drilled from **Omicron**. Asphaltene precipitation is to be mitigated via continuous down hole injection by means of a deep set Chemical Injection Valve (typically 3/8" control line) which will be installed with the injection point set as low as possible along the tubing so as to maximize the effect of the asphaltene inhibitor. The preferred Chemical Injection Valve location is below the production-tubing packer.

**Scale inhibitor** is expected on wells with high formation water production, mainly anticipated on Omicron wells, where higher aquifer support is anticipated. Injection is done down hole using the same control line as the asphaltene inhibitor injection. Note that Asphaltene and scale inhibitor will not be injected at the same time.

A **hydrate inhibitor** is required for discontinuous use during start-up and planned shutdowns to prevent hydrate formation in the flowlines and multi-phase pipeline. Methanol is to be used as the hydrate inhibitor. Currently the design assumes a separate Methanol injection system.

## 4 MAXIMUM CONCENTRATIONS OF THE CHEMICALS AND MAXIMUM AMOUNTS THAT ARE GOING TO BE USED IN ALL PERIODS

The physical properties of the injection chemicals have been taken from the Nalco Material Safety Sheets (MSDS) provided by ENERGEAN and are presented in the table below:

**Table 3: Chemical properties for the offshore facilities**

	Chemical	Nalco No.	Fluid density (kn/m <sup>3</sup> )	Fluid viscosity (dynamic: cP) (kinetic: cst)	Flash point (°C)	Vapour pressure (kPa)
<b>Existing chemicals</b>	Demulsifier	EC-2173A		23.35 cst	65	
	Scale inhibitor	EC-6156A		4 cst	>93.3	
	Scale inhibitor	EC-6187A		8 cst (0 °C) / 3.6 (25 °C)	80	3.2 (25 °C)
	Corrosion inhibitor	EC-1175A			100	
	Corrosion inhibitor	EC-1185A		1.6 cst (40 °C)	31	
	Antifouling	EC-6201A		1.40 cst (40 °C)	>100	
	Antifouling	EC-6388A	9.6 lb/gal		>93.3	
	Oxygen scavenger	EC-6213A		1.60 cst (20 °C)		3.2
	Cationic	EC-6176A		560 cst	>93.3	3.19

	Chemical	Nalco No.	Fluid density (kn/m <sup>3</sup> )	Fluid viscosity (dynamic: cP) (kinetic: cst)	Flash point (°C)	Vapour pressure (kPa)
	polyelectrolyte			(21 °C)		
	Triethylene glycol	-			177 (closed cup) / 165.5 (open cup)	
	Hydrate inhibitor (methanol)	-			12 (closed cup) / 16 (open cup)	12.3
	Citric acid	-				
<b>Future chemicals</b>	Asphaltene inhibitor	EC-3019A	1100	7.2 cP	70	4.0
	Corrosion inhibitor	EC-1175A	1040	10.4 cP	100	See Note 1
	Demulsifier	EC-2173A	930	7.6 cP	65	3.2
	Scale inhibitor	EC-6187A	1040	21.7 cP	80	See Note 1
	Hydrate inhibitor (methanol)	-	See note 2	See note 2	See note 2	See note 2

Notes:

1. Water based chemicals, water vapour pressure to be assumed
2. 2. Methanol system to be verified.

Dosage rates have been defined for each chemical that is continuously injected. These are indicated in the tables below:

**Table 4: Expected dosage rates - Delta**

Chemical	Dosage basis	Dosage (ppm)	Oil/water flow (bpd)	Dosage (tn/yr)
EC-2173A	Oil + water	25 ppm		30
EC-6165A	Oil + water	7ppm		4.2
EC-6187A	Oil + water	25 ppm		2
EC-1175A	Oil + water	8 ppm		12
EC-1185A	Oil + water	8 ppm		15
EC-6201A	Oil + water	Butch: 200 liter twice per week		12
EC-6388A	Oil + water	-		20

Chemical	Dosage basis	Dosage (ppm)	Oil/water flow (bpd)	Dosage (tn/yr)
EC-6213A	Oil + water	10 ppm		10
EC-6176A	Oil + water	2 ppm		6
Triethylene glycol	Oil + water	Quantity 8 tn in closed loop system with regeneration		6
Hydrate inhibitor (methanol)	Oil + water	Delta plt. actual : Small quantities at winter time		0,5
Citric acid	Oil + water			8

**Table 5: Expected dosage rates - Lamda**

	Chemical	Dosage basis	Dosage (ppm)	Oil/water flow (bpd)	Dosage (l/h)
Lamda platform	Asphaltene inhibitor	Oil	250	12,000	19.9
	Corrosion inhibitor	Oil + water	200	18,000	24.0
	Demulsifier	Oil + water	50	18,000	6.0
	Scale inhibitor	Oil + water	40	18,000	5.0
	Hydrate inhibitor	Oil +water	See note 1	See note 1	See note 1

Notes:

1. Methanol will be used on planned shut down and cold restarts. These events will be rare and methanol is only required between Oct=>May period. Total volume injected for each planned event is estimated between 2 to 4 m<sup>3</sup> at typical injection rates of 5-10m<sup>3</sup>/hr (meaning the dosage operation is typically less than 30 mins).

**Table 6: Expected dosage rates - Omicron**



Chemical	Dosage basis	Dosage (ppm)	Oil/water flow (bpd)	Dosage (l/h)
Asphaltene inhibitor	Oil	250	6,000	10.0
Corrosion inhibitor	Oil + water	200	9,000	12.0
Demulsifier	Oil + water	50	9,000	3.0
Scale inhibitor	Oil + water	40	9,000	2.4
Hydrate inhibitor	Oil +water	See note 1	See note 1	See note 1

Notes:

1. Methanol will be used on planned shut down and cold restarts. These events will be rare and methanol is only required between Oct=>May period. Total volume injected for each planned event is estimated between 2 to 4 m<sup>3</sup> at typical injection rates of 5-10m<sup>3</sup>/hr (meaning the dosage operation is typically less than 30 mins).

Based upon the above dosage rates and mid case production forecasts the following annual consumption levels for both Lamda and Omicron platforms have been calculated.

**Table 7: Annual chemical consumption rate for Lamda & Omicron (m<sup>3</sup>/annum) – except hydrate inhibitor (methanol)**

Row levels	Average of CI (CK-990G or EC-1175)	Average of Demulsifier (EC-2173A)	Average of Asphaltene Inhibitor (EC-3019)	Average of Scale inhibitor (EC-3019)
2016	3,3	0,8	2,9	0,7
2017	9,0	2,3	8,4	1,8
2018	9,0	2,2	9,1	1,8
2019	10,0	2,5	9,1	2,0
2020	8,3	2,1	6,3	1,7
2021	7,4	1,9	4,7	1,5
2022	7,2	1,8	3,9	1,4
2023	7,4	1,9	3,4	1,5
2024	7,5	1,9	3,0	1,5
2025	7,5	1,9	2,6	1,5

Row levels	Average of CI (CK-990G or EC-1175)	Average of Demulsifier (EC-2173A)	Average of Asphaltene Inhibitor (EC-3019)	Average of Scale inhibitor (EC-3019)
2026	7,6	1,9	2,4	1,5
2027	7,8	1,9	2,2	1,6
2028	7,9	2,0	2,1	1,6
2029	8,1	2,0	2,0	1,6
2030	8,2	2,0	1,9	1,6
2031	8,3	2,1	1,8	1,7
2032	8,4	2,1	1,7	1,7
2033	8,5	2,1	1,6	1,7
2034	8,6	2,2	1,5	1,7

As mentioned previously the hydrate inhibitor (methanol) will be used in a discontinuous way during start-up and planned shutdowns, so as to prevent hydrate formation in the flowlines and multi-phase pipeline. Up to two planned events per year are currently foreseen.