ENVIRONMENTAL IMPACT ASSESSMENT

PROJECT:

NEPTUN DEEP

PROJECT TITLEHOLDERS:

OMV Petrom S.A

Romgaz Black Sea Limited

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ENVIRONMENTAL IMPACT ASSESSMENT REPORT

CHAPTER 2 – DESCRIPTION OF THE PROJECT

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CONTENTS

List of Figures

List of Tables

CHAPTER 2 DESCRIPTION OF THE PROJECT

2.1 GENERAL DESCRIPTION OF THE PROJECT LOCATION

2.1.1 Location of the onshore and offshore location of the project

The project proposes the execution of the Neptun Deep production facility both offshore and onshore as follows:

- **Onshore facilities (on land):** Pipeline and Communications Cable Installation, Beach , Cliff, Roads and Railway Undercrossing; Realization of Temporary Railway Level Crossing; Construction of Regulation and Measurement Station - NGMS, Control Centre - CCR, Fencing, Lighting, Parking, Green Spaces, Platforms and Internal Roads; Site Organization, Insurance and Connection to Utilities.
- **Offshore facilities (at sea):** Domino and Pelican South infrastructure (Drilling Centres, Wells, Manifolds, Umbilical Systems, Risers, Supply/Intake Pipes, Auxiliary Equipment); Production Platform located in shallow waters; Natural Gas Production Pipeline; Fibre optic cable; Undercrossing the Shore; Utilities.

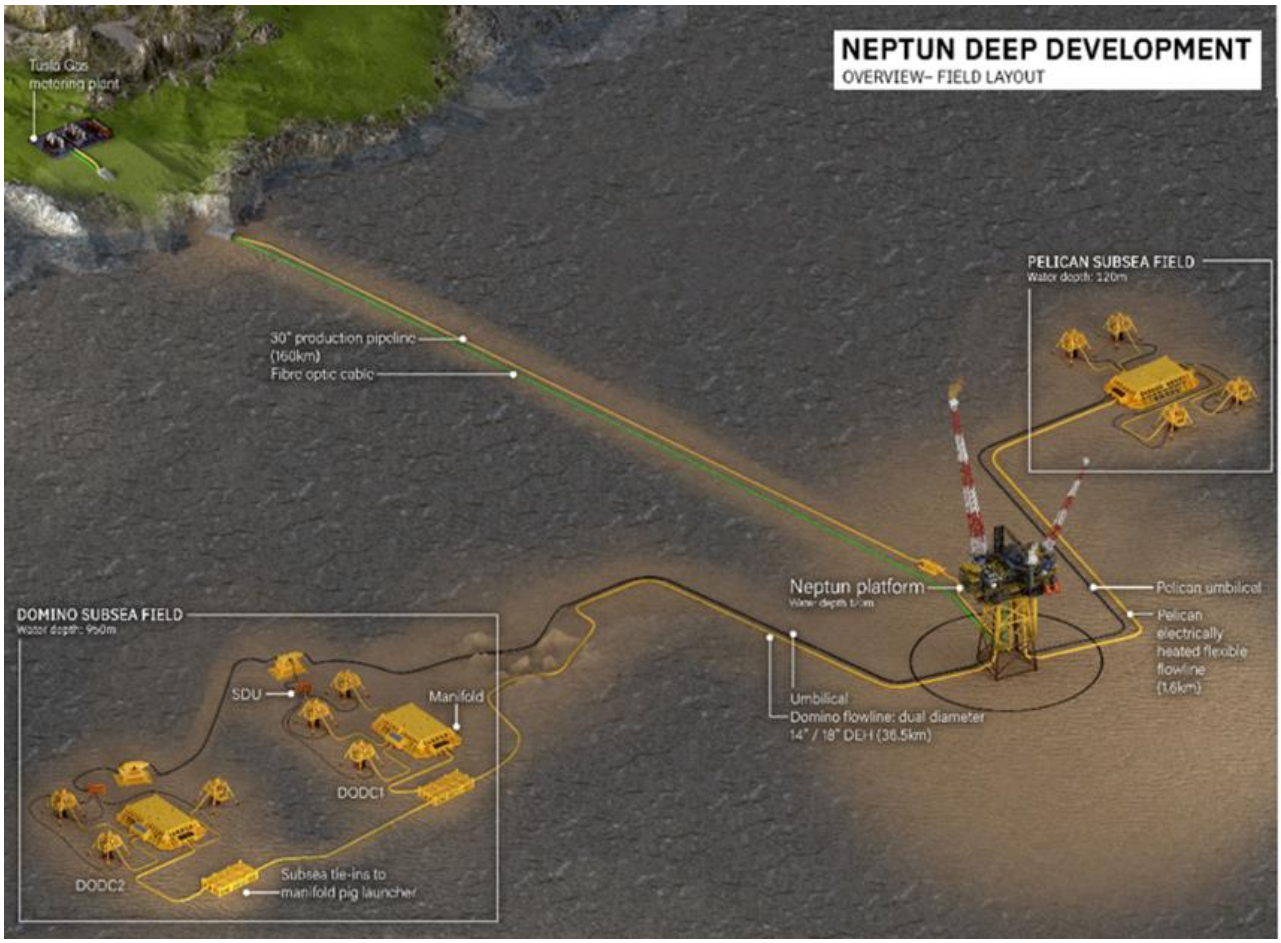

Figure 2.1 Framework plan of the Neptun Deep project

2.1.1.1 Onshore site location

The proposed location for the construction/installation of the onshore facilities of the Neptun Deep Project is located in the southern area of the administrative territory of Tuzla commune, Constanța County, close to the northern border of the administrative territory of Costinești commune.

OMV Petrom SA owns three plots of land located in the inner and outer areas of Tuzla commune:

- Urban land S1 with a total area of 85,000 m 2. registered under cadastral number 109216;
- Extra-urban land S3 with a total area of 70,880 m2 registered under cadastral number 109659;
- Extra-urban land S4 with a total area of 67,304 m2 registered under cadastral numbers 109729 and 100819.

The vicinity of the onshore project site is represented by:

- **North:** Exploitation road De 229/1, private property (plot A259/89, cadastral number 108838), private property (plot A259/91);
- **East:** Exploitation road De269, cliff on land, beach and Black Sea (about 60 m);
- **South: private property (plot A289/3b),** plant protection curtain (cadastral number 109189), private property (plot A259/105, cadastral number 100794 and plot A259/106, cadastral number 107526);
- **West:** private property (plot A289/1a, lot 2/1, cadastral number 109365 and lot 2/2, cadastral number 109364).

The Stereo 70 coordinates of the all parcels owned by OMV PETROM SA which will be affected by the construction/installation works of the onshore facilities of the project and the micro-tunnel for shore crossing described in this documentation, are presented below in Table no. 2.1.

Table 2.1 *The inventory of coordinates in the STEREO 70 system of the lands affected by the realization of the project in the onshore area*

Parcel description	Cadastral number	Total area (m^2)	Coordinates in Stereo 70		
			No	North(X) m	East(Y) m
S1 – the proposed location for SWP, CCR and related facilities	109216	85,000	56	281,679.30	792,252.52
			57	281,610.29	792,478.52
			5	281,440.02	792,476.37
			6	281,452.29	792,426.28
			7	281,282.95	792,384.74
			8	281,358.35	792,149.48
			9	281,657.24	792,245.43
S3 – proposed location of a gas production pipeline section and fibre optic cable (onshore section) and shut-off valve housing 3	109659	70,880	1	281,628.59	792,510.22
			2	281,625.47	792,881.61
			3	281,576.74	792,881.12
			4	281,522.81	792,880.57
			5	281,511.08	792,880.45

Parcel description	Cadastral number	Total area (m^2)	Coordinates in Stereo 70		
			No	North(X) m	East(Y) m
			6	281,491.87	792,880.26
			7	281,482.67	792,880.16
			8	281,473.46	792,880.07
			9	281,464.25	792,879.98
			10	281,439.75	792,879.73
			11	281,434.02	792,879.67
			12	281,437.12	792,510.41
			13	281,442.86	792,510.41
			14	281,467.35	792,510.39
			15	281,476.56	792,510.41
			16	281,485.77	792,510.41
			17	281,494.98	792,510.32
			18	281,514.19	792,510.50
			19	281,514.19	792,510.41
			20	281,525.91	792,510.52
			21	281,579.86	792,510.75
			22	281,579.86	792,510.37
S4 – proposed location of a gas production pipeline section and fibre optic cable (onshore section) and micro tunnel entry point	100819 109729	67,304	2	281,520.10	793,350.93
			3	281,514.69	793,352.43
			4	281,508.32	793,354.20
			5	281,503.30	793,355.60
			6	281,495.57	793,357.74
			7	281,488.80	793,359.62
			8	281,484.41	793,360.84
			9	281,479.41	793,362.23
			10	281,470.07	793,364.83
			11	281,460.78	793,367.41
			12	281,460.74	793,367.42
			13	281,457.28	793,368.38
			14	281,435.88	793,374.33
			15	281,433.15	793,375.09
			16	281,430.17	793,375.92
			17	281,434.30	792,883.68
			18	281,440.00	792,883.74
			19	281,464.84	792,883.99
			20	281,474.11	792,884.08
			21	281,483.43	792,884.18
			22	281,492.79	792,884.27
			23	281,499.55	792,884.34
			24	281,512.27	792,884.47
			1	281,524.02	792,884.59
			28	281,577.03	792,885.14

Parcel description	Cadastral number	Total area (m^2)	Coordinates in Stereo 70		
			No	North(X) m	East(Y) m
			27	281,573.25	793,335.25
			26	281,565.69	793,337.60
			25	281,539.48	793,345.55

Figure 2.2 Onshore site location of Neptun Deep Project

The site plan with the location of the lands in the area is presented in ***Annex A - General Plan for Site Location.***

a) Location of NGMS, and CCR and Shut-off Valve Station

On the S1 land plot, the Natural Gas and Metering Station (NGMS) and the Control Center/Central Control Room (CCR) will be constructed/installed, along with other related facilities included within the NGMS and CCR sites.

The NGMS will be an automated facility for metering and custody transfer of natural gas to the NTS (National Gas Transmission System) operated by Transgaz, without personnel. The total area occupied by the NGMS site will be approximately 23,183 square meters. The CCR (Central Control Room) site will be enclosed and has an estimated area of approximately 3,459 square meters.

A shut-off valve, equipped with a perimeter protection fence, will be located to the east of the level crossing with the railway.

The coordinates in Stereo 70 and WGS (World Geodetic System - World Geodetic System) 84 TM30NE for the enclosed NGMS, CCR, and shut-off valve are presented in the table 2.2 from below:

Table 2.2 Coordinates of the enclosed NGMS, CCR, and Shut-off Valve Station

Cnstruction description	Stereo 70			WGS84/TM30NE	
	Point No	Nord(X) m	Est(Y) m	Nord (m)	Est (m)
Natural Gas Metering Station (NGMS)	1	281,533.00	792,257.49	4,869,931.31	391,124.62
	2	281,435.89	792,257.49	4,869,741.83	391,112.97
	3	281,415.00	792,243.38	4,869,749.80	390,983.32
	4	281,343.00	792,243.38	4,869,821.60	390,987.74
	5	281,343.00	792,373.38	4,869,841.57	391,003.09
	6	281,533.00	792,373.38	4,869,938.42	391,009.04
Control Centre/Centralized Control Room (CCR)	1	281,633.83	792,324.46	4,870,034.87	391,082.01
	2	281,583.98	792,310.68	4,870,012.32	391,145.55
	3	281,566.01	792,375.72	4,869,964.09	391,128.98
	4	281,615.21	792,389.31	4,869,985.99	391,065.21
Perimeter of the Shut-off Valve	1	281513.41	792976.46	4,869,874.79	391,724.86
	2	281493.13	792976.46	4,869,873.56	391,744.97
	3	281493.13	792996.62	4,869,853.33	391,743.72
	4	281513.41	792996.62	4,869,854.57	391,723.62

The site plan showing the location of the NGMSand CCR is presented in ***Annex A - General Plan for Site Location.***

b) Onshore route location of the production pipeline and fibre optic cable.

The production pipeline and fibre optic cable will have a total length of 160 km, out of which approximately 1.772 km will be on the onshore area of the project.

The onshore production pipeline and fibre optic cable will be installed side by side in a microtunnel and trench.

Considering the coastline configuration and the protected natural area ROSCI 0273 - Marine Zone at Capul Tuzla in the coastal area, to ensure preservation, it has been decided to cross the area by means of a cemented microtunnel with a length of 890 m.

The microtunnel will have its entry point onshore, located on the S4 land plot, and will cross beneath the following areas: Exploitation Road De 269 (cadastral number 109115), the shoreline (cadastral number 110670), and the beach (cadastral number 106571), situated adjacent to the eastern side of the onshore project site. The microtunnel's exit point will be located in the coastal waters of the Black Sea.

Between the microtunnel entry point and the pig station at the NGMS entry, the production pipeline and fibre optic cable will be installed underground, covering a distance of 882 meters. The onshore section will be mainly installed underground on the S4 and S3 land plots and will traverse beneath the communal road DC4, the exploitation road De 259/4, and the Constanța Mangalia railway line.

The coordinates in Stereo 70 and WGS 84 TM30NE for the onshore route of the production pipeline, fibre optic cable, and microtunnel are presented in the table below (Table 2.3):

Table 2.3 Inventory of coordinates in the STEREO 70 system for the onshore route of the production pipeline

Construction name	Stereo 70			WGS84/TM30NE	
	Point no.	North(X) m	East(Y) m	North (m)	East (m)
Onshore route of the production pipeline and fibre optic cable (section between undercrossing and NGMS). KP 156,965÷157,847	1	281,507.90	792,349.10	4,869,907.77	391,098.85
	2	281,507.70	792,374.70	4,869,905.99	391,124.37
	3	281,506.60	792,519.60	4,869,896.01	391,268.81
	4	281,506.20	792,566.60	4,869,892.73	391,315.66
	5	281,503.70	792,880.40	4,869,871.00	391,628.45
	6	281,503.00	792,973.70	4,869,864.58	391,721.46
	7	281,502.30	793,067.10	4,869,858.15	391,814.56
	8	281,501.70	793,136.40	4,869,853.30	391,883.64
	9	281,501.10	793,212.30	4,869,848.05	391,959.30
	10	281,500.00	793,215.70	4,869,846.75	391,962.62
Microtunnel KP 156,075÷156,965	1	281,493.00	793,234.30	4,869,838.50	391,980.75
	2	281,495.30	793,235.00	4,869,841.00	391,981.59
	3	281,234.20	794,081.40	4,869,528.50	392,809.69
	4	281,231.90	794,080.70	4,869,526.50	392,808.84

The coordinates in Stereo 70 and WGS 84 TM30NE for the onshore entry point and offshore exit point of the microtunnel are presented in the table below (Table 2.4):

Table 2.4 Coordinates of the entry and exit points of the microtunnel

Location	Stereo 70 system coordinates		WGS84/TM30NE coordinates	
	North (m)	East (m)	North (m)	East (m)
Land entry point	281,495.40	793,230.70	4,869,841.70	391,977.73
Exit point from the sea	281,233.00	794,081.70	4,869,527.71	392,810.30

The site plan showing the route of the production pipeline and fibre optic cable is presented in ***Annex A - General Plan for Site Location***.

c) Location of the site organization

The temporary level crossing with the railway will be located immediately east of the NGMS and CCR site. The coordinates in Stereo 70 and WGS84/TM30NE for the area affected by the temporary level crossing with the railway are presented in the table below (Table 2.5):

Table 2.5 Coordinates of the temporary level crossing with the railway

No.	Stereo 70 coordinates		WGS84/TM30NE coordinates	
	East (m)	North (m)	East (m)	North (m)
1	281,611.30	792,478.50	4,870,004.90	391,232.31
2	281,589.60	792,478.30	4,869,983.27	391,230.78
3	281,576.70	792,525.60	4,869,967.50	391,277.16
4	281,598.50	792,525.60	4,869,989.25	391,278.49

The construction site organization for NGMS and CCR will be located on the S1 area (cadastral number 109216) owned by OMV Petrom. The coordinates in Stereo 70 and WGS84/TM30NE systems of the area affected by the construction site organization are presented in the Table 2.6 below:

Table 2.6 Coordinates for NGMS and CCR construction site organization

No.	Stereo 70 coordinates		WGS84/TM30NE coordinates	
	East (m)	North (m)	East (m)	North (m)
1	281,621.00	792,384.60	4,870,020.33	391,139.26
2	281,594.80	792,476.00	4,869,988.60	391,228.80
3	281,515.60	792,476.00	4,869,909.61	391,223.95
4	281,516.30	792,364.00	4,869,917.18	391,112.29
5	281,566.70	792,364.00	4,869,967.44	391,115.38
6	281,566.70	792,374.20	4,869,966.82	391,125.55
7	281,592.00	792,381.10	4,869,991.62	391,133.99
8	281,593.20	792,377.10	4,869,993.07	391,130.07

The facilities and temporary works (microtunnel construction site organization and access roads) necessary for building the microtunnel and installing the gas production pipeline and fibre optic cable inside the tunnel will primarily be carried out on the S3 (cadastral number 109659) and S4 (cadastral numbers 109792 and 100819) areas owned by OMV Petrom. The access road De 259/4 will be partially affected by the temporary works.

The coordinates in Stereo 70 and WGS84/TM30NE systems of the enclosed location for the microtunnel construction site organization are presented in Table 2.7 below:

Table 2.7 Site organization coordinates for the microtunnel

No.	Stereo 70 coordinates		WGS84/ TM30NE coordinates	
	North (m)	East (m)	Nord (m)	North (m)
1	281,522.90	793,181.60	4,869,873.62	391,928.08
2	281,522.40	793,246.70	4,869,869.13	391,992.97
3	281,432.50	793,245.90	4,869,779.53	391,986.66
4	281,433.10	793,180.70	4,869,784.12	391,921.67

The Stereo 70 and WGS84/ TM30NE coordinates of the temporary access roads to the microtunnel site organization and pipe assembly and storage areas are shown in Table 2.8 below:

Table 2.8 Coordinates of temporary access roads

No.	Stereo 70 coordinates		WGS84/ TM30NE coordinates	
	North (m)	East (m)	Nord (m)	North (m)
1	281,590.50	792,525.80	4,869,981.25	391,278.20
2	281,583.50	792,525.80	4,869,974.27	391,277.77
3	281,580.90	792,535.60	4,869,971.08	391,287.39
4	281,580.60	792,536.60	4,869,970.78	391,287.37
5	281,580.50	792,537.60	4,869,970.56	391,289.36
6	281,579.50	792,545.90	4,869,969.05	391,297.57
7	281,574.50	792,586.40	4,869,961.58	391,337.66
8	281,573.50	792,590.30	4,869,960.35	391,341.49
9	281,570.90	792,594.50	4,869,957.50	391,345.52
10	281,568.10	792,597.10	4,869,954.54	391,347.94
11	281,565.10	792,598.80	4,869,951.45	391,349.45
12	281,559.70	792,600.20	4,869,945.98	391,350.51
13	281,556.60	792,600.30	4,869,942.88	391,350.42
14	281,462.90	792,600.40	4,869,849.43	391,344.78

No.	Stereo 70 coordinates		WGS84/ TM30NE coordinates	
	North (m)	East (m)	Nord (m)	North (m)
15	281,460.70	792,600.50	4,869,847.23	391,344.74
16	281,458.40	792,600.80	4,869,844.91	391,344.90
17	281,455.20	792,601.60	4,869,841.67	391,345.50
18	281,451.70	792,603.10	4,869,838.09	391,346.78
19	281,448.40	792,605.10	4,869,834.68	391,348.57
20	281,446.00	792,607.30	4,869,832.15	391,350.62
21	281,443.30	792,610.50	4,869,829.26	391,353.65
22	281,441.70	792,613.00	4,869,827.51	391,356.04
23	281,440.10	792,616.90	4,869,825.68	391,359.83
24	281,439.30	792,620.90	4,869,824.63	391,363.77
25	281,439.10	792,623.30	4,869,824.29	391,366.15
26	281,439.10	792,624.70	4,869,824.20	391,367.55
27	281,439.10	792,628.10	4,869,823.99	391,370.94
28	281,439.10	793,161.60	4,869,791.28	391,902.99
29	281,439.10	793,164.90	4,869,791.08	391,906.29
30	281,439.20	793,168.10	4,869,790.98	391,909.48
31	281,439.90	793,172.30	4,869,791.42	391,913.71
32	281,440.80	793,175.70	4,869,792.11	391,917.16
33	281,442.10	793,179.00	4,869,793.20	391,920.53
34	281,442.90	793,180.80	4,869,793.89	391,922.38
35	281,451.10	793,180.90	4,869,802.06	391,922.98
36	281,450.30	793,179.60	4,869,801.34	391,921.63
37	281,449.60	793,178.40	4,869,800.72	391,920.39
38	281,448.60	793,176.60	4,869,799.83	391,918.54
39	281,448.00	793,175.00	4,869,799.33	391,916.90
40	281,447.50	793,173.50	4,869,798.93	391,915.38
41	281,446.90	793,171.60	4,869,798.44	391,913.45
42	281,446.50	793,169.30	4,869,798.19	391,911.13
43	281,446.20	793,167.60	4,869,797.99	391,909.41
44	281,446.10	793,166.00	4,869,797.99	391,907.81
45	281,446.10	793,162.10	4,869,798.23	391,903.92
46	281,446.10	792,624.40	4,869,831.20	391,367.68
47	281,446.40	792,620.60	4,869,831.73	391,363.91
48	281,447.40	792,617.30	4,869,832.93	391,360.68
49	281,450.20	792,612.90	4,869,835.99	391,356.46
50	281,452.40	792,610.90	4,869,838.31	391,354.60
51	281,456.70	792,608.50	4,869,842.75	391,352.47
52	281,460.70	792,607.50	4,869,846.80	391,351.72
53	281,462.80	792,607.40	4,869,848.90	391,351.75
54	281,466.10	792,607.40	4,869,852.19	391,351.95
55	281,556.00	792,607.40	4,869,941.84	391,357.47
56	281,559.20	792,607.40	4,869,945.04	391,357.66
57	281,561.00	792,607.20	4,869,946.84	391,357.57
58	281,565.00	792,606.40	4,869,950.88	391,357.02

No.	Stereo 70 coordinates		WGS84/ TM30NE coordinates	
	North (m)	East (m)	Nord (m)	North (m)
59	281,567.90	792,605.30	4,869,953.84	391,356.10
60	281,569.80	792,604.40	4,869,955.79	391,355.32
61	281,570.90	792,603.70	4,869,956.93	391,354.69
62	281,571.30	792,603.60	4,869,957.34	391,354.61
63	281,571.70	792,603.70	4,869,957.73	391,354.74
64	281,572.00	792,603.90	4,869,958.02	391,354.96
65	281,572.30	792,604.20	4,869,958.30	391,355.27
66	281,572.30	792,604.60	4,869,958.27	391,355.67
67	281,572.20	792,605.40	4,869,958.12	391,356.47
68	281,509.50	793,122.40	4,869,863.89	391,868.22
69	281,506.30	793,148.80	4,869,859.08	391,894.35
70	281,504.50	793,163.50	4,869,856.38	391,908.90
71	281,504.00	793,167.90	4,869,855.62	391,913.26
72	281,503.50	793,170.60	4,869,854.95	391,915.92
73	281,502.90	793,172.90	4,869,854.21	391,918.18
74	281,501.90	793,175.60	4,869,853.05	391,920.81
75	281,501.10	793,177.40	4,869,852.14	391,922.55
76	281,500.00	793,179.40	4,869,850.92	391,924.48
77	281,498.80	793,181.40	4,869,849.60	391,926.40
78	281,506.90	793,181.50	4,869,857.67	391,927.00
79	281,507.50	793,180.30	4,869,858.35	391,925.84
80	281,508.20	793,178.80	4,869,859.14	391,924.38
81	281,508.70	793,177.50	4,869,859.71	391,923.12
82	281,509.10	793,176.40	4,869,860.18	391,922.05
83	281,509.60	793,175.00	4,869,860.76	391,920.68
84	281,510.00	793,173.50	4,869,861.26	391,919.21
85	281,510.50	793,171.20	4,869,861.26	391,919.21
86	281,510.70	793,169.90	4,869,862.17	391,915.66
87	281,510.90	793,169.00	4,869,862.43	391,914.78
88	281,511.20	793,166.70	4,869,862.87	391,912.50
89	281,587.60	792,536.60	4,869,977.70	391,288.80
90	281,590.50	792,525.80	4,869,981.25	391,278.20

The situation plan with the location of the construction sites, the railway crossing area, the pipeline installation area, the pipeline storage area, the internal access road is presented in Annex B Onshore and offshore situation plan.

2.1.1.2 Location of the offshore facilities

The development area of the Neptun Deep perimeter is located i in the Western Black Sea, in the exclusive economic zone (EEZ) of Romania.

The general location of the offshore components of the Neptun Deep project is shown in Annex A.

a) Marine production platform Neptun Alpha

The marine production platform, hereinafter referred to as the Neptun Alpha Platform, to which the Domino and Pelican South infrastructures will be connected, is located on the continental platform of the Black Sea, approximately 160 km West of Tuzla, Constanta County.

The coordinates in the Stereo 70 and WGS84 system of the location of the production platform are presented in table no. 2.9, below:

Table 2.9 Coordinates of the Neptun Alpha Platform

Location	Stereo 70		WGS84/ TM30NE	
	North (m)	East (m)	Nord (m)	North (m)
Marine production platform	298,534.29	947,751.25	4,877,318.00	547,062.00

b) Drilling centres

In the Neptun perimeter, for the 2 Domino and Pelican South fields, 3 drilling centres are proposed, one drilling centre in Pelican South and 2 drilling centres in Domino

The South Pelican Drilling Centre (PSDC1) is located on the Black Sea continental shelf approximately 160 km West of Tuzla and approximately 2 km NorthEast of the production platform.

The Domino drilling centres (DODC1 and DODC2) are located on the continental slope of the Black Sea, approximately 175 km West of Tuzla and approximately 24 km SouthEast of the production platform.

A selection of coordinates in the Stereo 70 and WGS84 system for drilling centres is shown in table no 2.10 below:

Table 2.10 Drilling centre coordinates

Location	Stereo 70		WGS84/ TM30NE	
	North (m)	East (m)	Nord (m)	North (m)
PSDC1	299,471.11	948,682.68	4,878,194.00	548,048.00
DODC1	280,058.98	964,335.02	4,857,884.92	562,445.99
DODC2	279,072.99	959,245.90	4,857,216.52	557,314.55

The plans with the drilling centres are presented in Annex B.

c) Gas production wells

The project provides for the drilling of 10 underwater gas production wells, respectively:

- 6 wells will be drilled to a vertical depth of 3,000 m from drill centres DODC1 and DODC2 (3 wells/ drill centre) in the Domino field at a water depth of 800 – 1,100 m;
- 4 wells will be drilled to a vertical depth of 3,400 m from a single drilling centre (PSDC1) in the South Pelican field, at a water depth of 120 - 130 m;

Table 2.11 Domino and Pelican South production well coordinates

The drilling centre	Wells ID	Stereo 70		WGS84 TM30NE	
		North (m)	East (m)	Nord (m)	Est (m)
DODC1	VXT581006	280,086.50	964,329.44	4,857,912.23	562,441.87
DODC1	VXT581007	280,032.87	964,341.32	4,857,858.06	562,450.40
DODC1	VXT581008	280,050.92	964,309.35	4,857,878.02	562,419.66
DODC2	VXT581010	279,046.42	959,252.03	4,857,189.21	557,318.67
DODC2	VXT581011	279,100.05	959,240.15	4,857,243.38	557,310.14
DODC2	VXT581012	279,082.00	959,272.12	4,857,223.42	557,340.88
PSDC1	VXT581001	299,445.21	948,674.49	4,878,168.27	548,037.99
PSDC1	VXT581002	299,460.49	948,708.22	4,878,181.41	548,072.55
PSDC1	VXT581003	299,482.62	948,657.58	4,878,206.59	548,023.45
PSDC1	VXT581004	299,497.90	948,691.31	4,878,219.73	548,058.01

d) Pelican South and Domino flowlines

The flowlines have the role of ensuring the active management of hydrates with the help of direct electric heating.

The route of the flowlines was determined based on the results of a route study carried out by a specialist contractor. The route study included evaluation of route survey data (eg geophysical investigations), flowline data, gas field and offshore production platform details, and manifold connection details.

The route of the flowline from the Neptun Alpha Platform to the DODC1 drilling centre and from the DODC1 drilling centre to the DODC2 drilling centre is shown in Appendix B

The route of the Pelican South flexible flowline is shown in Appendix B.

A selection of Domino direct heating flowline route coordinates is shown in Table 2.12 belows:

Table 2.12 Selection of coordinates from the route of the Domino feeder/ supply pipeline

No.	Stereo 70		WGS84 TM30NE	
	North (m)	East (m)	Nord (m)	North (m)
1	279025.23	959218.53	4857170.63	557284.24
2	276777.67	963127.25	4854690.05	561040.14
3	279825.01	964862.25	4857619.27	562956.87
4	281781.66	961391.27	4859783.03	559619.21
5	282876.55	960055.45	4860956.40	558355.79
6	285033.30	957585.58	4863044.50	556407.62
7	298468.42	947769.66	4877251.22	547076.27

A selection of coordinates along the route of the Pelican South flexible supply/ supply pipeline is shown in Table 2.13, below.

Table 2.13 Selection of coordinates from the Pelican South feeder/ intake pipeline route

No.	Stereo 70		WGS84 TM30NE	
	North (m)	East (m)	Nord (m)	North (m)
1	298,529.48	947,778.10	4,877,311.55	547,088.43
2	298,571.46	948,025.82	4,877,338.14	547,337.97

No.	Stereo 70		WGS84 TM30NE	
	North (m)	East (m)	Nord (m)	North (m)
3	299,330.15	948,715.31	4,878,051.53	548,071.82
4	299,467.24	948,686.46	4,878,189.91	548,051.54

e) Pelican South and Domino umbilical control systems

The Domino and Pelican South subsea systems will be monitored and controlled using electrical and hydraulic control systems connected to the Neptun Alpha Platform via dedicated umbilicals. The Domino subsea system will include two electrical and hydraulic control umbilical segments: one between the offshore production platform and the DODC1 drilling centre and one between the DODC1 drilling centre and the DODC2 drilling centre. The Pelican South subsea system will include an electrical and hydraulic control umbilical system between the Neptun Alpha Platform and the PSDC1 drilling centre.

A selection of coordinates along the tracks of the Domino and Pelican South umbilical systems are shown in Tables 2.14 and 2.15 below:

Table 2.14 Selection of coordinates from the route of the Domino umbilical systems

No.	Stereo 70		WGS84/ TM30NE	
	North (m)	East (m)	Nord (m)	North (m)
1	279,121.45	959,273.77	4,857,263.07	557,345.25
2	278,877.80	963,092.03	4,856,784.79	561,134.75
3	280,010.52	964,307.35	4,857,838.13	562,415.66
4	286,370.59	955,974.01	4,864,690.13	554,504.48
5	279,121.45	959,273.77	4,857,263.07	557,345.25
6	278,877.80	963,092.03	4,856,784.79	561,134.75
7	280,010.52	964,307.35	4,857,838.13	562,415.66

Table 2.15 Selection of coordinates from the route of the South Pelican umbilical system

No.	Stereo 70		WGS84/ TM30NE	
	North (m)	East (m)	Nord (m)	North (m)
1	298,546.51	947,776.63	4,877,328.61	547,088.04
2	298,616.90	947,858.51	4,877,393.70	547,173.99
3	298,600.03	948,011.18	4,877,367.45	547,325.08
4	299,466.47	948,684.77	4,878,189.25	548,049.81

f) Locating the offshore route of the production pipeline and fibre optic cable

The route of the optical production pipeline has a total length of 160 km of which approximately 1,772 km is installed in the onshore area of the project and microtunnel.

The offshore section of the 762 mm (30 inches) production pipeline and fibre optic cable will occupy an underwater area of approximately 638,080 m^2.

The fibre optic cable will be installed parallel to the gas production pipeline to near shore.

A selection of coordinates of the offshore route of the production pipeline, in Stereo 70 and WGS84/ TM30NE system is shown in table 2.16, below:

Table 2.16 Selection of coordinates of the offshore route of the production pipeline

No.	Stereo 70		WGS84 TM30NE	
	North (m)	East (m)	Nord (m)	North (m)
1	281,233.00	794,081.70	4,869,527.71	392,810.30
2	280,514.69	796,410.36	4,868,668.52	395,088.50
3	291,750.12	871,995.75	4,875,227.04	471,141.24
4	292,997.32	884,786.55	4,875,682.74	483,968.06
5	293,912.28	888,135.82	4,876,388.46	487,362.89
6	294,566.70	899,038.30	4,876,369.01	498,270.08
7	299,913.63	916,468.31	4,880,623.45	515,971.83
8	298,791.36	933,715.27	4,878,440.74	533,090.74
9	299,142.90	936,628.57	4,878,611.23	536,015.69
10	298,950.56	940,460.87	4,878,182.97	539,822.79
11	299,299.92	944,046.66	4,878,309.71	543,417.67
12	298,595.21	947,777.93	4,877,377.05	547,092.35

A selection of coordinates of the sea route of the optical fibre cable, in Stereo 70 and WGS84/ TM30NE system is shown in table 2.19, below:

Table 2.17 Selection of coordinates from the sea route of the fibre optic cable

No.	Stereo 70		WGS84 TM30NE	
	North (m)	East (m)	Nord (m)	North (m)
1	281,233.00	794,081.70	4,869,527.71	392,810.30
2	280,514.69	796,410.36	4,868,668.52	395,088.50
3	291,750.12	871,995.75	4,875,227.04	471,141.24
4	292,997.32	884,786.55	4,875,682.74	483,968.06
5	293,912.28	888,135.82	4,876,388.46	487,362.89
6	294,566.70	899,038.30	4,876,369.01	498,270.08
7	299,913.63	916,468.31	4,880,623.45	515,971.83
8	298,791.36	933,715.27	4,878,440.74	533,090.74
9	299,142.90	936,628.57	4,878,611.23	536,015.69
10	298,950.56	940,460.87	4,878,182.97	539,822.79
11	299,299.92	944,046.66	4,878,309.71	543,417.67

2.1.1.3 Location of the project in relation to the borders

The closest national border to the onshore project site is the territorial border of the Republic of Bulgaria, located more than 25 km to the South. The national borders of the Republic of Ukraine and the Republic of Moldova are located more than 100 km North of the project site, respectively approximately 140 km (Ukraine) and 170 km (Republic of Moldova).

The gas production pipeline has a length of approximately 160 km in a West-East direction, from the shore to the location of the Neptun Alpha Platform on the continental shelf. The pipeline is generally parallel to the Southern border of Romania's EEZ, on the border with the Northern border of Bulgaria's EEZ. The distance between the production pipeline and the EEZ boundary varies between 25 km in the shore area and 46 km in the area of the production platform.

The production platform is located approximately 46 km North of the Southern limit of Romania's EEZ (on the border with Bulgaria's EEZ) in the Black Sea.

Drilling centre PSDC1 is located approximately 47 km North of the Southern limit of Romania's EEZ, and drilling centres DODC1 and DODC2 are located approximately 35 km North of the Southern limit of Romania's EEZ (on the border with Bulgaria's EEZ) in the Black Sea.

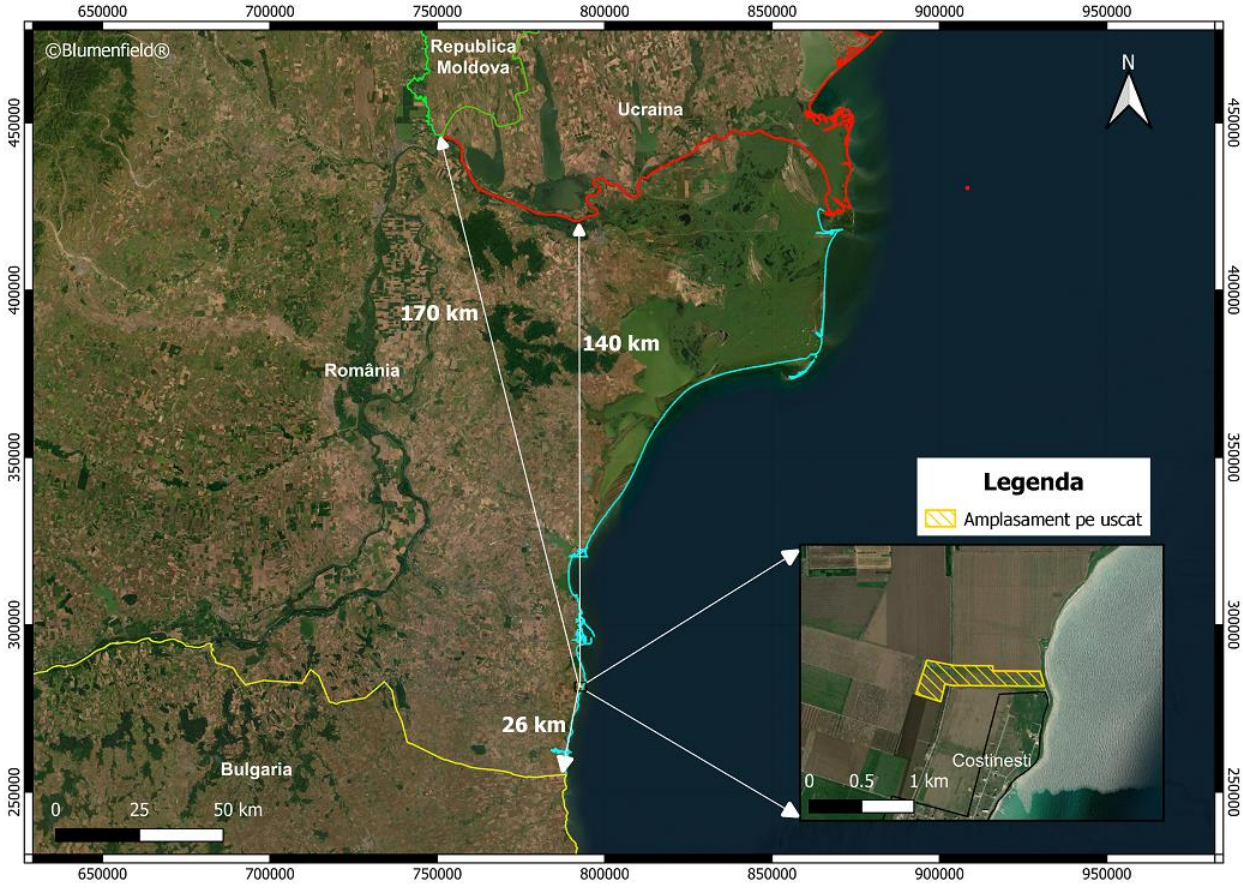

Figure 2.3 Location of the project on land compared to the borders

2.1.1.4 Location of the project in relation to the borders

Dwellings were identified to the South and South-East of the site boundary, the closest to the site being located approximately 100 m South of the site boundary proposed for the installation of the gas production pipeline and the entry point into the microtunnel, respectively approximately 700 m South of the site boundary proposed for the NGMS construction.

The Neptun Alpha platform is located on the continental shelf of the Black Sea, approximately 160 km West of Tuzla, Constanța county.

The South Pelican Drilling Centre (PSDC1) is located on the Black Sea continental shelf approximately 160 km West of Tuzla and approximately 2 km NorthEast of SWP.

The Domino drilling centres (DODC1 and DODC2) are located on the continental slope of the Black Sea, approximately 175 km West of Tuzla and approximately 24 km SouthEast of SWP.

2.1.1.5 Location of the project in relation to the protected areas

The area provided for the implementation of the project offshore, respectively the installation route of the production pipeline and the optical fibre cable overlaps with the protected areas ROSAC 0273 Marine area from Capul Tuzla and ROSPA 0076 Black Sea.

Other protected areas are located more than 3 km from the land area of the project.

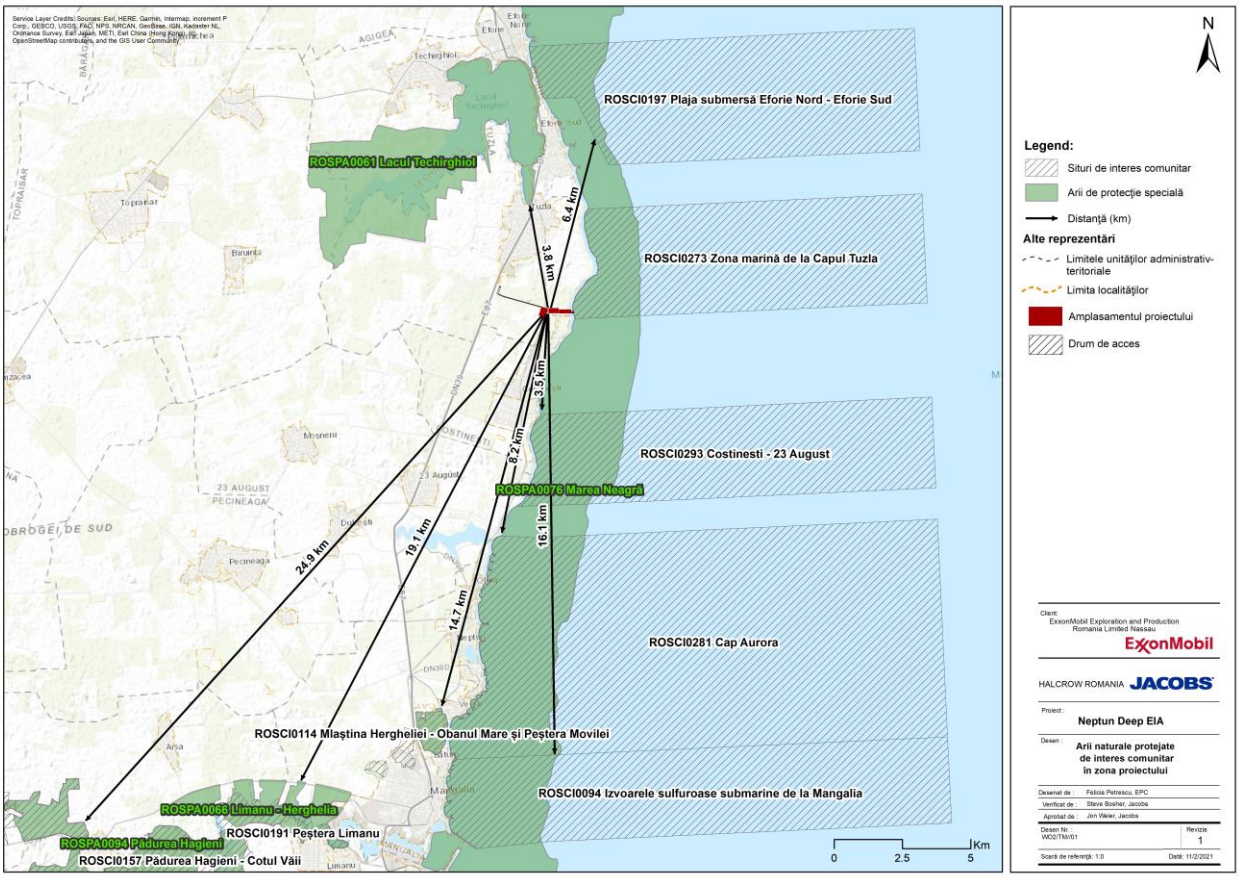

Figure 2.4 Location of the land site of the project in relation to the protected natural areas of community interest (Natura 2000 sites)

2.1.2 Description of the project location

2.1.2.1 Description of the onshore location

For the onshore component, the project owner developed the Zonal Urban Plan (PUZ) for "Establishment of Natural Gas Metering Station and Control Centre, Construction of road and route of underground pipelines for natural gas transport", for which approval decision no. 100 of November 16, 2020 issued by the Tuzla City Council.

Following the approval of the PUZ documentation by the Tuzla City Hall, the private land owned by OMV Petrom registered under cadastral number 109216 (surface S1, with a total area of 85,000 m^2) which is proposed for the construction/ installation of the NGMS , CCR and other related facilities included in the NGMS and CCR sites, was introduced into the urban area of the Tuzla commune.

Currently, the onshore project site has agricultural land use, and no industrial activities have been identified on the site or in the immediate vicinity.

The onshore location is crossed, from west to east, by the following roads and railway:

- Communal Road DC4 located East of surface S1 (cadastral number 109216);
- Constanța - Mangalia railway (cadastral number 109182) located between the DC4 communal road and the De277 exploitation road;
- The exploitation road De277 located between Calea Ferată Constanța - Mangalia and surface S3 (cadastral number 109659);
- De 259/ 4 exploitation road located between surfaces S3 and S4 (cadastral numbers 109729 and 100819).

All these roads and the railway line will be under-crossed by the production pipeline and the fiber optic cable.

The Black Sea is located approximately 60 m East of the Eastern boundary of the project site.

Tuzla Airport is located approximately 2 km NorthWest of the site's Western boundary.

Dwellings were identified to the South and SouthEast of the site boundary, the closest to the site being located approximately 100 m South of the limit of the area proposed for the installation of the natural gas production pipeline and the entry point into the microtunnel, respectively approximately 350 m SouthEast of the site boundary proposed for the NGMS installation.

Adjacent to the Western boundary of the site is an orchard owned by private owners.

2.1.2.2 Description of the offshore location

The proposed development is part of the XIX Neptun perimeter. The production pipeline and fibre optic cable will be placed in the sea, for an approximate length of 160 km.

The proposed offshore production pipeline route crosses 3 faults and several possible cables.

There are no other production platforms in the area. The Ana production platform of the Midia Natural Gas Development project is located approximately 50 km West of the Neptun Deep project production platform and approximately 4 km North of the production pipeline.

The water depth in the area of the Neptun Deep perimeter varies from 700 – 1,100 m in the area of the Domino field, to 120 – 130 m on the continental shelf in the area of the Pelican South field and the Neptun Alpha Platform. The slope of the basin separates the Domino and Pelican South fields. Along the route of the gas production pipeline from the continental shelf to the shore, the water depth drops from 120 m to 10-15 m at the proposed shore crossing.

The approximate depth of sea water in the Neptun Deep project area is as follows:

- Production platform: 120 - 130 m;
- South Pelican Drilling Centre: 120 - 130 m;
- Domino 1 drilling centre: 970 – 980 m;
- Domino 2 drilling centre: 945 – 955 m.

2.1.2.3 Access to the project area

Currently, access to the project area is made on public roads (communal road, exploitation roads) existing in the project area, as follows:

- The S1 surface can be accessed via the communal road DC4 (width 4 m), located to the East and via the exploitation road De229/ 1 (width 4 m), located to the North. Access to both roads can be achieved from the national road DN39;
- The S3 surface can be accessed from the towns of Tuzla or Costinești, via the exploitation road De277 (width 4 m), located to the West;
- The S4 surface can be accessed from the Tuzla or Costinești towns, via the De269 exploitation road (width 4 m), located to the East.

Access to the onshore project area, during the life of the project, will be provided from the European Road E87 (National Road DN 39) through a new access road approximately 2 km long, which will connect the European Road E87 (National Road DN 39) located West of the NGMS and CCR site and the DC4 communal road located East of the NGMS and CCR site. The new permanent access road will support the construction and operation of the project's onshore facilities. For the construction of this road, the Municipality of Tuzla issued Construction Authorization No. 27/ 12/ 02/ 2022 with extended validity until 11/ 05/ 2025.

2.2 DESCRIPTION OF THE PHYSICAL CHARACTERISTICS OF THE ENTIRE PROJECT

2.2.1 Presentation of the need to implement the project

OMVP has carried out initial activities for the identification and exploration of hydrocarbon deposits in the Romanian sector of the Black Sea to assess their characteristics and to determine the existence of a feasible production potential from these resources. In 2012, the exploration campaign discovered natural gas reserves in the deep waters of the XIX Neptun perimeter located in the Romanian sector of the Black Sea.

The proposed objective of the Neptun Deep project is to develop natural gas reserves from the Pelican South and Domino fields and to deliver the gas treated within the production platform to the Romanian NTS operated by Transgaz.with an emphasis on environmental protection during the development and operation of the facilities, an objective aligned with the Energy Strategy of Romania 2019-2030, with perspectives until 2050.

The identified gas is a very clean gas, with a high content of methane gas and a low content of carbon dioxide (CO^2), Sulfur and other hydrocarbons (ethane, propane, butane, etc.).

The project will be developed in accordance with the requirements of national regulations on the construction and operation of natural gas infrastructure, including the provisions on protection and safety zones applicable to natural gas installations/ facilities. The project will be carried out by benefiting from international expertise specialized in similar deepwater development projects and will be implemented in accordance with the best construction and installation practices in the industry and the latest technologies used in the field.

The development of the proposed project includes a number of advantages, such as: minimizing the impact on local communities due to the location of the offshore production platform and underwater equipment approximately 160 km from the shore, and avoiding the current and planned tourist area, by using the latest construction methods of the shore crossing (microtunneling).

The exploitation of new natural gas reserves has a positive economic impact by generating additional revenues to the national budget and represents an option for ensuring national energy independence and feasible energy costs for public and private customers.

This development of gas resources can generate a positive impact on the local and national economy and on neighboring local communities. Additional revenues to the local budget will be provided from taxes and contributions necessary for the development of the project. The project can also contribute to the economic development of the area and represent an opportunity for the development of other investments and socio-economic activities in the project area.

The project would generate a positive impact on the local road infrastructure due to the construction of a new access road (*subject to a separate authorization procedure)* to the NGMS and CCR sites. This new access road will represent a new connection of the national road DN 39 to the communal road DC 4. In addition, the project would contribute to the development of the local electricity distribution system due to the installation of a transformer in the area of the NGMS site and the extension of the electricity distribution line to the onshore project site (project subject to a separate authorization procedure).

The zonal urban plan - PUZ, which regulates the location and development of the project on land, was approved by the Tuzla City Council (Decision no. 100 of November 16, 2020) and the Constanța County Council (Opinion no. 67 of November 27, 2019). Copies of these approvals are presented in *Annex C. Regulatory acts issued by the authorities.*

2.2.2 Presentation of the project implementation schedule, including the estimated duration, start and end dates of construction, operation and decommissioning of the project;

The construction and installation of the project infrastructure is estimated to be completed in approximately 2 years, according to the current schedule, from the date of obtaining all project development approvals from the regulatory authorities. The main onshore, nearshore and offshore construction/ installation stages are presented in the following paragraphs, in the construction schedule chart, table 2.18 and the work area identification image figure 2.5.

The onshore and offshore facilities will operate for over 20 years.

At the end of their life, the facilities will be decommissioned/ abandoned according to the specific decommissioning/ abandonment plans that will be in accordance with the legislation in force from that date. The decommissioning/ abandonment works shall be executed in accordance with an appropriate execution plan (schedule) which shall form part of the decommissioning/ abandonment plans.

2.2.2.1 Construction/ installation of infrastructure on land

The main stages of onshore construction/ installation activities will include:

- Construction/ installation of temporary site organization from NGMS and CCR (including site preparation, earthworks, arrangement of storage spaces, installation of containers, etc.) and other temporary works (eg right of way for pipeline installation, temporary railway level crossing, temporary construction roads, etc.);
- Construction/ installation of NGMS and CCR (including site preparation, earthworks, civil works, installation of buildings/ offices and equipment, utilities, etc.) and other related facilities (utilities, internal roads and platforms, parking, fencing, landscaping, etc.);
- Installation of onshore section of gas production pipeline (including shut-off valve) and fibre optic cable, including execution of undercrossing of local roads, railway and existing utilities (eg existing RAJA water pipeline);

- Decommissioning of temporary constructions and facilities (site organization, temporary railway level crossing, temporary construction roads, etc.) and restoration of the land affected by the construction/ installation works.

NGMS and CCR sites will consist of a prepared surface, foundations, skid and individual equipment, and prefabricated and assembled structures (prefabricated structural steel components), buildings (e.g., CCR building, LER, gas chromatograph and moisture analyzer shelter), equipment packages (e.g., electric heaters, pig station, separator/ filter, transformers, standby diesel generator with built-in diesel storage tank), and piping assemblies (including pipes, fittings and taps) and internal roads, parking and platforms.

The installation of the onshore production pipeline and fibre optic cable (including shut-off valve and sub-crossings) will be managed in such a way as to avoid conflicts of simultaneous operations with the other onshore installations.

Upon completion of the construction/ installation works, the temporary works will be decommissioned and the sites affected by the construction/ installation works will be returned to their original condition.

For certain operations, seasonal work restrictions and mitigation measures will be considered during the construction period and the decommissioning period of temporary works and land restoration, given the proximity of the project site to residential and tourist areas.

2.2.2.2 Construction/ installation of undershore crossing by gas production pipeline and fibre optic cable

An estimated total construction duration of approximately 10 months has been established, considered from the start of the shore crossing works to the end of the land restoration works. Tunneling works will be executed in 3 shifts, 24/ 7, respectively 10 working hours/ day for other construction works related to microtunneling. The shore crossing execution plan will include both onshore and offshore works as outlined below.

- Works performed on land:
  - Construction of temporary access roads, arrangement of the construction site organization and restoration of the areas occupied by the temporary access roads, organization of the construction site from the microtunnel to the completion of the construction works;
  - Work related to the launch pad, including launch pad construction, launch pad conversion and launch pad removal;
  - Tunnel construction work, including mobilisation, tunnel excavation (launching, operation and arrival), tunnel preparation (removal of equipment, installation of pipes, tunnel flooding) and demobilization of equipment;
  - Pipeline construction, including delivery, stringing, welding, non-destructive testing, hydrotesting (pre-installation);
  - Tunnel filling, including equipment mobilization, equipment filling and demobilization.

- Works performed at sea:
  - TBM reception pit;
  - Recovery of the drilling machine;
  - Excavation of the trench near the shore;
  - (Partial) filling of the ditch near the shore;
  - Pulling pipelines to shore.

Upon completion of the construction and installation works related to the shore undercrossing, the site organization will be decommissioned and the onshore and offshore areas affected by the works will be restored to their original conditions.

2.2.2.3 Construction/ installation of infrastructure at sea

According to the current schedule, the construction/ installation of the offshore infrastructure is expected to be completed in several seasons. The main stages of installation activities at sea will include:

- Installation of gas production pipeline at sea (including operations of vessels used for installation):
  - Installation of prefabricated pipe assemblies - the section of the pipeline from the sea and up to the connection point of the pipeline near the shore, the end of the pipeline assembly and the riser up to the connecting shaft;
  - Execution of the foundation for the end-of-pipe assembly;
  - Gravel/ crushed stone reinforcement for rock berms on seabed faults;
  - Installation and pre-commissioning of the prefabricated pipeline;
- Offshore installation of Domino flowlines(including vessel operations used for installation):
  - Installation of prefabricated pipe assemblies – pipe end assembly, in-line T-assembly, riser bushing, flowline connections, underwater pig station and in-line direct electric heating components;
  - Execution of foundations for pipe end assembly, in-line T assembly and underwater pig station;
  - Installation and pre-commissioning of prefabricated flowlines;
- Offshore Installation of the prefabricated Pelican South flowline and pre-commissioning (including installation vessel operations);
- Offshore Installation of Pelican South and Domino umbilical control systems;

- Offshore Installation (including installation vessel operations) of subsea equipment (manifold foundations, manifolds, flowlines connection, well connection pipes, connecting pipes and cables, flowlines risers and anti-trawling protection structures, including:
  - Suction pile foundations for the subsea production manifolds for the Domino and Pelican South drilling centres;
  - Installation of subsea production manifolds (pre-filled with conservation fluid) for the Domino drilling centres (DODC1 and DODC2) and the Pelican South drilling centre - PSDC1 (equipped with a pre-installed anti-trawling protection structure);
  - Installation of anti-trawling protection structures for PSDC1 wells;
  - Installation of rigid connection pipes to the flowlines from DODC1 and DODC2;
  - Installation of rigid connection pipes to wells from DODC1 and DODC2;
  - Installation of risers of the gas production pipeline and the Domino flowline to the marine production platform;
  - Installation of the gas production pipeline connecting pieces between the offshore and the nearshore sections;
  - Installation and pre-commissioning of prefabricated support equipment;
- Offshore installation of the production platform jacket and topside, including vessel operations used for installation and connection work;
- Offshore installation of fibre optic cable between shore sub-crossing and offshore production platform.

2.2.2.4 Drilling campaign execution plan

The total drilling and completion period is estimated to be approximately 800 days (10 wells, 80 days/ well), 4 wells at Pelican South and 6 wells at Domino. All wells will be drilled in a continuous drilling and completion campaign using a mobile propulsion assisted and anchored offshore drilling unit – MODU.

Table 2.18 Schedule for the implementation of the Neptun Deep project

	WEEK	2024						2025												2026									
		VII	VIII	IX	X	XI	XII	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	I	II	III	IV	V	VI	VII	VIII	IX	X
Lucrari de instalare/construire SRM/CCR (3)																													
Amenajare organizare de santier, drumuri de acces, platforme de lucru	4																												
Lucrari civile	17																												
Instalarea conductei pe uscat	4																												
Instalarea conductei de productie si CFO cu executarea subtraversarilor	3																												
Construire SRM/LER/CCR	61																												
Lucrari construire microtunel (2)																													
Amenjarea organizarii de santier microtunel	4																												
Construirea caminului de lansare	13																												
Lucrări de construcţie a microtunelului	9																												
Mobilizarea navei si construirea caminului de iesire	4																												
Executare santului de trazitie	4																												
Instalarea conductei de productie si FCC	4																												
Forare sonde Pelican Sud(D1)																													
Forarea sondei Pelican 4 si conservarea sondei	8																												
Forarea sondei Pelican 1 si conservarea sondei	9																												
Forarea sondei Pelican 2 si conservarea sondei	4																												
Forarea sondei Pelican 3 si conservarea sondei	9																												
Instalarea capetelor de sonda(Xmas tree)	4																												
Forare sonde Domino 1 (D2)																													
Forarea sondei Domino E1 si conservarea sondei	9																												
Forarea sondei Domino E2 si conservarea sondei	9																												
Forarea sondei Domino E3 si conservarea sondei	4																												
Instalarea capetelor de sonda(Xmas tree)	2																												
Forare sonde Domino 2 (D3)																													
Forarea sondei Domino C2 si conservarea sondei	4																												
Forarea sondei Domino C1 si conservarea sondei	4																												
Forarea sondei Domino C3 si conservarea sondei	4																												
Instalarea capetelor de sonda(Xmas tree)	2																												
Instalare Platforma de foraj(1)	26																												
Instalare Jacket + suprastructura	26																												
Instalare Conducta de productie (4)																													
Instalare conducta de productie inclusiv testele(4)	22																												
Instalare cablu cu fibra optica(5)																													
Instalare cablu cu fibra optica	4																												
Instalare structuri de protectie antitraulare FOC	4																												
Instalare componente subacvatice Centru de foraj Pelican SUD(6)																													
instalare Manifold + SDU Pelican	3																												
Instalare conducta de alimentare/aductiune Pelican	2																												
Instalare sistem ombilical Pelican	2																												
Instalare componente subacvatice Centru de foraj Domino 1(7)																													
instalare Manifold + SDU DODC1	3																												
Instalare conducta de alimentare/aductiune DODC1	2																												
Instalare conducta De-watering DODC1	2																												
Instalare sistem ombilical DODC1	2																												
Instalare componente subacvatice Centru de foraj Domino 2(8)																													
instalare Manifold + SDU DODC2	3																												
Instalare conducta de alimentare/aductiune DODC2	2																												
Instalare conducta De-watering DODC2	2																												
Instalare sistem ombilical DODC2	2																												
Instalare conducte/ sistem ombilical de la Domino la SWP (9)																													
Instalare conducta de alimentare si sistem ombilical 1A / 1B de la Domino la SWP	3																												
Instalare conducte/ sistem ombilical de la Pelican la SWP (10)																													
Instalare conducta de alimentare si sistem ombilical Pelican la SWP	4																												

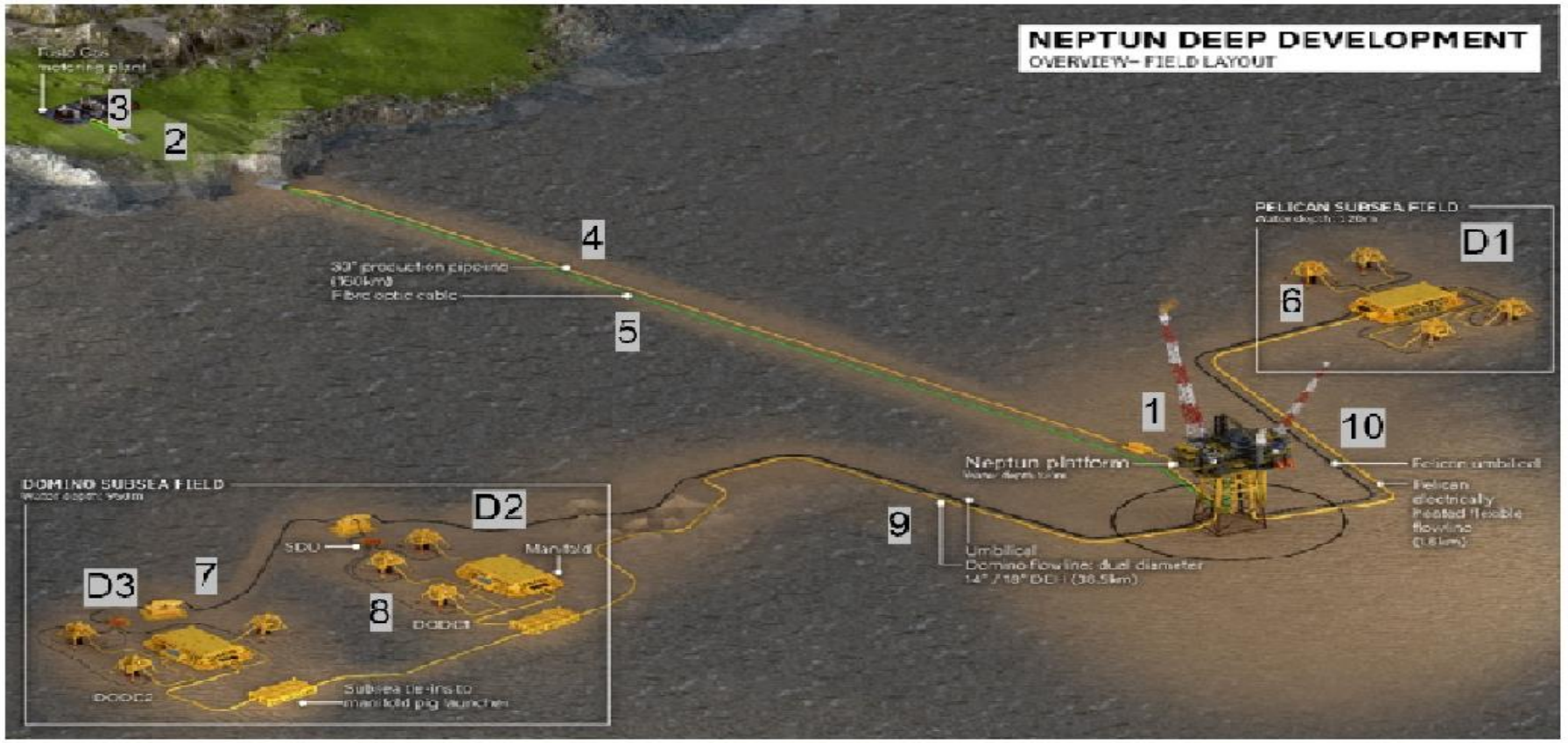

Figure 2.5 Identification of areas for installation/ construction of project components

D1 Pelican well drilling

D2 Drilling Domino 1 wells

D3 Drilling Domino 2 wells

1 Installation of the production platform

2 Execution of the microtunnel including the installation of the pipeline

3 Installation/ construction of NGMS / CCR

4 Installation of the production pipeline

5 Fibre optic cable installation

6 Installation of aquatic components Pelican drilling centre

7 Installation of aquatic components Domino1 drilling centre

8 Installation of aquatic components Domino1 drilling centre

9 Domino umbilical pipe/ system installation at SWP

10 Pelican umbilical pipe/ system installation at SWP

2.2.3 Description of the main components of the project

The Neptun Deep project represents a proposal for the development of natural gas resources in the XIX Neptun exploration-exploitation-development Perimeter, located in the deep area of the Black Sea.

The main sea and land components of the project are as follows:

- The **subsea infrastructure of the Domino and Pelican South fields,** including subsea production wells, flowlines connected to the Neptun Alpha Platform from the Domino and Pelican South fields, electrical and hydraulic control umbilical systems from the production platform to the Domino and Pelican South drilling centres and other subsea equipment;
- **The unmanned Neptun Alpha platform** for the processing of natural gas from the Domino and Pelican South fields, located in waters with a depth of approximately 130 m, and underwater control equipment located on the production platform;
- **Natural gas production pipeline** approximately 160 km long and 762 mm (30 inches) outside diameter from the production platform to the onshore NGMS, including an undershore (microtunneling) section;
- **Fibre optic cable** routed parallel to the production pipeline from the production platform to the onshore CCR, including an undershore (microtunneling) section;
- **NGMS on land operated without personnel** to measure and transmit the processed gas to the NTS;
- **Onshore CCR** located adjacent to the NGMS site which will serve as the main operations monitoring and control centre for all Neptun Deep project facilities (subsea systems, production platform, production pipeline and NGMS);
- **Other permanent onshore facilities/ areas included in the NGMS and CCR site area** (eg fencing, lighting, parking, landscaping, internal roads, technology platforms and utilities).

Figure no. 2.6 presents the general technological scheme of the Neptun Deep project, and Figure no. 2.7 presents the general development concept of the Neptun Deep project.

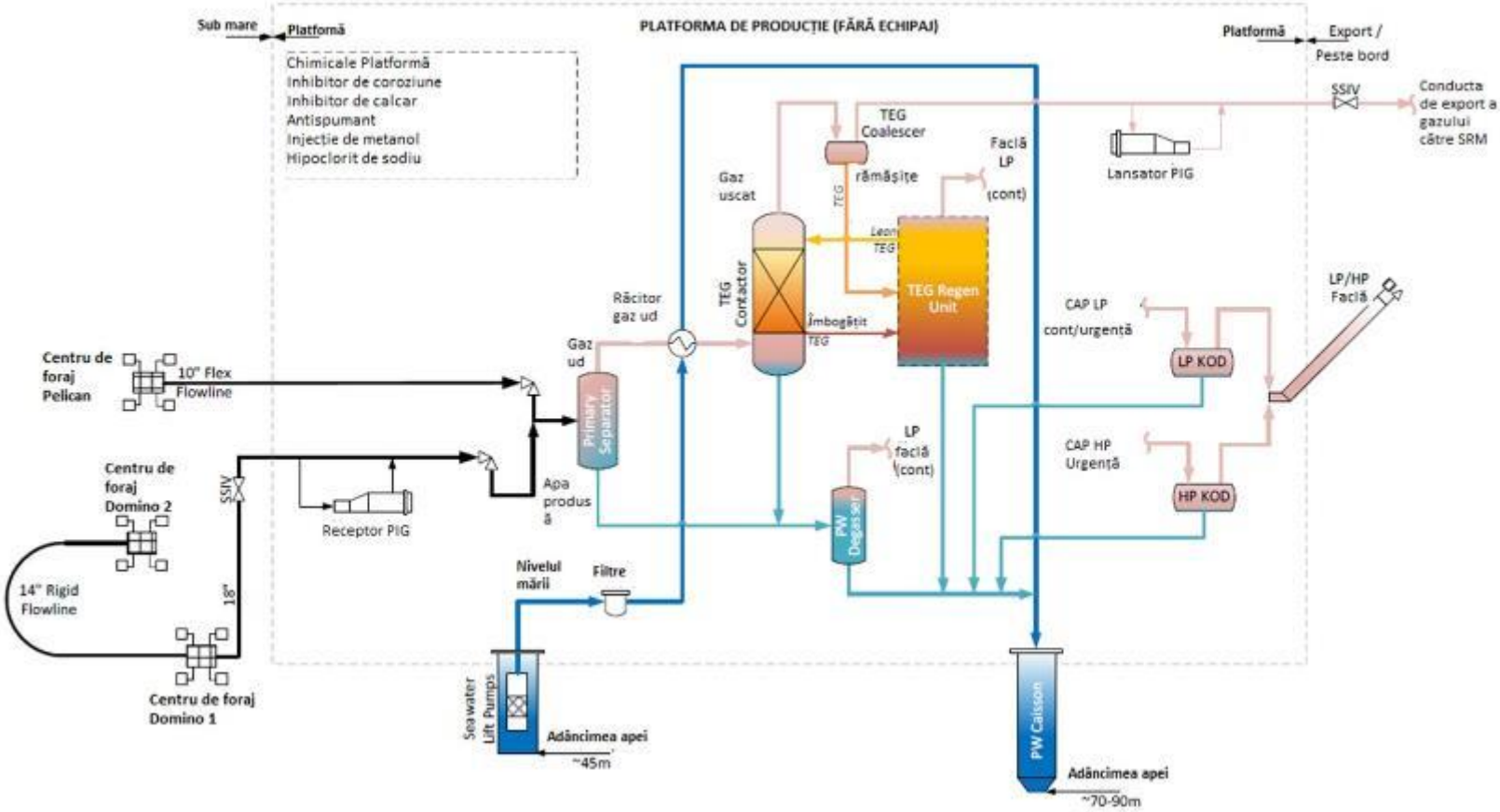

Figure 2.6 General technological scheme of the Neptun Deep Project

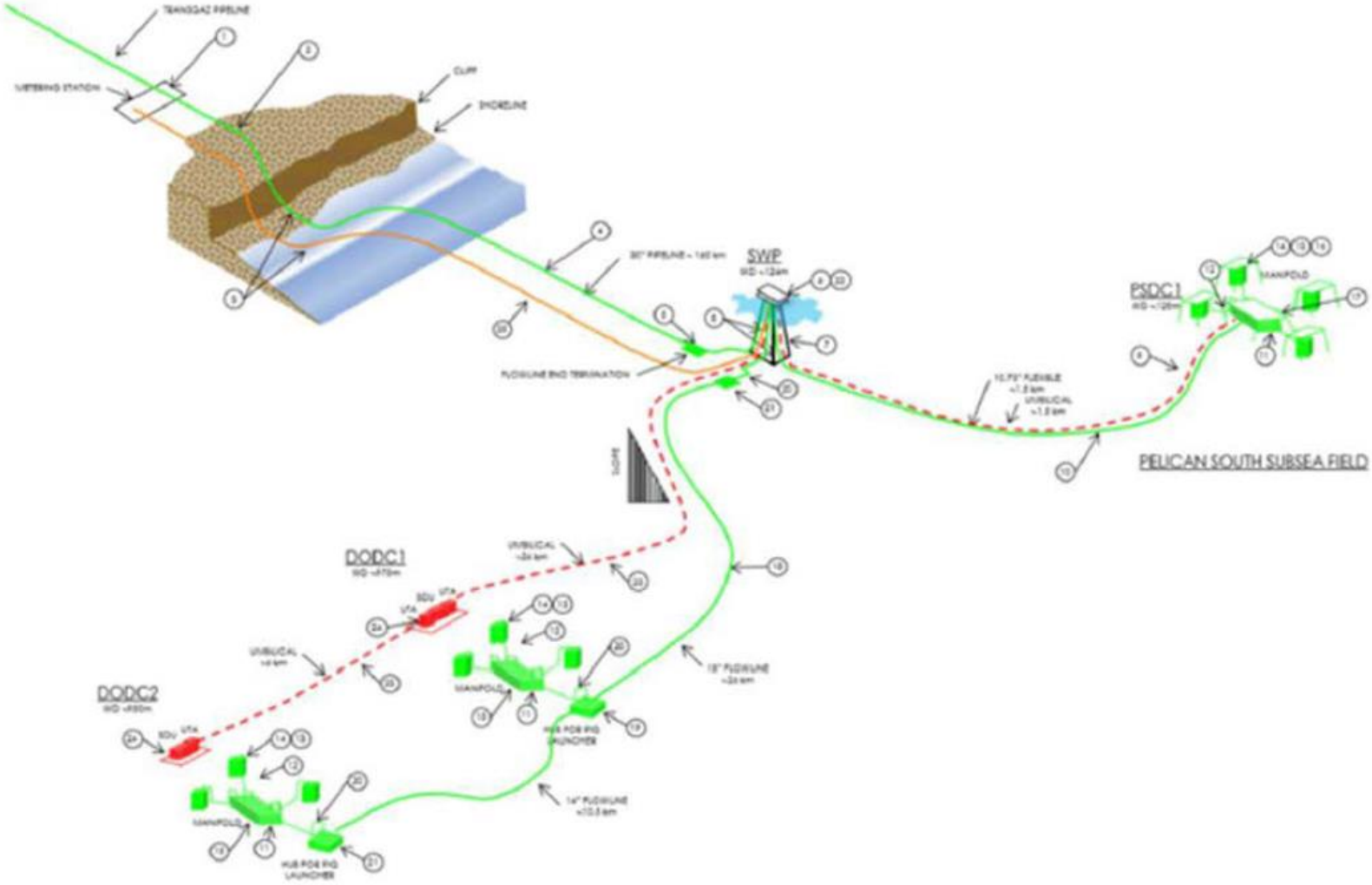

Figure 2.7 Neptun Deep project – general development concept

2.2.3.1 Underwater infrastructure of the Domino and Pelican South deposits

The main components of the infrastructure of the Domino field consist of:

- 2 separate drilling centres DODC1 and DODC2 connected by a 14 inches flowline and an electro-hydraulic umbilical system. The drilling centres consist of 6 gas production wells (each 3 wells/ centre) connected to 2 underwater manifolds (1 manifold/ centre).
- Approximately 36.5 km long 14 inch (355.6 mm)/ 18 inch (457.2 mm) variable diameter steel flowline connecting the drilling centres to the offshore production platform. In order to prevent the formation of hydrates, the 18 inch/ 14 inch variable diameter flowline is equipped with a direct electric heating (DEH) system, and will be insulated;
- 2 segments of the electro-hydraulic control umbilical system: one segment between the Neptun Alpha Platform and the DODC1 drilling centre and one segment between the DODC1 drilling centre and the DODC2 drilling centre. Umbilical systems will also deliver chemicals to underwater facilities. Flying leads will then connect the umbilical system from the subsea distribution unit (SDU) at the drilling centre to the wells and manifold;
- Underwater pig launcher/receiver will be installed to enable cleaning of the flowlines to the offshore production platform;
- Manifolds will have pile foundations installed by suction;
- Support structures will be used for the umbilical/ subsea distribution unit end assembly.
- 18" SSIV system at the production platform.

The main infrastructure components of the Pelican South field consist of:

- A PSDC1 drilling centre consisting of 4 gas production wells connected to a single subsea production manifold.
- 10.75 inches (273 mm) diameter flexible heated flowline approximately 1.5 km long from the Neptun Alpha Platform to the PSDC1 Drilling Centre; the pipeline will be buried for protection against fishing activity;
- Electro-hydraulic control umbilical system between the Neptun Alpha Platform and the PSDC1 drilling centre. The umbilical system will also deliver chemicals to underwater facilities. The umbilical system will be buried for protection against fishing activity. Flying leads will then connect the umbilical system from the SDU in the drilling centre to the wells and manifold;

a) Drilling centres

Drilling centers shall be designed as standard underwater wells. Drilling centre layout takes into account installation and commissioning considerations, along with future expansion possibilities.

The configuration of the drilling centres will include a dual pressure multiplex electro-hydraulic control system, communication system and communication system power supply.

Drilling centres DODC1 and DODC2 will be provided with SDU and umbilical termination assembly (UTA) at each drilling centre that has the same foundation structure. The connection between UTA and SDU will be made through connection cables.

The PSDC1 drilling centre will be provided with hydraulic and chemical supply from the umbilical system, connected directly to a multi-connection manifold. Distribution of hydraulic, chemical, electrical power and control signals will be integrated into the manifold.

b) Gas production wells

The current drilling plan consists of drilling and securing a maximum of 10 gas production wells (underwater), respectively:

- 6 wells are planned to be drilled to a vertical depth of 3000 m from the DODC1 and DODC2 drill centres (3 wells/ drill centre) in the Domino field at a water depth of 945 - 980 m;
- 4 wells will be drilled to a vertical depth of 3400 m from a single drilling centre (PSDC1) in the South Pelican field, at a water depth of 120 - 130 m;

c) Domino and Pelican South flowlines

The main characteristics of the flowlines are shown below:

- Approximately 36.5 km variable diameter direct heating feed/ intake pipeline respectively: approximately 26 km long and 457.2 mm (18 inches) OD between the DODC1 Drilling Centre and the Neptun Alpha Platform and approximately 10.5 km long and 355.6 mm (14 inches) OD between the DODC1 Drilling Centre and the DODC2 Drilling Centre, including a Flowline End Terminal (FLET) to the offshore production platform, an in-line T-connection assembly (ITA) at the DODC1 drilling centre where the pipe diameter changes, as well as a FLET at DODC2. The route from the Domino field to the Neptun Alpha Platform involves crossing a slope along the continental plateau;
- 273 mm (10.75 inches) inner diameter flexible heated flowline approximately 1.5 km long from the Neptun Alpha Platform to the PSDC1 Drilling Centre, including manifold connection and a FLET to the offshore production platform.
- The Domino flowline will also have a Subsea Isolation Valve (SSIV) located at a safe distance of 500m from the offshore production platform, and at a depth of 120 m. The system will consist of an 18 inci (457.2mm) ball shut-off valve, designed to allow the use and movement of a pig ("PIG") inside the pipeline, thus facilitating periodic pipeline cleaning, internal inspections or other maintenance operations or pipeline condition monitoring.
- The closure system will be hydraulically controlled directly from the platform's hydraulic unit, being protected by an SSIV protective structure.

Domino flowline with direct heating system

To ensure active hydrate management with electrical heating, Direct Electrically Heated (DEH) equipped flowlines will be used. The DEH system will include:

- Supply, control and monitoring equipment (Neptun Alpha and CCR Platform components);
- 1 dual core or coax cable, pull head riser, bend restrictor and J tube seal (if applicable);
- 1 underwater junction box;
- 1 or 2 armored power cables, depending on the design of the cable core;
- Cable associated with the pipeline, 37 km long, with anti-trawling protection and fixing system;
- 2 end-of-pipe devices (1 at the offshore platform, 1 at the DODC2 drilling centre);
- 2 current transfer zones with concrete mattress foundations to ensure that the transfer zone is stable on the seabed.

The main characteristics of the Domino flowlines are as follows:

- Carbon steel pipe;
- Thermal and anti-corrosion insulation;
- Anodes, flanges/ connectors, etc.;
- Riser and connection coils;
- Direct electric cable heating system.

The route of the Domino direct electric heating flowlines was determined based on the results of a route study carried out by a specialist contractor. The route study included evaluation of route investigation data (eg geophysical investigations), flowline data, gas field and offshore production platform details, and manifold connection details.

The route of the supply/ induction pipeline from the Neptun Alpha Platform to the DODC1 drilling centre and from the DODC1 drilling centre to the DODC2 drilling centre is shown in Appendix B.

Pelican South Electrically Heated Flexible Duct

To ensure active hydrate management through electrical heating, an electrically heated flowline will be used for Pelican South. The Pelican South electrically heated flexible flowline will be equipped with supply, control and monitoring equipment (offshore production platform and CCR components).

The main characteristics of the Pelican South feed/ supply pipeline are the following:

- Connection head, bend restrictor and J-tube seal (if applicable) ;
- Power, control and monitoring equipment;
- Option: Combine flexible feed/ supply pipe and Pelican South umbilical system into one integrated production package.

The route of the Pelican South electrically heated flowline and umbilical system between the Neptun Alpha Platform and the Pelican South manifold was determined based on the results of a route survey carried out by a specialist contractor. The route study included evaluation of route investigation data (eg geophysical investigations), flowline data, details of the Pelican South gas field and offshore production platform, as well as connection details to the Pelican South manifold.

The flowline routes and umbilical system are in a straight line for most part of the route, except in the area near the Pelican South drill centre, with the umbilical system running parallel 30 m away from the centre line of the route.

d) Domino şi Pelican South umbilical system

The Domino and Pelican South subsea systems will be monitored and controlled using electrical and hydraulic control systems connected to the Neptun Alpha Platform via dedicated umbilical control connections.

The Domino subsea system will include two electrical and hydraulic control umbilical segments: one between the offshore production platform and the DODC1 drilling centre and one between the DODC1 drilling centre and the DODC2 drilling centre. The umbilical systems will also provide chemicals for underwater installations. Flying leads will then connect the umbilical system from the subsea distribution unit at the drilling centre to the wells and manifold.

The Pelican South subsea system will include an electrical and hydraulic control umbilical system between the Neptun Alpha Platform and the PSDC1 drilling centre. The umbilical system will also deliver chemicals to underwater facilities. The umbilical system will be buried for protection against fishing activity. Connecting pipes will then connect the umbilical system from the subsea distribution unit at the drilling centre to the wells and manifold.

The main characteristics of umbilical systems are presented below:

- Domino umbilical system within the field approximately 6 km long, from the DODC1 drill centre to the DODC2 drill centre;
- Domino umbilical system on the continental shelf approximately 26.5 km long, from the Neptun Alphap Platform to the DODC1 drilling centre;
- Pelican South umbilical system approximately 1.5 km long, from the offshore platform to the PSDC1 drilling centre.

The routes of the umbilical systems between the Neptun Alpha Platform and the Domino and Pelican South drilling centres were determined based on the results of specific route studies carried out by a licensed contractor.

The routes of the Domino and Pelican South umbilical systems are presented in Annex B.

The configuration of the underwater umbilical system will include the following components:

- A connection head, used to connect the umbilical system to the platform system and to pull the umbilical system to the host installation;
- A platform TUTA (topside umbilical termination assembly) used to support the umbilical system at the host facility;

- Static umbilical segments;
- The UTA and associated foundation structures connected to the subsea ends of the main umbilical systems and both ends of the umbilical system between the DODC1 well centre and the DODC2 well centre;
- Bending restraints at each umbilical system - UTA interface to prevent torsion of the umbilical system during installation and/ or recovery;
- Cathodic protection system covering the umbilical and UTA systems with anodes placed on the UTA;
- Funnel at the end of each J tube through which the 2 static umbilical systems will be drawn to the production platform;
- Centres in J-tubes for installation and/ or operation;
- Reinforcement of the umbilical system according to the requirements;

The umbilical system will prevent and mitigate problems that may occur as a result of the operation of the direct electric heating system that is part of the Domino flowline (corrosion due to alternating current, induced voltage, communication interference, grounding, etc.).

e) Manifolds, pile foundations and support platforms

Each drill centre will contain wells clustered around a production manifold. The production wells will be connected to 2 production manifolds at the DODC1 and DODC2 drilling centres, respectively a production manifold at PSDC1, which are installed on support platform foundations and suction piles.

- 2 piles with associated platforms for the 2 Domino production manifolds;
- 1 piles with associated platform for Domino Inline Tee Assembly (ITA);
- 1 piles with associated platform for the Domino Feeder/ Supplier End Device at the DODC2 Drilling Centre (FLET);
- 1 support platform for the end device of the Domino flowline to the offshore production platform;
- 1 support platform for the pipeline end terminal (PLET) at the offshore production platform.

f) Other underwater equipment

The following FLET, PLET and ITA will be installed:

- A 457.2 mm (18 inch) FLET of the Domino flowline to the offshore production platform;
- A 355.6 mm (14 inch) FLET of the Domino flowline at the DODC2 drill centre;
- One ITA 457.2 mm (18 inches)/ 355.6 mm (14 inches) of Domino feed/ intake pipe (with concentric expansion from 14 to 18 inches and direct electric heating cable included) at the DODC1 drilling centre;

- A 762 mm (30 inch) PLET of the production pipeline to the offshore production platform.

Within the project, 2 risers will be installed (one for the natural gas production pipeline and one for the Domino flowline) and 7 J-tubes.

Auxiliary equipment includes:

- 355.6 mm (14 inches) underwater Domino flowline pig station which is used to maintenance the multi-diameter Domino flowline;
- ID Pelican South Electrically Heated Flexible flowline Underwater Pig Station (will only be used prior to commissioning).

2.2.3.2 Neptun Alpha Platform

The Domino and Pelican South infrastructure will be connected to the automated and autonomous production platform, composed of a structural support (*jacket)* with the facilities located on two levels of the topside. The production platform will be located on the continental shelf, in water between 120-130 m deep and will occupy a total area of approximately 3,547 m $^{2.}$

Figure no. 2.8 shows a conceptual 3D model of the Neptun Alpha Platform.

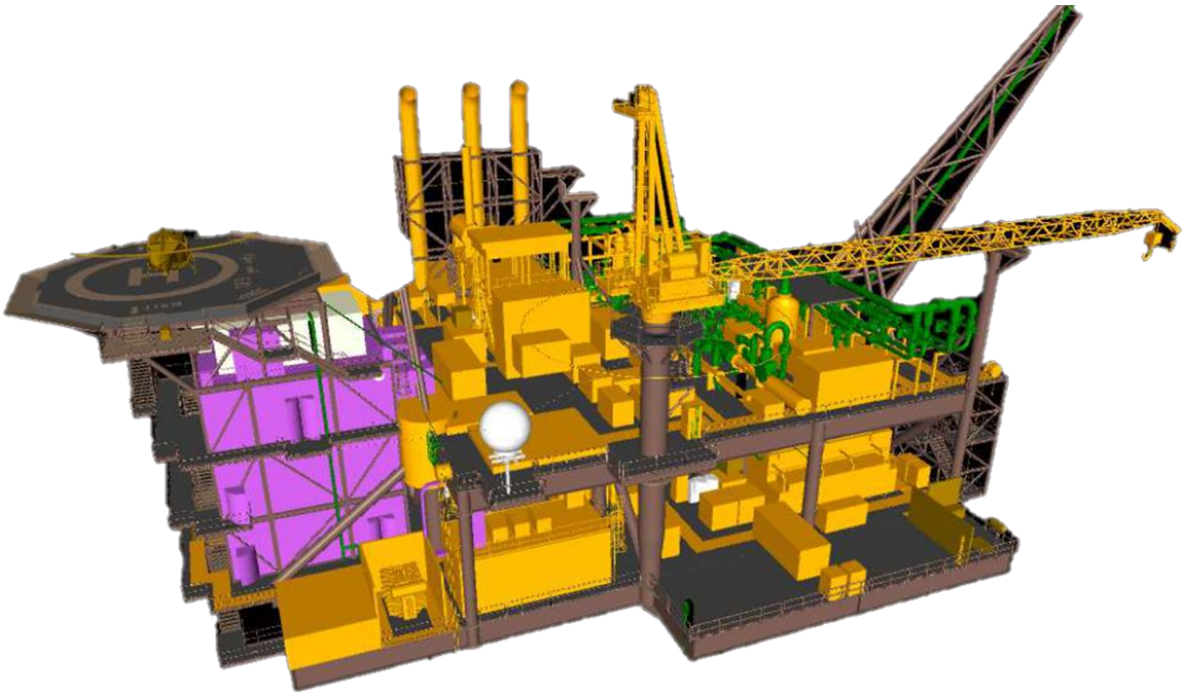

Figure 2.8 Conceptual 3D model of the production platform

a) Structural Support (Jacket)

The main design features of the jacket support structure are summarized below:

- The Jacket is a fixed support structure with a height of 120 m;
- Estimated weight: 9000 tons (subject to detailed design and final weight allocation);
- Integrated platform at sea level;

- Fixed to the seabed by eight pillars 84 inches (2133.6 mm) in diameter and 110 meters long.

The jacket will be anchored in the seabed, using "skirt" type pillars, over the main pillars, which will be inserted through the legs of the jacket. The use of "skirt" type pillars will allow fluid storage inside the legs of the jacket. The project provides for the use of 2 "skirt" pillars on each leg, for a total of eight pillars. Based on current information, the target penetration for each pillar is 90 m below sea level (mudline).

The platform jacket will support 7 tanks (1 x TEG storage, 1 x open drainage storage, 2 x methanol storage, 2 x seawater lift and 1 x potable water discharge), thus jacket legs providing storage volumes for various utility liquids.

The jacket will use the upper compartment of all four legs as storage tanks of 200 m 3 each for the process fluids (1 tank for the storage of lean glycol, 2 tanks for the storage of methanol and 1 tank for the fluids collected by open drainage), which will be used during the platform operations. The pump caissons will descend vertically from sea level and will be connected to the leg storage tanks by interconnecting pipes. A closing diaphragm will separate the leg storage compartment from the lower leg compartment of the jacket, which will be flooded with seawater during the jacket lift. The inside of the jacket legs will be coated with a protective layer and will benefit from cathodic protection with sacrificial anodes to prevent corrosion from liquids stored inside the leg caisson.

Rainwater falling on the platform surfaces of the production platform equipment will be captured and diverted into an open drainage system. Similarly, water used for surface washing will also be captured and diverted into the open drainage system. All open drainage water will be directed to the 200 m^3 storage tank located in one of the steel legs of the production platform.

2 risers and 7 J-tubes will be installed at the production platform to receive the production flows and to include the placement of umbilicals and power cables for subsea equipment. The risers/ J-tubes will pass through the jacket and the upper end will terminate on a platform located at the top of the jacket. The cables and conduits at the top will then connect to the platform that houses these terminations and junction boxes.

The jacket will have a "Sea Deck" level near the top of the jacket. The "Sea Deck" will support the anchor flanges for the risers and J-tubes. The Sea Deck is designed to allow the umbilicals and cables to be pulled and installed prior to rig superstructure installation. This installation requires the Sea Deck to be designed to support a cable reel system that will be required to pull the cables and umbilicals through the J-tubes.

b) The topside

The current concept of the production platform provides for a 2-level deck. The upper deck mainly includes process equipment and power generation equipment. The lower deck mainly includes utilities and underwater control equipment.

The jacket will be of four-legged steel braided structure with a "skirt". The jacket will support the superstructure, fittings and piping. The configuration of the jacket will allow the installation of equipment for lifting and handling heavy materials (heavy lift).

The platform topside will house process equipment, utilities, subsea equipment control systems and other functional requirements. The top will also accommodate a pedestal crane and a support arm for the low pressure flare and high pressure flare.

A safety zone of 500 m will be established around the platform, in which the access of unauthorized vessels will be prohibited. Signaling, marking and guidance equipment for navigation, specific to marine platforms, will also be installed on the platform.

The main features (processes, utilities, controls, etc.) related to the platform topside are presented below:

- Estimated weight: 8000 tons (aspect subject to design for final weight configuration);
- PCS/ SIS system (normally the SIS functions are configured for the integrity of the production platform. The process will be remotely controlled from the onshore control room via back-up FOC and VSAT;
- Two phase water-gas separation - 63 m^3/ hour of normal operation; flow rate of 830 m^3/ hour for the handling of liquids during drilling operations;
- Wet gas cooler;
- Gas dehydration unit;
- Standard Tri-Ethylene Glycol (TEG) regeneration technology;
- Low pressure flare for routine outgassing;
- High pressure flare for gas evacuation in emergency situations;
- Water lifting system for cooling;
- Technological wastewater (reservoir water) degassed and discharged into the sea;
- 3x50% gas turbines (2 operational and 1 stand-by), providing 9.2 MW of power to the production platform, with a thermal efficiency of 30%;
- 1x 100% generator for essential services;
- 1x 50% backup generator;
- Local room for electrical and control systems equipment, including the submarine control system;
- The DEH (Distributed Electrical Heating) power and control module is responsible for power supply and control of the DEH system;
- A separate hydraulically actuated unit shall be used for subsea flare heads/ manifolds and surface valves;
- Electrohydraulic crane platform for maintenance work support;
- Landing areas for support vessel gangway access on routine basis (heave compensated gangway for vessel movements), helideck for emergency access.

2.2.3.3 Natural gas production pipeline

After processing the natural gas at the offshore platform, a gas production pipeline approximately 160 km long and 30 inches (762 mm) in diameter will transport the gas to the onshore NGMS.

The production pipeline will end with a pig station within the NGMS. The production pipeline route from the offshore platform to the NGMS includes the following components/ sections:

- Pigging station and riser installed on offshore production platform;
- The offshore section of the production pipeline;
- The section related to the under-crossing of the shore;
- The onshore section of the production pipeline, including the railway undercrossing, the shut-off valve housing located outside the NGMS on the East side of the railway, several road undercrossings; and
- Pigging station installed within NGMS.

The complete route of the production pipeline from the offshore platform to the NGMS is shown in Appendix B.

The gas production pipeline will also include an end-of-line device (PLET) installed within the offshore platform and a subsea isolation valve assembly, mounted remote from the offshore platform within the 500 m safety zone and at a water depth of 120m. The assembly will consist of a 30-inch ball valve (fullbore) operated and hydraulically controlled directly from the platform's hydraulic supply unit. Also, the underwater isolation valve assembly will be protected by a protective structure.

The production pipeline will have the following characteristics:

- Carbon steel pipe;
- Lined internally to ensure flow and coated externally against corrosion;
- Concrete cover for stability on the seabed;
- Anodes, flanges/ connectors, etc.;
- Riser, SSIV, mosor connection, shore undercrossing, onshore section of pipeline to NGMS.

The production pipeline is sized to support the designed production rates. The main design parameters of the pipeline are given below:

- Outer diameter: 762 mm (30 inches);
- Pipeline length: about 160 km (on a length of about 1 km it will be installed on land);
- Material type: DNV SAW 450;
- Pig need: Yes;
- Minimum specific strength: 450 MPa;
- Wall thickness (class 2): 30 mm (class 2);

- Wall thickness (class 1): 17.5 mm;
- Permitted internal corrosion (permitted external corrosion applies only in the breakwater area): 2 mm;
- Design pressure: 139 barg;
- Internal fluid density (gas): 34-110 kg/ m^3;
- Maximum design temperature: 55°C;
- Maximum operating temperature: 45°C;
- Minimum design temperature: -29°C;
- Expected operating pressure: from 102 barg (at the exit from the production platform) to 55 barg (at the shore entrance);
- External anti-corrosion coating: epoxy resin applied by fluidization and concrete coating for stability/ three layers of extruded polyethylene (3LPE);
- Inner Lining: Lining to ensure flow with a thickness of approximately 80 (-0/ +25) microns;
- Water depth range: 7 ÷ 137 m.

The system design pressure can maintain a LinePack (the effective volume of gas in the piping system at any one time) of up to 50 barg in the production pipeline. However, a LinePack of approximately 20 barg is expected to be maintained to support the operational flexibility of the production system.

The offshore section of the production pipeline will include variations in steel pipe wall thickness, concrete lining and trenching (limited to the nearshore area) to maintain stability on the seabed.

The production pipeline will be lined internally to ensure flow, coated externally against corrosion and partially concreted for buoyancy and stability on the seabed.

The proposed offshore production pipeline route crosses 3 faults and several possible cables, according to *Appendix B. General Situation Plans.*

In support of the installation of the pipeline and its protection during the period of operation, on a sector of approximately 3375 m in length extending from the sea exit point of the microtunnel to the water depth of 35 m, the pipeline will be installed in a trench (Appendix B). Laying the pipeline near shore will require anchored vessels.

The production pipeline intersects the shoreline in a high bluff area. Due to this local topography and efforts to keep the protected area ROSAC0273 Cape Tuzla Marine Area, cliff and beach intact, the production pipeline and fibre optic cable will cross the coastal area by means of a cemented microtunnel, approximately 1 km long.

The onshore pipeline route will be located between the onshore entry point of the onshore microtunnel and the NGMS site, respectively up to the first connection upstream of the pig receiving station.

2.2.3.3.1 Microtunnel

The shore crossing will be carried out for a length of 890 m between the land entry point located at kilometer point (KP) 156.965 of the pipeline route and the sea exit point located at KP 156.075 of the pipeline route. The onshore entry point of the microtunnel will be located on private land (surface S4) owned by OMV Petrom. The exit point of the microtunnel will be located in the coastal waters of the Black Sea. The microtunnel will undercross the unpaved road De269 (belonging to the public domain), the cliff (private domain of the Tuzla municipality) and the beach (public domain of the Romanian Waters National Administration - Dobrogea Water Basin Administration - Littoral).

The main design parameters of the microtunnel alignment are:

- Length: 890 m;
- Maximum depth: 25 m;
- Range: 2,500 m;
- Exit angle: 2°;
- Details of the shore undercrossing are given in Appendix B.

The main specifications of the production pipeline and fiber optic cable conduit in the tunnel are:

- **Production pipeline:**
  - Diameter: 762 mm (30 inches);
  - Wall thickness: 30 mm;
  - Material: DNV 450 FDU;
  - Density: 7,850 kg/ m^3 ;
  - Outer lining: 3.4 mm 3LPE.
- **Fibre optic cable conduit:**
  - Diameter: 250 mm;
  - Wall thickness: 22.7 mm (Standard dimensional ratio - SDR11);
  - Material: High Density Polyethylene (HDPE)/ Polyethylene PE100.

  The cross section of the microtunnel is shown in Figure no. 2.9, below.

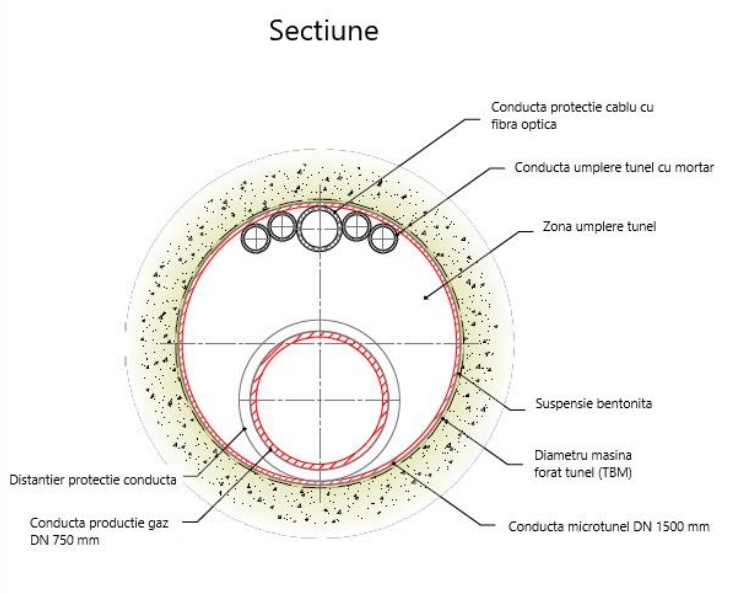

Figure 2.9 Microtunnel cross-section

2.2.3.4 Fibre optic cable

A fibre optic cable will be installed parallel to the gas production pipeline and will provide communication between the offshore platform (which normally operates unmanned) and the CCR with a VSAT connection for backup and redundancy.

The fibre optic cable allows control of the offshore facilities and wells at the CCR and monitoring through the cameras installed at the offshore platform. Internet access will be provided in the local equipment room related to the marine platform, and Wi-Fi will be provided on the marine platform (as part of the control system) and will allow the supervision of processes through manual devices during the presence of operation and maintenance personnel on the platform.

The fibre optic cable route includes:

- An offshore section;
- A shore undercrossing section;
- An splice box on land;
- An onshore section, including a railway undercrossing, several local road undercrossings and the connection to the CCR.

The fibre optic cable will be installed along and adjacent to the production pipeline route from the offshore platform to the CCR (located in the vicinity of the NGMS site).

The fibre optic cable installed between the CCR and the offshore platform follows a similar route to the production pipeline, with a lateral offset of 30m along most of the sea route. The gap is increased to about 52 m on the approach to the platform to access connection points on the platform. The onshore and nearshore sections of the fibre optic cable are positioned in close proximity to the pipeline as the fibre optic cable will be installed in the same trench and tunnel.

The offshore section of the fibre optic cable will be buried at a proposed depth of 1 m below the seabed, with 0.5 m as the minimum depth. In fault zones, the seabed does not need to be

excavated to make the trench. The fault crossing solution will consider the anti-trawling protection of the cable.

In the shore undercrossing, the fibre optic cable will be installed in a 250 mm diameter High Density Polyethylene pipe pre-installed in the shore undercrossing tunnel during its construction and installation.

The onshore fibre optic cable protection conduit will be installed in a trench along with the onshore production conduit.

The main design parameters of the fibre optic cable between Platform Neptun Alpha and CCR are presented below:

- Estimated length: 160 km;
- Number of optical fibre pairs: 12 pairs (24 fibres);
- General concept: reinforced tube;
- Minimum burial depth: 0.5 m;
- Optimal burial depth: 1 m;
- Shore crossing: in pre-installed pipe;

The cable shall have a minimum design life of 25 years in the underwater environment in which it is installed.

A VSAT system will be used as a backup for critical internet traffic between CCR and the Neptun Alpha Platform in case of loss of fibre optic communications.

2.2.3.5 Natural Gas Metering Station on shore

The NGMS will be an automated, unmanned, natural gas metering and custody transfer facility to NTS operated by Transgaz, located in the vicinity of the CCR site. The NGMS location will be fenced and will be located within the S1 area (cadastral number 109216) owned by OMV Petrom. The total area occupied by the NGMS site will be approximately **23,183 m^2.**

The NGMS will be designed with remote monitoring from the CCR, located in the vicinity. NGMS will measure dry natural gas, delivered to the Romanian NST, from the Neptun Deep development. The NGMS will include a combined system to control the flow and pressure of the gas delivered to the NTS.

The NGMS will include only the infrastructure required for essential operation with a limited number of buildings such as the local equipment room (LER) and gas/ moisture analyzer housing. No office, storage or workshop spaces are provided in the fenced area related to NGMS.

For most of the NGMS related equipment and buildings, off-site prefabricated skids and subassemblies will be used, including the pig receiving station, metering equipment and valves.

The land on which the NGMS will be built will include a fenced area dedicated to connecting to the NTS, a facility that will be separately authorized by Transgaz. ***The Transgaz facilities are not part of the Neptun Deep project.***

Hydrocarbons will not be processed on the NGMS site. The separation and processing of the natural gas will be carried out on the maritime production platform, before entering the production pipeline, which brings the natural gas onshore, to the NGMS. Even if liquids are not anticipated to accompany the processed gases arriving at the NGMS , during normal operations, a filter/ separator will be installed on the inlet to the NGMS , equipped with level switches, alarms and manual purge valves, to protect the flowmeters from possible small amounts of water transmitted from the Neptun Alpha Platform in case of failure.

The pig receiving station will be installed at the entrance to the NGMS to facilitate the use of the Pipeline Inspection System and the maintenance of the production pipeline. The pressure class (design pressure and maximum working pressure) of the pipelines and associated gas handling equipment in the NGMS shall conform to that for the production pipeline pressure. The design of the pig receiving station will allow reverse use (from the NGMS to the offshore production platform) as required for pre-commissioning pipeline emptying activities.

The NGMS will include a combined flow and pressure control system to control gas deliveries to the NTS.

The list of the main buildings/ equipment that will be built/ installed within the NGMS according to *the Situation Plan facilitated on land - Annex B* includes:

- Gas quality analyzer chamber (Chromatograph and Moisture analyzer);
- LER for control, communication and the Integrated Control and Safety System (SICS);
  - Heaters;
  - Local Equipment Rooms (LER) for NGMS control;
- 2 Input filters/ separators (N+1);
- pig reception station;
- Flow measurement skid with 5 lines (N+1) with ultrasonic flowmeter, nominal diameter 300;
- 2 flow control valves (N+1) and 1 shut-off valve (located East of the railway);
- Emergency gas dispersion system (gas dispersion basket);
- Gas heaters (3x2MW (3x33%)) to meet the gas temperature conditions at the entrance to the NTSGN;
- Rainwater drainage tank;
- Technology platform;
- Protective fence;
- Personal emergency exit gates;
- Vehicle access gate.

All buildings and equipment installed on the fenced site of the NGMS will respect the maximum height limit of 12 m provided by the Urbanism Zonal Plan in force.

Open areas inside the fenced NGMS site (except for the technology platform) will be covered with geotextile crushed stone to prevent vegetation from appearing on the site. The technological platform and internal roads of NGMS will be covered with concrete.

The rainwater collection basin will be made of reinforced concrete, installed underground, adjacent to the Eastern corner of the NGMS , the tank will have a total volume of 128 m^3 (80 m^3 useful volume).

The Local Equipment Rooms (LERs)

Two distinct local electrical equipment rooms (LER) are provided, as follows:

- LER for NGMS control, as well as 400V energy distribution in the perimeter of the site.
- LER heaters, intended for the location of the control and power supply panels of the electric heaters

The LER buildings will be container type type 1AAA (back to back).

Gas quality analyzer shelter

The fenced site of the NGMS will also include a shelter for the gas chromatograph, moisture analyzer and other gas sampling/ sampling equipment. The gas quality analyzer shall be skid type, prefabricated, pre-wired and pre-tested. The analyzer shelter will have a foundation of reinforced concrete of the general razer type.

The gas chromatograph and moisture analyzer will monitor the quality of the gas before it enters the NTS. The design provided for the ability to remotely monitor gas quality by the CCR operator.

Inlet filter separators

The NGMS will include 2 inlet separator filters for the protection of the downstream ultrasonic meters and control valves in the event of the appearance of liquids from the marine production platform. The separator will be equipped with level switches, alarms and manual purge valves to transfer liquids to the slopes drain tank. The inlet filter/ separator will be mounted on a reinforced concrete foundation.

Pig receiver

A pig receiver will be set up at the inlet of the NGMS. The pig receiver will be located on a reinforced concrete foundation.

The rated pressure for the pig station will be equal to that of the production pipeline. The design of the pig station assembly must also allow it to be used in the reverse direction (from the NGMS to the offshore production platform) as it may be required for production pipeline dewatering activities prior to commissioning.

Gas metering skid

A standard solution will be used to support the gas transfer. Custody transfer gas measurement will be performed by multi-channel ultrasonic meters. A total of 5 (N+1) measurement circuits with a nominal diameter of 300mm will be installed to measure the gas transfer from the custody.

The measuring skid will be placed on a reinforced concrete foundation and will be provisioned with a mterlic structure shelter, covered with metallic panels, to protect the metering equipment from direct sunwaves, wind and rain/snow.

Technological pipeline systems

The process equipment will be connected through a metal piping system, and the NGMS piping will be designed to meet the nominal pressure requirements of the upstream piping, being equipped with overpressure protection equipment.

The design of the NGMS pipelines will include temporary connections to allow for receipt of gas from NTS to support the commissioning of the offshore production pipeline and production platform when operations starts. This will require a dedicated custody transfer flow meter, complete with moisture analyzer and chromatography equipment, on the reverse pressurization line for fiscal measurement and accounting of gas volumes taken by NTS.

Valves

The control of the gas volumes transferred to Transgaz will be done through 2 x 100% control valves (N+1), installed at the NGMS level, downstream of the measuring equipment.

These valves will also ensure the ability to maintain the downstream pressure within the established operational limits. Control valves can also be used to control upstream gas production to ensure optimal system operation.

Flow control valves will be placed on reinforced concrete foundations in the form of slabs.

A manual isolation valve will be located East of the level crossing with the railway near the microtunnel entry point, and the emergency shut-off valve inside the NGMS will serve also as an isolation valve West of the level crossing with the railway.

The location of the isolation valve will be provided with a perimeter protective fence.

Vent System

Inside the NGMS there will be no continuous purge to the vent.

The gas emissions resulting from the programmed and planned maintenance/ maintenance works of the NGMS -related pipelines that require their depressurization, will be carried out by means of a gas dispersion vent in the atmosphere, located in the fenced premises of the NGMS.

The NGMS gas evacuation system shall be designed to safely capture/ manage the emergency depressurization of gases from the NGMS facility during the operating period as well as during maintenance activities. The size of the vent is determined by the largest discharge volume of gases in case of fire emergency.

The gas evacuation system collects both manual evacuations from all process equipment and emergency evacuations. The system shall be provided with a drainage pan at the lowest point, insulated to avoid freezing. The drain pan is equipped with a level transmitter for the indicator.

The maximum height of the flue is 12 meters due to local height restrictions. As a safety requirement, the vent tip will be fitted with electrostatic rings and cylinder to reduce the

possibility of sparking. The vent tip shall be installed with flanges to allow easy replacement during maintenance.

The vent will be equipped with a silencer to meet the local noise standards imposed by the regulations in force.

The vent shall be positioned away from any source of ignition and/ or overhead power line and shall be designed to ensure adequate dispersion of gases. The vent will be positioned at least 50 m away from the equipment or the fenced boundary of the site.

Gas Heater skids

The delivery temperature for the sale gas downstream of NGMS is established by ANRE Order 92/ 2018 at a minimum of 0°C. NGMS 's gas heaters have the role of heating the natural gas to meet the delivery temperature requirements of NTS, especially in the cold season.

The heating skids will be mounted on reinforced concrete foundations.

Metering and control instruments

230V AC UPS (uninterruptible power supply system) system will be installed within the NGMS to power essential emergency systems such as ICSS and telecommunications equipment.

A flowcomputer compatible with the specifications of the custody flowmeters shall be installed to calculate the gas flow through the ultrasonic meters. The control of the general function of the NGMS will be done through the process control system. Data from the flowmeter computer and NGMS will be transmitted to the CCR via a dedicated communication link.

The flowcomputer will also control gas flow through the NGMS. The flow regulation point will be provided by the transmission system operator in the CCR. The NGMS 's control system will also provide downstream pressure regulation capability to meet contractual requirements for delivered gas pressure.

The general process control and the shutdown process of the NGMS installation will be managed by the Process Control System (PCS) and the Safety Instrumentation System (SIS).

Emergency shutdown

Fire and gas detection equipment will be installed within the NGMS. Confirmation of fire/ gas will automatically trigger a plant process shutdown which will isolate the NGMS piping from the attached transmission pipe(s) to protect the equipment and surrounding facilities. Isolating and draining pipe sections is the most appropriate method against fires at a natural gas facility.

Inside the LER and other areas on the NGMS site, fire extinguishers, materials/ equipment for extinguishing fires will be placed according to the requirements for onshore installations.

2.2.3.6 Control Centre/ Central Control Room (CCR)

The CCR location will be fenced and located inside the S1 surface (cadastral number 109216) owned by OMV Petrom. It is estimated that the CCR site will have a total area of approximately **3459 m ^{2}**.

The list of the main facilities within the CCR, presented in the *Onshore Facilities Situation Plan - Annex B,* includes:

- The Central Control Room itself, including operator consoles, HMI and workstations;
- Storage area
- Backup generator;
- Internal roads and parking area;
- Security fence;
- Personal emergency evacuation doors;
- Vehicle access gate;
- VSAT type satellite antenna mounted on a metal structure with a reinforced concrete foundation.

The fenced surface of the CCR and the connection to ***the main access road (separately authorized)*** will be made of concrete, with the exception of the area adjacent to the perimetral fence, where grass will be planted.

The buildings and equipment installed on the fenced site of the CCR will respect the maximum height limit of 12 m, provided by the Zonal Urbanism Plan in force.

The Control Center/Central Control Room - CCR will be realized as an independent building located near the NGMS. The CCR building is serving as the main control centre for all Neptun Deep operations. Project facilities (subsea systems, offshore production platform, natural gas production pipeline and NGMS).

The CCR building will have permanent staff to monitor and control the operations of marine facilities, NGMS and the production platform. The Control Room Operator will also monitor NGMS and production platform security aspects.

The CCR building will mainly include: operating consoles with human-machine interface (HMI), offices, equipment room, centralized control room, work permit office, meeting room, restroom, supply storage room, kitchen, and waiting area, material warehouse.

The CCR building will be equipped with an HVAC air conditioning system to ensure the temperature, relative humidity and air quality necessary for reliable operation of electronic equipment and acceptable working conditions. The HVAC equipment will be located on the roof of the CCR building.

2.2.3.7 Other facilities/ permanent areas on land included in the area of NGMS and CCR sites

Security and fencing

Anti-cutting and anti-climbing perimeter security fences will be installed around the NGMS site as well as the CCR. Security fences will be provided with gates for vehicle access and personnel evacuation in case of emergency.

The perimeter fence that will be installed at the NGMS and CCR sites will be made of metal posts located 2.5 m apart, anchored in concrete foundations. Galvanized steel mesh panels will be installed between the fence posts. The vehicular access gate will be steel and 4 m wide. Perimeter fencing will be transparent/ opaque and have a maximum height of 2.5 m.

The NGMS related security system will include closed circuit surveillance (CCTV) cameras, intrusion detection, card reader access gates and perimeter fencing. Security systems and cameras will be connected to the CCR for remote monitoring and alarming.

The CCR will be located adjacent to the NGMS and will share the access control area with it. Dedicated security will be provided to the CCR area (access card readers, vehicle access gate with intercom, monitored CCTV system, lighting and anti-cut/ anti-climb security fence, etc.). The Control Room section within the CCR will be designated as a restricted access area, with access doors operated by means of security badges and requiring separation from the space intended for other uses.

Lighting

NGMS and CCR locations will be provided with lighting facilities to ensure a safe working environment for personnel to meet operational requirements and comply with applicable codes/ standards. The design was carried out with the aim of limiting light pollution.

Parking

Outdoor parking areas will be provided within the fenced site of the CCR as well as outside the fenced area. Access to the NGMS will be by vehicle or pedestrian from the CCR.

Green spaces

A perimeter vegetal curtain composed of woody vegetation will be installed around the entire plot of land comprising NGMS and CCR (surface S1 with cadastral number 109216, owned by OMV Petrom except for the gas pipeline protection zone, as national regulations do not allow the planting of trees or any other plants with roots deeper than 50 cm in these areas.

The species and sizes of plant material used for the perimeter green screen will be selected to best achieve adequate screening of the site. The vegetal curtain created around the onshore facilities of the project will help to minimize the overall visual impact.

All areas outside the fenced sites, located on the S1, S3 and S4 areas owned by OMV Petrom, will be covered with grass.

Internal roads and technological platforms

Within the NGMS and CCR sites, the following internal roads and technological platforms will be built:

- Access roads to NGMS and the Transgaz connection point (***separately authorized)*** will be built on a total area of approximately 1831 m^2 ;
- Internal roads and the technological platform will be built in the fenced perimeter of the NGMS on a total area of approximately 3493 m^2 ;

- A concrete platform (including a parking lot) will be built around the CCR, inside the fenced site, on a total area of approximately 1644 m^2.

2.2.4 Description of the activities required for the execution of the drilling works and the construction/ installation of the onshore and offshore project components

2.2.4.1 Works necessary for the construction of site organizations and other temporary works

a) Temporary railway crossing

In order to ensure access between the construction areas of the project, a temporary railway crossing will be made, at km 248 + 983.25 of the Constanța - Mangalia railway line, between Eforie Sud and Costinesti.

The developed area of the level crossing will connect the two existing roads, the DC4 communal road and the De 277 exploitation road over a length of 20 m.

The temporary railway level crossing and related connections to local roads (communal road DC4 and exploitation road De277) will occupy a total area of 1,030 m^2.

The phases of the technological process of setting up the crossing at the CF level are the following:

- Closing the railway traffic during traffic breaks;
- Preparation of the platform for the installation of prefabricated slabs;
- Installation of prefabricated slabs
- Construction of existing road connections (DC4 and De277) at the temporary crossing over the railway.

Arrangement of existing road connections (DC4 and De277) at the temporary crossing over the railway, included in the following works:

- Removal of topsoil on a thickness of 30 cm from the level crossing layout area and storage outside the CF catchment for reuse;
- Improvement of the foundation land thickness 50 cm
  - removal by digging around 50 cm of the loess layer;
  - the realization of the "loess layers" settlement by reusing the excavated material and putting it back into the work in successive layers of 15 - 20 cm thick after compaction.
- Waterproof geotextile installation;
- laying layers of 20 cm ballast and 20 cm crushed stone;
- laying the layer of fixing gravel (10 cm) with the assurance of design elevations and slopes.

The builder will ensure that there is no possibility of stagnation of rainwater in the railway track and will take all necessary measures to remove water from the railway track (for example by making temporary earth trenches).

During the execution of the works, road signage will be provided in accordance with SR 1848/ 1-2011.

Details for the temporary railway level crossing are presented in Annex E - E4, E5.

b) Site organization for the construction of NGMS and CCR

A site organization will be required to support the construction/ installation of NGMS, CCR and other related facilities.

The main facilities included in the site organization for NGMS and CCR according to the Site Organization and Temporary Works Situation Plan (Annex B) are:

- Temporary pre-assembly area with an area of approximately 5,379 m^2, which also includes:
  - Storage area ;
  - Fenced area for chemical storage with the area of approximately 48 m^2
  - Fuel tank of 7.5 m^3 ;
- An area of approximately 3,261 m^2 that includes the following facilities:
  - Administrative area, including contractor's office, customer office, dining room, first aid station, toilet and showers and guard booth;
  - Temporary road for site organization with an area of approximately 408 m^2 ;
  - Septic tank for collecting household water with a volume of 20 m^3 ;
  - Water tank with a volume of 12 m^3 ;
- Temporary parking with an area of approximately 1,130 m $^{2.}$

The total area occupied by the site organization (including office containers, parking, pre-assembly area, site road, etc.) will be approximately 9,770 m^2.

The infrastructure of the temporary works inside the NGMS site organization (administrative area, temporary parking, pre-assembly area, storage of materials and chemicals, site road) will include:

- Removal of the vegetable soil on a thickness of 30 cm;
- Improvement of the foundation land by desensitization to wetting, including:
  - the removal by excavation of approximately 50 cm of the loessoid layer;
  - creating the "loess layers" by reusing the excavated material and putting it back into the work in successive layers of 15-20 cm thick, after compaction;
- Installation of waterproof geotextile;
- Laying the layer of 20 cm of ballast, optimal mix sort 0-63 mm;
- Laying the layer of 20 cm of crushed stone, sort 0-63 mm;
- Laying a layer of 10 cm of fixing gravel.

Drainage slopes will be made to prevent rainwater from stagnating on the land.

A perimeter security fence will be installed around the construction site

The security fence will have pedestrian gates and 2 vehicle access gates with posts 4m apart. The gates will be equipped with a locking system. The vehicle access gates will each have an emergency exit gate for personnel.

The site organization situation plan is presented in Annex B.

c) Site organization necessary for the construction of the microtunnel

For the construction of the shorecrossing (microtunnel) and the installation of the gas production pipeline and fibre optic cable in the tunnel, temporary facilities and works will be required.

The total area temporarily occupied by the facilities related to the organization of the microtunnel site will be approximately 15,349 m^2.

The main facilities (Appendix B) required for the construction of the shorecrossing (microtunnel) and the installation of the gas production pipeline and fibre optic cable include:

- The main construction site for the microtunnel (including the launch tunnel) with an area of approximately 5,850 m^2 ;
- Temporary access roads to the site organization, the pipeline assembly area and the pipeline storage area with an area of approximately 9,499 m^2,

The infrastructure works necessary to realize the temporary facilities mentioned above (site organization and temporary access roads) will include:

- Removal of the vegetable soil on a thickness of 30 cm;
- Improvement of the foundation ground by desensitization to moisture, including:
  - removal by excavation of approximately 50 cm of the loessoid layer;
  - creating the "loess layers" by reusing the excavated material and putting it back into the work in successive layers of 15-20 cm thickness after compaction;
- Installation of waterproof geotextile;
- Laying the layer of 20 cm of ballast, optimal mix sort 0-63 mm;
- Laying the layer of 20 cm of crushed stone, sort 0-63 mm;
- Laying the 10 cm layer of fixing gravel.
- Drainage slopes will be made to prevent stagnation of rainwater on the land.

The description of each of the temporary facilities mentioned above is presented below.

Microtunnel site organization (construction shaft area)

The main facilities/ equipment related to the fenced microtunnel site (Appendix C) include:

- Tunnel boring equipment control cabin;
- Tunnel pipe storage area;
- Pipe loading-unloading crane;
- Hydraulic power unit;

- Diesel generators 3 pcs;
- Recirculation unit;
- 2 bentonite silos;
- Mixing unit;
- Buffer tank;
- Water storage tank;
- Pumping unit;
- Workshop containers;
- Equipment storage containers;
- Office, sanitary, first aid containers;
- Personal Containers;
- Two containerized steel tanks with a volume of 30 m^3 each for the collection of excess water resulting from the preparation of the drilling fluid;
- Fresh water tank, with a capacity of 12 m^3;
- Domestic waste water collection basin with a capacity of 20 m^3.

A storage area of 1,100 m^2 will be created for the storage of topsoil excavated from the entire site. The storage area will be made South of the pipeline installation corridor.

A storage area of 8,420 m^2 will be created adjacent to the launch pad area for the storage of excavated soil resulting from the launch pad construction. Of the total volume of excavated soil, a part of it will be used for backfilling at the completion of the construction work, and the remaining volume will be transported and disposed of at the authorized landfill.

Drilling cuttings resulting from the tunneling process will be separated from the drilling fluid in the separation facility (recycling unit) and will be temporarily stored on site in the area of the separation facility before being transported and disposed of to an authorized disposal facility.

The main construction site will be provided with perimeter security fences. The fencing system of the microtunnel site organization will be similar to that installed at the NGMS site organization. The site organization at the microtunnel will be provided with a sliding gate for vehicle access.

Temporary access roads for construction

Temporary roads will be constructed of crushed stone and fixing gravel and will provide access to the microtunnel execution area and pipe assembly and storage areas. The total area temporarily occupied by the access roads for the construction site is approximately 9.499 m^2. The temporary access roads will have a total length of 1.357 m and a width of 7 m along the entire length of the road.

The temporary roads will be decommissioned after construction is completed and the land will be returned to its original condition.

The site organization situation plan is presented in Annex B.

2.2.4.2 Construction and installation of NGMS and CCR

Construction and installation works related to NGMS and CCR will include:

- Construction of temporary facilities (NGMS Site Organization, Microtunnel Site Organization, Temporary Railway Level Crossing, Temporary Access Roads to Site Organizations) and installation of related equipment, necessary for the construction of permanent facilities;
- NGMS construction/ installation (including pig station);
- CCR construction/ installation;
- Construction/ installation of other permanent facilities on NGMS and CCR sites (for example internal roads, platforms, buildings, fencing, landscaping, utilities, etc.);

Execution of civil construction works to the Transgaz pigging facility (for example, the internal access road to this facility). ***The Transgaz facility is not part of this project and is subject to a separate authorization procedure.***

Within the NGMS and CCR sites, the following internal roads and technological platforms will be built:

- Internal access roads to NGMS and the Transgaz connection point (***separately authorized)*** will be built on a total area of approximately 1,056 m^2 ;
- A technological platform will be built in the fenced perimeter of the NGMS on a total area of approximately 1,519.60 m^2 ;
- A concrete platform (including a parking lot) will be built around the CCR, inside the fenced site, on a total area of approximately 1,177 m^2.

The technological platform from the NGMS , the internal roads to the NGMS and the location of the connection point with the NTS will be covered with fixing gravel.

The works required for the construction of the technological platform from the NGMS, the internal roads to the fenced site of the NGMS and the connection point with the NST, will include:

- Removing topsoil with separate storage and protecting it;
- Improvement of the foundation land on a thickness of 0.50 m, with a degree of compaction of at least 98% Proctor Normal (PN); the improvement of the foundation land is done by desensitization to moisture and consists of:
  - the removal by excavation of approximately 50 cm of the loessoid layer;
  - creating the "loess layer" by reusing the excavated material and putting it back into the work in successive layers of 15 - 20 cm thickness after compaction.
- Waterproof geotextile installation;
- Bedding layer of 20 cm of ballast, optimal mix sort 0-63 mm according to SR EN 13242+A1:2008, degree of compaction minimum 98% PN;
- Bedding layer of 20 cm of broken stone, sort 0-63 mm according to SR EN 13242+A1, degree of compaction minimum 98% PN;
- Kraft paper installation;

- Pouring a 20 cm concrete layer.

A concrete platform will be built around the CCR building, up to the limit of the CCR fence. This platform also includes parking. The infrastructure of the concrete platform around the CCR will include:

- Uncovering topsoil with separate storage and protecting it;
- Improvement of the foundation land on a thickness of 0.50 m, with a degree of compaction of at least 98% PN;
    - the removal by excavation of approximately 50 cm of the loessoid layer;
    - creating the "loess layer" by reusing the excavated material and putting it back into the work in successive layers of 15-20 cm thickness after compaction.
- Waterproof geotextile installation;
- Bedding layer of 20 cm of ballast, optimal mix sort 0-63 mm according to SR EN 13242+A1:2008, degree of compaction minimum 98% PN;
- Bedding layer of 20 cm of broken stone, sort 0-63 mm according to SR EN 13242+A1, degree of compaction minimum 98% PN;
- Kraft paper installation;
- Pouring a 20 cm concrete layer.

Between the concrete platform and the CCR fence, a grass area with an approximate width of 1m will be maintained.

The concrete platform will be framed with 20 x 25 cm monolithic boards placed on a concrete foundation. In order to collect rainwater from the concrete platform, it will be made with slopes of 1% and 2.5% towards the collection gutters.

After the underground work is done, the equipment, pipes and buildings will be installed on their foundations. Details of building and equipment foundations have been presented above in points 2.2.3.6 and 2.2.3.7.

The next stage is the installation and connection of interconnecting pipes and cables.

The gas production pipeline shut-off valve will be installed as part of the pipeline installation campaign.

Simultaneous operations with the installation of the pipeline and the related Transgaz pig station will be coordinated and managed to minimize the impact on third parties.

2.2.4.3 Production Pipeline (GPP) and Fibre Optic Cable (FOC)

The complete procedure for execution of the gas production pipeline and fibre optic cable installation will include procurement, fabrication, transport and installation, system completion (including flooding testing and measurement, system integrity testing, hydrotest water removal, drying and inerting), and commissioning of the 30-inch (762 mm) gas production pipeline and fibre optic cable from the Neptun Alpha Platform to the NGMS.

For the construction and operation of the facilities within the Neptun Deep Project (including the pipeline and the fiber optic cable) the project will exercise its right of way in accordance with the provisions of Law 256/2018.

The components of the gas production pipeline (pipe end, riser, connecting piece, etc.) will be manufactured, integrated, completed, tested and commissioned to the greatest extent before delivery for installation.

It is currently anticipated that the manufactured modules and equipment will be shipped to Romania by sea transport. Once in Romania, the components and equipment will be stored in a port warehouse until they are needed on site. When required at the onshore site, equipment modules and components will be loaded onto vehicles and transported to site via public roads and dedicated permanent or temporary access roads. There will only be limited temporary storage on the site and there will be no facilities for direct sea or rail access.

Pipe (30 inch/ 762 mm OD) shall be internally coated and externally coated against corrosion. After completion of fabrication and coating, the pipeline will be transported from the fabrication site to the offshore storage/ preparation site. Additionally, the pipeline will be concrete lined against buoyancy.

The concrete elements used for the construction of the microtunnel will be pre-fabricated off-site.

Upon completion of the installation of the offshore, microtunnel and onshore sections of the pipeline, as well as the construction and installation of the NGMS , the production pipeline and its components will be connected and prepared for testing and commissioning. The production pipeline will be flooded with filtered and treated seawater from the underwater end to the onshore end for hydrotesting and leak testing.

The fibre optic cable will be manufactured, coiled and stored at the manufacturer's site for direct loading onto the installation vessel or delivery to onshore site organization sites. The onshore section of the fibre optic cable will have the same specifications as the sea section and will be manufactured by the same supplier.

The entire fibre optic cable route will be tested on site after installation.

a) Construction and installation works of the onshore section of GPP and FOC

The construction and installation works of the onshore section of the GPP and FOC including the installation of the isolation valve, local road undercrossings, railway, utility pipelines, as well as the interconnection to the pig station at NGMS, will be executed using conventional onshore construction and installation methods and equipment

To allow the access of personnel and equipment to the construction and installation areas of the pipelines located on the Eastern side of the Mangalia-Constanța railway line, the temporary level crossing with the railway and the temporary roads will be used.

Local roads and railways will be crossed using directional drilling or horizontal drilling (HDD) methods.

Existing utilities (for example water pipes) crossed by GPP and FOC will be executed using construction methods and conventional equipment in accordance with the requirements of the notices and agreements issued by the authorities (RAJA Constanta, ANIF Constanta)

The shut-off valve of the onshore gas production pipeline, located in the Eastern part of the railway, will be made during the construction and installation period of the GPP. The surface of the valves location area will be paved and will have a total area of 409 m^2. The location of the shut-off valve will be provided with a perimeter protective fence.

The onshore route of the production pipeline will be approximately 1 km long, from the onshore entry point of the onshore microtunnel to the NGMS site, ie to the first connection upstream of the PIG Receiving Station.

Construction and installation works consist of the following operations:

- setting up the work corridor for pipeline installation by removing the layer of topsoil on a thickness of 30 cm.

The temporary pipeline installation work corridor will have a total area of approximately 16,523 m^2 (AnnexB), with a width of 21 m along its entire length of approximately 787 m. The pipeline installation right of way will not be fenced and will be marked with safety strips. The vegetable soil will be the temporary storage at the limit of the work corridor, on a width of 4.26 m ;

- making the trench for GPP and FOG installation

The trench will be 2 m deep (with a burial depth to the top of the pipe of 1.25 m below natural ground level and a minimum separation of 0.5 m in any direction from other pipes or utilities).

The production pipeline and fibre optic cable will be installed in a sand-bed trench for protection.

- Installation of GPP and FOC protection pipe in the excavated trench;
- Trench backfilling. A sand and excavated soil mix will be used to fill the trench up to the base of the natural topsoil layer. The rest will be filled with topsoil up to ground level.

The onshore section of the FOC will be connected to the microtunnel and sea sections by splicing cables in a pre-installed underground splice vault.

The GPP and FOC will be laid at a minimum depth of 1 m from the NGMS / CCR to the entrance of the shore sub-tunnel. In the area of railway underpasses, local roads and utilities, the cable shall be installed at a minimum depth of 1.5 m.

Works for railway and roads DC 4, De277 undercrossing of GPP and FOC

Undercrossings of local roads and railways will be done by horizontal drilling. A temporary corridor will be provided for the execution of undercrossing of local roads and railway by the onshore production pipeline and fibre optic cable protection pipeline (Appendix E). The total area temporarily occupied for the execution/ installation of local road and railway underpasses is approximately 539 m^2. The execution of the corridor will include the removal of the layer of vegetable soil on a thickness of 30 cm and the appropriate signage in the construction site.

The under-crossing of the railway, the DC4 communal road and the exploitation road De 277 of the production pipeline with a diameter of 762 mm will be carried out by horizontal drilling directed at km 249+071.20, in the steel protection pipeline with an outer diameter of 965x12.5 mm (according to STAS 9312/ 87 and SR EN ISO 3183: 2013).

The undercrossing of the railway, the DC4 communal road and the exploitation road De 277 with a fibre optic cable with a diameter of 250 mm will be carried out by horizontal drilling directed at km 249+073.40, in the steel protective pipe with an outer diameter of 508 x 10 mm (according to ID 28/2004).

For the realization of the two sub-crossings, joint drilling/ shooting premises will be created, as follows:

- Drilling area with a length of 14.50 m, positioned at a distance of 26 m from the CF axis;
- 6.95 m long end (pulling) enclosure, positioned at a distance of 20.55 m from the CF axis.

The width of the drilling/ pulling enclosures is 6 m. The exact dimensions of the drilling/ pulling enclosures will be determined according to the size of the drilling equipment.

Drilling will be done with the introduction of sections of steel protective pipes. After inserting a section, as the drilling progresses, they will insert other sections of pipe until the sub-crossing is completed. The total length of the steel protective pipe is 78.60 m.

The soil resulting from the drilling will be stored in a landscaped area outside the work area.

After the drilling and the introduction of the gas production pipeline and the fibre optic cable, the two enclosures (drilling and pulling) will be filled with soil resulting from the excavation, and will be compacted in successive layers of 15-20 mm, so that the land is brought to its original state.

Undercrossing area of railways and roads DC 4 and De 277 of GPP and FOC is shown in attached in *APPENDIX E Details of other land facilities.*

Undercrossing works of the exploitation road De259/ 4 of GPP and FOC

The under-crossing of the production road De 259/ 4 of the production pipeline will be done through an open trench for the installation of a steel protection pipeline with an outer diameter of 965 mm.

The under-crossing of the exploitation road De 259/ 4 of fibre optic cable will be done through an open trench for the installation of a steel protective pipe with an outer diameter of 508 mm.

A temporary work corridor will be set up for the execution of the trench. The preparation of the working stripconsists of the removal of the layer of topsoil to a thickness of 30 cm from the work corridor and the temporary storage at the limit of the work corridor and the appropriate signage of the work area.

The laying depth of the steel protective pipes for under-traversing the production pipeline and fibre optic cable is approximately -1.25 m from the service road level, measured from the road surface to the top generator of the protective pipe.

Transgaz will be responsible for the construction, installation, connection, mechanical completion and commissioning of the pig station, onshore pipeline and any other facilities required downstream of the NGMS to connect to the NTS.

b) Construction of the shorecrossingand installation of the GPP and FOC gas production pipeline

The main construction and installation works related to the shore underpass will include:

- Setting up the site organization;
- Construction of the tunnel launch pad;
- Execution of tunneling works;
- Construction of outlet and trench for pipeline;
- Recovery from the sea of the tunnel drilling;
- Installation of GPP and FOC by pulling from shore through microtunnel;
- Tunnel filling and ditch plugging.

The installation of the pipeline through the microtunnel is carried out by pulling it towards the shore from an anchored ship located at sea.

The total estimated duration for the execution of the shore crossing works is 13 months.

- ***Site organization for the microtunnel***

The construction works for the organization of the microtunnel construction site are detailed in point 2.2.4.1, letter c.

- ***Construction of the tunnel launch pad***

The launch pit will have an area of approximately 113 square meters and a depth of 19 m. To pull the pipeline from the tunnel, it is necessary to extend the launch pit to a length of approximately 50 m.

The execution of the launch pad consists of the following works:

- Execution of the concrete wall with bored piles;
- Excavation of the interior of the pit;
- Concreting the bottom of the pit;
- Ancillary works: safety handrail, access ladder in the pit.

The launch shaft walls will be executed by bored piles or, alternatively, with the installation of sheet piles. Water will be used for drilling bored piles. The excess water will be collected in 2 metal tanks with a volume of 30 m ^{3}/ tank and at the completion of the works will be transported to a treatment plant.

After the walls of the pit are built, its interior can be excavated (wet or dry system) depending on the groundwater level.

Next, the bottom of the pit will be concreted. After the concrete has hardened, the pit can be partially filled with groundwater. This water will be tested inside the pit before pumping and disposal. Water will remain in the pit until test results are available.

After the pit is built, it will be equipped for tunneling work (sealing, jacking frame, tunnel boring machine, etc.).

- ***Execution of tunneling works***

The tunneling operation is carried out for a total length of approximately 890 m until the tunnel boring machine (TBM) reaches the exit bore executed at sea, from where it will be recovered by a ship.

The tunnel boring machine is composed of two parts: a fixed part and a mobile part. The moving part consists of the cutting head, the shredding device (together with the drive motors) and the sealing element; the 'fixed' part consists of the excavation protection tubes, tubes that house the pipes and other control devices inside. As the TMB advances, the concrete tubes are connected and the whole mechanism is progressively pushed into the tunnel with the help of powerful hydraulic presses located in the launch chamber.

The soil is mechanically excavated with the rotary cutting head and using water-based drilling fluid, the drilling fluid loaded with the crushed soil is hydraulically transported back to the site through a closed suspension system.

The water-based drilling fluid is processed on site in a separation facility, where the soil or rock is separated from the drilling fluid through a series of screens and hydrocyclones. Soil will be temporarily stored on site for sampling and testing prior to disposal in an authorized storage facility. The estimated total amount of soil to be excavated through the tunneling process is approximately 4,030 m^3. The cuttings resulted from the separation facility will be collected and transported to an authorized contractors.

The recovered drilling fluid is reused for tunnel drilling. Although it is "recovered" in the separation plant, some part will need to be replaced/ changed to keep the optimal parameters of use. Depending on the need, the used drilling fluid can be stored on site in containers or in an additional tank with sufficient storage capacity. After the tunnelling works are complete, the used drilling fluid that cannot be re-used will be disposed of at an authorized facility.

The drilling fluid is not only used to transport the material excavated by the TBM, but also to stabilize the ground surface in front of the TBM and to lubricate the outside of the tunnel pipes.

Because of the permeability of the soil, the drilling fluid will continuously penetrate and partially seal the formation. Most of this volume is excavated during TBM advance, but a fraction of the fluid volume may not be recovered. To compensate for these losses, a new bentonite water slurry will be constantly mixed on site to replenish the system.

During tunneling, water is required to compensate for drilling fluid losses and to clean the tunnel. The total estimated amount of water required to complete the tunneling process (including the suspension and cleaning system) is approximately 5,450 m^3.

Prior to TBM recovery, all service lines will be removed from the tunnel and conduits for fibre optic cable and fill lines will be installed.

Pipeline installation is often combined with tunnel clearance work to limit the number of transports in the tunnel. The HDPE pipes are mounted on the ceiling of the tunnel with brackets, where they are interconnected by means of electrical couplings.

- ***Construction of exit pit and trench for pipeline***

The exit pit will have an area of 585 m ^{2} (26 m long x 22.5 m wide) and a depth of approximately 1.62 m. The estimated volume of excavated material is 950 m^3.

Given that in this area, the seabed is represented by degraded limestone, with larger blocks or rock fragments, appropriate equipment will be used for excavation.

The exit pit will be excavated with an excavator mounted on a barge. The excavator will be equipped with filters to reduce the dispersion of sediments in the water.

Excavated material will be loaded onto barges and transported to shore or relocated to the seabed.

The exit pit is located approximately 680 m from the shore and is located in the vicinity of ROSCI 0273 Cape Tuzla marine area. The sea water level in the exit pit area is about 10 m.

The shaft will then be filled with gravel, and optionally, a ballast type material can be deposited over the end of the tunnel to secure the tunnel against flotation.

The trench for the production pipeline will start from the outfall to the sea on an approximate length of 3,675 m and a width of 17 m (between KP 152,400 ÷ KP 156,075) to a depth of sea water of approximately 35 m. An excavated material volume of 40,000 m^3 is estimated.

Digging the trench will be done with a bulldozer dredger (BHD) with a digging capacity of 300 m^3/ h. The material dredged for the installation of the pipeline on the seabed will be stored next to the trench and after the installation of the pipeline, it will be placed again on top of it.

- **Tunnel drilling recovery**

After the tunnel is completely built, all the equipment is removed from the tunnel and the pipes are installed.

To extract the drill through the outlet shaft, the tunnel will be flooded.

For the recovery of the drilling, excavation works will be required, which will be carried out from a single ship/ barge and transported to the shore.

Various equipment will be used to retrieve the TBM from the reception dorm. The backfill material will be removed by water flow excavation (pumps) and sinking operations will be required to activate a separation module on the TBM.

The TMB will be recovered by a lifting equipment and it is expected that excavation, sinking and recovery work will be executed from a single vessel/ barge.

Depending on the lifting capacity of the vessel and the distance from the port, the TBM will either be fully recovered on deck or transported suspended underwater to the port.

- **Installation of GPP and FOC by pulling to shore through microtunnel;**

For the installation of the pipeline from the sea to the land, a winch installed on land will be used and a barge and a support ship will be used on the sea.

A work corridor (shown in Appendix B) will be required for this pulling operation.

An anchoring system consisting of 8 anchors will be used to position and secure the barge, and a support ship will be used to move them.

The barge will be positioned above the trench and will move as the pipeline is pulled. It is estimated 8 positions of the barge during the installation, for each position it is not necessary to move all the anchors. The support ship will pick up the anchors and place them in the new position. It is estimated that for the installation of the entire pipe section, each anchor will be moved 2 times. During the installation of the pipeline through the microtunnel, 3 of the 8 anchors of the barge will be placed in the protected area ROSAC 0273 Marine area from Capul Tuzla and they will be installed at the beginning and moved only once to the last position of the barge.

The method of anchoring the barge while pulling the pipeline is presented in Annex B, ND-D-EM -10-OI-DLAY-001-0001.

- ***Work after completion of pipeline installation***

After the installation of the production pipeline and the fibre optic cable conduit, the trench and reception pit will be filled with gravel.

After the trench and outlet are plugged, the tunnel will be backfilled with a mortar-type material. The filling of the tunnel will be of the wet-in-wet type, with the mortar being poured through dedicated filling lines, up to the lower end of the tunnel. During grouting, the seawater inside the tunnel will be displaced. This excess water will no longer reach the sea because the end of the tunnel is blocked and will be moved into the launch chamber. This water will be pumped and temporarily stored on site in the water storage tank until testing and disposal.

c) Offshore construction/ installation of production pipeline and fibre optic cable

The offshore section of the production pipeline will be installed by retrieving and tying off the end of the nearshore pipeline section and laying the pipeline to the offshore production platform using a dynamic positioning vessel and S-lay pipeline launch system.

The stability of the production pipeline on the seabed will be managed by a combination of concrete casings and the trenching/ filling method. A combination of post-installation jetting and pre-excavation using dredging is expected to be used to install the production pipeline and fibre optic cable.

Material dredged from the seabed during nearshore pipeline installation will be properly and safely disposed of on the seabed.

Excess material will be transported to suitable locations along the pipeline construction corridor, ensuring that final disposal sites will provide a water depth of at least 30 m.

Pre-remediation of the seabed in specific areas along the pipeline route, particularly at fault crossings, will require the installation of rock dikes on the seabed using a conventional rock unloading vessel.

After the optical fibre leaves the cross-bank pipeline section, an appropriate method of trenching or protection (eg, rock cover) shall be used to bury and protect the optical fibre along its entire length.

Material dredged from the seabed during pipeline installation will be stored and reused to cover the pipeline.

The optical fibre can be installed before or after the installation of the platform. The J-tube on the platform jacket will be designed to facilitate the installation of the fibre optic riser before or after installation on the platform.

2.2.4.4 Installation of the production platform

The production platform will be manufactured off-site by specialized companies and will be delivered to the site by ship in 2 separate components, namely:

- Steel jacket, including:
  - 2 pre-installed risers;
  - 7 pre-installed J tubes of which 6 planned for use and 1 spare;
  - 7 caissons (1x TEG (triethylene glycol) storage, 1 x open drain storage, 2 x MeOH (methanol) storage, 2 x seawater (SW) lift and 1 x purified water (PW) discharge.;
  - Marine deck to provide installation of fibre optic cable, umbilical systems, Domino direct electric heated cable and Pelican South heated flexible feed/ intake pipe;
  - The jacket foundation includes the installation of "skirt" piles.
- Gas processing facilities on the production platform topside.
- Flare boom

The jacket will be loaded onto a transport and launch barge and transported to the shore operations base in preparation for installation.

The jacket will be transported to site by heavy transport vessel or barges and installed by heavy lifting crane vessel and fixed in position by pushing piles. The skirt piles will be driven and fixed at the appropriate depth using underwater hammers. The sizing of the skirt piles will be monitored during construction activities to ensure that the pile cap, hammer and crane block sink after penetration by their own weight.

After the installation of the jacket and the subsequent underwater pulling operation, the upper part of the structure will be towed offshore by a heavy transport vessel and installed by means of a heavy lifting crane vessel.

After the topside is placed on the jacket, the following installation activities of subsea umbilical systems and subsea flowlines and offshore assembly and commissioning activities will be performed prior to the handover of the installation to the operating team:

- The upper part of the structure will be welded to the jacket.
- Connection activities between the jacket and the upper part of the structure.
- Pulling and connecting the flowlines, GPP (gas production pipeline to shore), umbilical cable, DEH (direct electric heating) feed cable and fibre optic communication (FOC) to the facilities.
- Connecting the caisson or J-Tube to the upper part of the structure.
- Testing of pipeline system for leaks and test fluid discharge.
- Completion of system completion activities.

2.2.4.5 Sub-sea systems

The complete development of offshore subsea systems (manifolds, production pipelines, umbilicals, risers, etc.) will include onshore fabrication and transportation, offshore installation, completion and system commissioning activities.

Subsea equipment and components shall be manufactured, integrated, tested and completed to the greatest extent possible before leaving the manufacturing or integration facilities.

The following underwater components will be installed:

- Production manifolds, including foundations.
- 18/ 14" diameter rigid pipe for Domino.
- Pelican Flexible Pipe.
- Umbilical cords from:
- SWP to DODC1.
- DODC1 to DODC2.
- SWP at Pelican.
- Flexible and/ or rigid pipelines/ jumpers between subsea pipelines, production platforms and wellheads.
- Hydraulic and electrical connectors between subsea umbilical termination points, subsea distribution units, production platforms and shafts.
- Subsea Safety Valves (SSIV) at SWP for Domino and GPP.

- Structures and foundations associated with flowlines, pipelines, umbilical systems and cables:
    - FLET, including foundations;
    - PLET, including foundations;
    - Subsea pig launcher
    - Subsea distribution assembly

For the installation of the subsea components mentioned below, a specialized flexible/ umbilical pipeline installation vessel, a specialized pipeline installation vessel or any of the dedicated multi-purpose service vessels (MSVs) will be used:

The general execution concept for offshore installation work is to start pipeline installation as early as possible. The Domino pipe and the DEH connecting cable will be installed simultaneously and secured together during the pipe installation operations.

Pelican Heated Flexible Conduit and DEH Power Cable Riser will be installed by initiating installations with end 1 riser fitting at SWP and will be laid from SWP to PSDC1/ DODC1.

The umbilicals for PSDC1 and DODC1 will be installed from the J-tube SWP risers to the drilling centres and the umbilical for DODC2 will be installed in either direction.

The underwater installation of the Pelican pipeline and umbilicals by excavation and natural fill of the trench along their entire length, and the installation of the Domino pipeline and umbilical from the SWP to a depth of 200m will provide protection against fishing interference.

Subsea wellheads will be installed separately by the drilling contractor.

2.2.4.6 Description of well drilling works

The scope of the drilling works includes drilling and equipping ten gas production wells in the Miocene formation of the deepwater Neptun perimeter in the Western Black Sea.

The wells will be drilled in a continuous drilling and rigging campaign using a mobile propulsion-assisted and moored marine drilling unit – MODU (*Mobile Offshore Drilling Unit)*. After connecting to the subsea facilities, the wells will produce to the offshore production platform.

The drilling platform

The drilling rig must be able to maintain position within a tight navigation circle to avoid excessive stress on the marine riser and the wellhead and the seabed conduit system. For shallow water locations, this requires the platform to have mooring capabilities (preferably with dynamic position assist). For deepwater locations, the dynamic positioning requirement is preferred to avoid the installation of complex mooring systems and to allow flexibility of movement between the two Domino drilling centers.

Figure 2.10 Example of Mobile Offshore Drilling Rig

To avoid loading and unloading between wells, the floating drilling rig must have storage capabilities that include:

- Casing storage, marine riser for maximum operating depth, drill pipes and drill strings.
- Cement; barite/ bentonite; saline solution for drilling fluid.
- Drilling Fluid Chemicals.
- Fuel for the drilling platform.
- Drinking water and fresh water.
- Critical spare parts for the drilling rig.

The drilling platform will be equipped with desalination systems to produce fresh water on board the drillship.

All third-party services required for typical drilling operations, such as cementing, drilling fluid logging, remotely operated vehicles (ROVs), will be installed on the drilling rig.

Waste water accumulated on the drilling platform and on support vessels during drilling operations until handover of the well will be managed in accordance with the appropriate marine regulations for the disposal of waste water.

Wells

The wells will be drilled to full depth in the Miocene formation and completed along the target intervals of the deposit via deviated drill holes.

Wells will be drilled using either a water-based drilling fluid or a non-aqueous drilling fluid. The composition of the drilling fluid is a mix of water and several chemical products.

Water-based drilling fluid will be used during the drilling of the first two sections of each well.

While drilling these top sections are drilled with water-based mud, a riserless mud recovery system (RMR) will be used to recover the water-based mud. A pump will transfer the mud back to the drilling platform. On the drilling rig the mud will be separated from the cuttings and the mud is recirculated into the rig tanks and wellbore. The cuttings from the water-based mud are discharged back to the sea floor.

Before drilling the last top section at each drill center the RMR system will have to be removed to allow the installation of the riser and BOP. In this case the last top-hole section will be drilled conventional with pump and dump, meaning that both the water-based mud and cuttings are returned to the sea-floor. The benefit of using the RMR system is that it reduces the overall volume of WBM lost to sea significantly.

Should the RMR subsea lift pump fail or needed to be recovered, the drilling process will continue conventionally with returns of mud and cuttings to seafloor.

The riserless mud recovery system is a technology specifically developed and used on floating rigs in deep water. It reduces the impact on the environment during drilling the top hole sections only.

Once the Subsea BOP and riser are installed a closed circulation loop is created and the drilling fluid will be swapped to non-aqueous drilling fluid. The non-aqueous drilling fluid is captured at the level of the drilling installation. There the mud is stripped from solids by cleaning equipment such as shale shakers. The recovered rock material or cuttings will still contain a percentage of non-aqueous drilling fluid, as the recovery process cannot remove it completely. Because of this, the recovered cuttings will be captured and transported to the shore for disposal at an authorized economic operator.

The drilling operations will begin at Pelican South Drilling Center, with the installation of 4 CANDuctors. The CANductors will be installed with a multifunctional vessel, before the drilling rig is mobilized and the drilling operations begin. A 36 inch section of the tubbing column will be integrated and cemented in the CANductor.

The general structure of the well construction will consist of:

- 36-inch (914.4 mm) pipe string:
  - Drilling a 42-inch (1066.8 mm) borehole by jetting with water-based drilling fluid;
  - 36-inch (914.4 mm) tubing string installation;
  - Column cementing to the level of the seabed;
- 22-inch (558.8 mm) pipe string:
  - Drilling 26-inch borehole with water-based drilling fluid;
  - 22-inch (558.8 mm) tubing string installation reduced to 20-inch (508 mm);
  - Column cementing to the level of the seabed;
  - 18-3/4 inch (476.25 mm) 1,035 bar blowout preventer installation.
- 13-3/8 inch (339.72 mm) tubing string:
  - Drilling 17.5 inch (444.5 mm) borehole with non-aqueous drilling fluid;
  - 13-3/8 inch (339.72 mm) tubing string installation;
  - Partial cementing of the column.

- 10-3/4 inch (273.05 mm) tubing string:
  - Drilling 14-inch (356.6 mm) borehole with non-aqueous drilling fluid;
  - Installation of 10-3/ 4-inch (273.05 mm) tubing string reduced to 9-5/8 inches (244.47 mm);
  - Partial cementing of the column.
- 5-1/2 inch (139.7 mm) base filter:
  - Drilling a 9.5-inch (241.3 mm) wellbore with non-aqueous drilling fluid to final depth;
  - 5-1/2 inch (139.7 mm) filter installation to final depth;
  - Dislocation of the well with saline solution (brine) and installation of gravel pack

During the drilling of the wells, various measurements will be taken in the wellbore.

Wellbore integrity throughout the drilling program will be maintained through the use of the following program features:

- Well control practices and procedures.
- Adequate drilling fluid density to ensure overcompensation.
- Drilling the surface hole and installing surface tubing to address potential hazards at shallow depth.
- The drilling of the intermediate and final sections from the productive layer and tubbing installation through the blow-out preventer (BOP).
- Shut-in piping locations selected to ensure well control integrity; and
- Testing of well control equipment.

The well schematic is shown in the figure below. Wells will be drilled with non-aqueous drilling fluid after the riser has been installed.

The productive layers will be drilled with 8½" hole and corrected to 9 ½" to allow for installation of production equipment.

Because of the unconsolidated structure of the reservoir, sand control equipment will be required in each well.

All production wells will have permanent bottomhole sand control field packers installed, with appropriate architecture to be compatible with different production objectives and requirements for smart equipment (including zonal isolation of bottomholes). A fluid loss control valve shall be included in the lower equipment to facilitate trouble-free operation of the upper equipment.

All production wells will be equipped with 7" and 29.0 lb/ ft tubing with the largest possible internal diameter (ID) to minimize flow restrictions. The final rig will be 5½" to match the minimum ID of the tubing hanger and facilitate the use of wireline intervention tools. The IWC (Intelligent Well Completion) will be used due to significant benefits resulting from reducing the number of wells, improving the management of discharges and stopping water.

Reservoir monitoring will be facilitated by including permanent pressure and temperature sensors in all wells and by measuring subsea multiphase flow on each wellhead. Sand detection monitors will be installed on each wellhead to detect any potential equipment failure. In such event, the wells will be adjusted to operate without sand production or will be shut down until the sand control equipment is repaired.

The wellheads will be installed and commissioned using a crane installed on the Multipurpose Support Vessel (MSV).

The location at great depth means that any intervention on the well will involve significant expense and risk. As a result, well designs will minimize remedial and recovery interventions by selecting optimal, fit-for-purpose equipment designed for the lifetime of Neptun Deep environmental conditions.

A general sketch of the execution/ construction of the wells is shown in the figure below.

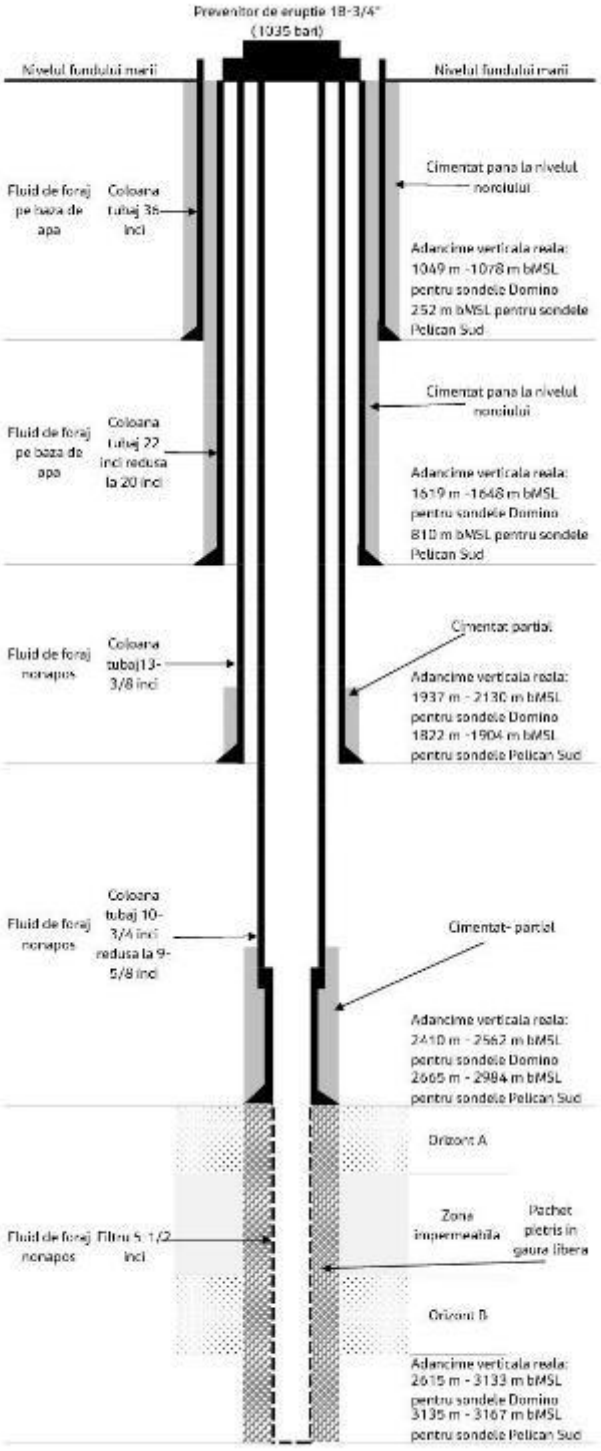

Figure 2.11 Well Schematic

Drilling fluid and cuttings

The wells will be drilled using two types of drilling fluid and a preservation fluid:

- Water based drilling fluid for the first 2 sections (42" and 26" section).
- Non-aqueous drilling fluid on intermediate, reservoir and production sections (17½", 12 ¼ " or 14½" and 9½" section).

- Saline solution

Seawater pumped from the Black Sea and/ or fresh water supplied from the shore will be used for the water-based drilling fluid for the top sections drilling.

The composition of the drilling fluid is a mix of water and several chemical products. Water-based drilling fluid will be used during the drilling of the first two sections of each well. While drilling these top sections are drilled with water-based mud, a riserless mud recovery system (RMR) will be used to recover the water-based mud. A pump will transfer the mud back to the drilling platform. On the drilling rig the mud will be separated from the cuttings and the mud is recirculated into the rig tanks and wellbore. The cuttings from the water-based mud are discharged back to the sea floor.

Before drilling the last top section at each drill center the RMR system will have to be removed to allow the installation of the riser and BOP. In this case the last top-hole section will be drilled conventional with pump and dump, meaning that both the water-based mud and cuttings are returned to the sea-floor. The benefit of using the RMR system is that it reduces the overall volume of WBM lost to sea significantly.

Should the RMR subsea lift pump fail or needed to be recovered, the drilling process will continue conventionally with returns of mud and cuttings to seafloor.

The riserless mud recovery system is a technology specifically developed and used on floating rigs in deep water. It reduces the impact on the environment during drilling the top hole sections only. It should be understood that this technology is not designed for and applicable for shallow water wells drilled with bottom supported Jack-up rigs or modular platform rigs.

Once the Subsea BOP and riser are installed a closed circulation loop is created and the drilling fluid will be swapped to non-aqueous drilling fluid. The non-aqueous drilling fluid is captured at the level of the drilling installation. There the mud is stripped from solids by cleaning equipment such as shale shakers. The recovered rock material or cuttings will still contain a percentage of non-aqueous drilling fluid, as the recovery process cannot remove it completely. Because of this, the recovered cuttings will be captured and transported to the shore for disposal at an authorized economic operator.

For rigging operations, the probes will be moved to filter the content of inhibited salts. At the end of rigging operations, the tubing may be moved to a lighter fluid (eg, nitrogen) to underbalance the wells in preparation for SWP cleaning.

The amount of drilling fluid and cuttings generated on each well is shown in the table below.

Tabel 2.19 Drilling fluids and detritus volumes for each well

Well name	Interval	Casing Size (in)	Interval Length (m)	Mud Type	Mud Density	WBM Volume (m^3)	NAF Volume (m^3)	Cuttings WBM (m^3)	Cuttings + WBM Discharge on the sea bed (m^3)	Cuttings + NAF shipped to shore (m^3)
Domino 1-1	42"	36"	100	WBM	8.7/12.0	437		357	795	
	26"	20"	542	WBM	8.7/12.0	6,526		464	6,990	
	17-1/2"	13-3/8"	489	NAF	9.6/9.8		660			117
	14"	9-5/8"	555	NAF	10.3/10.8		768			85
	9-1/2"	5-1/2"	652	NAF	11.3/11.6		608			46
	Total:					**6,963**	**2,035**	**821**	**7,785**	**248**
Domino 1-2	42"	36"	100	WBM	8.7/12.0	437		357	795	
	26"	20"	542	WBM	8.7/12.0	6,526		464	6,990	
	17-1/2"	13-3/8"	643	NAF	9.6/9.8		703			154
	14"	9-5/8"	926	NAF	10.3/10.8		965			142
	9-1/2"	5-1/2"	665	NAF	11.3/11.6		641			47
	Total:					**6,963**	**2,310**	**821**	**7,785**	**342**
Domino 1-3	42"	36"	100	WBM	8.7/12.0	437		357	795	
	26"	20"	542	WBM	8.7/12.0	6,526		464	6,990	
	17-1/2"	13-3/8"	519	NAF	8.7/12.0		668			124
	14"	9-5/8"	768	NAF	8.7/12.0		876			117
	9-1/2"	5-1/2"	825	NAF	8.7/12.0		655			58
	Total:					**6,963**	**2,198**	**821**	**7,785**	**300**
Domino 2-1	42"	36"	100	WBM	8.7/12.0	437		357	795	
	26"	20"	601	WBM	8.7/12.0	7,183		515	7,697	
	17-1/2"	13-3/8"	325	NAF	9.6/9.9		619			78

Well name	Interval	Casing Size (in)	Interval Length (m)	Mud Type	Mud Density	WBM Volume (m^3)	NAF Volume (m^3)	Cuttings WBM (m^3)	Cuttings + WBM Discharge on the sea bed (m^3)	Cuttings + NAF shipped to shore (m^3)
	14"	9-5/8"	607	NAF	10.4/10.6		778			93
	9-1/2"	5-1/2"	309	NAF	10.8/11.4		536			22
	Total:					**7,620**	**1,933**	**872**	**8,492**	**192**
Domino 2-2	42"	36"	100	WBM	8.7/12.0	437		357	795	
	26"	20"	601	WBM	8.7/12.0	7,183		515	7,697	
	17-1/2"	13-3/8"	1,075	NAF	9.6/9.9		833			257
	14"	9-5/8"	1034	NAF	10.4/10.6		1,058			158
	9-1/2"	5-1/2"	198	NAF	10.8/11.4		584			14
	Total:					**7,620**	**2,474**	**872**	**8,492**	**429**
Domino 2-3	42"	36"	100	WBM	8.7/12.0	435		356	791	
	26"	20"	601	WBM	8.7/12.0	7,183		515	7,697	
	17-1/2"	13-3/8"	635	NAF	9.7/9.9		707			152
	14"	9-5/8"	548	NAF	10.4/10.6		777			84
	9-1/2"	5-1/2"	276	NAF	10.8/11.4		544			19
	Total:					**7,618**	**2,029**	**870**	**8,488**	**255**
Pelican South 1-1	42"	36"	126	WBM	8.7/12.0	528		449	977	
	26"	20"	558	WBM	8.7/12.0	6,704		478	7,182	
	17-1/2"	13-3/8"	1,530	NAF	11.8/12.2		800			366
	14"	9-5/8"	1431	NAF	12.4/12.7		1,135			219
	9-1/2"	5-1/2"	204	NAF	12.8/13.4		475			14
	Total:					**7,233**	**2,411**	**926**	**8,159**	**599**
Pelican South 1-2	42"	36"	126	WBM	8.7/12.0	528		449	977	

Well name	Interval	Casing Size (in)	Interval Length (m)	Mud Type	Mud Density	WBM Volume (m^3)	NAF Volume (m^3)	Cuttings WBM (m^3)	Cuttings + WBM Discharge on the sea bed (m^3)	Cuttings + NAF shipped to shore (m^3)
	26"	20"	558	WBM	8.7/12.0	6,704		478	7,182	
	17-1/2"	13-3/8"	1,228	NAF	11.8 / 12.2		714			293
	14"	9-5/8"	1494	NAF	12.4 / 12.7		1,139			228
	9-1/2"	5-1/2"	161	NAF	12.8 / 13.4		453			11
	Total:					**7,233**	**2,307**	**926**	**8,159**	**533**
Pelican South 1-3	42"	36"	126	WBM	8.7/12.0	528		449	977	
	26"	20"	558	WBM	8.7/12.0	6,704		478	7,182	
	17-1/2"	13-3/8"	1,353	NAF	11.8 / 12.2		750			323
	14"	9-5/8"	1044	NAF	12.4 / 12.7		928			160
	9-1/2"	5-1/2"	589	NAF	12.8 / 13.4		514			41
	Total:					**7,233**	**2,191**	**926**	**8,159**	**524**
Pelican South 1-4	42"	36"	126	WBM	8.7/12.0	528		449	977	
	26"	20"	558	WBM	8.7/12.0	6,704		478	7,182	
	17-1/2"	13-3/8"	1,315	NAF	11.8-12.2		739			314
	14"	9-5/8"	1528	NAF	12.4/12.7		1,164			234
	9-1/2"	5-1/2"	281	NAF	12.8/13.4		483			20
	Total:					**7,233**	**2,385**	**926**	**8,159**	**568**
TOTAL GENERAL						**72,678**	**22,274**	**8,784**	**81,462**	**3,989**

2.2.5 Description of the activities involved for the commissioning and operation of the project

The modules preliminary testing will be accomplished to the greatest extent possible at the fabrication site and shore base prior to mobilization for offshore and onshore installation.

The list of main activities to be carried out before the installation of onshore and offshore infrastructure can begin is given below:

- Prior to installation, testing (including hydrotesting and boring, as appropriate) of:
  - All pipelines on the platform, including pre-installed production pipeline, flowline risers and mechanical, electrical and control systems;
  - All components of underwater equipment and control systems, connection pipes to the discharge head and flowlines and riser drums;
- External leak testing of all flowline connections and risers;
- Flooding, piging, chemical inhibition and hydrostatic testing of the entire gas production pipeline, as well as testing of flowlines prior to installation of connection pipelines and riser drums;
- Dewatering of hydrotest water from the entire system; the water discharge will be done in the anoxic layer (950m water depth), near DODC2.
- Drying of the gas production pipeline;
- Hydrotesting of umbilical systems, testing and verification of control functions and communications functions after installation;
- Leak testing of umbilical systems after installation of connecting hydraulic pipes;
- Leak testing of the entire gas production pipeline, flowlines (after installation of connection pipelines and riser drums) and topside piping and equipment;
- Checking electrical continuity and functionality of all underwater controls after installation of electrical and fiber optic cables;
- Testing and verifying the integrity of fiber optic communication cable after installation;
- Testing and verification of facilities and functions on the topside after completion of connections following the installation;
- Testing and verifying of the functions from the onshore section of the gas production pipeline after installation and connection;
- Wells clean-up at the offshoreplatform;
- Onshore component testing and commissioning activities.

2.2.6 Description of the activities involved in decommissioning the project;

2.2.6.1 Decommissioning works after completion of construction

Upon completion of the construction and commissioning of the offshore facilities, no site restoration work is required for the offshore components of the Neptun Deep project (production platform, drilling centers, feed/ intake pipelines and marine section of the production pipeline).

For the onshore components of the Neptun Deep project, upon completion of the construction works, several site restoration activities will be carried out, such as:

Removal of equipment and installations from the NGMS and microtunnel related site organizations

- All facilities and equipment within the site organizations, such as containers (office containers, facility containers, etc.), skid type equipment (pumps, generators, etc.), will be loaded by crane into trucks and transported off-site.
- Temporary foundations will be demolished by excavation and breaking with demolition hammers. The resulting concrete waste will be disposed of at an authorized landfill.
- The holes resulting from the excavation of the temporary foundations will be filled with soil, and the last 30 cm from the surface will be filled with topsoil.

Removal/ demolition of temporary construction infrastructure

- All temporary construction infrastructure (site roads, temporary railway level crossing, technological platforms, parking areas, storage areas, etc.) will be demolished upon completion of construction work.
- Graders will be used to break up the layers of fixing gravel, gravel and crushed stone and to break up the consistency of the layers.
- The resulting gravel mixture will be loaded into trucks using front-end loaders or excavators and transported off-site for proper disposal or recycling.
- The surfaces occupied by the temporary infrastructure will be refilled with soil, and the last 30 cm of the surface will be filled with topsoil.

All areas affected by construction and installation work will be restored by:

- Scarification, filling and leveling as required.
- If contaminated areas are identified, the site will be rehabilitated, and the contaminated materials will be managed in accordance with the legal provisions in force.
- Revegetation of the site (use of grass seeds, fertilizers, etc., as appropriate).

2.2.6.2 Decommissioning works at the end of the project's operating life

Following the cessation of production, the Neptun Alpha offshore facilities will be engineered down, cleaned and made safe to allow safe removal. This will include safeguarding all systems as well as preparations required to facilitate facilities removal in accordance with applicable regulations at that time.

2.2.6.2.1 Offshore Facilities and Pipelines Putting Into Safety

Key Activities included in this phase;

- Operations drain, flush, purge and vent all platform hydrocarbon systems.
- Engineering down, including: physical isolation, de-energise, vent and drain all platform hydrocarbon systems.
- Cleaning of all platform hydrocarbon systems.
- Domino, Pelican and GPP Pipeline flushing using a combination of platform and subsea deployed equipment.
- Waste management

2.2.6.2.2 Wells Abandonment

At the end of field life, the 10 wells part of the Neptun Deep project will be permanently plugged and abandoned in accordance with OMVP Engineering Standards and Romanian legislation and reviewed by the NAMR Expert / Well Examiner. The plug and abandonment operations for each well are estimated to take around 30 days.

The abandonment sequence of operations performed on wells at the end of their life cycle generally consist of the following:

- Kill the well and install barriers in the lower completion and upper completion from an intervention vessel.
- Recover the Subsea XMT to surface.
- Install subsea riser and BOP.
- Recover the upper completion barrier and circulate kill wt Brine.
- Cut the tubing/packer and recover the tubing hanger and upper completion string.
- Set a 50m cement plug above the lower completion barrier inside the 9 5/8” (or 10 ¾” in case of IWC well) and confirm integrity.
- Cut the 9 5/8” (or 10 ¾” in case of IWC well) and 13 3/8” casing strings and recover to surface.
- Set 100m cement plug inside the 20” surface casing at the cut point and confirm integrity.
- Set 50m cement plug inside the 20” surface casing 50m below the seabed and confirm integrity.
- Recover the subsea BOP stack.
- Cut the 22” x 20” surface casing below the bottom on the 36” conductor.
- Pump out of 36” conductor and recover the CANductor and subsea wellhead.
- Take seabed survey of the abandoned well with the ROV.

2.2.6.2.3 Topside Preparation

Topsides preparation includes the activities involved in preparing the topsides for removal:

- Topside structural preparation for topsides separation from jacket ready for single lift via heavy lift crane
- Engineering-up temporary utilities e.g. power, and water as needed after cessation of production
- Caisson separation from topsides and pinning/clamping in preparation for jacket removal.
- J-tube and riser separation from topsides and pinning/clamping in preparation for jacket removal.
- Release or cutting of Flexible flowlines, Umbilicals, Fibre Optic cables from topsides hang off using temporary winches
- Preparation for flare boom separation

2.2.6.2.4 Topside Removal

Topsides Removal includes final removal preparation, vessel operations and transit on/off site, grillage, sea- fastening, transportation and load-in, the key activities include;

- Removal of the flare using HLV crane vessel and lay down on HLV;
- Topside is removed by reverse heavy lift single lift operation using a suitable HLV crane vessel with a high weight capacity;
- Topsides is assumed to be lifted onto a Heavy lift transportation barge for transportation to dismantling yard complete with transportation grillage;
- Yard location to be determined based on capacity at the time of decommissioning.

2.2.6.2.5 Substructure (Jacket) Removal

Substructure jacket removal covers the preparation, vessel operations and transit on/off site, sea-fastening, transportation and load-in, the key activities include;

- Jacket is cut into 5-sections. The piles will be internally cut at circa 5m below mudline;
- Loading and securing of cut elements on the barges for the safe transportation to shore, as well as the transport itself.

2.2.6.2.6 Topside & Substructure Onshore Recycling

The onshore dismantling, recycling and final disposal of facilities topsides and substructure activities include:

- Offloading of topsides and substructure
- De-construction of both topsides and jackets.

- Cleaning and handling of hazardous waste including waste management accounting and reporting.
- Re-use, recycle and disposal of all materials

2.2.6.2.7 Subsea Infrastructure

The preparation and removal, or part removal of the subsea infrastructure for the field covering manifolds, SSIV skids, mud-mats, spools, pipelines, FOC cables, umbilicals, buckle arrestors, mattresses and subsea protection structures including transportation & disposal onshore. The following are the key activities;

- All pipelines are flushed using a combination of platform based and subsea deployed equipment; platform- based pumping is by temporary pumping equipment installed as part of safeguarding activities.
- Subsea pipelines, umbilicals and Fibre Optic Cables which are trenched are to be left in-situ cut and both ends and rock-dumped, disposal of recovered sections will be to onshore. Flexible flowlines, umbilicals, piplines, and FOC sections which are not trenched are removed using the cut & lift methodology or reverse installed and re-reeled onto a CSV.
- Subsea pipeline spools and jumpers are cut and lifted, disposal is onshore.
- All subsea structures including manifolds, SSIV skids, pig launcher/receivers, SDUs, protection covers, mud- mats, suction piles, FLETS, PLETS and ITAs are lifted by CSV transport for disposal onshore.
- Mattresses and protection frames are lifted by CSV for disposal onshore.

2.2.6.2.8 Onshore Facilities

Following the cessation of production from Neptun Deep the onshore facilities will also be decommissioned, these facilities include:

- Natural Gas Metering Station (NGMS).
- Pigging Facilities.
- Central Control Room (CCR).
- 30” Gas import line (land section).
- Fibre Optic Cable (land section).

2.2.6.2.9 Facilities & Pipelines Safeguarding

Following the cessation of production Neptun Alpha onshore facilities will be engineered down, cleaned and safeguarded to allow demolition. This will include de-pressurisation, de-energisation/isolation and cleaning of systems. Note systems associated to the Tranzgaz systems are outwith the scope of OMVP and will be decommissioned by others. Key activities are;

- Drainage operations, flush, purge and vent all hydrocarbon systems

- Engineering down, including physical isolation, de-energising, venting and draining all hydrocarbon systems.
- Cleaning all hydrocarbon systems and vessels and inertization with nitrogen.
- Isolation and de-energising of all utilities (including at valve stations), electrical equipment and sub- stations.

2.2.6.2.10 Decommissioning of Above Ground Piping Process Equipment

This includes the activities involved in demolishing all pipework, process plant, equipment and vessels to ground level in preparation for removal from site and covers:

- Demolition of piping, gantries, vessels & equipment using crawler-track excavators fitted with mechanical shears.
- Demolition of all pipework at valve stations, including cathodic protection anode beds using crawler-track excavators fitted with mechanical shears.
- Isolating and removal of electrical and instrumentation items.
- Processing of all pipework and gantry structural members to scrap.
- Disconnection and removal of valves and backloading to lorries direct.
- Segregation, loading and removal of debris using crawler-track excavators fitted with claw and bucket attachments direct to lorries.

2.2.6.2.11 Demolish below ground pipeline Equipment

This includes the activities involved in safeguarding onshore pipeline section, pipeline crossings and micro tunnel below ground level:

- Pipeline sections will be left within ground but cleaned and purged with Nitrogen
- Pipeline crossings will be exposed either side of crossing , cut and filled with grout to avoid future issues with collapse and subsidence
- Micro tunnel entry shaft will be exposed, pipeline section and FOC will be trail grouted from tunnel exit shaft location to entry shaft
- Excavations will be made good and backfilled

2.2.6.2.12 Buildings (including soft strip)

Soft strips and demolition of buildings and warehouses to ground level in preparation for removal from site and these activities cover:

- Soft strip of office buildings to remove valuable items including furniture, fittings, fitments, electrical and electronic equipment, cabling, suspended ceilings, fluorescent tubes, etc.
- Demolition of office buildings using crawler-track excavators fitted with mechanical shears.

- Demolition of warehouse buildings
- Demolition of simple buildings (basic store-rooms, sub-stations, etc.).
- All bricks, masonry, concrete blockwork, concrete floors are loaded and sent to site crusher.
- Segregation, loading and removal of debris using crawler-track excavators fitted with claw and bucket attachments direct to lorries.

2.2.6.2.13 Equipment Disposal

This includes the activities involved in reduction, recycling and final disposal of large process equipment items:

- Dismantling of plant, equipment, cutting into manageable sized pieces using cutting torches (including burning equipment / oxygen / gas) or mechanical shears, lifting via craneage & backloading onto lorry transport through to final disposal.
- Toppling / lifting of vent stack, cutting, ready for backloading.

2.2.6.2.14 Ground Works

This includes the activities involved in the excavation of site areas (concrete, tarmac, hardstandings, etc.), backloading of all site material on to lorry transport (including from buildings and above ground pipework) through to making good and final disposal.

- Excavating, cutting, grouting, sealing and backfilling pipeline ends at valve stations, pigging stations and slug catchers including removal of cathodic protection probes.
- Excavating reinforced concrete pads and subsurface utilities under process equipment including crushing and separating rebar ready for removal from site.
- Excavating tarmac and paved areas ready for removal from site.
- Backloading of all debris (steel, metals, rebar, concrete, tarmac, etc.) onto lorry transport including all handling and disposal.
- All fencing is assumed to be removed.

2.2.6.2.15 Site Remediation

All works associated with site remediation including removal and/or treatment of contaminated soil, clean fill, grading and making good will be complete.

2.2.7 Description of associated/ auxiliary works required for the project, including information on access roads, water supply, waste water management, electricity supply, gas supply, heating, ventilation and air conditioning systems, telecommunications and security systems;

2.2.7.1 Access routes

***a)* Land access routes**

Access to the land area of the project, during the life of the project, will be ensured from the European Road E 87 (National Road DN 39) through a new access road of approximately 2 km long, to the communal road DC 4 located East of the NGMS and CCR site. The new permanent access road will support the construction and operation of the project's onshore facilities. (The access road construction project is subject to a separate authorization procedure)

At the beginning of the construction period, respectively until the completion of the new access road to the NGMS and CCR site, the project site will be accessed through the existing local roads in the project area (for example, the DC 4 communal road).

In addition, during the construction period, a temporary railway level crossing and temporary construction roads will be installed to allow personnel and equipment access to the microtunnel construction and pipeline installation areas located on the left side of the Mangalia-Constanța railway line.

***b)* Sea access routes**

Access to the offshore components of the project during construction and operation will be by water or air.

During drilling/ construction/ installation, access to the offshore site will be by water, with specialized construction and installation vessels, and personnel exchange will be by helicopter transport or by vessel, as required.

The departure point for support and transport ships will be the Port of Constanța, and for helicopters it will be one of the two airports located in Constanța county.

The Neptun Alpha platform is designed as an unmanned facility requiring only periodic visits by specialized personnel for scheduled and unscheduled maintenance operations, and transportation for normal operations will be provided by marine vessels only.

The marine fleet will include a fast supply vessel and/ or a platform support vessel capable of reaching the platform location within 8 hours from the Constanța area.

2.2.7.2 Water supply

a) Water supply onshore

No connections to the local water supply network are planned during construction periods

Water supply during the construction phase

Fresh water will be provided by water tanks supplied from water sources located in the project area, based on specific contracts signed with the regional water supply operator, until the moment of connection to the supply network.

Each construction site organization (for NGMS and Microtunnel) will be provided with temporary water storage and supply tanks with a volume of 12 m^3, to ensure the water required for household and hygienic-sanitary consumption for offices and site staff (for example, showers, toilets). The tanks are provided with thermal insulation and electrical resistance against freezing.

A water tank with a diameter of 15 m and a volume of 1,000 m^3 will be provided as part of the site organization from the construction of the microtunnel, to ensure the necessary water for the construction works and installation works (for example, the water needed for the tunneling process, installation and testing of the pipes, etc.). Fresh water will be used for the hydrotesting of the pipeline in the undershore microtunnel.

The tanks will be filled based on agreements concluded with authorized economic operators.

Drinking water will be provided from commercial sources (bottled water) based on agreements concluded with service providers.

Water supply during operation

During operation, drinking water supply (for hygiene and sanitary purposes) will be carried out from the network of the regional water supply operator (RAJA Constanța)

Fresh water will only be used to supply sanitary installations (toilets, washing basins, sinks).

Drinking water will be provided from commercial sources (bottled water) based on agreements concluded with service providers.

The water supply system inside the CCR building will be made of heat-bonded polypropylene water supply pipes. Hot water will be supplied by means of an electric boiler equipped with electrical resistance.

Cold water and hot water pipes will be insulated with thermal insulation and anti-condensation sleeves. The external pipes will be thermally insulated downto the depth of freezing and protected by electric anti-freeze cables controlled by a thermostat for temperatures below 5 ^{o}C.

Details regarding the water supply network are presented in APPENDIX E Details regarding the facilities on land

b) Water supply of the components from the sea

Water supply during the construction phase

The domestic/ sanitary and potable fresh water requirement for the rig will be provided by transport from the port or by desalination of seawater by the desalination facilities available on the rig. The drilling platform will be provided with a potable water storage tank of approximately 160 m^3 (1,000 barrels)

Seawater or desalinated seawater will be used for extinguishing fires, and desalinated seawater will be used for cooling equipment.

The desalinated water will be used to produce the drilling fluids needed to drill the production wells.

The desalinated water required for the production of drilling fluids, extinguishing fires, cooling the equipment will be stored in a tank with an approximate volume of 1,600 m^3 (10,000 barrels).

The need for fresh water for the construction/ installation works carried out at sea will be provided by the support vessels for the construction/ installation works, the water being taken from authorized water sources located on land, in the Constanța port area.

Salt water (from the sea) will be used for the hydrotesting of the production pipeline from NGMS to Neptun Alpha Platform PIG Receiving station, as well as the Domino and Pelican Sud flowlines. The water used for hydrotesting will contain special chemicals for this type of test.

During the project, drinking water will be provided from commercial sources (bottled water) brought from the shore based on agreements concluded with service providers.

Water supply during operation

The Neptun Alpha platform is an autonomous platform that normally operates without personnel, and which requires the presence of personnel only in case of emergency and/ or for scheduled maintenance/ maintenance works. The crew responsible for carrying out the maintenance/ suport work will be accomodated on the transport vessel, so there is no need for a domestic water supply system on the production platform.

The water supply will be necessary during the presence of personnel on the platform in order to carry out maintenance/ suport operations and to supply water for sanitary purposes for showers. The water requirement will be provided by the support vessel, equipped with pressure regulation capacity. Water will be supplied to the production platform through a hose. To avoid cross-contamination, the hose connections will be differentiated so that the connection on the ship only matches the corresponding hose connection on the production platform.

The shower tanks will be replenished with fresh water coming from the support ship through a water connection permanently connected to the tanks. Eyewash units will be refilled from drinking water canisters brought from shore.

Drinking water will be provided from commercial sources (bottled water) brought from the shore based on agreements concluded with service providers.

2.2.7.3 Waste water management

a) **Waste water management on land**

Wastewater management during the construction phase

Connections to the local sewage networks are not planned. Each site organization (from NGMS and Microtunnel) will be provided with 20 m^3 household waste water storage basins. The basins are periodically emptied and the used water is transported to treatment stations based on an agreement concluded with authorized economic operators.

The used water resulting from the construction/ installation works (for example, the excess water from the drilling fluid production system and from the cleaning of the tunnel) will be collected in a basin, which will be periodically emptied and the used water is transported to treatment plants based on an agreement concluded with authorized economic operators or is discharged into the sea in compliance with the concentration limit of the quality indicators, approved by the authorities (for example, the excess water from the installation of the pipeline in the microtunnel, seawater from filling the microtunnel)

On the access road proposed to be built before exiting on DN 39, a truck wheel washing area will be set up. The washing area will be regulated separately, but it is provided in the procedure for obtaining agreements and approvals for the access road.

Wastewater management during operation

During operation, household wastewater will be discharged into the network of the regional water operator.

The sewage system of the CCR area is designed to be connected to the local sewage network managed by RAJA Constanta, taking into account all the requirements of local regulations, and the NGMS is a normally unmanned installation, which eliminates the need for an on-site sewage system.

The water from the concrete platforms, internal roads, parking areas will be discharged through a hydraulic separator into the buffer tank, and the water collected from the buildings will be discharged directly into the buffer tank. Drains will be designed to collect water from platforms, roads and parking areas.

Pumped water from the buffer tank will be gravity discharged to drain naturally into dedicated designed areas within the onshore site boundaries.

The volumes of domestic waste water discharged into the local sewage network will be measured and recorded during the operation of the onshore facilities.

b) **Waste water management of components at sea**

Drilling period

Domestic waste water (grey water, black water) is collected in a dedicated storage tank. Domestic wastewater is treated in a treatment system installed on board the drilling platform, tested and then discharged into the sea, unless it exceeds the maximum concentration of 15 ppm of hydrocarbons according to the MARPOL Convention.

Bilge water from the drilling rig will be collected and transported onshore for treatment/ disposal at an authorized facility.

Waters (precipitation, fresh water used for washing the deck, effluent from starting the well, etc.) that do not correspond to the limits imposed by maritime conventions will be transported ashore for treatment/ disposal at an authorized facility.

Water-based drilling fluids are discharged directly to the seabed from the borehole (this volume cannot be captured as there is no connected riser to return the discharges to the surface).

Well completion and start-up effluent is planned to be captured and barged to shore for subsequent disposal at licensed wastewater treatment facilities.

Volumes of wastewater collected and transported ashore for treatment/ disposal at an authorized facility or discharged into the sea will be monitored and recorded

Construction/ installation period

The waste water (for example, gray water, black water, storm water) generated by the support ships will be collected on board, managed/ purified, tested and discharged into the sea, after

meeting the water discharge criteria according to the maritime conventions in force (MARPOL Convention, Black Sea Convention, etc.). If the wastewater does not meet the regulatory criteria for discharge into the sea, the wastewater will be transported on land for treatment/ disposal at an authorized facility.

Bilge water from support vessels used for construction/ installation work will be transported onshore for treatment/ disposal at an authorized facility.

Upon completion of the hydrostatic testing of the gas production pipeline and supply/ supply pipelines, the water used for hydrostatic testing is planned to be discharged into the Black Sea using the manifold from the Domino 2 drilling center, which will be located deep in the anoxic waters of the Black Sea at a depth of more than 950 m. This discharge is a one-time operation.

The volumes of waste water collected and transported ashore or discharged into the sea will be monitored and recorded.

Operating period

The produced water will represent the largest volume of wastewater related to the operating period. It is currently anticipated that the produced water will be discharged through the produced water discharge caisson mounted on the offshore production platform. The total volume of produced water discharged will be continuously monitored and measured by means of a flow meter. Monitoring produced water discharge volumes will also facilitate the calculation of chemicals required for well management. Well management chemical usage calculations will be performed quarterly or as needed using telemetry data based on rig activities.

Rainfall and any wash water falling on the covered surfaces around the rig equipment will be captured and diverted into an open drain system which includes a 200 m^3 storage tank fitted with a hydrocarbon analyser. The oily fraction will be periodically removed from the support vessels and shipped ashore for proper management by authorized/ certified contractors. If acceptable hydrocarbon content is confirmed, water from the open drain system is pumped into the produced water discharge caisson for combined discharge into the sea with the produced water.

Rainfall and fresh water used for safety showers and platform washing falling on the grating deck areas and stairs will not be collected and will pass directly to the sea surface.

The subsea valves on the wellheads are operated by a water-based hydraulic control fluid. An extremely small amount of fluid operating underwater valves will be released into the sea when they are operated.

Volumes of water discharged into the sea or transported ashore for further disposal in authorized facilities will be monitored and recorded.

2.2.7.4 Electricity supply

a) **Electricity supply on land**

Energy supply during the construction phase

Power supply is required for onshore site organizations (for NGMS and microtunneling). The electricity supply for the site organization from NGMS will be provided from the electrical

substation (*which is not part of the project described in this presentation memorandum and will be the subject of a separate authorization procedure)* which will be installed in the Eastern part of the future site of NGMS. The electrical switchboards installed in the site organization from NGMS will provide the necessary energy for its facilities and equipment (including lighting).

The electrical energy required for the organization of the microtunnel site will be provided by three diesel generators of 750 kW each, which will be installed within it. Diesel generators will provide power for microtunneling installations and equipment (including lighting).

Power supply during operation

The electricity supply to the onshore components of the project (NGMS, CCR, etc.) will be made from the network of the local energy supplier through a transformer station that will be installed in the Eastern part of the NGMS site. The electricity grid connection project will include an access road and a perimeter fence. ***The electricity grid connection project is not part of the project described in this technical memorandum and will be subject to a separate authorization procedure.***

Electricity supplied from the local power grid will serve as the primary power source for the onshore project facilities. Power and distribution cables shall be buried and designed to minimize obstruction of above ground activities.

A standby diesel generator equipped with an automatic power transfer switch will be installed in the CCR area and will provide backup power for both the CCR and the NGMS. The standby generator will be sized to support the essential operational consumption for both NGMS and CCR during power outages. A small diesel fuel tank, sized to provide 3 days of continuous operation at full load, will be installed/ incorporated into the backup generator. If necessary, the diesel tank will be supplied by fuel tankers based on a contract signed with authorized contractors.

An automatic transfer switch will also be installed to provide automatic transfer to and from the generator.

b) **Power supply of the offshore components**

Electricity supply during the construction phase

The vessels used in different periods of the project (construction/ installation, commissioning, maintenance and operations, and decommissioning) will be provided with specific power generation and distribution systems to ensure the power supply on board the vessels.

The drilling rig will provide electricity through its own power generation systems and will be equipped with an emergency generator

Power supply during operation

The electricity required to operate the offshore infrastructure (production platform, subsea systems, lighting systems, etc.) will be produced on site using natural gas from the production pipeline as a fuel source.

Main electricity will be generated on the platform by three gas turbine generators operating in an N + 1 configuration, thus allowing one main generator to be on standby at all times. The nominal

output of two generators is approximately 9.2 megawatts (MW) The generators will be sized to supply all electrical loads, including the direct heating system, in all operating conditions including DEH in all operating conditions. The direct electric heating system represents the dominant electrical load.

If all main gas turbine generators are shut down, all subsea wells will be shut down and rig equipment will be locked out. No electrical power is required to safely isolate underwater or platform equipment. All valves required to safely isolate the installation are "safe", meaning that on loss of power they move to the safe closed or open position by a mechanical spring.

Backup for gas turbine generators is represented by a non-redundant 230 V AC uninterruptible power supply system (UPS) which is a battery system whose function is to provide power to keep the control and communication equipment running for several hours.

The Main Power Generation System provides fail-safe operation or shutdown of the Subsea Well Protector (SWP) in the event of loss of primary electrical power. This is achieved by means of a main essential generator, which is a 690 V, 3 phase, 50 Hz diesel generator with a rated power of 1,500 kW. Critical equipment includes uninterruptible power supplies (UPS), safety systems, equipment protection, critical heating, critical operating equipment, and safety and control systems.

Power Backup Generation - has the role of allowing the SWP to restart in the event of loss of primary and essential electricity supply. This is provided by a secondary generator of 690 V, 3 phase, 50 Hz, with a diesel engine. Typically, start-up requirements in the event of a power outage will be limited to the equipment required to start a gas turbine (GTG), after which plant operation can be resumed as normal.

A Local Equipment Room (LER) will be used to ensure efficient power distribution on the SWP, to minimize/ optimize cable size and length, and to protect equipment from the external ambient environment. LERi will house all necessary electrical, instrumentation, control and fire protection equipment to meet process and infrastructure requirements

2.2.7.5 Gas supply

a) **Gas supply on land**

Connection to local gas supply networks is not planned during construction and operation periods.

b) **Gas supply of components at sea**

Downstream of the gas dehydration unit and before entering the production pipeline, a stream of dehydrated gas will be taken for use as fuel gas for power generation and instrument gas for process control valves. The gas production pipeline will function as a storage tank for instrumental gas in the event of plant shutdown.

During the cold start and initial period of operation, this gas stream is properly superheated with an electric heater, to meet the requirements of the selected primary power generators and to avoid low temperatures due to the Joule-Thomson effect in the discharge valves, where the pressure is reduced to about 30 bar. The temperature is maintained at least 0 °C before entering

the fuel gas scrubber. During the mid- to late-stage operating period of the rig, when system pressure drops, a bypass will be provided around the heater.

Parallel and redundant control valves shall be installed to ensure a safe supply of fuel gas and instrument gas. Parallel control valves provide redundancy to prevent the failure of a single control valve from causing the loss of instrument gas or fuel supply to the entire installation. A bypass shall be provided with an autonomous pressure regulator to supply fuel gas to the essential generator during cold start. Bypass valves must be manually operated to allow transfer of fuel gas from the production line to the superheater. Power will be provided from the UPS during this operation. Once the essential generator is running, the power supplied to the superheater will be fed from the essential switchboard.

From the pressure drop station, the fuel gas is directed to a scrubber of 1x100% and 2x100% fuel gas filters. Most of the flow downstream of the fuel gas scrubber is sent to the 3x50% main power generators, where each package is provided with 2x100% own safety filters at the inlet of each turbine.

The remaining flow is sent to the low pressure fuel gas system for purging/ stripping and to the low pressure instrument gas system (7 barg). Safety valves set to 10 bar will be installed downstream of the control valves to provide overpressure protection to end users.

2.2.7.6 Heating, ventilation and air conditioning systems

a) **Heating, ventilation and air conditioning systems on land**

Heating, ventilation and air conditioning systems in the construction phase

The containers related to the construction site organizations will be provided with electric heating, ventilation and air conditioning systems.

Heating, ventilation and air conditioning systems during operation

HVAC systems will be installed at the LER and CCR buildings located on land. The HVAC system will consist of an air handling control unit connected to an external evaporative unit with variable refrigerant volume, high efficiency and low energy consumption. The air conditioning system will be mounted on the roof of the building.

The distribution of air conditioning in the rooms will be done through rectangular air ducts made of galvanized sheet, thermally insulated with basalt mineral wool mattresses.

The selection of the routes of the distribution channels was made taking into account the location of the air treatment station and the possibilities of laying and masking the pipes.

For the introduction of air into the rooms, exhaust holes were provided with ceiling mounting. The connection between the discharge mouth and the flexible aluminum connection with which it is connected to the air distribution pipe is made by means of a telescopic plenum.

The air evacuation from the rooms will be done through the air recirculation/ evacuation holes with grid, mounted in the false ceiling, these being equipped with an exhaust flow control system.

b) **Heating, ventilation and air conditioning systems for components at sea**

The ships will be equipped with specific heating systems on board.

The HVAC system will be installed on the Neptun Alpha Platform to ensure an acceptable environment (temperature, humidity and filtration standards) in all enclosed areas and to maintain the separation of hazardous from non-hazardous areas through pressure differentials and/ or ventilation dilution.

2.2.7.7 Telecommunications and security systems

a) **Telecommunications and security systems on land**

Telecommunications and security systems under construction

Telecommunications within the construction site organizations will be done with mobile phones and high frequency radios.

Telecommunications and security systems in operation

The communication between LER and CCR, then between CCR and Neptun Alpha Platform is through a direct link through the fiber optic cable installed parallel to the production pipeline. The fiber optic cable will ensure communication between the Neptun Alpha Platform and the operators working within the CCR located on land. Optical fiber was selected based on bandwidth and availability for the remote process control application.

The CCR will be equipped with facilities for communication with the NGMS and the offshore production platform. The offshore section of the fiber optic cable will serve as the primary means of communication with the offshore production platform. A spare VSAT type satellite dish will also be installed in the CCR framework to provide satellite communications with the offshore production platform.

Telephone and internet services will be provided by local providers. There will be a dedicated MPLS fiber optic connection with a bandwidth of at least 30 Mbps to connect the local area network to the wide area network (WAN). There will also be a wireless connection (IBPC) with 30 Mbps bandwidth for the Dual Line telephone service, which will provide a secondary connection to the WAN. The antennas for the wireless connection will be located on the roof of the CCR.

The CCR will be equipped with specialized security systems, including a monitored CCTV system and access card readers. Security card access will be required to enter the restricted area of the CCR building control room. In addition, the NGMS site will be equipped with security systems including CCTV, intrusion detection and card reader access gates. Security systems and cameras will be connected to the CCR for remote alarming and monitoring. Both CCR and NGMS sites will be provided with perimeter fences.

b) **Telecommunications and security systems at sea**

The main communication and security systems related to the sea facilities will include:

- Fiber optic cable and VSAT as spare;
- Ultra High Frequency (UHF) radio system;
- Maritime radio system;
- CCTV system;
- Voice communication system with dedicated line and satellite phones;
- Automatic identification system.

- Public announcement and general alarm system

The fiber optic cable will transmit dedicated Voice Communication lines between the CCR and the offshore production platform, general alarm as part of the instrumented safety system, video camera, marine radio and two-way radio. Provision shall be made for remote access to the Beneficiary's private communications network and to allow suppliers to remotely access their respective networks within the production platform.

In case of unforeseen loss of fiber optic cable transmission, the Neptun Alpha Platform is equipped with a backup satellite dish (VSAT) to ensure data transmission between the production platform at sea and the CCR on land. When communicating via back-up VSAT instead of fiber optic cable, to determine what level of control and oversight will be lost, the bandwidth elimination/ network prioritization philosophy will be adopted. The production platform will continue to operate normally on the backup communication (VSAT). If both the fiber optic cable and the VSAT cannot transmit data from the production platform to the CCR, the production platform will be safely shut down based on the control and interlocking systems provided on the platform.

UHF radio system

The system will provide radio communications for platform personnel and land-based control room operators for emergency and maintenance activities. The land and sea portions of the system will be connected by fiber optic cable to/ from shore so that personnel can communicate between all sites. The control room operator interface to the radio system must be available at the CCR console. The system must consist of radio repeaters, portable radios and control stations. The crane/ operator must be equipped with a UHF radio for loading and unloading activities.

Maritime radio system

For offshore operations, the system will provide communications between supply vessels/ crew vessels, production rig, drilling rig and control room operators. The marine radio on the production platform must be located in the LER and include the remote control function for operation in the temporary shelter. The radio on the production platform will be connected to the control room operators via fiber optic link. The control room operator interface to the production platform's marine radio must be available at the CCR console. The crane/ platform operator must also be equipped with a marine radio for communications with supply vessels/ crew vessels.

CCTV system

This system will provide CCR operators with high definition video images from most areas of the Neptun Alpha Platform. The CCTV system will be a dual role system, one for operations and one for security, and will include the latest technology for security monitoring and surveillance on an unmanned platform. The system design must provide a detailed view of most areas/ equipment on the production platform for CCR operators. Thus, if a major hazard event occurs while operators are on board the production rig, the CCR operators will be able to monitor the potential major hazard event, including the affected areas, and thus assist rig operators with situational awareness.

Voice Communication Hot-Line system and satellite phones

Hot-Line Voice Communication system will provide immediate communications between CCR operators and various locations on the production platform. Locations for the dedicated line will include the LER, the temporary shelter and the DEH building. The operator interface for the hotline system will be available at the CCR console. Satellite phones will be available for critical or emergency phone service from the production platform. Satellite phones will also serve as back-up communications to the CCR in the event of a dedicated line system failure.

Automatic identification system

On the production platform, an automatic identification system will transmit a safety message to similarly equipped vessels in the vicinity of the production platform. Data received from similarly equipped vessels in the production platform area will be displayed on a console screen at the CCR. This system uses transponders on ships and will be used to eliminate ship collisions with the production platform.

Public Announcement and General Alarm System (PAGA)

The Public Announcement and General Alarm (PAGA) system on the platform has the functionality to provide both general alarms and public announcements. The PAGA will interface with the SIS (Instrumented Safety System) and F&G (Fire and Gas Control System) systems to initiate general platform alarms. This will be achieved through secure and fail-safe hardwired signals. There will be an additional interface with the UHF two-way radio system. It will be possible to make PAGA broadcasts from selected handheld devices and interrupt activity on all radio channels via PAGA announcements.

2.2.7.8 Logistic support bases

An authorized logistics base will be established ashore in the Constanta area to support both onshore and offshore project activities and will include port and warehousing facilities to ensure the storage, loading and unloading, transportation, security, monitoring and tracking of cargo, equipment, materials and supplies.

Personnel required to operate the shore base will include dockers, crane and forklift operators, truck drivers and warehouse workers.

Offshore facility operation and maintenance activities will require part-time maritime support of a supply vessel that can function as a means of transporting personnel from the shore to the offshore production platform, as an accommodation vessel, as a supply vessel and will have sufficient deck space for the carriage of materials and crane.

Tuzla Airport will provide part-time helicopter transport services, including medical evacuation, search and rescue, and personnel transport for urgent operations.

2.2.8 Description of further developments that may occur as a result of project implementation

Upon completion of the development of the project, the gas network of the National Transport System will be expanded, thus more localities can be connected to the gas distribution system.

A new 2 km long access road will be built and will provide a connection between the European Road E87 (National Road DN 39) and the communal road DC4.

In order to supply the onshore components of the project (SRM, CCR, etc.) with electricity, a transformer station will be built

2.2.9 Identification of existing activities that may be modified or changed as a result of project implementation

2.2.9.1 Activities on land

Agricultural activities are carried out in the vicinity of the site, namely there are grain crops and an orchard.

During the implementation of the project, local roads will be used (communal road DC 4 and exploitation roads DE 277, DE 259/ 4 and DE 269). In the areas where the route of the gas production pipeline and fiber optic cable intersects with local roads and the Constanța Mangalia railway line, undecrossings will be executed and there will be present a temporary impact.

In addition, a temporary railroad crossing will be made that is necessary for access to the construction area of the gas production pipeline.

Tuzla beach is located to the East of the project site, and will be crossed by the microtunnel.

2.2.9.2 Activities at sea

The existing activities in the sea site area mainly include maritime traffic and fishing activities.

The fishing grounds overlap with the route of the Neptun Deep production pipeline and shallow water subsea infrastructure (e.g. Pelican South infrastructure). Submarine equipment and installations located in normal fishing areas will be protected from trawling activities.

Shipping routes from Ukrainian, Romanian ports, and Bosphorus and/ or Bulgarian ports cross the proposed route of the Neptun Deep offshore production pipeline.

The Ana production platform of the Midia Natural Gas Development project is located approximately 50 km West of the Neptun Deep project production platform and approximately 4 km North of the gas production pipeline.

2.2.10 Identification of existing or planned developments with which the project may have cumulative effects

The existing or planned projects with which the project may have cumulative effects are presented in the tables below:

Table 2.20 Existing projects and activities in the Neptun Deep project area

No.	Project Name	Description	Status	Connection with Neptun Deep project	Remarks
EXISTING and/ or completed PROJECTS					
1.	Reduction of coastal erosion Phase II (2014-2020), Holder: Romanian Waters National Administration - Dobrogea-Litoral Constanța Water Basin Administration (ABADL)	Perimeters: 2 Mai, Mangalia, (Saturn, Balta Mangalia, Venus, Cap Aurora, Jupiter, Neptune, Olimp) The purpose of this project is to ensure adaptation to climate change, prevention and risk management through protection against coastal erosion by building dykes and extending beaches. Implementation period: 2018-2023 and is completed	Completed	As part of this project, erosion protection works were carried out in an area located between the shipwreck Evangelia and the Forum Hotel in Costinești. The closest component of the Neptun Deep project to the site of the erosion protection works, is represented by the microtunnel which is located approximately 1.5 km North of the Northern limit of the erosion protection works area mentioned above.	APM Constanța address no. 6102 dated 29.05.2023 Environmental agreement no. 20/ 11.11.2016
2.	Antierrosion works for the cliff in the area of Tuzla, Constanța county, Beneficiary: Romanian Waters National Administration - Dobrogea-Litoral Constanța Water Basin Administration (ABADL)	The aim of the project is to prevent the extension of landslides and increase the tourist attraction in the coastal sector of Tuzla municipality. The works involve excavation and filling to provide a 1:1.5 cliff slope, berms 2.5m wide and 4m high from the ground, stone and concrete block protection at the base of the cliff and construction of a concrete slab walkway.	-	The seawall strengthening works will be carried out on the seawall located along the Eastern side of the onshore project site. The microtunnel related to the Neptun Deep project will cross the cliff area, it is being drilled in the rock layer below the cliff, > 2 m deep, thus not affecting the cliff or its consolidation works.	Currently, the works are suspended due to a dispute between ABADL and Tuzla City Hall.
3.	The regional project for the development of the water and wastewater infrastructure in the area of operation of SC RAJA SA Constanța, in the period 2014-2020 - Rehabilitation and expansion of distribution and sewerage networks, rehabilitation of the wastewater pumping station and	The general objective of the project is the continuation of the strategy for the development of the water and wastewater sector, in order to achieve the objectives assumed by Romania through the Treaty of Accession to the European Union, by preparing the Application for funding to access European funds for environmental infrastructure in the programming period 2014-2020 and the completion of the necessary technical-economic documentation.	Ongoing	The project also includes the rehabilitation of a 500 mm discharge pipe that crosses from South to North the S3 area owned by OMV Petrom within the project site, by removing the old water pipe and installing a new pipe along the DE 277 local road. The onshore section of the Neptun Deep production pipeline and fiber optic cable	Address CJ Constanța no. 17489/ 15.05.2023 CP no. 3 of 20.01.2022 Constanța CJ

No.	Project Name	Description	Status	Connection with Neptun Deep project	Remarks
	wastewater discharge pipes in Tuzla, Constanța county, Owner: RAJA SA Constanta	The purpose of the project also includes the rehabilitation and expansion of the distribution and sewerage networks, the rehabilitation of the wastewater pumping station and the wastewater discharge pipes in Tuzla, Constanța county. The project is financed from European funds within the Large Infrastructure Operational Program (POIM), Priority Axis 3 - Development of environmental infrastructure under conditions of efficient resource management, Specific Objective 3.2. - Increasing the level of collection and treatment of urban waste water, as well as the degree of ensuring the supply of drinking water to the population. Implementation period: ongoing		will cross the location of the new RAJA discharge pipeline.	
4.	Midia Natural Gas Development Project Beneficiary: Black Sea Oil & Gas SA in partnership with Petro Ventures Resources SRL and Gas Plus Dacia SRL	The Midia Natural Gas Development Project includes the Ana and Doina gas fields discovered in 2007 and 1995, respectively. Both are of Miocene and Upper Dacian age, contained in biocene gas reservoirs consisting of shallow marine sands, located approximately 120 km from the Romanian coast, in the shallow water area of the XV Midia perimeter where the water depth is 70 meters. Regarding the industrial facilities, the project consists of digging five production wells (one underwater well at Doina and four production wells at Ana), an underwater production assembly on the Doina field that will be connected by an 18 km pipeline to the production platform monitored and operated from the shore, located on the Ana field. A 121 km underwater pipeline will transport gas from the Ana platform to shore, where a 4.1 km underground pipeline follows to the new gas treatment plant. The treated gases will be	Completed	The Ana production platform of the Midia Natural Gas Development project is located approximately 50 km West of the Neptun Deep project production platform and approximately 4 km North of the production pipeline.	

No.	Project Name	Description	Status	Connection with Neptun Deep project	Remarks
		delivered through the gas measurement station located in the perimeter of the gas treatment station, to the NTS operated by Transgaz.			
5.	BRUA/ Phase 2 – Black Sea Coast Pipeline - Podisor (RO) for the collection of gas from the Black Sea, Holder: National Natural Gas Transport Company Transgaz SA	The "Black Sea Coast Pipeline - Podișor (RO) for the collection of gas from the Black Sea" project consists in the construction of a telescopic pipeline with diameters of 48 inches (Dn 1200) and respectively 40 inches (Dn 1000), designed for the transport of natural gas at a pressure of 63 bars. The pipeline will have a total length of approximately 308 km and will connect the Black Sea coast with the Podisor technological node, crossing Amzacea and Vlasin. The pipeline will transfer the gas to the NTS with the possibility of transmitting through the BRUA pipeline (Bulgaria, Romania, Hungary, Austria) to other European countries the expected gas production of ExxonMobil and OMV Petrom from the Domino and Pelican Sud fields in the Black Sea. Implementation period: 2020-2022	-	As part of the BRUA Phase 2 project, a Transgaz facility connected to the NGMS of the Neptun Deep project will be built. The Transgaz connection point (*facility that is not part of the Neptun Deep project, will be subject to a separate authorization procedure)* will be installed on the private land owned by OMV Petrom (area S1, cadastral number 109216). The Black Sea Coast - Podișor (RO) pipeline will transport the gas produced in the operational phase of the Neptun Deep project, in the NTS in Romania.	The proposed project is in the phase of obtaining approvals and authorization s APM Constanța address no. 6102 of 29.05.2023
Existing activities in the Neptun Deep project area					
1.	Shipping in the Black Sea	Shipping in the Black Sea is carried out along the recommended one-way routes using traffic separation schemes, especially in congested areas such as the Bosphorus and the approach to it and in large ports such as Odessa and Constanta. Each of the countries bordering the Black Sea uses maritime transport in its commercial activities.	-	Waterways from Ukrainian and Romanian ports and the Bosphorus and/ or Bulgarian ports cross the proposed offshore route of the Neptun Deep project production pipeline.	-
2.	Fishing in the Black Sea	- Commercial fishing takes place between 20 and 150 m water depth, based on natural and legal limits. Basically, fishing is limited to shallower depths due to the capabilities of most of the vessels used.	-	The fishing grounds overlap with the Neptun Deep production pipeline route and underwater infrastructure (eg Pelican South infrastructure).	-

No.	Project Name	Description	Status	Connection with Neptun Deep project	Remarks
		The Romanian fleet operates up to 30 - 35 nautical miles (55 to 65 km) in the Black Sea or at a water depth of approximately 60 m depending on the characteristics of the vessels and their limited autonomy. - Sports recreational fishing takes place in the shore area up to 20 m water depth			
3	Tourist activities	Undeveloped Tuzla beach	-	The beach area will be crossed by the proposed microtunnel works within the Neptun Deep project. The undercrossing area is approximately 2 m deep so that the beach is not affected.	Seasonal activities that take place in the summer period, from July to September)
4	Rail transport	Constanța - Mangalia non-electrified railway	-	The Neptun Deep project provides for the construction of a temporary railroad crossing and its undercrossing for the installation of the gas production pipeline.	

Table 2.21 Planned future projects in the Neptun Deep Project area

No.	Project Name	Project description	Connection with Neptun Deep project	Remarks
1.	Neptun Deep - Creation of an access road, organization of the construction site, securing and connection to utilities, the access roads to them, related to NGMS and CCR, Owner: OMV Petrom	The overall objective of the project is to build a new access road connecting DN 39 to the NGMS and CCR sites within the Neptun Deep project. Construction work for the new access road is expected to be executed prior to the construction of the NGMS and CCR.	The new permanent access road will support the construction and operation of the Neptun Deep project facilities.	Town planning certificate issued by the Tuzla Commune Local Council no. 80/ 08.07.2021
2.	Construction of a roundabout in the area of the national road DN39 (E87) - km 23 + 190, Tuzla commune, Constanța county,	The purpose of the project is to build a roundabout on the national road DN39 - KM 23 + 190 to connect the new access road proposed for the	The proposed roundabout will connect the proposed new access road for the Neptun Deep project with DN39.	Urban planning certificate issued by the Tuzla Joint Local

No.	Project Name	Project description	Connection with Neptun Deep project	Remarks
	Owner: Romanian National Road Infrastructure Administration Company (CNAIR)	Neptun Deep Project and the new access road proposed for Tuzla Airport with DN 39. It is expected that the construction work for the new roundabout will be executed before the construction of NGMS and CCR.		Council, no. 113/ 3.08.2021
3.	Neptun Deep – Electricity supply site organization natural gas measuring station and control center Holder: OMV Petrom	The purpose of the project is to provide an electrical connection for the NGMS and CCR sites during construction and operation periods. The works will include the construction and installation of: • An overhead power line (LEA) connected to the existing power grid in Costinești; • An electrical transformer station that will be installed in the Eastern part of the NGMS site (20/ 0.4kV - 630kVA); and • An underground cable connection between the LEA network in Costinești and the new transformer station (1,459 m long).	The proposed substation will provide electricity for the construction and operation of the onshore components of the Neptun Deep project (SRM, CCR, etc.).	Urban planning certificate issued by the Constanta County Council, no. 16446/ 30.07.2021
4.	Electrification and rehabilitation of the Constanta Mangalia railway line Beneficiary – National Railway Company CFR SA through SC Baicons Impex SRL	The project aims to rehabilitate and electrify the railway infrastructure on the railway section between Constanta and Mangalia. The modernization mainly involves the improvement of the infrastructure and the railway system so that the maximum permitted speed of the route of 160 km/ h can be reached. The project has an estimated completion time of 24 months, but the start date of the works is not specified	The railway to be rehabilitated passes through the project area. In the Neptun Deep project, works are planned to cross the gas production pipeline and during the construction period, a temporary crossing at the level of the railway will be arranged, which will also include an arrangement of existing road connections (DC4 and De277) at the temporary crossing over the railway	Address CJ Constanța no. 17489/ 15.05.2023 UC no. 24/ 10/ 03/ 2022 Tuzla City Hall address no. 3908/ 18.06.2023 APM Constanța address no. 6102 of 29.05.2023
5.	Exploitation for sand from the Extrasand 1 and 2, Mamaia-Marea Neagra 1 and 2, Comprest 2,	Exploitation perimeters in the Black Sea. In different stages of approval / operation	Located on the continental shelf, in the Romanian Economic Exclusive Zone, at distances larger than	

No.	Project Name	Project description	Connection with Neptun Deep project	Remarks
	Mamaia 2, Van Ooord 9 and 10, Envisan Sud, Envisan Zona B, Eforie 1,2 and 3, Boskalis 1, 2 and 3 perimeters, Constanţa county, Black Sea continental shelf. Licence Owners: SC EXTRASAND PCM SRL, SC STRICT AQUASERV SRL, SC COMPREST UTIL SRL, SRL, SC METAL TRADE RNG SRL, SC VAN OORD DREDGING AND MARINE CONTRACTORS, ENVISAN NV BELGIA - SUCURSALA PITEȘTI, SAGA LOGISTICS MANAGEMENT SRL, BOSKALIS INTERNAȚIONAL BV		10 km from the marine area of the analized project.	

2.2.11 Description of associated/ auxiliary works that are excluded from the environmental impact assessment and justification for exclusion.

There are no asssociated/ auxiliary works excluded from the impact assessment.

2.3 DESCRIPTION OF THE PROJECT SIZE

2.3.1 Description of the land areas occupied by the permanent onshore, undershore and offshore components of the project

2.3.1.1 Permanently occupied land surface on land

The permanent onshore components of the project (NGMS, CCR and the shut-off valve) will be located on the land owned as property by OMV Petrom SA, respectively parcel S1, cadastral code 109216) NGMS , CCR and auxiliary components NGMS and CCR) and parcel S3 cadastral code 109659 (station shut-off valve).

The total area of permanently occupied land is approximately **28,132 $m^{2,}$** of which:

- 23,183 $m^{2,}$ the area occupied by NGMS ;
- 3,459 $m^{2,}$ the area occupied by CCR;
- 25 $m^{2,}$ the surface of the rainwater collection basin;
- 409 $m^{2,}$ the area occupied by the stop valve of the station
- 1,056 $m^{2,}$ internal roads to the Transgaz and NGMS connection point

The underground onshore section of the gas production pipeline and fiber optic cable, from the NGMS to the onshore microtunnel entry point, will occupy an area of approximately **2,117 $m^{2.}$**

The green areas (perimeter curtain of trees, green hedge of shrubs and areas covered with grass) designed for the land site of the project will occupy a total area of approximately 20 ha.

2.3.1.2 Permanently occupied surface at sea

The area permanently occupied by offshore components (marine production platform, Domino and Pelican Sud drilling centers, umbilical systems, flowlines, gas production pipeline and other auxiliary facilities) is approximately 813,607 m 2, of which, approximately:

- 3,547 m^2 will be occupied by the marine production platform;
- 8,686 m^2 will be occupied by the Domino 1 Drilling Center (DODC1) and related underwater equipment (manifold, breakout heads, etc.);
- 8,722 m^2 will be occupied by the Domino 2 Drilling Center (DODC2) and related underwater equipment (manifold, breakout heads, etc.);

- 11,088 m^2 will be occupied by the South Pelican Drilling Center (PSDC1) and related underwater equipment (manifold, breakout heads, etc.);
- 73,260 m^2 will be occupied by the Domino flowline;
- 2,952 m^2 will be occupied by the Pelican Sud flowline;
- 2,952 m^2 will be occupied by the umbilical system from the production platform to the PSDC1 drilling center;
- 52,280 m^2 will be occupied by the umbilical system from the production platform to the drilling center DODC1;
- 12,040 m^2 will be occupied by the umbilical system from the DODC1 drilling center to the DODC2 drilling center; and
- 638,080 m^2 will be occupied by the 30 inch (762 mm) natural gas production pipeline and fiber optic cable.

2.3.1.3 Surface occupied by the shore under-crossing

The microtunnel crosses the shore, the net and the DE 259 exploitation road. The entrance point to the tunnel is located on the parcel S4 owned by OMV Petrom SA and the exit point is in the coastal area of the Black Sea. The underground surface occupied by the microtunnel is approximately 2,136 m^2, of which:

- 678 m^2 in the shore area;
- 1,458 m^2 in the coastal area of the sea.

2.3.2 Description of land areas temporarily occupied by site organizations and other temporary works/ facilities

The land areas temporarily occupied by construction site organizations and other temporary works will occupy a total area of approx. **52,451 m^2**, of which the area of approximately:

- 1,030 m^2 will be occupied by the temporary level crossing with the railway, including the connection with local roads;
- 16,523 m^2 will be occupied by the installation corridor of the gas production pipeline;
- 539 m^2 will be occupied by the undercrossing of the railway and local roads by the gas production pipeline;
- 9,490 m^2 will be occupied by the site organization for NGMS and CCR (including office containers, parking and pre-assembly area) of which;
    - 5,379 m^2 total pre-assembly area which includes the warehouse for storing materials, the enclosed area for storing chemical products and the fuel tank;
    - 2,981 m^2 total area occupied by containers, administrative area, construction site road, household waste water collection basin and water tank;
    - 1,130 m^2 surface of the temporary parking area.

- 5,850 m^2 will be occupied by the construction site for the microtunnel, including the pipeline launch area;
- 9,499 m^2 will be occupied by the temporary access roads to the construction site for the microtunnel;
- 1,100 m^2 topsoil storage area;
- 8,420 m^2 Excavated soil storage area;

The plan with the temporary components of the project on land are presented in Annex B

2.3.3 Description of the works to restore the initial state and subsequent uses of the land temporarily occupied with the activities involved in the project

After the completion of the construction and installation of the project components, the works to restore the initial state will be carried out in the area on land affected by the site organizations (NGMS and microtunnel contruction site organization), the temporary access road and temporary railway crossing, the installation corridor of the gas production pipeline, and fiber optic cable and other temporary areas affected by the construction activity.

The restoration works will include the following activities:

- Moving containers and other facilities installed in the organization of the NGMS and microtunnel site;
- Demolition/ removal of temporary construction infrastructure (construction site roads, temporary railway level crossing, technological platforms, parking areas, storage areas, etc.)
- Filling ditches with soil from excavations;
- Withdrawal of machinery and equipment used during construction;
- Adequate management of waste water, waste, chemicals and other materials used during construction;
- Scarification, filling and leveling as required. If contaminated areas are identified, the site will be rehabilitated, and the contaminated materials will be managed in accordance with the legal provisions in force.
- Revegetation of the site (planting grass, applying fertilizers and fertilizers, etc., as appropriate).

Upon completion of the construction and commissioning of the offshore facilities, no site restoration work is required for the offshore components of the Neptun Deep project (production platform, drilling centers, flowlines and offshore section of the production pipeline).

2.3.4 Description of buildings and equipment developed as part of the project

2.3.4.1 Buildings and equipment within NGMS and CCR

All constructions and project equipment in the project must respect the maximum height of 12 m, according to the approved Zonal Urbanism Plan.

The height of buildings and equipment in the NGMS and CCR area are presented in Annex I Architectural and landscape plans.

The CCR will be a building constructed on isolated foundations with a concrete beam structure. Built area 1097,60 m^2, usable area 987.40 m^2. Height regime - ground floor, external dimensions of the building are 39.20 m x 28.00 m, maximum height 11.00 m.

Adjacent to the CCR building, a storage warehouse made of metal structure closed with sandwich panels will be constructed. Constructed area will be 88 m^2. Exterior dimensions of the warehouse are 11.00m x 8.00m , maximum height 10.00 m.

The LER buildings will be a container type, with a ground floor height, having a steel structure with perimeter walls, placed on individual foundations connected with perimeter beams, made of reinforced concrete. Built area for each LER os 60 $m^{2,}$ external dimensions 12.00 x 5.00m, maximum height 4.20 m.

The NGMS is provided with metering equipment, which include:

- Gas quality analyzer chamber (Chromatograph and Moisture analyzer);
- LERs for control, communication and the Integrated Control and Safety System (ICSS);
  - Heaters;
  - Local Equipment Rooms (LER) for NGMS control;
- 2 Inlet filters/ separators (N+1);
- Pig receiver station;
- Flow metering skid with 5 lines (N+1) with ultrasonic flowmeter, nominal diameter 300;
- 2 flow control valves (N+1) and 1 shut-off valve (located East of the railway);
- Emergency gas dispersion system (gas dispersion vent);
- Gas heaters (3x2MW (3x33%)) to meet the gas temperature conditions at the entrance to the NTS;
- Rainwater collection basin;
- Oily Water Separator;
- Technological platform;
- Protective fence;
- Personal emergency exit gates;
- Vehicle access gate.

The gas quality analyzer (Chromatograph and Moisture Analyzer) and other sampling equipment will be skid type, prefabricated, pre-wired and pre-tested. The analyzer will have a 0.6 m thick reinforced concrete foundation.

The inlet filters/ separators for the protection of downstream ultrasonic meters and control valves, in the event of the appearance of liquids from the Neptun Alpha Platform, will have dimensions of approximately 4.95 m in length and 1.65 m in diameter and 4 m in height. The filter will have a 0.9 m thick reinforced concrete foundation.

The pig reception station will be located on a reinforced concrete foundation with a thickness of 1 m.

The vent system consists of a 12 m high vent stack with a diameter of 12 inches (305 mm). The height and diameter of the vent are chosen to minimize the potential negative visual impact caused by the presence of the NGMS. The vent system from the NGMS allows the safe discharge of the gas feed and allows the NGMS pipes to be depressurized to 6.9 bar in 20 minutes. The vent stack will be mounted on a 1.2 m thick reinforced concrete foundation.

The flow measurement skid will be mounted on a 0.8-thick reinforced concrete foundation and will measure approximately 18.5 m long and 13 m wide.

The gas heaters from NGMS are to heat the natural gas to meet the delivery temperature requirements of SNT, especially in winter, in the cold season. The heating skids will be mounted on 1 m thick reinforced concrete foundations. The platform of the 3 heaters will be approximately 13 m long and 11 m wide.

The gas flow control valves will be mounted on a 0.6 m reinforced concrete foundation.

The shut-off valve of the station will be located in a buried reinforced concrete manhole. The location of the shut-off valve will be provided with a perimeter protective fence.

The equipment infrastructure installed in the CCR perimeter includes:

The VSAT satellite antenna will be installed on a metal structure, on a 1.2 m thick concrete foundation.

The power transformer is placed in a container on a 0.6 m thick concrete foundation.

The rainwater collection basin is a concrete underground basin with manholes.

The perimeter fence that will be installed at the NGMS and CCR sites will be made of metal poles located 2.5 m apart, anchored in concrete foundations. Galvanized steel mesh panels will be installed between the fence posts. The vehicle access gate will be metal and will have a width of 4 m.

Outdoor lighting at the NGMS and CCR sites will be provided using 8.2 m high lighting poles.

2.3.4.2 Components installed offshore

The topside of the offshore production platform is mounted on the jacket which is a 4-leg steel structure.

Decks on the platform are as follows:

- The Sea Deck is +12.4 m above mean sea level (MSL)

- The lower deck at a height of + 21 m (MSL),
- The upper deck is at a height of +32 m (MSL)
- Helideck +38 m above MSL.

The mooring deck includes a temporary storage area and access to the sea stairs. This deck will not normally be accessed during routine operations.

The lower deck measures 68 meters (East-West) by 44 meters (North-South). It is equipped with the electric LER to the West. The utility area, including chemical injection, seawater treatment and flare KO vessels, are located in the center of the deck. The pig launcher and receivers are located at the East end of the deck. Two corridors are designed for access to the walkways.

The Temporary Refuge (TR) and Emergency Overnight Accommodation (EOA) are located North of the LER. The EOA can accommodate up to 20 people overnight, which is the maximum number of personnel allowed on the platform at any one time during normal operations. The TEMPSC (lifeboat) is on the West side within easy reach of the temporary shelter and there are escape chutes with life rafts positioned at the North-West and South-East corners.

The upper deck measures 68 meters (East-West) by 36.6 meters (North-South). The top deck process equipment includes the primary separator, wet gas cooler, TEG contactor and TEG regeneration system. The three Gas Turbine Generators (GTG) are also located on the upper deck.

The helipad sits above the upper deck and extends a further 14.4 meters to the West.

The flare arm is bracketed in the Eastern area of the platform to minimize the ignition potential of any accidental release of gas on the platform. It is fixed to the lower deck and the upper deck midway along the East side, and extends diagonally above the sea. The top of the flare stack is 105 meters above sea level.

Neptun Alpha has an electrically powered box boom pedestal crane to facilitate overboard (to and from the Field Service Vessel (FSV)) and onboard (within Neptun Alpha) lifts. It is located halfway along the South side on the upper deck. The crane jib is 15 meters above the level of the upper deck and has a lifting radius of 44 meters and can access all areas on the upper deck and the South side of the lower deck as well as the FSV deck./ supply vessels alongside

The layout of the two decks is shown in Appendix D. Process Equipment Layout Plans.

The Neptun Alpha platform will include the following modules/ containers:

- DEH container having a total spread area of 52.50 $m^{2,}$ a maximum height of 4.00 m and external dimensions of 10.50 m/ 5.00 m;
- Container for Temporary Refuge having a total area of 29.80 $m^{2,}$ a maximum height of 2.80 m and external dimensions 2.44 m/ 12.20 m;
- LER container having a total area of 352 $m^{2,}$ a maximum height of 8.40 m and external dimensions of 20.99 m/ 12.00 m.
- The architecture of SWP modules/ containers is presented in Section 2.3.5.2.

2.3.5 Description of the architecture of the buildings developed as part of the project

2.3.5.1 The architecture of the NGMS and CCR buildings

CCR building

The building will consist of four prefabricated and equipped sections. The main characteristics of the CCR building are:

- Concrete beam structure;
- External dimensions of 39.2 mx 28.00 m;
- Maximum height 11.00 m;
- Built area of 1,097.60 m^2 ;
- Usable surface of 987.40 $m^{2.}$

The exterior structure of the building consists exterior finishing and termal insulation with protection plaster finishing type. The concrete slab will be covered with RAL 7024 graphite gray protective plaster and the sandwich panel walls will be painted with RAL 7038 agate gray paint.

The building will have three access ways, one on the North side, one on the West side and one on the East side and will be accessible to people with disabilities. All entrances will be provided with stairs and a ramp of 1.2 m width and 8% slope. The access doors are with two wings.

The windows and doors of the building will be made of pre-printed RAL 7024 graphite gray aluminum profile.

The roof structure consists of polyvinyl chloride (PVC) roof membrane, high-density batt thermal insulation, vapor barrier and pre-printed steel roof panel. HVAC equipment for CCR will be located on the roof.

2.3.5.2 The architecture of the buildings on the offshore production platform

The architecture of the main buildings (DEH Module, Temporary Accommodation Container, LER Container) installed at the Neptun Alpha Platform is described below:

DEH module

The DEH module will consist of a closed steel structure with the following external dimensions: 10.50 m x 5.00 m and a maximum height of 4.00 m. The built area will be 52.50 $m^{2.}$

The module will have a ground floor height regime. The usable area will be 45.40 m^2

Access to the module will be achieved through two doors.

The walls at the level of the facade will be made of corrugated steel sheet, RAL 7038 agate grey. The carpentry will be made of aluminum profiles in a multi-chamber system and will be graphite grey RAL 7024.

The floor will be covered with homogenous antistatic polyvinyl chloride.

The roof type will be flat roof terrace accessible by a vertical steel ladder. It will house a series of equipment bounded by a fixed metal railing.

The exterior walls and roof shall be constructed of fire-retardant materials and shall be protected against atmospheric corrosion.

Container for temporary accommodation

The container for temporary accommodation is a marine prefabricated module that will consist of a closed steel structure, having the following external dimensions: 2.44 m x 12.20 m. The maximum height will be 2.80 m.

The built area will be 29.80 m^2 and the total area of 29.80 $m^{2.}$

The module will have a height regime on the ground floor and will be divided into bedroom, rest room and kitchen. The usable area will be 26.70 $m^{2,}$ of which:

- Bedroom - 15.55 m^2 ;
- Restroom - 0.6 m^2 ;
- Kitchenette - 10.55 $m^{2.}$

Access to the module will be through two doors.

Walls at the level of the facade will be made of corrugated steel sheet, RAL 7038 agate grey. The carpentry will be made of aluminum profiles in a multi-chamber system and will be graphite grey RAL 7024.

The floor will be covered with homogeneous polyvinyl chloride.

The roof type will be flat roof terrace.

The exterior walls and roof shall be constructed of fire-retardant materials and shall be protected against atmospheric corrosion.

LER container

The LER Container will be represented by a module that will consist of a closed steel structure, having the following exterior dimensions: 20.90 m x 12.00 m. The maximum height will be 8.40 m.

The built area will be of 250.80 m2 and the spread area (total area) of 352.00 m2.

The building will have a two levels height regime (ground floor + 1st floor).

A transformer room and a main room will be accommodated on the ground floor.

The access to the ground floor will be achieved through four pedestrian doors located as follows: one wing door on the north side, two one wing doors on the west side and one two wing door on the south side.

Fastenings at the facade level will be carried out of corrugated steel sheet, RAL 7038 agate grey. The carpentry will be made of aluminum profiles in multi chamber system with aluminum profile window and will be graphite grey RAL 7024.

The flooring will be anti-static homogeneous poly vinyl chloride covering.

The roof type will be flat roof terrace, accessible through a steel vertical ladder. It will accommodate a series of equipment delimited by a fixed metallic railing and the second module.

A battery room and a telecommunication & equipment room will be accommodated on the first floor.

The access to the first-floor module will be achieved through four pedestrian doors located as follows.

The exterior walls and roof will be constructed from non-combustible materials and will be protected from atmospheric corrosion.

The usable area of the LER Container will be 326.80 m2, from which:

- Transformer room (ground floor) – 41.20 m^2;
- Main room (ground floor) – 194.30 m^2;
- Battery room (1st floor) – 45.65 m^2;
- Telecommunications and equipment room – 45.65 m^2.

The layout of the SWP buildings is shown, attached in Annex I. Architectural and Landscape Plans.

2.3.6 Description of the traffic generated or diversified as a result of the implementation of the project.

During the construction phase, road traffic will be temporarily increased locally due to vehicles/ trucks used to transport equipment, natural resources, aggregates and other construction materials to onshore construction sites.

During the operational phase, road traffic to NGMS and CCR will be mainly represented by vehicles used to transport NGMS and CCR operators. The road traffic generated during the operation of the project is estimated to be limited and will not have a significant impact on the traffic in the project area.

Access to the offshore area during the drilling/ construction and installation/ pre-commissioning and commissioning phase will be by water with special construction and installation vessels with personnel shifts being transported by helicopters. The support ships and helicopters will temporarily contribute to increased naval and air traffic in the Black Sea region.

The Neptun Alpha platform is designed as an unattended facility, with periodic visits by specialized operations personnel to perform scheduled and unscheduled maintenance activities. It will be accessible for normal operations only by seagoing vessels. Under normal operating conditions, an offshore maintenance activity is expected to take place every 3 months (4 times a year) using support vessels. The helicopters will only be used in an emergency at Platform Neptun Alpha and are not considered a significant source of additional traffic given their limited use.

2.4 DESCRIPTION OF THE MAIN CHARACTERISTICS OF THE OPERATIONAL PHASE OF THE PROJECT, INCLUDING PRODUCTION PROCESSES, ENERGY REQUIREMENT AND ENERGY USED, NATURE AND QUANTITY OF MATERIALS AND NATURAL RESOURCES USED

2.4.1 Description of the production processes necessary for the operation of the project (including the presentation of flow charts related to the technological process

2.4.1.1 Description of production processes at sea

The proposed objective of the Neptun Deep project consists in the development of natural gas resources from the Pelican Sud (one drilling center) and Domino (two drilling centers) fields. The mixture of gas and water reaches the Neptun Alpha Platform facilities through separate flowlines from the drilling centers of the Pelican Sud and Domino fields. The Neptun Alpha platform will be equipped with installations and facilities to support the gas production, separation and dehydration process, such as:

- Inlet manifold;
- Input separator;
- Gas dehydration unit;
- Glycol regeneration system;
- Degassing of produced water;
- The wet gas cooler;
- Installations for coupling;
- Installations for cleaning the well

Due to the expected concentration of 99.4% dry gas/ methane without liquid hydrocarbons present in the gas streams from Domino and Pelican South, the process equipment at the facility is not designed to handle liquid hydrocarbons.

a) **Production manifold**

The flowline system incorporates a direct electric heating open loop system that is used for continuous hydrate prevention for the Domino field and a flexible electrically heated flowline for the Pelican South field. The electricity generated on the platform is used to power both heating systems of the flowlines. The Domino feed/ intake pipe will have a fixed riser and the Pelican Sud flexible pipe will go up in the jacket through a J-tube.

On the platform, the two risers pass through the boarding valves, followed by piggable T-connections. The flow path through the mainline of the barred tee provides piggable access to either a pig receiver for Domino or a connection for a temporary pig trap for Pelican.

A permanent pig receiver is provided for the Domino production flowline sized to accommodate the largest maintenance and ILI (In Line Inspection) pig. On the platform space will be allocated to allow unloading of the pigs. Purging of the pig receiver trap will be performed from a nitrogen system that has also snuffing capability of the emergency relief and is sized to provide a minimum

of three snuffing attempts in addition to maintenance purging. Pressurized nitrogen bottles are provided along with a distribution header to facilitate purging of equipment such as pig traps.

The flow from the well is directed to the production manifold by means of the piggable tees. Isolations valves as well as riser chokes are installed on both flowlines (Pelican Sud and Domino) upstream of the manifold and prior to being comingled. The return line from Domino's pig station is also mixed with the flow from the wells in the production manifold before being directed to the primary separator.

To prevent hydrate formation during winter, the risers are electrically heated from the splash zone to the inlet separator, including the inlet manifold. While ambient temperatures can reach -17°C, electric heating will maintain a process temperature above the hydrate formation temperature.

b) Separation of gases

Production from the Domino and Pelican South fields will be distributed through the manifolds so that each stream can be directed to the inlet separator. The full flow from the wells is then separated into produced gas and produced water through the inlet separator.

The inlet separator is a traditional vertical gravity separator designed to separate liquid from vapor and has an overflow capacity of 23 m^3.

The operating pressure of the inlet separator will be 100-110 barg in the early period of operation, but will decrease to 60 barg towards the end of life (reduced flow). Operating pressure will continue to decrease as production rates decrease as export pipeline pressure decreases. The average arrival temperature of the gases is 25 °C; however, in summer the temperature can reach up to 30°C.

Antifoam will be injected at the inlet of the primary separator to prevent foam from forming inside the separator. The wet gas separated from the primary separator flows to the gas dewatering/ drying unit (TEG Contractor).

The liquid exiting the bottom of the separator is composed of produced water, injected chemicals and solids (reservoir sand). It should be noted that there will be no liquid hydrocarbons in the liquid stream.

The inlet separator and piping were designed so that the sand remained trapped in the aqueous phase and conveyed to the produced water separator to prevent sand build-up in the separation system and piping.

While gas metering for well allocation occurs underwater at the wellhead, metering for fiscal custody transfer occurs onshore within the NGMS. Also, level measurement supervision for gas and water flows is provided from the separator.

The liquid level in the separator will be controlled by a level regulator and control valves fitted at the liquid exit from the separator. The pressure is controlled by a pressure regulator located downstream at the pipe inlet. The gas outlet temperature will be monitored to ensure that it is operating above the hydrate formation temperature (15^{o}C) and below the maximum operating temperature limit of 35^o C of the gas dehydration unit, which has low performance starting at 30^{o}C. The flow rates from Pelican Sud (high temperature fluids) and Domino can be adjusted as necessary to keep the temperature within operating limits. As a result of the high temperatures

possible when the gas arrives from Pelican, to allow production exclusively from Pelican, a wet gas cooler is included to improve the performance of the downstream gas dewatering system so that it can meet export sales specifications. The system will use a seawater lifting system to supply the coolant, and the coolant is directed to the caisson to discharge the produced (process) water into the sea.

Pressure Safety Relief Valves and Blowdown valves for overpressure protection will be provided on the separator and will be connected to the collector of the high-pressure gas dispersion flare, and the emergency collector.

The gas from the inlet separator is directed through the gas cooling system (Wet Gas Cooler) to the gas dehydration unit. The liquid discharged from the inlet separator is directed into the produced water degassing vessel where the residual gas remaining in the mixture of produced water, particles and chemicals is removed by a flash separation at low pressure (0.5 bar). The gas thus separated is directed to the low pressure flare (LP), and the rest of the produced water effluent will be managed in accordance with the specific legislation in force.

c) Gas cooling (Wet Gas Cooler)

The wet gas cooler (shell tube heat exchanger type) is installed to ensure a constant feed temperature to the downstream TEG contactor. The wet gas cooler increases the efficiency of TEG regeneration and reduces continuous low-pressure combustion volumes. This allows for operational flexibility and increased uptime, enabling Pelican-exclusive production and increased plant start-up efficiency.

The gas is cooled to 25°C so as to maintain an adequate margin over the hydrate formation temperature. The gas is cooled by means of cooling water in the form of treated seawater. Seawater is pumped and treated in coarse filters. The seawater flow passes through the outside of the heat exchanger and comes into contact with the tubes containing the production gas, cooling the gas to the target temperature. The seawater is then directed to the process water caisson and the gas enters the TEG contactor/ gas dewatering unit.

A bypass shall be provided on the process gas side to allow direct gas flow to the TEG contactor/ gas dehydrator in the event the wet gas cooler is not operating.

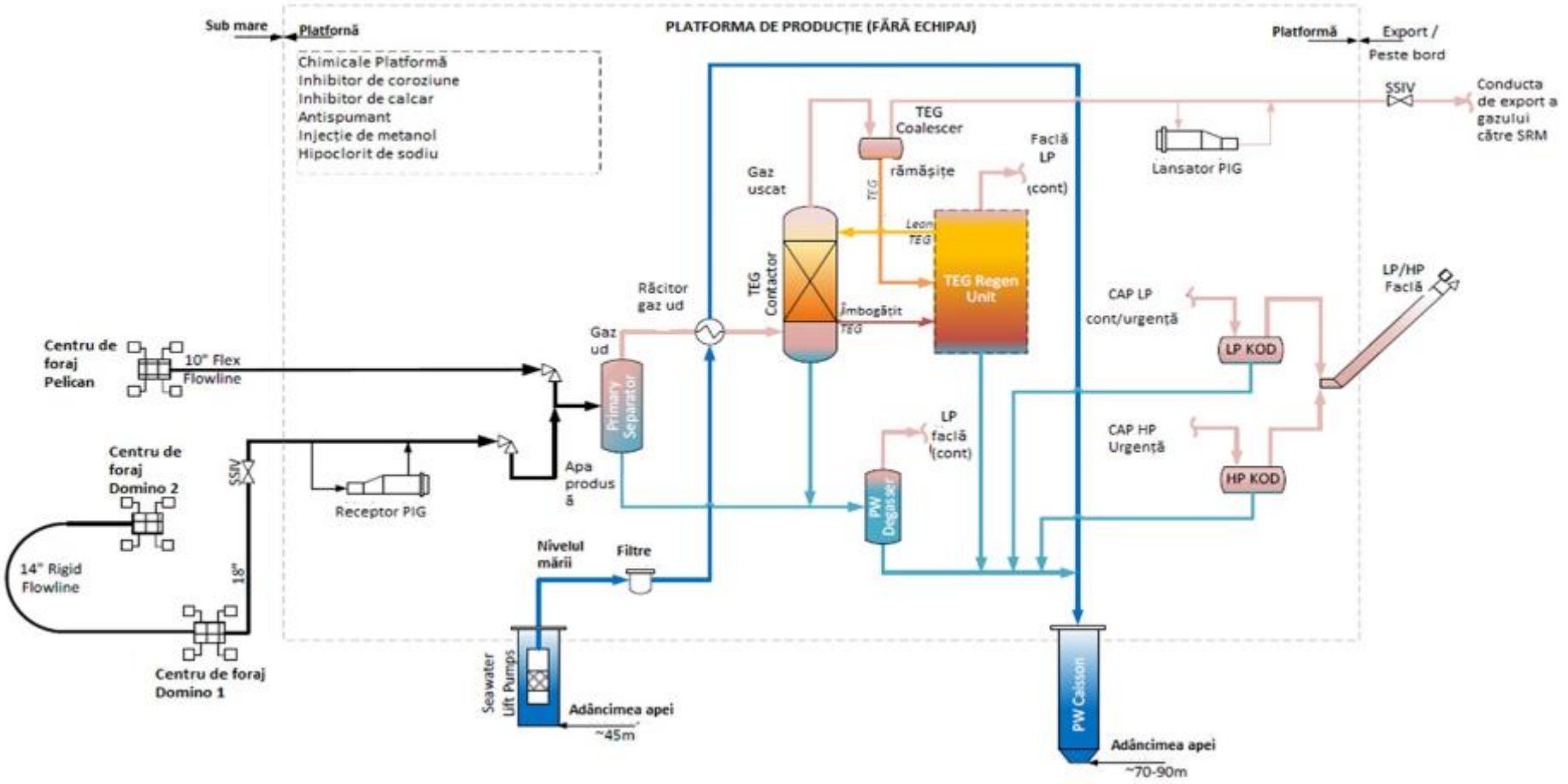

Figure 2.12 Simplified process flow diagram

d) Dehydration/ drying of gases

The product gas from the inlet separator is dehydrated/ dried in the TEG unit using lean TEG. Lean TEG absorbs water during the dehydration process and becomes glycol rich TEG. The water-rich TEG stream is regenerated in a conventional glycol regeneration system. For system start-up and initial filling, the lean glycol is stored in the TEG storage tank with a storage volume of 200 $m^{3,}$ installed in one of the legs of the jacket.

The TEG contactor uses a "chimney" tray arrangement to direct the gas upward while preventing the rich glycol from entering the vessel basin. A mist reducer is provided before the gas passes through the "stack" to remove any captured water droplets.

A return pipe from the stack will be used to control the level of leaked TEG, and the total volume held above the stack will be calculated to hold the entire TEG inventory of the package plus the liquid level at the high level alarm. In the event of an unplanned process shutdown, the TEG is prevented from entering the lower vessel by closing the TEG outlet.

A large capacity structured package with a top access glycol distributor will be used to ensure distribution throughout the structure so that there is no possibility of gas leakage through the TEG contactor.

In order to minimize the amount of TEG blocked in the gas flow at the exit from the contactor, two forms of liquid collection are provided:

- Buffer screen located at the top of the TEG Column to remove larger TEG droplets.
- A separator filter at the output of the TEG contactor. This is located downstream of the TEG contactor and will collect the finer TEG particles. The collected liquids will be directed to the regeneration unit of the TEG.

Dehydrated gas exiting the dehydration unit is routed through the subsea production pipeline to the onshore gas metering station and finally to the NTS for further distribution.

A wet gas analyzer is installed at the outlet pipe from the TEG Contactor. Process Safety Valves (PSV) alarm and trip systems will be fitted as appropriate to facilitate the safe operation of the system.

e) Regeneration of triethylene glycol (TEG)

The rich TEG from the degassing system exits is directed to the TEG regeneration system. The rich TEG is regenerated for reuse by low-pressure flash separation, heating, and fuel gas removal. The regenerated lean TEG is directed back to the gas dehydration system. Lean TEG from the storage tank will be added to the system to maintain optimal system operating parameters.

The TEG regeneration system is composed of (equipment listed according to the order of the technological flow):

- TEG Reflux condenser: mounted at the top of the TEG still column;
- Rich TEG flash tank (biphasic vertical separator);
- Rich TEG filters;

- Lean/ rich glycol heat exchangers;
- TEG still column (vertical) mounted on top of TEG reboiler;
- TEG Reboiler (horizontal) with electrical heater located inside;
- Electric resistance reheater TEG (4 x 200 kW) consisting of 4 bundles, each bundle with 33% excess elements (not connected to the power supply) required as spare;
- Gas Stripping Stahl Column (vertical);
- Lean TEG Surge Vessel (horizontal drum);
- Lean TEG pumps;
- Lean TEG air cooler: combined unit with reheater exhaust air cooler using common fans; during normal operation only one fan will operate; both fans will operate during peak periods;
- Reboiler Vent Air Cooler: combined unit with TEG air cooler using shared fans;
- Reboiler Vent Knock Out Drum: vertical 2-Phase separator with outlet connected to low pressure flare.

The TEG regeneration unit is a package unit. All of the above equipment and associated piping is included within the unit skid, except for the reboiler vent knock out drum, which is outside the skid.

In the rich TEG inlet line to Regeneration unit, a hand control valve is used to reduce the pressure down to rich TEG Flash Drum operating pressure of 6 barg (from 125 to 75 barg in gas dehydration unit). The rich TEG is pre-heated in the TEG Reflux Condenser (located at the top of TEG Still Column) by heat exchange with the vapor from the TEG Reboiler. From the condenser, the rich glycol flows to the rich TEG Flash Drum, where the glycol is flashed to remove any dissolved gases to Low Pressure (LP) Flare Header. Rich TEG Flash Drum is to liberate the residual gas and formation water that were dissolved in the TEG during gas drying process by depressurization and heating. Note that there is no hydrocarbon liquid present in the production fluids and hence no liquid hydrocarbon is expected in the TEG Regen system. Hence no hydrocarbon separation system is provided in the Flash Drum and also no charcoal filters required for hydrocarbon adsorption. However, the TEG system is a closed loop where decomposition and corrosion residues could accumulate. The rich TEG from the Flash Drum flows through Glycol Filters to remove any solids/impurities larger than 5 microns size. Two filters are provided, one for operation and the other in standby.

After the Glycol Filters, the rich glycol is heated further in the Lean/Wet Glycol exchanger by cross exchange with the hot lean glycol coming from the TEG Reboiler. After the Lean/Wet Glycol exchanger, the rich glycol flows to the TEG Still Column where the water is removed from the glycol through distillation. The Still Column operates at approximately 0.5 barg. The temperature is 204°C at the bottom of the still and vapor leaving the TEG Reflux Condenser is controlled to ~100°C by the flow of cold Rich TEG through the cooling coils and its bypass. The non-refluxed vapor not condensed by the overhead condenser is sent to Vent Cooler. This cross exchange cools

the column overhead vapors providing reflux in the Still Column to minimize glycol losses. Liquids from the Still Column flow to the glycol Reboiler located at the bottom of the Still Column. The TEG Reboiler uses Electric Heaters to heat and vaporize the water from the glycol. The temperature in the TEG Reboiler is kept at 204 °C.

From the TEG Reboiler, the lean glycol flows via an overflow pipe to the Gas Stripping Stahl Column. In the column TEG flows counter current to a small amount of stripping gas (fuel gas) for final water removal. The required concentration of Lean TEG to dehydrate the gas is reached in this column. This stripping gas is taken from the LP Fuel Gas System and is preheated by flowing through a coil inserted in the TEG Reboiler. Excess stripping gas can cause high TEG losses in the TEG Still Colum and hence the flow rate will be controlled.

The bottoms of the Stahl column flow through the Surge Drum while the overhead returns to the glycol Reboiler. The Surge Drum feeds the Lean/Rich Exchanger where the lean glycol is cooled by cross exchange with the rich glycol. After the Lean/ Rich Exchanger, the lean glycol flows to the TEG Surge Vessel. This liquid flows by gravity. The TEG Surge Vessel provides a buffer volume for the circulating glycol and is used to maintain a suitable inventory of TEG in the system to provide reasonable operating time before TEG must be added to the system. It is also designed to hold sufficient Lean TEG volume and contain TEG volume displacement due to thermal expansion when the system is heated.

The Lean TEG is pumped from the TEG Surge Vessel by the Lean TEG Pumps through Lean TEG Air Cooler into the gas dehydration system. There are two Lean TEG Pumps with one operating and the other stand by. When the duty pump trips the standby pump will start automatically. The Lean TEG Air Cooler further reduces the temperature of Lean TEG for the gas dehydration unit injection. Note that Lean TEG supply temperature would be adjusted based on gas dehydration unit operating temperature and ambient temperature conditions.

The overhead non-refluxed vapor from TEG Reflux Condenser is sent to Reboiler Vent Air Cooler and then to Reboiler Vent Knockout Drum. The condensed water is separated and disposed via Produced Water Disposal Caisson. The separated gas from the top of the knockout drum is vented to LP Flare.

TEG Still Column Top/ Reflux Condenser overhead gas temperature is controlled by adjusting the bypass control valve around the condenser exchanger. Flash Drum liquid level will be controlled by a level controller and control valve provided in the liquid outlet. Flash Drum Pressure is controlled by pressure control valve located at vapor outlet. Reboiler Rich TEG temperature is controlled by heater element control. Fuel gas flow (stripping gas) is controlled by a Flow Controller in the fuel gas supply line. A minimum flow control is provided for Lean TEG Recirculation pump protection.

Lean TEG supply temperature controlled by the Lean TEG bypass control provided across Lean TEG Air Cooler. Surge Drum level is controlled by the on-off mode operation of Lean TEG Storage pump.

Pressure Safety Valves and Blowdown valves are provided for equipment/piping over pressure protection.

f) Gas transfer to shore

Downstream of the gas drying units, the combined treated gas stream is collected and transported to shore. A back pressure control valve is provided on the comingled flow to allow a constant pressure independent of pipeline filling, emptying or gas flow rate to the onshore NGMS. A dew point analyzer is fitted to ensure that dew point specifications are met as the gas exits the dewatering system to the pipeline. A small amount of gas is then taken to feed the fuel gas system on the platform before the remaining gas leaves the platform and is transported to shore via the production pipeline.

For the maintenance of the production pipeline, a single pig station is provided, sized to accommodate the largest pig for proper maintenance of this pipeline. Sufficient space will be allocated to allow loading of the pig into the pig station as well as the addition of an extension to receive an in-line maintenance and inspection system. The purge of the launcher is carried out from the nitrogen system. Gas from the gas drying system will be used to drive the cleaning pig.

g) Treatment of produced water

The liquid flow collected in the primary separator is estimated to be only in the aqueous phase. Both Domino gas and Pelican gas are very low in liquid hydrocarbons, and a hydrocarbon fraction is unlikely to exist in the liquid stream.

When starting the wells, the fluid stream may contain some non-aqueous drilling fluid, methanol and brine. Every time the well is shut-in/ restarted, methanol is injected into the process, which reaches in the liquid stream.

Aqueous fluids, normally condensate from the reservoir, with the potential for subsequent production of produced brine, are directed to the produced water degasser to allow the absorbed gases (methane and CO_2) to escape so that the final discharged water is clean and degassed. The water is discharged into the sea through the produced water discharge caisson.

Filtration system

Oil Separation Flow Back Filters are installed downstream of the produced water degasser and upstream of the level control valves. The upper deck facilities are used to filter the well cleaning fluids that are transported from the wells. This operation may take several months as Domino is situated a considerable distance from Neptune Alpha and it may take time for all well cleaning fluids and any associated well completion fluids to reach the platform. It may also be the case that there is a staggered start-up of the reservoirs which results in an occurrence of wellbore fluids after start-up, although this would still be during the start-up period. Each filter can remove 99.9% of particles 50 microns and larger.

The produced process water circuit includes a pass through oil removal filters so that particles are removed from the water. In this mode of operation, the "treated" water is then directed to the open drain tank, where the oils in the water can be analyzed.

Well cleaning fluids are processed according to procedures using the open drain tank and then through the degasser.

The water flow load associated with the reverse flow oil cleaning process is sized only for the maximum water load produced from a single well. The presence of significant amounts of produced water at the beginning of field exploitation is not expected to be the same as the amount of fluid used to start the well.

Filters are installed for service/ standby to meet uptime and maintenance requirements. The instruments provided will indicate wheter blockages are occurring caused by particles (high differential pressure), so that the switching valves can be operated remotely to switch the flow to the designated backup unit.

Isolation around each set of filters allows maintenance activities to be carried out.

Produced water degasser

The produced water degasser provides pressure reduction for gas desorption and separation before the water is discharged to sea via the produced water discharge caisson which is sized and configured to handle normal and abnormal operating events. These are:

1. Normal water flow is expected to be low, associated with:
    - Condensed water associated with gas production;
    - Produced water up to a maximum equivalent of 10 barrels per MMSCF.

2. The flow of water associated with running pig operations in the flow from Domino

The system of the produced water degasser is connected to the low pressure flare system (LP Flare), therefore the degasser is designed to operate at a pressure that matches the pressure of the LP Flare system. The vessel is oriented and sized so that it can operate on a liquid flow basis using static liquid pressure when the LP Flare system pressure is at atmospheric.

Level control is provided so that during an emergency depressurization event within the LP flare that results in increased system back pressure, there is no liquid loss event that results in a gas release into the produced water discharge caisson.

Liquid retention times are based on the maximum produced water flow and may deviate from the liquid retention times specified in the process design requirements. A review of the safety time of the process, in terms of closing the liquid discharge valve and the response of the level control valves, considers the case of gas discharge through the liquid outlet.

The vessel is equipped with an internal cleaning system. The fluid will be provided by temporary installations.

The vessel includes instruments for measuring pressure and liquid level.

On the outlet line, the produced water degasser has an oil-in-water analysis system to meet uptime and maintenance requirements. The analyzer is installed downstream of all discharge lines that are routed to the produced water discharge sump so that water quality is confirmed prior to disposal. The regulated water discharge limit is 15 ppmv of oils in water.

The exhaust line downstream of the level control valve includes an exhaust pipe directed directly to the open drain tank.

Caisson of discharge of produced water

Technological water resulting from the degasification vessel, water collected at the open drain system and the water recovered from the flare separators, will be directed to the caisson vertical discharge into the sea. The caisson is equipped with a ventilation valve located on the line of entrance **The discharge head of the caisson in the sea is located at a depth of 90m, with a diameter of 500mm.**

g) Utilities

A. Chemical injection systems

The chemical injection system includes:

- Corrosion inhibitor tank with a volume of 21.5 m^3 ;
- Deposition inhibitor tank with a volume of 21.5 m^3 ;
- Antifoam tank with a volume of 14.4 m^3 ;
- Reserve tank with a volume of 14.4 m^3.

The injection system consists of a 4-compartment tank, one compartment for each of the identified chemicals, and injection pumps. The capacity of each compartment is sized to provide the necessary for 3 months, depending on the working level between 10% and 90% of the measured level. A supplement of 25% was added to the volume calculated on the basis of the certified capacity of 790 MMSCFD.

Antifoam chemical specifications require that the antifoam tank require a heater to maintain a temperature of no less than 5°C.

The top of each tank has connections for filling points. Chemical filling is done by gravity drainage from the tanks located on the upper deck and properly served by the platform crane. Color-coded chemical-specific couplings ensure that no chemical connections are mixed during feeding.

The chemical product injection tank and its couplings are located in a retention tank without grates, so that any leaks can be contained. The drum is sized to accommodate the chemical volume within the largest compartment. This is provided with a drain valve which is connected to the open drain system, as well as a connection point so that the drain can be collected in its entirety by means of a portable temporary pump.

The common tank includes a spare compartment. Nozzles are provided for all possible future connections, which are supplied shielded and sized similarly to the antifoam tank.

Each pump has facilities to allow calibration of the pump suction flow, and on the discharge side each has a pulsation damper, a safety valve (1 x 100%) and an exhaust facility, so that the safety valve will not lift in the absence of normal flow to the designed service. There are particles filters downstream of the pump discharge line to ensure that the delivered fluid is clean. The filter will remove 99% of particles that are > 50 microns in size.

B. Open drain system

All open drain operations are manual and require the presence of the offshore operator. Automation of these systems is not permitted. Drainage is carried out in the open drain tank.

The upper deck is equipped with drainage channels. These sections collect rainwater in catchment areas sized for storm events.

Drains from the helideck are directed directly to the open drain tank without interconnection with the deck drains. The helideck drain line is sized for free venting with an automatic three-way valve so that during normal operation rainwater can be directed to the produced water caisson.

The outlet of any "free vent" drain connection includes an elbow and grid to prevent rainwater ingress and bird nesting.

B.1 Drain tank open

The open drain tank is located in one of the legs of the Neptun Alpha Platform. It is operated at atmospheric pressure and is therefore an "atmospheric" tank, although it will withstand static water pressure maintained at maximum liquid level.

B.2 Open drain pump caisson

The open drain caisson pump is adjacent to the drain tank, with a connecting pipe between the two, installed at the lowest possible elevation in the open drain tank.

A vent line similarly connects the air space above the maximum fill level in the open drain tank to that of the open drain pump caisson. The size of this line ensures that suction occurs without the pressure exceeding the design pressure of the caisson. The caisson is designed to take static water pressure maintained at maximum liquid level, plus a system design pressure of less than 0.5 barg to negate any PED requirements.

The open drain pump (1 x 100%) is installed in the open drain pump caisson below the bottom flange of the open drain tank. The height ensures that the pump is always submerged and that there is sufficient liquid column above the low pump liquid level. The open drain pump is dimensioned so that it can process the maximum flow of rainwater or 11 m^3/h, whichever is greater. The open drain pump is installed in the upper part of the tank and can be recovered, hydraulically with lifting units located on Neptun Alpha.

The discharge pipe for the open drain pump is in the produced water discharge caisson. An analysis system provided on the outlet line monitors the presence of liquid hydrocarbons in the discharged water. The discharge line has a discharge connection to FSVs (support vessels) for the discharge of contaminated water, for transport and treatment ashore by authorized economic agents.

C. Methanol system

Methanol is supplied from a common storage and feed system to three separate operations. As such, there are three separate methanol pump systems.

- Upper deck operations
- Riser and SSIV operations.

- Underwater – wellhead and manifold operations

Methanol injection is not normally continuous. It is only required during well start-up, shut-in and restart operations.

The methanol storage tanks are located in the legs of the Neptun Alpha platform jacket. The total volume of methanol stored on the platform is approximately 432 $m^{3.}$ This is to provide methanol for shutdown, well restarts and any upper deck requirements. The methanol volume must be verified as sufficient to provide 2 field shutdowns and 3 cold restarts (10 wells) at any point during the production life before requiring methanol refilling.

Methanol is loaded through the FSV (support vessel) using a self-threading hose connection and a suitable coupling for connection to the FSV.

The methanol storage tanks have level sensors so that the level in the tank is indicated both locally and at the CCR. The methanol level can also be monitored by operators during fueling operations. An audible alarm warns the operator of a possible overfill.

Each methanol storage tank has an adjacent methanol storage caisson with an internal methanol pump rated at 15 barg. The pumps are sized so that any one of them can process a maximum methanol injection flow rate of 11 $m^{3/}$h.

Each platform methanol storage pump. Vent and bleed connections, along with a gas detection valve allow confirmation that the caissons have been adequately vented before safe opening takes place.

The methanol pumps are configured as 2x100%, with the flow from the service pump directed to the methanol prefilters. These are cartridge type filters with top opening flanged ends so the internal cartridge can be removed and cleaned. Methanol prefilters each have:

- 1 x 100% safety valve.
- Drain connections for methanol recovery.
- Local vent valve.

Remotely operated directional valves are provided on the inlet of each prefilter so that the run/ standby arrangement can be activated when a dirty filter is detected.

High-pressure methanol injection pumps, operating at 320 barg, provide a methanol purge to the jumper connections between the breakout heads and manifolds during a controlled shutdown of the subsea production system. Methanol is required in this process because the jumpers are not served by the direct electric heating (DEH) (Domino) or electric heating (EH) (Pelican) system and would otherwise be vulnerable to hydrates formation.

High-pressure methanol is also required upstream of the subsea nozzles at start-up while the wells are heating up and to equalize the pressure across the bottom safety valves (DHSVs) to allow them to open.

The methanol injection pumps and SSIV are configured as 2 x 100% and operate at 144 barg.

The methanol injection pumps on the platform are configured as 2 x 100% and operate at 105 barg. The pumps are sized to meet the maximum service identified for platform operations. These are:

- Wet gas cooler - supercooling on startup.
- Operational evacuation – primary separator.
- Hydrate inhibition, only at Domino.

D. The Flare System

Neptun Alpha has two separate flare systems:

- Low pressure system (LP Flare): gas arrives from all overpressure sources from upstream equipment with design pressure not higher than 45 barg; plus low flow/ inventory operational emissions from process plant that cannot tolerate excessive variable back pressure.
- High pressure system (HP Flare): gas arrives from all overpressure sources from upstream equipment with a design pressure greater than 45 barg; plus high flows from pressure control functions that are part of the process start-up system and short-term operational interruptions.

Each of these systems is completely independent of the other.

D1 Low Pressure Flare System (LP Flare) - Design

The low pressure flare system is designed to incorporate operational low pressure (wet gas) sources. Platform overpressure protection ensures that no liquid discharges are allowed into the LP combustion system. The exception to this is the discharge of rupture disks from the wet gas cooler.

Sources associated with LP flare are routed to a KO tank dedicated to the LP flare. All liquid collected in this KO tank is directed to the produced water degasser, which is then directed to the produced water discharge caisson

The KO reservoir is sized for maximum gas flow and is designed so that no liquid droplets larger than 450 microns are present in the updraft directed to the flare.

D2 High Pressure Flare System (HP Flare) - Design

Sources associated with HP Flare are directed to a KO tank related to the HP Flare. All liquids collected in this KO tank are directed to the produced water discharge caisson based on the absence of liquid hydrocarbons.

The canister filter is sized for maximum gas flow and is designed so that no liquid droplets larger than 600 microns are present in the exhaust stream directed to the flare. This is based on a sonic peak where droplets are expected to be atomized.

D3 The structure of the Flare, the Peak of the Flare

The flare system includes:

- A common support arm for the HP and LP flare on the East side of Neptun Alpha.
- HP flare tip
- LP flare tip

The HP tip is a type of sonic equipment, so the back pressure generated in the flare boom results in practical sizing of the flare column. HP and LP flare tips are at a common elevation of 105 meters above sea level as determined by boom length evaluation, flame radiation and standard performance criteria;

The HP flare tip is designed for a maximum flow of 950 MMSCFD.

The LP tip is designed for the maximum identified overpressure emergency release scenario. This is identified as the gas flow entering from the primary separator to the produced water degasser.

The reduction flow rate is defined as the lowest flow rate at which the selected flare tip will operate while maintaining sonic flow conditions. Flow below this level is subsonic, where reduced air entrainment can result in incomplete combustion. The LP flare is a type of subsonic equipment because it must maintain a low back pressure during the low flow exhaust period.

Gas for the flare pilot systems is taken from the low pressure fuel gas system. Both HP and LP flares use the same pilot gas ignition systems. The primary pilot gas ignition source uses a high energy electric spark system capable of multiple ignition attempts. There are flameout detection sensors that monitor HP and LP pilot gas ignition.

There is no rigid duct interconnected atmospheric ventilation system. Equipment is provided with local air vents where practical and safe.

The flare structure includes a vertical access ladder similar to the ship type ones from deck level to the top, complete with rest platforms every 10m, fall arrest system and lockable swing gate to platform deck access.

E. Fuel gas supply system

The fuel gas system takes dehydrated gas at sale quality from the export line. Fuel gas is supplied from high-pressure gas and to users from low-pressure gas:

- Gas turbine power generators (GTG) – high pressure.
- Flare Pilots – low Pressure.
- Flare manifold bleeds - low pressure.
- Cover gas for methanol and lean TEG storage - low pressure.

The fuel gas is preheated by an electric heater to prevent low temperatures and ice formation in the fuel gas filter due to Joule-Thomson cooling; and to ensure that the fuel gas is supplied according to the operating specifications of the GTG (at least 15°C above the dew point of water at 30 barg).

The fuel gas filter is downstream of the fuel gas superheater and the pressure relief control valve. The fuel gas filter can trap any liquids that may have condensed out of the gas phase. All liquids are directed to the rich TEG vapor reservoir.

F. Technological air

A permanent air generator will not be provided on the platform, but rather a temporary supply of utility air will be provided when required. Hose reel connections provided with disconnect couplings provide quick release in the event of an uncontrolled disconnect.

Neptun Alpha has a technological air distribution system with hose stations located on each deck. A connection is provided to supply a portable air compression unit.

Compressed air is not used on the Neptun Alpha platform.

G. Technological water

Neptun Alpha has a technological water distribution system with hose stations located on each deck. The distribution pipe is dimensioned based on a required flow rate of 10 m^3/h for two utility stations that will be running at that time.

The technological water is fed from the FSV. Hose reel connections to FSV supplied with disconnect couplings provide quick release in the event of an uncontrolled disconnect.

H. Nitrogen cylinders

Nitrogen pressure cylinders along with a distribution network are intended to facilitate the purging of equipment such as pig stations. Neptun Alpha has a nitrogen distribution system with hose stations located on each deck. Nitrogen is supplied in cylinder racks accessible by crane on the upper deck.

I. Hydraulic drive system

There are three separate hydraulic power units (HPUs) on the platform with different fluid types to suit the services. HPU tubing is fully welded except for mechanical joints where maintenance is required.

I1 Underwater system

The subsea system is designed with a vent where the used fluid is locally vented into the sea when the valve is closed, along with reduced leakage from the subsea control modules (SCM) A water-glycol based hydraulic fluid is selected for the subsea HPU to minimize the environmental impact when discharged into the sea.

HPU system feeds both the HP and LP systems in the Domino and Pelican fields through umbilical connections. There is redundancy within each umbilical in case of future damage to the hydraulic

fluid core. The HP supply has a design pressure of 690 bar and the LP supply has a design pressure of 345 bar. Pump flows are sized to meet the requirements of the subsea control system. No platform valves or SSIVs are connected to the HPU system that serves underwater equipment.

I2 Platform and SSIV

The SSIV system is a direct hydraulic system for the SSIV, where the return is received through the same line in a "pressurize to open, depressurize to close" configuration.

The surface side of the upper function and SSIV HPU is a closed circuit where the return is accepted through dedicated recirculation lines or grouped into a common recirculation header. Return fluids are collected in a dedicated return tank, separate from the supply tank. The return fluid is cleaned and renewed before being transferred to the supply tank.

The platform HPU and SSIV provide a stable supply of clean hydraulic fluid to SAE AS4059 Rev F Class 6 at a design pressure of 228 barg (operating pressure 207 barg). The hydraulic fluid is a water-glycol based control fluid of the same type used in the underwater control system.

I3 Caisson pumps

The HPU caisson pumps consist of a single tank, 2 x100% service pumps, a cooler and a filter. The service pumps are of the rotary type, with the ability to recycle back into the tank without operating any particular pump.

The system operates at a minimum temperature with power from the service pumps providing the necessary heat to reach that temperature in the HPU tank before initiating drive to any of the caisson pumps. An air cooler provided on the return line prevents overheating once the required temperature is reached.

A built-in filter in the circulation path keeps the system clean.

The four caisson pumps are 2 methanol storage pumps, 1 open drain pump and 1 TEG storage pump. Each of these pumps is located in the attached caissons to the jacket legs and used to lift fluids stored in the associated jacket leg.

J. TEG storage

The TEG storage tank stores TEG for startup and topping up during normal operations. The additional capacity accommodates the total volume of TEG inventory in the dehydration and regeneration system in the event of a requirement.

Lean TEG is provided by FSV. The Neptun Alpha has a dedicated self-tapping hose connection and coupling for connection to the FSV when the TEG is supplied/ refilled.

The lean TEG storage tank is equipped with a level sensor for both local readingand CCR. An audible alarm shall be provided to alert the operator of possible overfilling.

The tank has a depressurization valve (1 x 100%). It also has a low pressure propellant blanket gas with inlet/ outlet breath control functionality.

K. Sea water supply system

The seawater supply system for the wet gas cooler consists of seawater lifting pumps and coarse filters.

The pumps are installed in caissons, each including an appropriately sized vent. The length of each pump reflects the NPSH requirement concurrent with the worst wave. Seawater lift pumps are equipped with a hypochlorite dosing ring to inhibit algae and other marine growth in the seawater supply system.

The seawater lift caisson is designed to be freely vented so that air entrainment does not occur in the discharged seawater.

The wet gas cooler also has a dedicated return line separate from the outlet line from the produced water degasser so that gas leak detection can be provided on the free vent line to detect any failure of the wet gas cooler (hole tube leak detection).

K1 Seawater lifting pumps

2 x 100% seawater lift pumps (1 active and 1 standby) are installed to ensure reliable operation of the wet gas cooler. Centrifugal pumps are sized for the pressure drop through the cooling water filter and respective pipes.

The pumps are designed to suit the requirements of the cooling system and are mounted in caissons (stainless steel, internally insulated), each including an appropriately sized vent. Each pump provides sufficient NPSH, simultaneously with the most unfavorable tide (assumed to be 12 m below LAT).

K2 Hypochlorite dosing system

Seawater lift pumps are equipped with a hypochlorite dosing ring to inhibit algae and other marine growth in the seawater supply system. Hypochlorite system includes a hypochlorite generator plus a backup generator and a buffer tank to allow a continuous dosing rate of 1-2 ppm and a shock dosage rate of 4-6 ppm (about 1 hour per day).

The common seawater return line from the wet gas cooler, the cooling water filters and the minimum flow from the seawater lift pumps include an analyzer to measure the concentration of free chlorine in the returned seawater.

L. Diesel system

Diesel is fed from the FSV and stored in a dedicated tank in the crane pedestal. Diesel is supplied in day tanks for diesel generators and also for TEMPSC. A diesel pump is provided to circulate the diesel from the pedestal storage through a coalescer and back to the pedestal storage to clean any marine/ biological matter from the supplied diesel. The diesel supply line is sized at 4” to cover flows of up to 50 m^3/h.

The diesel storage capacity is determined to meet the needs of all diesel users taking into account operating time and operational intervention visits. The tank capacity has sufficient working

volume to operate the generator for 5 days at 75% of maximum load, plus to operate the generator for 6 hours every 2 weeks at minimum stable load. The calculated workload takes into account a normal replenishment period of 3 months.

Sufficient free space in the tank allows breathing during replenishment operations, and the working level exceeds the lower volume in which the settled water phase accumulates at the bottom of the tank.

A diesel storage tank level sensor provides both local reading and CCR. An audible alarm will alert the operator of a possible overfill.

The diesel fuel storage tank has a vent pipe that functions as a vent for fueling operations

A pump provides diesel fuel to any users for which gravity feed is not possible (eg essential generators). A local sump at the pump and coalescer filter directs any leakage/ spill to the drain system. The holding tank incorporates an isolation valve that can be connected to a hose for temporary pump evacuation.

The diesel fuel supply to the TEMPSC uses a hand gun system and an isolation valve located locally on the TEMPSC.

M. Electricity production system

The electricity production system is presented in paragraph 2.2.7.4.

N. Instrumentation, Control and Telecommunications

Telecommunications and security systems is presented in paragraph 2.2.7.7

N1 Navigation equipment

Neptun Alpha has a navigation system (NAVAIDS), according to IALA requirements for marking offshore platforms, making it more visible to passing maritime traffic.

The package is equipped with lanterns, fog horn, photoelectric cells and fog detector (visibility meter). It includes warning lights (off-wave) for both the helideck and W2W gangway to warn when Neptun Alpha cannot be safely accessed. The warning lights are visible to all approaching aircraft and marine vessels and transmit a high-visibility flashing red beacon with equal marking space.

The NavAids system is integrated with the ICSS system so that the (onshore) CCR operator is alerted to any system failure.

The system must have a dedicated DC UPS to ensure continuous operation for a minimum of 96 hours with all equipment operating under normal conditions. The battery charger for the system is provided via the AC UPS.

N2 Obstacle warning lights

Aviation obstacle lights are installed on the high points of the platform, including the crane cabin and crane boom.

The crane boom and other elevated structures (excluding the flare support boom) are equipped with aviation obstruction lights on each third of the total height of the obstacle. At least one light on each level is visible in all directions.

Aviation obstacle lights are steady-state, low-intensity, omnidirectional red lights.

The flare is illuminated by projectors in the deck area.

N3 Helideck Lighting

Helideck lighting includes:

- Perimeter lights.
- Landing Position Marking Circle (TD/ PM) and Helipad Identification "H" Marking.
- Status alert lights.

The entire lighting system of the Helipad is LED.

The perimeter lighting is evenly distributed around the Helipad with a maximum distance of 3 m between the lighting fixtures. The lights are green with defined intensity, color and chromaticity.

The lighting arrangement supports the helicopter pilot for the approach and landing of the aircraft.

2.4.1.2 Description of onshore production processes

After processing the natural gas at Neptun Alpha Platform to meet commercial specifications for gas delivery, the gas production pipeline will transport the gas to the onshore NGMS for metering prior to deliver to the downstream Transgaz pipeline feeding the NTS.

The NGMS will include a combined flow and pressure control system to control gas deliveries into the NTS. The control of the gas volumes transferred to the NTS will be carried out using the two control valves installed in the NGMS , downstream of the measuring equipment.

Three electric heaters with a total power of 6.0 MW are used. The heaters are equipped with local control panels with PLC and installed in the LER (Local Equipment Room) of the heaters, which will control the power of the heaters in order to maintain the commercial requirements for the natural gas delivery (minimum 3°C).

Hydrocarbons will not be processed within the NGMS. Separation and processing of the natural gas will be carried out at the offshore production platform, before transportation through the production pipeline to the NGMS. An inlet filter/ separator equipped with level switches, alarms and manual discharge valves will be installed within the NGMS to protect the NGMS meters from potential small amounts of water sent to the NGMS as a result of process failures that may occur within the production platform.

A pig station will be installed at the entrance to the NGMS to facilitate in-line inspection and maintenance of the production pipeline. The pressure (design pressure and maximum working

pressure) of the NGMS piping and associated gas handling equipment shall correlate with the nominal pressure of the production pipeline. The design of the pig station will allow for use in the reverse direction as this may be required for pipe dewatering activities during the test phase prior to commissioning.

The design of the NGMS pipelines includes measures to allow the "temporary" receipt of gas from the NTS to support the commissioning activities of the offshore production pipeline and the Neptun Alpha Platform during the initial operational phase of the project. For the measurement and fiscal accounting of gas volumes received from SNT, a temporary quality meter dedicated to custody transfer equipped with a moisture analyzer and gas chromatographic equipment, will be installed on the reverse pressurization line.

The Custody Transfer Metering Skid ensures the measurement of export gas in the national transport system (SNT). This is a quantitative and qualitative measurement equipment that consists of standard and commercially available components. The measuring unit will be equipped with 5 (N+1) ultrasonic flowmeters and a turbine flowmeter which will be installed in series with the ultrasonic flowmeters. 4 of the 5 ultrasonic flowmeters will be selected as active, while the fifth will be redundant.

The turbine flowmeter shall have a maximum flow capacity equal to that of an ultrasonic flowmeter and shall be used as the reference flowmeter for measurement.

An online gas chromatograph and moisture analyzers will be installed on the metering unit to check the quality of gas delivered to or received from the SWP.

CCR will serve as the main operations control center for all Neptun Deep project facilities (subsea systems, production platform, production pipeline and NGMS). The CCR will house the equipment for remote monitoring and operation of the project facilities.

Flow diagrams for the technological process are presented in Annex C

2.4.2 Description of the types and quantities of raw materials and energy required for the construction and operation of the project, including information on the implications of the extraction of raw materials on the environment, respectively the efficiency and sustainability of the use of energy and raw materials;

Natural resources (e.g. freshwater, seawater, wood, etc.), mineral aggregates (e.g. sand, gravel, limestone, bentonite, etc.), construction materials (e.g. concrete, geotextiles, and other project-specific construction materials), energy, fuels, chemicals, and other project-specific materials and products will be used during the construction and operation of the project.

In order to ensure optimal conditions for the protection of environmental factors and the health of the population, all hazardous chemical substances and preparations that will be used will be labeled and stored properly, in specially provided containers/ tanks and in specially designated spaces, with restricted access and the provision of all necessary protective measures.

2.4.2.1 Description of the types and quantities of raw materials and energy required for the construction of the project

When carrying out the project, raw materials and materials will be used, in accordance with the regulations and national standards in force, they will be used within the works designed according to the stages that will be carried out.

The main raw materials used during the preparation and organization period will be mineral aggregates, which will be transported from the nearest quarries authorized by NAMR. The other materials used in this stage will be provided by specialized units.

The chemicals will be used for hydrotesting the pipelines. The means of transport will be refueled in distribution stations and not on site, and the oil change will be done in specialized units.

The raw materials/ materials used in the construction of the project are the following:

Table 2.22 List of raw materials/ materials used in the construction of the project

No.	Raw material	M.U.	Total quantity
1	Crushed stone	m^3	62,615
2	Ballast	m^3	9,665
3	Sand	m^3	2,025
4	Filling material	m^3	24,162
5	geotextile	m^2	48,325
6	Fixing gravel	m^3	4,714
7	Concrete	m^3	1,945
8	Concrete steel	T	645
9	Concrete	m^3	1,945
10	Drilling fluid (microtunnel)	t	820
11	30-inch pipeline (gas production pipeline)	m	160
12	Fiber optic cable	m	160
13	14-inch pipe (Supply/ supply pipe)	m	10,500
14	18-inch pipe (Supply/ supply pipe)	m	26,000
15	10.75 inch-inch pipe (Supply/ supply pipe)	m	1,500
16	Domino umbilical system	m	36,500
17	Pelican umbilical system		1,500
18	Microtunnel pipe Dn 1500 mm	m	890
19	Protection pipe CFO Dn 300	m	890
20	Metal pipe undercrossing protection Dn 965 mm	m	80
21	Underpass protection metal pipe Dn 508 mm	m	80
22	Prefabricated tiles used for the temporary crossing at CF level	pcs.	46
23	Fuel (diesel)	m^3	33,745
24	Ship fuel	m^3	31,657
25	Paint	m^3	0.20
26	Diluent	m^3	0.03
27	Hydrosure™ HD-5002	m^3	35.0
28	Chemicals used in pipeline hydrotesting*	kg	18.5
29	Chemicals used to start wells*	m^3	2295
30	Sacrificial Anodes	pcs	1285

**The list of chemical products used in construction is presented in Annex G, G2*

The table below shows the main raw materials and materials used in the execution phase of drilling works, as well as their estimated consumption.

Table 2.23 List of raw materials and materials used during well drilling

No.	Raw material	M.U.	Total quantity
1	Water based drilling fluid	m^3	72,678
2	Non-aqueous drilling fluid	m^3	22,274
3	Cement	tons	8,600
4	Cement additives	liters	369,812
5	Combustible	tons	40,000
6	Helicopter fuel	tons	76.5
7	Ship fuel	tons	131,250

The drilling fluid will be supplied ready prepared, transported to the drilling rig with support vessels and will be unloaded on the drilling rig. Here the conditioning of the drilling fluid will be carried out according to the needs.

Tubing columns are metal columns of different sizes with a role in isolating the processes in the well from the geological layers crossed. They will be stored on the special ramps of the drilling rig. The following types of columns will be used:

- 36-inch (914.4 mm) pipe string:
- 22-inch (558.8 mm) pipe string:
- 13-3/8 inch (339.72 mm) tubing string:
- 10-3/4 inch (273.05 mm) tubing string:
- 5-1/2 inch (139.7 mm) base filter:

The list of chemical products and additives used for the production of drilling fluids are presented in annex G -G1.

The volume of water required during construction is presented in table 2.25

Table 2.24 Volume of water used in the construction stage

No.	Project component	M.U.	Total Volume
1	**Works on land, of which:**	**m^3**	**12,800**
	Water used for domestic purposes	*m^3*	*2,300*
	Microtunnel construction (including for production of drilling fluids and hydrotesting)	m^3	*8,000*
	Construction work, concrete making, surface spraying, wheel washing	m^3	*2,500*
2	**Works at sea, of which:**	**m^3**	**195,015**
2.1	***Well drilling***		**98,000**
	Water used for domestic purposes	*m^3*	*44,000*
	Sea water for the preparation of drilling fluid	*m^3*	*40,000*
	Sea water for the preparation of cement paste	*m^3*	*10,000*
	Sea water for the preparation of non-aqueous drilling fluid	*m^3*	*4,000*

No.	Project component	M.U.	Total Volume
2.2	***Construction/ installation of large components of the project***		***97,015***
	Water used for domestic purposes	*m^3*	24,500
	Sea water for pipe testing	*m^3*	*72,441*
	Preparation of umbilical system fluid	*m^3*	*74*

2.4.2.2 Description of the types and quantities of raw materials and energy required for the operation of the project

The chemical products used during the operation period are presented in the table below:

Table 2.25 List of raw materials and materials used during the operation period

No.	Name of the chemical product	M.U.	Amount
1	Methanol	m^3/ well	16
2	CORR12452A	m^3/ year	132
3	SCAL13370A	m^3/ year	26
4	AFMR20400A	m^3/ year	41
5	Triethylene Glycol	-	N/ A
6	Sodium hypochlorite	m^3/ year	5.8
7	Pelagic 100 H	m^3/ year	7
8	Fuel	t/ year	38.5
9	Natural gas for generators	t/ year	19,718

The chemical products used during the operation are presented in Annex G-G3.

Drinking water will be provided from commercial sources (bottled water) being brought from the shore.

During the operating period, quarterly routine maintenance works are planned to be carried out. Considering an average number of 40 people, 15 working days/ each campaign and a water consumption of 250 liters/ day/ person, it was estimated that a total volume of approximately **680 m^3/ year** of fresh water is required during the performance of routine maintenance works.

In addition to routine maintenance planned quarterly, major maintenance campaigns will occur regularly every 4 years for the life of the project. Considering an average number of 40 people, 7 working days/ each campaign and a water consumption of 250 litres/ day/ person, it was estimated that a total volume of approximately **80 m^3/ year** of fresh water is required during the performance of major maintenance works.

As part of the cooling system, two seawater lift pumps (1 in service and 1 standby) are installed to ensure reliable operation of the wet gas cooler, and they are equipped with a hypochlorite dosing ring to inhibit the growth of marine vegetation in the seawater supply system. This operation required up to 317 m^3/ h for maximum 20 years.

The estimated annual volume of sea water required for this operation is 2,766,920 m^3/ year.

2.4.2.3 Information regarding the implications of the extraction of raw materials on the environment, respectively the efficiency and sustainability of the use of energy and raw materials;

As presented in the point above, natural resources, raw materials and mineral aggregates will be used during the drilling of the wells and the construction and installation of the onshore and offshore infrastructure.

Indirect effects generated by the transport of natural resources, raw materials and mineral aggregates from the site of origin to construction sites can include air emissions, noise and vibration and the generation of waste. A temporary increase in local traffic may be generated during the construction phase due to vehicles/ trucks used to transport raw materials to the onshore construction site or shore base of Port Constanța. In order to minimize potential disruptions in the project area, road transport of raw materials and natural resources will be carried out on approved heavy vehicle traffic routes using main local and regional roads (eg national road DN39). The access of vehicles transporting raw materials from the national road DN39 to the project area on land will be ensured through the new access road to NGMS and CCR without the need for access to other local roads present in the site area (communal road DC4, local), exploitation roads (De277, De259/ 4 and De269).

Water required for onshore construction works will be delivered by water trucks from water sources operated by the regional water supplier. The need for fresh water for the development of the offshore project will be provided by construction/ installation vessels fed from authorized water sources in the Port of Constanța.

The raw materials and mineral aggregates will be brought from authorized economic operators with sufficient production capacities, located within the radius of Constanta county at less than 100 km (depending on availability) for better efficiency and to reduce the impact on the environment due to the emissions of transport equipment. Materials will be loaded from the extraction site and transported by authorized vehicles to the onshore construction sites or port logistics base and then on board the offshore construction/ installation vessels.

The general criterion used in the selection of materials is based on the minimization of costs over the entire life cycle (capital and operating costs), ensuring the design duration of the expected production and compliance with the construction schedule.

The production processes of the project will not require the use of fresh water. The Neptun Alpha platform is normally an unmanned platform and this eliminates the need to install a water system at the SWP. Fresh water requirements at the SWP will be limited and will only occur while personnel are arriving at the SWP in case of emergencies and for scheduled operations and maintenance, with water provided by support vessels.

The NGMS was designed as a stand-alone, normally unmanned facility with no water requirements. The CCR building will be a stand-alone building that will be permanently staffed. The limited number of permanent staff requires a minimum consumption of water for domestic use.

2.4.3 Identification and quantification of hazardous chemical substances and preparations during drilling, construction and installation, operation and decommissioning of the project;

2.4.3.1 Identification and quantification of dangerous chemical substances and preparations during drilling and construction

The chemicals required for the construction of the onshore components and the construction/ installation of the microtunnel (eg, lubricating oils, paint, thinners, etc.) will be purchased from authorized suppliers and temporarily stored on the onshore construction sites.

The chemical products required for well drilling and construction/ installation will be purchased from authorized suppliers and temporarily stored at the logistics base in the port and transported to the drilling platform with support vessels. Chemicals will further be transported to offshore drilling and construction/ installation sites by specialist installation vessels.

All chemicals will be properly stored in dedicated storage areas on board the drilling rig and support vessels and will be handled in accordance with legal provisions and material safety data sheet requirements.

Lists of estimated chemicals to be used during well drilling and construction/ installation of onshore and offshore infrastructure are presented in *Appendix G. Lists of Estimated Chemicals.* The lists include information on chemical description, use, quantities, risk and hazard phrases, and safety and precautionary measures.

Other specific information related to the estimated chemicals is presented in each chemical's Safety Data Sheet attached to *Appendix H. Chemical Safety Data Sheets.*

2.4.3.2 Identification and quantification of hazardous chemical substances and preparations during operation

The main chemicals estimated to be used in the operation phase include diesel fuel for the onshore standby power generator, fuels for offshore operations and maintenance vessels, triethylene glycol for the gas dewatering system, injected chemicals for flow assurance (methanol, corrosion inhibitor, scale inhibitor)., antifoam, nitrogen to facilitate purging of equipment, hydraulic fluids for hydraulic units and minimal amounts of biocide for occasional cleaning of the open drain system (including storage tank).

The list and estimated quantities of hazardous substances used in the operational phase are presented in *Appendix G. Lists of estimated chemicals.* are presented in the Safety Data Sheet of each chemical product attached to *Annex H. Chemical Safety Data Sheets.*

2.4.3.3 Identification and quantification of hazardous chemical substances and preparations during decommissioning

Chemicals used in the decommissioning phase may include vehicle, vessel and equipment fuels, oils, lubricants, greases, and other typical chemicals required to perform the decommissioning/ abandonment work as available at the date of the decommissioning work. The full list and

quantities of chemicals and hazardous substances used/ generated during the decommissioning phase will be available upon completion of the decommissioning/ abandonment plan.

The chemical products will be purchased, transported, stored and managed in accordance with the legal provisions in force at the date of the decommissioning/ abandonment works.

2.4.4 Traffic generated by the transportation of raw materials, including natural resources, as well as the transportation of workers and visitors during drilling, construction and installation, operation and decommissioning of the project;

2.4.4.1 Transport of raw materials, including natural resources

The raw materials, including the natural resources (for example, water) needed during the life cycle of the project will be purchased and transported from economic operators within the Constanța county (depending on availability) in order to reduce the impact on regional and local traffic as well as the emissions generated by vehicles used to transport raw materials and natural resources to construction sites. Raw materials and natural resources will be transported by authorized vehicles to onshore locations or port logistics base and then on board support vessels that support the project throughout its life cycle (drilling, construction and installation, operation and maintenance and decommissioning).

Road transport of raw materials and natural resources will be carried out on approved heavy vehicle traffic routes, using the main local and regional roads (eg National Road DN39). The access of vehicles transporting raw materials from the national road DN39 to the onshore construction site will be ensured through the new access road to NGMS and CCR without the need for access to other local roads present within the onshore construction site (communal road DC 4, local roads). DE 277, DE 259/ 4 and DE 269).

A temporary increase in local traffic will be generated during the construction phase due to the movement of vehicles/ trucks used to transport raw materials to the onshore construction site or port logistics base.

During the operation phase, the traffic generated for the transport of raw materials is reduced.

An increase in regional maritime traffic in Romania's Black Sea basin will occur due to the presence of supply vessels/ barges used to transport raw materials (e.g. and natural resources (fresh water)) to offshore sites during construction, operation and maintenance, and decommissioning phases.

The Neptun Alpha platform will be accessible for normal operations only by maritime vessels. Quarterly routine maintenance work and major maintenance work (pressure safety valve periodical testing according to legislative requirements, annual coating maintenance, turbine overhauls every 5 years, multiple internal inspections of pressure vessels) will take place regularly during the life of the project.

Naval transport operations will be carried out from Constanța Ports using agreed routes for naval traffic.

2.4.4.2 Transportation of workers and visitors

Road transport of workers and visitors during the life cycle of the project (construction, operation, decommissioning) will be carried out on the main national, regional and local roads (eg National Road DN39). Access from the national DN39 to the NGMS and CCR sites will be provided via the new permanent access road that will be built to support the onshore components throughout their life cycle (construction and installation, operation, decommissioning).

Transport vehicles such as buses will be used to transport construction support workers to reduce the number of road transports and the effect on traffic during the onshore construction and installation of the project.

A limited number of transport vehicles will be used to provide daily transport of project facility operators to the NGMS and CCR site.

It is anticipated that the road transport of workers during the decommissioning phase will be carried out by buses, vans or other means of transport, depending on their availability on the date of the decommissioning works.

Access to the components from the sea during the life cycle of the project (drilling, construction and installation, exploitation, decommissioning) will be done by water from Constanța Port or by air (one of the two airports located in Constanța county, respectively the Tuzla and Constanța airports). The sea and air transport of workers will be carried out on specific routes approved by the authorities.

During transportation operations, marine vessels used to transport workers during the life cycle of the project will temporarily contribute to increased local and regional air and ship traffic. The helicopters will only be used in an emergency at the Neptun Alpha Platform and are not considered an important source of increased air traffic given their limited use.

2.4.5 Environmentally relevant social and socio-economic implications during drilling, construction and installation, operation and decommissioning of the project ;

The proposed objective of the Neptun Deep project is to develop the natural gas reserves in the Pelican South and Domino fields and deliver the treated gas to NTS in Romania. As a result of the implementation of the project, further connections to the national natural gas transmission system of new customers may occur due to the expansion of the natural gas NTS.

The project would generate a positive impact on the local and national economy and on the neighboring local communities. Additional revenues to the local budget will be provided through taxes and contributions necessary for the development of the project. The project can also contribute to the economic development of the area and represents an opportunity for the development of other investments and socio-economic activities within the project area.

The project can generate local and regional opportunities for the creation of new jobs and the purchase of products and services in all phases of the project (construction, operation, decommissioning).

A large part of the equipment and components required for the Neptun Deep Project are of a specialized nature and will be purchased from outside Romania.

Project activities involving Romanian labor are expected to begin with onshore development and offshore drilling, followed by offshore installation, connection and commissioning activities for subsea pipelines, umbilicals, risers and flowlines, gas production pipelines and offshore production platform facilities.

Peak labor requirements will occur during the short period when both well drilling and construction, installation and connection of onshore, offshore and offshore infrastructure take place. During this time, the estimated workforce from the country and abroad will reach a maximum of 800 people. Although there is some potential for Romanian drilling, similar to the drilling activities during the Neptun Deep exploration drilling campaign, most of the labor requirements during this period will be qualified personnel with specific experience on drillships, specialized installations, support vessels.

In-country labor recruitment for installation and construction activities during the development of the project is determined by the project requirements, the location of the manufacturing activities and the Contractor's requirements regarding jobs, the demand for specific work skills and the required number of workers, the Project implementation period.

During the operation phase, the CCR will be operated by operators continuously (24 hours x 7 days). In current planning, an estimated 10 operators are required for the full schedule, including any sick leave, vacation, training or going offshore to the platform. It is expected that these 10 operators will all be national or foreign employees.

For the initial commissioning and start-up phase, experienced expert operators will be needed to supplement the national operators. The number of foreign operators required will be determined after the hiring of domestic operators so that an assessment of the gaps in required skill sets can be completed.

The Neptun Alpha platform is normally unmanned, with personnel required on site only in case of emergency and for scheduled operations and maintenance.

The procurement of goods and services during the life cycle of the project will be provided to the extent possible through local or regional suppliers. These activities can indirectly create new jobs and contribute to increasing the local and regional employment rate.

The beach area located to the East of the onshore project site will be undercrossed by the shore crossing microtunnel to avoid the impact of current and planned tourist areas, including the beach area. In addition, no residential or tourism construction restrictions (guesthouses, hotels, etc.) will be implemented for properties located outside the 200 m wide production pipeline safety zone that are located adjacent to property boundaries owned by project beneficiaries. Construction restrictions are applicable only on land areas owned by the beneficiaries of the Neptun Deep Project.

Consequently, tourism and other development activities on the beach and the area adjacent to the onshore project site will not be blocked by the project and the likelihood of the project generating job losses for tourism or development activities in the area is low.

In the project area, there may be an increase in demand for the accommodation of personnel involved in the construction, operation and decommissioning phases. This aspect can generate a

positive impact on local tourism activities and also create opportunities for new jobs in the project area.

In order to minimize the visual impact generated by the project on the adjacent residential and tourist areas, the entire area of NGMS and CCR will be provided with a perimeter tree protection. In addition, the NGMS and CCR fenced sites will be provided with green perimeter fencing/ hedge made of shrubs.

The offshore production platform is located approximately 160 km offshore, therfore no significant effect on tourism activities along the Black Sea coast is expected.

During the life cycle of the project (drilling, construction and installation, operation, decommissioning), fishing and shipping activities will be disrupted at the local level due to restrictions generated by the presence of designated safety (exclusion) zones around the shore and temporary and permanent offshore facilities (e.g. drilling rig, offshore production platform, drilling centers, etc.)

2.4.6 Presentation of information regarding accommodation and service provision for temporary or permanent employees of the project.

Construction sites on land will not include accommodation facilities. Accommodation for workers supporting the execution of the construction and installation works of the onshore project will be provided through the existing accommodation spaces available in the onshore project area.

The onshore construction site will be provided with containerized administrative areas, which will also include dining areas, toilets and showers, first aid areas and offices. Also, the construction sites will be provided with a fresh water tank, septic tank for waste water and other auxiliary facilities.

Onshore construction sites will be supplied with all services and supplies required by workers (eg fresh water, potable water, food, etc.) procured from authorized suppliers in bulk and having appropriate quality, health and safety standards.

Accommodation and provision of services and supplies for workers supporting the execution of well drilling and the construction and installation of offshore components will be provided by supply vessels.

The onshore project facilities will be operated by a limited number of personnel and no accommodation will be provided within the NGMS and CCR premises. The CCR building will include offices, kitchenette, toilet and other facilities for CCR operators.

There are no living quarters on board the offshore production platform. A maintenance and supply vessel dedicated to supporting regular operations and maintenance activities must remain on standby near the Neptun Alpha Platform to provide accommodation/ shelter, provision of services (e.g. food, water and other services) and for the evacuation of personnel in emergency situations. In addition, a temporary shelter is provided to allow personnel to rest and sleep in the event that personnel are stranded on the platform due to a major breakdown of the crew craft (reserve vessel) or an adverse weather event or a combination of these two events.

It is currently anticipated that the accommodation of workers supporting the execution of onshore decommissioning works will be provided through the existing accommodation spaces available in the onshore project area at the date of the decommissioning works. Similar to the offshore drilling and construction phase, worker accommodation during the decommissioning/ abandonment phase will be aboard marine support vessels.

2.5 ESTIMATION OF TYPES AND QUANTITIES OF WASTE, RESIDUES AND EMISSIONS RESULTING FROM THE PROJECT

2.5.1 Presentation of the waste estimated to be generated by the project during well drilling, construction and installation, operation and decommissioning of the project, including information on the types and quantities of waste;

2.5.1.1 The waste estimated to be generated by the project during the construction and installation of the components

The estimated types and amounts of waste associated with the construction stage of the components on land, including the microtunnel, and how they are managed are presented in table 2.25:

Table 2.26 List of waste generated during construction

Waste code	Waste name	UM	Estimated quantity	Physical condition	Method for storage	Recovery/ disposal operation according to GEO 92/ 2021
A. Waste generated in the construction activity at sea						
20 03 06	Waste from sewer cleaning	m^3	21,600	liquid	Basin	Transported to the shore, to a treatment plant
08 01 11*	Waste paints and varnishes containing organic solvents or other hazardous substances	tons	0.5	solid	Metal container	D9 disposal by authorized economic operators
13 02 05*	Non-chlorinated mineral motor, transmission and lubricating oils	m^3/ year	0.5	liquid	Sealed metal container	R12 capitalization through authorized economic operators
16 10 01*	Aqueous liquid waste containing hazardous substances	m^3	1.0	liquid	Metal container	D9 disposal by authorized economic operators

Waste code	Waste name	UM	Estimated quantity	Physical condition	Method for storage	Recovery/ disposal operation according to GEO 92/ 2021
20 03 01*	Mixed municipal waste	tons	54.0	solid	Collected in big bags and in metal containers	D9 disposal by sanitation operators
15 01 03	Wooden packaging	tons	10.0	solid	Metal container	R12 capitalization through authorized economic operators
11 01 98*	Other waste containing hazardous substances (cement)	tons	15.0	solid	Collected in big bags and in metal containers	D5 disposal by authorized economic operators
16 01 17	Ferrous metals	tons/ year	5.0	solid	Metal container	R12 capitalization through authorized economic operators
16 01 18	Non-ferrous metals	tons/ year	3.0	solid	Metal container	R12 capitalization through authorized economic operators
16 01 19	Plastic materials	tons/ year	3.0	solid	Metal container	D9 disposal by authorized economic operators
16 01 17	Ferrous metals	tons	1,920.0	solid	Metal container	R12 capitalization through authorized economic operators
20 01 33*	batteries and accumulators included in 16 06 01, 16 06 02 or 16 06 03 and unsorted batteries and accumulators containing these batteries	tons/ year	0.1	solid	Metal container	D9 disposal by sanitation operators
17 05 04	Earth and stones other than those specified in 17 05 03	tons	40,950.0	solid	Stored on the bottom of the sea and fully	Used for filling the pit and trench after

Waste code	Waste name	UM	Estimated quantity	Physical condition	Method for storage	Recovery/ disposal operation according to GEO 92/ 2021
					reused when filling the manhole and trench after the installation of the pipeline	installing the pipe
15 01 01	Paper and cardboard packaging	tons	10.0	solid	Metal container	R12 capitalization through authorized economic operators
16 10 01*	Aqueous liquid waste containing hazardous substances	m^3	3500	liquid	Metal pools	Transported to the shore, to a treatment plant
18 01 03*	waste whose collection and disposal are subject to special infection prevention measures	tons/ year	0.02	solid	Special containers for collecting medical waste	D10 disposal disposed of by authorized economic operators
B. Waste generated in the construction activity on land						
20 03 06	sewer cleaning	m^3	1400	liquid	Basin	Transported to a sewage treatment plant
20 03 06	Waste from sewer cleaning	m^3	192	liquid	Basin	Transported to a sewage treatment plant
01 05 04	Freshwater-based drilling muds and wastes	m^3	200.0	liquid	Metal pools	Transported to a sewage treatment plant
01 05 04	Freshwater-based drilling muds and wastes	m^3	3140.0	liquid	Metal pools	Transported to a sewage treatment plant
16 10 01*	Aqueous liquid waste containing hazardous substances	m^3	1070.0	liquid	Metal pools	Transported to a sewage treatment plant
20 03 01*	Mixed municipal waste	tons	17.5	solid	Collected in big bags and in	D9 disposal by sanitation operators

Waste code	Waste name	UM	Estimated quantity	Physical condition	Method for storage	Recovery/ disposal operation according to GEO 92/ 2021
					metal containers	
17 05 04	Earth and stones other than those specified in 17 05 03 (excavated soil)	m^3	7770.0	solid	Bulk storage in the landscaped area	R10 filling the launch funnel and the pipe trenches D5 disposal by authorized economic operators
15 01 03	Wooden packaging	tons	10.0	solid	Metal container	R12 capitalization through authorized economic operators
15 01 01	Paper and cardboard packaging	tons	10.0	solid	Metal container	R12 capitalization through authorized economic operators
16 01 17	Ferrous metals	tons	5.0	solid	Metal container	R12 capitalization through authorized economic operators
16 01 19	Plastic materials	tons	3.0	solid	Metal container	D9 disposal by authorized economic operators
20 01 33*	Batteries and accumulators included in 16 06 01, 16 06 02 or 16 06 03 and unsorted batteries and accumulators containing these batteries	tons	0.1	solid	Metal container	D9 disposal by sanitation operators
08 01 11*	Waste paints and varnishes containing organic solvents or other hazardous substances	tons	0.1	solid	Metal container	D9 disposal by authorized economic operators

Recovery/ disposal operations according to GEO 92/ 2021

R1 *Use mainly as fuel or as another source of energy*

R3 *Recycling/ Recovery of organic substances that are not used as solvents (including composting and other biological transformation processes*

R4 *Recycling/ Recovery of metals and metal compounds*

R10 *Land treatment resulting in agricultural or ecological benefits*

R12 *Exchange of waste for exposure to any of the operations numbered R 1 to R 11. If there is no other corresponding R-code, this includes preliminary operations prior to recovery, including pre-processing such as, but not limited to, dismantling, sorting, crushing, compacting, granulation, dry shredding, conditioning, repackaging, separation and mixing prior to being subjected to any of the operations numbered R1 to R1 1.*

D5 *Specially constructed storage facilities (eg, storage in separate sealed compartments that are covered and isolated from each other and from the environment, etc.)*

D9 *Physical-chemical treatment not mentioned elsewhere in this annex, which generates final compounds or mixtures removed by means of one of the processes numbered from D1 to D12 (for example, evaporation, drying, calcination, etc.)*

D10 *Incineration on the ground*

D13 *Mixing prior to any operation numbered D1 to D12. If there is no other corresponding D-code, this includes preliminary operations before disposal, including pre-processing such as, but not limited to, sorting, crushing, compacting, granulating, drying, dry grinding, conditioning or separating before undergoing any of the operations numbered D1 to D12.*

The list of waste generated from the construction activity with the types of waste is presented in Annex F.

2.5.1.2 Waste estimated to be generated by the project during the execution of well drilling

The estimated types and quantities of waste associated with the drilling stage of exploitation wells and their management are presented in table 2.26:

Table 2.27 List of wastes generated during drilling

Waste code	Waste name	UM	Estimated quantity	Physical condition	Method for storage	Recovery/ disposal operation according to GEO 92/ 2021
20 03 06	Waste from sewer cleaning	m^3	31,040	liquid	Basin	Transported to the shore, to a treatment plant
01 05 04	Freshwater drilling muds and wastes	m^3	72,678	liquid	Not stored	It flows to the bottom of the sea
20 03 01*	Mixed municipal waste	tons	78.0	solid	Collected in big bags and in metal containers	D9 disposal by sanitation operators
01 05 05*	Oil-containing drilling muds and wastes	m^3	3,989	solid	Metal skips	D9 disposal by authorized economic operators

Waste code	Waste name	UM	Estimated quantity	Physical condition	Method for storage	Recovery/ disposal operation according to GEO 92/ 2021
16 01 15	antifreeze liquids other than those specified in 16 01 14	m^3	350	liquid	Metal container	D9 disposal by authorized economic operators
01 05 04	Freshwater drilling muds and wastes	m^3	8,784	solid	Not stored	It flows to the bottom of the sea
16 10 02	aqueous liquid waste, other than those specified in 16 10 01	m^3	31,300.0	liquid	Basin open drainage system	It is discharged into the sea after checking the concentration of hydrocarbons < 15 ppm
16 10 01*	Aqueous liquid waste containing hazardous substances	m^3	61,480.0	liquid	Pool contaminated water	D9 disposal by authorized economic operators
11 01 98*	Other waste containing hazardous substances (cement)	tons	15.0	solid	Collected in big bags and in metal containers	D5 disposal by authorized economic operators
15 01 03	Wooden packaging	tons	10.0	solid	Metal container	R12 capitalization through authorized economic operators
15 01 01	Paper and cardboard packaging	tons	10.0	solid	Metal container	R12 capitalization through authorized economic operators
20 01 33*	batteries and accumulators included in 16 06 01, 16 06 02 or 16 06 03 and unsorted batteries and accumulators containing these batteries	tons	0.1	solid	Metal container	D9 disposal by sanitation operators
08 01 11*	Waste paints and varnishes containing organic solvents or other hazardous substances	tons	0.5	solid	Metal container	D9 disposal by authorized economic operators
18 01 03*	waste whose collection and disposal are subject to special infection prevention measures	tons	0.02	solid	Special containers for collecting medical waste	D10 disposal disposed of by authorized economic operators

The list of waste generated from the well drilling activity with the types of waste is presented in Annex F

2.5.1.3 Waste estimated to be generated by the project in the operational phase

The estimated types and quantities of waste associated with the operational phase and their management are presented in table 2.27:

Table 2.28 List of waste generated in the operational phase

Waste code	Waste name	UM	Estimated quantity	Physical condition	Method for storage	Recovery/ disposal operation according to GEO 92/ 2021
A. Waste generated in the operation activity at sea						
20 03 06	Waste from sewer cleaning	m^3	480	liquid	Basin	Transported to the shore, to a treatment plant
16 10 01*	Aqueous liquid waste containing hazardous substances	mc/ year	50.0	liquid	Metal container	Transported to the shore, to a treatment plant
16 06 02	aqueous liquid waste, other than those specified in 16 10 01	m^3/ year	150.0	liquid	Basin open drainage system	It is discharged into the sea after checking the concentration of hydrocarbons < 15 ppm
20 03 01*	Mixed municipal waste	tons/ day	0.005	solid	Collected in big bags and in metal containers	D9 disposal by sanitation operators
20 01 33*	batteries and accumulators included in 16 06 01, 16 06 02 or 16 06 03 and unsorted batteries and accumulators containing these batteries	tons/ year	0.1	solid	Metal container	D9 disposal by sanitation operators
08 01 11*	Waste paints and varnishes containing organic solvents or other hazardous substances	tons	0.5	solid	Metal container	D9 disposal by authorized economic operators
15 01 03	Wooden packaging	tons	2.0	solid	Metal container	R12 capitalization through authorized economic operators

Waste code	Waste name	UM	Estimated quantity	Physical condition	Method for storage	Recovery/ disposal operation according to GEO 92/ 2021
15 01 01	Paper and cardboard packaging	tons	3.0	solid	Metal container	R12 capitalization through authorized economic operators
16 01 19	Plastic materials	tons	2.0	solid	Metal container	D9 disposal by authorized economic operators
20 01 40	Metals	tons	10.0	solid	Metal container	R12 capitalization through authorized economic operators
18 01 03*	Waste whose collection and disposal are subject to special infection prevention measures	tons	0.005	solid	Special containers for collecting medical waste	D10 disposal disposed of by authorized economic operators
B. Waste generated in the construction activity on land						
16 10 01*	Aqueous liquid waste containing hazardous substances	m^3/ year	20.0	liquid	Metal container	Transported to the shore, to a treatment plant
18 01 03*	waste whose collection and disposal are subject to special infection prevention measures	tons	0.01	solid	Special containers for collecting medical waste	D10 disposal disposed of by authorized economic operators
15 01 03	Wooden packaging	tons	1.0	solid	Metal container	R12 capitalization through authorized economic operators
15 01 01	Paper and cardboard packaging	tons	1.0	solid	Metal container	R12 capitalization through authorized economic operators
20 01 33*	batteries and accumulators included in 16 06 01, 16 06 02 or 16 06 03 and unsorted batteries and accumulators containing these batteries	tons/ year	0.05	solid	Metal container	D9 disposal by sanitation operators
08 01 11*	Waste paints and varnishes containing organic solvents	tons/ year	2.0	solid	Metal container	D9 disposal by authorized economic operators

Waste code	Waste name	UM	Estimated quantity	Physical condition	Method for storage	Recovery/ disposal operation according to GEO 92/ 2021
	or other hazardous substances					
20 03 01*	Mixed municipal waste	tons/ day	0.005	solid	Collected in big bags and in metal containers	D9 disposal by sanitation operators
16 01 19	Plastic materials	tons	2.0	solid	Metal container	D9 disposal by authorized economic operators
20 01 40	Metals	tons	15.0	solid	Metal container	R12 capitalization through authorized economic operators

2.5.1.4 Waste estimated to be generated by the project during decommissioning

At the end of the project lifetime (maximum 20 years), the project infrastructure will require decommissioning/ abandonment in accordance with a dedicated demolition/ decommissioning/ abandonment plan.

The full list and estimated quantities of hazardous and non-hazardous waste generated during the decommissioning phase will be available upon completion of the decommissioning/ abandonment plan.

All waste resulting from the decommissioning phase will be managed in accordance with the legal provisions in force at the date of the decommissioning/ abandonment works.

2.5.1.5 The methods for the collection, storage, treatment, transport and final storage of waste

All waste streams (hazardous and non-hazardous), which will be generated during all phases of the project, will be managed in accordance with domestic and international regulations applicable to land and maritime operations to ensure proper management of waste streams, to preserve the health of personnel and to protect the environment.

The fundamental requirements of effective waste management are based on the following key principles:

- Use only those waste management processes and methods that do not endanger human life and the environment;
- The "polluter pays" principle;
- The principle of producer responsibility;
- Using the most cost-effective technologies and best practices available.

a) Collection of waste during construction

All onshore site organizations will have designated waste collection areas. Metal or plastic containers will be provided for the selective collection of waste. Hazardous waste will be temporarily stored in a closed enclosure in suitable containers to prevent accidental spills. For identification, all containers will have labels with the waste type and code.

The contractor will conclude waste collection contracts with authorized economic operators.

The person responsible for waste management will keep a chronological record of the management of waste generated, disposed of, recovered.

In the case of offshore work, the waste generated during the drilling activity will be selectively collected and stored in appropriate containers in dedicated areas on the drilling platform. They will be transported ashore with support vessels. A temporary waste storage area will be set up in the logistics base in the port until it is sent to authorized economic operators for disposal or recovery.

b) Waste collection in the operational phase

On the onshore area, waste will be generated from the maintenance of facilities and administrative waste from CCR employees.

The waste generated at the Neptun Alpha Platform comes from the maintenance operations carried out periodically, is collected, loaded onto the support ships and transported to the shore from where it is sent to authorized economic operators for intermediate collection, recovery, disposal.

2.5.2 Presentation of liquid effluents generated by the project

2.5.2.1 Information on the types and quantities of liquid effluents generated by the project

a) **Information on the types and quantities of liquid effluents generated during construction and installation**

The main waste water/ produced water flows generated during the construction and installation of the onshore facilities of the project, during the execution of the shore crossing microtunnel as well as the installation of the offshore facilities, include:

- Household wastewater generated by the administrative area (containers) related to the NGMS and microtunnel site organizations will be collected on site in wastewater storage tanks that will be periodically emptied by trucks. Wastewater will be subsequently transported and discharged to authorized disposal facilities based on specific agreements signed with authorized contractors;
- The waste water generated by the truck wheel washing facility that will be collected periodically with trucks, transported and discharged to authorized disposal facilities based on specific agreements signed with authorized contractors;
- Produced water resulting from the construction of the shaft, the tunneling process (fluid system drilling and tunnel cleaning);

- Produced water resulting from the construction/ installation of the production pipeline (pipeline hydrotesting);
- Water displaced from the tunnel (sea water) following the tunnel grouting operation
- Hydrostatic test water of the underwater pipelines;
- Wastewater and rainwater generated by support vessels for construction/ installation work.

Household waste water

A total volume of domestic wastewater of **1,803 m ^{3}** is estimated to be generated during the construction period from the NGMS and microtunnel site organizations, of which a volume of 1,586 m^3 will be generated by the NGMS site organization and a volume of 217 m^3 will be generated by the microtunnel site organization.

Produced water resulting from the construction of the shaft

Fresh water will be used to prepare the fluid required during the drilling of bored piles.

A total volume of produced water of 200 m^3 is estimated to be generated by the construction of the shaft.

Water resulting from the tunneling process

During tunneling, fresh water is required for drilling fluid preparation and tunnel cleaning. The total estimated volume of water produced as a result of the tunneling process (drilling fluid system and tunnel cleaning) is **3,140 m^3**, of which a volume of 1,740 m^3 will result from the drilling fluid system and a volume of 1,400 m^3 will result from the tunnel cleaning process.

Hydrotest water resulting from production pipeline testing

For the hydrotesting of the production pipeline section installed in the microtunnel, fresh water will be used, without other additives.

A total water volume of **300 m^3** is estimated to be generated by hydrotesting the production pipeline section in the microtunnel.

Displaced water from the tunnel (sea water) resulting from filling the tunnel with mortar

The estimated total amount of displaced tunnel water (seawater) resulting from tunnel filling is **3,250 m^3**

Underwater Pipelines Hydrostatic Test Water Hydrostatic test water will be drawn from the Black Sea, filtered and treated with preservative chemicals to inhibit pipeline damage. Hydrostatic test water from the Black Sea will be treated with a common chemical (Hydrosure HD5002) used in the marine pipeline construction industry.

A total volume of **72,441 m^3** of hydrostatic test water is expected to be discharged from the following sections:

- Domino flowline: 4,794 m^3 ;
- Pelican pipeline: 104 m^3
- Gas production pipeline to shore: 67,543 m^3.

b) Information on the types and quantities of liquid effluents generated during well drilling

The main wastewater streams during the drilling/ construction/ installation/ testing/ commissioning period include:

- Water resulting from drilling and well start-up activities;
- Wastewater and rainwater generated by support vessels for construction/ installation work.

Waters resulting from drilling and well start-up activities

Water-based drilling fluids and non-aqueous drilling fluids will be used to drill production wells.

Water-based drilling fluids will be used for the first two sections of the wells, where drilling is done without a riser. Water-based drilling fluids, on the other hand, are discharged directly onto the seabed from the wellbore during pipe installation. The estimated total volume of water-based fluids used for drilling is 2,400 m^3/ well, respectively 24,000 m^3 in total.

The estimated volume of preservation fluid (brine plus chemicals) in one well is 50 m^3 for Domino wells and 70 m^3 for Pelican wells.

The total volume of well start-up fluids is estimated to be between 347 m ^{3} per well, 3470 m^3 in total.

Wastewater generated by the drilling rig and support vessels

Waste water (eg gray water, black water, storm water, etc.) generated by the drilling rig and support vessels will be collected on board, managed and discharged in accordance with the appropriate maritime regulations (eg MARPOL Convention, Black Sea Convention) regarding waste water disposal.

During the drilling campaign, it is estimated that a total volume of **35,168 m^3** of domestic waste water will be generated, taking into account 194 operators, a daily volume of 200 l/ day/ person and a duration of 800 days.

Rainwater falling in the operational areas will be collected on board, managed and discharged in accordance with the appropriate maritime regulations (eg MARPOL Convention, Black Sea Convention) regarding waste water disposal. Rainwater falling outside the operational areas of the drilling rig will be discharged directly into the sea.

Bilge water from the drilling rig and support vessels will be transported onshore for treatment/ disposal at an authorized facility.

c) Information on the types and quantities of liquid effluents generated during operation

The main wastewater flows resulting during the operating period include:

- Effluent (produced water) resulting from operation and maintenance and effluent resulting from well restart;
- Underwater valve actuation fluid;
- Storm/ washwater from the offshore production platform;
- Sewage and stormwater from support vessels for operations and maintenance.

Effluent (produced water) resulting from operation and maintenance and well restart effluent

The reservoir water (produced water) will be the largest volume of wastewater produced during the operating period.

During the life of the project, it is assumed that the volume of water produced will be between 50 and 1,590 m^3/ day. The volume of 50 m^3/ day of condensed water will remain a relatively constant component of the produced water wastewater flow throughout the lifetime of the field. During the middle period of the project, the groundwater becomes part of the produced water flow and increases to the point where the total volume of produced water can reach 1,590 m^3/ day in the final years of the project.

The estimated annual volume of field water discharged into the sea is 18,250 m^3/ year in the first 10 years and 511,000 m^3/ year in the last years of production.

The sea water used in the cooling process will be discharged into the sea and will have an annual volume of 2,766,920 m^3.

Spillage of subsea valve actuator fluids

Subsea valves on the wellheads utilize the pressure of a control fluid to actuate those valves.

It is estimated that there will be 22 actuations per year for each of the valve, i.e. a total effluent volume of 0.78 m^3.

Storm/ washwater from the marine platform

Precipitation falling on the production platform and fresh water used during maintenance washing are two sources of water expected to result at the production platform.

Precipitation falling on the open platform deck and stairs will not be collected and will drain directly to the sea surface.

Precipitation falling in the landscaped areas around the production platform equipment will be captured and diverted into the open drainage system. Similarly, any wash water falling into the landscaped areas will be captured and diverted into the open drain system.

Based on average rainfall and the total area of the open drainage system, accumulation in the storage tank over a 3-month period is expected to total approximately 53 m^3. To accommodate the excess volumes, the tank will have a capacity of 200 m^3.

Wastewater generated from operations and maintenance vessels

Waste water (e.g. household water, storm water, etc.) generated by operations and maintenance vessels will be collected on board, managed and discharged in accordance with the appropriate maritime regulations (e.g. MARPOL Convention, Black Sea Convention) regarding the disposal of waste water.

It is estimated that a total volume of domestic wastewater of approximately **11,200 m^3** will be generated during the quarterly routine maintenance campaigns and major maintenance campaigns carried out by the operation and maintenance teams

d) **Information on the types and quantities of liquid effluents generated during decommissioning**

At this moment, it is estimated that the volumes of wastewater/ technological water generated during the decommissioning phase will be lower than those generated during the construction/ installation period.

The volumes of wastewater/ process water generated during decommissioning will be available upon completion of the decommissioning/ abandonment plan before the start of decommissioning works.

2.5.2.2 Composition, toxicity or hazardousness of all liquid effluents produced by the project

a) Composition, toxicity or dangerousness liquid effluents generated during construction and installation

Produced water resulting from the construction of the shaft

Fresh water will be used to prepare the fluid required during the drilling of bored piles.

Water resulting from the tunneling process

During tunneling, fresh water is required for drilling fluid preparation and tunnel cleaning.

Hydrotest water resulting from production pipeline testing

For the hydrotesting of the production pipeline section installed in the microtunnel, fresh water will be used, without other additives.

Displaced water from the tunnel (sea water) resulting from filling the tunnel with grouting

The estimated total amount of displaced tunnel water (seawater) resulting from tunnel filling is **3,250 m^3**

Hydrostatic test waters of underwater pipelines

Hydrostatic test water from the Black Sea will be treated with a common chemical (Hydrosure HD5002) used in the offshore pipeline construction industry. This additive is specially designed for such operations and is based on didecyldimethylammonium chloride (20-25%) and ammonium bisulphite (10-20%) and has the role of preventing corrosion and algae formation inside the pipeline during the test, as well as monitoring the maintenance of the respective pressure for a certain period of time. The concentration of the Hydrosure chemical in the hydrostatic test effluent is 200 - 500 ppm (depending on the duration of the hydrotest).

b) The composition, toxicity or dangerousness of the liquid effluents **generated during well drilling**

Waters resulting from drilling and well start-up activities

Water-based drilling fluids and non-aqueous drilling fluids will be used to drill production wells.

Water-based drilling fluids will be used for the first two sections of the wells, where drilling is done without a riser. Water-based drilling fluids, on the other hand, are discharged directly onto the seabed from the wellbore during pipe installation.

The composition of the drilling fluid is a mix of desalinated water and several chemical products.

Once the non-riser sections are drilled and the riser installed, non-aqueous drilling fluids will be used until the full depth of the well is reached. The estimated total volume of non-aqueous drilling fluids used for drilling is 5,300 m^3/ well, respectively 53,000 m^3 in total. The non-aqueous drilling fluid returns to the drilling platform, where it is separated from the cuttings to be reused for drilling.

Non-aqueous drilling fluid consists of a mixture of desalinated seawater with specific chemicals (e.g., weighting agent, emulsifiers, fluid loss reducing agent, fluid loss control agent, viscofier, filtrate control agent, base hydrocarbons, low-toxicity casing cleaners, plugging agent, return loss materials, etc.).

After drilling is completed, the wells will be filled with a clean inhibited brine to serve as a make-up fluid to preserve the wells until production begins. Fresh water mixed with calcium chloride ($CaCl_2$) will be used to create the well completion fluid (brine). The effluent in which this brine is found will not be discharged into the sea, but it will be collected and transported to shore.

The effluent resulting from starting the wells will reach the production platform together with the reservoir water. This effluent will not be discharged into the sea. It will be collected at the production platform and transported to the shore.

Well start-up effluent will contain the following chemicals:

- Corrosion inhibitor (concentration in effluent of 3 kg/ m^3);
- Oxygen inhibitor (concentration in effluent of 2 kg/ m^3);
- Biocide (concentration in effluent of 1 kg/ m^3);
- Caustic soda (concentration in effluent of 1 kg/ m^3);
- Monoethyl glycol MEG (concentration in effluent of 500 kg/ m^3);
- $CaCl_2$ brine (concentration in effluent of 150 kg/ m^3);
- $CaBr_2$ brine (concentration in effluent of 463 kg/ m^3);
- Xanthan brine (concentration in effluent of 15 kg/ m^3);
- Inhibitor J228 (concentration in effluent of 10 kg/ m^3);
- Surfactant (concentration in effluent of 10 kg/ m^3);
- Organic acid (concentration in effluent of 10 kg/ m^3);

c) The composition, toxicity or dangerousness of the liquid effluents generated during the operation

Effluent (produced water) resulting from operation and maintenance and well restart effluent

The discharged effluents will comply with all the provisions established by the operating authorizations and defined in the national legislation (NTPA 001 - regarding the establishment of pollutant load limits of industrial and urban wastewater when discharged into natural receivers), except for those parameters that are naturally found in higher concentrations in the Black Sea

water. For the chemical parameters that are not covered by the provisions of NTPA001, the permissible discharge limits (maximum permissible concentrations) were developed in collaboration with the National Institute for Marine Research and Development (INCDM) "Grigore Antipa". INCDM "Grigore Antipa" carried out ecotoxicity laboratory tests using native marine species in order to provide the necessary information for the development of authorizations and monitoring programs.

The ecotoxicity testing of the concentrations was done by testing the toxicity of the entire effluent (WET), using three marine species located at three trophic levels (phytoplankton, zooplankton and fish), which reflect the organisms present in the wastewater receiving waters.

Whole effluent toxicity testing was considered an appropriate and acceptable approach for examining the potential cumulative environmental toxicity of an effluent without the need to examine individual constituents. The three test species (*Acartia tonsa, Skeletonema costatum* and *Chelon aurata)* were selected to best reflect the trophic levels of the Black Sea marine community potentially exposed to the effluents considered in the toxicity study.

The chemicals expected to be found in discharged water fall into two categories: geogenic substances and well management substances. Geogenic chemicals are natural and come from the mined deposit.

Production well management substances which are substances added to the system to ensure the safe and efficient operation of the wells and production platform. The composition and concentration of the substances included in the composition of the produced water and well restart effluent, according to their safety data sheets (SDS), and the maximum concentration of these substances that should be found in the effluent, upon discharge, corresponding to the maximum permissible value provided for these effluents are as follows:

Table 2.29 Recommended maximum concentrations of chemical products

Chemical product	Recommended concentration to be used to reach the maximum permissible limits of NTPA 001
Corrosion inhibitor	61 ppm
Scale inhibitor	108 ppm
Antifoaming	30 ppm

During the process of selection and testing of chemical substances, the dosage rates were reviewed for the purpose of optimization. Following their test-based optimization, the following injection rates, discharge concentrations calculated in process water and diluted with cooling water were selected.

The concentration of the products at injection, the concentration at discharge in the emissary and respectively the volumes of effluent estimated to be discharged during the life cycle of the project, are highlighted in the table below.

Table 2.30 Injection concentration of chemical products

Use	Injection concentration (ppm)	The concentration at discharge in the emissary (ppm)	Estimation of discharged effluent volume (m^3/ day)		
			0-3 years	3-6 years	6-20 years
Corrosion inhibitor	50	5.9	0.36	0.72	1.24
Scale inhibitor	15	2.6	0.11	0.22	0.57
Antifoaming	10	1.7	0.07	0.14	0.38

It should be noted that, during the life cycle of the project, the concentration of substances at discharge in the outfall will remain constant, while the volume of water (effluent) will increase with the maturity of the deposit.

The effluent resulting from operation and maintenance has the following concentrations:

Table 2.31 Composition of the effluent resulting from operation and maintenance

Effluent/ Composition	Concentration (ppm)
1. Effluent resulting from operation and maintenance	**1%**
Corrosion inhibitor	5,975
Limescale inhibitor	2,591
foaming	1,727
Sodium hypochlorite	0.2
TEG	0.495

Toxicity (WET) testing is included as a monitoring parameter and will serve to document the effects of the combination of substances in the effluent, if any.
Ecotoxicity tests for *Acartia tonsa and Chelon auratus* have shown that the products or their mixture **were free from acute toxicity at the concentrations proposed for discharge**. Toxicity tests for *Skeletonema costatum* showed little effect for AFMR20400A antifoaming and SCAL13370A deposition inhibitor (growth inhibition 15% and 18%, respectively), and a large effect for corrosion inhibitor CORR12452A and their mixture (growth inhibition 79% and 92%, respectively).

Long-term toxic effects (chronic toxic) were assessed by INCDM "Grigore Antipa" considering the information available in the database of the European Chemicals Agency (ECHA). [1]

In order to quantify and document the potential risk to the marine environment from substances in the water discharged through the discharge caisson, modelling was carried out using DREAM software to determine **the effect by dose** and **environmental impact factor (EIF).**

Through the Water Management Permit draft issued by ABA Dobrogea Litoral, it was established the requirement that throughout the validity period of the water management permit, the

[1] INCDM "Grigore Antipa", May 2023 - Ecotoxicity tests for the environmental agreement Neptun Deep Project

beneficiary will develop and submit to ABADL, the eco-toxicity study by performing chronic toxicity tests, for all chemicals that will be discharged into the sea, including biocide and methanol, by means of which to validate / demonstrate that the maximum allowable limit values established for discharge into the marine environment, at the level of each chemical ensures the protection of the marine environment, has a low impact on the marine aquatic ecosystem and does not lead to failure to achieve the environmental objectives set by the Marine Strategy Framework Directive (2008/56/EC).

Spillage of subsea valve actuator fluids

Subsea valves on the wellheads utilize the pressure of a control fluid to actuate those valves. Hydraulic fluid is usually an aqueous solution of ethylene glycol and contains 55-70% water and 30-45% ethylene glycol (a biodegradable substance)

Wastewater generated from operations and maintenance vessels

Waste water (e.g. household water, storm water, etc.) generated by operations and maintenance vessels will be collected on board, managed and discharged in accordance with the appropriate maritime regulations (e.g. MARPOL Convention, Black Sea Convention) regarding the disposal of waste water.

d) **The composition, toxicity or dangerousness of the liquid effluents generated during decommissioning**

The composition, toxicity or hazardousness of the wastewater/ process water generated during decommissioning will be available upon completion of the decommissioning/ abandonment plan prior to the commencement of decommissioning work.

2.5.2.3 Methods of collection, storage, treatment, transport and final storage of liquid effluents

a) Methods of collection, storage, treatment, transport and final storage of liquid effluents generated during construction and installation

Household waste water

Each site organization on land (NGMS site, microtunnel site) will be provided with a domestic waste water storage tank with a volume of 20 m^3/ basin which will be emptied periodically. Drained water will be transported to authorized disposal facilities based on specific agreements signed with authorized contractors.

Produced water resulting from the construction of the launch pad

The excess water resulting from the construction of the launch pad will be collected in 2 metal tanks with a capacity of 30 m^3/ basin and will be transported to authorized disposal facilities based on specific agreements signed with authorized contractors.

Water resulting from the tunneling process

The water resulting from the tunneling process will be collected on site in a dedicated storage facility that will be periodically emptied by trucks and the wastewater will be transported and

discharged to authorized disposal facilities based on specific agreements signed with authorized contractors.

As the tunnel boring machine pierces the seabed at the exit point of the micro-tunnel, a small portion of the water-based drilling fluid will reach the seabed. This small volume of water-based drilling fluid cannot be captured. This event only happens once during the lifetime of the project.

Water resulting from the tunneling process (drilling and cleaning fluid system) will be collected temporarily on site and subsequently transported for disposal to authorized facilities based on specific agreements signed with authorized contractors.

Hydrotest water resulting from production pipeline testing

The water resulting from hydrotesting will be tested and discharged into the sea in case of compliance with the legal parameters for discharge into the Black Sea

Displaced water from the tunnel (sea water) resulting from filling the tunnel with grouting

After the trench and outlet are filled, the tunnel will be backfilled with grouring. The grouting operation of the tunnel will displace the seawater inside it. This water will be pumped and temporarily stored on site in the water storage tank for testing and subsequent discharge into the Black Sea through the fiber optic cable protection pipeline, after approval of the discharge parameters by the authorities.

Hydrostatic test water of underwater pipelines

The water resulting from hydrotesting will be tested and discharged into the sea using the manifold from Domino 2 drilling center that will be placed in the anoxic layer of the Black Sea, at a depth of over 950m, lacking of marine life conditions. This will be a one-time discharge, before operation starts, according to international best practices. Due to the large volume of utilized test water no alternate method can be identified to support the handling this large volume of test water. The dispersion modelling of this effluent in the water column indicates that it will not rise more than 700m water depth, concluding that there is no potential impact on the marine biodiversity.

b) Methods of collection, storage, treatment, transport and final storage of liquid effluents generated during well drilling

Waters resulting from drilling and well start-up activities

The drilling of the production wells will be done either using a water-based drilling fluid or a non-aqueous drilling fluid. The composition of the drilling fluid is a mix of desalinated water and several chemical products.

Water-based drilling fluid will be used during the drilling of the first two sections of each well. Upon completion of these first two sections, the water-based drilling fluids will be discharged from the well directly to the seabed.

The cuttings-laden non-aqueous drilling fluid, resulted from drilling of the following sections, will be recovered and treated by centrifugation for cuttings separation. The recovered drilling fluid will be reused into the technological process and the cuttings resulting from the separation will be transported to the shore for disposal at an authorized economic operator.

Fluids from starting the wells

The well start-up effluent will go to the production platform along with the produced water. This effluent will not be discharged into the sea but will be collected and transported ashore for proper disposal at an authorized facility.

Wastewater generated by the drilling rig and support vessels

Waste water generated by the drilling rig and support vessels will be collected on board, managed and discharged in accordance with the appropriate maritime regulations (eg MARPOL Convention, Black Sea Convention) regarding waste water disposal.

Rainwater falling in the operational areas will be collected on board, managed and discharged in accordance with the appropriate maritime regulations (eg MARPOL Convention, Black Sea Convention) regarding waste water disposal. Rainwater falling outside the operational areas of the drilling rig will be discharged directly into the sea.

Bilge water from the drilling rig and support vessels will be transported onshore for treatment/ disposal at an authorized facility.

c) Methods of collection, storage, treatment, transport and final storage of liquid effluents generated during operation

Effluent (produced water) resulting from operation and maintenance aswell as well restart effluent

The flow of water produced will be discharged through the single-port landing caisson mounted on the offshore platform at a sea depth of 90 m.

Discharge of underwater valve actuator fluid

An extremely small amount of an aqueous solution of ethylene glycol will be released onto the seabed into the marine environment when the taps at the eruption ends of the wells are closed. Releasing small amounts of water-based control fluid to operate underwater taps is common practice in the oil and gas industry around the world.

Rainwater/washing water from the offshore platform

Rainfall on the production site and fresh water used during maintenance washing are two sources of water that are anticipated to result at the production site.

Precipitation falling on the open deck of the platform and stairs will not be collected and will flow directly to the sea surface.

Rainfall falling in areas arranged around the equipment of the production platform will be captured and diverted into the open drainage system. Similarly, any wash water that falls into landscaped areas will be captured and diverted into the open drainage system.

All water from the open drainage system will be routed to a storage tank located in one of the steel legs of the production platform. The tank shall be fitted with an oil and water separator and an analyser enabling the water fraction to be discharged, unless the maximum limit of 15 ppm of hydrocarbons is exceeded. The oily fraction will be periodically removed by a ship and shipped ashore for treatment by certified/authorized contractors.

The water will be directed to the caisson for the discharge of water produced into the sea. In situations where the water has a hydrocarbon content exceeding the acceptance limit approved by the regulatory authorities, the discharge of water from the open drainage system will cease and all contents of the open drainage system tank will be retained until a maintenance vessel can transfer the contaminated water for disposal to an approved shore wastewater management facility.

Produced water treatment system

The production stream is essentially a mixture of gas and water, with the main processing path for oil-free water collection. Fine sands likely present in small amounts will be entrained in the production stream and expected to follow the flow path of the fluids.

Under normal operating conditions, most of the water will be collected in the primary separator, MBD62301, and is directed to the degasser. The purpose of this vessel is to allow any gas absorbed into the water stream to escape prior to disposal.

The water flow from the TEG dehydration system is continuous and recovered. This is the result of residual water in the gas stream that needs to be removed so that the exported gas meets the wet gas export specification. This water flow is also free of liquid hydrocarbons.

Wastewater generated from operations and maintenance vessels

Waste water (e.g. household water, storm water, etc.) generated by operations and maintenance vessels will be collected on board, managed and discharged in accordance with the appropriate maritime regulations (e.g. MARPOL Convention, Black Sea Convention) regarding the disposal of waste water.

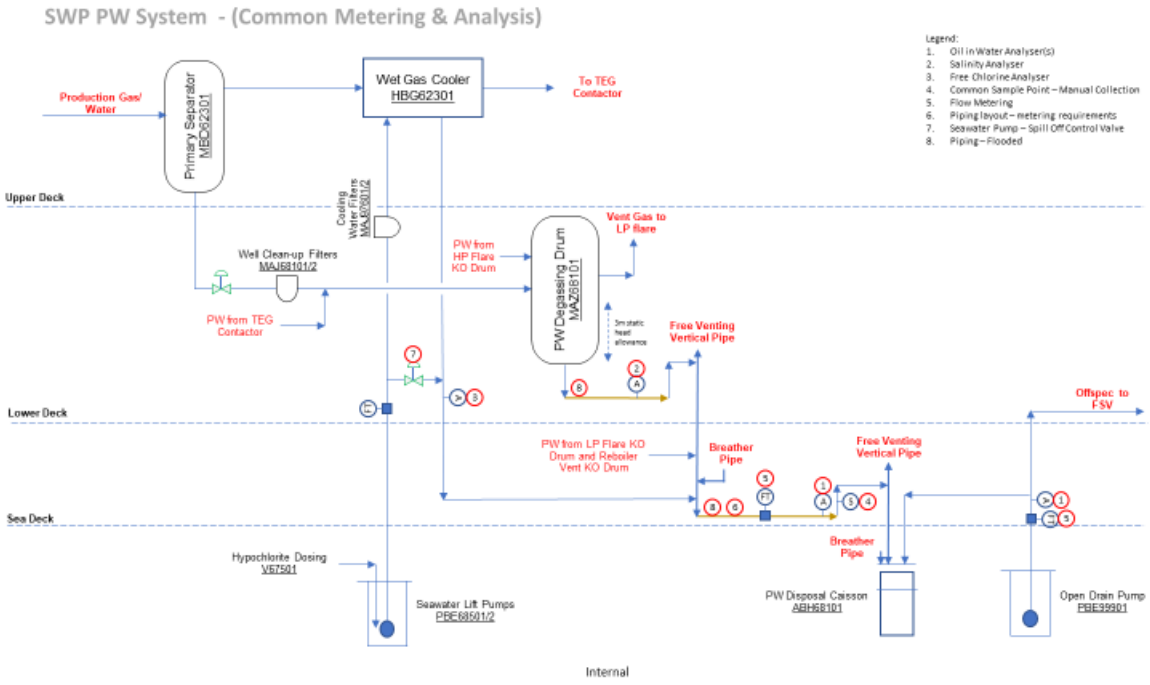

Figure 2.13 Functional diagram of the produced water treatment system

d) Methods of collection, storage, treatment, transport and final storage a liquid effluents generated during decommissioning

Methods of collection, storage, treatment, transport and final disposal of waste water/ process water generated during decommissioning shall be available upon completion of the decommissioning/ abandonment plan prior to commencement of decommissioning works.

2.5.3 Presentation of gaseous and dust pollutant emissions estimated to be generated by the project during well drilling, construction and installation, operation and decommissioning of the project

2.5.3.1 Types, amounts of gaseous and dust pollutant emissions and their composition generated by the project

a) The types, amounts of gaseous and dust pollutant emissions and their composition generated by the project during the construction phase, including testing and commissioning

Onshore emissions

The associated sources of airborne dust emissions from non-directed emission sources are as follows:

- Site development and execution of civil works;
- Dust emissions generated by site traffic
- Handling of excavated soil, fill material, aggregates and construction materials;
- Handling of construction waste (for example, cuttings resulting from the execution of the microtunnel);
- The operations performed on the site before commissioning (welding, painting, etc.);
- Use of diesel generators for powering construction facilities and equipment;

Sources of emissions from mobile sources:

- Combustion gas emissions from the operation of the crane with Diesel fuel which generate the following pollutants: CO_2, CO, NO_x, N_2O, CH_4, SO_2, and VOC (Volaticle organic compounds).
- Combustion gas emissions from the operation of heavy machinery with Diesel fuel (cranes, excavators, trucks, front loaders, concrete mixers, compactors, nacelles, generators, air compressors)

CALCULATION OF FLOWS OF EMISSIONS OF POLLUTANTS

The calculation of pollutant flows emitted by mobile sources was made using the EPA Air Emissions Factors Quantification methodology AP-42: Compilation of Air Emissions Factors, section 1.3[2]

In the calculation hypothesis, the following was considered:

- The density of Diesel fuel is minimum 820 kg/ m^3 and maximum 845 kg/ m^3. An average density of 832.5 kg/ m^3 was used in the calculation. LHV = 11.83 KWh/ kg and HHV = 12.67 KWh/ kg. where LHV is the Lower Heating Value and HHV the Higher Heating Value
- It is estimated that the machines will work 8 hours/ day and consume 1÷42 l/ h depending on the machine.
- Diesel consumption for each machine is as follows:

Table 2.32 Diesel consumption for each machine used in construction

Machinery	Hours of operation (hours)	Fuel consumption (l/ h)
Crane	3,200	2.5
Excavation	21,760	15
Transport trucks	86,400	30
Front loaders	26,800	12
Concrete	6,400	1.0
Compactor	2,240	5.0
Aerial	6,720	4.0
Diesel generators	14,400	1.25
Air compressor	360	42

Table 2.33 Estimation of the amount of pollutants emitted into the air during the construction period on land

Description	Pollutant	Amount of pollutant (tons/ construction period)	Emission	Remarks
Equipment used in land construction	NO_X	164.500055	Continuous	During the construction period
	CO	43.478971		
	PM	-		
	CH_4	-		
	VOC	5.538722		
	SO_2	11.077445		
	N_2O	-		
	CO_2	8,861.9558		

[2] https:/ / www.epa.gov/ air-emissions-factors-and-quantification/ ap-42-compilation-air-emissions-factors

Offshore emissions

Sources of air emissions from offshore construction/ installation vessels include:

- Emissions from the operation of ships, tugs, machinery, barges, cranes from construction/ installation at sea, fueled with Diesel Fuel, the emitted pollutants being the following: CO_2, CO, NO_x, N_2O, CH_4, SO_2, and VOC.
- Emissions from the operation of vessels used at the Pelican drilling center for pre-commissioning (filling pipelines, Hydrotest, emptying and pressure tests) the emitted pollutants being the following: CO_2, CO, NO_x, N_2O, CH_4, SO_2, and VOC.
- Emissions from the operation of vessels used at the Domino drilling centers for pre-commissioning (filling pipelines, Hydrotest, emptying and pressure tests) the emitted pollutants being the following: CO_2, CO, NO_x, N_2O, CH_4, SO_2, and VOC.
- Emissions from the operation of vessels for gas production pipeline filling and tightness tests
- Emissions from the platform's temporary power Diesel generators (the essential generator and the backup generator) for commissioning and start-up
- Emissions from gas turbine generators since commissioning.

Sources of emissions from the start-up and commissioning of the equipment on the platform:

- Offshore LP/HP Flare Pilot – The Low Pressure (LP) Flare is only used during this phase when transitioning from Commissioning to Operations. The LP Flare will be lit when the first of the SPS's commences forward gas (expected to be Pelican). A combined LP & High Pressure (HP) Flare tip with 3 pilots is assumed. Pilots will be lit during the GPP N2/ back gassing process. This is assumed to be a 2-day process, noting that the pilots cannot be lit until natural gas is present in the vent gas as N2 will snuff the pilots, generating gas combustion products, including CO2, CO, NOX, CH4, Particulate Matter (PM) and VOCs.
- HP Flare - Initial Cold Start (Pelican well ramp-up) – Based on the Pelican system being brought online first and may take up to 5 days generating gas combustion products, including CO2, CO, NOX, CH4, PM and VOCs.
- Flaring - Start Up Gas - Domino Flowline Purging (Flaring). The Domino flowline is initially filled with N2 with Pelican production flared while N2 system purges (24h – slow well ramp up). This assumes a mixing zone of 50% of total Domino flowline volume with a worst case 100% CH4 in the mixing zone to be flared generating gas combustion products, including CO2, CO, NOX, CH4, PM and VOCs.
- Venting of start-up gas (pre-flare ignition) generating CO2, CH4, and VOCs. An assumption is made that there is no pig train barrier during the back gas operation with relative plug flow assumed, and some mixing will take place. Estimated mass of methane vented prior to ignition of HP Flare is 66 te (assuming 100% methane in the

mixing zone). Venting is calculated as an average over the year; however, the peak flow is 96,500 kg/h over a 41-minute duration.

Sources of air emissions from offshore shipping include:

- Helicopter emissions that generate CO_2, CO, NO_X, CH_4, SO_2 and VOCs. The distance to the offshore production platform (SWP) and return is considered to be 320 km, It is assumed that, during construction, 4 helicopter trips will be made per day for 90 days, assuming that it covers the winter period.
- Emissions from support vessels used for transport that generate CO2, CO, NOX, CH4, SO2 and VOCs.

CALCULATION OF EMMISSIONS DURING OFFSHORE CONSTRUCTION/ INSTALLATION

The calculation of emissions by mobile sources was carried out using the United States EPA Air Emissions Factors Quantification AP-42 methodology, using:

- Emission factors from section 1.3[3] for the calculation of emissions from Diesel generators, and for testing and commissioning equipment
- The emission factors from Table 3.1-1 and Table 3.1-2a for the main gas turbine generators at start-up, LP/ HP pilot flare, HP flare - cold start
- Emission factors from table 13.5.1 Emission Factors for Flare operations for - Flaring of gases - Ignition of gas - Cleaning of Domino pipe by flaring

Emission factors from ships are from the EMEP/ EEA Air Pollutant Emission Inventory Guidebook, 1.A.3.d Navigation-Shipping 2019 - update 2021. (Efs for MGO users), Table 0-2

The emission factors for helicopters are from the EMEP/ EEA Air Pollutant Emission Inventory Guidebook, 1.A.3.a Aviation 2019. (Efs for helicopters), table 3.3

In the calculation hypothesis, the following was considered:

- The density of Diesel fuel is minimum 820 kg/ m^3 and maximum 845 kg/ m^3. An average density of 832.5 kg/ m^3 was used in the calculation. LHV = 11.83 KWh/ kg
- The density of MGO marine fuel at a temperature of 15 ℃ is 860 kg/ m^3 The density of MGO taken as 860 (at 15°C).
- The density of helicopter fuel is 762 kg/ m^3
- It is estimated that the ships will operate 24 hours/ day
- Diesel consumption on each type of ship is as follows:

[3] https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emissions-factors

Table 2.34 Fuel consumption of ships used to build/ install components at sea

Vessel	Days of operation (days)	Fuel consumption (l/ h)
Ship pipeline installation	190	35
Pipelay vessels	802	10
Crane vessel (10000t)	88	50
Heavy transport vessel	10	20
Flexlay installation vessel	43	15
Subsea Construction Vessel (heavy)	101	15.0
Subsea Construction Vessel (light)	299	15
Survey Vessel	146	8
Transport barge including tugboat or coaster	6,720	4.0
Fleet	300	12
Crew Transfer Vessel (CTV)	540	3
Rescue intervention ship in emergency situations	140	5
Dredging vessel	45	10
Rocks Dumper	10	10

Table 2.35 Estimation of the amount of pollutants emitted into the air during the construction period on land

Description	Pollutant	Fuel	Amount tons/ year	Emission type	Remarks
The platform's temporary power Diesel generators	NO_X	Diesel	0.040355	Continuously	24 hours/ day, 1 MW during the commissioning period of the platform (120 days)
	CO		0.010719		
	PM		0.001261		
	CH_4		-		
	VOC		-		
	SO_2		0.012737		
	N_2O		-		
	CO_2		1,814.59		
Main generators for commissioning	NO_X	Gas	2.972131	Continuously	2 generators, 24 h/ day for 7 days 4,605 MW, 2.73 MMSCFd (2200 kg/ hr)
	CO		0.761609		
	PM		0.061300		
	CH_4		0.079876		
	VOC		0.019505		
	SO_2		-		
	N_2O		-		
	CO_2		1,010.059943		
Backup generator for preparation and commissioning	NO_X	Diesel	0.000566	Intermittent	800 kW @ 50 kg/ hour for 24 hours/ day for 7 days.
	CO		0.000150		
	PM		0.000018		
	CH_4		-		
	VOC		-		
	SO_2		0.000178		
	N_2O		-		
	CO_2		25.43		

Description	Pollutant	Fuel	Amount tons/ year	Emission type	Remarks
Essential generator for preparation and commissioning	NO_X	Diesel	0.003608	Intermittent	1.4 MW @ 319 kg/ hour for 24 hours/ day for 7 days.
	CO		0.017493		
	PM		1,394.229375		
	CH_4		-		
	VOC		-		
	SO_2		0.001139		
	N_2O		-		
	CO_2		162.2410		
Construction ships - preparation for commissioning - Pelican - filling	NO_X	Diesel	0.000380	Intermittent	Duration for pre-commissioning the Pelican rig for 7 days based on the diesel units of the offshore construction vessel. Diesel consumption is expressed in liters per hour. The total duration of the activity is 7 days. Filling - 24 hours, Filling Pump - x1 @ 80 litres/ hour, Service Air Compressor - x1 @ 80 litres/ hour and Power Generator - x1 @ 45 litres/ hour.
	CO		0.000082		
	PM		0.000027		
	CH_4		-		
	VOC		-		
	SO_2		0.000025		
	N_2O		-		
	CO_2		12.399665		
Construction ships - commissioning preparation - Pelican - Hydrotest	NO_X	Diesel	0.0005190	Intermittent	Duration for pre-commissioning the Pelican rig for 7 days based on offshore construction vessel diesel units. Diesel consumption is expressed in liters per hour. The total duration of the activity is 7 days. Hydrotest - 4 days, Service air compressor x 1 @ 45lt/ hr, Generator x 1 @ 25lt/ hr = 70 l/ h.
	CO		0.000112		
	PM		0.000036		
	CH_4		-		
	VOC		-		
	SO_2		0.000034		
	N_2O		-		
	CO_2		16.93613		
Construction ships - preparation for commissioning - Emptying and pressure tests	NO_X	Diesel	0.00916	Intermittent	The total duration of the activity is 7 days. Emptying and pressure tests - 2 days, Primary compressor x 12 @ 140lt/ hr, Generator for NPU x 2 @ 50lt/ hr, Booster x 3 @ 155lt/ hr, Exhaust pump x 2 @ 100lt/ hr, Energy generator x 1 @ 25lt/ hr.
	CO		0.001973		
	PM		0.000644		
	CH_4		-		
	VOC		-		
	SO_2		0.000602		
	N_2O		-		
	CO_2		298.80168		
Construction ships - preparation and commissioning - Domino - filling	NO_X	Diesel	0.000271	Intermittent	Pipeline preparation time is 15 days on a marine construction unit with diesel engines. Duration 15 days. Filling- 4 days, Lifting pump - x1 @ 160lt/ hr, Filling pump - x1 @ 80lt/ hr, Power generator x 1 @ 45lt/ hr, Air compressor x 1 @ 80lt/ hr.
	CO		0.000058		
	PM		0.000019		
	CH_4		-		
	VOC		-		
	SO_2		0.000018		
	N_2O		-		
	CO_2		8.830908		
Construction ships - preparation and commissioning - Domino - Hydrotest	NO_X	Diesel	0.000266	Intermittent	Hydrotest - 5 days, Lift pump - x1 @ 77lt/ hr, HP pump - x2 @ 70lt/ hr, power generator x 1 @ 25lt/ hr, compressor x 1 @ 45lt/ hr.
	CO		0.000057		
	PM		0.000019		
	CH_4		-		
	VOC		-		
	SO_2		0.000017		
	N_2O		-		
	CO_2		8.679856		

Description	Pollutant	Fuel	Amount tons/ year	Emission type	Remarks
Construction ships - commissioning preparation - Domino Emptying and pressure tests	NO_X	Diesel	0.027339	Intermittent	Emptying and pressure tests 6 days, Primary compressor x 12 @ 140lt/ hr, Generator for NPU x 2 @ 50lt/ hr, Booster x 3 @ 155lt/ hr, Exhaust pump x 2 @ 100lt/ hr, Energy generator x 1 @ 13lt/ hr.
	CO		0.005889		
	PM		0.001922		
	CH_4		-		
	VOC		-		
	SO_2		0.001798		
	N_2O		-		
	CO_2		892.050039		
Construction vessels - preparation and commissioning - Production pipeline - filling	NO_X	Diesel	0.000851	Intermittent	The total duration of preparation and commissioning is 7.5 days. The duration of the filling is 6.5 days. filling - 6 days, lifting pump - x3 @ 160lt/ hr, flood pump - x2 @ 80lt/ hr, power generator x 1 @ 45lt/ hr, Air compressor x 1 @ 80lt/ hr.
	CO		0.000183		
	PM		0.00006		
	CH_4		-		
	VOC		-		
	SO_2		0.000056		
	N_2O		-		
	CO_2		27.763043		
Construction vessels - preparation and commissioning - Production pipeline with tightness	NO_X	Diesel	0.000195	Intermittent	Leakage test duration - 1.5 days Power generator x 1 @ 25lt/ hr, Air compressor x 1 @ 45lt/ hr = 70 l/ h.
	CO		0.000042		
	PM		0.000014		
	CH_4		-		
	VOC		-		
	SO_2		0.0000128		
	N_2O		-		
	CO_2		6.351048		
Offshore LP Flare Pilot	NO_X	Gas	0.000571	Intermittent	The LP flare is only used in this phase during the transition from commissioning to operation. The LP flame will be lit when the first SPS starts supplying gas at the start (expected to be Pelican). It is estimated to be a combined LP and HP Flare, so the assumption is that pilot gas is included in the HP flare allocation = 0.09 tonnes/ day
	CO		0.0001428		
	PM		0.0001999		
	CH_4		0.001604		
	VOC		0.00002970		
	SO_2		-		
	N_2O		0.00001513		
	CO_2		0.492		
Offshore LP/ HP Flare Pilot	NO_X	Fuel Gas	0.000571	Intermittent	3 Pilot LP & HP Flare Combo Flare. The pilots will be ignited during the introduction of N_2 This process is assumed to take 2 days, noting that the pilots cannot be ignited until natural gas is present in the exhaust gas, as the nitrogen will extinguish the pilots. Propane gas stored in containers will be used to light the piles 0.09 tons/ day
	CO		0.0001428		
	PM		0.0001999		
	CH_4		0.001604		
	VOC		0.00002970		
	SO_2		-		
	N_2O		0.00001513		
	CO_2		0.492		
HP Flare - Initial Cold Start (Increasing production on Pelican probes)	NO_X	Gas	25.04936	Intermittently	Considering that the Pelican system will be started first, it is expected to be done within 2 days, although 5 days have been allocated for this process. The total estimated amount of gas sent to HP flare is 15,000 tons).
	CO		136.2979777		
	PM		0.8541561		
	CH_4		51.572208		
	VOC		-		
	SO_2		-		
	N_2O		-		

Description	Pollutant	Fuel	Amount tons/ year	Emission type	Remarks
	CO_2		40,993		Once the performance of the probes has been monitored and understood, faster restarts are expected, especially in terms of restarting the HP Flare. During the initial startup of the Pelican system, propane gas from canisters will be required to ignite the pilots from the HP flare.
Combustion of gases - Turning on the gas - Cleaning the Domino pipeline by combustion	NO_X	Gas	8.349786	Intermittent	The Domino pipeline was initially filled with nitrogen (N_2); It is assumed that the system will be left at a pressure of 95 bar. The Domino well start-up operation will be done slowly while Pelican produces under stable conditions (250MMscfd). Pelican production will be burned during the N_2 purge process (24 hours - slow well rise A mixing zone of 50% of the total volume of the Domino stream is estimated - worst case, 100% CH_4 (methane) in the mixing zone to be burned.
	CO		45.432659		
	PM		0.284719		
	CH_4		17.190736		
	VOC		-		
	SO_2		-		
	N_2O		-		
	CO_2		13,664		
Onshore Preparation and commissioning of the production pipeline (GPP) - filling	NO_X	Diesel	0.000389	Intermittent	The duration of pipeline preparation is 15 days with operation 12 hours/ day Filling duration 6 days. Filling - 6 days, energy generator x 1 @ 25lt/ hr, air compressor x 1 @ 45lt/ hr.
	CO		0.000084		
	PM		0.000027		
	CH_4		-		
	VOC		-		
	SO_2		0.000026		
	N_2O		-		
	CO_2		12.70210		
Onshore Preparation and commissioning of the production pipeline (GPP) - Hydrotest	NO_X	Diesel	0.002920	Intermittent	Hydrotest - 5 days, Transfer pump - x1 @ 80lt/ hr, HP pump - x4 @ 120lt/ hr, energy generator x 1 @ 25lt/ hr, compressed air compressor x 1 @ 45lt/ hr.
	CO		0.000629		
	PM		0.000205		
	CH_4		-		
	VOC		-		
	SO_2		0.000192		
	N_2O		-		
	CO_2		95.2657		
Onshore Preparation and commissioning of the production pipeline (GPP) – Emptying and pressure tests	NO_X	Diesel	0.061484	Intermittent	Emptying and pressure tests - 4 days, Primary compressor x 10 @ 140lt/ hr, Generator for NPU x 5 @ 50lt/ hr, Booster x 2 @ 155lt/ hr, Exhaust pump x 1 @ 100lt/ hr, Energy generator x 1 @ 13lt/ hr.
	CO		0.013245		
	PM		0.004322		
	CH_4		-		
	VOC		-		
	SO_2		0.004043		
	N_2O		-		
	CO_2		2,006,2053		
installation of offshore equipment and installations	NO_X	Diesel	1.401416	Intermittent	See estimates 24 hours/ day - 2 forklifts and 1 crane estimate 3l/ h forklift. estimate 8l/ h crane Consumption 350 liters/ day.
	CO		0.301892		
	PM		0.098512		
	CH_4		-		
	VOC		-		

Description	Pollutant	Fuel	Amount tons/ year	Emission type	Remarks
	SO_2		0.092157		
	N_2O		-		
	CO_2		45,727,545		
Evacuation of the starting gas (ignition of the flare)	NO_X	Gas	-	Intermittent	The mixing zone is estimated to represent 10% of the GPP requirement, or circa 16 km of N_2 at 14 bar pipe pressure. Estimated mass of methane vented prior to HP Flare ignition is 65 tons (100% CH4 assumed in mixing zone). Pelican, 1.5 km pipeline It estimates that the system is left at 14 bar pressure and N_2 is blown throughout the system before the HP pilots are ignited. It is estimated that 0.5 t of methane is vented prior to ignition of the HP Flare (cold methane) pilots. 1 te = 66 tons. Duration is unknown
	CO		-		
	PM		-		
	CH_4		65.408372		
	VOC		0.447550		
	SO_2		-		
	N_2O		-		
	CO_2		0.144078		
Emissions from transport (Helicopter)	NO_X	Combustible aviation	0.063842	Intermittent	The distance to the platform is 160km (*2=320km). During the construction, it is estimated that there will be 4 helicopter flights/ day. Fuel consumption is 5.5 km/ l at a density of 762 kg/ m3
	CO		19.152524		
	PM		-		
	CH_4		-		
	VOC		0.303248		
	SO_2		0.01596		
	N_2O		-		
	CO_2		49,477		
Transport emissions (vessels using MGO)	NO_X	MGO	3,021.425600	Intermittent	Consumption per ship and per day is presented in table 2.32
	CO		160.696320		
	PM		-		
	CH_4		-		
	VOC		73.234000		
	SO_2		76.16336		
	N_2O		-		
	CO_2		134,164,688		

The total amount of pollutants emitted during the offshore construction period is presented in the table below:

Table 2.36 The total amount of pollutants emitted into the air during the construction period at sea

Pollutant	Average quantity (tonnes)	
	Continuous emissions	Intermittent emissions
NO_X	3.01	3,056
CO	0.77	361.92
PM	0.06	1,395
CH_4	0.08	134.17
VOC	0.02	73.98
SO_2	0.01	76.28
N_2O	-	-
CO_2	2,825	238,173

b) The types, amounts of gaseous and dust pollutant emissions and their composition generated by the project during the well drilling phase

The sources of emissions in the well drilling phase are the following:

- Emissions from diesel powered crane operation generating CO_2, CO, NO_X, N_2O, CH_4, SO_2 and VOCs. The cranes are assumed to operate for 12 hours per day for a total of 800 days during the drilling period and consume 2.5 liters of fuel per hour of operation.
- Gas emissions from the operation of the rig's eight diesel fueled power generators generating CO_2, CO, NO_X, N_2O, CH_4, SO_2 and VOCs. They are estimated to operate 24 hours/ day for 800 days, with an estimated diesel consumption of 50 tons/ day.
- Emissions from the operation of temporary diesel fueled equipment generating CO_2, CO, NO_X, N_2O, CH_4, SO_2 and VOCs. The Riserless Mud Recovery (RMR) system is estimated to consume 500 litres/ hour for 80 days. Wireline (WL) and General Pumps (GP) are estimated to consume 458.37 litres/ hour, for 5 days and 2 days respectively.

The sources of emissions from transport are the following:

- Helicopter emissions that generate CO_2, CO, NO_X, N_2O, CH_4, SO_2 and VOCs. It is estimated that during construction, 1 trip/ day will be carried out for 800 days. The distance from NGMS and Pelican is 218 km and to Domino is 238 km. Fuel consumption is estimated at 5.5 km/ l
- Emissions from vessels used for transport (support vessels, anchor handling tugs, multipurpose vessels (MSVs)) generate CO2, CO, NOX, CH4, SO2 and VOCs. An estimated duration of 800 days for support vessels and anchor handling tugs, multi-functional vessels (MSV) 60 days. Fuel consumption is estimated at 35 tons/ day.

CALCULATION OF THE FLOW OF POLLUTANTS EMITTED DURING WELL DRILLING

The calculation of pollutant flows emitted by mobile sources was carried out using the EPA Air Emissions Factors Quantification AP-42 methodology, using:

- The emission factors from section 1.3 for the calculation of emissions from Diesel generators,

  Emission factors from ships are from the EMEP/ EEA Air Pollutant Emission Inventory Guidebook, 1.A.3.d Navigation-Shipping 2019 - update 2021. (Efs for MGO users), Table 0-2
- The emission factors for helicopters are from the EMEP/ EEA Air Pollutant Emission Inventory Guidebook, 1.A.3.a Aviation 2019. (Efs for helicopters), table 3.3

In the calculation hypothesis, the following was considered:

- The density of Diesel fuel is minimum 820 kg/ m3 and maximum 845 kg/ m3. An average density of 832.5 kg/ m3 was used in the calculation. LHV = 11.83 KWh/ kg
- The density of MGO marine fuel at a temperature of 15 °C is 860 kg/ m3 The density of MGO taken as 860 (at 15 ° C).
- The density of helicopter fuel is 762 kg/ m3

Table 2.37 Estimation of the amount of pollutant emissions in the well drilling phase

Description	pollutant	Fue	Amount tons/ year	Emission type	Remarks
Diesel generators	NO_X	Diesel	2.6930	Continuously	31.5 MW @ 50 t/ day, 24 hours/ day, 800 days 8 Diesel generators (42 MW) 75% utilization is estimated under normal conditions (drilling system, DP thrusters, utilities) for 24 hours/ day Estimated consumption is 50 tons/ day
	CO		0.7153		
	PM		0.0842		
	CH_4		-		
	VOC		-		
	SO_2		0.850		
	N_2O		-		
	CO_2		121,093		
Diesel temporary equipment	NO_X	Diesel	0.228483	Intermittent	RMR uses 12m ^{3}/ day, 80 days = 500 l/ hour WL - 5 days, 1m ^{3}/ day/ well = 458.37 l/ hour GP pump skids - 2 days/ well 1m^3/ day = 458.37 l/ hour for 10 wells + 1 rebore = 1416.74 l/ hour
	CO		0.049220		
	PM		0.016061		
	CH_4		-		
	VOC		-		
	SO_2		0.015025		
	N_2O		-		
	CO_2		7,455.306068		
Crane	NO_X	Diesel	0.001854	Intermittent	Average 12 hours/ day, 800 days with consumption of 2.5 l/ hour
	CO		0.000399		
	PM		0.000130		
	CH_4		-		
	VOC		-		
	SO_2		0.000122		
	N_2O		-		
	CO_2		60.4862		
Transport emissions (Helicopter)	NO_X	Aviation Fuel	0.305908	Intermittent	It is estimated that during construction, 1 trip/ day will be carried out for 800 days. The distance from NGMS and Pelican is 218 km and to Domino is 238 km. Fuel consumption is estimated at 5.5 km/ l with a fuel density of 762 kg/ m^3
	CO		91.772509		
	PM		-		
	CH_4		-		
	VOC		1.453065		
	SO_2		0.076477		
	N_2O		-		
	CO_2		237.0790		
Transport emissions (ships with MGO fuel)	NO_X	MGO	9,476,250	Intermittent	2 transport vessels per campaign, 2-3 support vessels with continuous rotation (platform/ transit/ port) on continuous rotation Pelican anchor handling tug - 1 month mobilization and 1 month demobilization.
	CO		504.00		
	PM		-		
	CH_4		-		
	VOC		229.68750		
	SO_2		238.8750		
	N_2O		-		
	CO_2		420,787.50		

Table 2.38 The total amount of pollutants emitted into the air during the well drilling period

Pollutant	Average quantity (tonnes)	
	Continuous emissions	Intermittent emissions
NO_X	2.6930	9,477
CO	0.7153	595.82
PM	0.0842	0.0162
CH_4	-	-
VOC	-	231.14
SO_2	0.850	238.97
N_2O	-	-
CO_2	121,093	428,540

c) The types, amounts of gaseous and dust pollutant emissions and their composition generated by the project during the operation phase

Onshore emissions

The sources of emissions during the operating period, from transport, are the following:

- Emissions of combustion gases from motor vehicles using petrol or diesel. These generate CO_2, CO, NO_X, N_2O, CH_4, SO_2, VOCs. It is estimated that the team's vehicles will travel at 60 km/ h, 365 days/ year with 50% diesel vehicles and 50% gasoline vehicles.

Sources of emissions under normal operating conditions are the following:

- Emissions from the diesel backup power generator;
- Emissions from filter replacement are estimated 2 times/ year, for 20 minutes to change the filters and empty the separator (0.6 t/ event).
- Emissions from pigging calibration, an annual calibration is estimated for the first two years and once every 4 years thereafter, according to the risk integrity analysis (together with the annual technical maintenance) (0.19 t/ event), for 20 minutes.
- Emissions during the planned technical maintenance (8 tons/ event), based on the physical volume of the entire facility on land of 170 m^3 (between the inlet and outlet valves), a maintenance is estimated once every 4 years, in parallel with the platform maintenance, for 40 minutes.
- Fugitive emissions – emissions from safety valves (PSV) due to sealing losses of PSV valves, assuming emission class V. Estimated annual emissions are 0.11 tonnes, including a 100% margin.
- Fugitive emissions from flange emissions (0.25 tonnes/ year), based on a current estimate of 200 flanges (which could increase), each flange having an acceptable emission rate of <1.4 m^3/ year.

CALCULATION OF FLOWS OF POLLUTANTS EMITTED DURING ONSHORE OPERATION

The calculation of pollutant flows emitted by mobile sources was carried out using the EPA Air Emissions Factors Quantification AP-42 methodology, using the emission factors from section 1.3

In the calculation hypothesis the following was considered:

- The density of Diesel fuel is minimum 820 kg/ m^3 and maximum 845 kg/ m^3. An average density of 832.5 kg/ m^3 was used in the calculation. LHV = 11.83 KWh/ kg

Table 2.39 Estimation of the amount of pollutants emitted into the air during the period of operation

Description	Pollutant	Fuel	Quantity tons/ year	Emission type	Remarks
Backup Diesel Generator	NO_X	Diesel	0.000205	Intermittent	Estimated 1 hour/ week It is estimated 305 KVA with a consumption of 70l/ hour
	CO		0.000054		
	PM		0.000006		
	CH_4		-		
	VOC		-		
	SO_2		0.000065		
	N_2O		-		
	CO_2		9.21		
Emissions from filter replacement	NO_X	Gas		Intermittent	It is estimated 2 times/ year, for 20 minutes to change the filters and empty the separator (0.6 t/ event).
	CO		-		
	PM		-		
	CH_4		1.189243		
	VOC		0.008137		
	SO_2		-		
	N_2O		-		
	CO_2		0.002620		
Emissions from pigging calibration	NO_X	Gas	-	Intermittent	an annual calibration is estimated in the first two years and once every 4 years thereafter, in accordance with the risk integrity analysis (together with the annual technical maintenance) (0.19 t/ event), for 20 minutes
	CO		-		
	PM		-		
	CH_4		0.188297		
	VOC		0.001288		
	SO_2		-		
	N_2O		-		
	CO_2		0.000415		
Emissions during planned technical maintenance	NO_X	Gas	-	Intermittent	The volume of gas in the entire installation is 170m ^{3} (between the inlet and outlet valves) - a depressurization is estimated at a pressure of 55 Bar -. Every 4 years in parallel with platform maintenance. During operation, there will be 5 maintenances, so 40 tons of 8 t per operation will be emitted.
	CO		-		
	PM		-		
	CH_4		7.928287		
	VOC		0.054248		
	SO_2		-		
	N_2O		-		
	CO_2		0.017464		
Emissions from Safety Valves (PSV)	NO_X	Gas	-	Intermittent	Based on emission class V (tbc during EPC phase). 3 x 40E50 PSV (heaters), 2 x 80J100 PSV (separating filter - 1 active and one reserve,
	CO		-		
	PM		-		
	CH_4		0.109014		
	VOC		0.000746		
	SO_2		-		

Description	Pollutant	Fuel	Quantity tons/ year	Emission type	Remarks
	N_2O		-		in stand-by) - only one was taken into account in the calculation. The annual emission is 0.11 t (with a margin of 100% because Class V emission refers to liquids and not gases) .
	CO_2		0.000240		
Fugitive emissions caused by emissions at flanges	NO_X	Gas	-	Intermittent	based on a current estimate of 200 flanges (which could increase), each flange having an acceptable emission rate of <1.4 m3/ year, emission 0.25 t/ year.
	CO		-		
	PM		-		
	CH_4		0.247759		
	VOC		0.001695		
	SO_2		-		
	N_2O		-		
	CO_2		0.000546		
Emissions from transport (diesel and petrol)	NO_X	Diesel and gasoline	0.007175	continuously	It is estimated that the team's vehicles will travel at 60 km/ h, 365 days/ year with 50% diesel vehicles and 50% gasoline vehicles.
	CO		0.010139		
	PM		0.000135		
	CH_4		-		
	VOC		0.001133		
	SO_2		0.000014		
	N_2O		0.000087		
	CO_2		0.070128		

Table 2.40 ***The total annual amount of pollutants emitted into the air during the operating period from the offshore activity***

pollutant	Average quantity (tons/ year)	
	Continuous emissions	Intermittent emissions
NO_X	0.00717	0.00020
CO	0.01014	0.00005
PM	0.00014	0.00001
CH_4	0.00000	9.66260
VOC	0.00113	0.06442
SO_2	0.00001	0.00006
N_2O	0.00009	0.00000
CO_2	0.07013	9.22652

Offshore emissions under normal operating conditions

The sources of offshore emissions during the operating period are the following:

- Emissions from gas turbine generators (GTG) containing the following pollutants CO_2, CO, NO_X, N_2O, CH_4, SO_2, VOCs. The GTGs are estimated to operate for 24 hours a day with 2 active units and a fuel consumption of 2,251 kg/ h;
- Fugitive emissions due to flange losses (exhaust), which generate CO_2, CH_4 and VOCs. An estimated number of 750 flanges (this number may increase) and each flange has

an acceptable loss rate of <1.4 m ^{3}/ year. Fugitive emissions from flange losses are not connected to the platform flare systems, therefore they are released into the air.

- Exhaust from the analyzer (exhaust), which generates CO_2, CO, NO_X, CH_4 and VOCs. An estimate is made based on the dew point analyzer for the wet gas, which is expected to be of the "grab" type with sequential analyses. As sampling volumes and emissions will be very small, emissions are assumed to be 0.0024 t/ d.
- Emissions from diesel fueled essential service generator and emergency start generator (BSG) operation, which generate CO_2, CO, NO_X, N_2O, CH_4, SO_2 and VOCs. It is estimated that there will be a 4 hour run test every two weeks for each generator, ESG and BSG rated at 1MW, and 800kW.
- Emissions from testing the Totally Enclosed Diesel Propelled Survival Craft (TEMPSC), which generates CO_2, CO, NO_X, N_2O, CH_4, SO_2 and VOCs. It is assumed that TEMPSC tests will take place during visits to the SWP for 4 hours per day and 4 times per year, for a total duration of 16 hours per year.

Sources of emissions from shipping:

- Emissions from vessels resulting from the use of Perimeter Support Vessels (FSVs) and Underwater Inspection, Repair and Maintenance (IRM) FSVs, as well as Domino pig cleaning, include the following pollutants CO_2, CO, NO_X, CH_4, SO_2 and VOCs. The FSV and FSV for underwater MRI, cleaning with the Domino pig are assumed to be operational for 90 and 30 days per year, respectively, with a fuel consumption of 20 tons/ day.

Sources of emissions from flare systems, fugitive emissions during operation under normal conditions of activity:

- Continuous emissions from the LP Flare from the TEG regenerator and produced water degasser, as well as the Header Purge, generate gaseous combustion products including CO, CO, NO, CH, PM and VOCs;
- Purging LP/ HP Flare Systems and pilots generates CO, CO, NO, CH and VOCs. It is estimated that a continuous supply of purge gases to the LLP, LP head and HP head is required and the fuel consumption is based on the GBA combustion peaks.
- Fugitive emissions due to losses at pressure relief valves (PSVs) and pressure control valves (PCVs) generate CO, CH and VOCs. The PSVs are expected to be "leak tight" as they will be tested and replaced in service in the event of lifting to confirm tightness. Losses from the PCV are caused by wear and tear during operation. The loss class is assumed to be V for both PSVs and PCVs. Emissions with a 100% margin are estimated to be 1.2 tonnes/ year.
- Methanol, the blanket gas of TEG tanks (flame) generates CO_2, CO, NO_x, CH_4 and VOCs. It is estimated that full refilling of the storage tanks occurs quarterly, with a low pressure, assuming a density of 1 kg/ m ^{3} and an additional loss of 20% during the year.

- TAR (Plant Turnaround) for HP flare generates CO_2, CO, NO_X, N_2O, CH_4, SO_2 and VOCs. Five TARs are planned per production period, one every 4 years, with a duration of 2 days and a total volume of 4,000 tons for each TAR event.
- Planned verification of platform pig receiver/ launcher to HP Flare generates CO_2, CO, NO_X, N_2O, CH_4, SO_2 and VOCs. Cleaning of the SWP pig receiver/ launcher will be done annually for the first two years and then with the SWP TAR. Therefore, two additional inspections will take place during the production period with emissions of 0.72 t/ event with a duration of 27 seconds.

CALCULATION OF FLOWS OF POLLUTANTS EMITTED DURING OFFSHORE OPERATION

The calculation of pollutant flows emitted by mobile sources was carried out using the EPA Air Emissions Factors Quantification AP-42 methodology, using:

- The emission factors from section 1.3 for the calculation of emissions from Diesel generators
- Emission factors from Table 3.1-1 and Table 3.1-2a for gas turbine main generators
- Emission factors from table 13.5.1 Emission Factors for Flare operations
- Emission factors from ships are from the EMEP/ EEA Air Pollutant Emission Inventory Guidebook, 1.A.3.d Navigation-Shipping 2019 - update 2021. (Efs for MGO users), Table 0-2

In the calculation hypothesis, the following was considered:

- The density of Diesel fuel is minimum 820 kg/ m^3 and maximum 845 kg/ m^3. An average density of 832.5 kg/ m^3 was used in the calculation. LHV = 11.83 KWh/ kg
- The density of MGO marine fuel at a temperature of 15 ℃ is 860 kg/ m^3 The density of MGO taken as 860 (at 15°C).

Table 2.41 Estimation of pollutant emissions during offshore operation

Description	Pollutant	Fuel	Quantity tons/ year	Issue type	Remarks
Diesel generator essential services	NO_X	Diesel	0.0022	Intermittent	Generator testing is estimated for 4 hours every 2 weeks. (Total number of hours per year = 104 at 1 MW).
	CO		0.0006		
	PM		0.0001		
	CH_4		-		
	VOC		-		
	SO_2		0.0007		
	N_2O		-		
	CO_2		100.43		
Backup Diesel Generator	NO_X	Diesel	0.000350	Intermittent	Generator testing is estimated for 4 hours every 2 weeks. (Total number of hours per year = 104 at 800 MW).
	CO		0.000093		
	PM		0.000011		
	CH_4		-		
	VOC		-		
	SO_2		0.000110		
	N_2O		-		

Description	Pollutant	Fuel	Quantity tons/ year	Issue type	Remarks
	CO_2		15.74		
Gas turbine generators	NO_X	Gas	158,677	Continuous	GTGs are estimated to operate for 24 hours a day with 2 active units and a fuel consumption of 2,251 kg/ h
	CO		40,661		
	PM		3,273		
	CH_4		4,264		
	VOC		1,041		
	SO_2		-		
	N_2O		0.0119625		
	CO_2		53,925.25		
TEMPSC test	NO_X	Diesel	0.0000004	Intermittent	It is assumed that TEMPSC tests will take place during visits to the SWP for 4 hours per day and 4 times per year, for a total duration of 16 hours per year.
	CO		0.0000001		
	PM		0.00000003		
	CH_4		-		
	VOC		-		
	SO_2		0.00000002		
	N_2O		-		
	CO_2		0.012109		
Flaca LP – Purge and Pilots	NO_X	Fuel Gas	0.434471	Continuously	LLP and LP purge head require daily - 0.6 tons/ day Based on GBA flare tip, 1.2 kg/ hour per pilot, 3 pilots – 0.09 tons/ day Total gas consumption = 0.69 t/ day.
	CO		2.36403602		
	PM		0.01481501		
	CH_4		0.89450012		
	VOC		-		
	SO_2		-		
	N_2O		-		
	CO_2		694,728		
Purge HP flare and light pilot	NO_X	Gas	0.483	Continuously	HP flare purge gas required under normal conditions - 0.7 tons/ day Based on GBA flare tip, 1.2 kg/ hour per pilot, 3 pilots – 0.09 tons/ day Total gas consumption = 0.79 t/ day.
	CO		2,629		
	PM		0.016		
	CH_4		0.995		
	VOC		-		
	SO_2		-		
	N_2O		-		
	CO_2		790.55		
TAR (Inspection and maintenance) for Facla HP - 1 TAR event (average - t/ event)	NO_X	Gas	6.679829	Intermittent	5 TARs during the production period, 1 every 4 years and lasts 7 days 4,000 tons/ TAR event
	CO		36.346127		
	PM		0.227775		
	CH_4		13.752589		
	VOC		-		
	SO_2		-		
	N_2O		-		
	CO_2		10,931.384667		
HP Flare – Planned check on platform pig	NO_X	Gas	0.001209	Intermittent	Cleaning of the SWP pig receiver/ launcher will be done annually for the first two years and then with the SWP TAR. Therefore, two additional
	CO		0.006576		
	PM		0.000041		
	CH_4		0.002488		

Description	Pollutant	Fuel	Quantity tons/ year	Issue type	Remarks
receiver/ launcher	VOC		-		inspections will take place during the production period with emissions of 0.72 t/ event with a duration of 27 seconds.
	SO_2		-		
	N_2O		-		
	CO_2		1.977897		
Methanol, the blanket gas of TEG tanks (flame)	NO_X	Fuel Gas	0.004843	Continuous	The tanks are refilled quarterly: Methanol 400 x 4m^3, TEG 200 x 4m^3 Total 2400 m^3. Low pressure at the density of Low 1kg/ m^3. an additional loss of 20% per year is estimated = 2.9 tons/ year
	CO		0.026351		
	PM		0.000165		
	CH_4		0.009971		
	VOC		-		
	SO_2		-		
	N_2O		-		
	CO_2		7.925254		
Fugitive emissions – losses from PSV & PCV (Flaring)	NO_X	Gas	0.002004	Continuously	The PSVs are expected to be "leak tight" as they will be tested and replaced in service in the event of lifting to confirm tightness. Losses from the PCV are caused by wear and tear during operation. The loss class is assumed to be V for both PSVs and PCVs. Based on class V losses (tbc during the EPC phase). 1 x 16" PCV (Primary Separator), 1 x 6" PCV (TEG contactor, 1 x 12" PSV (Primary Separator), 1 x 4" PSV (TEG Contactor) = 1.2 t/ year
	CO		0.010907		
	PM		0.000068		
	CH_4		0.004127		
	VOC		-		
	SO_2		-		
	N_2O		-		
	CO_2		3.279355		
LP flare - continuous flame	NO_X	Gas	0.191958	Continuously	LP continuously discharged from the TE regenerator and the produced water degasser. From H&MB Case 3 (Max water), the total is 0.253 MMscfd (all hydrocarbons, CH4) Purging is additional and continuous (26.1 kg/ hour) estimated (extra line) = 4.9 tons/ day.
	CO		1.044476		
	PM		0.006546		
	CH_4		0.395207		
	VOC		-		
	SO_2		-		
	N_2O		-		
	CO_2		4,891.0		
Fugitive emissions - losses from flanges (Venting)	CH_4	Gas	0.990366	Continuous	An estimated number of 750 flanges (this number may increase) and each flange has an acceptable loss rate of <1.4 m^3/ year. Fugitive emissions from flange losses are not connected to platform flare systems and are not burned. Emissions of 1 t/ year are estimated
	C_2H_6		0.00130		
	C_3H_8		0.000546		
	iC_4H_{10}		0.000360		
	iC_5H_{12}		0.000447		
	nC_5H_{12}		0.000447		
	nC_6H_{14}		0.001068		
	N_2		0.002604		
	CO_2		0.002182		
Analyzer Losses (Venting)	CH_4	Gas	0.868742	Continuous	An estimate is made based on the dew point analyzer for the wet gas, which is expected to be of the "grab" type with sequential analyses. As sampling volumes and emissions will be very
	C_2H_6		0.00114		
	C_3H_8		0.000479		
	iC_4H_{10}		0.000316		
	iC_5H_{12}		0.000392		

Description	Pollutant	Fuel	Quantity tons/ year	Issue type	Remarks
	nC_5H_{12}		0.000392		small, emissions are assumed to be 0.0024 t/ d.
	nC_6H_{14}		0.000937		
	N_2		0.002284		
	CO_2		0.001914		
Emissions from transport (Ships use MGO)	NO_X	MGO	173.3	Intermittent	It is estimated that the FSV and FSV for underwater MRI, cleaning with the Domino pig are operational for 90 and 30 days per year, respectively, with a fuel consumption of 20 tons/ day.
	CO		9.2160		
	PM		-		
	CH_4		-		
	VOC		4.20		
	SO_2		4.3680		
	N_2O		-		
	CO_2		7,694.40		

Table 2.42 The total annual amount of pollutants emitted into the air during the operating period from the offshore activity

pollutant	Average quantity (tons/ year)	
	Continuous emissions	Intermittent emissions
NO_X	159.79	179.96
CO	46.72	45,57
PM	3.31	0.2279
CH_4	8.42	13.76
VOC	-	4.20
SO_2	-	4.37
N_2O	0.01	-
CO_2	70,453.61	18,743.95

d) Types, quantities of gaseous and dust pollutant emissions and their composition generated by the project in the decommissioning phase

The types, amounts of gaseous and dust pollutant emissions and their composition generated during decommissioning will be available upon completion of the decommissioning/ abandonment plan prior to the commencement of decommissioning works.

The composition of atmospheric emissions during the decommissioning phase include:

- NOx, SO_2, CO, CO_2, PM, from internal combustion engines of vehicles, ships and barges, and other equipment;
- Powders (dust) clearance of the site, vehicle traffic, handling of materials and waste.

2.5.3.2 Methods of capture, treatment and storage of emissions in the atmosphere

It is not expected that specific installations for the retention and dispersion of pollutants in the atmosphere will be installed during the construction period. Drilling/ construction/ installation vehicles and equipment will be checked to ensure compliance with applicable air protection regulations.

During the operating period, no gas odorization equipment (mercaptan equipment) will be included in the NGMS.

During the period of operation, an onshore gas dispersion stack and 2 flare systems on the offshore production platform will be operational.

A brief description of these facilities is provided in the paragraphs below.

Gas dispersion vent installed at NGMS

The maximum height of the vent is 12 meters due to local height restrictions. The vent will be provided will be provided with a tip equipped with high temperature thermocouple elements and a control panel for the burner. The thermocouples will be connected directly to the control panel where an alarm will be set to indicate accidental ignition of the vent. As a safety requirement, the vent tip will be fitted with electrostatic rings and cylinder to reduce the possibility of sparking. The vent tip shall be installed with flanges to allow easy replacement during maintenance.

The ventilation column will be equipped with a silencer to meet the local noise standards imposed by the regulations in force.

The gas dispersion vent shall be positioned away from any source of ignition and/ or overhead power line and shall be designed to ensure adequate dispersion of gases. The basket will be positioned at least 50 m away from the equipment or the fenced boundary of the site.

Neptun Alpha has two separate flare systems:

- Low pressure system (LP Flare): gases arrive from all overpressure sources from upstream equipment with design pressure not higher than 45 barg; plus low flow/ inventory operational emissions from process plant that cannot tolerate excessive variable back pressure.
- High pressure system (HP Flare): gases arrive from all overpressure sources from upstream equipment with a design pressure greater than 45 barg; plus high flows from pressure control functions that are part of the process start-up system and short-term operational interruptions.

Each of these systems is completely independent of the other.

D1 Low Pressure Flare System (LP Flare) - Design

The low pressure flare system is designed to incorporate operational low pressure (wet gas) sources. Platform overpressure protection ensures that no liquid discharges are allowed into the LP combustion system. The exception to this is the discharge of rupture disks from the wet gas cooler.

Sources associated with LP flare are routed to a KO tank dedicated to the LP flare. All liquid collected in this KO tank is directed to the produced water degasser, which is then directed to the produced water discharge caisson.

The KO drum is sized for maximum gas flow and is designed so that no liquid droplets larger than 450 microns are present in the updraft directed to the flare.

D2 High Pressure Flare System (HP Flare) - Design

Sources associated with HP Flare are directed to a KO drum related to the HP Flare. All liquids collected in this KO drum are directed to the produced water discharge caisson based on the absence of liquid hydrocarbons.

The KO drum is sized for maximum gas flow and is designed so that no liquid droplets larger than 600 microns are present in the exhaust stream directed to the flare.

D3 Flare Structure, Flare Tip

The flare system includes:

- A common support arm for the HP and LP flare on the East side of Neptun Alpha.
- HP flare tip
- LP flare tip

The HP tip is a type of sonic equipment, so the back pressure generated in the flare bridge results in practical sizing of the flare column. HP and LP flare tips are at a common elevation of 105 meters above sea level as determined by boom length evaluation, flame radiation and standard performance criteria;

The HP flare tip is designed for a maximum flow of 950 MMSCFD.

The LP tip is designed for the maximum identified overpressure emergency release scenario. This is identified as the gas flow entering from the primary separator to the produced water degasser.

The reduction flow rate is defined as the lowest flow rate at which the selected flare tip will operate while maintaining sonic flow conditions. Flow below this level is subsonic, where reduced air entrainment can result in incomplete combustion. The LP flare is a type of subsonic equipment because it must maintain a low back pressure during the low flow exhaust period.

Gas for the flare pilot systems is taken from the low pressure fuel gas system. Both HP and LP flares use the same pilot gas ignition systems. The primary pilot gas ignition source uses a high energy electric spark system capable of multiple ignition attempts. There are flameout detection sensors that monitor HP and LP pilot gas ignition.

There is no rigid duct interconnected atmospheric ventilation system. Equipment is provided with local air vents where practical and safe.

The flare structure includes a vertical access ladder similar to the ship type ones from deck level to the top, complete with rest platforms every 10m, fall arrest system and lockable swing gate to platform deck access.

2.5.3.3 The characteristics of the sources of emissions in the atmosphere as well as the characteristics of their elimination (e.g. location, stack height, treatment and storage of these emissions)

The sources of emissions into the atmosphere during the operating period include:

- The electric power generators on the marine production platform;

- The essential generator on the marine production platform;
- The reserve generator on the platform
- Offshore production rig flare systems ;
- Gas dispersion vent installed at NGMS ;
- Diesel generator used in case of breakdown from NGMS.

The characteristics of the emission sources are presented below:

Gas turbine generators

- Type: Gas turbine generators
- Number: 3;
- Input data: 9.2 MW;
- Estimated annual operating hours: 2*50%, 1 reserve
- Fuel type: natural gas;

Essential generator:

- Number: 1 piece of 975 kW;
- Estimated annual operating hours: Estimated generator testing for 4 hours every 2 weeks. (Total number of hours per year = 104 at 1 MW).
- Fuel type: diesel

Backup generator

- Number: 1 pc;
- Estimated annual operating hours: Estimated generator testing for 4 hours every 2 weeks. (Total number of hours per year = 104 at 800 MW).
- Fuel type: diesel

LP Flare System

- Number: 1;
- Estimated annual operating hours: continuous operation 365 days/ year;
- Gas type: natural gas.
- The height of the stack from the platform level (m): 77.8;
- Boom angle: 45°
- Actual height (m): 107.87
- Stack diameter (m): 0.450 m;

- Exit temperature (K): 1473.15;
- Exit velocity (m/s): 5.7
- Exhaust mass flow in reference conditions: 4.9 tons/ day

HP Flare System

- Number: 1;
- Estimated annual operating hours: interrupted operation
- Gas type: natural gas.
- Stack height from the platform level (m): 77.8;
- Actual height (m): 108.99
- Stack diameter (m): 0.5973 m;
- Exit temperature (K): 1473.15;
- Exit velocity: 1357.5 (abnormal operating conditions)

NGMS Vent Stack

- *Quantity:* 1;
- *Estimated annual operating hours:* 20 minutes once every 4 years;
- *Gas type:* natural gas;
- *Stack height* (including silencer): 12m;
- Stack diameter (m): 0.30 m;
- *Exhaust gas temperature* (K): 228;
- Exit velocity: 447 m/s

NGMS backup generator:

- *Number:* 1 piece of 120 kW;
- *Estimated annual operating hours:* Estimated 1 hour/ week 305 KVA with a consumption of 70 l/ hour
- *Fuel type:* diesel;
- *Exhaust gas temperature* (K): 513;

2.5.4 Information on the potential for resource recovery from waste and residues, including reuse, recycling or energy recovery from solid waste or liquid effluents

The waste is collected selectively both at sea and on land and the recyclable waste is sent to authorized economic operators for recovery.

Waste resulting from project activities is not disposed of by final disposal if there is another option for example disposal with energy recovery.

The non-aqueous drilling fluid used to drill the wells is recovered, separated from the cuttings and re-introduced into the technological process.

2.5.5 Identification and quantification of noise and vibration sources from the project;

2.5.5.1 Identification and quantification of noise and vibration sources during the construction period

Sources during construction/ installation on land

During the construction period, the noise sources will have a temporary character and duration and will manifest themselves locally and intermittently.

The Constanța - Mangalia railway passes in the area of the project perimeter, so there will be a background noise that manifests itself locally and is for a short period of time.

The main sources of noise during the construction/ installation period on land will be represented by:

- Car traffic in the project area
- Operation of equipment used during construction work
- Excavation activities for the organization of the site, the execution of trenches for laying the production pipeline, the execution of the launch pit, respectively the loading and unloading of the soil;

Noise and vibration sources during construction/ installation at sea

The noise generated will be on surface and underwater.

The sources of noise during construction/ installation at sea are the following:

- Execution of dredging/ trenching works and their filling;
- Execution of the microtunnel exit path
- Installation of the production platform (eg, jacket piles), production pipeline, supply/ supply pipelines and other subsea equipment;
- Noise generated by transport ships, construction/ installation;

In order to assess the level of noise associated with the construction/ installation activity, an underwater noise modeling was carried out. The modeling is presented in Annex M

2.5.5.2 Identification and quantification of noise and vibration sources during well drilling

The sources of noise and vibrations during the well drilling period are the following:

- Well drilling
    - Surface noise (equipment and machines);

- Subaquatic noise (the actual drilling);
- Equipment related to the drilling platform (eg power generators, cranes, etc.)
- Noise generated by support vessels;
- Aerial noise, produced by helicopters used to transport personnel, equipment or medical emergencies.

In order to evaluate the noise level associated with the drilling activity of the wells, an underwater noise modeling was carried out. The modeling is presented in Annex M.

2.5.5.3 Identification and quantification of noise and vibration sources during operation

Noise sources during operation in the NGMS and CCR area

- Operation under normal operating conditions:
  - Control valve and overhead piping ~ 75 dB LpA at 1m;
  - Flow conditioning devices and downstream overhead pipes~ 75 dB LpA at 1m;
  - Other additional noise-generating/ flow-restricting devices in the piping system and downstream overhead piping with estimated noise levels >75 dB LpA at 1 meter
  - Relief valves, pressure relief valves and associated orifices and downstream overhead piping up to and including the ventilation trench - 85 dB LpA at the nearest normally accessible location in an emergency, if practicable, but not exceeding 110 dB LpA
  - External air conditioning unit from CCR building ~ 60 dB LpA at 1m
  - Diesel generator operation: estimated 1 hour/ week ~ 75 dB LpA at 1m. The generator is equipped with an insulating case and vibration dampers.
  - Venting during maintenance: Maintenance is estimated to be performed once every 4 years for approximately 20 minutes

When performing maintenance or in emergency situations, the installation is depressurized so that the gas flow will be redirected to the vent stack through the pressure safety valves (PSV), unloading valves (BV) and restriction orifices (RO) in the NGMS. Pressure relief valves (PSVs), relief valves (BVs), restriction orifices (ROs) and downstream connected piping will generate high noise levels, typically in the range of 120-140 dB LpA at 1 meter, due to the high flow and pressure drop across the valves and associated orifices. However, with acoustic insulation on the downstream ducts and the silencer-equipped vent, it is expected to reduce noise levels by 20-30 dB(A).

To assess the level of noise associated with the NGMS , a noise modeling was performed. The modeling is presented in Annex M

Noise sources during operation at sea

The sources of noise during operation at sea are the following:

- Offshore production platform equipment and operations;
- Operations and maintenance vessel traffic and equipment.

2.5.6 Identification and quantification of sources of heat, light or other form of electromagnetic radiation originating from the project;

Welding work is a source of light and thermal radiation, during the construction/ installation period (for example, during the preparation of the pipeline for installation in the onshore pipeline assembly area, the installation of offshore pipelines and the Neptun Alpha Platform, etc.) and the operation period (for example, welding work during the performance of periodic maintenance work);

During the drilling of the 10 wells, geophysical investigations of the well holes are carried out using radioactive methods.

2.5.7 Presentation of the methods for estimating the quantities and composition of all identified residues and emissions, as well as possible difficulties.

The estimation of the quantities and composition of residues and emissions was carried out on the basis of technical data and project information provided by the Project Beneficiary (quantities of raw materials and materials, volumes of work, estimated equipment to be used and other design data), national methodologies/ standards and guidelines for the calculation/ inventory of emissions.

Information on the types, quantities and estimated composition of waste generated during the life cycle of the project was provided by the Beneficiary of the project. The estimation of the quantities and composition of the expected type of waste to be generated during the drilling phase took into account the results of the previous exploration drilling campaign, correlated with the volumes expected to be generated during the development of the production wells. In the case of the estimated type, quantities and composition of waste to be generated during the construction and operation phases of the project, the estimate was based on the experience of the Project Beneficiary in other similar oil and gas projects.

The estimation of the daily amounts of domestic wastewater to be generated during the construction and operation phases of the project was carried out using the information provided by the Beneficiary of the project regarding the estimated number of personnel/ day and daily consumption/ person. Stormwater volumes were calculated by the engineering team using available rainfall information and specific standards and norms (eg STAS 9470-73: Hydrotechnics - Maximum rainfall - Intensities, Duration, Frequencies). For other liquid effluents (produced water, well start-up and restart effluents, hydrostatic test water, produced water related to the execution of the microtunnel, etc.), the quantities and composition were provided by the beneficiary

The inventory of air emissions during the construction and operation of the project was calculated based on specific design data provided by the beneficiary through IO Consulting (for example, data on equipment, fuel consumption, gas volumes, energy consumption, etc.), previous studies of air emissions/ dispersion carried out by the Client and using specific emission factors and methodologies/ guidelines for the calculation of atmospheric emissions inventories, such as: EMEP/ EEA Air Pollutant Emission Inventory Guide 2019, EPA Air Emissions Factors Quantification AP-42R), equipment supplier sheet specifications (eg, emission factors for generators). The results

of the atmospheric emissions inventory are provided in Appendix M Modeling and Calculation of Emissions

2.5.8 Presentation of uncertainties related to residue and emission estimates.

Given that the Contractors of the construction works will be selected at a later stage, the main uncertainty for estimating the amounts of waste, liquid effluents, atmospheric emissions and noise levels in the construction phase is correlated with the decisions and the type of construction works that will be implemented by the Contractor.

During the operational phase, the frequency of operations and inspections and maintenance work may be modified/ changed based on the experience gained in the project. This may influence the estimates presented in this Environmental Impact Assessment Report, which have been made based on currently available data and the estimated schedule of current maintenance and operations.

Related to the decommissioning phase, considering that the works are planned to be completed only at the end of the operation of the project (+20 years) and based on a specific decommissioning plan to be drawn up in accordance with the provisions in force at that time, the decommissioning technologies and emission estimates could not be fully evaluated and detailed in this EIA report.