PROJECT:

EastMed Pipeline Project

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3 PROJECT DESCRIPTION OVERVIEW

3.1 Purpose of this Section

This Section provides an overview of the EastMed Pipeline Project and background information, regarding technical parameters and considerations, including:

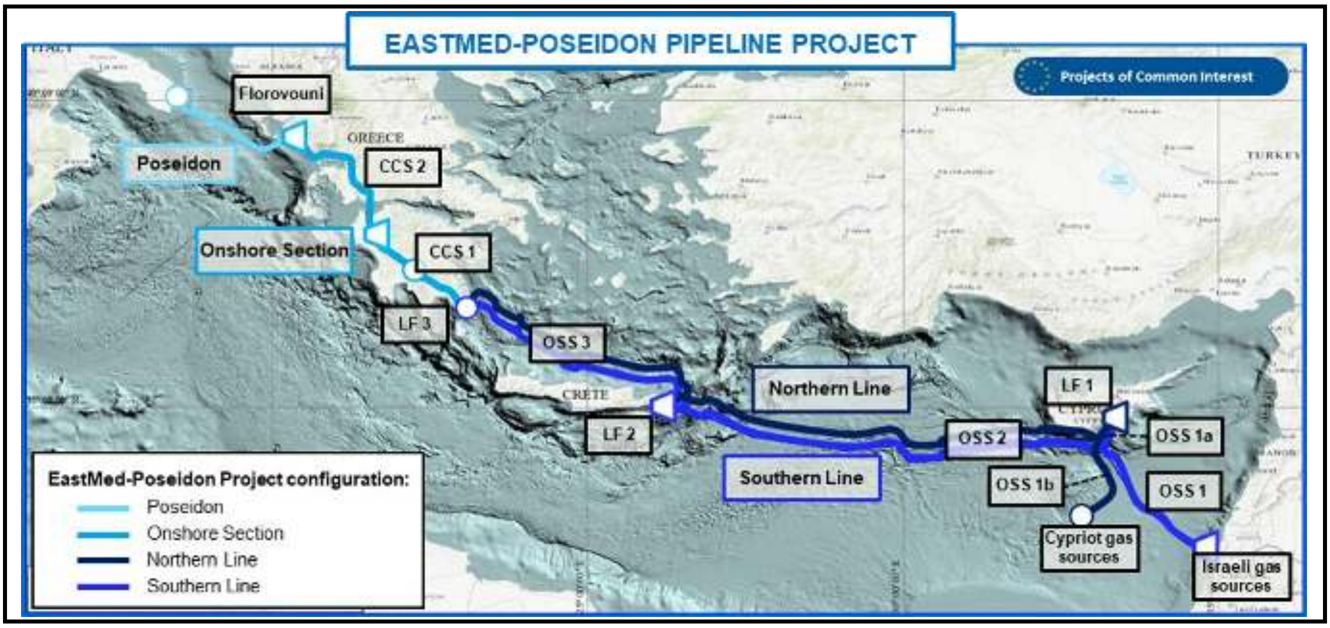
- Basic data, such as size, technology, power, workforce, timeline, etc.;
- Construction and Operation philosophy; and
- Estimated required materials, utilities and wastes.

Details are provided in the technical description of the project (Section 6) and impact assessment (Section 9).

It is noted that data provided in this section are based on the FEED Project design data and are subject to slight modifications. According to the provisions of Art. 7 of L. 4014/2011 (Procedure for final study assessment and implementation study of a project or activity), if more accurate data is derived that may have environmental impact, a Final Design Compliance File or a Technical Environmental Study shall be submitted according to the design modifications.

3.2 Project Context

The EastMed-Poseidon Pipeline Project will connect the Eastern Mediterranean natural gas sources to the Eastern energy system, providing Europe with a new energy corridor, through a new route, integrating markets and enhacing diversification of energy supply, both in terms of sources and routes.The EastMed Pipeline shall consist of a Southern Line and a Northern Line to deliver gas from Israeli and Cypriot sources, respectively, to the Poseidon Pipeline System compressor station that is located in north-western Greece and from there to Italy.



Source: EastMed, 2020

Figure 3-1 EastMed Pipeline Northern and Southern Lines and Combined Line

The entire EastMed-Poseidon Pipeline Project is about 2,200 km long (the EastMed Pipeline Project is approximately 2,000 km long). The 1,440-km offshore gas pipeline will link Israel, Cyprus and Greece via Crete, before traversing 540 km through the Greek mainland to reach Italy via the 210 km offshore Poseidon Pipeline.

The components of the Greek Section of the EastMed Pipeline Project are summarized in Table 3-1 and depicted in Figure 3-2.

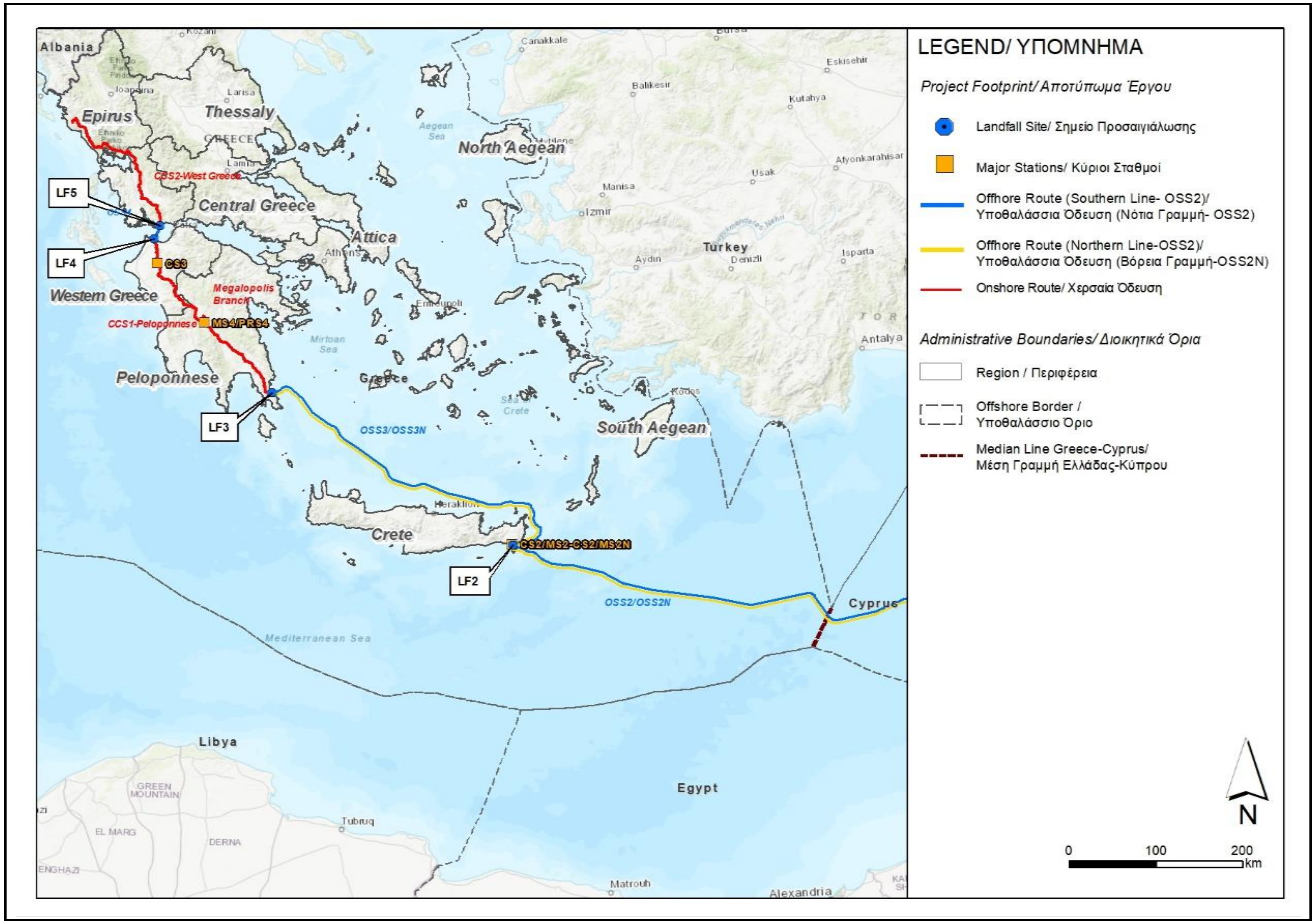
Table 3-1 Main Greek Section Project Components (in Successive Order from East to West)

Component	Description
OSS2 / OSS2N	Pipeline System OSS2/OSS2N, (26”) that stretches 392km across the eastern Mediterranean Sea, from the middle of the sea straits between Greece and Cyprus to the designated landfall in Crete (LF2), reaching a maximum depth of approximately 3,000 m, 200 km after entering in Greek territory and almost 500 km from the start of the OSS2/OSS2N route.
LF2	Landfall in Crete.

Component	Description
CS2/MS2 and CS2/MS2 N	Compressor and Metering Station at Crete, which willl host – in the same fenced area – two separate units that will be used for compressing and metering/regulating purposes of the Southern and Northern Lines.
OSS3/OSS3N	Pipeline System OSS3/OSS3N (28") starts from the selected landfall in south-eastern Crete, LF2, and by crossing the Cretan Fore-Arc Basin and the Hellenic Margin, ends at landfall LF3 in south-eastern Peloponnese. At this location there is also a short onshore section to the landfall station (LS03). Its total length is 427 km and the maximum water depth is 1,590 m, located at almost 15 km from the start.
LF3	Landfall in southern Peloponnese
CCS1	Cross country pipeline (48"/46") crossing Peloponnese from LF3 stations in Laconia region to LF4 (coast of Gulf of Patras); its length is approximately 300 km (Maximum elevation ~ 704 m)
MS4/PRS4	A Metering and Pressure Regulating Station in the wider area of Megalopoli. Also, for the total flow of 21 BSCM/yr downstream of LS03, a gas heating station will be required to ensure the gas temperature remains at least 5°C above the dew point along the route, which will be hosted in the same plot. The Megalopolis branch downstream MS4/PRS4 is a component of the project.
CS3	In order to achieve this transmission capacity, an additional Compressor Station in the area of Peloponnese (CS3), as it is considered at approximately 35 km upstream from LS04, with total installed capacity of 70 MW.
LF4	Landfall at the southern coast of the Gulf of Patras
OSS4	The OSS4 offshore section for passage of the Gulf of Patras will be approximately 17 km long with a diameter of 46''. The maximum depth is 141 m.
LF5	Landfall at the north coast of the Gulf of Patras.

Component	Description
CCS2	Cross country pipeline (48“) crossing west Greece from Akarnania region (coast of Gulf of Patras) to Thesprotia prefecture is approximately 235 km long (Maximum elevation ~ 863 m). The end of the EastMed Pipeline Project is at the Poseidon compressor station in Florovouni, Thesprotia

Source: IGI, 2021



Source: ASPROFOS, 2022.

Figure 3-2 Project Overview

3.2.1 Pipeline

3.2.1.1 *Offshore Section*

The Offshore Section includes deep-water sections of the pipelines up to the 40 m water depth contour line at the landfalls. The part of the Project under consideration (EastMed-Offshore Section – Greek Section) has a total length of approximately 838 km in the offshore.

3.2.1.2 *Nearshore Section*

The nearshore zone extends from the shoreline at each landfall location to the 40 m water depth contour. The nearshore pipeline sections are approximately 5 km in length, and the diameters vary as follows:

- LF2:
  - 2 pipelines (OSS2/OSS2N) incoming (26”),
  - 2 pipelines (OSS3/OSS3N) out-going (28”);
- LF3: 2 pipelines (OSS3/OSS3N) incoming (28”);
- LF4: 1 pipeline (OSS4) out-going (46”); and
- LF5: 1 pipeline (OSS5) incoming (46”).

The nearshore pipelines’ sections will be buried in the shore approach areas for protection against external factors and for pipeline stability. A minimum burial depth of 1.5 m cover on top of the pipeline is adopted.

3.2.1.3 *Onshore Section*

The onshore pipeline section is approximately 540 km in length with a diameter of 46”/48". The design pressure of the main pipeline is 100 barg. The Megalopoli Branch is approximately 10 km in length and has a diameter of 16”. Its design pressure is 80 barg.

The pipeline shall be installed in accordance with ELOT EN1594. Typically, the onshore pipeline will be buried. The standard soil covers of the buried onshore pipeline (measured from top of pipe) shall be at least 1 m to comply with the Greek Technical Regulation of Natural Gas Transmission System with pressure greater than 16 bars - Ministerial Decision. Δ3/Α/ΟΙΚ.4303 ΠΕ 26510, as amended by Ministerial Decision Δ3/Α/8857 (GOV. GAZ. 2026/Β/20.06.2012 and by Ministerial Decision ΥΠΕΝ/ΔΥΔΡ/89630/650/6-12-2018 (GOV.GAZ 5908/Β’/31-12-2018.

In most cases at crossings, there are also requirements for increased pipeline route cover due to applicable codes and standards. The depth of cover will be increased as required at road and service crossings to ensure the minimum clearances are maintained and highway authority/utility requirements are met.

Technical characteristics of the Greek EastMed pipeline segments are summarised in the following table.

Table 3.2 Summary of Investigated Pipeline Sections

Section	Pipe Size (inch)	Flow Rate (BSCM/y)	Length (km) (approx.)	Maximum Depth (m)
OSS2/OSS2N	2 x 26	11/10	392	approx. 3,000
OSS3/OSS3N	2 x 28	10.5/10.5	429	approx. 1,590
CCS1a-1 (to MS4/ PRS4 at Megalopoli)	48	21	138	-
Megalopoli Branch	16	1	10	-
CCS1a-2 (from MS4/ PRS4 up to CS3 in Achaia)	48	20	127	-
CCS1b	46	20	35	-
OSS4	46	20	17	approx. 140
CCS2	48	20	233	-

Source: IGI, 2021

The pipeline is complemented by few permanent associated facilities. These include:

- Line Valve Stations (Landfall Valve Stations and Block Valve Stations)
- Scraper Stations
- Main Stations (Compressor Stations, Metering Stations and Heating Station)
- Operations & Maintenance Base (O&M) – Dispatching Centre

3.2.2 *Line Valve Stations*

3.2.2.1 *Landfall Block Valve Stations (LSs)*

The landfall block valve stations (LS) are located in the following areas:

- In the area of Atherinolakkos, in Crete (inside the compressor plot, LS02);

- In the southern Peloponnese (500 m north of the settlement of Agios Fokas in the municipality of Monemvasia, LS03);
- In the area south of the Gulf of Patras (2.5 km northwest of the settlement of Kalamaki in the municipality of Western Achaia LS04); and
- In the area north of the Gulf of Patras (3.1 km southeast of the settlement of Galatas in the municipality of Nafpaktia, LS05).

The purpose of the landfall stations is to cover the requirements for transition between the offshore pipeline and the facilities and the pipeline onshore .

3.2.2.2 *Block Valve Stations (BVS)*

The block valve stations are installed along the pipeline so that the pipeline can be isolated for maintenance or emergency reasons during operation. At this stage of design, there is provision for 15 BVS stations along sections CCS1 and CCS2. The maximum distance between two stations cannot be more than 32 km (when the location class is 1), and 8 km (when the location class is 4).Along Section CCS1, the maximum actually selected distance between two successive BVS (BVS-2 and BVS-3) is about 30 km, whilst the distance between the other BVSs varies in general from 20 to 29 km, except in few cases, where it is less than 20 km. Along section CCS2, the maximum selected distance between two successive proposed BVS's (BVS-15 and BVS-16) is approximately 31 km (at location class 1), while the distance between the other BVS's varies in general from 27 to 29 Km.

3.2.2.3 *Scraper Stations (SS)*

The SS have been designed for the use of permanent scraper launcher and receiver traps and to permit isolation, venting, de-pressurization and scraper operations and they will be installed at the following locations:.

<u>CCS1</u>

- At inlet and outlet of the landfall station at Agios Fokas LF3 area (KP 0.30 of CCS1) at south-east Peloponnese;
- At the inlet and outlet of Heating / Metering/Regulating Station, and at the beginning of Megalopoli Branch pipeline (KP 138.43 of CCS1);
- At the inlet and outlet of CS3 (KP 265.17 of CCS1) ; and
- At Perivolia, at the end of the Megalopoli Branch pipeline (KP 9.89 of branch)

<u>CCS2</u>

- At LF5 – North of Patraikos Gulf at the inlet and outlet of the landfall station at Galatas (KP 0.59 of CCS2); and

- At Eleochori, an intermediate point in the section of pipeline (KP 118.13 of CCS2)

3.2.3 Main Stations

3.2.3.1 Compressor Stations

Compressor stations are installed on pipelines of great length in order to provide the required pressure for gas transmission. Considering that there are limitations on the maximum allowable operating pressure for the pipes, more than one compressor station is required along the pipe.

The new compressor stations (CS) that will be designed in the Greek onshore area are the following:

- Compressor station in Crete (single plot where CS2 and CS2N are included); and
- Compressor station in Achaia (CS3).

Table 3-3 Basic Technical Data for Compressor Stations

Parameter	CS2	CS2N	CS3
Total flow (BSCM/yr)	11[1]	10	20
No. of compressors operating	3	3	3
No. of spare compressors	1		1
Gas flow per compressor (Sm3/hr)	465,083	422,723	776,569
Required power (MW) per compressor	17.6	14.7	10.0
ISO power (MW) per compressor at site conditions	25.2	25.2	17.5
Minimum Total installed ISO power (MW)	4* x 25.2 = 100.8	3 x 25.2 = 75,6	4 x 17.5 = 70
Annual Fuel gas Consumption (MMSm3/yr)	115	96	70
No. of stages	1	1	1
* this results from the 3 operating compressor units and the 1 spare.			

Source: P617-000-BD-DBS-01_3, Design Basis Memorandum – Facilities and E780_00225-Ev31A-TDR-00051_2_System Consolidation Report

[1] CS2 referred to Southern Line (11 BSCM/Y) and CS2 N referred to Northern Line (10 BSCM/Y), whilst the Combine Line has 10.5 BSCSM/Y for each one.

3.2.3.2 *Metering Station*

The purpose of the metering unit is to measure the quantity/quality of gas being transferred between the upstream pipeline operator and EastMed.

The following metering stations have been designed for the Greek section of the EastMed Pipeline Project:

- Two metering stations in Crete, at the same location as the compressor station (MS2 and MS2N, one for CS2 and the other for CS2N), and
- A metering station in the broader area of Megalopoli (MS4).

The metering station of EastMed in Crete will be located inside the compressor station while the one in the area of Megalopoli in an individual position.

Table 3-4 Basic Technical Data for Metering Stations

Parameter	MS2	MS2 N	MS4
Flow capacity	11[2] BSCM/yr	10 BSCM/yr	1 BSCM/yr
Inlet pressure (max)	77 barg	77 barg	93 barg
Inlet temperature (min)	1.9 °C	3.4 °C	0 °C
Outlet (delivery) pressure (min)	75 barg	75 barg	25 barg
Outlet temperature (min)	1.9 °C	3.4 °C	3 °C

Source: P616-000-BD-DBS-01_3, Design Basis Memorandum – Pipeline and Facilities E780_00225-Ev31A-TDR-00051_2_System Consolidation Report

3.2.3.3 *Heating Station*

Gas will be heated for the combined operation of the Southern and Northern Lines when the 48/46-inch cross-country pipeline allows transportation of 21 BSCM/yr up to the Megalopoli's metering station and 20 BSCM/yr from there onwards, the gas must be heated in order to avoid condensation inside the pipeline.

The heating station location is assumed planned to be installed in Megalopolis, on the same plot as MS4 / PRS4.

[2] CS2 referred to Southern Line (11 BSCM/Y) and CS2 N referred to Northern Line (10 BSCM/Y), whilst the Combined Line has 10.5 BSCSM/Y for each one.

The heating station will include gas /water heat exchangers. Basic operation data for the exchanger operation is provided in below tables.

Table 3-5 GRS Design Data – Combined Southern and Northern Line

Parameter	Value
Flow capacity	20 BSCM/yr
Inlet Pressure	73.6 barg
Pressure drop (max)	2 barg
Inlet temperature (min)	1.2 °C
Outlet temperature (max)	7 °C

Source: P616-370-DB-BDS-01_2_ Design Basis Memorandum – Heating Station

Table 3-6 GRS Results – Combined Southern and Northern Line

Parameter	Value
Required Total Station Heating Duty (MW)	25.4
Annual Fuel gas Consumption (MMSm3/yr)	21.2

Source: E780_00225-Ev31A-TDR-00051_2_System Consolidation Report

3.2.4 Operations & Maintenance Base (O&M) – Dispatching Centre

The proper operation of the gas transmission system requires the construction of facilities that include the buildings for the Control, Operation and Maintenance of the pipeline (MDC and O&M: Main Dispatching and Operation & Maintenance Center (s)). For this reason, it is planned to install a main O&M base, in the wider area of Western Achaia, which will be manned 24 hours a day, 365 days a year.

3.2.5 Design Philosophy

The design philosophy is to ensure that the gas transport system meets all safety requirements of the main national and European codes and standards and that impacts on the natural and social environment are kept to a minimum. The design life of the onshore/offshore pipeline system is 50 years and minimum 25 years for the facilities. These are common values for onshore/offshore pipeline systems. The original pipeline design life shall be verified by a re-qualification at the end of a 40-year period from initial installation or sooner. Re-qualification means that the pipeline condition is assessed relative to its originally installed condition.

The pipeline and stations will be designed in accordance with requirements resulting from:

- National and local regulations;

- International standards for pipeline construction and operation;
- Safety of the people and personnel living/working close to pipeline infrastructure;
- Protection of the environment;
- Protection of property and facilities;
- Geotechnical, corrosivity and hydrographical conditions;
- Requirements for construction, operation and maintenance; and
- Third party activities.

The design pressure will be between 231 and 363 barg for the offshore sections excluding OSS4, whilst the design pressure will be between 80 and 100 barg for the onshore sections and OSS4, sufficient for the EastMed Pipeline Project overall export capacity of 21 BSCM/yr + 1 BSCM/yr to Cypriot domestic use. The final design pressure will be defined after finalisation of an iterative technical study considering all relevant parameters. However, it is anticipated that any changes will be very small deviations around the design parameters described in this document and will not result in significant changes to the size and design of the main Project components.

For each section of the EastMed pipeline system, the MOP (maximum operating pressure) and DP (design pressure) to be considered for design are presented in the following table.

Table 3-7 Summary of EastMed Pipeline Pressures

Parameter	OSS1-OSS2	OSS2N	OSS3	OSS3N	CCS1	Megalopoli Branch Line	OSS4	CCS2
MOP (barg)	345	345	220	220	95	75	95	95
DP (barg)	363	363	231	231	100	80	100	100

Source: P616-000-DB-BDS-01_3, Design Basis Memorandum – Pipeline and Facilities, 000225-Ev-32A-BOD-00053_03, Project Design Basis and 00225-Ev32A-BOD-00302_01, Project Design Basis – Northern System

The EastMed Pipeline Project will transport natural gas which is a naturally occurring gas mixture consisting primarily of methane. Other hydrocarbons and accompanying substances (e.g. ethane, propane, butane, pentane, hexane, carbon dioxide, nitrogen and traces of sulphur) are typically present in proportions that can vary from 0% to 25%.

The gas composition for Israeli Gas and EastMed Gas is tabulated in Table 3-8. It can be observed that the gas composition contains negligible amounts of water.

Table 3-8 Gas Composition

Component	EastMed Gas Proportion (mol %)	Israeli Gas Proportion (mol %)
H_2O	0.0007	0.0008
Glycol	0.0000	0.0000
Nitrogen	0.2504	0.2284
CO2	0.1896	0.1383
Methane	98.8678	98.9692
Ethane	0.3583	0.3564
Propane	0.1477	0.1441
i-Butane	0.0389	0.0394
n-Butane	0.0385	0.0371
i-Pentane	0.0278	0.0205
n-Pentane	0.0092	0.0097
n-Hexane	0.0163	0.0150
Mcyclopentane	0.0027	-
Benzene	0.0001	-
n-Heptane	0.0335	0.0256
Mcyclohexane	0.0029	-
Toluene	0.0003	-
n-Octane	0.0121	0.0117
E-Benzene	0.0002	-
m-Xylene	0.0003	-
o-Xylene	0.0001	-
n-Nonane	0.0021	0.0030
n-Decane	0.0004	0.0007
n-C11	0.0001	0.0001
n-C12	<0.00001	<0.00001
C13+	<0.00001	<0.00001
O2	<0.00001	<0.00001
Total	100.00	100.00

Source: P616-000-DB-BDS-01_3, Design Basis Memorandum – Pipeline and Facilities

Fluid properties for both gases, Israeli and EastMed gas, are shown in Table 3-9.

Table 3-9 Fluid Properties

Property	EastMed Gas	Israeli Gas
Molecular Weight	16.33	16.30
Density at STP (kg/m^3)	0.691	0.689

Source: P616-000-DB-BDS-01_3, Design Basis Memorandum – Pipeline and Facilities

The hydraulic analysis for the pipelines downstream of CS2/MS2, CS2/ MS2 Nconsiders one gas composition that is a mixture of the Israeli and EastMed gas compositions, which is referred to as Combined Gas composition. The mixture is a ratio of 1.31:1 Israeli Gas to EastMed Gas.

3.2.6 Key Codes and Standards

The basic codes and standards for the Project design are presented below. These combine national laws/requirements as well as international design codes as needed.

3.2.6.1 *Onshore Section*

As EastMed will cross European territory, the pipeline system will be designed within the EN (Euro Norm) framework.

- European Standard: EN 1594: 2013; and
- International Design Code for guidance: ASME B31.8.

Construction material for the piping arrangements is grade L485 carbon steel (or API 5L X70) for all pipe sizes.

Only steel pipes and sections of steel piping will be used.

The materials of the main parts of the pipes are in full compliance with the following construction codes:

- EN ISO 3183, Petroleum and Natural Gas Industries. Steel Pipe for Pipeline Transportation Systems (Oil and Gas Industries. Steel Transmission Pipelines);
- EN ISO 3183, for pipeline transmission systems;
- EN 14141, for valves; and
- EN 14870, for pipe bending, coating and flanges.

The following codes apply for stations:

- EN 1594 Gas supply systems – pipelines for maximum operating pressure over 16 bar functional requirements;

- EN 1776 Gas supply systems – natural gas measuring stations – functional requirements;
- EN 12186 Gas supply systems – gas pressure regulating stations for transmission and distribution - functional requirements; and
- EN 12583 Gas supply systems – compressor stations – functional requirements.

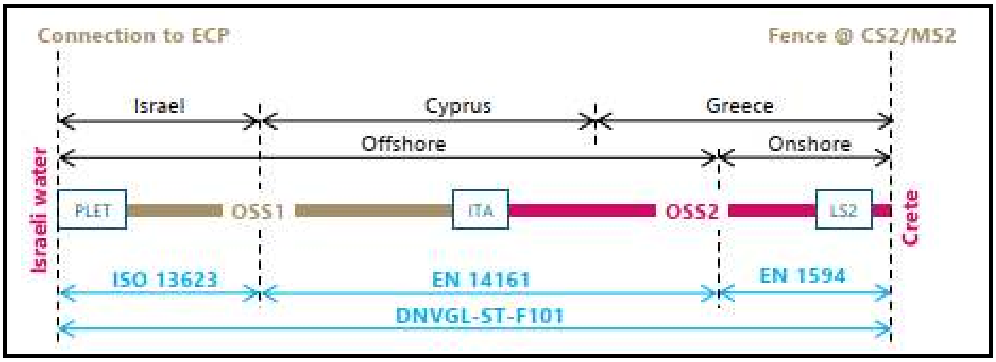
Additional requirements are identified in the future in the Project implementation study phase.

- Greek legislative and regulatory framework:
  - Greek Technical Regulation "Gas Transmission Network that operates at a maximum pressure of over 16 bar. Ministerial Decision D3/A/4303/PE; 26510/12 (GG 603/B/05.03.12) as amended by D3/A/8857/2012 (GG 20126/b/20.06.12),
  - Law 4001/GG 179 A/22.8.2011 "On the Operation of the Electricity and Gas Energy Markets, on Research, Production and Hydrocarbon Transmission Networks and Other provisions",
  - Law 4014/GG 209/A/21.09.2011 - Environmental licensing of projects and activities.

3.2.6.2 *Offshore Section*

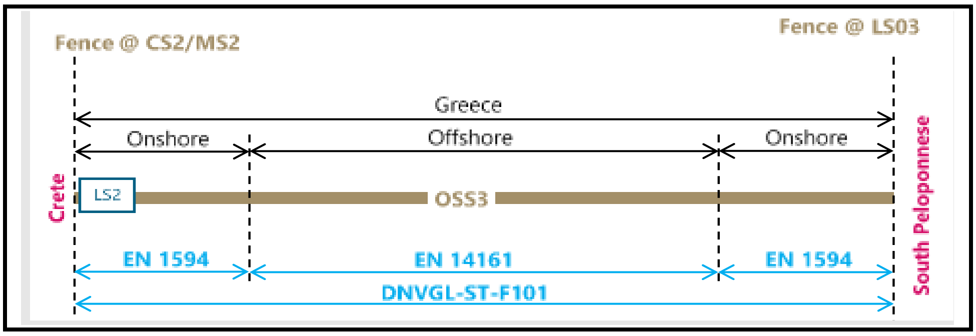
- European standards (EN):
  - As EastMed will cross European territory, the pipeline system shall be designed within the EN (Euro Norm) framework,
  - European Standard EN 14161:2011 is applicable for the offshore sections in EU (i.e., Cypriot and Greek) waters;
- International design codes:
  - Since EN standards are not design handbooks or a code of practice, DNVGL-ST-F101 (2017) is selected as the primary pipeline design code for the complete offshore pipeline system, including the short onshore parts of the offshore pipelines,
  - This code is intended to comply with EN 14161 but there are some intentional deviations. It provides the additional detailed guidelines needed for this Project.

The above design code framework is schematically shown in Figure 3-3, Figure 3-4 and Figure 3-5 for the EastMed Pipeline Project within Greek territory.



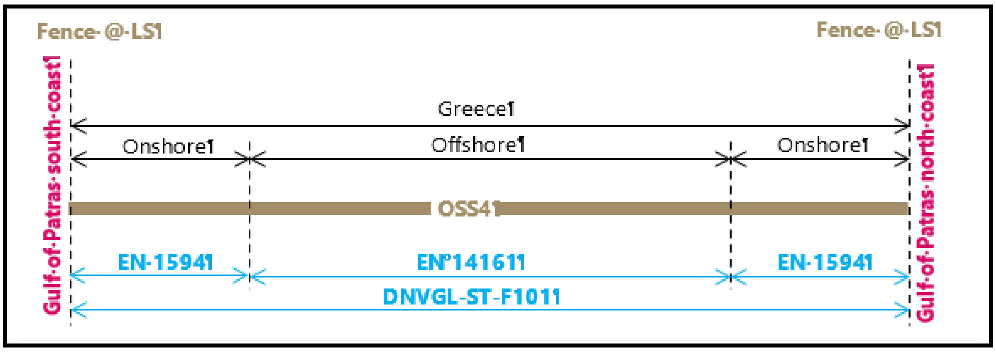
Source: 000225-Ev-32A-BOD-00053_03, Project Design Basis

Figure 3-3 Schematic Overview of Design Codes for OSS1 – OSS2



Source: 000225-Ev-32A-BOD-00053_03, Project Design Basis

Figure 3-4 Schematic Overview of Design Codes for OSS3



Source: 000225-Ev-32A-BOD-00053_03, Project Design Basis

Figure 3-5 Schematic Overview of Design Codes for OSS4

3.2.7 Project Workforce

Workforce, during construction, is presented in Table 3-10.

Table 3-10 Estimated Workforce during Project Construction.

Project Component	Estimated Mean Workforce	Maximum (Peak)
ONSHORE		
Pipeline construction (including temporary facilities for crossings)	450[1]	500[1]
Main stations (compressor and metering stations)	250[2]	600[2]
Line stations (15 BVSs and 7 SS)	100[3]	100[3]
Landfall	48[4]	52[4]
Operation and Maintenance Base	70	-
OFFSHORE		
Operations base/port	It depends on the final selection of the appropriate port by EPC, however it could be assumed that no additional staff will be needed as it is planned to use the port's available facilities.	
Vessel crews (combining pipelaying and support vessels)	1,216[5]	2,080[5]

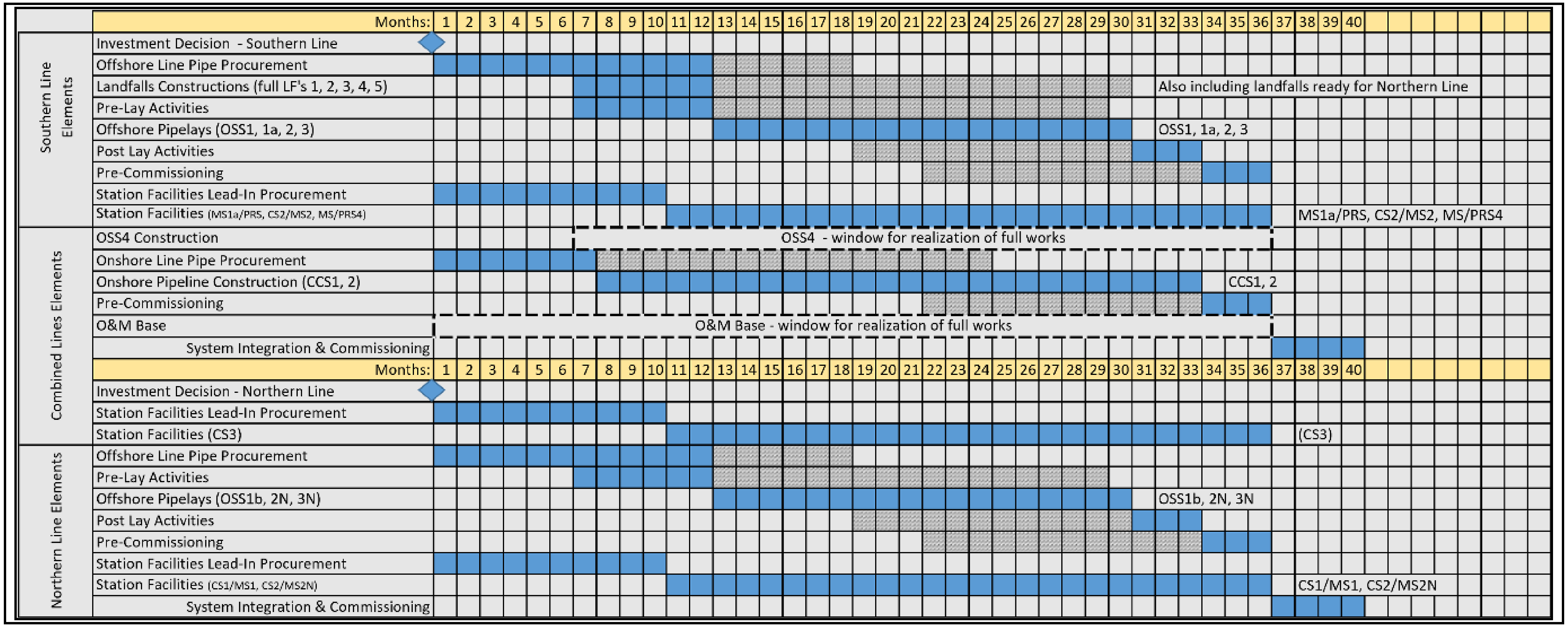
[1]It is assumed that construction of the pipeline will be separated in 3 spreads, and the estimated workforce refers to each one separately.
[2]This is the estimated workforce per station.
[3] It could be divided in spreads i.e if 2 spreads are working, then the estimated workforce will be 50 people per spread.
[4] The estimated workforce is per landfall site.
[5] The estimated vessel crews are in total and not per offshore section.

Source: IGI Poseidon, 2021

During the Operation phase, regarding the pipeline, a number of permanent employees for inspection, maintenance and other work will be required, up to about 20 persons. These employees will be based in the O&M base, whilst regarding stations, the workforce during operation is estimated at approximately 25 persons per main station.

3.2.8 Project Schedule

Overall construction of the EastMed Pipeline Project (Cyprus and Greece) is anticipated to last approximately 3 years for construction of related infrastructure (Figure 3-6). Project execution is envisaged to commence in January 2024 and commissioning is expected to start after December 2026.



Source: IG Poseidon , 2021

The figure represents an estimate of each Project activity duration, from construction authorization to commissioning. The schedule doesn't provide a precise timeline as the Northern and Southern Lines are independent pipelines.

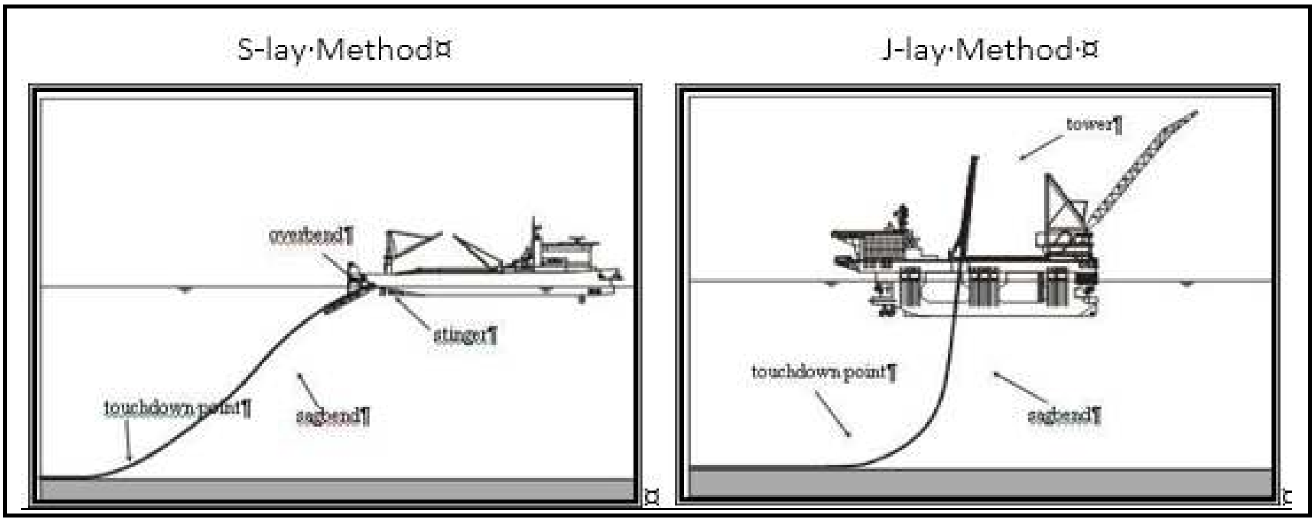
Figure 3-6 Indicative Duration of Project Activities (Greece and Cyprus)

3.3 Construction Philosophy

3.3.1 Offshore Section

The preferred offshore pipeline installation method for Eastmed Pipeline Project is the "S-lay", where the pipe is spanning from the vessel to the seabed in an S-like shape (Figure 3-7). To guide the pipe in this configuration, it is supported on rollers by a stinger structure extending from the vessel into the water. The stinger is generally constructed as an open truss framework and may be rigid or articulated. The welding stations on an S-lay vessel are placed along the vessel axis and are orientated horizontally, which allows for relatively efficient offshore pipe string fabrication.

The "J-lay" installation method is recognized by the absence of the stinger and the high departure angle (Figure 3-7). The pipe is closer to the vertical on board the vessel than to the horizontal axis. Pipe joints, usually pre-fabricated multiple-joint strings, are lined up in a tower construction that is called the J-lay tower. J-lay is only applicable for deep water, where a long section of the pipe is suspended below the vessel in a catenary shape. The capacities of these vessels are set to suit this functionality. Compared to other installation methods, the tension capacity of the vessel is very high, but is specialised for holding the weight of the pipe string in deep water rather than for maintaining an acceptable pipe shape through the water column. J-lay equipment currently available can handle pipe diameters up to 32 inches.



Source: 00225-Ev80A-TDR-00325_1 – Pipeline Installation Methodology Report – Northern System

Figure 3-7 Offshore pipeline installation methods

In principle, the pipeline is simply placed on the bottom of the sea; however according to the current design level, few areas along the pipeline may require pre-lay or post-lay intervention to allow pipe installation and safe operation; that is ensuring pipeline stability and integrity or protection against external threats.

The S-Lay method is the chosen installation technique for all offshore pipelines of the EastMed Pipeline Project. Nonetheless, J-Lay cannot be excluded as an option in developing the FEED for installation scope.

During the installation of the offshore pipeline, it may be needed to perform some seabed intervention work (described in a sub-section below) in order to overcome the irregularities met on the seafloor surface (e.g. freespan, hoverangs, bumps, etc.).

In general, major part of the pipeline is to be laid directly on the seabed, minimizing seabed disturbance across the Greek offshore area. However, seabed intervention works are expected to be required in specific areas, either before or after pipe-laying to allow pipe installation and safe operation; that is ensuring pipeline stability and integrity or protection against external threats.

Intervention works can vary, depending on the nature of the area to intervene, as well as other factors such as water depth, burial depth or sediment conditions. Seabed features or specific pipe sections that may require seabed intervention are the following:

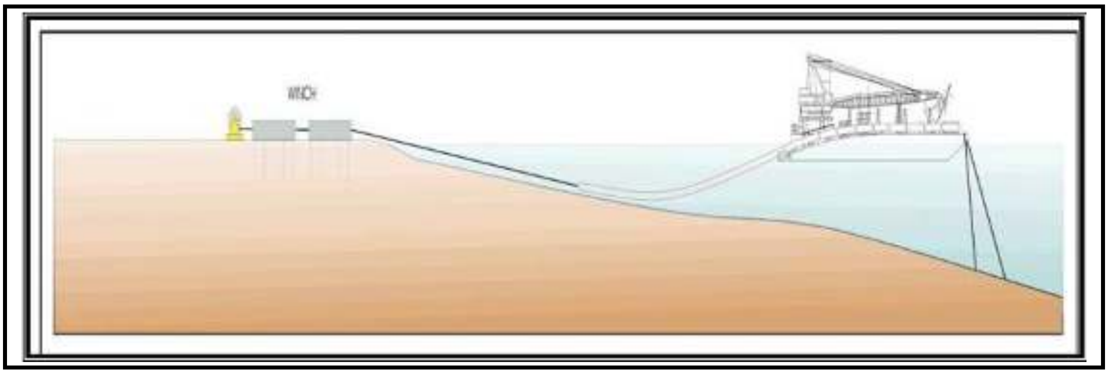
- Shallow water sections or landfalls;
- Crossing of existing infrastructure; based on the positions of known existing cables;
- Irregular seabed causing unacceptable pipeline free spans;
- Hot pipe section with tendency to buckle;
- Sections at risk of interaction with fishing gear or impact from shipping activities; and
- Geohazards.

3.3.2 Nearshore Section

Shore crossing construction methods are presented in the relevant section, and pipeline installation onto the sea bottom within a trench is described below. One of the following methods can be used:

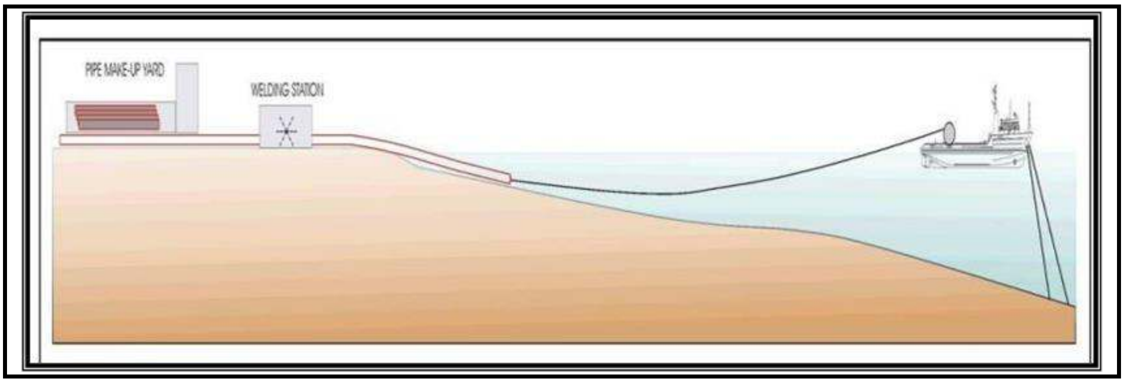
- **Shore Pulling Method.** Pipeline is assembled on a barge stationed offshore and the pipeline section is pulled through a pre-dredged trench using land based cable winches. Typically, this method includes offshore mooring of the barge and stringing the pipeline that has been assembled on the barge, pulling towards the shore using land based winches. The site needed onshore for winches, cable drums, power generators, support equipment and construction installations is approximately 2,000 m². Also, an additional area will be required for temporary storage of the trenched material;

- **Barge Pulling Method.** Pipeline sections are assembled and fully prepared onshore, and then the pipeline string is pulled offshore by a barge equipped with the required winches. The construction site needed for pipeline storage, welding, etc. is larger than the one required in the previously described method, and it is estimated around 10,000 m². A land strip approximately 300 – 500 m long is estimated for placement of the pipeline strings. This land strip could be located along the onshore construction working strip; and
- **Barge Pulling via Sheave Block**. This third method consists of the combination of the two previously mentioned methods, as it involves both pipeline construction and winching being performed onboard the barge. Like the shore pulling method, the pipeline is constructed on the barge moored offshore and then pulled to shore through a pre-dredged trench. The pulling cable winch goes through an onshore sheave block and back to the barge. The method is technically more demanding than the two methods described above and is used only where there are serious restrictions regarding the available workspace at landfall locations.



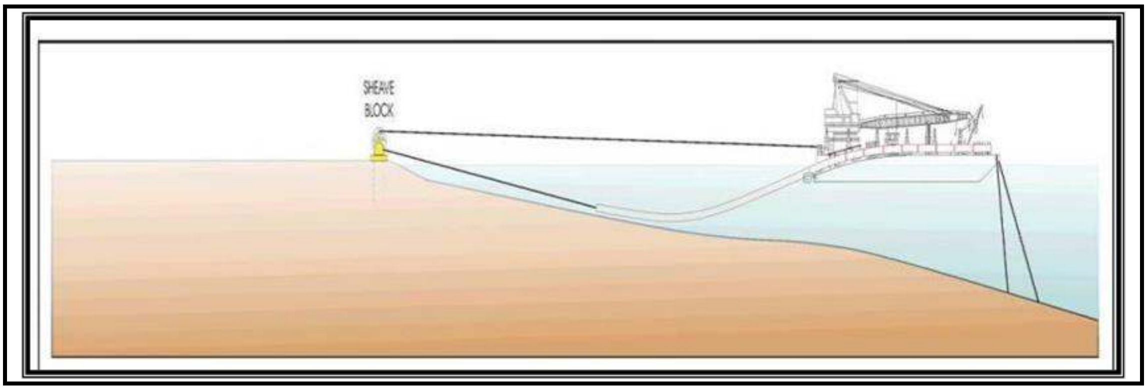
Source: EastMed Feasibility Study -Preliminary Design Report –Offshore (EM-620-20-PL-RPT-001, REV 2), 2020

Figure 3-8 Shore Pulling Method



Source: EastMed Feasibility Study -Preliminary Design Report –Offshore (EM-620-20-PL-RPT-001, REV 2), 2020

Figure 3-9 Barge Pulling Method



Source: EastMed Feasibility Study -Preliminary Design Report –Offshore (EM-620-20-PL-RPT-001, REV 2), 2020

Figure 3-10 Barge Pulling via Sheave Block

Regarding accessibility, the following are noted: as mentioned, it is envisaged that no new access roads will be required. Existing roads might be improved and the working strip will be used as the main access roads for the shore crossing construction site. Especially for the shore construction site, some heavy equipment could be transported by shallow vessels. However, given the specific works at the landfall sites, the EPC contractor may deem it necessary to construct a temporary access to the landfall site for personnel, materials, equipment, etc. In such a case (as well as in other places with special characteristics where the EPC contractor may deem temporary construction access necessary), all necessary permits will be acquired by the EPC contractor.

3.3.3 Shore crossing (Landfall sites)

The shore crossing is the intersection area between the offshore and onshore part of a pipeline, where special construction techniques are required. The size of this intersection area depends on local circumstances such as bathymetry, topography, metocean conditions, seabed characteristics (e.g. seabed material, morphology) and environmental conditions. Generally, the area runs from a water depth of around 10 - 20 meters to the onshore end of the beach. Note that in general the same methodology applies for all landfalls.

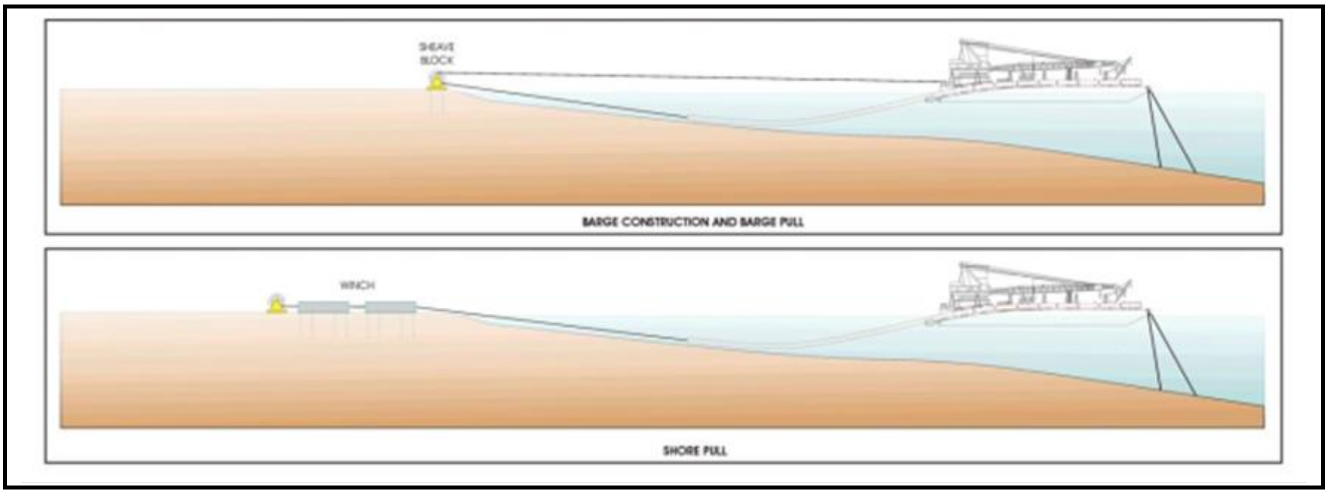
Open cut is the proposed construction methodology for shore crossings at landfall locations. In addition, OSS2 and OSS2 N will be installed at the same time, and the same is true for OSS3 and OSS3 N.

The open cut construction methodology is a common technique where, generally, the nearshore section is trenched by a combination of dredging equipment (e.g. deeper sections by cutter suction dredger or trailing suction hopper dredger and shallower sections by pontoon-based backhoe) and the onshore section by common excavators to enable the pipeline to be pulled ashore at a required depth of burial. To enable the use of heavy equipment, the landfall requires a sufficiently sized beach (preferably minimum 50 metres to shoreline and minimum 100 metres wide) and good access. To minimise dredging volumes and to protect the trench from natural backfilling during the period between trench excavation and pipeline installation, a cofferdam is often used. If the subsoil is not suitable for sheet piles, a causeway can be created by using rock boulders or gravel of sufficient size to secure a stable dam during the installation process.

Main steps involved in landfall construction include:

- **Step 1:** Mobilisation of construction equipment to the site;
- **Step 2:** Construction of a cofferdam or construction of causeway at landfall sites.
  A conservative approach is adopted at this stage of the project, where cofferdams and causeways are installed on both sides of the pipeline corridor. If natural backfilling is limited and excavation of the trench is possible with one single cofferdam/causeway, one cofferdam/causeway can be considered;
- **Step 3:** Trenching using excavation equipment suitable for hard soil and/or rocky soil conditions (e.g. backhoe equipped with hydraulic hammer / chisel, cutter suction dredger) will be employed. The trench bottom should be levelled to provide an even and continuous pipe support and shall be clear of debris immediately prior to laying/pulling the pipe. The trench dimensions should be sufficient to accommodate any natural backfilling in the period between excavation and pipeline installation.

- **Step 4:** During pull-in, (Figure 3-11 depicts the pipe pull options) the pipeline joints are welded on board the lay vessel and pulled towards the trench by means of a cable running to shore.
  The pull-in pipeline installation methodology is considered feasible at all landfall locations.
  Survey and dredging equipment will be on site until completion of the pipeline pull operation and will survey, dredge and re-survey the trench as required to ensure that the required depth of pipeline cover will be achieved.
  At landfall sites, it is practical to install all pipelines in the same trench from a construction point of view. This will minimise the amount of excavation activities;



Source: EastMed Feasibility Study -Preliminary Design Report –Offshore (EM-620-20-PL-RPT-001, REV 2), 2020

Figure 3-11 Schematic Pipe Pull Options

- **Step 5:** An S-lay installation vessel will perform the pipe pull and will continue pipe laying; . The shore pull operation and subsequent shallow water pipelay is performed by a shallow water S-lay vessel. Depending on the adopted offshore installation scenario, the pipeline will be laid down in a water depth suitable to perform a surface tie-in or to be recovered by a larger S-lay vessel to continue pipelay activities into deeper water;
- **Step 6:** Backfill trench with suitable (engineered) backfill material to prevent liquefaction and to ensure backfill stability; backfilling shall not commence until completion of the as-laid survey of the pipeline and removal of any pipeline buoyancy aids. A granular bedding material will be placed under the pipe at free spans in such a manner that any gap under the pipe is effectively filled. Excavated material may be used where possible; and
- **Step 7:** Demobilise causeways/cofferdams and reinstate construction site.

Construction of the pipelines shore crossing sections can be executed offline from the offshore pipelaying and are accomplished in advance to provide pre-assembled pipeline ends ready for the connection (AWTI - Above Water Tie In) with the deep-water pipeline.

Assuming access to shore and availability of general utilities is granted, shore crossings are usually executed in sequence like:

- installation of the linear winch and pipeline rollers, construction of the relevant causeways, excavation of the open trench: 3-4 months;
- pipeline pulling from the shallow water lay barge: 1 month;
- backfilling of the trench and reinstatement of the shore: 2-3 months;

Each landfall shore crossing can be executed independently, while pipeline pulling depends on the availability and schedule of the shallow water lay barge. AWTI is usually executed by a shallow water lay barge according to relevant construction schedule with no intervention from shore.

Trenching and backfilling of the pipeline as laid, if required, can be executed by specialised naval assets with no intervention from shore.

Table 3-11 presents a summary of the trench dimensions at the landfalls:

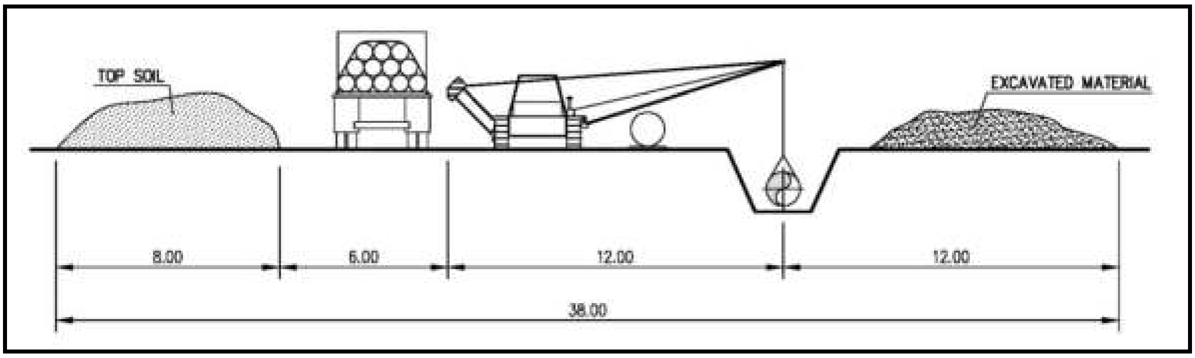
Table 3-11 Summary of Cofferdam/Trench Dimensions

Landfall	Location	Pipeline Characteristics	Cofferdam Size			Nearshore Trenching		
		(number & diameter)	Length (m)	Width (m)	Depth (m)	Length of Trench (m)	Width (m)	Depth (m)
LF2	Crete	4 (2x26”/2x28”)	n.a.	n.a.	n.a.	300	50	2.5
LF3	Peloponnese	2 (2x28”)	n.a.	n.a.	n.a.	600	30	2.5
LF4	South Patras	1 (1x46”)	200	21	5	1000	15	3
LF5	North Patras	1 (1x46”)	200	21	5	1000	15	3

Source: IGI Poseidon, 2021

3.3.4 Onshore Section

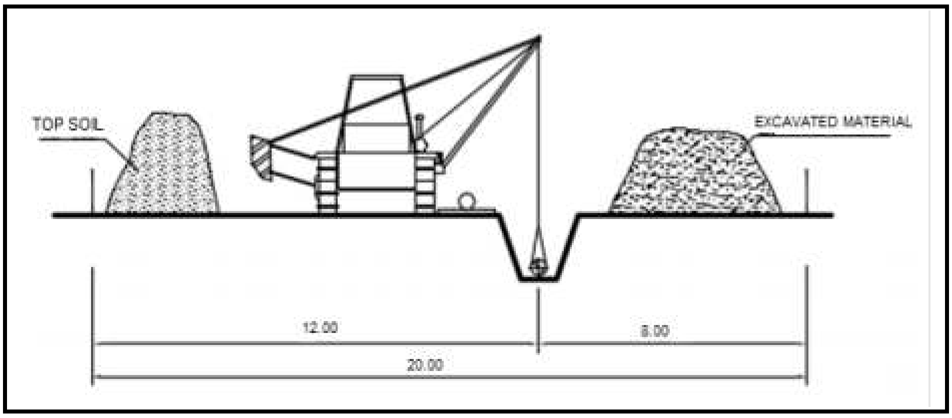
Pipeline will be placed in a trench of approximately 2,0 m deep with a minimum cover on top of the pipeline of 1,0 m. The working strip is the temporary corridor along the pipeline where construction takes place. It must be wide enough to allow all activities to be carried out safely whilst providing sufficient room to store topsoil and trench material separately and keeping agricultural crop loss to a minimum. The width of the working strip is proportional to the diameter of the pipeline to be installed. It follows that the greater the pipe diameter, the greater the extracted trench material that has to be stored. The width of the working strip is also determined by the size of the heavy machinery needed to safely lift and lower pipe into the trench and dig the trench. The width of the working strip in open country for pipelines with nominal diameter (ND) 48'' and 46'' will be 38 m.



Source: P616-000-DB-BDS-01_3, Design Basis Memorandum – Pipeline and Facilities, IGI Poseidon, 2021

Figure 3-12 Regular Working Strip in Open Country for Pipeline ND 48" and 46"

The width of the working strip in open country for pipeline of ND 16'' will be 20 m.



Source: P616-000-DB-BDS-01_3, Design Basis Memorandum – Pipeline and Facilities, IGI Poseidon, 2021

Figure 3-13 Regular Working Strip in Open Country for Pipeline ND 16”

In sensitive areas, such as organized tree crops, the width of the construction strip will be 28 m, whilst in forested areas, with dense vegetation, even more. However, the construction strip shall not be less than 22 m for pipelines with ND 48” and 46” and 14 m for pipelines with ND 16”. The widths of the construction areas have been determined by international practice so that the necessary construction activities can be safely carried out. In special locations, such as junctions and other special locations, the work zone may be a bit longer.

Table 3-12 Summary of Working Strip width

Diameter of the pipelines (inches)	Regular Working Strip (m)	Reduced Working Strip (m)	Reduced Working Strip without Topsoil Stripping (m)	Boring methods (Area Required) (m^2)	HDD (Area Required) (m^2)
48 and 46	38	28	22	45 x 50 and 45 x 30 (each side)	100 x 100
16	20	14	14	40 x 40 and 40 x 20 (each side)	100 x 100

Source: IGI Poseidon, 2021

Onshore facilities include metering, compression and regulation facilities. Compressor Stations, Measuring Stations and Valve Stations are supportive pipeline installations and are indispensable for the operation of the entire project

Pipeline's construction strip as well as Onshore Facilities plots will be used as the main construction sites. However, few storage yards and main construction sites will be temporarily created to accommodate necessary storage of equipment, machinery, pipes and personnel offices. These will be located in areas close to transportation infrastructure and in proximity to project's footprint.

Existing roads shall be used for project's construction. In some cases, improvement of the existing network might be performed in order to allow transportation of heavy machinery and equipment. According to the design so far, the construction of new roads is not foreseen.

After construction, most sites will be restored to their original condition where possible. Along the route a permanent pipeline protection strip (PPS) with a width of 8 m (4 m either side of the centreline right of way) will be established (see Section 6.5.4.1 for more details).

A typical sequence for onshore pipeline construction is illustrated in Figure 3-14.

Source: ASPROFOS,2022

Figure 3-14 Typical Pipeline Construction Sequence

3.4 Operating Philosophy

The EastMed Pipeline Project will be controlled from a dedicated main dispatching centre (MDC), located at the O&M Base.

The main functions of the control room will be monitoring, control and operation of the EastMed Pipeline Project via SCADA, among other things. All stations will be designed on the basis that they are unstaffed and controlled remotely.

The design will allow planned and orderly expansion to meet projected data acquisition and equipment needs. The full design will allow modular expansion such that the dispatching centre is easily reconfigured to add processing capacity.

A backup dispatching centre (BDC), located geographically separate from the MDC, will duplicate all functions of the control centre, except for the pipeline trainer and interfaces to the business and maintenance systems.

Compressor stations have been designed for remote operation from the MDC and the BDCs via SCADA (e.g. settings for compressor duty, speed, etc.). At each station, a station control system (SCS) will be provided for local control of all compressors and equipment associated with the station..

The flow control and pressure control operating principles are applicable to long-distance gas transportation pipelines and therefore relevant to EastMed. Both methods may be employed depending on the specific section

Given that the compressor station at Florovouni, and hence the downstream system, will be operating in flow control mode, the part of the EastMed system between CS2 and Florovouni should also be operated in flow control mode. This is because most of the system (from LS03 onwards) is a low pressure system with a limited scope for line packing. In addition, the HP/LP interface at LS03 prevents the OSS3 pipeline from being operated at elevated pressure, i.e. OSS3 cannot be packed.

The system upstream of CS2 is a high-pressure system with large pipeline volume (long pipeline lengths) hence provides flexibility in terms of line packing.

The summary of the recommended control type for each section of the EastMed system is presented in Table 3-13.

Table 3-13 Recommended EastMed Control Philosophy

System	Pipeline Segment	Control Type	Reasoning
Southern Line	OSS1-OSS2	Pressure control	To make use of the available large inventory/line-pack in the pipeline. Control with pressure let down provisions at Crete compressor station.

System	Pipeline Segment	Control Type	Reasoning
	OSS1a	Pressure control	OSS1a is part of the OSS1-OSS2 system and upstream of CS2, hence requires same control type
	OSS3	Flow control	Pipeline is interfacing a low pressure system hence line packing is not feasible.
	CCS1, OSS4 and CCS2	Flow control	Low pressure part of the system with limited line-packing potential. Control to manage interconnection points with future transmission system operators (TSO)
Northern Line	OSS1b	Pressure control	OSS1b is upstream of CS2, hence requires same control type as rest of the system
	OSS2N	Pressure-control	To make use of the available line-pack in the pipeline and to allow comingling of flow from Southern and Northern Linesat CS2
	OSS3N	Flow control	Same as OSS3. Pipeline runs in parallel with OSS3 pipeline with comingled source at CS2

Source: IGI, 2021

3.5 Use of Resources and Environmental Interference

3.5.1 Land Take

During construction, land will be occupied for:

- Working strip
- Marshalling and storage yards
- Construction sites; and
- Access roads.

Table 3-14 summarises the land required by the Project.

Table 3-14 Land Take of the Project

Project Component	Temporary Land Take (Total Area) (m^2)	Permanent Land Use (m^2)
Pipeline (543.06) working strip	16,088,951	4,344,480
Main stations (compressor and metering stations)	490,724	490,724
Line stations (15 BVSs and 7 SS)	127,234	127,234
O&Ms	32,000	32,000
Construction sites	243,098	0
Pipe yards (continental pipeline)	456,086	0
Marshalling yards (offshore sections)	180,000	0
River crossing (HDD method)	108,040	0
Road crossing	155,827	0
Landfall sites (four)	27,000	0

Source: IGI Poseidon, 2021

3.5.2 Raw Materials

The bottom of the trench as well as the padding material consists of well graded, round material with an estimated volume of 7,767.9 m^3 per km of pipeline route in order to avoid any damage to the pipeline coating. If the excavated material from the trench is suitable (e.g. sandstone) it will be recycled for bedding and padding. Additional padding material will be provided in areas where flysch is encountered.

Sand and aggregate will be obtained from local authorised and approved quarries.

Where excavation disturbs topsoil, the first layer of excavated material (topsoil) will be stored separately so that it can be replaced on the surface when the excavated area is restored.

Regarding the stations (MS and CS), the selected sites are more or less leveled and no extended excavation works will be performed that would result in generation of substantial aggregates.

An estimate of the key materials consumed during the construction phase is shown in Table 3-15. The material types and amounts are based on similar projects and the current status of design.

Table 3-15 Estimated Material Consumption during Construction-Raw Materials Onshore

Material	Quantity (tn)
Steel	420,000
Concrete	12,000
Polyethylene tape	7,500
Sand	690,000
Excavated material	3,187,137.60 m^3
Backfilled material	1,302,954.15 m^3

Source: IGI Poseidon, 2021

Table 3-16 Estimated Material Consumption during Construction-Raw Materials Offshore

Material	Pipeline Section				
	OSS1-OSS2	OSS2 N	OSS3	OSS3 N	OSS4
Steel (mT)	590,000	445,000	207,000	207,000	18,000
Concrete coating (mT)	830	5,360	1,470	1,470	10,810
3 LPP coating (mT)	8,980	6,800	4,230	4,230	290

Source: IGI Poseidon, 2021

3.5.3 Fuel Usage

Heavy equipment and motor engine driven equipment used during the construction phase will be fuelled with diesel. Diesel fuel will be delivered via approved fuel road tankers to the construction sites. An estimated total volume of fuel required for construction activities is given in Table 3-17.

For the vessels, considering construction times are beyond a vessels normal endurance, refuelling at sea will be undertaken via a tanker and all precautions taken to eliminate spills. A boom will be deployed at the stern and bow of the vessel when refuelling is taking place; additionally there will be sufficient absorbents available during the fuelling process whereby, in the unlikely event of any spill occurring it will be dealt with immediately.

Table 3-17 Estimated Material Consumption during Construction – Fuel Usage

Section	Use	Total Quantity
Onshore	Equipment and vehicles	480,000 m3 Diesel
Offshore	Vessels	101,630 t MGO
	Pre-commissioning equipment	16,850 t Diesel

Source: IGI Poseidon, 2021

As the compressor stations will be operated with natural gas, no fuel consumption is expected during the operation phase.

3.5.4 Water Consumption

The foreseen water consumption during the construction phase is related primarily to watering construction sites to reduce dust emissions due to earthmoving activities and for civilian uses. In the Pre-commissioning phase, water consumption is related to hydrotesting activities.

Table 3-18 shows the estimated water consumption during the construction and pre-commissioning activities.

Table 3-18 Estimated Water Consumption during Construction

Use	Approx. Volume	Comments
Civil Water	Max 21 m^3/day	60l/person per day (considering 350 people working simultaneously)
Industrial water	5-10 m^3/day	Working strip dust suppression
Industrial water	9,000 m^3/day	Trenchless slurry

Source: Asprofos, 2022

The quantity of water used for hydrotest, considering the complete onshore section, is approximately 600,490.4 m^3. This volume of water is the maximum that could be used. However, it is best international practice to transfer water between hydraulic test sections and re-use it as much as possible so the final volume is expected to be much smaller. Table 3-19 shows the potential water sources identified along the pipeline route and the volumes required for hydrotesting for each main section.

Table 3-19 Water Requirements for Hydrotest Sections

Pipeline Spread		Water Source	Approx. Volume Required (m^3)	Pipeline Section
From KP	To KP			
Short Onshore Section at Crete				
0	50	Evrotas	54,900	CCS1
50	100	Evrotas	54,900	CCS1
100	130	Evrotas	32,940	CCS1
130	150	Alfeios	21,960	CCS1
150	200	Alfeios	54,900	CCS1
200	250	Pineiakos Ladonas	54,900	CCS1
250	300	Pineiakos Ladonas - Pineios	50,500	CCS1

Pipeline Spread		Water Source	Approx. Volume Required (m^3)	Pipeline Section
From KP	To KP			
			18,451	OSS4
0	35	Evinos	38,430	CCS2
35	55	Water Canal of Trichonida	21,960	CCS2
55	70	Acheloos	16,470	CCS2
70	135	Arachthos & Louros	71,370	CCS2
135	200	Louros	71,370	CCS2
200	233	Louros & Acherontas	36,234	CCS2
0	4	Alfeios	492	Megalopoli Branch
4	9.8	Alfeios	713.4	Megalopoli Branch

Source: IGI Poseidon,2021

After taking into account the Project workforce during operation, the estimated water consumption for domestic use is 210 l/d whilst the estimated grey water would be 50 m^3/yr.

3.5.5 Air Emissions

During construction, earth dust particles from soil movement, as well as pollutants from the exhausts of heavy equipment and vehicles will be emitted. Dust will mainly be produced during excavation and backfilling activities. Earthworks take place in worksites for pipeline, compressor station and BVS construction activities. Other sources of dust emission will be traffic movements of trucks, minivans and other heavy equipment on the working strip. Pollutants will be produced by heavy equipment and vehicles due to the fuel combustion in their engines and released in the exhaust gas. The main pollutants produced will be NOX, CO, dust and SOX. During the pre-commissioning phase, the main air emission sources are equipment foreseen for the Pre-Commissioning activities (Conventional SPT and SPT Replacement).

During operation, the significant air emission sources are the gas turbine stacks at the compressor stations. Additional secondary sources of emissions can be considered negligible, and are limited to the following: emissions from heating, auxiliary power generation, and the diesel generator, to be operated only for electrical power supply in cases of emergency. For normal operation[3] the maximum

[3]Normal operation means a load range between 70 % and 100 % of system capacity

concentrations in the flue gas from the gas turbines will be < 50 mg/Nm^3[4] for nitrogen oxides (NO_X expressed as NO_2). This low value is achieved due to the installation of dry low-NO_X burners. Based on the maximum value guaranteed by the gas supplier, sulphur content in the gas, and thus the gas turbine fuel, is low, and the concentration of emitted SO_2 will be below 5 mg/Nm^3.

3.5.6 Noise Emissions

Indicative noise emissions generated by heavy construction equipment at the working strip, worksites and the compressor station site are listed in Table 3-20. The reported noise pressure levels at 1 metre from the source are typical for the equipment considered.

Table 3-20 Typical Noise Levels for Construction Equipment

Type of Equipment	Noise Level (dBA)
Excavator	70 – 84
Backhoe loader	70 – 84
Crane	70 – 84
Pipelayer	70
Side-boom	84 – 99
Pipe bending machine	60
Engine generator	70 – 84
Pay-welder	70 – 84
Concrete mixer	95
Concrete pump	70 – 84
Soil compactor	70 – 84

Source: IGI Poseidon, 2021

Table 3-21 Typical Noise Levels for Offshore and Nearshore Construction

Type of Equipment	Noise Level (dBA)
Deep water pipelay vessel	84-99
Intermediate water depth S-lay vessel	84-99
Shallow water S-lay vessel	84-99
Support vessel	99-115
LF construction equipment	79 dB at 10 m

[4] Nm^3 stands for "normalized cubic meters," which means that the volume referenced to is at a temperature of 273º K and a pressure of 101,3 kPa

Type of Equipment	Noise Level (dBA)
Pre-commissioning activities - Alternative SPT	67 – 103 dB at 1m
Pre-commissioning activities – Conventional SPT	79 – 99.2 dB at 1m

Source: IGI Poseidon, 2021

During the pre-commissioning phase, the main noise sources are equipment foreseen for the SPT activities (Conventional SPT and SPT Replacement). More details are reported in the assessment section of the ESIA; refer to Chapter 9.

Marine equipment operation will produce underwater noise (trenching, vessel engines; etc) and aerial noise (vessel and heavy equipment diesel engines, equipment).

During the operation phase, based on applicable legislation (PD 1180/1981), noise limits at the fence line of a facility are determined based on the dominant characteristics of the areas land use (seeTable 3-22).

Table 3-22 Allowable Noise Levels According to P.D. 1180/1981 (HGG A' 293/1981).

Area's Description	Maximum Allowable Noise Level (dBA)
Statutory Industrial Areas	70
Areas where industrial characteristics are dominant	65
Areas where industrial and urban characteristics are equally present	55
Areas where urban characteristics are dominant	50

Source: IGI Poseidon, 2021

3.5.7 Liquid and Solid Waste Generation, Handling and Disposal

In general, waste management will be in full compliance with the legal framework and under consideration of international best practice principles and Greek/EU legislation.

All waste materials will be collected, stored and transported separately in appropriate and approved bins and containers.

Detailed lists of the quantities of waste by type during onshore construction are shown in Table 3-23 which describes the typical waste types generated by pipeline construction. Waste type generated and estimated quantities are an assumption based on experience gained from similar projects and the current status of design. During construction +/- deviations are possible.

3.5.7.1.1 Typical Waste Generated during Project Construction and Pre-commissioning

Table 3-23 Typical Waste Generated during Project Construction and Pre-commissioning

Activity	Waste Generation	Approximate Amount*	Disposal Recommendation
Construction sites/storage yards			
Site preparation	Likely to be negligible.	-	-
Operation	Office rubbish, paper, canteen refuse, etc.	(Included in rubbish from yard)	Recycle where possible and send rest to a licensed waste disposal site.
	Rubbish from pipe yards and construction sites	45 tonnes per week	Collect in covered skips to recycle where possible or send to a licensed waste disposal site.
	Scrap metal	45 to 720tonnes	Recycle or sell as scrap.
	Sewage	24 tankers per month	Cesspit to sewer or emptied regularly.
Site reinstatement	Workshop waste, e.g. paints, oil, etc.	45 tonnes	Collect in secure containers and send to a licensed waste treatment or disposal site.
	Concrete foundations, etc.	0 to 600 tonnes	Send to licensed waste disposal site.
Pipeline construction			
Working width preparation	Hedges, timber, vegetation, fence posts, wire, etc.	-	In accordance with applicable legislation
Pipe-string and bending	Pipe-bands and end caps	-	Collect in skips and send to licensed waste disposal or recycling site.

Activity	Waste Generation	Approximate Amount*	Disposal Recommendation
Welding, testing and coating	Spent welding rods, grinding wheels, visors, shot-blast	5 to 10 tonnes per week and per construction spread	Collect in covered skips or tipper trucks and send to licensed waste disposal site.
Trenching, lowering and laying of the pipeline	Soil and rock	Approx. 2,400,000 m^3 for the whole pipeline route	Set aside to be used in backfilling. Excess quantities used to restore abandoned quarries, in coordination with Authorities
Backfilling and grading	Surplus spoil and rock	0 to 3,000 tonnes per day (based on 600 m backfilling per day), dependent on ground conditions	Subject to landowner/ occupier's agreement. Re-use if possible/take to licensed waste disposal site.
Reinstatement	Temporary stone roads Temporary fencing, gates, troughs, etc.		Re-use elsewhere within project's area. Re-use if possible.
Horizontal directional drilling (HDD)	Bentonite, spoil and rock cuttings	0 to 600 tonnes/crossing (depending on whether used)	Store in sumps or storage pits, then dispose of using road truck tankers to licensed waste disposal site.
Thrust-boring	Spoil and rock cuttings	0 to 900 tonnes (depending on whether used)	Dispose of using road truck tankers to licensed waste disposal site.

Activity	Waste Generation	Approximate Amount*	Disposal Recommendation
Main stations construction			
Site preparation	Likely to be negligible	-	-
Backfilling and grading	Surplus spoil and rock	For CS2-MS2 / CS2N – MS2N (m^3): • Total Excavated Material: 145,291.99 • Backfilling Material: 326,338.70 • Net: 181,046.71 (FILL)	Subject to owner's agreement. Re-use if possible/take to licensed waste disposal site.
		For CS3(m^3): • Total Excavated Material: 315,029.70 • Backfilling Material: 24,186.45 • Net: 290,843.25 (CUT)	
		For MS4(m^3): Total Excavated Material: 44,687.43 Backfilling Material: 29111.80 • Surplus Material: 15,575.63 (CUT)	
Pre-Commissioning			
Dewatering, cleaning and gauging of the pipelines	MEG	Up to 1,165 tonnes	MEG will be recovered in tanks and recycled/disposed by certified company

Activity	Waste Generation	Approximate Amount*	Disposal Recommendation
Only estimates and estimated ranges for waste quantities can be given at this stage of the Project. These estimates will be refined when detailed design has been finalised and the locations of the construction sites and storage yards have been defined further.			

Source: IGI, 2021

Table 3-24 describes the construction waste inventory for EastMed (Landfalls are excluded and are shown in Table 3-25). Waste types and amounts are an assumption based on similar projects and the current status of design. During construction +/- deviations are possible.

Table 3-24 Construction Waste Inventory

Waste Type	EKA Code	Amount (tonnes)*	Disposal
Hazardous			
NDT waste	06 03 13*	> 10	Authorised Waste Manager
Rags and oil absorbents	15 02 02*	100	
Pipeline coating chemicals	07 02 14*	< 12	
Aerosol cans	07 02 14*	< 12	
Batteries Wet, Batteries Dry	16 06 01* & 16 06 02*	<12	
Activated carbon	06 13 02*	<12	
Cables/copper	17 04 09*	6	
Chemicals (Hazardous)			
Adhesives	08 04 09*	< 12	Authorised Waste Manager
General Chemicals	18 01 06*	40	
Freighting foam	07 02 16*	< 12	
Glycols	07 01 03*	< 12	
Solvents	07 03 03*	< 12	
Hydrotest fluids	08 04 15*	< 12	
Diesel, Fuel and Oil Waste (Hazardous)			
Diesel generator lube oil	13 01 11*	20	Authorised Waste Manager
Misc. oils (incl. hydraulic)	13 01 13*	50	
Vehicle and equipment lube oil	13 02 04*	50	
Glycol sludge	07 07 11*	>10	
Light bulbs	20 01 35*	12	
Medical	18 01 03*	12	
Paint sludge	08 01 11*	12	
Paint and cans/brushes	08 01 13*	25	
Non –Hazardous			
Paper and cardboard	20 01 01	100	Recycling
Pipe bands and end caps	20 01 39	100	Municipal Waste Management
Plastic bottles	17 02 03	300	Recycling

Waste Type	EKA Code	Amount (tonnes)*	Disposal
Plastic 'epoxy' drums	08 04 09*	40	Recycling
Polystyrene	15 01 02	150	Recycling
PPE and clothing	15 02 03	<40	Municipal Waste Management
Steel	20 01 40	36	Recycling
Welding materials	20 01 28	80	Recycling
Wood	20 01 38	720	Municipal Waste Management
Aluminium cans	19 12 03	<12	Recycling
Electrical/electronic comps	20 01 36*	<12	Recycling
Filters (water)	20 03 06	12	Municipal Waste Management
Food	20 03 99	2,400	Municipal Waste Management
Inert (Non – Hazardous)			
Bricks and building materials	17 01 02	80	Municipal Waste Management
Concrete/foundations	17 01 01	150	Municipal Waste Management
Glass	17 02 02	<12	Recycling

Source: ASPROFOS, 2022

Table 3-25 Construction Waste Inventory for Landfalls

Waste Type	EKA Code	Approximate Quantity**	Disposal Recommendation**
Oil waste and liquid fuel waste (except edible oils)			
Mineral based non-chlorinated hydraulic oil (*)	13 01 10*	0.1 – 1 tonnes	Recycling
Mineral-based non-chlorinated engine, gear and lubricating oils (*)	13 02 05*	0.1 – 1 tonnes	Recycling
Other engine, gear and lubricating oils (*)	13 02 08*	0.1 – 1 tonnes	Recycling
Other emulsions (*)	13 08 02*	0.1 – 1 tonnes	Disposal

Waste Type	EKA Code	Approximate Quantity**	Disposal Recommendation**
Waste packaging (absorbents, wiping cloths, filter materials and protective clothing not otherwise specified)			
Plastic packaging	15 01 02	0.1 – 1 tonnes	Recycling
Wooden packaging	15 01 03	1 – 10 tonnes	Recycling
Mixed packaging	15 01 06	10 – 30 tonnes	Recycling
Packaging containing residue of or contaminated by dangerous substances (*)	15 01 10*	0.1 - 1 tonnes	Disposal
Absorbents, filter materials (including oil filters not otherwise specified), wiping cloths, protective clothing contaminated by dangerous substances (*)	15 02 02*	0.1 – 1 tonnes	Disposal
Wastes not otherwise specified in the list			
Components removed from discarded equipment other than those mentioned in CER 16 02 15	16 02 16	0.01 – 0.1 tonnes	Recycling
Alkaline batteries	16 06 04	0.001 tonnes	Recycling
Aqueous liquid wastes other than those mentioned in CER 16 10 01	16 10 02	TBD	Disposal
Oil filters(*)	16 10 07*	0.01 – 0.1 tonnes	Recycling
Construction and demolition wastes (including excavated soil from contaminated sites)			
Wood	17 02 01	1 – 10 tonnes	Recycling
Plastic	17 02 03	TBD	Recycling
Iron and steel	17 04 05	10 – 50 tonnes	Recycling
Soil and stones other than those mentioned in CER 17 05 03	17 05 04	TBD	Recycling
Mixed construction and demolition wastes other than those mentioned in	17 09 04	TBD	Recycling

Waste Type	EKA Code	Approximate Quantity**	Disposal Recommendation**
CER 17 09 01, 17 09 02 and CER 17 09 03			
Wastes from human health care			
Waste with collection and disposal subject to special requirements in order to prevent infection(*)	18 01 03*	0.01 – 0.1 tonnes	Disposal
Municipal waste (household waste and similar commercial, industrial and institutional wastes) including separately collected fractions			
Paper and cardboard packaging	20 01 01	0.5 – 2 tonnes	Recycling
Glass	20 01 02	1 -5 tonnes	Recycling
Biodegradable kitchen and canteen waste (food waste)	20 01 08	1 -10 tonnes	Recycling
Fluorescent tubes (*)	20 01 21*	0 – 0.1 tonnes	Recycling
Biodegradable waste	20 02 01	1 – 10 tonnes	Recycling
Mixed municipal waste	20 03 01	1 – 5 tonnes	Recycling
Sewage water	20 03 04	TBD	Disposal
* classified as hazardous waste ** related to recent and previous similar projects on Landfall Site TBD: Quantity of such waste is not quantified due to kind of activities not yet defined in the Project and the number of staff employed			

Source: ASPROFOS, 2022

3.5.7.1.2 Effluents from Vessels in Accordance with Marpol

Table 3-26 describes the standard effluents from vessels in accordance with Marpol

Table 3-26 Summary of Liquid Discharge Estimates from Pipelaying and Support vessels

Waste flow	Main Sources and Approximate Volume Generated	Main Possible Components	Comments
Bilge water disposal	Cleaning out of engine rooms. Bilge water generation variable, depending upon	Hydrocarbons, Increased Biochemical Oxygen Demand (BOD)	Bilge water to be processed through an oil-water separator /system to reduce the hydrocarbon content in

Waste flow	Main Sources and Approximate Volume Generated	Main Possible Components	Comments
	vessel characteristics, discharge volume variable. Small quantities of *oily water* might be generated during the regular vessel activities, such as maintenance activities. Estimated up to approximately 20 m^3/month.		the water to a maximum of 15 ppm, as required by MARPOL; fitted with an alarm system.
Deck drainage	Run-off of rain water. Deck drainage water generation variable depending on vessel characteristics and rainfall amounts; discharge volumes variable, though expected to be low.	Hydrocarbons, cleaning products.	Rain water run-off will depend on the severity of storms and on the direction of the wind compared to the direction that the vessel is travelling in. All discharges will be in compliance with MARPOL 73/78, Annex I. Deck drainage to be monitored and treated to remove oil and grease; discharge not to exceed 15 ppm of oil content.
Grey Water	Dishwasher, showers, laundry, bath and washbasin drains Estimated 220 l per person per day. Total volume: 22 m^3 per day (assuming capacity of 100 people within all vessels).	Increased BOD, solids, detergents	On-board sewage treatment unit to comply with MARPOL 73/78 Annex IV: no floating solids or discoloration of surrounding water; no discharges of treated sewage from vessels within 3 nm of the nearest land. residual chlorine content <1.0 mg/ l

Waste flow	Main Sources and Approximate Volume Generated	Main Possible Components	Comments
Sewage (Black water)	Water effluent from toilets Estimated 100 l per person per day Total volume: 10 m^3 per day (assuming capacity of 100 people within all vessels)	Microorganisms, nutrients, suspended solids, organic material, pathogens, chlorine	On-board sewage treatment unit to comply with MARPOL 73/78 Annex IV: no floating solids or discoloration of surrounding water; no discharges of treated sewage from vessels within 3 nm of the nearest land. Residual chlorine content <1.0 mg/ l.
Ballast water	Dependent on vessel characteristics and stabilisation needs	Oil and alien organisms	Vessels will discharge ballast water beyond the 200 nautical miles limit, to the extent possible, and at least 50 nm from nearest land in depths over 200 m prior to reaching Greek waters. There will be no de-ballasting in coastal waters.

Source: IGI Poseidon, 2021

MARPOL 73/78 states that vessels in excess of 100 gross registered tonnage are required to prepare a Garbage Management Plan detailing how each type of waste will be stored. All waste should be stored appropriately, and storage and transfer of wastes are recorded.

Solid waste from vessels shall be stored onboard appropriately in accordance with Annex V of MARPOL 73/78.

Table 3-27 Sample of Offshore Construction Vessel Garbage Placard

Waste Classification	Skip Contents
Scrap Metal (Non hazardous)	All scrap metal including swarf, metal shavings, uncontaminated metal cans and tins, metal wires, damaged slings, etc.

Industrial Waste (Non hazardous)	Deck sweepings, plastics, waste flux, concrete spoil, damaged field joint sleeves, excess PU foam, glass, wood, etc.
Domestic Waste (Non hazardous)	Waste food, napkins, paper towels, plastic and paper cups, water bottles, etc.
Special Waste (hazardous)	All oil / chemical / paint contaminated materials including paint tins, oily rags, chemical containers, aerosols, waste mastic, oil spill granules, batteries, medical waste (bagged and sharps bins), exhausted oil, oil filters and oil contaminated materials, etc.

Source: ASPROFOS, 2022

During operation, the pipeline itself has no solid waste generating activities.

Waste from the O&Ms is not calculated within the present study. It will be presented in a separate study, if and as applicable. Waste from the stations is estimated to be around 2000 kg per year.

Solid waste during the operation phase is produced mainly from compressor stations The following table present the solid waste categorisation.

Table 3-28 Solid Waste Categorisation from Compressor Stations

EWC Code	Waste Type	Quantity tn/a	Management
16 0601*	Lead batteries	0.3	Disposed of by licenced companies
17 04 05	Iron and steel	6	Recycling
15 01 06	Mixed packaging	1.5	Recycling
17 02 03	Plastic	0.03	Recycling
17 02 02	Glass	0.03	Recycling
20 03 01	Mixed municipal waste	510	Collection by the competent authority
13 02 08*	Other engine, gear and lubricating oils	12	Disposed of by licenced companies
20 01 28	Paint, inks, adhesives and resins other than those mentioned in 20 01 2	0.3	Disposed of by licenced companies
15 02 02*	Absorbents, filter materials (including oil filters not otherwise specified), wiping cloths, protective clothing	0.6	Disposed of by licenced companies

EWC Code	Waste Type	Quantity tn/a	Management
	contaminated by dangerous substances		
16 03 05	Organic wastes containing dangerous substances	3	Disposed of by licenced companies
15 01 09*	Textile packaging	18	Disposed of by licenced companies
16 02 16	Components removed from discarded equipment other than those mentioned in 16 02 15	1500 items	Recycling

Source: IGI Poseidon, 2021