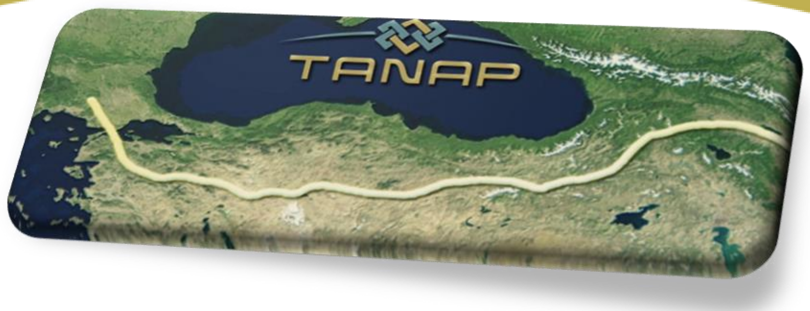
POTANTIAL CHALLENGES
OF THE EASTMED PIPELINE PROJECT

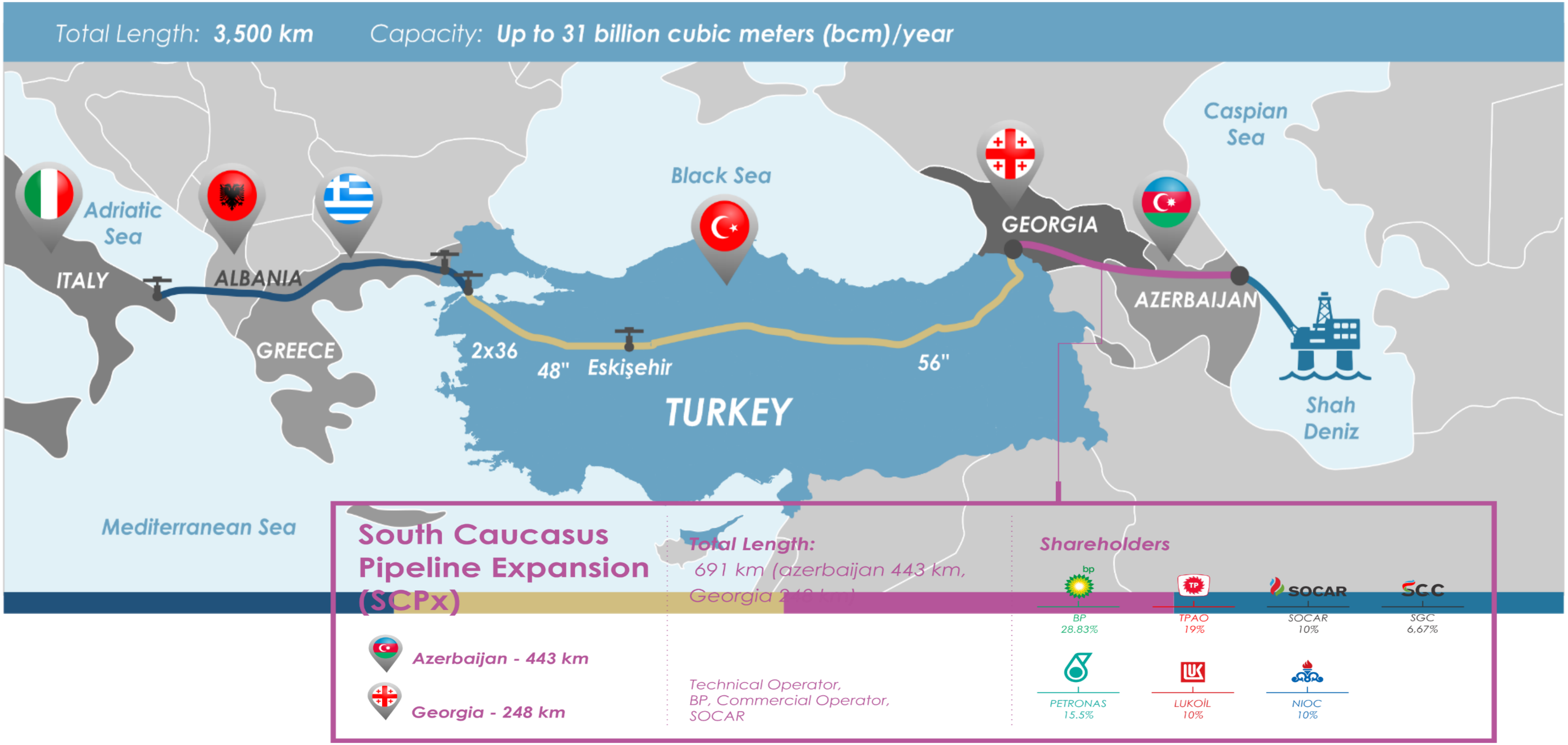


Ömer KORKMAZ – Projects And Modifications Director

Presentation Outline

- ✓ Safety Moment
- ✓ SOUTHERN GAS CORRIDOR
- ✓ TANAP PROJECT /ONSHORE/OFFSHORE
- ✓ TAP OFFSHORE /ADRIATIC SEE CROSSINGS
- ✓ TURK STREAM OFFSHORE PROJECT
- ✓ BIGGEST AND MOST CHALLENGES OFFSHORE PROJECTS
- ✓ EAST-MED PIPELINE PROJECT/CHALLENGES
- ✓ EAST MED CAPEX ESTIMATION

Southern Gas Corridor and TANAP



Total Length: **3,500 km** Capacity: **Up to 31 billion cubic meters (bcm)/year**

Trans Anatolian Natural Gas Pipeline (TANAP)

Total Length:
1850 km (Turkey)

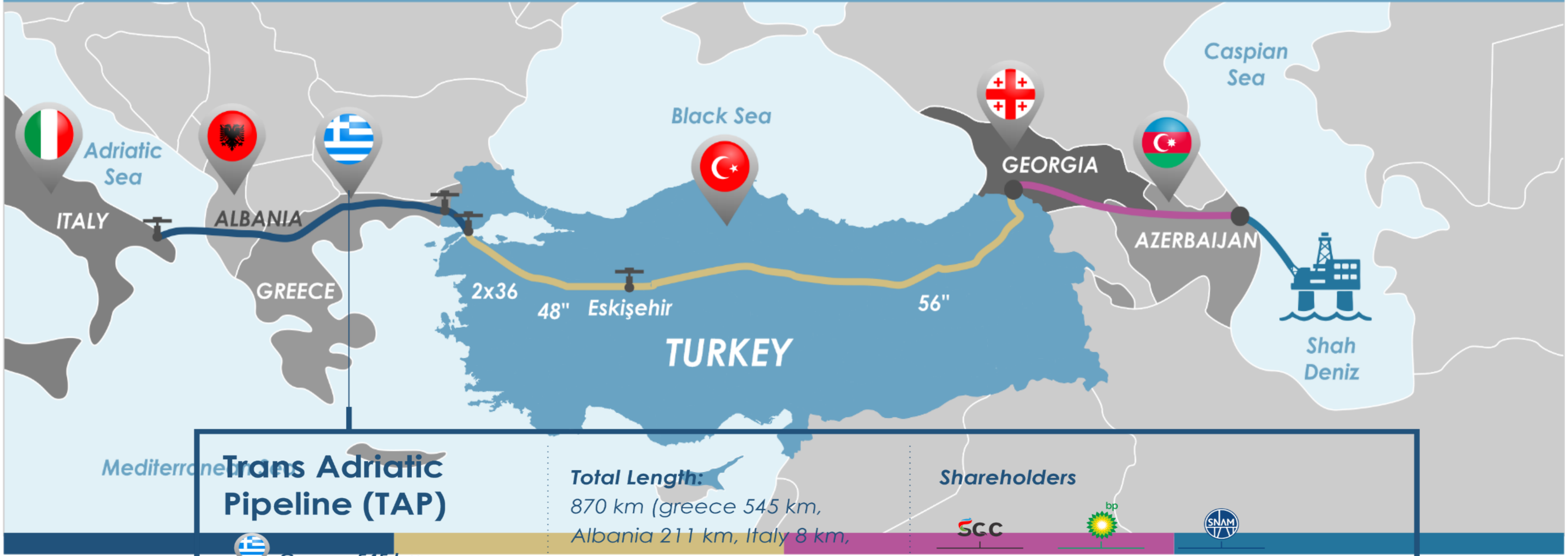
Shareholders

SGC	SOCAR	BOTAŞ	BP
51%	7%	30%	12%

Turkey - 1850 km

Southern Gas Corridor and TAP

Total Length: **3,500 km** Capacity: **Up to 31 billion cubic meters (bcm)/year**



Trans Adriatic Pipeline (TAP)

Greece 545 km

Albania 211 km

Italy 8 km

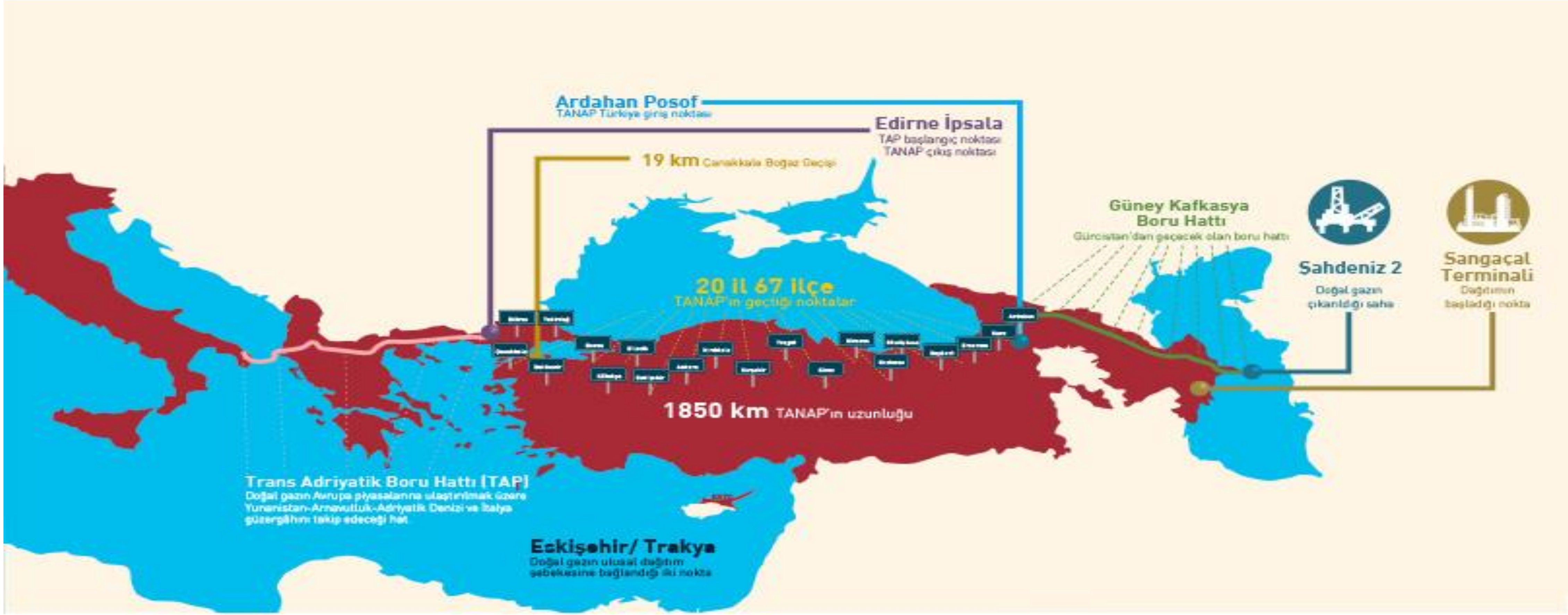
Total Length:

870 km (greece 545 km, Albania 211 km, Italy 8 km, Adriatic Sea 105 km)

Shareholders

SGC	20%
BP	20%
SNAM	20%
Fluxys	19%
Enagas	16%
Axpo	5%

TANAP OVERVIEW



TANAP Project Scope

End Point: Greece- Turkey border (İpsala-Edirne)	Start Point: Georgia - Turkey border (Türkgözü)

GAS TRANSMISSION CAPACITY

PHASE 0 CAPACITY 2018	6 bcm/y
PHASE 1 CAPACITY 2019	16 bcm/y
PHASE 2 PLANNED CAPACITY	24 bcm/y
PHASE 3 PLANNED CAPACITY	31 bcm/y

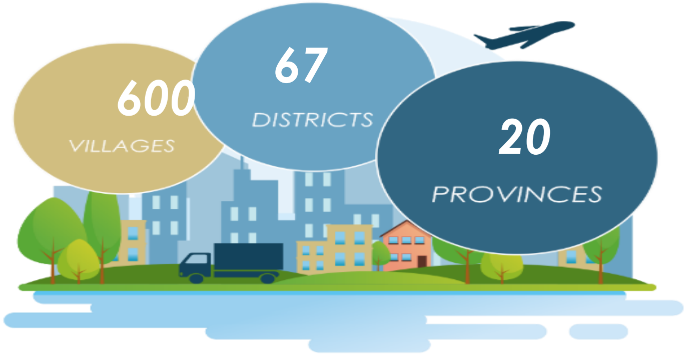
PIPELINE (1.850 km)

56 inch	48 inch	2 x 36 inch
Ardahan Eskişehir	Eskişehir Edirne	Dardanelles Strait (twin pipeline systems)
(1.340 km)	(492 km)	(2x17.6 km)

STATIONS (FOR 31 bcma)

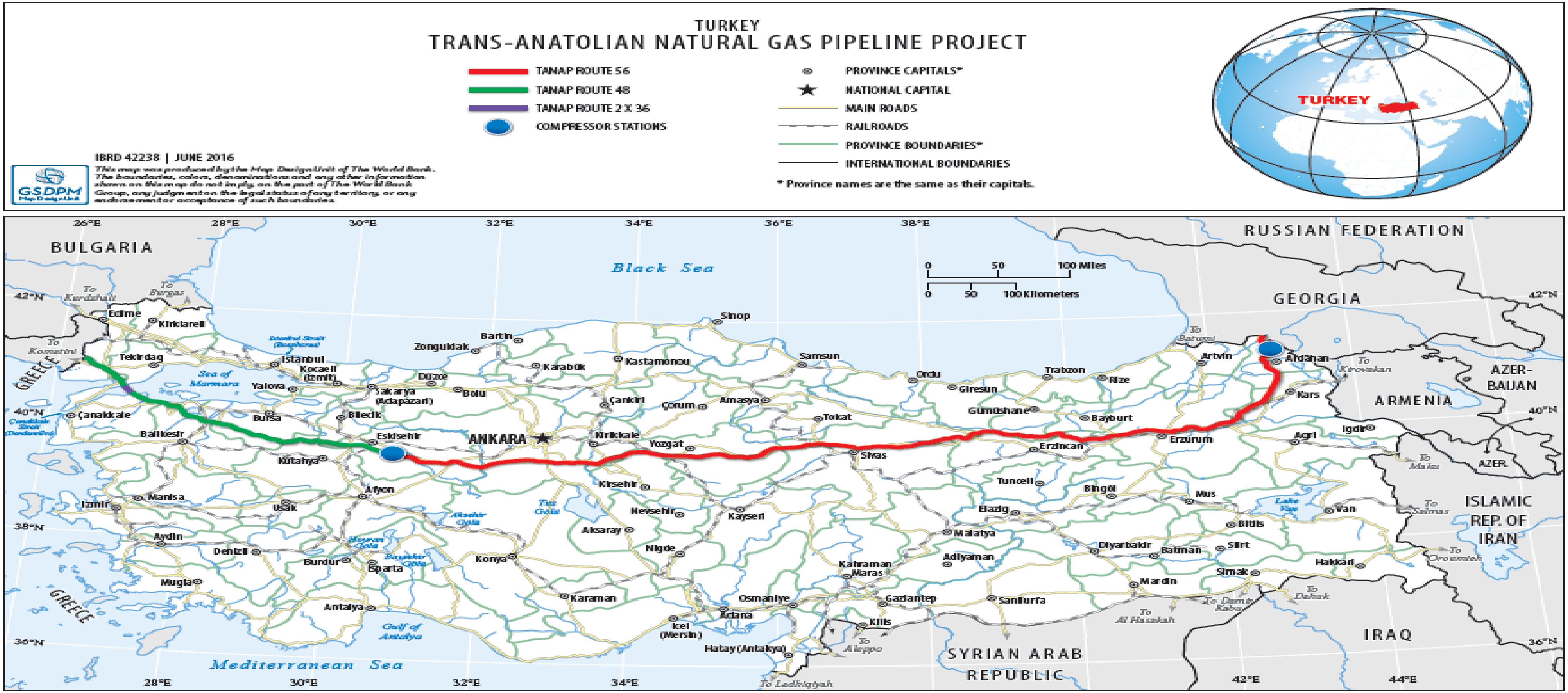
Off-Take Points:	Compressor Stations	Metering Stations	Pig Stations	Block Valves Stations
2 Phase	Phase 0 2		Phase 0 6	39
Phase	Phase 1 2		Phase 0	Phase 1 10

PIPELINE ROUTE



Pipeline Project Presentation

Overall TANAP Project Route



High Altitude

- Approximately % 30 of the pipeline was constructed higher than 2000 m above sea level.
- Project highest elevation is in Lot 1 and approximately 2760 m above sea level at KP 621.

Kızıldağ KP 621

Project Overview
Major Challenges / Lot 1-Spread 9

Stringing Activity

Lowering-in Activity

Kızıldağ Spread 9

Kızıldağ Spread 9 Padding Activity

Kızıldağ Spread 9 Stringing Activity

Kızıldağ Spread 9 KP 621+540

Karstic Area in Lot 2 between KP 651 to KP666.

Lot 2 Karstic Region KP 656

Lot 2 Karstic Region KP 654

Paddy Field Crossing

- 26 km of paddy field crossed during lot 4 construction activities.

- **KP 1617 – KP 1622 (5 KM)**
- **KP 1678 – KP 1683 (5 KM)**
- **KP 1684 – KP 1687 (3 KM)**
- **KP 1696 – KP 1699 (3 KM)**
- **KP 1747 – KP 1749 (2 KM)**
- **KP 1784 – KP 1878 (3 KM)**
- **KP 1810 – KP 1815 (5 KM)**

- Longest River Crossing with HDD (Horizontal Directional Drilling) 56” Diameter (28,01mm Wall Thickness) in EU - 1100 meters (SAKARYA River)
- 16th of February 2017; Sakarya River Crossing has been performed successfully with HDD. It has been recorded as the longest river crossing with HDD in Europe. (Previous Record for the longest river crossing of the
- Europe has been belonged to Italian Bonatti Company at Elbe River/ Germany.) (56”x1073 mt.)

Sakarya River Crossing KP 1222

- **145 Joints welded in a day (2 km) / 5 km section lowered in one piece as the longest section**
- **145 nos of joints / 2 km in length have been welded successfully with 5 welding crews, 16 welders in a day.**
- **5 km section has been lowered into the trench as the longest lowering-in section in TANAP Project successfully.**
- **In a day, 11,2 km of Lowering-in activity has been performed as the best progress in all LOTS.**

Lot 3 Lowering in Activity

Photos
Pipeline Construction Activities

Lowering in Activity

Lowering in Activity

Lowering in Activity

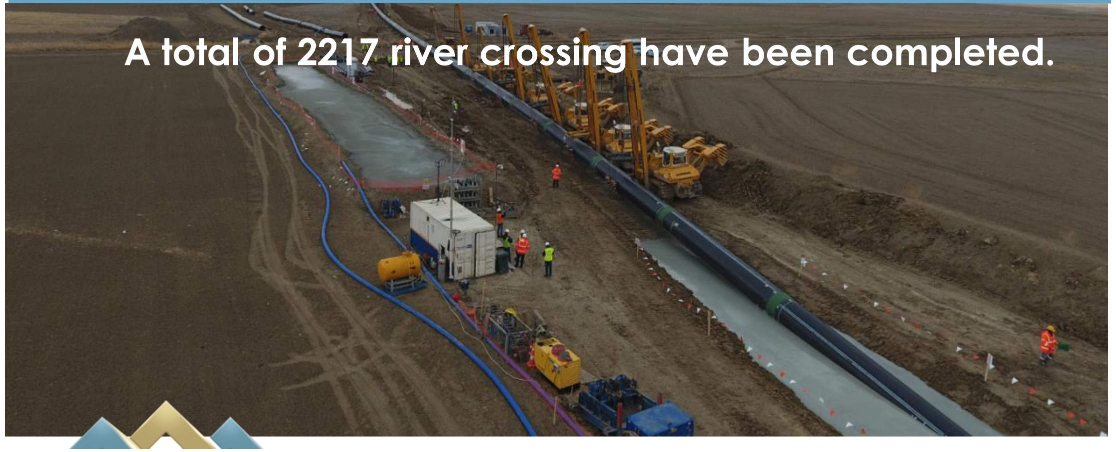
Lowering in Activity

Road Crossing KP 1152

Tie-in Activity KP 1120+800

Kızılırmak River HDD Crossing KP 1093+500

Sakarya River Crossing KP 1222



Photos
Pipeline Construction Activity-Winter Period

Site Equipments

Trenching Activity

Lowering in Activity

Repair Activity

Pipeline Construction Activity-Winter Period

Ilgar Mountain KP 20

Karadağ Mountain KP 540

Photos - Above Ground Installations

BVS 42

BVS 47

BVS 48

BVS 49

Photos
Pipeline Facilities (Phase 0 & 1)

Phase 0 Pipeline Reinstated

TANAP-TAP Golden Weld (Completed)

PS1 Launcher (56'')

Pig Receiver (48'')

BVS 41

DSE

Phase 1 Pipeline Linefill Activities (completed)

Environmental and Social Performance
ESIA and Bio-Diversity Studies

ECOLOGICAL STUDIES

- ✓ 246 Sampling stations for Terrestrial Flora Studies
- ✓ 133 Sampling Stations for Amphibian Species
- ✓ 243 Sampling Stations for Terrestrial Invertebrates
- ✓ 189 Sampling Stations for Freshwater
- ✓ Fish and Macro invertebrates studies
- ✓ Biodiversity Action Plan covering 67 Terrestrial and 27 Freshwater Critical Habitats/Biodiversity Offset Strategy
- ✓ 10 arthropod and 1 plant species, which were not previously recorded in the scientific literature were discovered.

SOCIAL STUDIES

- ✓ Surveys and Public Meetings
    - ❖ 513 Muhtar Surveys
    - ❖ 2253 Household Surveys
    - ❖ 307 Focus Group Meetings
    - ❖ 151 In-depth Interviews
    - ❖ 63 Public Participation Meetings
- ✓ Stakeholder Engagement Plan
- ✓ Resettlement Action Plan for Pipeline & AGIs
- ✓ Livelihood Restoration Plan for Fisheries and AGIs
- ✓ Grievance Mechanism
- ✓ Social & Environmental Investment Program

ARCHAEOLOGICAL STUDIES

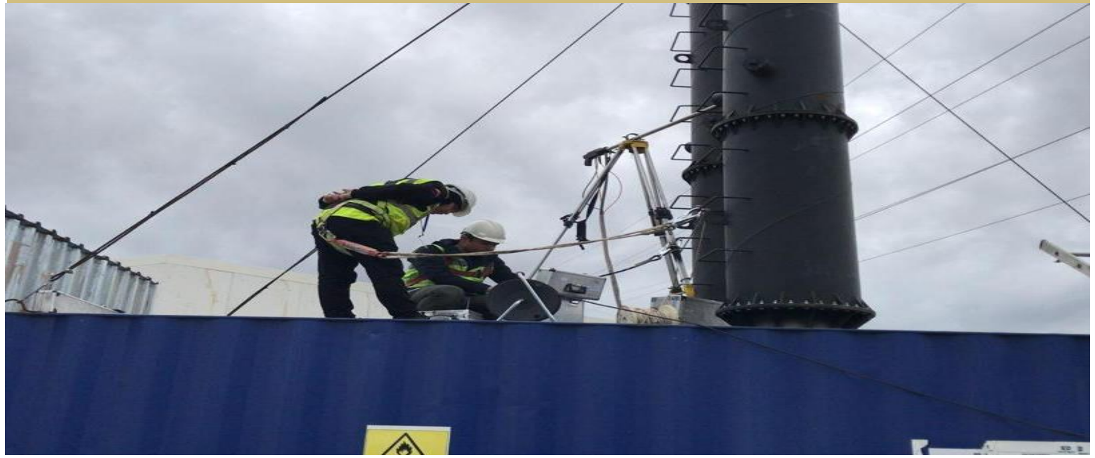
- ✓ 106 Newly Discovered Archaeological Sites During Route Selection
- ✓ 48 New Archaeological Sites During Construction

Photos Environmental Monitoring

Surfacewater Sampling

Soil Sampling

Boiler Stack Gas Measurements



Noise Measurment

Overall TANAP Offshore Project Route

Pipeline Project Presentation

Engineering

OFFSHORE CONTRACT includes detailed engineering related to all aspects of the offshore pipelines and offshore Fiber optic cables system. The engineering activities also includes HAZOP/HAZID review of the pipeline system and the operability of temporary facilities such as pipeline safety systems for testing and pre-commissioning as well as installation engineering, and all construction engineering and analysis required for installation of the offshore pipeline and the associated Fiber optic cable systems.

Procurement

OFFSHORE CONTRACT includes procurement of all materials, permanent or temporary, equipment, and consumables needed for completion of the Works including but not limited to the following:

- 36-inch O.D/2x18km line pipe Longitudinal Submerged Arc Welded Line Pipe for Offshore;
- Internal pipe coating of line pipe;
- External corrosion coating of line pipe;
- Concrete weight coating;
- Anode Bracelets;
- 4 X Offshore Fibre optic cables (2 x 192 Core, 2 x 48 Core ; single span crossing – continuous length);
- Onshore cable termination beach manholes (Construction);
- Materials for pipeline joint coatings, including heat shrink sleeves and infill materials;
- Consumables;
- Armour/Rock for pipeline cover at crossings and shore approach sections;

Overall TANAP Offshore Scope of Work

Pipelines Installation

OFFSHORE CONTRACT includes provision of all necessary equipment, materials, pipe installation vessels(s), trenching and rock dump vessels, manpower and other resources necessary for successful construction of two (2x18km) 36 inch O.D. offshore pipelines.

Fiber Optic Cables (FOC) Installation

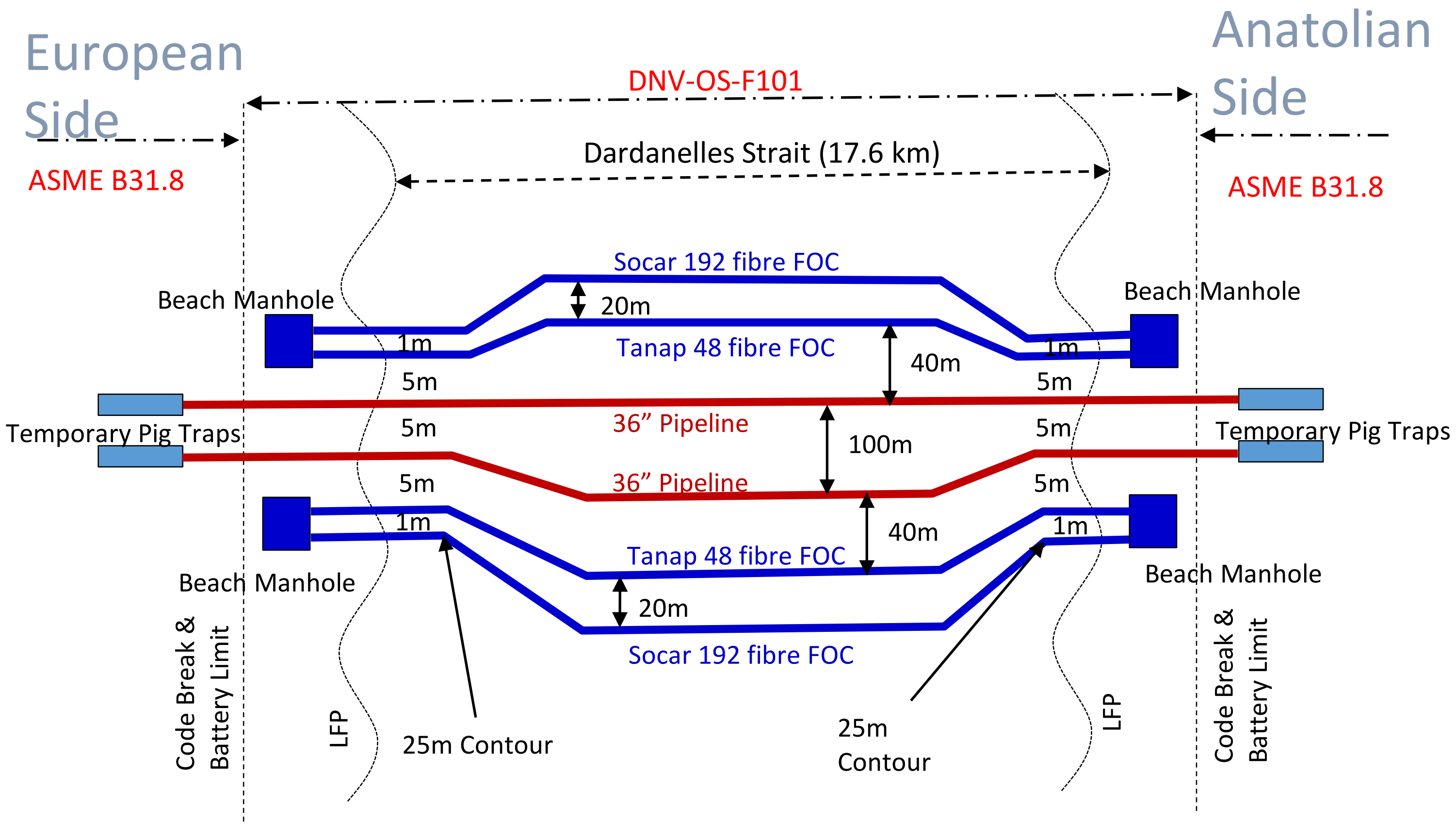
OFFSHORE CONTRACT includes provision of all equipment, materials, installation and trenching vessels, manpower, and other resources necessary for successful procurement and installation of two (2) 48 core FOC and two (2) 192 core offshore FOC. These FOC shall be of continuous length.

Site Construction and Site Services

These services includes but not limited to

- Supply and operation of all marine and land based equipment and spreads required to perform the Works;
- Loadout, sea-fastening, and transportation of line pipe and other materials;
- Transportation, accommodations, and subsistence for all CONTRACTOR, SUBCONTRACTOR, third party, and CLIENT personnel on CONTRACTOR's vessels for the duration of pipeline installation, testing, and pre-commissioning activities

Pipeline Project Presentation



- As seen above, fibre optic cables are laid parallel and located outboard of the two 36 inch offshore pipelines

Tanap Offshore Project Lines

Pipeline Characteristics :

- 2 x 18kmx 36” pipelines laid by SK1200 in standard S lay, in water depth 0m at shore down to -67m
- 22.9mm wall thickness with concrete weight coat from 60mm to 110mm thickness, approximately 18kms long, laid 5m apart out to the -25m contour where the lines diverge from each other to 100m separation.
- Pre-trenched from shore out to -25m water depth at each landfall
- Laid on open seabed between these points
- Crossing 4 x existing 3rd party owned FOC’s and Çanakkale Straits Vessel Transit System
- 4 x Fibre Optic cables trenched to 3m depth

Offshore Construction Activities

Trenching: Cutting Nearshore trench prior to pipelaying operation

ÇANAKKALE BOĞAZ GEÇİŞİ AVRUPA YAKASI KIYI YAKLAŞIMI TARAMASI
ÇANAKKALE STRAIT EUROPEAN SIDE SHORE APPROACH DREDGING

ÇANAKKALE BOĞAZ GEÇİŞİ DENİZ KAZISI KAYA ÖRNEĞİ
ÇANAKKALE STRAIT EXAMPLE OF ROCK AFTER DREDGING

ÇANAKKALE BOĞAZ GEÇİŞİ DENİZ KAZISI KAYA ÖRNEĞİ
ÇANAKKALE STRAIT EXAMPLE OF ROCK AFTER DREDGING

Offshore Construction Activities

Trenching: Dredging offshore prior to pipelaying operation

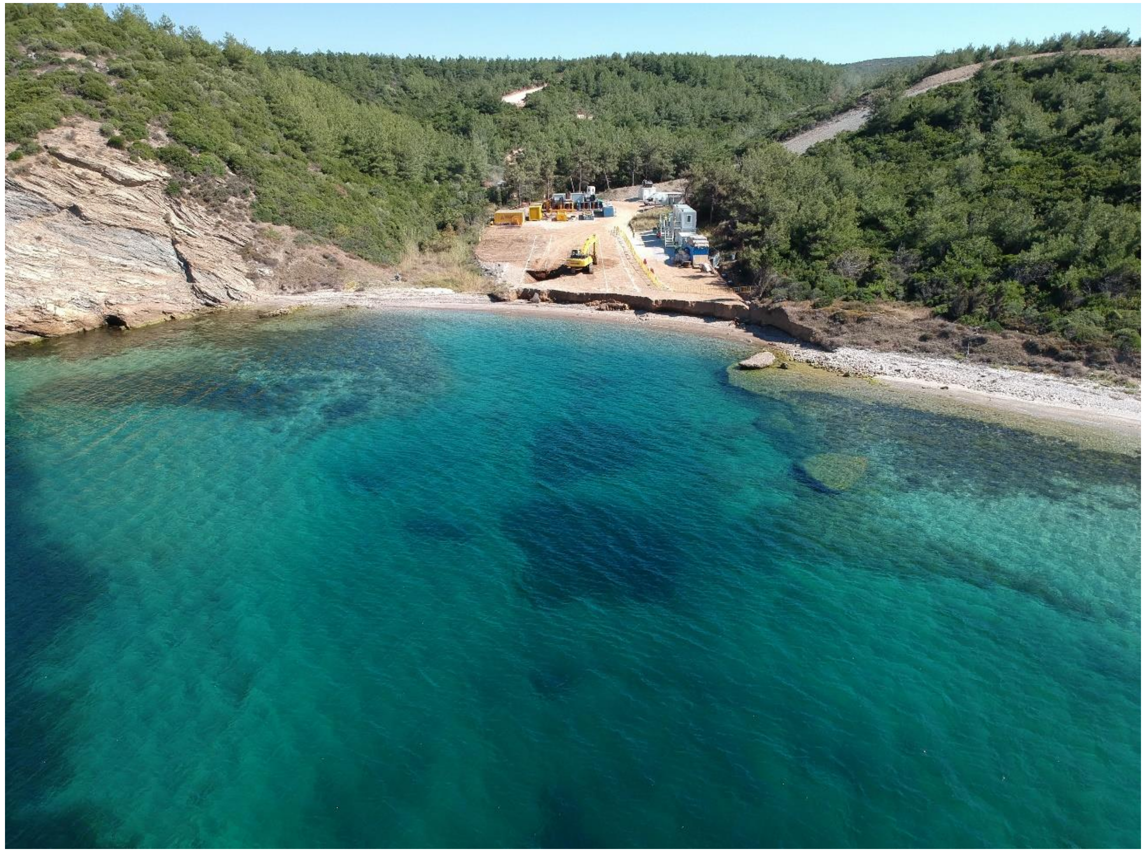
ÇANAKKALE BOĞAZ GEÇİŞİ TSHD İLE DENİZ TARAMASI
ÇANAKKALE STRAIT TSHD OFFSHORE DREDGING

Pipeline Project Presentation

Tanap Offshore Project Lines

ONSHORE WORKS ANATOLIAN SITE

Overhead view of site with onshore trench being cut



Offshore trench complete and onshore trench starting

Pipeline Project Presentation

Tanap Offshore Project Lines

ONSHORE WORKS EUROPEAN SITE

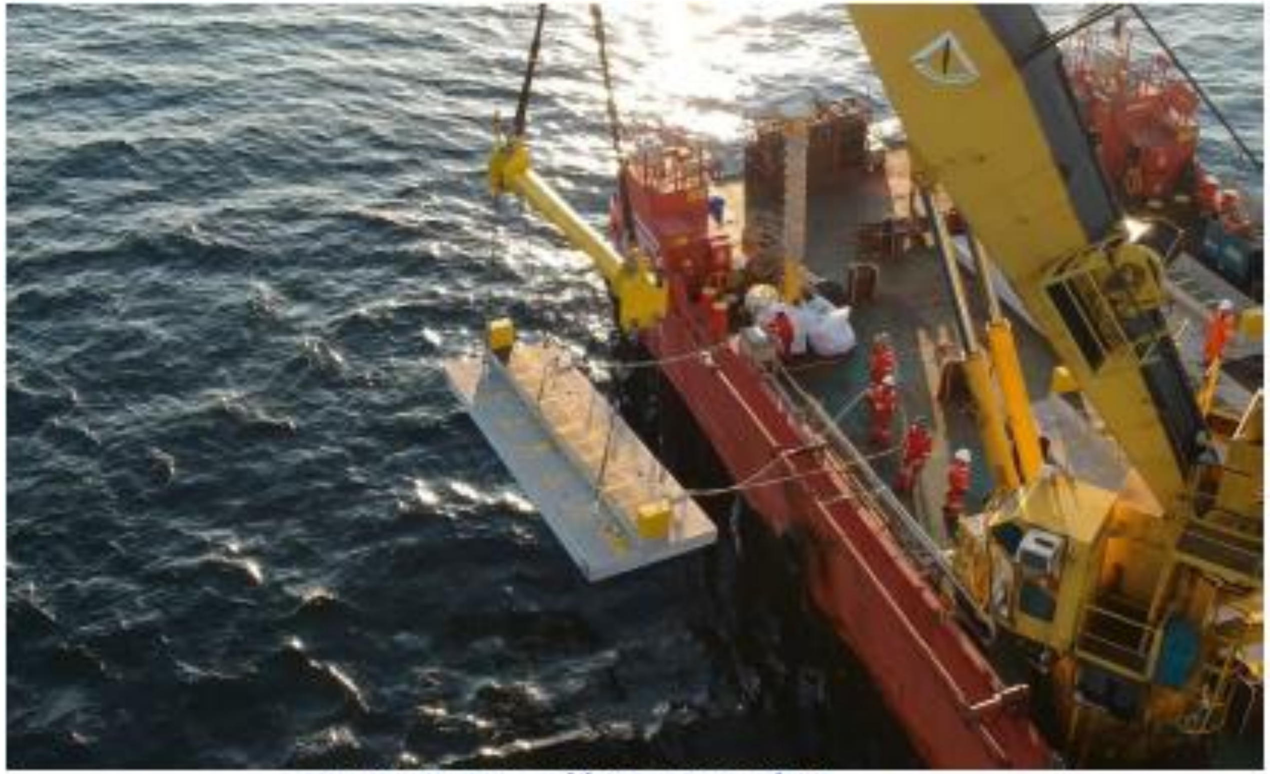
Topsoil cleared and crane track started

Overhead of view down site to sea

Pipeline Project Presentation

Offshore Construction Activities

Pre-Cast Crossing Supports Sleepers and Mattress Installation

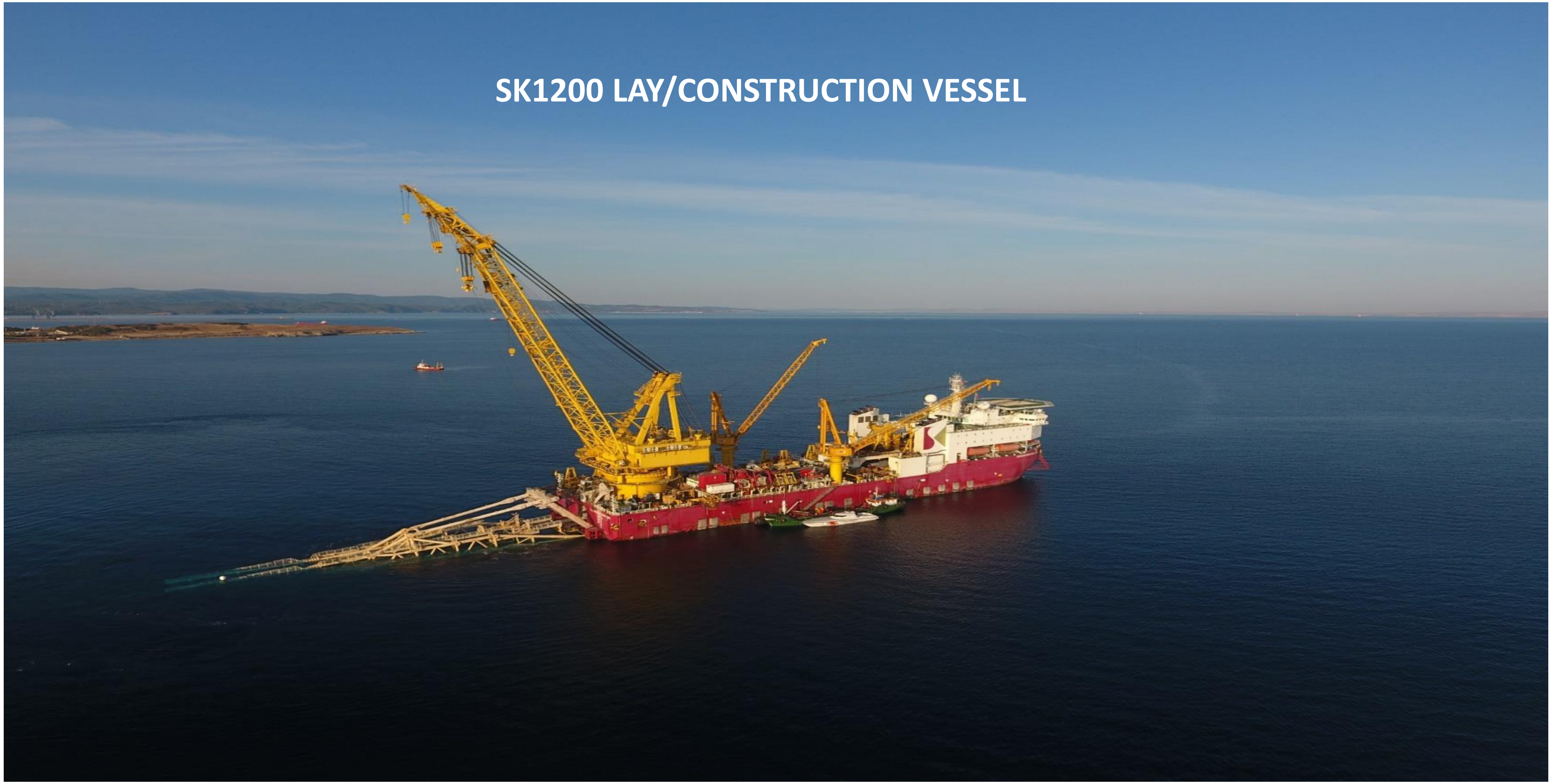


ÇANAKKALE BOĞAZ GEÇİŞİ BETON YERLEŞTİRME
ÇANAKKALE STRAIT INSALLATION OF CONCRETE SLEEPER

ÇANAKKALE BOĞAZ GEÇİŞİ KESİŞME NOKTASINA DESTEK YERLEŞTİRME
ÇANAKKALE STRAIT CROSSING SUPPORT INSTALLATION

Pipeline Project Presentation

Offshore Construction Activities

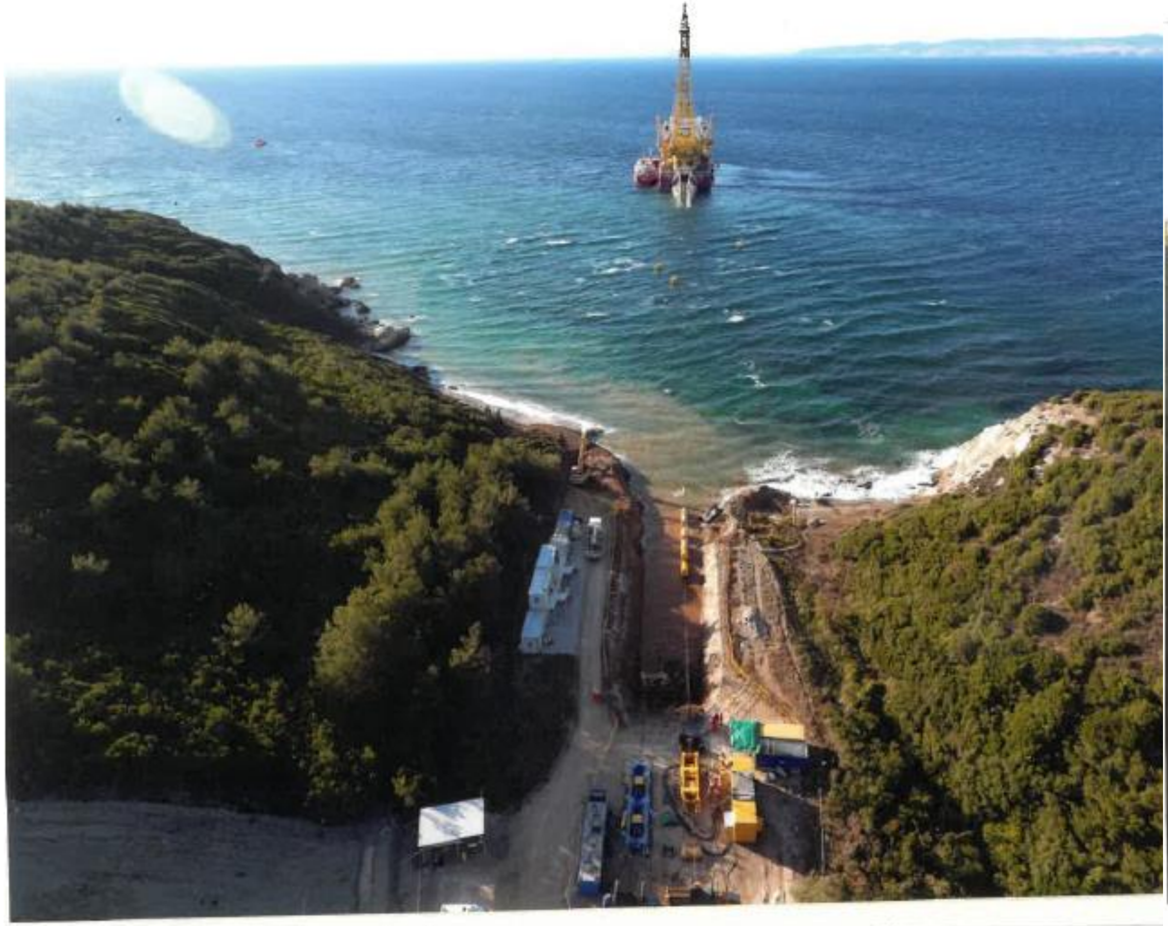


Pipeline Project Presentation

Offshore Construction Activities

Pipeline Project Presentation

Anatolian Side Pipeline Shorepull Operation with SK1200 lay Vessel



ÇANAKKALE BOĞAZ GEÇİŞİ ANADOLU YAKASI KIYI BORU ÇEKİMİ
ÇANAKKALE STRAIT ANATOLIAN SIDE SHORE PULL ACTIVITY

ÇANAKKALE BOĞAZ GEÇİŞİ ANADOLU YAKASI KIYI BORU ÇEKİMİ
ÇANAKKALE STRAIT ANATOLIAN LANDFALL SHORE PULL

Pipeline Project Presentation

Offshore Construction Activities

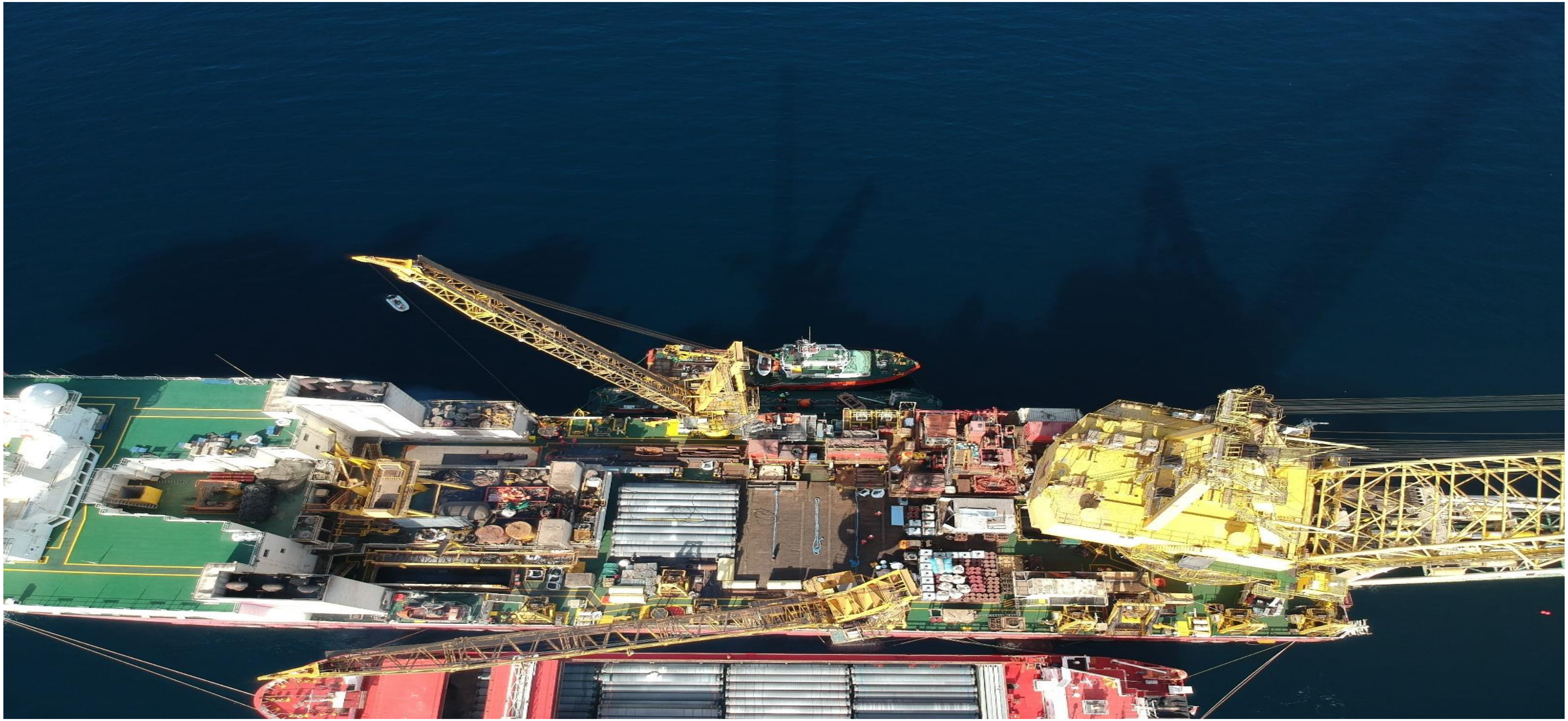
Pipelines Shorepull Operation at both Anatolian and Europran Landfall

ÇANAKKALE BOĞAZ GEÇİŞİ ANADOLU YAKASI KIYI BORU ÇEKİMİ
ÇANAKKALE STRAIT ANATOLIAN LANDFALL SHORE PULL

ÇANAKKALE BOĞAZ GEÇİŞİ AVARUPA YAKASI KIYI BORU ÇEKİMİ
ÇANAKKALE STRAIT EUROPEAN LANDFALL SHORE PULL

Pipeline Project Presentation

SK1200 Deck view with pipe delivery vessel alongside



Pipeline Project Presentation

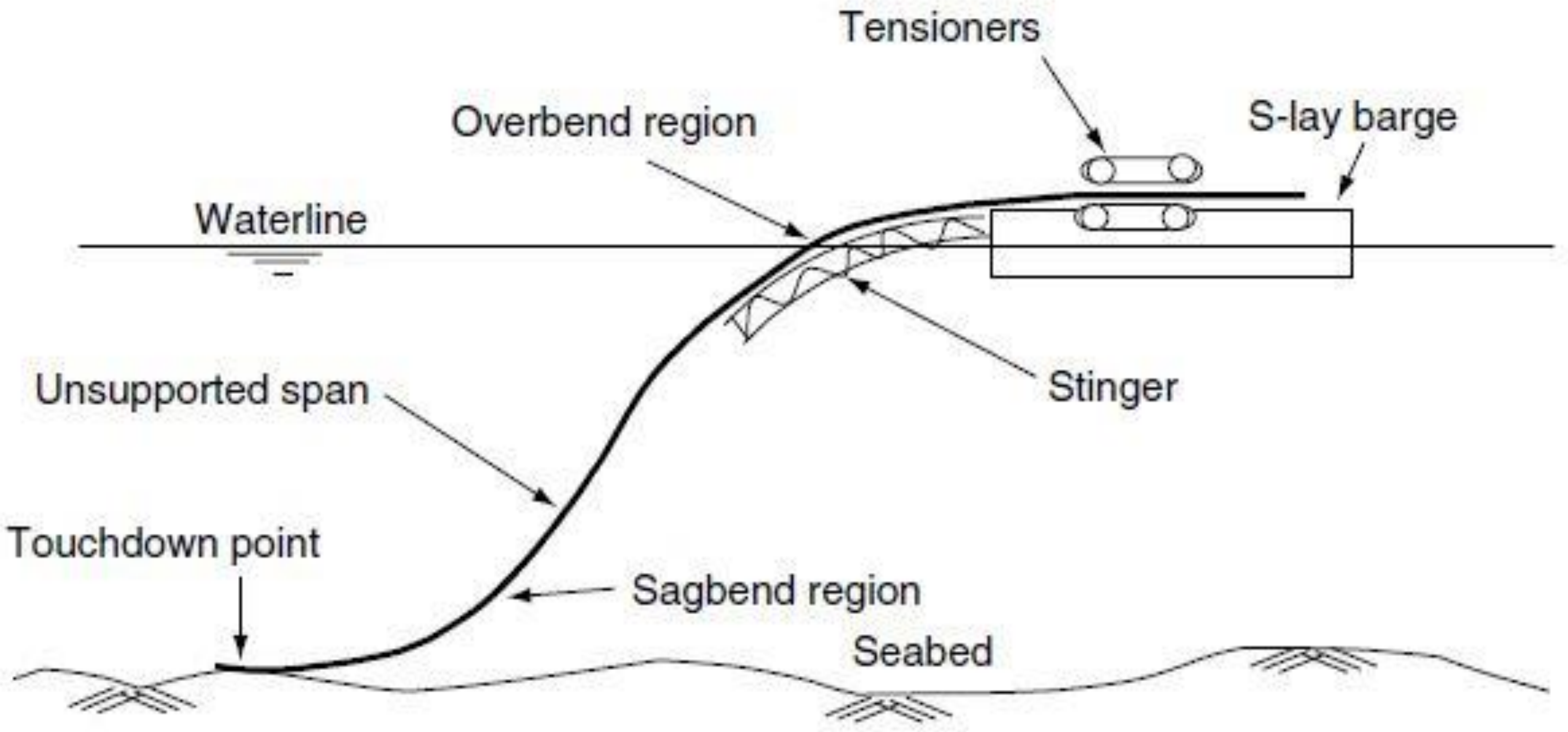
Types of offshore pipelay: Normal S lay

The most common method of pipeline installation in shallow water is the S-lay method. In the S-lay method, the welded pipeline is supported on the rollers of the vessel and the stinger, forming the over-bend. Then it is suspended in the water all the way to the seabed, forming the sag-bend. The over-bend and sag-bend form the shape of an ‘‘S.’’

Pipeline Project Presentation

Types of offshore pipelay: Normal S lay

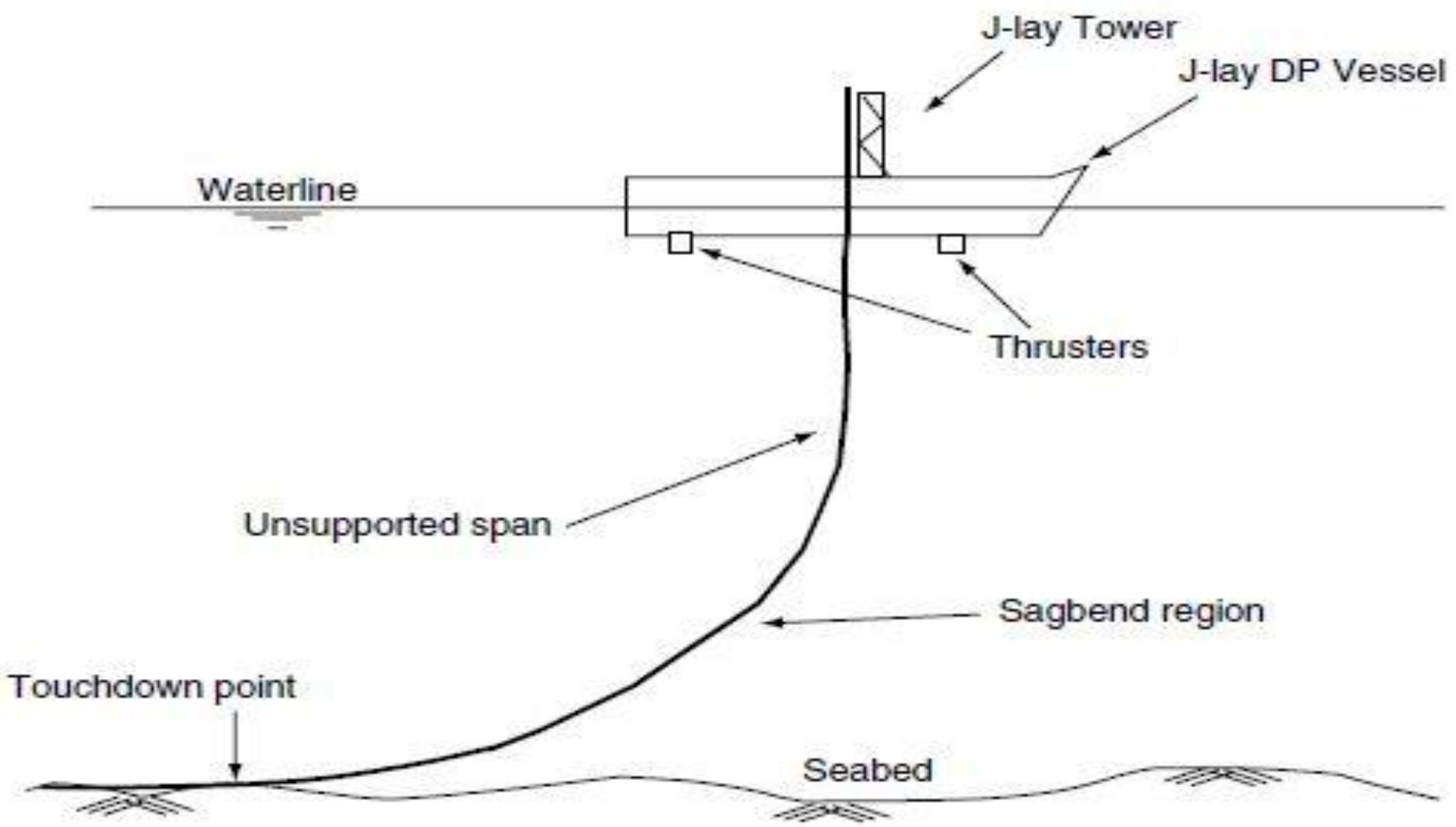
In the S-lay method, tensioners on the vessel/barge pull on the pipeline, keeping the whole section to the seabed in tension. The reaction of this pull is taken up by anchors installed ahead of the barge or, in the case of a dynamically positioned (DP) vessel, by thrusters. These barges/vessels are fitted with tension machines, abandonment and recovery (A&R) winches, and pipe handling cranes. The firing line for welding the pipe may be placed in the center of the barge or to one side. The firing line consists of a number of stations for welding, NDE, and field joint application. The field joint station is located after the NDE station and the tension machines.



Pipeline Project Presentation

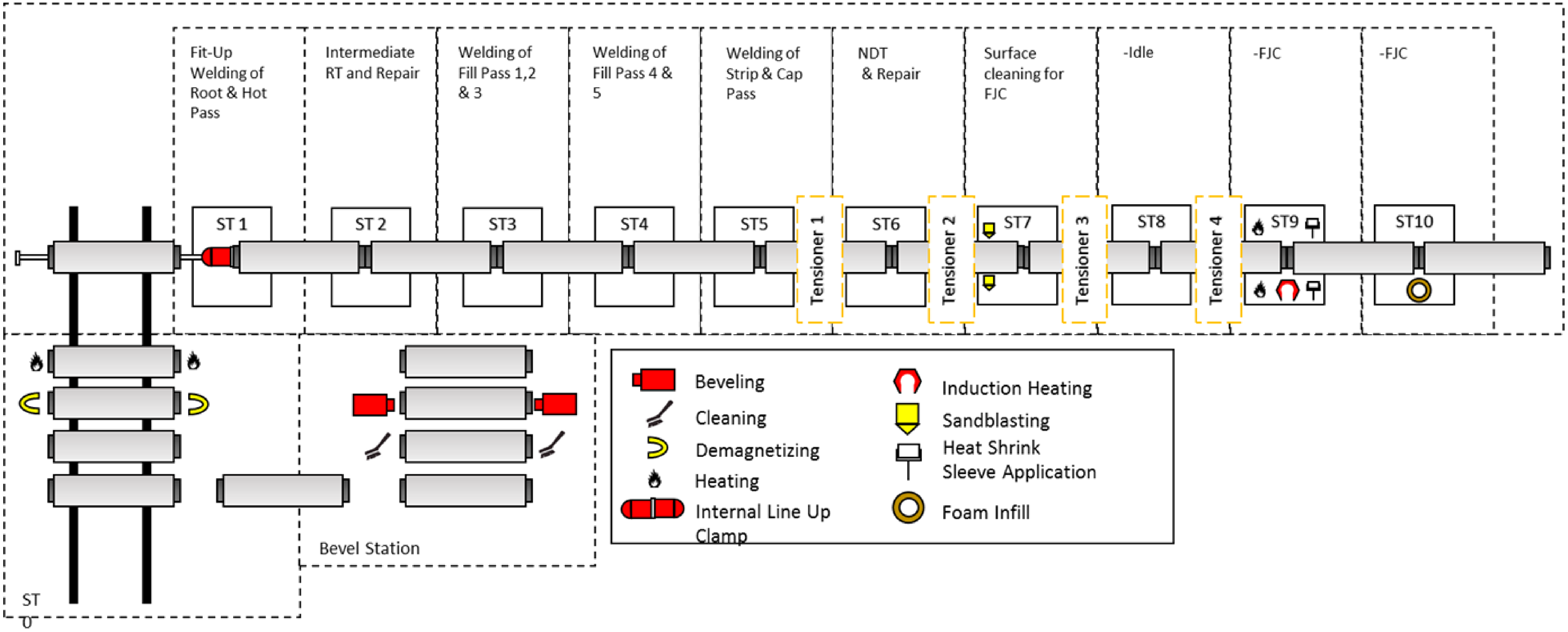
Types of offshore pipelay: J Lay Method

To keep up with the discovery of deepwater oil and gas fields, the J-lay system for pipeline installation was invented. In this system, lengths of pipe are welded in a near vertical or vertical position and lowered to the seabed. In this configuration, the pipeline from the surface to the seabed is one large radius bend resulting in lower stresses than an S-lay system in the same water depth. There is no over-bend, and a large stinger required in S-lay to support the pipe in deepwater is eliminated. The horizontal forces required to maintain this configuration are much smaller than required for an S-lay system. This lends itself for DP shipshape vessels and derrick barges to be equipped with a J-lay tower.



Pipeline Project Presentation

SK1200 FIRING LINE



Pipeline Project Presentation

SK1200 Pipelay Activities

ÇANAKKALE BOĞAZ GEÇİŞİ "SK 1200" BORUNUN KAYNAK YAPILMASI AKTİVİTESİ
ÇANAKKALE STRAIT "SK 1200" PIPE WELDING ACTIVITY

ÇANAKKALE BOĞAZ GEÇİŞİ TAMAMLANMIŞ KAYNAK AKTİVİTESİ
ÇANAKKALE STRAIT COMPLETED PIPE ACTIVITY

ÇANAKKALE BOĞAZ GEÇİŞİ BORUNUN TEMİZLENMESİ
ÇANAKKALE STRAIT CLEANING OF THE PIPE

ÇANAKKALE BOĞAZ GEÇİŞİ BİRLEŞME NOKTASI OTOMATİK ULTRASONİK TEST
ÇANAKKALE STRAIT AUTOMATIC ULTRASONIC TESTING AT THE JOINT

ÇANAKKALE BOĞAZ GEÇİŞİ BİRLEŞME NOKTASI KAPLAMASI
ÇANAKKALE STRAIT JOINT FIELD COATING

ÇANAKKALE BOĞAZ GEÇİŞİ "SK 1200" BORU DÖŞENMESİ
ÇANAKKALE STRAIT "SK 1200" LAYING THE PIPES

ÇANAKKALE BOĞAZ GEÇİŞİ BİRLEŞME NOKTASI ANTİ-KOROZYON KAPLAMASI
ÇANAKKALE STRAIT JOINT CORROSION COATING OF THE PIPE

ÇANAKKALE BOĞAZ GEÇİŞİ DENİZE BORU İNDİRİLMESİ
ÇANAKKALE STRAIT LAUNCHING THE PIPE

ÇANAKKALE BOĞAZ GEÇİŞİ BORUNUN GERGİNLİĞİNİ SERBEST BIRAKMA
ÇANAKKALE STRAIT RELEASE THE TENSION OF THE PIPE

Pipeline Project Presentation

Pipelines Above Water Tie-in Activity

ÇANAKKALE BOĞAZ GEÇİŞİ "SK 1200" İLE TİE İN YAPILMASI
ÇANAKKALE STRAIT "SK 1200" ABOVE WATER TIE IN

ÇANAKKALE BOĞAZ GEÇİŞİ "SK 1200" İLE TİE İN YAPILMASI
ÇANAKKALE STRAIT "SK 1200" ABOVE WATER TIE IN

ÇANAKKALE BOĞAZ GEÇİŞİ "SK 1200" BORU DÖŞEME GEMİSİ İLE TİE İN YAPILMASI
ÇANAKKALE STRAIT "SK 1200" ABOVE WATER TIE IN

Pipeline Project Presentation

FOCs Shore Pull and Laying operation with Sapura Conquest Vessel

ÇANAKKALE BOĞAZ GEÇİŞİ KABLONUN KIYI ÇEKİMİ
ÇANAKKALE START BEACH PULL CABLE-LAY

ÇANAKKALE BOĞAZ GEÇİŞİ KABLO DÖŞEME AKTİVİTESİ
ÇANAKKALE START CABLE LAYING ACTIVITY

ÇANAKKALE BOĞAZ GEÇİŞİ ANADOLU YAKASI BEACH PULL AKTİVİTESİ
ÇANAKKALE STRAIT ANATOLIAN SIDE BEACH PULL ACTIVITY

Pipeline Project Presentation

FOCs Post Trenching Operation with Trenching Equipment mobilized on Topaz Commander Vessel

FOC KABLO GÖMME GEMİSİ "TOPPAZ COMMANDER"
POST TRENCHING VESSEL "TOPPAZ COMMANDER"

FOC KABLO GÖMME EKİPMANI "PULLUK"
POST TRENCHING EQUIPMENT "THE PLOUGH"

Pipeline Project Presentation

Rock Dumping Operation with Fall Pipe Vessel

TAŞ OCAĞI MALZEMESİ YÜKLEME İSKELESİ
THE LOADING PIER FOR QUARRY MATERIAL

GEÇİŞLERİN ÜZERİNE KORUMA MALZEMESİ DÖKÜM GEMİSİ "RISING SUN"
FALL PIPE VESSEL "RISING SUN" FOR INSTALLATION OF PROTECTION MATERIAL OVER CROSSINGS

Pipeline Project Presentation

Pipeline Pre-Commissioning Set up and operation

DEVREYE ALMA ÖNCESİ TESTLERİNİN EKİPMANLARI YERLEŞİMİ
THE SETTLEMENT OF PRECOMMISSIONING EQUIPMENT

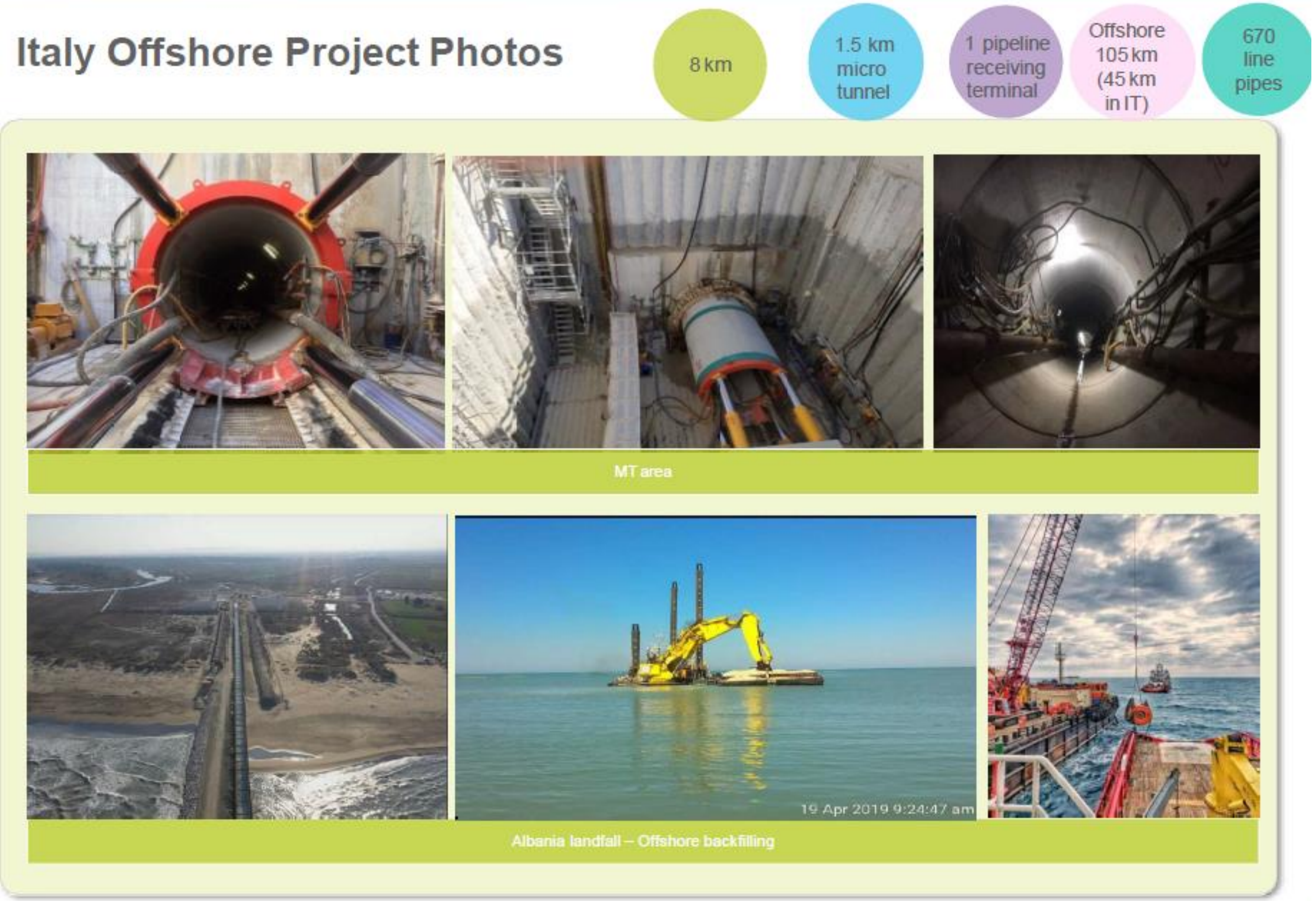
PIG ALICI İSTASYONU & TEMİZLEYİCİ PIG
PIG RECEIVER & CLENING PIG

CALIPER PİGİ PIG SÜRÜM DÜZENEĞİNE YERLEŞTİRME
INSERTING THE CALIPER PIG INTO LAUNCHER

TAP /ADRIATIC SEE CROSSING/ OFFSHORE SECTION

- LENGTH: 105 KM of offshore
- 1.5 km Micro Tunnel
- Deepest point: 880 mt
- Diameter : 36”
- WT: 20-34 mm
- Cost: 1.5-2 billion usd (Not confirme

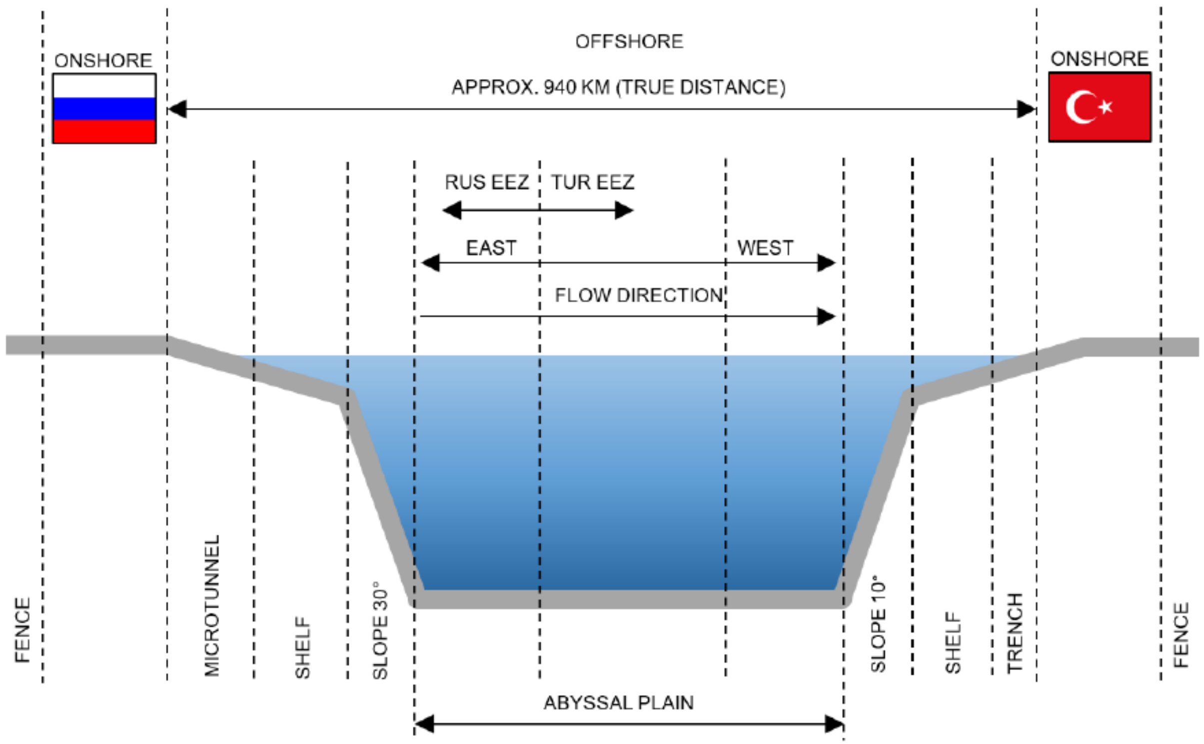
Offshore EPCI	Saipem S.p.A
Offshore line pipes (110km)	Salzgitter Mannesmann International GMBH



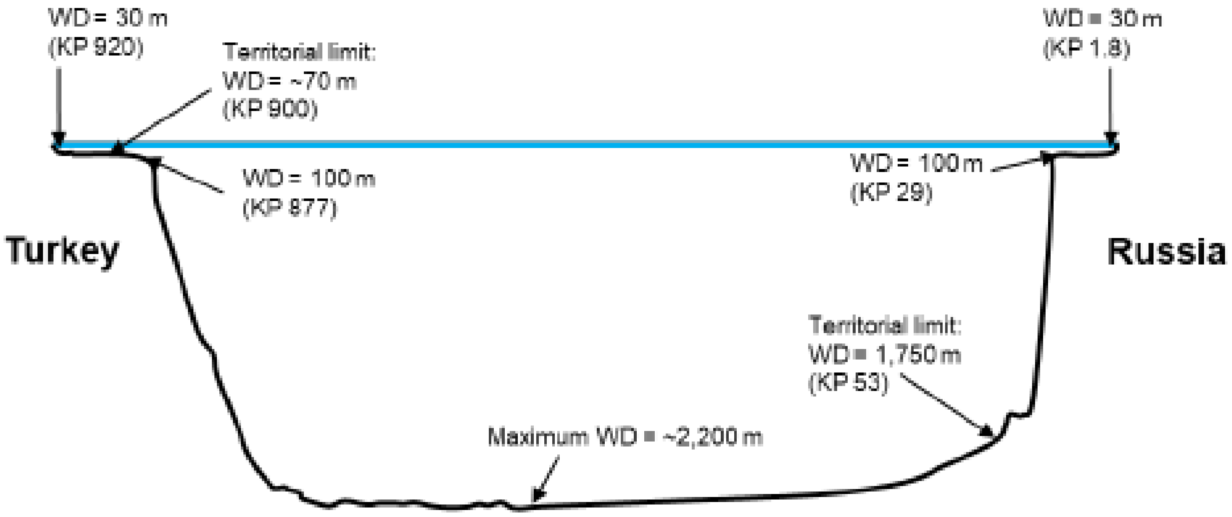
THE TURKSTREAM OFFSHORE PIPELINE PROJECT

TurkStream Project

- TurkStream consists of two parallel pipelines running through the Black Sea connecting the Landfall Facility Russia (LFR) with the downstream Receiving Terminal (RT) in Turkey.
- The pipelines enter the water near Anapa, on the Russian coast, and come ashore on the Turkish coast some 100 kilometres west of Istanbul, near the village of Kiyiköy.
- The TurkStream Offshore Pipeline System comprises two (2) 32-inch (39 mm WT) pipelines (including a short onshore pipeline section at each end). Lengths are around 942 km (1880 km total), with maximum water depths of approximately 2200 m.
- Annual capacity of pipeline is 15.75 bcm for each pipeline (2 pipeline)
- Total capacity is 31.5 bcma
- Design pressure is 300 bara (30 MPa)
- Capex : Around 8.8 Billion US$



OFFSHORE
ONSHORE
APPROX. 940 KM (TRUE DISTANCE)
ONSHORE
RUS EEZ
TUR EEZ
EAST
WEST
FLOW DIRECTION
FENCE
MICROTUNNEL
SHELF
SLOPE 30°
SLOPE 10°
SHELF
TRENCH
FENCE
ABYSSAL PLAIN



WD = 30 m
(KP 920)
Territorial limit:
WD = ~70 m
(KP 900)
WD = 30 m
(KP 1.8)
WD = 100 m
(KP 877)
WD = 100 m
(KP 29)
Turkey
Russia
Territorial limit:
WD = 1,750 m
(KP 53)
Maximum WD = ~2,200 m

Most Challenges and Expensive Pipeline Projects

Pipeline Properties:

KP	**KP 138 to KP 42 (Nearshore side)**	**KP 42 to KP 0 (Deepwater side)**
Outside Diameter	323.9 mm	323.9 mm
Wall Thickness	18mm	18mm
Coating	40mm (Concrete)	2.25mm (3LPE)

Client : Murphy Oil Corporation
Contractor : Sapura Energy
Field : Kikeh Field, Offshore Malaysia
Period : 2006 – 2008
Contract Value : US$ 176 million (**110 US$/DIA-INCH)**
Max Water depth : 1,450m

Background:

- The Kikeh Field, located 110km off the north-west coast of Sabah, Malaysia, is discovered in August 2003 and was the first offshore deepwater development in Malaysia. The field was developed utilizing dry tree wells located on a Dry Tree Unit floating platform and subsea completions connected to a turret-moored FPSO vessel. Treated and stabilized crude oil is periodically offloaded to shuttle tankers and associated gas is exported to Labuan Gas Terminal plant onshore.

Pipelay Scope of Work:

- 12” x 138km export pipeline, PLEM, tie-in jumper spool and in-line future tap tie-in installation

Most Challenges and Expensive Pipeline Projects

Vessels Used : Sapura 3000

Main Particulars

Overall Length :	151.2 m
Length Between Perpendiculars :	144.2 m
Breadth Molded :	37.8 m
Depth to Work Deck, Molded :	15.0 m
Depth to Freeboard Deck, Molded :	9.1 m
Draft, Maximum Loaded :	6.5 m

Heavy Lift Capability

Heavy lift Mast Crane

Capacity, Main Hoist (± 25° over stern) :	3000 S.T at 27 m radius
Capacity, Main Hoist Revolving :	2200 S.T at 31 m radius
Capacity, Auxiliary Hoist :	800 S.T at 53 m radius
Capacity, Whip Hoist :	200 S.T at 91 m radius

* *(Main hoist capacity can be upgraded to 3000 MT)*

Pipelay Capability

Pipe Size :	6” to 60” diameter plus concrete coating
Tensioners :	3 x 80 MT

Stinger

Total Length :	90 m (adjustable geometry in three sections)
Minimum Overboard Radius :	70 m
Maximum Pipe Departure Angle :	87 deg

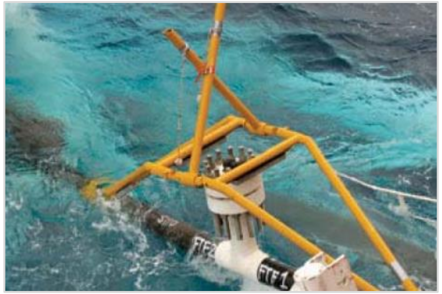
Pipeline Project Presentation

The pipeline connection at existing LGAST terminal presented significant challenges. With limited access, Sapura needed to construct an access from the main road in Labuan down to the pipeline pull-in location. This limited space also presented challenges for pipeline testing, conditioning and testing operations. The final connection of the offshore pipeline to the land section required an open excavation over 2m in depth to be constructed in the tidal zone of the beach

Pipelay operations up to 120m WD were executed with a single section stinger (hinge section). However, to accommodate pipe laying operations in water depths beyond 120m, an additional section (Section 2) needed to be installed as a stinger extension to enable a steeper departure angle for the pipeline to facilitate deeper water pipelay operations to 1,450m WD. In full operation, the total stinger weight is 700MT with an overall length of 90m.

Pipelay operations constructed into the Kikeh Field (1,450m) where the pipeline needed to be laid into a 6m x 3m target box on the seabed. The pipe was laid down in an S-lay configuration, into existing Kikeh field in an area that was already populated with subsea structures and flexible pipe. Maximum pipelay lay down tensions were recorded at 10MT

For the installation of the deepwater PLET, Sapura 3000 was mobilized with a project specific hang-off platform that allowed the pipe to be recovered in a J-lay configuration and hung-off to the side of the vessel. Once the pipe lay down head was removed, the 83MT PLET was then up-ended and hung onto its near vertical position for connection to the subsea pipeline. After connection and test were complete, the pipeline and PLET were lifted (163MT) and laid onto the sea bed into a target box of 6m x 3m



The pre-commissioning services were completed successfully and without a LTI which was a magnificent result considering the challenges of 6600psig (445 barg) test pressure in such deepwater and with complex subsea architecture. Without the use of an innovative Gel isolation, the project would have been at risk of inducing hydrates immediately upon start up as well as causing potential delays to production.

Most Challenges and Expensive Pipeline Projects

Client : Sabah Shell Petroleum Company (Shell)

Contractor : Sapura Energy

Field: Gumusut Kakap Field, Offshore Malaysia

Period: 2008 – 2013

Contract Value: US$ 825 million (**230 US$/DIA-INCH)**

Max Water depth: 1,200m

Background:

- The Gumusut-Kakap Field is located 120km northwest of Labuan, offshore Malaysia. It is the region's first deepwater (1,200m) field utilizing a moored Semi-submersible Floating Production System (Semi-FPS). The crude oil is transported to the onshore Sabah Oil and Gas Terminal (SOGT) using a single 18" oil export pipeline.

Pipelay Scope of Work:

- 18" x 198km pipeline in both S-lay and J-lay configuration, including shore approach, pipeline burial, flowlines and SCRs installation

Pipeline Properties:

KP	KP 150 to KP 109 (Nearshore side)	KP 109 to KP 34 (Conventional)	KP 34 to KP 3 (Deepwater side)
Outside Diameter	457.2mm	457.2mm	457.2mm
Wall Thickness	17.5mm	17.5mm	20.62mm
Coating	50mm (Concrete)	40mm (Concrete)	-

Pipeline Project Presentation

Vessels Used : Sapura 3000

Main Particulars

Overall Length :	151.2 m
Length Between Perpendiculars :	144.2 m
Breadth Molded :	37.8 m
Depth to Work Deck, Molded :	15.0 m
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** (Main hoist capacity can be upgraded to 3000 MT)*

Pipelay Capability

Pipe Size :	6" to 60" diameter plus concrete coating
Tensioners :	3 x 80 MT

Stinger

Total Length :	90 m (adjustable geometry in three sections)
Minimum Overboard Radius :	70 m
Maximum Pipe Departure Angle :	87 deg

Pipeline Project Presentation

Pipeline installation was done in both S-lay and J-lay. The J-lay operation was carried out using a J-lay tower which was fitted at the starboard side of Sapura 3000.

Installation of manifolds and PLETs in deepwater were also executed utilizing the J-lay tower at the vessel

Wet storing and recovery of Steel Catenary Risers (SCRs). For operational reasons, 6 out of 10 SCRs were wet stored on the seabed prior to the FPS arriving in=field. When the FPS was moored, the SCRs were recovered from the seabed, then cross hauled under the FPS and hooked-up.

The welding process, especially for the SCRs, demanded uncompromising quality and stringent compliance to process. All production welding was completed on schedule, with the welding of the SCRs being of the highest quality.

Most Challenges and Expensive Pipeline Projects

Client: Mumbai Port Trust

Field: Jawahar Dweep, Mumbai,India (**Fifth Oil Berth Project – Assets Utilized)**

Period: 2018 – 2019

Max Water depth: 7m

Contract Value: not less than 150 US$/DIA-INCH

Pipeline Properties:

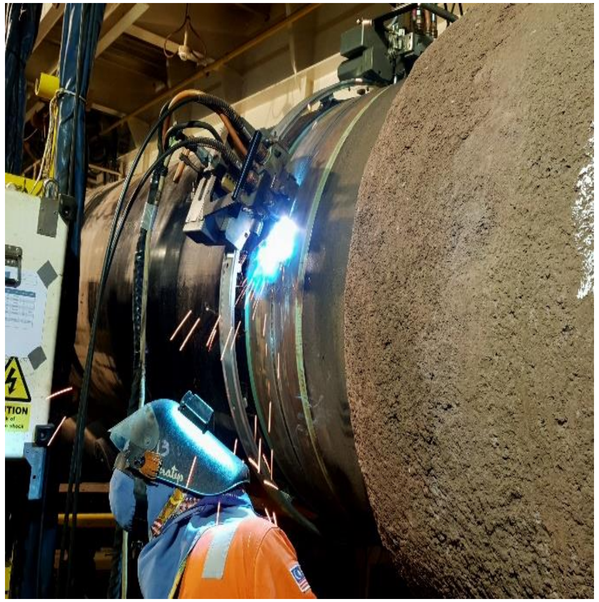
Pipeline Location	Offshore	Onshore
Outside Diameter	1,067mm	1,067mm
Wall Thickness	17.5mm	17.5mm
Coating	3.3mm (3LPE) + 100mm (concrete)	3.3mm (3LPE)

Background:

- The Mumbai Port is a natural harbor sheltered between Mumbai Island and Mainland. The port presently has 27 berths in Indira Dock. The port has 4 jetties for handling crude and POL products. Mumbai Port intends to construct Fifth Oil berth as a replacement to the Fourth Oil berth.

Pipelay Scope of Work:

- 42” x 4km offshore pipeline from Jawahar Deep to Pir Pau. 42” x 1km onshore pipeline at Pir Pau side and 42” x 0.25km buried onshore pipeline at Jawahar Deep side. Include scope of shore approaches at 2 sides and above water tie-ins.



Pipeline Project Presentation

Vessels Used : Sapura 2000

Principle Dimensions

Classification :	ABS✠A1 Barge, Pipelay/Heavylift
Flag :	Malaysia
Total Length :	120 m
Breadth Moulded :	40.1 m
Depth Moulded :	9 m
Draft Designed :	6 m

Main Crane

Main Hook Capacity Tie-Back :	2,000 MT @ 32 m
Main Hook Capacity Fixed :	1,600 MT @ 32 m
Main Hook Capacity Revolving :	1,200 MT @ 32 m
Aux. Hook Capacity :	300 MT @ max. rad. 70 m
Whip Hook Capacity :	50 MT @ max. rad. 98.7 m

Pipelay Capabilities

Pipe OD :	6" to 60"
Tension Capacity :	140 MT (2 nos. x 70 MT each)
Tension Capacity-1 A & R Winch :	150 MT
Welding Station :	5 nos.
NDT Station :	1 no.
Field Joint Stations :	2 nos.
Davits :	6 nos. x 50 MT

Stinger

Type of Stinger :	Articulated 4 section Ballastable Stinger

Mooring System - 100T Max.

150T Mooring Winches (Electrical) :	12 nos.
Mooring Anchors :	13 nos. x 12 MT (Delta Flipper)
Storm Anchor	1 no. 10 MT

OFFSHORE PROJECTS CAPEX STUDIES- WORLDWIDE CRITICAL PROJECTS								
NO	PIPELINE PROJECT (Name)	Deepest Point (mt)	CONSTRUCTION YEARS	Diameter (inches)	Length (km)	Overall Cost (US$-billion)	Cost per Unit length (diameter-inch (US$)	Cost per Unit length (Million (US$) /km)
1	LANGELED Project	360	2007	44	1166	3	58.47	2.57
2	POLARLED			36	482	1.3	74.92	2.70
3	NSP1	210	2010-2012	48	2454	9.6	81.50	3.91
4	MEDGAZ	2160		24	210	0.7	138.89	3.33
5	ICHTHYS PİPELİNE		2013-2016	42	889	3.4	91.06	3.82
6	PLUTO			36	180	0.75	115.74	4.17
7	TURKSTREAM	2200	2017-2019	32	1880	8.8	146.28	4.68
8	GALSİ			48	865	3.9	93.93	4.51
9	WHEATSTONE			44	225	1.4	141.41	6.22
10	TAP ADRIATIC	880	2017-2020	36	110	1	252.53	9.09
11	TANAP OFFSHORE	65-70	2017-2018	36	36	0.13	100.31	3.61
12	BOTAS MARMARA PROJECT	65-70	2006-2008	36	18	0.055	84.88	3.06
13	SAPURA Kikeh Field, Offshore Malaysia PROJECT	1450	2006-2008	12	138	0.176	106.28	1.28
14	SHELL/ Gumusut Kakap Field, Offshore Malaysia	1200	2008-2013	18	198	0.825	231.48	4.17
15	EAST MED PROJECT- OFFSHORE	2900-3000	2020-2023?	32	1300	7.5-10.8 billion US$	180-260	6-8 Million usd/km
16	EAST MED PROJECT-ONSHORE	N/A	2020-2023	48	600	1.008	30-40 USD/inch mt	1.7 million usd/km
	EAST MED PROJECT-ONSHORE/OFFSHORE (EXCLUDING AGIs and Compressors)	N/A	2020-2023	32-48	1800	8.5- 12 billion usd	30-40 USD/inch mt	N/A

EAST MED PIPELINE PROJECT

The EastMed project

- Current design envisages: 1.300 km offshore pipeline and a 600 km onshore pipeline.
- Diameter : 32” offshore, 42” onshore (Not fixed yet)
- Transport 10 bcm/y Natural gas gas from Levantine Basis to West Greece – Italy (IGI) and alternatively to Bulgaria through IGB Pipeline project
- Project sections:
  - Section 1: 200 km offshore pipeline from Eastern Mediterranean sources (Levantine (Leviathan ve Afrodit sahaları) Basin to Cyprus
  - Section 2: 700 km offshore pipeline connecting Cyprus to Crete (Girit) Island
  - Section 4: 400 km offshore pipeline from Crete to mainland Greece (Peloponnese);
  - Section 5: 600 km (42”) onshore pipeline crossing Peloponnese and West Greece.

- The EastMed pipeline is preliminarily designed to have exit points in Cyprus, Crete, mainland Greece as well as the connection point with the Poseidon pipeline.

EASTMED PIPELINE PROJECT

Basic offshore pipeline construction steps

- Exploration (Keşif – Survey)
- Seismic Acquisition Interpretation (sismik)
- Final Investment Decision (FID)
- Front End Engineering Design (FEED)
- Concept Select
- Production of ITT
- Bidding Process
- Selection of EPCI
- Route Survey & Site Investigation
- Detailed Design
- Offshore Construction
- Pre or post trenching

Pipeline Project Presentation

Offshore Pre-Engineering Survey

- **Hydrographic, geophysical and geotechnical measurements, crossings inspection and Debris/UXO details.**
- **Bathymetry measurements as part of hydrographic survey. (Su derinlik grafiği)**
- **Determination of the morphology of sea floor and detecting underwater bodies, debris, pipelines, cables, rocky outcrops and possible UXO by using side scan sonar.**
- **Determination of the stratigraphy of survey area by using sub-bottom profiler.**
- **Determination of the location of embedded cables, shipwrecks and the objects with a magnetic field that are located in the target area (like cables and UXO) with gradiometer/magnetometer survey.**
- **Determination of the geological formation of the areas with geotechnical survey.**
- **Determination of the seabed makeup from core sampling across the target area.**

CURRENT STATUF/PROBLEMS OF THE PROJECT

- Under Development . Has been discussed since 2012.
- TAP is transporting Shahdeniz-2 Gas to Europe. IGI (Italy Greece Interconnector) shall also be constructed.
- Turkstream is ready to Transport gas to Bulgaria and Greece as well
- A liquefied natural gas (LNG) import facility at Revythoussa, in Greece near Athens was just expanded
- Gas Demand in Greece and Bulgaria has not been increased so much, even decreased. Italy shall drive the Project . Demand is weak
- Proven Gas quantity?
- Planning to perform marine surveys and FEED design/Detail design
- Tender packages to be Prepared
- FID (Final Investment Decision) not Received yet
- CAPEX Estimate: 6 billion US$) Not Realistic

Potential Technical /Commercial Challenges

- One of the deepest offshore pipeline project (9500 feet- 2900-3000 mt)
- Mediterranean Sea is deep and has an anomalous geomorphology, which creates uncertainty in the installation and operation of necessary materials
- Accessibility to the route not so easy (far way from landfall-onshore)
- Technical challenges (only few Lay barges to be used). Risk for CAPEX.
- Onshore pipeline : 20-40 US$/Dia-İnch (Flat area). Steep Slope: 40-50 USD/dia-inch.
- Offshore Normal: 150 usd/dia-inch, Steep slope: EAST MED: Could be 300-400 even 500 usd/dia-inch (Depends on the geotechnical and marine survey investigations)
- Security risks- Political risks (During Operations)
- No Schedule- No Realistic Capex estimate-
- No FID
- Could not be so feasible for EU countries: Far higher than the present average Russian gas price that the EU counties are paying.

Thank you