Appendix 5-A: Hudson River Cable Installation Methodology

Hudson Cable Installation Methodology

Champlain Hudson Power Express

Doc. ID.:	1AA0622663	Classification:	Method statement	Prepared by:	
Revision:		Language:	eng	Prepared date:	
Status:	Draft	Function:		Approved by:	
Security level:	Confidential	Project ID:	G22002	Approval date:	

Table of Contents

List of Terms and Abbreviations

Term	Definition
CHPE	Champlain Hudson Power Express
CLV	Cable Lay Vessel
DP	Dynamic Positioning
DSV	Divers Support Vessel
FO	Fiber Optic
HDD	Horizontal Directional Drill
HVDC	High Voltage Direct Current
IMR	Inspection, Maintenance and Repair
LCE	Linear Cable Engine
MBES	Multi-Beam Echo Sounder
MBR	Minimum Bending Radius
MP	Mile Post
MT	Metric Ton
MW	Megawatt
PLB	Post-Lay Burial
RBT	Remedial Burial Tool
ROV	Remotely Operated Vehicle

SLB	Simultaneous Lay and Burial
TBC	To Be Confirmed
TDP	Touch Down Point

1 Scope and Purpose

This document details the methodology to be used by Asso.subsea Single Member S.A. (Asso) to implement the successful installation of the underwater high voltage direct current (HVDC) transmission cables in the Hudson River as part of the Champlain Hudson Power Express (CHPE) project. This document is indicative and for information purposes and may be subject to revision following additional engineering.

2 Introduction

The CHPE Project includes two separate segments of submarine cable to be located in the Hudson River.

- The first segment, referred to herein as the "**Cementon-Stony Point Hudson Marine Segment**," is approximately 67.6-miles long and begins in the Hamlet of Cementon, Town of Catskill, Greene County, New York and ends in the Town of Stony Point, Rockland County, New York.
- The second submarine cable segment, referred to herein as the "**Congers-Harlem Hudson Marine Segment**," is approximately 21.7-miles long and begins in the Hamlet of Congers, Town of Clarkstown, Rockland County, New York and ends at the mouth of the Harlem River.

Asso has been selected by NKT as the preferred installer of the submarine cable segments due to their previous track record of successful export cable installations, the range of vessels and equipment they have available and their prior experience in the Hudson River.

Asso has successfully completed numerous submarine projects around the world during the last 45 years of which amongst others included the Hudson Transmission Project, which was completed in 2013. The installation of the 660 MW electric transmission link between New York City and New Jersey demonstrates working experience in the United States offshore market, safety culture and quality standards.

Details of the equipment to be used are included as Section 5 of this document and planned methodologies are included as Section 7.

3 Route Engineering Process

Route engineering has been (and continues to be) a collaborative and iterative process involving CHPE, Asso and NKT.

Whilst no major changes to the currently proposed route (as of March 2024 are anticipated, there will likely be minor adjustments made for optimization and micro routing to avoid any small riverbed features.

Any deviations will be agreed with and approved by all relevant parties prior to installation works.

4 Plan of Installation Works

The overall plan of installation works for the Hudson River segments of the CHPE project is as follows. Note that this may be subject to change.

Location	Operation	Vessel	Description
Cementon landfall	First end pull-in	Atalanti	Initiation of cable to landfall from Atalanti
Cementon-Stony Point Hudson Marine Segment, batch #1	Cable installation	Atalanti	Cable lay and simultaneous lay and burial (SLB) operations with remedial post-lay burial (PLB) performed as required from the Astrea
Cementon-Stony Point Hudson Marine Segment, batch #2	Cable installation	Ariadne	Cable lay and SLB operations with remedial PLB performed as required from the Astrea
Cementon-Stony Point Hudson Marine Segment, batch #3	Cable installation	Ariadne	Cable lay and SLB operations with remedial PLB performed as required from the Astrea
Stony Point landfall	Second end pull-in	Ariadne	Second end pull in and completion of upper Hudson cable deployment
Congers-Harlem Hudson Marine Segment to Harlem jointing	Jointing	Ariadne	Jointing operations between pre-deployed Harlem cable end and Congers-Harlem Hudson Marine Segment cable
Congers-Harlem Hudson Marine Segment,	Cable installation	Ariadne	Cable lay and SLB operations with remedial PLB performed afterwards as required from the Ariadne with remedial burial tool (RBT)
Congers landfall	Second end pull-in	Ariadne	Second end pull in and completion of Congers-Harlem Hudson Marine Segment cable deployment

5 Equipment

The vessels and equipment to be utilized for the installation are as detailed in this section. It should be noted that for activities such as pull-ins, additional smaller support vessels will be required. These will be specified and procured during the detailed engineering process.

The vessels and equipment detailed herein are Asso owned and operated.

5.1 Vessels

5.1.1 Atalanti

For the execution of the northern part of the Cementon-Stony Point Hudson Marine Segment (first batch), loading, transportation to worksite, pull-in onshore, installation and simultaneous lay and burial activities, the cable lay vessel (CLV) Atalanti will be mobilized. The vessel is specially designed for safe operation at shallow water depths with a maximum draft of 4.26m (6.46 with thrusters down) and spud cans for position keeping redundancy.

Figure 5-1 CLV Atalanti

The vessel has a cable laying spread consisting of one or two turn tables, capable of handling 4,500 and 2,500 metric ton (MT) of cable each (4,500 MT maximum if both used together). It has two cable tensioners with 20 and 10 metric tons of capacity. The firing line cableway conforms to a minimum cable bending radius of 5m. It has a main Knuckle boom crane with 35 MT capacity backed by two additional smaller cranes with 1.2 MT and 20 MT capacity. The vessel is also fitted with an ROV.

For the majority of the route, CLV Atalanti will operate with the dynamic positioning (DP) system to take position and execute laying and burial operations. When required to stay stationary for longer periods (such as for landfall pull-in), position can be maintained with spuds (controlled by winches).

Cable installation from the Atalanti will be in combination with the Asso HydroPlow (section 5.2.1). The Atalanti with the HydroPlow will operate in a simultaneous lay and burial (SLB) mode (section 7.3). However, in some locations along the route at which the HydroPlow cannot be used, the

Atalanti will free-lay the cable on the bottom without burying it for the subsequent post-lay burial (PLB) operation (sections 7.4 and 7.5).

Atalanti specification sheet is provided as Appendix 1.

5.1.2 Ariadne

For the execution of the Cementon-Stony Point Hudson Marine Segment batches 2 and 3 and the full Congers-Harlem Hudson Marine Segment, the CLV Ariadne will be mobilized. The Ariadne is a DP-3 CLV specially configured for cable laying, protection, and repairs as well as for diving, remotely operated vehicle (ROV), survey, and IMR work. The primary function of the vessel is execution of power cable installation projects, but also can be used on any kind of subsea and offshore project.

Figure 5-2 CLV Ariadne

The vessel has a complete and permanent cable laying spread consisting of a 5,000 metric ton (MT) carousel on deck, a 1,500 MT below deck carousel (with a combined capacity of 6,500 MT), two firing lines with one cable tensioner each, conforming to a cable MBR of 4m and a bight quadrant deployment system. The vessel is also fitted with an ROV.

Cable installation by the Ariadne will be executed with the Asso HydroPlow. The Ariadne with the HydroPlow will operate in a SLB mode (section 7.3). However, in some locations along the route at which the HydroPlow cannot be used, the Ariadne will free-lay the cable on the bottom without burying it for subsequent PLB operation (sections 7.4 and 7.5).

In the Congers-Harlem Hudson Marine Segment the Ariadne will be mobilized with the RBT for remedial jetting operations following the main installation campaign. This will consist of PLB operations on locations at which depth was not achieved with the SLB pass.

Ariadne specification sheet is provided as Appendix 2.

5.1.3 Astrea

Astrea is a DP-2 vessel and will be equipped with the RBT. The vessel will carry out the PLB in the Cementon-Stony Point Hudson Marine Segment as required.

Figure 5-3 MSV Astrea

Astrea specification sheet is provided as Appendix 3.

5.2 Cable Burial Tools

5.2.1 Asso HydroPlow

The simultaneous lay and burial operation for the Cementon-Stony Point Hudson Marine Segment and the Congers-Harlem Hudson Marine Segment involves the utilization of the HydroPlow underwater jetting sled. This underwater vehicle is able to install the cable to the required 7-foot depth to top of cable in soft riverbed soils and the basis of its design allows it to be towed by the vessel to perform SLB operations. Sufficient number of spares and tools will be loaded on the CLVs to maintain and service equipment during execution of the works.

The structural configuration of the HydroPlow includes the following main items:

- Chassis frame;
- Skids that slide on the riverbed;
- Bellmouth that provides a controlled entry of the cable into the machine; and
- Stinger with the double function of excavating the trench by jet assisted plow and placing the cable at the trench bottom.

These are as shown in the below figure:

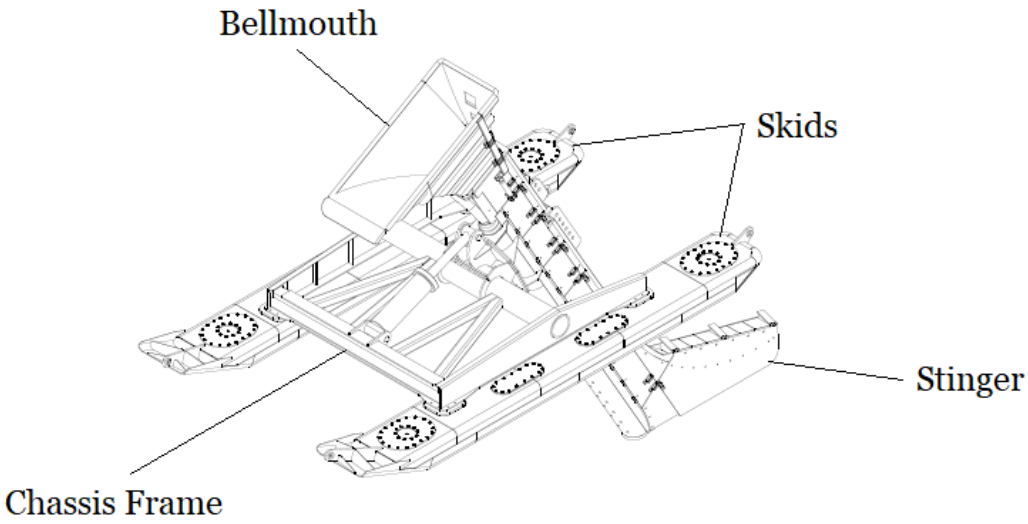


Figure 5-4 HydroPlow Construction

The sled is equipped with sensors and equipment to closely monitor the cable integrity and installation and is accompanied with sufficient spares and repair kits to compensate for any potential malfunction.

Launch and recovery of the HydroPlow will be performed from the CLV via correctly rated lifting gear installed on the stern of the vessel, suitable to handle the vehicle weight even in marginal weather conditions.

Cable is deployed from the stern of the vessel and enters the HydroPlow at the top bellmouth, being passed through the body of the vehicle through to deployment at burial depth from the stinger.

Figure 5-4 Asso HydroPlow

Full specification is provided as Appendix 4.

5.2.2 Remedial Burial Tool

For the execution of the Cementon-Stony Point Hudson Marine Segment burial works, the installation methodology involves the utilization of the tracked burial tool RBT (or similar) in jetting mode.

The RBT (or similar) is designed to meet the needs of the underwater power and telecommunication industries, providing reliable solutions in trenching operations. Manufacturing took place at dedicated facilities of Asso based at Elefsis, Greece, following certified quality procedures. Sufficient spares and tools will be loaded on the support vessel to maintain and service equipment during execution of the works.

Furthermore, its robust structure is specifically designed to work in conditions where ROV-based, jetting systems are unable to perform. Along with its support vessel it can reach remote shallow water areas without the need for further support or propulsion.

RBT is compact and versatile and by utilizing the jetting system, lowering of cable under difficult conditions is made possible without compromising the safety of the protected cable system. The vehicle moves on the riverbed on hydraulically driven tracks and trenching of the riverbed for this application will be only by the use of jetting swords for material fluidization.

RBT sits at the top of trencher’s range and has undergone its third upgrade. Its long track record has proven its worth as a durable, efficient and long-lasting hard soil and rock trenching machine.

The RBT 3rd upgrade is designed to cover the need for PLB of flexible products in jettable and non-jettable riverbed, with increased production rates.

The design of the vehicle has incorporated all the advantages found in the previous arrangements of the previous RBT and in practice combines the ability to load heavy products with small to no slack.

The hydraulic and electrical power required to drive the direction control and operational control systems is provided to the vehicle through the umbilical that contains pressure hydraulic lines and power cables. The umbilical also includes multiplexed data lines through which sensor data and video images are transmitted to the surface and command and control signals are directed to the vehicle.

Figure 5-5 Remedial Burial Tool

Key features include the following:

- 3.0 m jetting swords (with optional 0.3m adaptor to increase length to 3.3m) trenching depth capability;
- Combination of jetting and trenching techniques to ensure optimum result;
- Variety of tracks for traction and distribution of vehicle weight over the soft top layer of riverbed eliminating sinking risks;
- Minimum slack requirement due to zero handling of the cable during jetting operations;

Control system with fully segregated circuits to minimize single fault cease of functioning of the vehicle and isolation of problematic sensors and subsystems

The vehicle comes fully equipped with all necessary sensors and equipment for correct operation according to safety standards and will be accompanied by enough spares and repair kits to compensate for any potential malfunction. Launch and recovery will be done from the support vessel using the vessel's lifting appliance.

The RBT is a tracked trenching vehicle to be utilized either for PLB operations or otherwise in a tandem-jetting SLB configuration.

The maximum angle that the RBT can readily traverse is +/-10°, this can be increase to +/-15° by keeping the RBT docked into the lifting line. The route has been designed in such a way that these limits should not be exceeded.

The RBT is to be used at any location that is evaluated as not suitable for simultaneous lay and burial. This can be for reasons such as riverbed morphology as well as proximity to land which is not conducive to the length of the SLB layback.

Full specification is provided as Appendix 5.

6 Pre-Installation Activities

Prior to the installation activities, shore-based equipment will be mobilized to facilitate the pull-ins from the land side. Equipment that will be mobilized to each of the pull-in sites will include:

- Personnel facilities
    - Office and canteen facilities
    - Portable lighting and security fencing (if required)
    - Power generators
- Pull-in equipment
    - Pulling winches and associated powerpacks / hydraulic power units (HPUs)
    - Excavators
    - Boom / knuckle boom cranes
    - Cable handling equipment (roller boxes, etc.)

All marine spreads including Asso vessels, pre-lay grapnel run (PLGR) vessel and diving barges, as well as any other supportive means (workboats, RIBs, barges), will be mobilized at suitable US berths and will transit to the worksite. Whilst the mobilization port location has not been finalized (as of March 2024), candidate locations will be in the vicinity of the Hudson River at Newark, Jersey City or Staten Island. Other yards in the vicinity of landing sites might also be used for the supportive marine means.

All personnel will be mobilized to vessels at the designated port and it is not intended that crew changes will be performed during the course of the works. Exemption on the above rule may be applied to the supportive marine means, i.e. Workboats, RIBs, Barges, of which the engagement is short-termed and on which the embarkation/disembarkation may be performed from permanently or temporarily established berths nearby the area of operations.

7 Installation Methodology

7.1 Pre-Lay Grapnel Run (PLGR)

Prior to HVDC cable installation a pre-lay grapnel run will be performed to clear the route from surface debris.

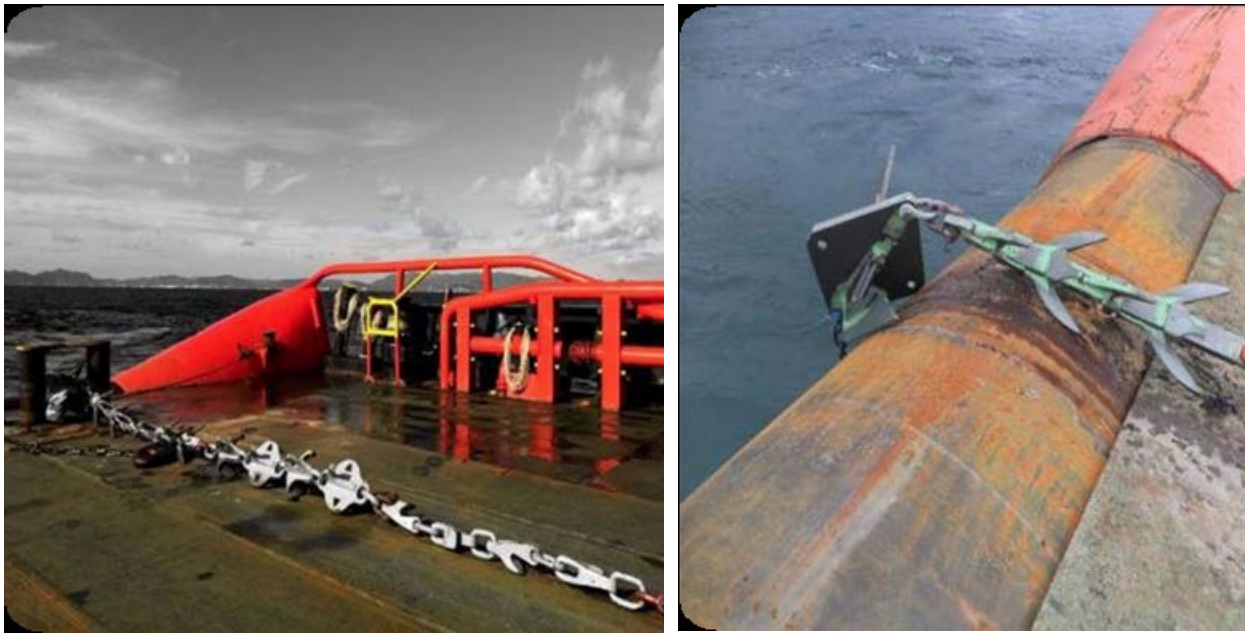


Figure 7-1 Grapnel tools which are planned to be utilized

PLGR activities consist of the deployment of a grapnel train which is dragged along the cable route whilst tension is monitored in order to pick up any debris (predominantly abandoned wire/chain and netting) which may obstruct cable installation works.

It is anticipated that PLGR operations for the Cementon-Stony Point Hudson Marine Segment will consist of:

- Cementon landfall to mile post (MP)245, commencing August 1, 2024, and lasting approximately 5 days.
- MP245 to Stony Point, commencing September 15, 2024, and lasting approximately 10 days.

For the Congers-Harlem Hudson Marine Segment, operations will provisionally start on September 1, 2025, and have a duration of approximately 5 days.

PLGR will be conducted along the entirety of the route with the exception of landfall locations and other restricted locations such as within 1,320 feet of water intakes. Operations will also be conducted only to a safe distance to co-located infrastructure as per the crossing agreements. At these locations the grapnel train will be recovered at a safe distance prior to the crossing and deployed at a safe distance on the other side.

Whilst it is intended that PLGR activities take place on a 24-hour basis, this will be subject to the selection of the PLGR subcontractor and their shift patterns.

7.2 First End Landfall Pull-Ins

The three cables will be pulled in to two HDDs; the first HDD will receive a single HVDC pole and the subsequent HDD will receive both the second HVDC pole as well as the fiber optic cable.

HDDs will be pre-installed prior to arrival.

For the Cementon-Stony Point Hudson Marine Segment scope, the initial cables pull-in will be performed from CLV Atalanti at Cementon landing site, while the final pull-in will be performed from CLV Ariadne at Stony Point landing site.

Deburial and preparation of the HDD punch outs, including the fitting of bellmouths and pigging runs will be performed by coordination of the land-based pull-in team and the offshore team including a support barge and divers. Preparation of the HDDs are planned to be performed approximately 3 days in advance of the pulling operation.

Because the HDD ends are installed at the required burial depth below the river bed, in order to access them, riverbed material needs to be excavated to the depth at which they are situated. This is to be achieved with a permit compliant methodology such as clamshell dredging or diver jetting techniques to open up access to the HDD ends. Once the HDD ends are safe to access, divers will be deployed in order to open the HDD end and fit the bellmouth through which the cable will be pulled. The HDD itself will remain at the correct burial depth so no lowering will be required at that location once the cable is pulled in.

A description of the pull-in operation is as per the below:

Upon safe vessel positioning and weather window availability, consecutive cables pulling onshore will take place. The landing operation will commence after assessment of weather reports and actual conditions and approval by the Master and the Offshore Manager. In case of favorable conditions, the go-ahead will be given, and the following generic procedure will be followed for each loaded cable:

1. All applicable check lists are filled in by the responsible engineers and reviewed by the Offshore Manager.
2. Diving team, operating from a conventional workboat (i.e., divers support vessel [DSV]), will retrieve the shore-side messenger line and deliver it to the vessel deck.
3. Shore end power cable or bundle (i.e. HVDC and/or fiber optic cables) will be connected to the land messenger line and paid out over the stern of the cable laying vessel. The speed of cable pay-out and the pulling force of the land winch will be controlled by the Offshore Manager. (Pull-in steps will be in conjunction with the approved analysis engineering procedure.)
4. The duct entrance will be monitored by diving spread or vessel ROV (or other suitable monitoring system) to ensure the cable’s safe entrance and smooth passage.

5. Cable pulling will stop when the cable head reaches the required distance onshore.
6. CLV Atalanti will be able to commence the cable bundle free-laying operation from the current milepost forward in an offshore direction (up to the point at which SLB operations will commence) when all three cables have been successfully pulled onshore.

Note: All crew can call a controlled stop during the above procedure if they feel something is incorrect or unsafe.

The support and monitoring of the whole pull in operation will be performed by divers or suitable monitoring system from the CLVs. The catenary as the cable enters the HDD and is winched towards land will be monitored at all times.

Finally, the divers will be responsible for the dismantling and removal of the bellmouth at the duct exit and installing the sealing split-flange on the end of the HDD around the cable, upon completion of pulling onshore operation.

7.3 Simultaneous Lay and Burial (SLB)

Simultaneous lay and burial is the process by which cable will be laid and installed in a single pass of the cable lay vessel operating in tandem with a trenching solution. For the context of the Hudson River cable installations, SLB is to be performed by the CLV utilizing the HydroPlow.

7.3.1 HydroPlow SLB

SLB operations using the Asso HydroPlow will consist of a single spread both laying the cable and pulling the plow to trench the cable to depth. An indicative side-on drawing of the Asso HydroPlow SLB operation is as shown in the below figure:

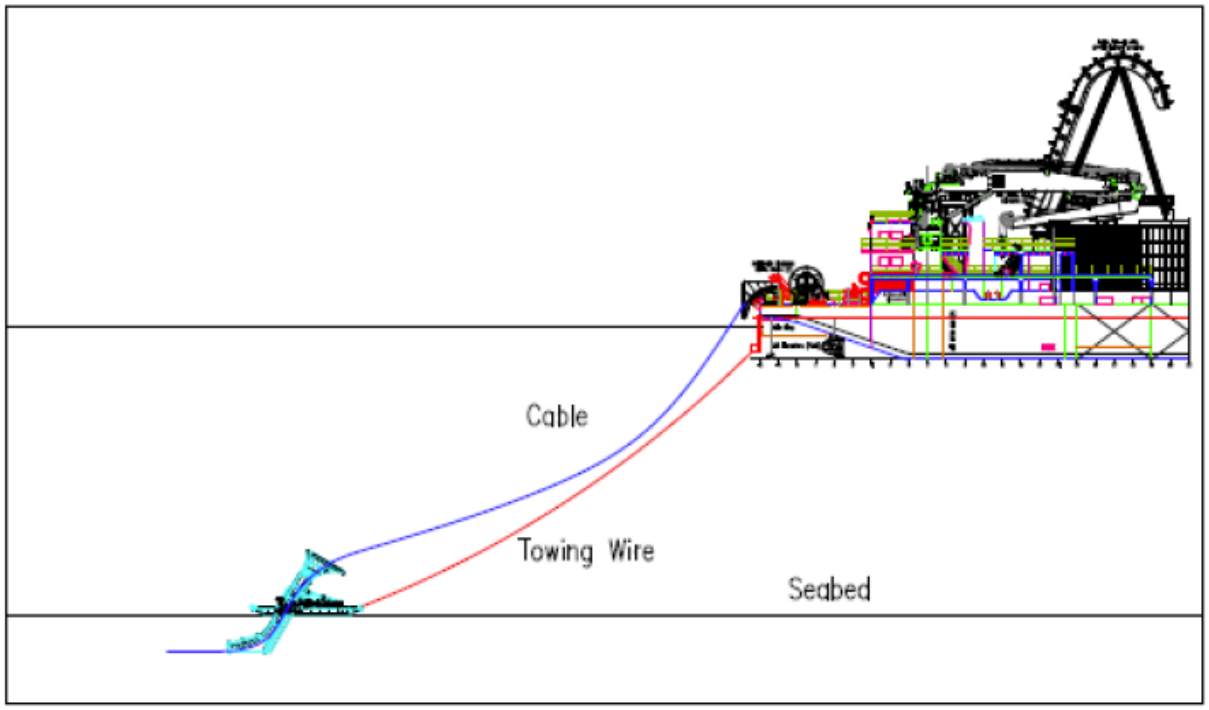


Figure 2 SLB Operation

To load the cable into the Asso HydroPlow, the cable should already be initiated and in a lay configuration; this is because the Asso HydroPlow is top-loaded and requires that the cable is laid directly into the opened channel at the top of the stinger.

Once the cable is initiated, the vessel can be moved offline, maintaining the good handling and cable catenary. The Asso HydroPlow is deployed to the riverbed by means of the deck crane and latching assembly. Once on the riverbed and in the correct start position, the crane is disengaged and cleared of the water and the towing bridle and water-hose confirmed as being under slight tension to avoid being loose in the water.

The CLV then pays in cable to raise the catenary whilst moving into position to suspend the cable catenary directly above the opened share. Whilst using cameras and sonar to watch the cable, the catenary is lowered into the Asso HydroPlow tool channel. When confirmed as being in the correct position, the channel will be closed and confirmed as ready for SLB.

The CLV will then move ahead on the line, paying out cable so as to maintain the correct catenary configuration in the water and monitoring tension on the towing wire.

As the vessel moves ahead towing the Hydroplow, the water system on the plow will be engaged and the tool share graded into the riverbed, lowering the cable down to the correct burial depth. Operations will then continue until the end of the planned installation section at which point the tool will be graded out of burial, the pumps turned off and the cable disengaged from the vehicle.

7.4 Cable Free Lay

At the onset of the cable free laying operation, the CLV's ROV (or other suitable touchdown monitoring system) will be deployed and located close to the cable in order to monitor and log the touch-down point of the cable.

The ROV will be equipped with cameras and sonars, which record the condition of the riverbed as well as a mobile transponder in order to transmit at all times its position and consequently the touch-down point position. Some of the information (that will be available continuously) includes the position of the vessel, the deviation of the laying point from the theoretical line and the speed of laying. The laying supervisor will utilize the information gathered from the navigation computers, the ROV images and the linear cable engine in order to adjust the synchronization of the vessel with the laying equipment.

The laying operation will rely on tension measurements at the linear cable engine and layback distance of the touchdown point (related to the vessel chute) according to the engineering studies. The tension meter has electronic readouts/feedbacks in the control booth. During continuous cable lay, the operation will be conducted according to the relevant standard technical procedure, which is based on the following principles:

1. The operation will be supervised by the Offshore Manager.

2. The speed of the vessel and other details involving positioning and cable track following will be automatically controlled by the vessel's DP system.

3. The primary input for synchronizing cable and vessel speed will be tension and/or laying angle measurements.

4. The cable pay-out speed will be adjusted by the cable engine operator according to the vessel's speed so that the cable laying angle is according to the laying analysis and as specified by the Offshore Manager. The two turntable operators adjust also accordingly. Laying angle and tension can be adjusted based on the touchdown distance of the cable bundle monitored by the ROV/touchdown monitoring system.

5. The mean cable speed while laying will be adjusted according to local conditions.

6. Data logging will be performed by the Surveyor on board the CLV.

During laying, the following are being documented:

- Position of cable laying vessel
- Length of cable laid
- Positioning of joints, if any
- Water depth

- Laying speed
- Tension at linear cable engine
- Wind velocity and direction
- ROV position, video and data

During free-laying operations the forward speed of the vessel, the vessel heave, the compressive load on the cable and the bending radii of the cable are monitored as well.

For clarity, cable free-lay is to be used as a prerequisite for subsequent PLB operations. Cable free-laid on the riverbed will be subject to burial to depth with the RBT. In the interim period between cable free-laying and PLB operations, guard vessels will be utilized to guard the sections of exposed cable to ensure that there is no adverse interactions with the cable and that all marine traffic are notified of its presence and how to avoid.

7.5 Post-Lay Burial (PLB)

Post-lay burial is the process of providing protection to the cable bundle by lowering into the riverbed to a specified depth after the cable has been laid. For the Hudson River segments, PLB will be performed as needed by the RBT as it does not require the cable to be loaded into the body of the vehicle, as do other means of burial.

Prior to PLB operations, data from the cable lay operation will be transmitted to the trenching team referencing touch down point (TDP) position. This is to provide an overview of where the cable can be expected on the riverbed.

The RBT will be launched offline of the cable (~10/20 m) and lowered until 2-5m clear of riverbed. With all stations confirming readiness, the vehicle will in-water transit on line to the cable and be fully deployed to riverbed straddling the cable with the jet-sword in the up position. Onboard sensors will detect the cable and the vehicle will be maneuvered into position ready to deploy jetting swords on either side of the cable.

Water pumps will then provide water to the jetting swords to fluidize the riverbed either side of the cable. The swords are lowered into the riverbed which in turn will lower the in-situ cable. Cable will be brought in and out of depth over the course of 10 to 20 m as required.

The vehicle will then progress down the cable route monitoring all parameters including speed over ground, water flow, force on the swords and cable position.

Before cables are lowered to the required depth there may be a gap in time between the cable being laid and the burial operation. During this period, guard vessels will be used to ensure that there is no interaction with the cable and to alert local marine traffic to its presence. The use of guard vessels will also be applied in the event that operations cease before lowering is complete.

The use of additional passes with the RBT and how many passes are to be performed will be assessed on a location-specific basis. Typically three passes are performed before additional passes are deemed ineffective, however, if it is assessed on site (based on feedback from the tool such as soil resistance, trafficability and success of previous passes) that additional passes would be beneficial to cable lowering and can be performed safely then passes in addition to the typical three can be performed.

7.6 Cultural Resources and Co-located Infrastructure

During the course of the cable installation works, cultural resource zones requiring specific distances of separation will be encountered, as well as co-located infrastructure crossings which will require special cable laying arrangements.

These locations will be preprogrammed into the vessels survey systems and overlays so that all operations crew are aware of where and what they are.

All cultural resources will have a demarcated exclusion zone which the cable installation process will not intrude into. These will be visible on the navigation screen and crew will be made aware of the significance of these features.

Co-located infrastructure crossings will each have a specific drawing and crossing agreement in place prior to cable installation activities.

7.7 Second End Landfall Pull-Ins

The final cables end pull-in will be performed after the CLV will have successfully finished the cables laying operation. Upon safe vessel arrival at the predefined point of the cable route, where bundling will stop and based on weather window availability, consecutive cables pulling onshore will take place.

The second end landing operation will commence after assessment of weather reports and actual conditions and approval by the Master and the Offshore Manager. In case of favorable conditions, the go-ahead will be given, and the following generic procedure will be followed:

1. The vessel will be laying the cables along the route, up to the predefined point, where bundling will stop.
2. The vessel will turn on a service route, laying on the riverbed one power cable, while the second power cable bundled with the fiber optic cable will be floated. Service route will be a straight section to avoid any overlays between the cables. Alternatively, both cables will be wet stored and the first cable will be recovered afterwards.
3. The necessary measurements and calculations will take place in order to determine the required length up to the cable head. Once the cutting point is confirmed, cutting of the

cables will be performed inside the turn tables. The cable heads will then be sealed and pull-in rigging will be assembled on the cable.

4. Asso workboats will control the floating cable. This operation is directly controlled and supervised by the Offshore Manager, whowill have overall command. The total number of workboats and RIBs will be determined at a more advanced stage.

5. Once the sealed cable head arrive at the chute, it will be carefully lowered from the vessel and the lead workboat will start to pull it towards the HDD conduit entrance. The cable head will be then connected to the shore winch wire and pulling through the HDD conduit will initiate. A barge equipped with a cable tensioner may also be used to assist with the cable pulling and reduce the tension applied from the winch to the cable.

6. The divers team will be always positioned near the HDD conduit entrance during the whole operation, ensure cable's safe entrance and smooth passage. Divers team will gradually remove the floats so that suitable catenary for the cable entrance in the HDD conduit will be maintained.

7. The beach winch will continue to pull the cable up to the pre-defined position. The cable will move towards its final position over rollers, while the workboats, following the instructions of the Offshore Manager, will handle the floating section of the cable.

8. After the successful pull-in of the first power cable (bundled with the fiber optic cable), the CLV will move astern, picking up the temporarily laid power cable from the service route and guiding it back to the turn tables.

9. Once the vessel arrives close to the designated point of the cable route (where bundling has stopped), the vessel will stop and again turn on a second service route. The same steps will follow:

    - The second cable will be floated.
    - The (already sealed) cable head will be rigged with pull-in head.
    - Once the sealed cable head arrives at the chute, it will be carefully lowered from the vessel and the lead workboat will start to pull it towards the HDD conduit entrance.
    - The cable head will be connected to the shore winch wire and pulling through the HDD conduit will initiate.
    - The divers team will be positioned at the conduit entrance and will gradually remove the floats and pulling operations will continue until the cable head reaches the final position.

Once the cables pull-in operations are completed, the divers will dismantle and remove the bellmouth at the duct exit.

7.8 Offshore Jointing

During the Cementon-Stony Point Hudson Marine Segment installation campaign (2024), CLV Ariadne will transit on the designated positions where the already wet-stored cables will be recovered, and in-line jointing operations will be performed by Contractor's jointers onboard the vessel.

For clarity, a wet-stored cable is the end of a section of cable that is then sealed and deployed to the riverbed to be subsequently recovered by the vessel with the next section of cable to facilitate jointing. At the end of the section, the team on the vessel will properly seal the cable ends against water ingress and these ends will be then lowered to the riverbed in a controlled manner with a marker buoy so that they can be safely recovered.

This procedure is planned to be followed since the submarine cable joint operation is to be performed between an already installed cable bundle with a wet stored end and a second cable bundle with its cable ends onboard the vessel at the commencement of the cable laying activities (in line joint).

The vessel is aligned in order to be positioned along the original cable path, always remaining in DP position. Initially, a visual ROV survey will be carried out to verify position and condition of cable's end, as well as recovery system. Then, the wet-stored cable segment is recovered onboard using the wire rope attached on the cable head. The ROV will be used to connect a pick-up line to the wire rope, and the cable(s) will be recovered on deck through the port chute, using the main linear cable engine (LCE) or deck winch, which will be of adequate capacity.

The wet stored bundled cables will be carefully recovered onboard as the vessel moves slowly backwards along the original route. During cable retrieval, the ROV is monitoring the touch down point to verify layback distance and cable bundle integrity. The cable end or bundled cable ends are then pulled on-board and are appropriately handled to be separately positioned for jointing operation. As soon as the cable(s) are in their final position, they are secured and safeguarded throughout the jointing operations.

When the joints are finished, each joint is progressively deployed overboard with assistance from vessel cranes. The joints are gradually transferred through the port chute, while respective cable length is being paid out from the cable tanks/turntables. The vessel advances forward in alignment to the designated route. The ROV is monitoring the operations to verify safe touchdown of the joint. As soon as the joint has been safely laid on the riverbed, the vessel continues to lay the cable bundle along the route.

Following deployment to riverbed, joints will be lowered to required depth of burial depth at the specific location.

7.9 Burial Survey

Survey operations will be performed with the use of the ROV rigged on the selected Asso trenching support vessel. Alternatively, the burial vehicle (RBT) can be utilized, if the available water depths are not sufficient for the ROV operation. The ROV will be fitted with a suitable cable tracker system (e.g. TSS 350) and Multi-Beam Echo Sounder (MBES) system (e.g. Norbit or R2 Sonic or similar). The ROV will perform cable tracking pass and MBES either simultaneously or independently, depending on the survey specifications required.

An ROV mounted, turnkey multi-beam sonar system, namely Norbit-iWBMSh (or similar MBES) will be mobilized which will provide high density sounding data within the project area. It will provide plan level information on a 0.1 (TBC) meter grid and will map the top layer of any aqueous sediment layer present.

7.10 Remedial Jetting

Remedial jetting operations will be conducted with the RBT and based on the data recorded during the burial survey operations.

Any sections along the installed route that are not to the required burial depth will be a candidate for remedial burial operations. Once the location is assessed as being suitable, the remedial burial operation can be planned and undertaken.

In the same way that PLB operations will take place, the RBT will be deployed and lined up onto the cable. The start position will be 10 – 20 m before the start of the section requiring remedial operations so as to allow the RBT to fully grade in and engage the cable between the swords prior to reaching the high spot location.

Operations will continue along the remedial section and come to an end a suitable distance after the high spot has been traversed, nominally 10 – 20 m.

A full survey will be undertaken following remedial jetting operations to verify that depth has been achieved.

Remedial burial operations are typically planned opportunistically based on location and when survey data is acquired. There is sufficient float in the schedules to include buffer for remedial passes. Typically, the elapsed time between survey operations and remedial burial operations would be less than a week. All intended remedial burial operations will be communicated to the authorities with as much notice as possible.

Locations that are not suitable for remedial jetting, such as those with shallow underlying rock, will be subject to remedial mattressing using the same procedures and the pre-lay mattressing at the identified locations.

7.11 Emergency and Contingency Planning

All operations will be planned using weather forecasts received every 6 hours from two independent forecasters to ensure that conditions are within allowable parameters for the operation to be undertaken. This is to ensure the safe and effective installation of the cables throughout the campaign.

However, in the eventuality that difficulties are experienced, emergency procedures will be in place on all vessels to ensure the safety of crew, equipment, and environment.

All operations are planned in detail with the inclusion of a risk assessment to ensure that all potential hazards are accounted for and mitigated as far as possible.

8 List of Appendices

Appendix 1 Atalanti Specification Sheet

Appendix 2 Ariadne Specification Sheet

Appendix 3 Astrea Specification Sheet

Appendix 4 Asso HydroPlow Specification Sheet

Appendix 5 RBT Specification Sheet

Table of Modifications

Rev.	Date	Prepared by	Description
A	2023-11-30	NKT	First issue of document

Appendix 1

asso.subsea

Atalanti

Cable Laying Vessel

Features

- DP 2
- 4,500T of cable in 1 or 2 turntables
- Shallow draught operation
- Beachable
- Spud-cans & 4-point mooring

Atalanti

The **Atalanti** is a DP-2 Cable Laying Vessel that has been specially designed and engineered for cable laying and protection works in shallow waters, which are not normally accessible by large cable laying vessels. She can handle at least 4,500 tons of cable in one or two electro-hydraulically operated Turn Tables, on a maximum draught of 4.26 meters.

High standard accommodation facilities for a total of 77 persons are provided, offering ideal hotel facilities for lengthy projects in remote areas of the world.

The vessel is fitted with an ABS certified Class II Dynamic Positioning System which controls the vessel's five (5) 1,000 HP Azimuthing thrusters and one (1) 2,400 HP Voith Schneider Propulsor.

The vessel also features two (2) specially designed "spud cans" for position keeping redundancy while operating in shallow waters and a 4-point mooring system consisting in four 30-Ton pull anchor winches (2 fore and 2 aft) each fitted with 800m of wire rope and a 5t Flipper-Delta anchor.

asso.subsea

Atalanti

Cable Laying Vessel

General information

IMO Number	8661616
Classification	ABS ✠A1, Barge, DPS-2
Flag	Greece
Hull built	China, 2008
Powered and outfitted	Greece, 2010
Major conversions	Greece, 2012 & 2014
Length Overall	96.99 m
Breadth Moulded	31.46 m
Depth (Main Deck)	5.50 m
Draught (Maximum-Hull)	4.26 m
Draught (Maximum – Thrusters Down)	6.46 m
Gross Tonnage	5,897
Deadweight	5,973 T

Power & Thrusters

Bow Thrusters	1 x Azimuthing, 1,000 HP 2 x Azi/Tunnel, 1,000 HP each
Stern Thrusters	2 x Azimuthing, 1,000 HP each 1 x Voith Schneider, 2,400 HP
Thruster Prime Movers	5 x Cat 3508B, each 820 kW 1 x Cat C280-6, 1,850 kW
Aux. Generators	3 x Caterpillar C-18, each 425 kWe 2 x Caterpillar C-32, each 910 kWe
Em'cy Generator	Caterpillar C4.4, 95 kWe

Anchoring Systems

Spud-Cans	2 off, port side, for 7m WD / 5Bf
Anchors	4 x Flipper Delta, each 5t
Anchor Winches	4 off, each 30t pull / 80t holding
Anchor Cables	4 x wires, 800m length each

D.P. System

Maker	Kongsberg Maritime
Type	KPos 21 with C-Joy (DP-2)
ERN Number	97, 96, 85
Sensors	3 x Gyro Compass 1 x Kongsberg SeaPath 380 3 x MRUs 3 x Wind Sensors
Position Reference Units	3 x DGPS with Sat. Corrections 1 x Kongsberg HiPAP-501 1 x KM Laser SpotTrack 1 x LTWS Bandak

Survey Systems

EIVA NaviSuite	1 x NaviPac , NaviScan online 1 x NaviModel , NaviEdit 3 x NaviPac Remote Stations
Time	1 x ATTU (Accurate Time Tagging) 1 x PPS Distributor
Network	Moxa Nports Fiber Optics , Lan & Serial connections through all Stations
CCTV System	Full coverage of deck areas with surveillance & recording stations

asso.subsea

Atalanti

Cable Laying Vessel

Cable Handling Equipment

Turntables	1 x 4,500 T (22m OD / 6m ID) 1 x 2,500 T (16m OD / 6m ID)
Cable Tensioners	1 x 20T Articulated LCE 1 x 10T Articulated LCE
Cable Chutes	Single, adaptable, 5M Radius
Cableways Radius	5M all over
Cable Pick-up arms	3 off, c/w wheel pairs

** Equipment is added and/or modified as required for each cable laying project.*

Tank Capacities

Fuel (MGO)	abt. 750 MT
Fresh Water	abt. 430 MT (Production 17 T/D)
Ballast Water	abt. 4,000 MT

Lifting Appliances

Aft work cranes	1 x Knuckle Boom 35T @ 20m 1 x Palfinger 1.2T @ 12m
Forward work crane	1 x Telescopic Boom 6.8T @ 25m / 20T @ 11.5m
Provision Crane	1 x Fixed Boom 2MT @ 10m

ROV Installed

Owner / Operator	Asso.subsea Ltd.
Position	Aft, port side
Type / Class	Work class
Maker / Model	SMD Atom
Power	100hp

Accomodation

Total POB	77
Cabins	2 x Suites 13 x Single Cabins 31 x Double Cabins

Mess Room

2 x Saloons

4 x Offices

Conference Room

Hospital

Gymnasium

Changing / Washing Room

Duty Mess / Smokers Room

Boat Landing (removable type) for CTVs

asso.subsea

Atalanti

Cable Laying Vessel

Communications

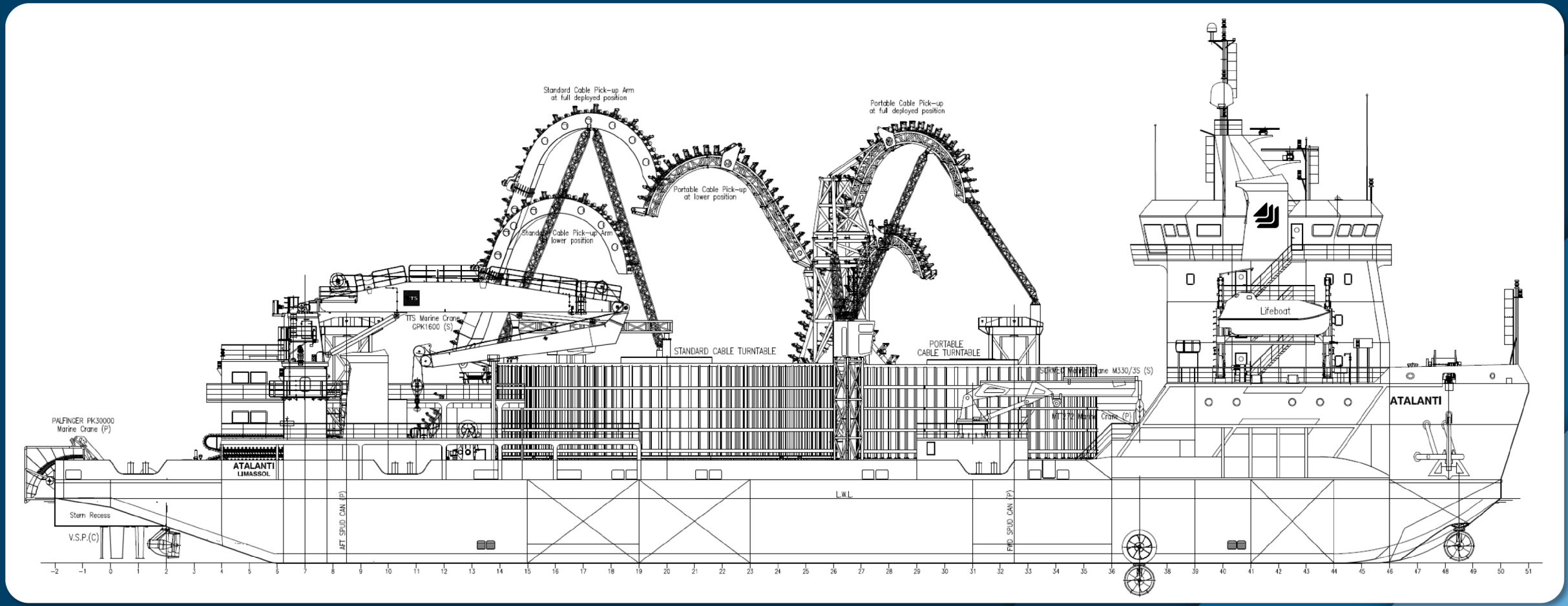
FBB500 Satellite Telephone
1 x Ku Band V-Sat System w/Land Line
1 x 4G Connection for Welfare
1 x Satellite TV System
GMDSS Plant as required for A3 Area

Life Saving Arrangements

Life Boats	2 x 40 Persons
Rescue Craft	Starboard-side life boat
Life Rafts	4 x 25 Persons, throw-overboard
Other LSA	As required by the SOLAS Convention

Atalanti

Cable Laying Vessel



Name “Atalanti”

“The Atalanti (Greek: Αταλάντη / *Atalántē*) is named after the ancient Greek mythological heroine of the same name, said to have been the fastest runner amongst the mortals and the only female crew member of the Argo during Jason’s mythological quest of the golden fleece (the Argonautic Expedition).”

asso.subsea

Contact Information

Asso.subsea

Greece
69 Okeanidon & 38 Charilaou
Trikoupi Str., Elefsina, 19200

Cyprus
Stratigou Makrigianni 2 Str.,
Limassol, 3022

Contact
T (Direct) : (+30) 211.888.5100 T (Main) : (+30) 211.888.5180
E. central@assogroup.com

www.assogroup.com

Membership - Accreditations

IMCA Contractor Member
International Marine Contractors Association www.imca-int.com
ISO 9001 ISO 14001 OHSAS 18001 BUREAU VERITAS Certification
BIMCO
HELMEPA
Achilles

Disclaimer

The specification details are illustrative for marketing purposes only. Actual equipment may be different as a result of product improvement or other reasons. Specific interface and performance information should be reconfirmed at time of order placement. Specifications are subject to change without any prior notification.

Appendix 2

asso.subsea

Ariadne

Cable Laying Vessel

Features

- DP 3
- 1 x 5,000MT Cable Carousel – above deck
- 1 x 1,500MT Cable Carousel – below deck
- Work Class ROV
- High sea state capability

Ariadne

The **Ariadne** is a DP-3 Cable Laying Vessel built for worldwide subsea operations, specially designed for OWF inter-array and export cable installation, interconnector cable installation and cable protection.

She is an Ulstein SX-121 design, originally built in Norway in 2009 as the Viking Poseidon and was acquired by her current owners in March 2017. Upon delivery her class was transferred from DnV-GL to ABS in line with company policy.

The vessel has been built to the requirements of DnV-GL Comfort Class (C-3, V-3) and she can accommodate a total of 106 persons in the highest level of comfort.

The vessel has completed her 2nd conversion stage, emerging with a complete and permanent cable laying spread consisting of a 5000 MT carousel on deck, a 1,500 MT below deck carousel (with a combined capacity of max. 6,500 MT), two firing lines with one cable tensioner each, conforming to a cable MBR of 4m and a bight quadrant deployment system. The vessel is also fitted with a Work-class ROV.

The next conversion stage will see her with a 4,000 MT carousel below deck (instead of the 1,500MT one) and compliant with the SPS2008 Code.

asso.subsea

Ariadne

Cable Laying Vessel

General information

IMO Number	9413535
Classification	ABS A1, AMS, HELIDK, ACCU, DPS-3, NBLES, ENVIRO, CRC(I), POT, HAB(WB)
Flag	Greece
Built	Norway, 2009
Length Overall	130.00m
Length BP	122.10 m
Breadth Moulded	25.00 m
Breadth Extreme	27.30 m
Draught (Max.)	7.80 m
Gross Tonnage	Abt. 12,000 (TBC)
Deadweight	Abt. 10,000 t (TBC)

Power & Propulsion

Main Generators	4 x MaK9M25, each 2,850 kW 2 x MaK9M20C, each 1,530 kW
Emergency Gen.	Scania DI1262M
Main Propulsion	2 x AZP120CP, each 3,500 kW
Bow Thrusters	2 x Tunnel, each 1,800kW 1 x Azimuthing 1,500 kW
Stern Thrusters	1 x Azimuthing 1,800 kW

Performance

Max Speed	abt. 14.5 kn
Consumption on Max Speed	abt. 35 T/D
Economic Speed	abt. 11.0 kn
Consumption on Econ. Speed	abt. 25 T/D
Port Consumption	abt. 3 T/D

D.P. System

Maker	Kongsberg Maritime
Type	KPos 21 & 11 with C-Joy (DP-3)
ERN Number	99,99,99
Sensors	3 x Gyro Compass 1 x FOG KM MGC R3 1 x Kongsberg Seapath 380 2 x MRU 5 3 x Wind Sensors
Position Reference Units	3 x DGPS with Sat. Corrections 2 x Kongsberg HiPAP-501 1 x MDL Laser Fanbeam

Survey Systems

EIVA NaviSuite	1 x NaviPac, NaviScan online 1 x NaviModel, NaviEdit 5 x NaviPac Remote Stations
Time	1 x ATTU (Accurate Time Tagging) 1 x PPS Distributor
Network	2 x Moxa Nports Fiber Optics, Lan & Serial connections through all Stations

asso.subsea

Ariadne

Cable Laying Vessel

Cable Handling

Turntables	1 x 5,000 MT (26 m OD / min 5 m ID) 1 x 1,500 MT (16 m OD /min 5 m ID)
Cable Tensioners	2 x 15T LCE
Cable Chutes	2 x 4 m MBR
Cableways Radius	5 m all over
Bight deployment	5 m MBR Quadrant c/w deployment system
Cable Touch Down Monitoring	OASYS System

Lifting Appliances

Offshore Crane	MacGregor, Knuckle-Boom SWL 250 MT @ 9m for 600 m WD with AHC and CT. Whip Hoist 25 MT @35m with AHC, CT and Man Riding.
Auxiliary Cranes	1 x Heila, Knuckle-Boom with SWL 15 MT @ 20 m 1 x Palfinger, Knuckle-Boom with SWL 5 MT @ 16 m
Provision Cranes	2 x Heila, Folding Boom with SWL 1.55 MT @ 14.8 m

ROV Arrangements

ROV Hangar	abt. 175 m^2 for 2 x WROVs
ROV Moonpool	4.9 m x 4.9 m (in hangar)
ROV Side Doors	2 off 5m (W) x 10m(H)
ROV Workshop	1 off
Control rooms	Vessel-integrated

Tank Capacities

Fuel (MGO)	abt. 2,850 MT
Fresh Water	abt. 990 MT (Production 55 T/D)
Ballast Water	abt. 7,900 MT

Personnel Transfer Systems

Boat Landing	Removable type
Helideck	14t M.T.O.W

ROV Installed

Number	1
Owner / Operator	Helix Robotics Systems
Position	Aft, starboard side
Launching method	A-Frame
Type / Class	Work Class
Maker / Model	Triton XLX
Power	200 HP
Depth Rating	3,000 m
Special Tooling	tba

asso.subsea

Ariadne

Cable Laying Vessel

Accomodation

Total POB	106
Cabins	5 x Suites 47 x Single Cabins 13 x Double Cabins 7 x Twin Double Cabins
Dedicated smoker's lounge	
Mess Room	
3 x Saloons incl. one dedicated for Client use	
8 x Offices	
Conference Room	
Hospital	
Gymnasium	
Changing / Washing Room (separate for male / female)	
Duty Mess / Smokers Room	
Personnel Elevator 14 Persons	
Helicopter briefing room / lobby	

Communications

FBB500 Satellite Telephone
2 x Dual Ku Band V-Sat System w/ Land Lines
2 x Satellite TV Systems
GMDSS Plant as required for A3 Area

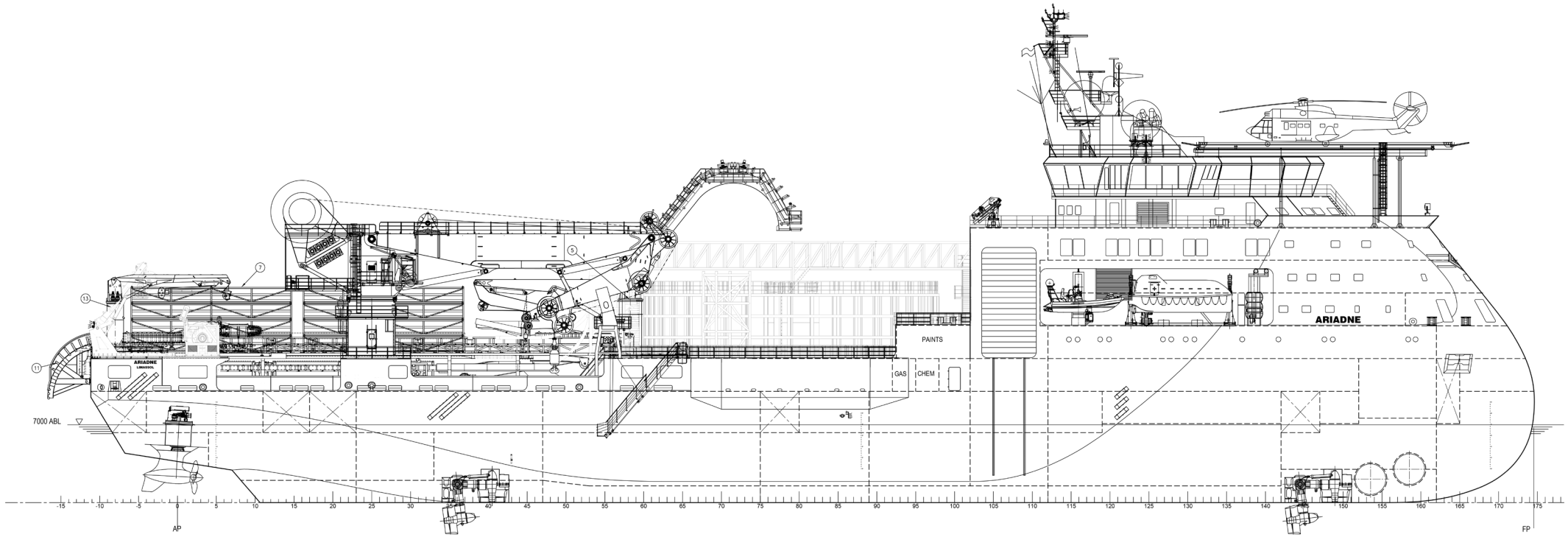
Life Saving Arrangements

Fast Rescue Craft	1 x for max 10 persons (S-Side)
Life Boats	2 x 106 Persons
Life Rafts	4 x 35 Persons, 2 x 39 Persons
Other LSA	As required by the SOLAS Convention

asso.subsea

Ariadne

Cable Laying Vessel



asso.subsea

Ariadne

Cable Laying Vessel

Name “Ariadne”

The Ariadne (/ˌæriˈædni/; in Greek: Ἀριάδνη) is named after the Cretan princess, daughter of King Minos of Crete, who according to Greek mythology, helped Theseus defeat the Minotaur by providing him with a sword and a ball of thread so that he could retrace his way out of the Minotaur’s labyrinth.

asso.subsea

Contact Information

Asso.subsea

Greece
69 Okeanidon & 38 Charilaou
Trikoupi Str., Elefsina, 19200

Cyprus
Stratigou Makrigianni 2 Str.,
Limassol, 3022

Contact
T (Direct) : (+30) 211.888.5100 T (Main) : (+30) 211.888.5180
E. central@assogroup.com

www.assogroup.com

Membership - Accreditations

IMCA Contractor Member
International Marine Contractors Association www.imca-int.com
ISO 9001 ISO 14001 OHSAS 18001 BUREAU VERITAS Certification
BIMCO
HELMEPA
Achilles

Disclaimer

Appendix 3

asso.subsea

Astrea

Multipurpose Support Vessel

Features

- DP 2
- SPS Certified
- 55T Wide-angle A-Frame
- Low fuel consumption
- Shallow draft operation

Astrea

The **Astrea** is a DP-2 Multipurpose Support Vessel built for worldwide operations and specially designed for cable laying, protection and repairs as well as for ROV work and surveys. She is fitted with twin CP propellers, twin split rudders, bow and stern thrusters linked to a Kongsberg DP-2 system, which give her an excellent station keeping capability.

Originally built in Norway in 1987 as a PSV, and fully refitted/renovated in Greece in 2008 under the highest DNV Class and Greek Flag Standards, she is now classed with ABS as a Special Purpose Vessel fully complying with the SPS Safety Code.

Her thruster and propulsion arrangements allow for full DP-2 operations with no protrusions below the keel, allowing her to approach relatively shallow waters.

She holds an extensive track record, on a variety of diverse projects ranging from cable laying and protection to FPSO installation works, and is being constantly kept up to date with new equipment and careful maintenance to ensure zero down-time and highest possible performance on her employments.

asso.subsea

Astrea

Multipurpose Support Vessel

General information

IMO Number	8520771
Classification	ABS A1, AMS, ACCU, TCM, DPS-2
Flag	Greece
Built	Norway, 1987
Length Overall	71.30 m
Length BP	65.50 m
Breadth Moulded	17.50 m
Depth (Main Deck)	7.30 m
Draught (Max.)	6.10 m
Gross Tonnage	2,592
Deadweight	2,851 T

Power & Propulsion

Main Engines	2 x Wartsila 6R32, each 3,060 BHP
Propulsion	2 x Liaaen CPP 4-Blade Propellers
Shaft Generators	2 x 2,100 kVA
Aux. Generators	2 x Caterpillar C-18, each 430 kVA 1 x Volvo D12D-AMG, 440 kVA
Em'cy Generator	Mercedes OM-407, 183 kVA
Bow Thrusters	2 x Tunnel, each 800 HP
Stern Thrusters	2 x Tunnel, each 800 HP

Performance

Max Speed	abt. 13.0 kn
Consumption on Max Speed	abt. 18~20 T/D
Economic Speed	abt. 11.0 kn
Consumption on Econ. Speed	abt. 12~14 T/D
Port Consumption	abt. 1.0 T/D

D.P. System

Maker	Kongsberg Maritime
Type	KPos 21 with C-Joy (DP-2)
ABS SKP No.	(99,98,89,64,1.5,North Sea)
Sensors	1 x Seapath 380, 3 x Gyro Compass, 4 x MRU 3 x Wind Sensors 1 x MBES Kongsberg EM 2040
Position Reference Units	3 x DGPS with Sat. Corrections 1 x Kongsberg HiPAP-500 1 x MDL Laser Fanbeam

Communications

FBB250 Sat Phone
Ku Band V-Sat System
TV Satellite Antenna System
GMDSS Plant as required for A3 Area

asso.subsea

Astrea

Multipurpose Support Vessel

Deck Capacities

Main Deck Area	abt. 500 m^2
Deck Strength	8 MT/m^2
Max. Deck Load	abt. 1,500 MT
Mezzanine Deck	abt. 80 m^2
Bulwarks	Open stern
Deck Workshop	1 off
Electrical Workshop	1 off
Boat Landing	Removable type

Tank Capacities

Fuel (MGO)	abt. 800 MT
Fresh Water	abt. 400 MT (Production 17 T/D)
Ballast Water	abt. 1,690 MT

Personnel Transfer Systems

Boat Landing	Removable type

Lifting Appliances

Main Crane	Sormec Telescopic Boom Crane with SWL 20 MT @ 11.5m, and SWL 6.8 MT @ 25m
Auxiliary Crane	Sormec Telescopic Boom Crane with SWL 17.5 MT @ 8m, and SWL 4 MT @ 21m
A-Frame	Wide angle type with SWL 55 MT

Accomodation

Total POB	55
SPS Status	Certified
Cabins	2 x Suites, 9 x Single Cabins, 22 x Double Cabins
Mess Room	
2 x Saloons	
2 x Offices	
Hospital	
Gymnasium	
Changing / Washing Room	
Duty Mess / Smokers Room	

ROV Installed

Owner / Operator	Asso.subsea Ltd.
Position	Mezzanine Deck
Type / Class	Work class
Maker / Model	SMD Quasar
Power	150hp

Life Saving Arrangements

Rescue Craft	1 x 22 person MOB boat, port side
Life Rafts	6 x 25 person, throw-overboard type 2 x 15 person, throw-overboard type
Other LSA	As required by the SOLAS Convention

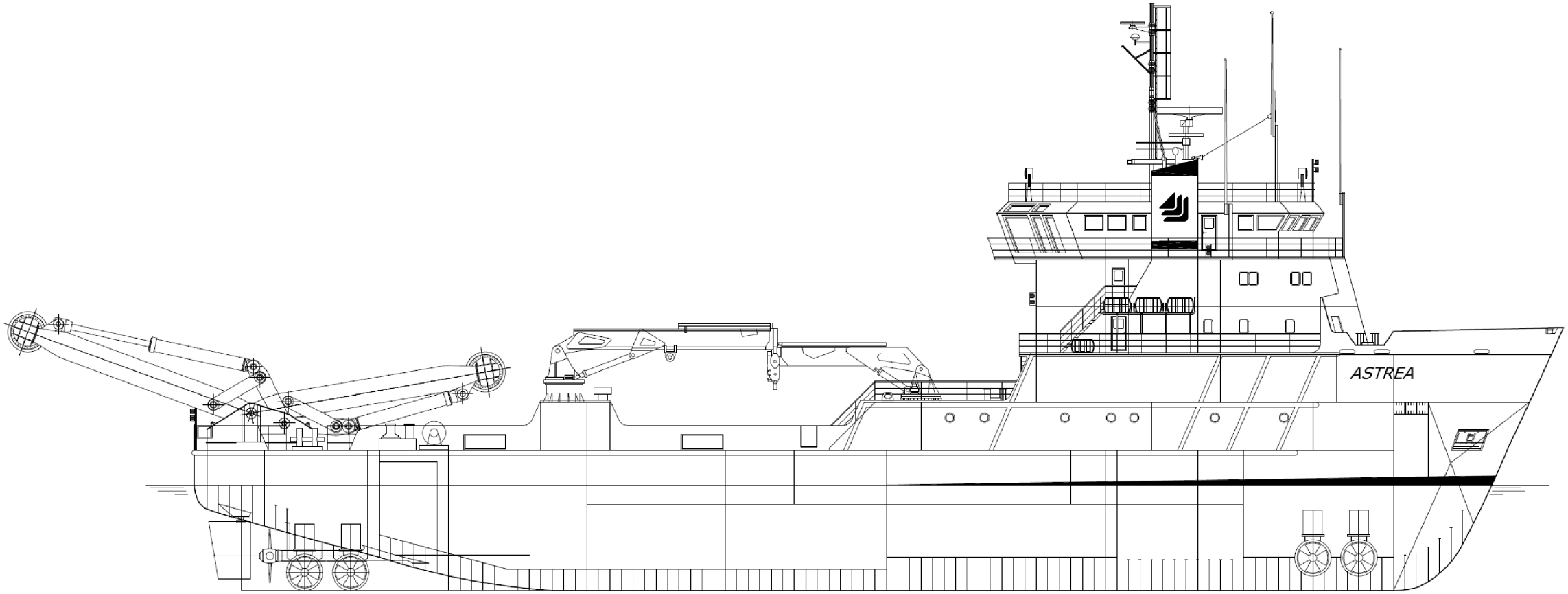
Survey Systems

EIVA NaviSuite	1 x NaviPac online, 1 x NaviScan, 1 x NaviEdit & NaviModel 2 x NaviPac Remote Stations
Network	Survey Network, Lan & Serial connections through all Stations

asso.subsea

Astrea

Multipurpose Support Vessel



asso.subsea

Astrea

Multipurpose Support Vessel

Name “Astrea”

The Astrea (/æˈstriːə/; in Greek: Αστρέα) is named after the Greek mythological virgin goddess of justice, innocence, purity and precision, and was the daughter of Astraeus and Eos. Etymologically the name Astrea means “star-maiden” and “starry night”

asso.subsea

Contact Information

Asso.subsea

Greece
69 Okeanidon & 38 Charilaou
Trikoupi Str., Elefsina, 19200

Cyprus
Stratigou Makrigianni 2 Str.,
Limassol, 3022

Contact
T (Direct) : (+30) 211.888.5100 T (Main) : (+30) 211.888.5180
E. central@assogroup.com

www.assogroup.com

Membership - Accreditations

IMCA Contractor Member
International Marine Contractors Association www.imca-int.com
ISO 9001 ISO 14001 OHSAS 18001 BUREAU VERITAS Certification
BIMCO
HELMEPA
Achilles

Disclaimer

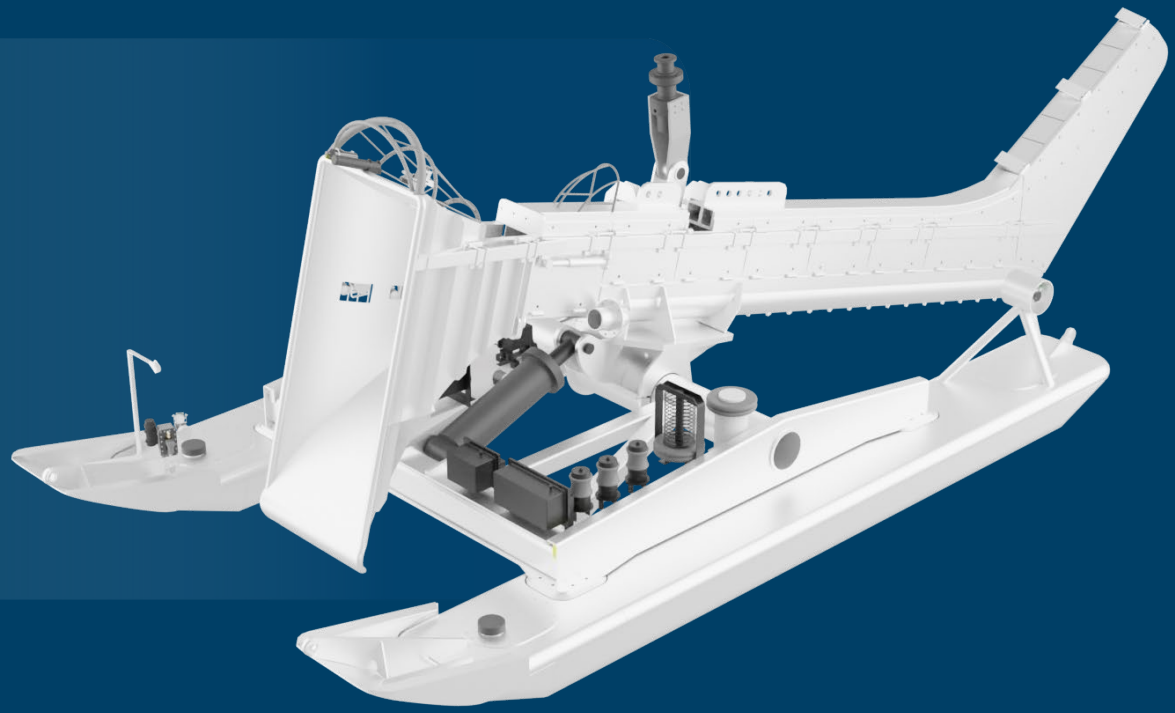
The specification details are illustrative for marketing purposes only. Actual equipment may be different as a result of product improvement or other reasons. Specific interface and performance information should be reconfirmed at time of order placement. Specifications are subject to change without any prior notification.

Appendix 4

asso.subsea

HydroPlow

Soft Soil Jetting Sled



asso.subsea

HydroPlow

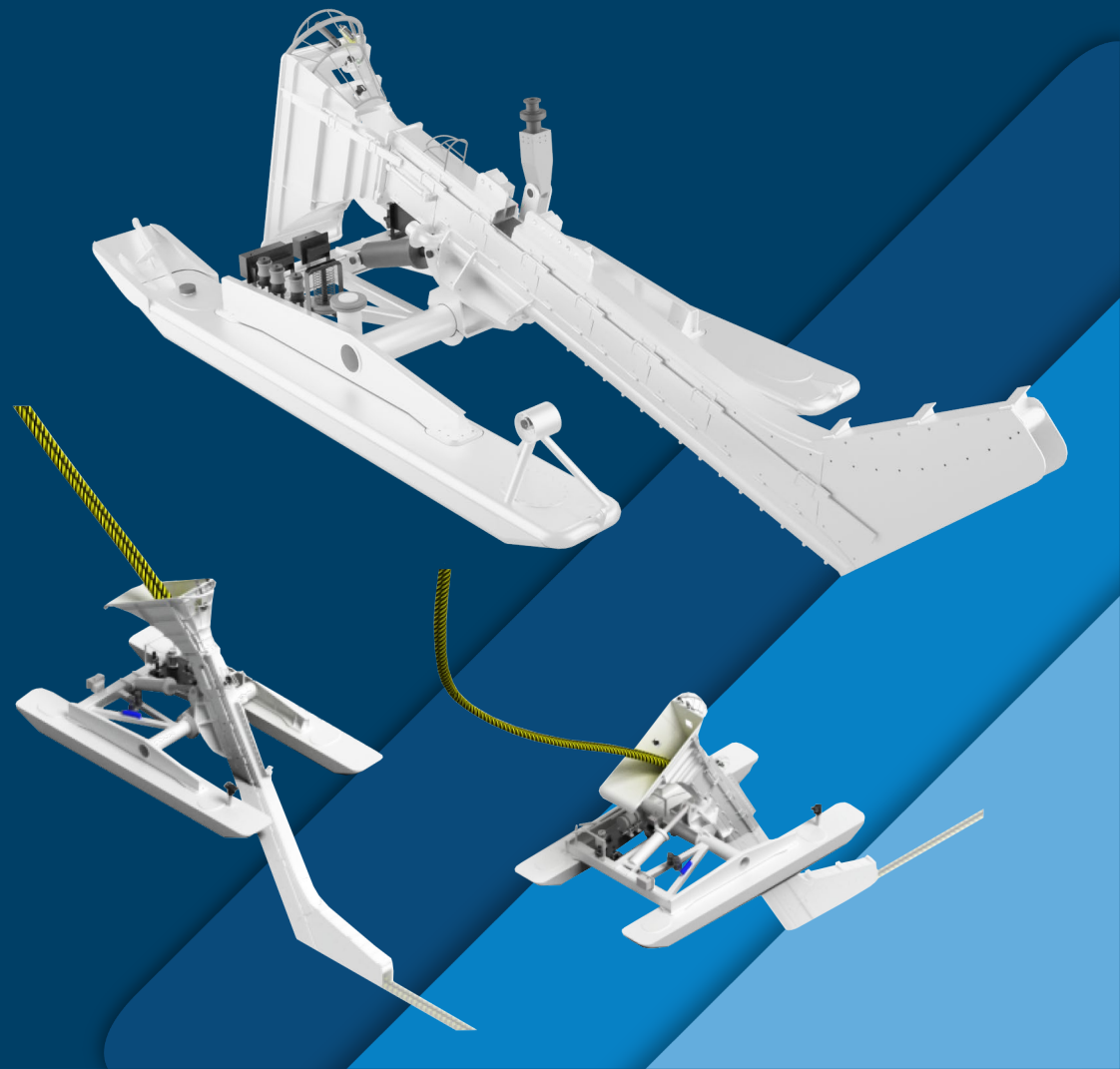
Soft Soil Jetting Sled

Asso.subsea Hydroplow is a lightweight jetting sled that is intended for use in tandem with a CLV (Cable Lay Vessel) for SLB (Simultaneous Laying and Burial). Its heave compensated tow system is designed in such a way so as to operate safely and thriftily in cohesive soil constitution with high shear strength and in severe weather conditions.

This vehicle is designed to bury almost all kinds of flexible products including umbilicals, power & telecommunication cables, flowlines and various flexible pipelines. The benefit of this system is that loading and unloading is independent, up to a certain limit, of weather conditions and can be established at high water depths.

The Hydroplow is supplied with a powerful water jetting system, which supplies high pressurized water to the cutting nozzles of the stinger from a water pump positioned on the tow support vessel/CLV. The benefit of this system is erosion and fluidization of the soil layers which results low tow forces and increased burial performance.

Fitted with the latest comprehensive instrumentation and surveillance electronic systems the Hydroplow vehicle provides real time data and image information continuously during burial operation.



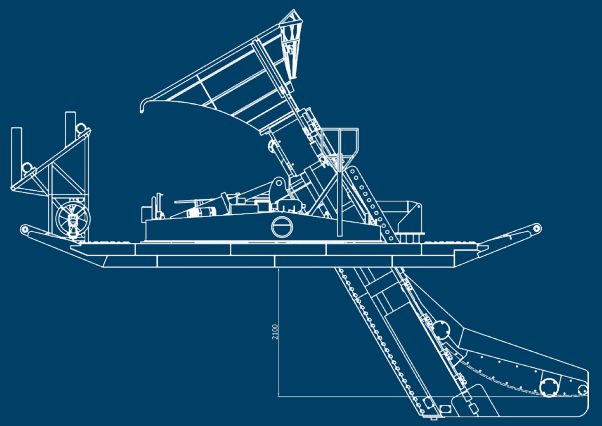
asso.subsea

HydroPlow

Soft Soil Jetting Sled

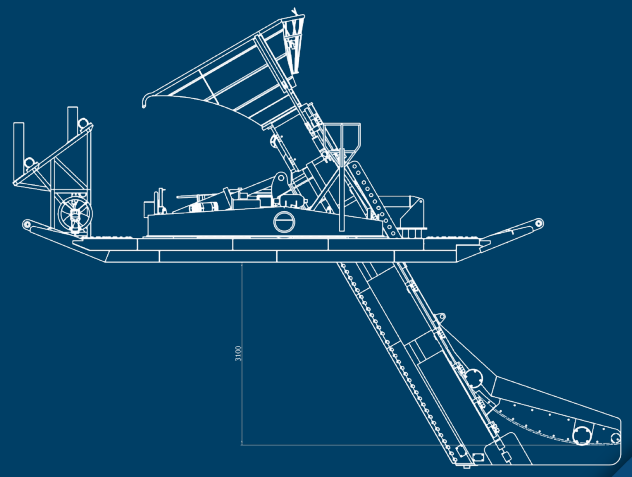
Specifications 2m stinger

Length	**7.4 m**
Length (O.A)	**9.4 m** (with stinger retracted)
Width	**4.4 m**
Height	**2.5 m** (with stinger retracted)
Weight in air	**approx. 13 Te**
Weight in water	**approx. 10 Te**
Depth rating	**150 m**



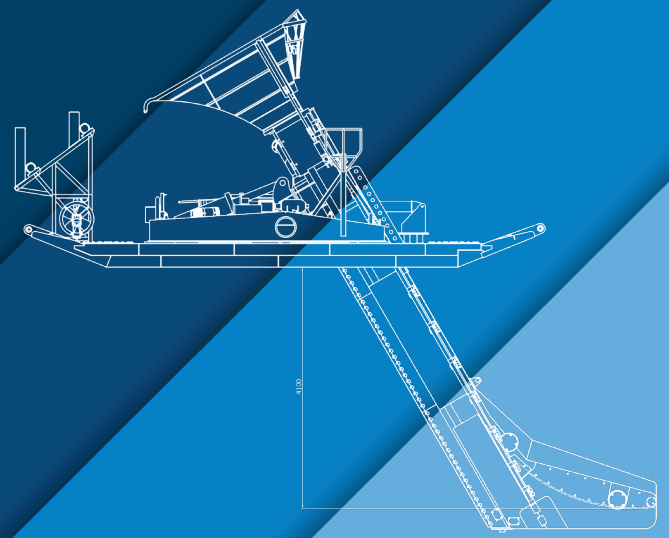
Specifications 3m stinger

Length	**10.2 m**
Length (O.A)	**11.2** (with stinger retracted)
Width	**4.4m**
Height	**3.3 m** (with stinger retracted)
Weight in air	**approx. 16 Te**
Weight in water	**approx. 13 Te**
Depth rating	**150 m**



Specifications 4m stinger

Length	**10.8 m**
Length (O.A)	**12.3 m** (with stinger retracted)
Width	**4.4 m**
Height	**3.3 m** (with stinger retracted)
Weight in air	**approx. 17 Te**
Weight in water	**approx. 14 Te**
Depth rating	**150 m**



asso.subsea

HydroPlow

Soft Soil Jetting Sled

Burial

Burial speed	**0.1-1 km/h** (depending on soil stiffness)
Burial depth	**Up to 4.0 m**
Keel depth	**Up to 4.5 m**
Trench width	**0.4 m**
Seabed type	**Up to 120kPa shear strength**

Towing

Max. Bollard Pull	**25 Te**
Bollard Pull Range	**5-12 Te** (depending on soil stiffness)

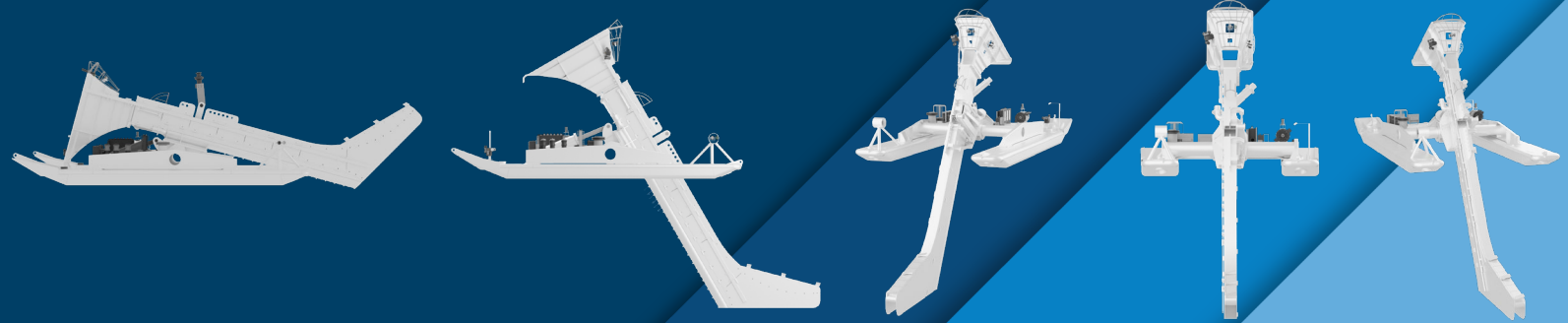
Performance

ASSO has been utilizing the HydroPlow jetting sled with surface-fed water pumps since 2012.
A modification in 2015 allowed for the option of high power onboard water pumps generated by respective High Voltage electric motors, improving its previous performance. This has eliminated the need of a hydroelectric umbilical with lengthy water hoses and complicated rigging, while instead a single, steel-reinforced High Voltage Umbilical is utilized, operated by a dedicated winch.

Fabricated from high strength steel S355

Burial Capabilities

A notable feature of the HydroPlow is the option for utilizing 3x stinger length options, offering the capability of lowering the submarine asset at a burial depth of up to two (2), up to three (3) or up to four (4) meters under the seabed.
As such, the HydroPlow offers a reliable solution to areas where increased protection is required.
The current design is capable of burying almost all kinds of flexible products including umbilical, power & telecommunication cables, flowlines and various flexible pipelines.



asso.subsea

HydroPlow

Soft Soil Jetting Sled

Electronic Equipment

- 6 x ASSO color camera
- 6 x Bowtech LED lights
- 2 x Sub-atlantic pan/tilt
- 1 x CDL INSENSE motion sensor
- 1 x Kongsberg imaging sonar
- 1 x Kongsberg profiler sonar
- 1 x Kongsberg altimeter
- 2 x Teledyne BlueView Sonar

Control Room

- Ergonomic control console
- 9 x 24” screens
- DVR Surveillance System
- Client information broadcasting
- Continuous monitoring & alarming of all crucial & pertinent information
- Integration with vessel information database for global data publication

Jet Sled’s Operation

The HydroPlow is operated using the ASSO’s proven custom-made and dedicated LARS, which ensures safe vehicle deployment and recovery even in challenging weather conditions.

HydroPlow design maintains ASSO’s tested innovative diver-less cable loading capabilities, constantly performed in various ASSO projects involving the HydroPlow since 2012. Loading and unloading operation of the cable is always monitored from the tools instrumentation and/or surveillance ROV to ensure that the cable is positioned safely and secured in the stinger.

Top-side, HydroPlow is planned to be operated from an ASSO’s modular Control Cabin certified under the DNV Classification or other equivalent. It is planned to incorporate all controls, graphic displays and telemetry between vessel and the HydroPlow.

Subsea, the vehicle is fitted with complete instrumentation and surveillance electronics, including Profile & Image sonars, dual BlueView sonars and a range of sensors in addition to multiple cameras and lights. All information is provided in real time through reinforced fiber umbilical.

asso.subsea

Membership - Accreditations

Disclaimer

The specification details are illustrative for marketing purposes only. Actual equipment may be different as a result of product improvement or other reasons. Specific interface and performance information should be reconfirmed at time of order placement. Specifications are subject to change without any prior notification.

Contact Information

Asso.subsea

Greece
69 Okeanidon & 38 Charilaou Trikoupi Str., Elefsina, 19200

Cyprus
Stratigou Makrigianni 2 Str., Limassol, 3022

Contact
T (Direct) : (+30) 211.888.5100 T (Main) : (+30) 211.888.5180
E. central@assogroup.com

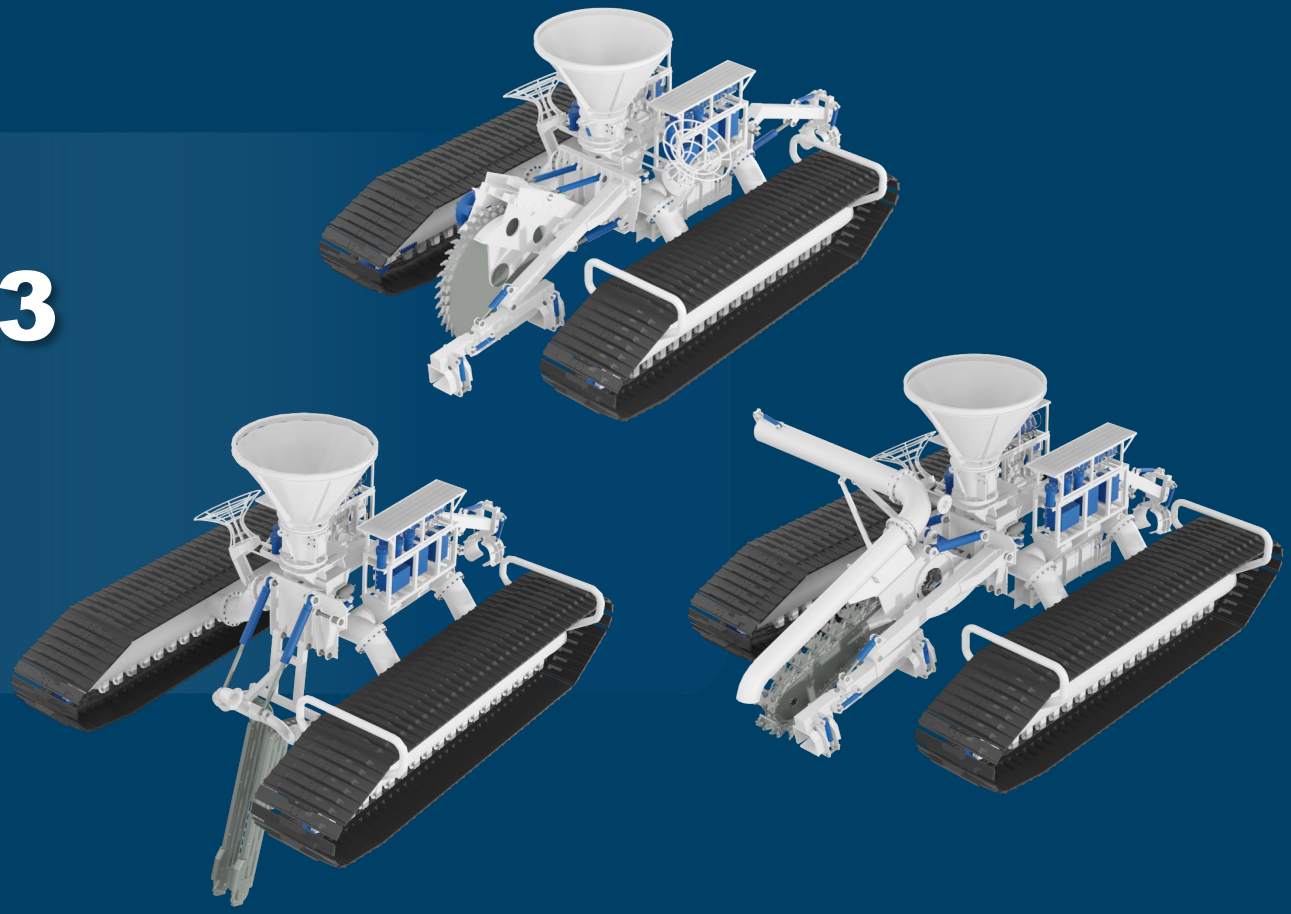
www.assogroup.com

Appendix 5

asso.subsea

AssoTrencher V Mk3

Shallow Water Trencher



asso.subsea

AssoTrencher V Mk3

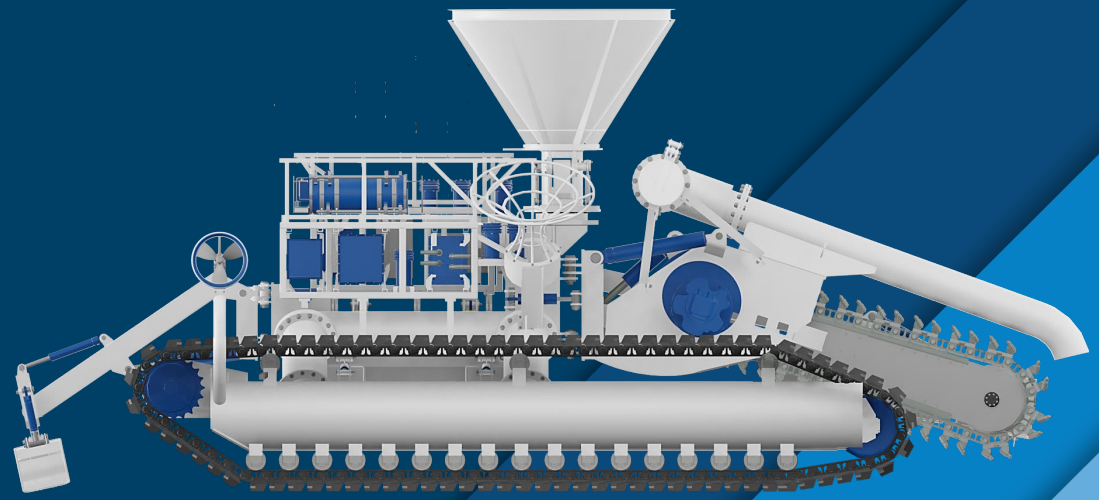
Shallow Water Trencher

Assotrencher V Mk3 is the 3rd version of the AssoTrencher V vehicle from the AssoTrencher series, designed for both shallow and deeper trenching environments. Specifically the Mk3 is a heavy-duty trencher capable of bearing multiple trenching tools yet lightweight in water due to sealed compartments all along its chassis.

The Assotrencher V Mk3 has a completely revisited loading system borrowed from other vehicles of the AssoTrencher family which allows it to incorporate diverless operations even in shallow water conditions.

A wide variety of tracks allow for a project-specific effective area of weight application over soft top layers of the seabed, and thus apply the necessary weight depending upon project conditions.

Irrespective to the above the Assotrencher V Mk3 has the ability to carry various trenching tools in order to suit every condition possible. With this option the vehicle can approach and tackle a wide variety of soil conditions without any compromise.



asso.subsea

AssoTrencher V Mk3

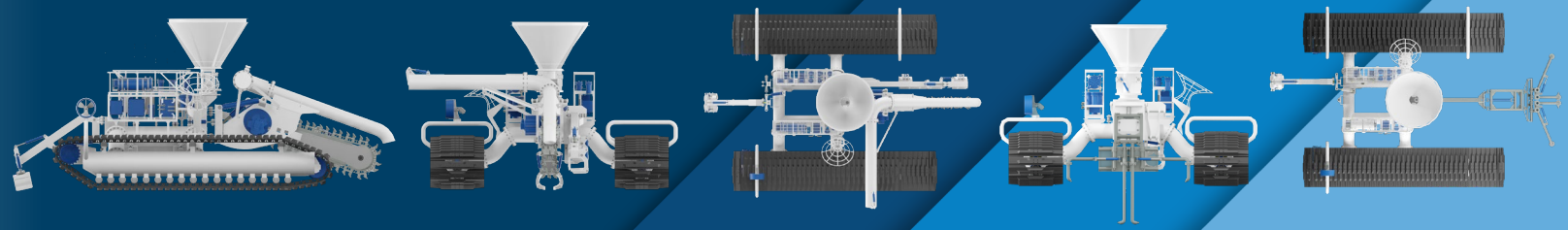
Shallow Water Trencher

Specifications

Max. Length	8.4 m
Max. Breadth	6.0 m
Max. Height	3.0 m
Max. Weight	27 Te
Depth rating	200 m
Cutting Chain Max. Trench Depth	2.4 m
Cutting Wheel Max. Trench Depth	1.3 m
Max. Depth of Jetting Swords	3.0 m
Max. Depth of Backfilling Swords	1.0 m
Cutting Chain Max. Soil Shear Strength	3 MPa
Cutting Wheel Max. Soil Shear Strength	50 MPa
Jetting Swords Max. Soil Shear Strength	120 kPa
Max. Seafloor Gradient	±15 deg (pitch & roll)
Total Power	550 kW

Key Features

- 2.4 m cutting chain trenching depth capability
- 1.3 m cutting wheel trenching depth capability
- 3.0 m jetting swords for remedial & final cable protection
- 1.0 m backfilling swords for material collapsing & jet backfilling
- Single eductor mode for cleaning/intervention operations
- Combination of jetting and trenching techniques to ensure optimum result
- Wide range of tracks surface for traction & distribution of vehicle weight over wide range of seabed
- Minimum slack requirement due to bottom loading technique ensuring minimum product lift
- Shallow water or deep-water mode available
- Onboard pumps or surface fed option by shallow drafted vessel/barge supported or from TSV
- Wide range of ancillary equipment available
- Wide soil range capability
- Diverless loading techniques
- Zero-visibility operation even in shallow water conditions



asso.subsea

AssoTrencher V Mk3

Shallow Water Trencher

Support Vessel

Support vessel (Shallow Water Mode):

Power units, control cabin, workshop and spares cabin are installed on a shallow draught support vessel. The support vessel follows the vehicle during continuous trenching operations in DP mode, towed by the vehicle itself or positioned using spuds depending on the vessel thus eliminating the need for long umbilical and Tether Management System (TMS).

Independent Operation (Extremely Shallow):

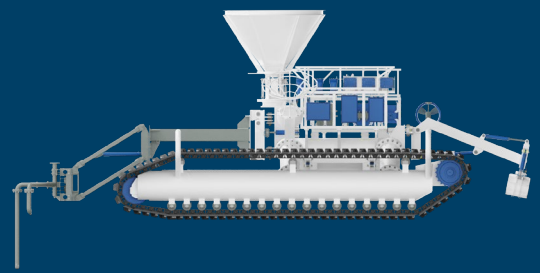
Power units, control cabin, hydraulics and water pump ancillary equipment fitted onboard a compact sized thruster maneuvered pontoon able to follow along the vehicle in order to perform trenching operations at even the most remote of areas.

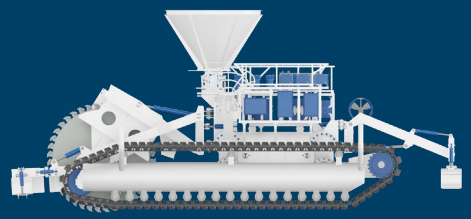
Sensor Equipment

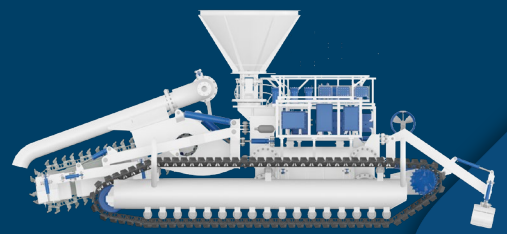
- **Kongsberg imaging sonar**
- **Kongsberg profiling sonar**
- **Blueview 3D sonar**
- **4 to 8 low light underwater cameras**
- **4 to 8 underwater lights**
- **DGPS Position feedback** (shallow water mode)
- **Fiber Optic Communications**
- **Pan-Tilt Sensors**
- **Temperature & Depth sensors**
- **Kongsberg Altimeters**
- **TSS 440/350 Cable Tracker available**
- **MBES Equipment available**
- **INS Navigation equipment available**
- **Survey grade gyro available**

In House Design Vehicle Features

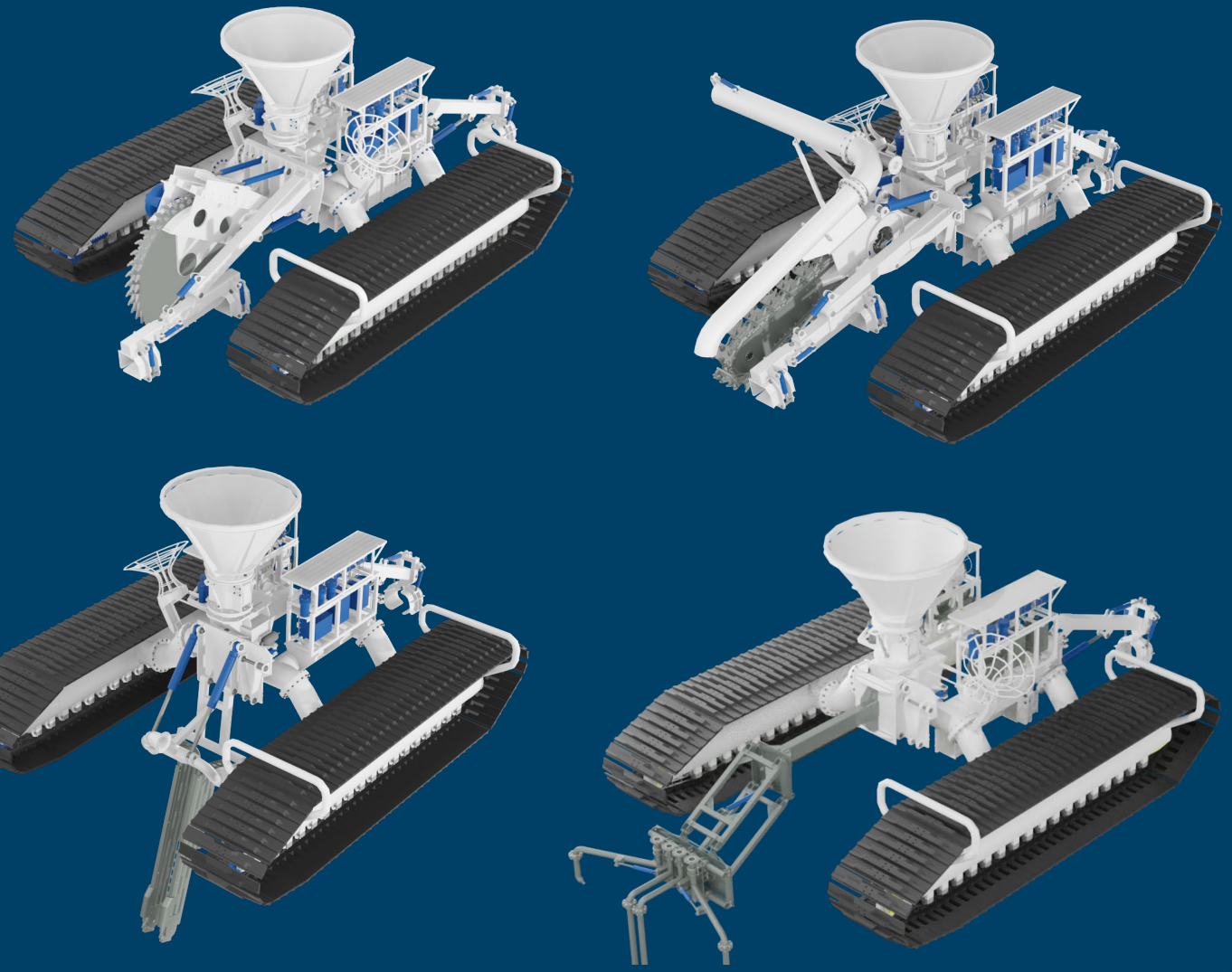
- **Trenching tools**
- **Hydraulic systems**
- **Electrical power- distribution**
- **Cameras, lights & telemetry architecture**
- **Control system (HMI/SCADA)**
- **Electronics & fault finding systems**
- **Chassis and steelworks**







asso.subsea



asso.subsea

Membership - Accreditations

Disclaimer

The specification details are illustrative for marketing purposes only. Actual equipment may be different as a result of product improvement or other reasons. Specific interface and performance information should be reconfirmed at time of order placement. Specifications are subject to change without any prior notification.

Contact Information

Asso.subsea

Greece
69 Okeanidon & 38 Charilaou Trikoupi Str., Elefsina, 19200

Cyprus
Stratigou Makrigianni 2 Str., Limassol, 3022

Contact
T (Direct) : (+30) 211.888.5100 T (Main) : (+30) 211.888.5180
E. central@assogroup.com

www.assogroup.com