CMS Method Statement - Remaining Works from 31 August 2018

Updated method statement for remaining works to be carried out after 31 August 2018

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Contents

1 Introduction

This document includes outline method statements and plan for the Caithness – Moray HVDC Link remaining works that are planned to be executed after the current licence expiry date of 31 August 2018. The document is intended to support an application to extend the licence.

1.1 Surveys - General

Each campaign will typically utilise existing survey data from previous campaigns. If such survey data does not exist or is outdated, an As-Found Survey will be carried out upon arrival at the field. A Multibeam Echosounder (MBES) survey is the typical method for mapping the current seabed conditions. Each campaign will also record the As-Left conditions by carrying out another MBES survey at the end of the campaign.

USBL will be used for work where ROV or other tooling is utilised that requires a live positioning record. Frequencies and noise levels depend on the vessels USBL system and will be part of the actual engineering documents for each campaign. Specifications of all equipment is provided and assessed in an Environmental Assessment 'Caithness-Moray HVDC Link - Additional Cable Replacement and Remediation Works: Environmental Appraisal Report. Project Number J/7/19/18. July 2018' – NKT Document 1JND14006D006546 carried out by NKT allocated Environmental Consultants. Requirements for MMO's and PAM equipment will be fulfilled during all offshore operations.

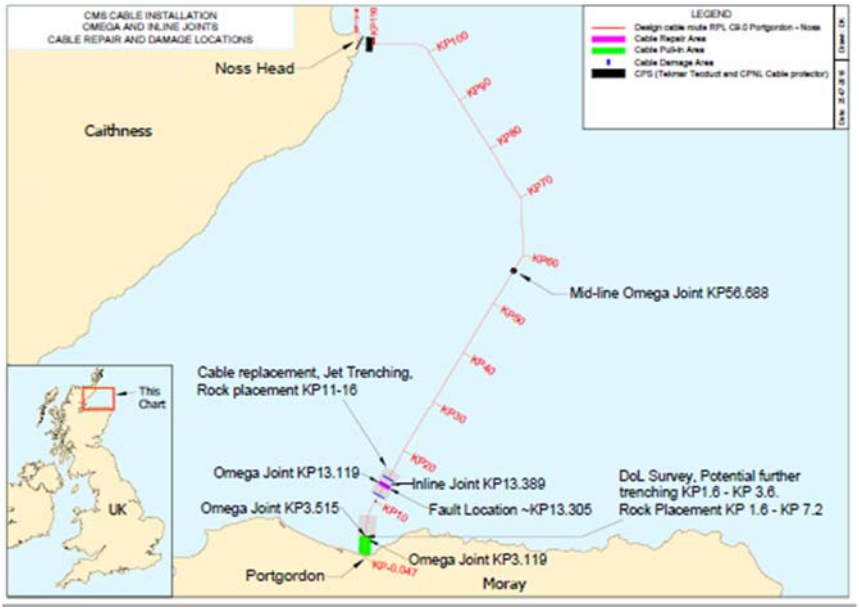


Figure 1-1 Topographical Map with new joints and fault location

1.2 Terms and Abbreviations

Abbreviation	Description
BHD	Backhoe Dredger
CFE	Controlled Flow Excavation
CMS	Caithness – Moray – Shetland
CPS	Cable Protection System
DC	Direct Current
DPFPV	Dynamic Positioning Fall-Pipe Vessel
DSV	Dive Support Vessel
DTM	Digital Terrain Model
HD	High Density (Rock)
HDD	Horizontal Directional Drilling
KP	Kilometre Point
HVDC	High Voltage Direct Current
LP	Low Pressure
MBES	Multibeam Echosounder
MMO	Marine Mammal Observer
MSBL	Mean Seabed Level
ND	Normal Density (Rock)
PAM	Passive Acoustic Monitoring
ROV	Remotely Operated Vehicle
SCAR	Ecosse's Subsea Trenching and Backfill System
TSHD	Trailing Suction Hopper Dredger
USBL	Ultra Short Baseline

2 Program overview

The remaining works are expected to continue beyond the 31 August expiry date of the current permit, with backfill and rock placement operations in Autumn / Winter 2018. The replacement cable sections will be installed in April 2019 after manufacture of the replacement cable. An overall schedule of works is included in Appendix F.

3 KP 1.6 – 3.6 Burial Survey & Possible further remedial burial works nearshore

3.1 Post Trenching Survey

Post trenching survey is required on a section of the route between KP1.6 (Portgordon HDD exits) and KP3.6 approximately. In this section the cables have been trenched by CFE. There are two options for conducting the survey as described below.

3.1.1 Option A - Cable Tracker Survey

The cable position will be measured using a Pangeo or TSS 440, 350 or equivalent cable tracker. Seabed level will be detected using a multibeam echosounder (MBES). The cable

depth of lowering relative to mean seabed level, and depth of cover over the cable, will be measured by combining the two datasets.

The survey will be conducted from a shallow draft DP vessel, for example the EDT Kennedy. The cable tracker and multibeam sensors will be mounted on an ROV, for example the suspended ROGE. Alternatively a dedicated survey vessel such as the Bibby Athena may be used. Typical survey speed with the DP vessel and ROV will be 250-500 m/hr. The survey will require one or two passes over the cable route.

Figure 3-1 EDT Kennedy

Figure 3-2 ROGE ROV

Figure 3-3 – Bibby Athena

3.1.2 Option B – Diver Survey

A small DSV will be mobilized with a 5-man UK HSE dive team to perform the diver survey. The dive team will track the cable and measure depth below seabed as found, using an RDS8000 or similar cable tracker with diver held subsea antenna and umbilical. The cable position will be measured at approximately 10m intervals along the cable. At the measurement positions the mean seabed level will be established using a beam or taut wire spanning any residual trench. The depth of the cable below the physically established mean seabed level will be measured by placing the subsea antenna of the tracker at seabed level and recording

the depth of lowering of the cable using the RDS8000 topside unit. Depth of cover over the cable will be measured by placing the antenna in the base of the part backfilled trench and again recording the depth of cover on the topside unit.

Figure 3-4 - RDS 8000 cable tracker and subsea antenna

Specification sheets for vessels, ROGE ROV and cable trackers are provided in Appendix A.

3.2 Program for Survey

A cable tracker survey using the Pangeo system, which is the currently preferred option, is expected to take around 3 days on site. Should the diver survey option be selected, a longer duration of 10-15 days infield would be required. Refer also to the schedule in Appendix F.

3.3 Further Remedial Burial Works KP1.6 – 3.5

Should the post-trenching survey indicate that further burial work is required, the work will be performed using similar methods to those described in Section 4. Due to the shallow water, the dredge heads may be positioned by divers for some, or all, of the remedial scope.

3.4 Post Burial Protection:

If on completion of survey and remedial burial works the cable protection is insufficient, post burial protection may be installed on the cable. The primary method of post burial protection will be by rock placement. The rock berm will be installed in compliance with the existing permit requirement (water depth not to be reduced by more than 5%).

4 Excavations & Inspections KP 11-16 & KP 83-87

4.1 Background to Excavation:

On completion of cable pull in and nearshore jointing at Portgordon High Voltage testing was carried out on CMS HVDC cables (24 & 25 April 2018). The HV testing resulted in identification of a fault within the negative DC cable that required investigation & repair of the subsea cable. Assessment of the backfill operations identified the possibility that the SCAR backfill plough had contacted the cables during its operation and several high-risk areas were identified between KP11-16 and KP 83-87.

4.1.1 Excavation & Inspections to date:

During May / June 2018 the HVDC cables were exposed between KP 11.150-11.300 & 13.150-13.350 utilizing an CFE spread, damage was identified at both locations. Further areas between KP 11-16 were initially considered for excavation but a decision was subsequently taken to replace the entire section of cable over the area of concern, inspection of the remainder was therefore deemed unnecessary.

4.1.2 Excavations Planned

The exact locations for excavation and inspection are yet under discussion. However, it is planned to excavate as a minimum one section between KP 83-87. The identified suspect location with highest risk in the area is KP 86.095. The location currently has rock in trench that will have to be removed. A length of approximately 30m will be excavated.

Upon completion of the inspection, a multibeam survey will take place to record the as-left status of the area. This will also be the final input for the rock design or other backfill method in this area.

4.1.3 Discharge of dredged soils

Based on previous dredging projects, discharged soil berms vary depending on the type of seabed material. The discharge hose must be relocated once the discharged berm reaches the height of the discharge nozzle. Typical shapes of berms created from dredging are described below:

Unconsolidated Sand/Clay

Typical properties of a soil berm created from discharged unconsolidated sand/clay:

- Height: approx. 1.0-1.3m
- Slope angle: 5-30°
- Approx. 50% of the sand/clay lands on the seabed, while a significant portion goes up the water column.

Rock

Typical properties of a soil berm created from discharged rock:

- Height: approx. 1.0-1.3m
- Slope angle: 20-30°
- 100% of the rock lands on the seabed

Figure 4-1 and Figure 4-2 below show areas discharge areas from dredging operations before and after.

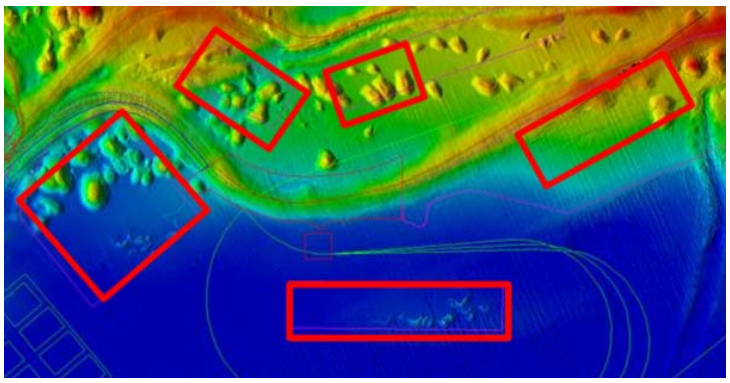


Figure 4-1 view of dredging- / dumping area based on as found survey data

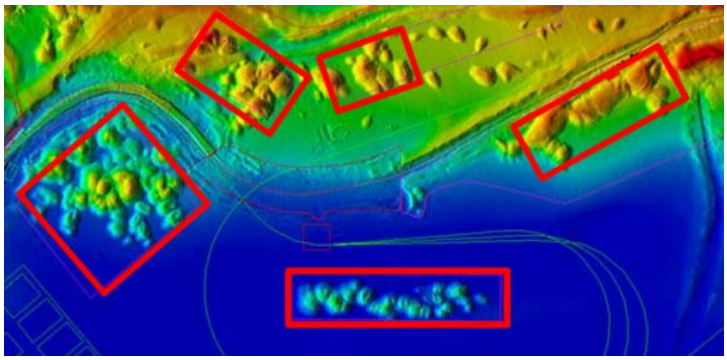


Figure 4-2 view of dredging / dumping area based on as left survey data

4.2 Method description

4.2.1 Option A – Subsea Standalone Dredge (Fixed, ROV operated)

The Subsea Standalone Dredge is a fixed pump unit deployed in a safe distance from subsea assets and landed on the seabed. Hoses are connected to the Dredge in one end and to an ROV operated nozzle in the other end. The hose is typically 10-12 inch, however the largest hose utilised may be up to 16 inch.

The Dredge is powered from an HPU placed on the vessel back deck via an umbilical that is deployed along with the Dredge. The hoses are typically deployed separately and connected subsea by the ROV. The ROV then grabs the nozzle and moves into position. The Dredge is powered up and the ROV operates and monitors the excavation.

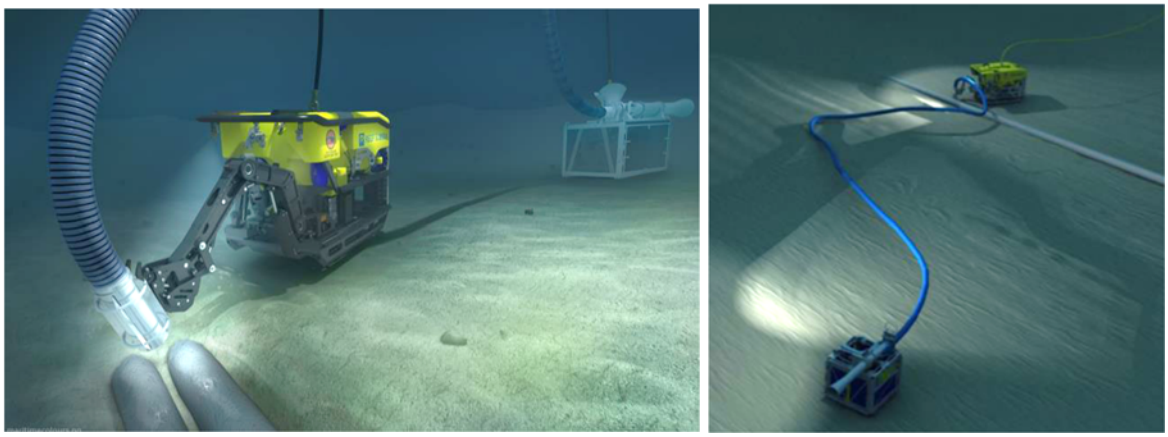


Figure 4-3 ROV Operated Standalone dredge (Image: Scanmudring)

The dredged soil exits from the exhaust pipe on the subsea dredger unit, spreading out over the seabed. Residual berms will consist of rock where there is rock in trench and unconsolidated soil from the spoil plume and can be minimised by iteratively relocating the dredger by vessel crane as required. The spread of the spoil plume is dependent on sea current and soil condition.

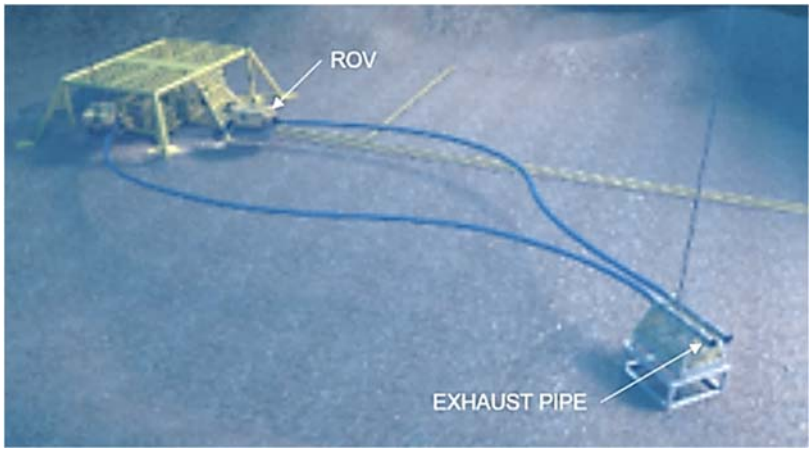


Figure 4-4 Example of Standalone Subsea Dredger, ROV operated nozzle – Deep C Subsea Dredger

Specification sheets of two typical subsea standalone dredgers are found in Appendix B.

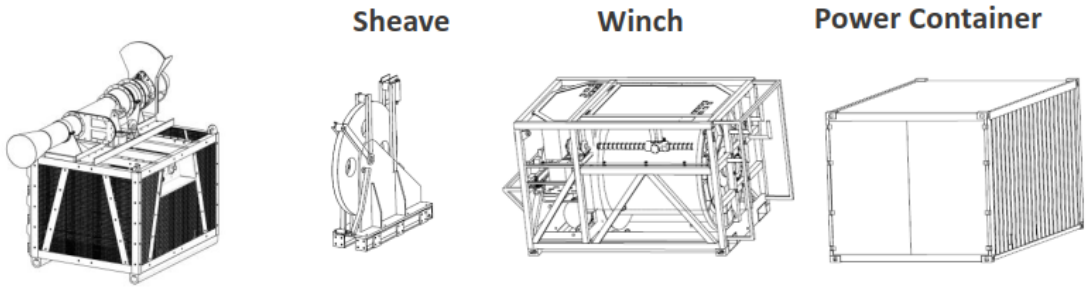


Figure 4-5 Standalone Dredge and typical on-deck equipment included in the spread.

4.2.2 Option B – Subsea Excavation Vehicle

The Subsea Excavator is a crawling excavation unit equipped with pump and typically a 10-12-inch hose attached to its hydraulic arm. The unit is deployed by the vessel crane and landed on the seabed in a safe distance from the subsea asset. The Excavator is equipped with caterpillars to allow moving along the seabed while DP vessel follow along. Main weather critical steps are deployment and recovery.

The Excavator pump can reverse flow if required, working as either a suction- or blow unit. In suction mode, the dredged soil exits through the exhaust pipe. The soil spreads out as the unit moves. However, there are also exhaust hoses and cribs available that can be used to dispose of soil at chosen locations.

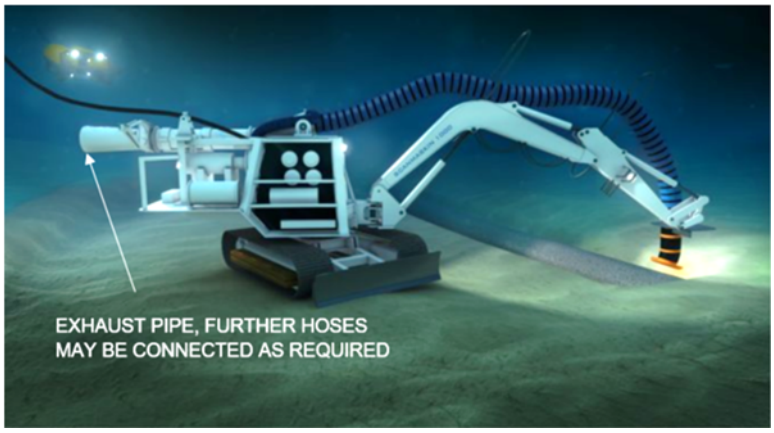


Figure 4-6 Example Subsea Excavation Vehicle - Scanmachine

Specification sheets of two Subsea Excavation Vehicles are found in Appendix C.

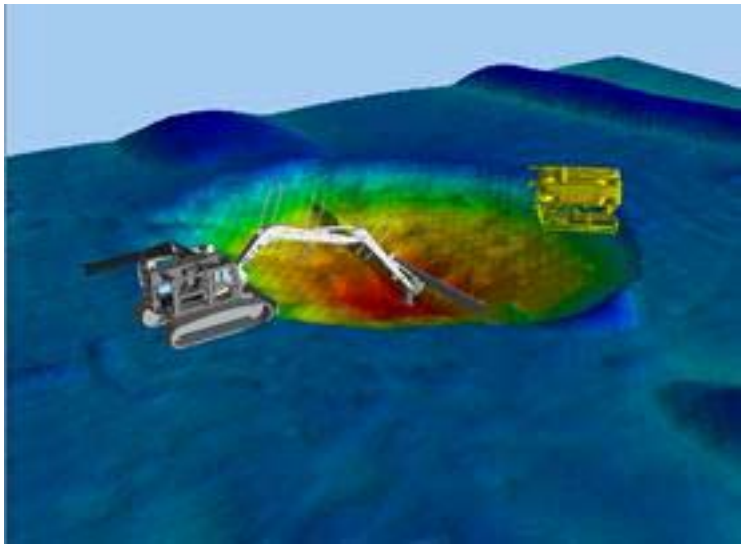


Figure 4-7 Example of screengrab from control room monitor during excavation with Excavation Vehicle

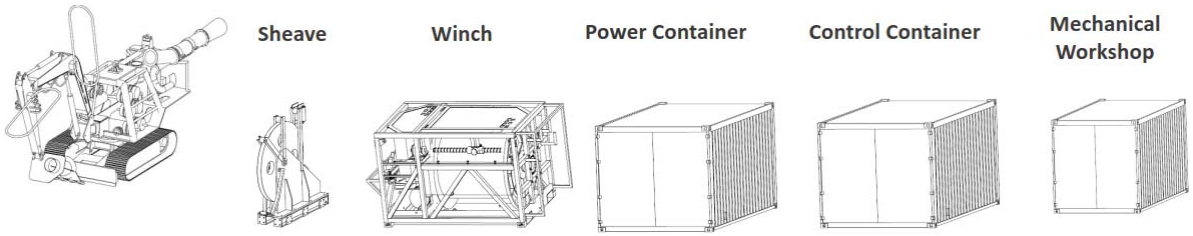


Figure 4-8 Excavation Vehicle and typical on-deck equipment included in the spread.

4.3 Cable Inspection

The cable is to be visually inspected for damages in the identified areas and the ROV will be equipped by a low-pressure water pump to wash the cable clean of any residual soil from the excavation and allow visual sight.

Figure 4-9 ROV cleaning cable with LP water pump.

4.4 Program for Excavation works:

Excavation and inspection works is planned to take place early August. However, availability of excavation spreads is yet to be confirmed and the campaign may slip to start up to 3 months later. The duration of the campaign depends on the number of inspection points but for the maximum scope is estimated to be approximately 10 days excluding weather downtime. Refer also to the schedule in Appendix F.

4.5 Survey

Upon completion of the excavation and cable inspection an MBES survey will be performed to record the as-left condition and allow engineering of backfill of the inspection trenches. The

MBES survey will extend to reach undisturbed seabed at the outer limits of the trenches – a swathe width of 15m is expected to be sufficient.

4.6 Backfilling proposals

Backfilling of excavated inspection sections is planned to be done by rock placement as a base case. Rock is to be placed in the trench or pit up to MSBL. The estimated tonnage of rock required to re-fill is approximately 1,000t at the KP83-86 area. The rock design and method is further described under Section 6.

An alternative under consideration is to utilise the dredger to return soil back in to the trench. However, as a primary method, this is deemed unlikely to achieve successful results as the dredged soil is expected to be spread out over the seabed.

Other alternative means of backfilling are described under Section 5 below.

5 Backfill Methodology

5.1 SCAR Plough (Originally Planned Method) using modified SCAR Plough (Base Case)

The originally proposed and permitted method of backfill was to return the trench spoil to the trench using the SCAR plough in backfill mode. Approximately 8km of the route have already been backfilled by this method. In the sections where it was used, the backfill plough was generally successful in backfilling the trench, as is shown by the Figure below.

Figure 5-1 – MBES image showing trench after SCAR backfill

Although backfill performance in terms of returning trench spoil and achieving cable cover was generally good, some difficulties were encountered with positioning the plough accurately over the centre of the trench. On at least one occasion the deviation of the plough from the trench allowed a plough skid to enter the trench and damage the cable, necessitating a repair. To mitigate this risk the plough has been modified as shown in the figures below. The principal changes are:

- Rotation of the plough skids has been limited to prevent them 'dropping' in to the trench.
- The width of the plough rear beam has been increased to place the skids further form the trench (and cable)
- The rear skids have deeper 'keel plates' fitted to improve directional stability
- An additional soil diffuser and (for softer soils) ballast weights have been added to minimise and counter soil uplift forces at the rear beam, hence improving penetration of the skid plates.

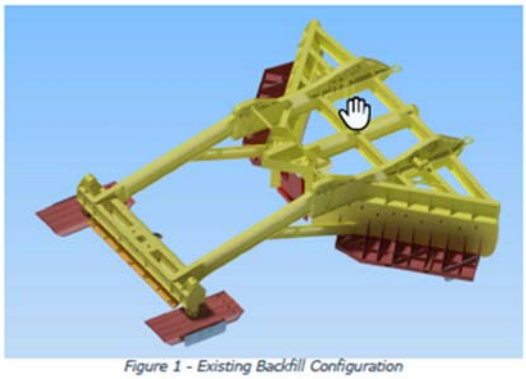


Figure 1 - Existing Backfill Configuration

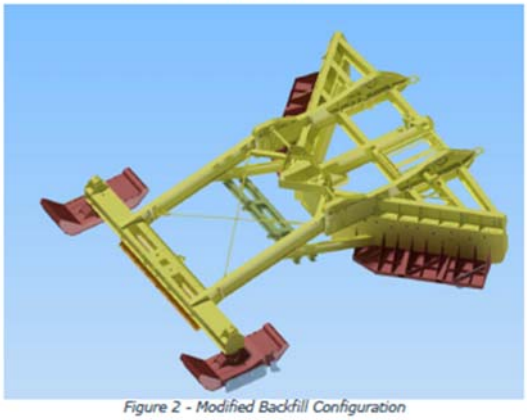


Figure 2 - Modified Backfill Configuration

Figure 5-2 - – Illustration of SCAR plough modifications, extracted from subcontractor report

It is proposed to trial the modified plough to verify that the modifications sufficiently mitigate the risk of cable damage. The plough trial will be made close to the cable route, but since this is not a direct part of the cable installation scope a separate permit application will be made by NKT. Subject to the outcome of the trial, the modified SCAR plough is a preferred option for

completing the trench backfill. Approximately 65km of the cable route remains to be backfilled by this method, or one of the alternatives described in Sections 5.3 to 5.4.

5.2 Backfill Alternative Solution 1: CFE backfill

An CFE tool would be used to backfill the trench by jetting the spoil berms toward the trench. The selected tool is the Rotech TRS2 (or similar). This is a low pressure / high flow tool which is the most suitable to displace the spoil with minimum loss of sediment. After review of the Pre- Backfill multibeam survey data on site the TRS2 tool will be configured in backfill mode (see figure below). In backfill mode the tool is aligned to run parallel with the trench. 1 x pass will be required either side of the trench. Jetting runs will commence, with the TRS2 running parallel to the berm and utilising low power to direct the berm materials back in to the trench. The displacement of soil in the berms will be monitored using 2x sonar systems. A profiler (Tritech NBI) and FWD facing Multibeam sonar (Tritech 720is) on a pan and tilt will be used to monitor the operation real time. At the start of operations, a short trial backfill run will be made and surveyed to verify that the flow settings are effective. In this way the residual berms can be minimised and the trench will be partially or wholly backfilled.

Figure 5-3 - Backfill by CFE

5.3 Backfill Alternative Solution 2: Continuous Rock Berm

Continuous rock berm to replace planned backfill: Rock berm would be placed in the trench / partly above seabed as required to achieve the required depth of cover. The method of rock placement is as previously permitted, and described in Section 6 below. This alternative is not preferred due to the significant additional rock which would be required. If this option is selected, additional permit(s) will be applied for to allow for the additional material required. It is estimated that 300,000t additional rock over that originally permitted would be required, therefore this option if adopted would be subject to a separate licence application.

5.4 Backfill Alternative Solution 3: Natural Backfill

Natural backfill: The minimum intervention approach is to allow the cable trench to backfill naturally over time. This minimum intervention approach has historically been used on many cable projects, particularly where jet trenching has been used. The disadvantage of this approach is the time which is expected to be required for natural backfill to occur. Based upon

changes in trench depth occurring between successive surveys during the installation work, it is estimated that In the shallow water sections (less than approximately 25m) natural backfill may occur in a further 1-2 years. Backfill in the northern 5-10km of the route where stronger tidal currents exist may occur in a similar timespan. In other sections it is expected that natural backfill could take 5 years or more. If this approach is to be adopted additional MBES surveys and potentially hydraulic modelling will be required to assess the expected backfill rates and trench profiles.

5.5 Backfill Alternative Solution 4: Trailing Suction Hopper Dredger and / or Backhoe Dredger

Trailing Suction Hopper Dredger (TSHD): A TSHD such as the 'Pearl River' would firstly 'borrow' backfill material from a suitable site using its suction dredge to lift material from the seabed in to the vessel hoppers. A potential 'borrow' site has still to be identified but could potentially be a site currently used for depositing spoil from port dredging. There are several such sites in the vicinity of the Moray Firth (https://marinescotland.atkinsgeospatial.com/nmpi/default.aspx?layers=712) .
Once filled with 'borrowed' backfill material, the TSHD would sail to the cable route, where the process would be reversed, returning the 'borrowed' material to the seabed to fill the trench. This method has been used with success on various pipeline backfill projects. TSHD backfilling would be subject to a dredging license.

Figure 5-4 - Pearl River TSHD

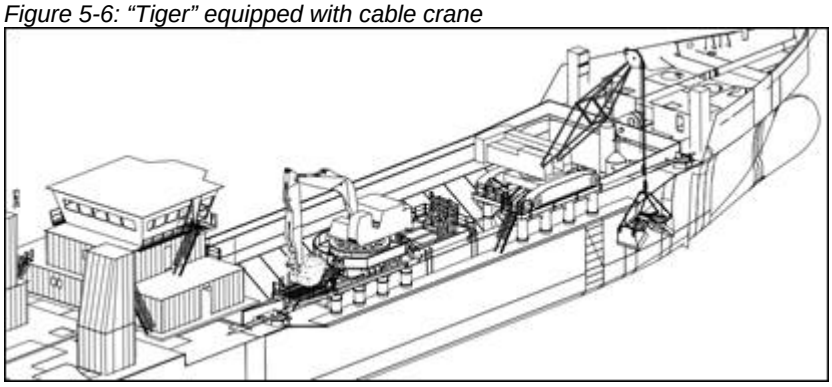
Backhoe Dredger (BHD): A backhoe dredger such as the Vitruvius (Jan de Nul) could be used in shallow water (less than approximately 30m) to excavate the residual spoil berms and replace them in the cable trench. The BHD would be positioned alongside the cable trench and secured with spud legs. The spoil berms would be excavated using the vessel's backhoe excavator and sidecast in to the trench. No material would be recovered to the surface.

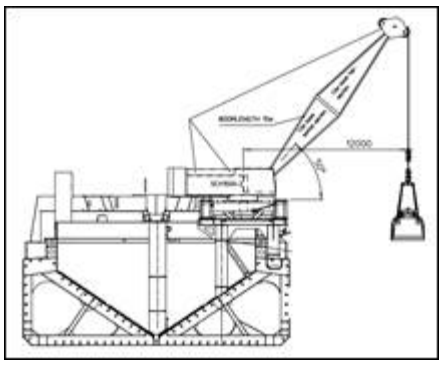
Figure 5-5 - Backhoe Dredger

Cable Crane Dredger: As an alternative to a BHD, a cable crane dredger such as the ‘Tiger’ has been proposed by potential subcontractors to excavate the residual spoil berms and replace them in the cable trench. The multi-purpose "Tiger" DP vessel has the following specifications:

Dynamic positioning vessel with cable crane	
Hopper capacity	3.700 m^3
Deadweight	6,310 tonnes
Length o.a.	99,5 m
Breadth	19.4 m
Draught loaded	5.85 m
Speed	13,0 kn
Accommodation	20
Built in	2012

Figure 5-6: "Tiger" equipped with cable crane





The vessel will be equipped, specifically for the project task, with a cable crane with a precise positioning system and a grab designed for the careful removal/handling of material.

6 Rock Methodology & Program

This section outlines the methodology and planning for remaining rock placement. The overall scenarios have not changed since the previous license. The current status of rock placement is shown in table 6.1 below.

Rock Placement Status Summary 27 July 2018				
Area:	Portgordon and Noss to 12nm	12nm to 12nm	Noss TZ1	Totals
Licence ID:	06600 & 04878	06043	04368	
Licence Amounts (Te):	221387	122369	18000	361 756
Placed by Seahorse (Te) (DPR TW-D395-5462-DPR-090)	115225	70448	0	185673
Placed by Atlantis (Te) (Atlantis Final Report TZ1)	0	0	11507	
Total placed	115225	70448	11507	197 180
Licence amount remaining (Te):	106162	51921	6493	164576

Table 6.1 – Rock Placed prior to expiry of existing permits on 31 August 2018

It is planned that additional rock will be placed in the areas listed in Table 6-2 below. As may be seen from the table, it is expected that the total rock placement will be within the originally permitted amounts.

Planned Installation Date	Area (KPs)	Rock Remaining to be placed (Te) & Zone / Licence ID				Estimate basis	Berm height	Vessel	Explanation
		PG & Noss to 12nm - 06600 & 04878	12nm to 12nm - 06043	Noss TZ1 - 04368	Totals (Te)				
November 2018	KP 1.622-2.812 (Area S0)	25000			25000	Worst Case 15Te/m: Approx. 18,000Te	0.3-0.6m Filter+ Armour	Seahorse	Protection of Post Lay trenched cables. Estimation for area S0 done by tideway
October 2018	Outstanding rock scope S1, S2-05, S06-1, s6-02, S6-03, S8, S11 and S17	22000			21803	SoW Tideway	0.3-0.6m Filter+ Armour	Seahorse	21061 Te estimated by Tideway for outstanding rock cuttent scope)
November 2018	KP 2.8-3.6	12000			12000	Worst Case 15Te/m: Approx. 12,000Te	0.6m Filter+ Armour	Seahorse (continued)	Protection of Post Lay trenched cables. Omega joint East and West Portgordon remidial work
November / December 2018	KP 3.8-7.2 (Potentially expanded to KP 3.6-7.641)	8200			8200	8,200Te	0.6m Filter+ Armour	Seahorse	Protection of cable laid in pre-cut trench. Remedial work post backfill
November / December 2018	KP 7.2-9.456	12300			12300	To be confirmed if required.	0.6m Filter+ Armour	Seahorse (continued)	Protection of cable laid in pre-cut trench.
	KP 11.156 – 11.300					8,800 – 12,300Te dependent on losses in soft (disturbed) soils.	0.6m Filter Layer, Back to MSBL		Filling of excavated inspection areas back to MSBL
	KP 13.558-16								Filling of excavated inspection areas back to MSBL
May-July 2019, approx. 2 trips á 7days	KP 11 - 16	8000			8000	Based on previous jet Trench results: Approx. 8,000Te Filter Layer	0.6m Filter Layer	Seahorse (TBC)	Protection of jet trenched cable. Pending trenching assessment and success of jet trenching
November 2018	KP 83-86		1000		1000	Excavation 30m x 1.6m deep x 9m max wide	0,6m Filter Layer	Seahorse	Rock required to back-fill excavated inspection location.
November 2018	KP100.795 - 108.549 (intermittent)	10000			10000	Current outstanding scope is 7067.42 Te		Seahorse	Protection of cable laid in pre-cut trench. Current outstanding scope is 7067.42 Te
November 2018	KP 18.430 - 18.511 (intermittent) (S50-01 and S50-02)	1000			1000	Based on TW SoW it is 742 Te		Seahorse	Protection of cable laid in pre-cut trench. Outstanding work for S50-01 and S50-02
November 2018	KP 111.345 – 112.467	2000			2000	Possible remedial at KP111.345-112.467: Approx. 2,000Te	0.3-0.6m	Seahorse	Possible Remedial rock placement pending results from Seahorse July campaign.
October-November 2018	TZ1 area 1, KP112.568-112.617			2500	2500	Worst case: Approx. 2,500Te	Remedial Armour	Atlantis	Requirement for additional rock at TZ1 is yet to be confirmed
Totals Remaining to be placed (Te)		100500	1000	2500	104000				
Amount remaining in existing licence (Te)		106162	51921	6493	164576				
Additional amount to be applied for (Te)		0	0	0	0				

Table 6-2 – Summary of rock planned to be placed after 31 August 2018

6.1 TZ1 Remedial Rock Placement, Noss Head landfall

The As-Built data from Rock Placement at TZ1, Area 1 indicates that additional remedial rock placement is necessary. Figure 6-1 shows in red the areas where additional rock is required to achieve the design profile

The required theoretical volume is 438 m^3 of High Density rock or 814 tonnes to meet the design. The practical value is approx. 1500 tonnes plus tolerances which leaves a total estimate of 2500 tonnes.

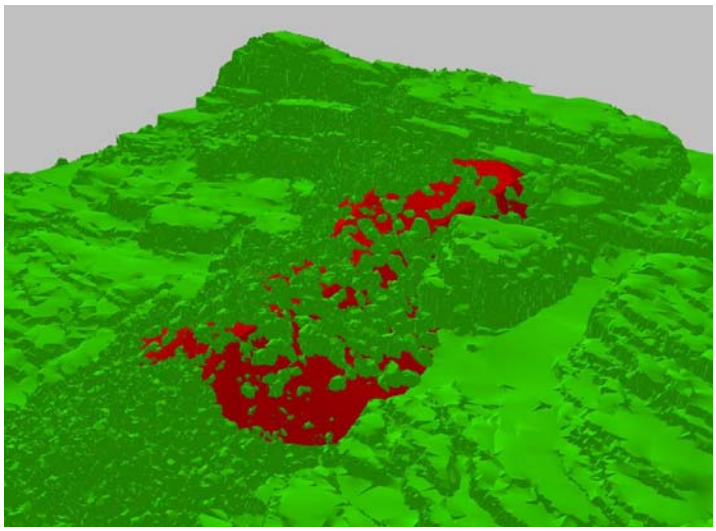


Figure 6-1 Status of current rock berm at TZ1 HDD exits

6.2 KP 11-16 Protection of new Cable

It is intended to replace a section of cable from KP11-16 which has been damaged. An estimate of the rock tonnage required for this area has been obtained based on previous jet trenched cable at KP 18.486-41.400 where a total of 15,000t has was designed. A similar proportion of rock at the KP11-16 area corresponds to a theoretical tonnage of 3,532t. Considering uncertainties, expected stiff soil material and tolerances, contractor estimates the total tonnage at the KP11-16 area to be approx. 8,000t. It is expected that the jetted trench will self backfill prior to rock dumping, so the majority of the rock volume will be placed above seabed level.

6.3 Rock Placement Vessels

The primary vessel to be used for rock placement operations is DPFPV Seahorse. For nearshore, shallow water rock placement it is planned to utilize Atlantis. Vessel specification sheets for both vessels are attached in Appendix E.

Figure 6-2 Seahorse – Rock Placement Vessel

Figure 6-3 Rock Placement Vessel Tideway Atlantis

6.4 Rock Placement works – Fall Pipe System

6.4.1 Rock Loading

Rock loading of the vessel is planned to be done in Jelsa, Norway and is done by means of onshore based conveyor belts or hydraulic cranes. The loaded material is graded crushed rock with sizes required for the works. Refer to Seabed intervention report (1JND14006D000273) and subcontractor's assessment.

6.4.2 Rock Placement Operation

Inside each hold a hydraulic excavator, placed on pedestal, unloads the rock onto longitudinal conveyor belts. The rock is transported to a central buffer hopper of approx. 70 m3 and from there the rock is fed into the Fall Pipe by means of vibratory feeder and Transverse Conveyor Belt. Adjusting the vibratory feeder controls the flow; this is controlled from the bridge.

A belt weighing system is incorporated in this conveyor belt to measure the dumped quantities. In this stage, the ROV will be positioned at working depth i.e. approx. 3 - 8 metres above the seabed.

Figure 6-4 Excavator onboard the vessel

The amount of rock placed per linear metre is a function of the rock flow rate and the tracking speed. The rate can be controlled by adjusting the outflow of the hopper, whereas the tracking speed can be adjusted using the DP system. In this manner, the rock volume placed per linear metre is controlled.

When sailing a track, the MBE screen (online cross profiles) and the Navigation screen give the operator information about the Classic Fall Pipe position relative to the dump area. The MBE cross profiles will be compared (at regular intervals) with the theoretical profiles extracted from the pre-survey. This allows the operator to monitor the progress and build-up of the rock material.

Intermediate surveys will be carried out at regular intervals to monitor the progress as well as for quality check purposes.

6.4.3 Fall-Pipe System

The fall pipe is launched through a moon pool in the centre of the vessel. Steel pipe sections of about 8 metre length (and a few pipes of approx. 4 metre and 6 metre length) are stacked on a suspended section at the lower end until the desired depth. A telescopic section at the top end of the Fall Pipe system allows for adjustments in length.

Characteristics of this closed Fall Pipe system are:

- No losses of fine material due to closed system
- High production without generating uncontrolled high flow rates at discharge end of Fall Pipe

With the classic fall pipe system it is possible to place rock up to a maximum size of 400mm in all directions.

The ROV is located at the lower end of the Fall Pipe and is suspended separately from the Fall Pipe on three wires. The wires are also used for power supply and data communication at the same time.

The ROV is equipped with 4 thrusters, which allows for horizontal corrections of the Fall Pipe bottom end position and also enables the ROV to rotate around the Fall Pipe. In this manner, the ROV can obtain an independent heading from the vessel and the survey instruments can be orientated in the same heading as pipelines, reference lines, etc.

The ROV is actively heave compensated, which provides a stable survey platform essential for the quality of data gathered by the survey sensors installed on the ROV.

6.4.4 Dynamic Positioning System

The Dynamic Positioning (DP) system on board the vessel is the primary vessel position control during rock placement and surveying operations. The DP system works with input from two Differential Global Positioning Systems (DGPS) or an alternative system such as a reference transponder or laser. The DP system allows the vessel to hold position on a certain spot or to sail tracks along a pre-defined line with a certain speed and heading.

6.4.5 Navigation

Two DGPS systems will control the vessel's positioning; one shall be operated as primary and the other as secondary system. This will serve as input for the navigation computer.

Furthermore additional equipment is interfaced to this computer, e.g.:

- Ship’s gyro and motion sensor
- ROV gyro and motion sensor

The navigation computer is capable to calculate the actual position of the vessel and the Fallpipe to a high degree of accuracy. The data is also used as input for the DP system. The second DGPS system is serving as a back-up system.

6.5 Rock Placement Survey

During the construction of the rock berm, intermediate surveys will be carried out having as main objective the verification of the progress, i.e. build-up of the rock berm, and the quality of

the work. All the surveys described below will be performed from the rock placement vessel using the permanently installed mutibeam echosounder (MBES) survey spread.

The progress of the construction will be monitored 'on-line' by comparing the results of the intermediate survey with data from the corresponding pre-rock placement survey.

6.5.1 Pre Rock Placement Survey

The pre-rock placement survey includes all operations, which contribute to establish the existing seabed conditions. Latest as-left survey data falls under this category.

The objectives of the pre-rock placement survey are:

- To determine the topography of the un-touched seabed
- To establish topography around the proposed rock placement location;
- To estimate the required quantity of rock

Installed reference heaps or any other clear seabed features might be used as benchmarks for later comparison between the pre-rock placement, intermediate and post-rock placement DTM surveys.

6.5.2 Post Rock Placement Survey

After completion of a part of the rock placement scope, a post-rock placement survey will be performed to record the as-built situation. The data gathered will be compared with the corresponding rock design data and pre-rock placement survey to ensure that the rock berm is built within specifications.

Since the post-rock placement survey will not discover the cable position but the rock berm profile and position, this survey in combination with the previously executed Post Mechanical Trench Back-fill Survey will define the final cable position with its Depth of Cover. As for every as-left or as-built survey, a final survey report will be issued.

6.5.3 Rock Placement in Shallow Waters

Rock placement in shallow waters will be performed using a Rock Side Dump Unit (RSDU) fitted to the Seahorse in lieu of the fall pipe. A short inclined pipe conveys the rock to the seabed. In other respects the operations are similar to those using the fall pipe system. The placement of rock in shallow waters will be measured and documented by mutibeam surveys pre and post rock placement.

Figure 6-5 – Rock Side Dump Unit (RSDU) fitted to rock placement vessel.

7 Cable Replacement KP 11-16

7.1 Scope

It is intended to replace a section of cable between approximately KP11 and 16 which has potentially been damaged in more than one position during backfill ploughing. The replacement cable will be laid parallel to the already installed cable at an offset of approximately 20m. The scope of work for cable replacement includes a survey of the route for UXO and obstructions, deburial and cut in to the damaged cable near to KP11 and KP16, cable lay and jointing of the replacement section, followed by burial using jet trenching. The potentially damaged cable, including a repair section previously inserted at KP13, will be recovered and recycled / scrapped ashore in accordance with legislation and NKT environmental policies. Where cover depth is insufficient, additional rock protection may be required, as is described in Section 6.2. The processes and resources to be used will be similar to those previously permitted for cable installation, as described below.

7.2 Route Survey

The route for the replacement cable will be parallel with the already installed cable, within the existing permit corridor, offset from the installed cable by about 20m. This path will be on the edge of the existing magnetometer survey coverage and for this reason an additional survey will be performed to ensure that the route is clear of UXO or other hazards. The survey will be performed using a survey vessel with towed or ROV mounted magnetometer. Typically the system comprises of a transverse gradiometer set up with two Geometrics G-882 magnetometers set one and a half (1.5) metre apart. The dual magnetometer set up is towed (or ROV carried) at a fixed altitude along several survey lines 5m apart to achieve the required corridor width. Optionally, a multibeam echosounder survey may be undertaken simultaneous with the magnetometer survey to update the existing bathymetric data for this route section.

Figure 7-1 - Typical Survey vessel and Geometrics G-882 Magnetometer

7.3 Vessel Installation Spread

EDT Hercules (or similar DP2 vessel) will be utilised for deburial operations and NKT Victoria will be utilised for the cable replacement works. All offshore operations will be similar to those previously permitted and shall be performed in line with the industry standards such as described in the DNV recommended practices. Vessel details are provided below.

7.4 EDT Hercules (example deburial vessel)

7.4.1 Overall Specifications

Figure: EDT Hercules

Description	Information
Vessel Name	EDT Hercules
Vessel Operator	EDT Shipmanagement Ltd
Year Built	2014
DP Class	II
Length Overall	88.8 m
Beam	19 m
Design Draft	6.6 m
Working Deck Area	~609 m2
Tugger Winch	10Te
Provision Crane	2T e
Offshore Crane	70 Te AHC
Accommodation	71 bunks

Table 7-1 - EDT Hercules Overall Specifications

7.4.2 Vessel Crane

A 70tm AHC MCGregor Crane is installed on the EDT Hercules

7.4.3 ROV

On board of the EDT Hercules a work class Schilling HD ROV is installed.

7.4.4 Cable Deburial Equipment (Controlled Flow Excavator)

Figure 7-2 – Controlled Flow Excavator

It is anticipated that a Rotech TRS2 controlled flow excavator will be utilised for any necessary deburial of cable during the exposure and removal of the potentially damaged cable section between KP11 and 16. It is anticipated that excavation will be necessary only to expose the cable at the cut positions.

7.5 NKT Victoria

NKT Victoria shall be utilised for the offshore installation of the submarine power cables.

Figure 7-3 - NKT Victoria

7.5.1 Overall Specifications

Description	Information
Vessel Name	NKT Victoria
Vessel Operator	NKT
Year Built	2017
DP Class	III
Length Overall	140 m
Beam	29.6 m
Design Draft	7.2 m
Working Deck Area	~1,600 m2
Carousels	1 x 7000Te Above Deck / 1 x 4500Te Below Deck
Tensioners	2 x 45Te
A & R Winches	3 x 45Te
Deck Crane	10Te Auxiliary crane, port side
Offshore Crane	25Te Heave Compensated knuckle boom crane, port side
Telescopic Crane	5Te Telescopic knuckle boom crane, starboard
Chute	2 x Integrated aft chutes
ROVs	2 x WROV
Accommodation	Maximum 100 POB

Table 7-2 - CLV Overall Specifications

7.5.2 Vessel Cranes

NKT Victoria has permanently installed cranes as follows:

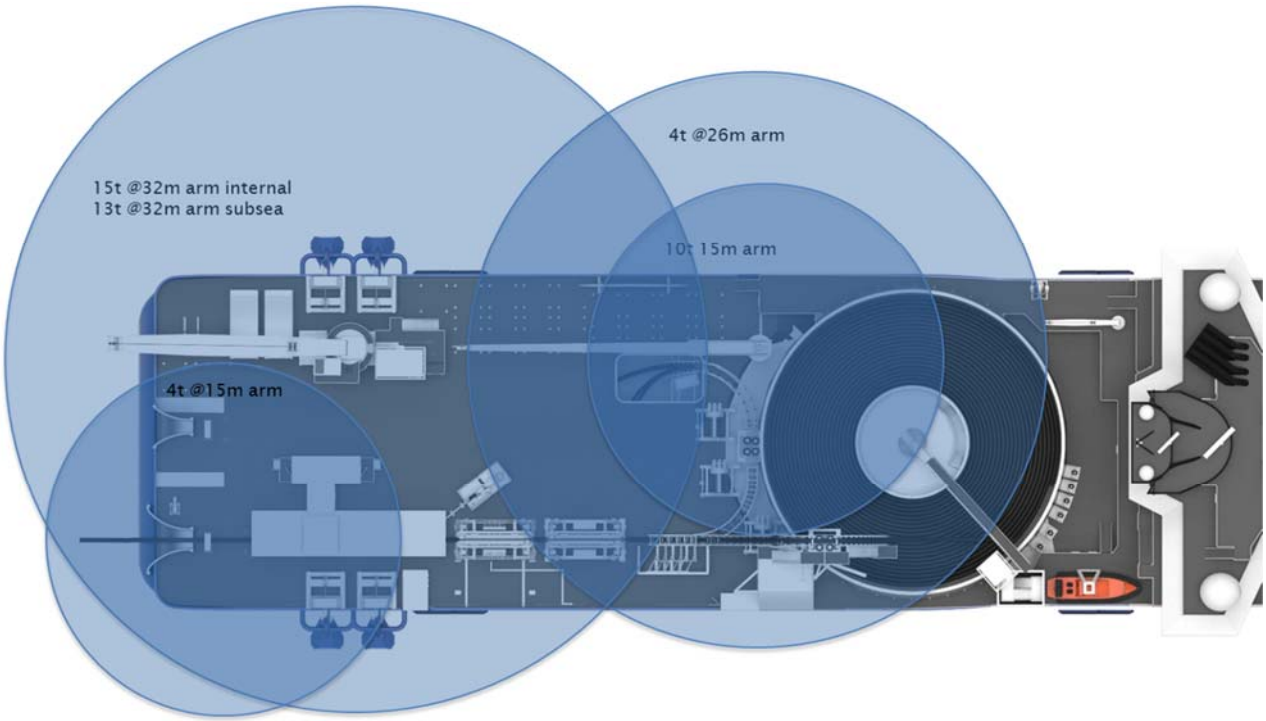


Figure 7-4 – NKT Victoria Cranes

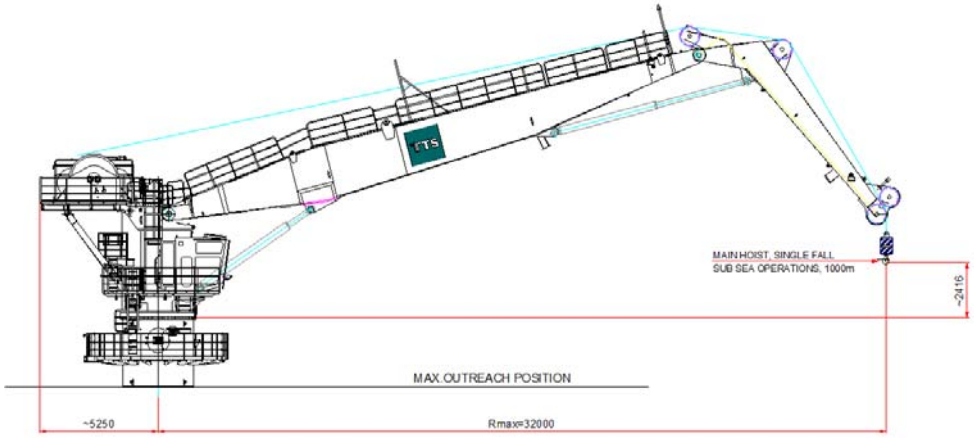


Figure 7-5: Offshore Crane Max Outreach Position

Description	Information
Offshore Crane	25te @ 23m, 15Te @ 32m with AHC
Deck Crane	10Te @ 15m, 5Te @ 26m
Telescopic Crane	5Te @ 5m, 4Te @ 15.6m

Table 7-3 – NKT Victoria Crane Specifications

7.5.3 ROV

On board of the CLV one work class Schilling UHD III ROV and one Panther XT Plus light work class system are installed and operated by ROVOP.

The Schilling UHD III ROV is operated from the ROV Hangar on the starboard side of the vessel and is launched with a dedicated LARS. The Panther XT Plus ROV is operated from the portside aft of the vessel side and is also launched with a dedicated LARS. This provides optimal performance of the ROV in shallow water.
The ROV main specifications are given in the sections below.

7.5.3.1 Schilling UHD III

Description	Information
Vehicle HPU	250 SHP
Depth Rating	3000 msw
Length	3.1 m
Width	1.9 m
Height	2.1 m
Min. Payload	450 kg
Weight	5500 kg
Camera	Low light B&W, colour zoom and tooling colour
Sonar	Tritech DST and Gemini

Table 7-4 - Schilling UHD III Specifications

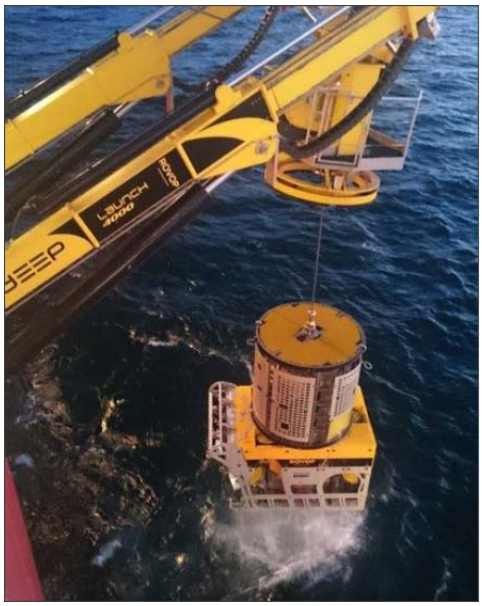


Figure 7-6 Schilling UHD III ROV

7.5.3.2 Panther XT plus

Description	Information
Electrical Power Requirement	3-phase 380-480VAC
Depth Rating	1000 msw
Length	2.14 m
Width	1.06 m
Height	1.22 m
Min. Payload	150 kg
Weight	800 kg
Camera	Low light B&W, colour zoom and tooling colour
Sonar	Gemini (As a standard)

Table 7-5: Schilling UHD III Specifications

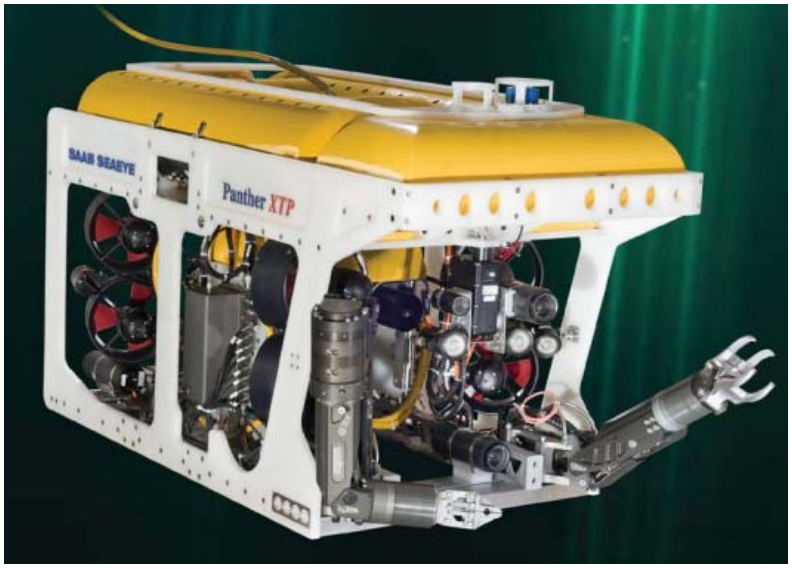


Figure 7-7 - : Panther XT plus ROV

7.5.4 Cable Lay Equipment

For the cable installation operations, dedicated equipment is used to install the product successfully. In the sections below the main equipment used during the cable installation is briefly discussed.

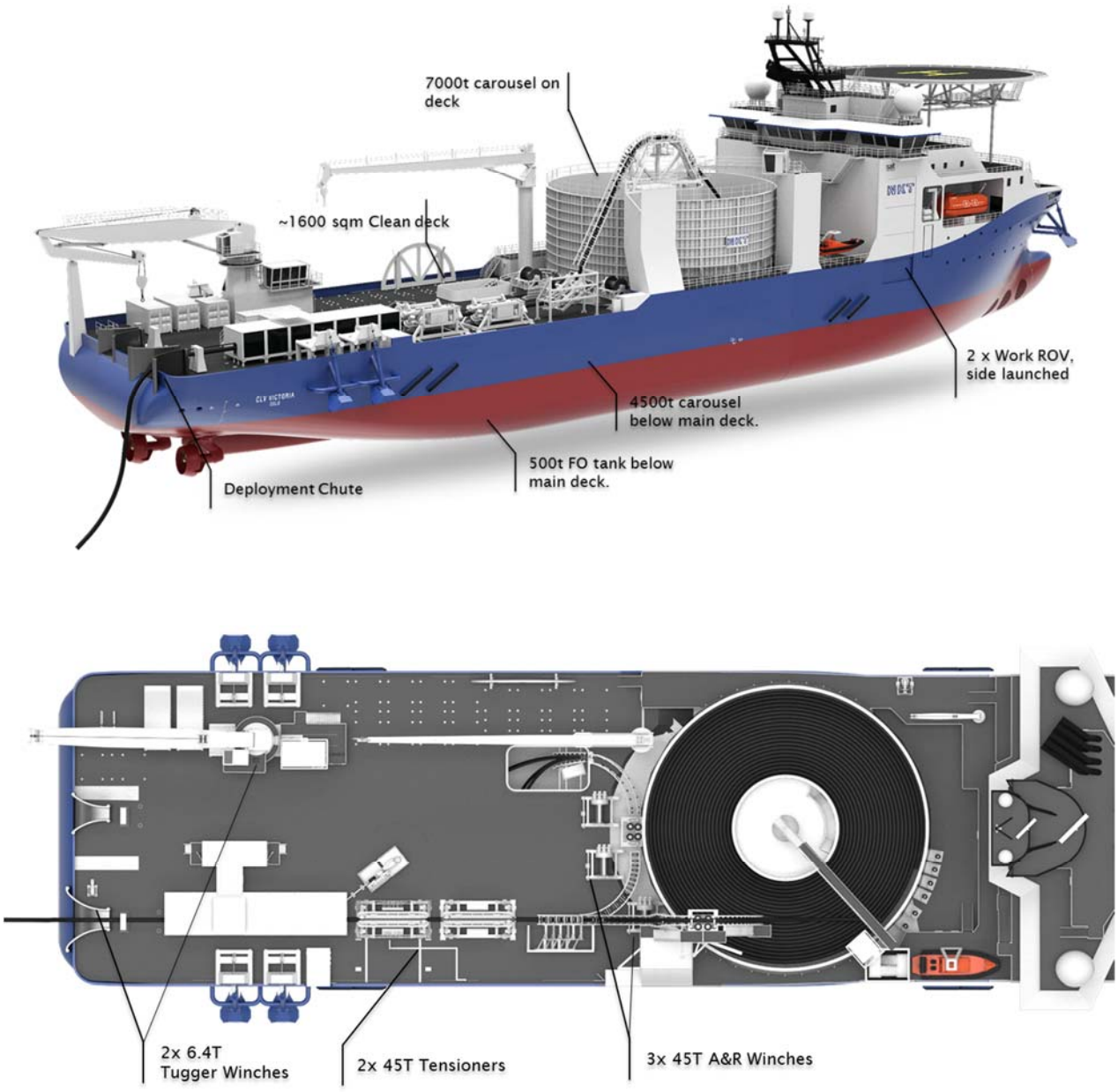


Figure 7-8 - Equipment setup NKT Victoria

7.6 Cable deburial

The cable deburial will be performed by EDT Hercules or similar vessel equipped with a Controlled Flow Excavator (CFE) or with a subsea dredge similar to that described in Section 4. The deburial vessel will uncover the cable at each end (KP11 and 16) of the existing plough backfilled section for sufficient distance to enable recovery. It is intended that the pre-cut ploughed and backfilled trench will not be excavated and thererefore it is expected that deburial will require only the removal of natural sediment backfill over a distance of approximately 150-200m at each location. Once the cable is exposed, the cable will be cut and sealed for subsequent jointing to the replacement section. The cut and seal could be done either by the deburial vessel or subsequently by the cable lay vessel.

7.7 Cable Recovery and Lay Procedure

Recovery of the cable ends, jointing and cable lay will be performed by NKT Victoria using her standard operating procedures. The sequence of work will be as follows:

- Cut of the cable bundle on seabed using the ROV, recovery to the vessel with the aid of ROV, and sealing of the cable ends. Cut and seal will be done at each end of the replacement section in turn. (alternatively this work might be done by the deburial vessel).
- Recovery of the cable bundle at the initiation end, and inline jointing on all 3 cables of the bundle to the replacement cable section onboard the CLV.
- Laying of the replacement cable section as a bundle.
- At the completion end, lay down the replacement cable in an ‘Omega’ configuration for jointing.
- Recovery of the previously cut cable bundle at the completion end, and jointing of the cable bundle onboard the CLV.
- Laydown of the jointed cable bundle at the completion end in an ‘Omega’ configuration. The Omega is expected to occupy an area of seabed approximately 350m x 30m.

7.8 Scrap Cable

On completion of the cable replacement, the previously installed, potentially damaged cable section KP11-16, including a prior repair at KP13 which has been inserted within the route corridor, alongside the main route, will be recovered. The CLV with the aid of ROV will recover the cable end to deck at one of the cut in positions. The damaged cable will be winched aboard the CLV using her cable tensioners to ‘peel’ the cable bundle from the seabed. Upon reaching the repair section the associated inline and Omega joints will also be recovered to the CLV using her cable winches and crane. The recovered cable will be taken to shore and scrapped / recycled in accordance with environmental requirements.

7.9 Jet Trenching

It is planned that the replacement cable section be buried by post lay jet trenching with a target cover depth of 0.6m. Typical resources for the work are described below:

7.9.1 Grand Canyon I / II / III

The Grand Canyon is a ST-259 CD design vessel, which is suited for the harshest offshore environments. The Grand Canyon was delivered in 2012 from Volstad, Norway, and is on long-term charter for COL. COL have committed to long-term charters (5 years) for 2 sister ships. The Grand Canyon II was delivered in April 2015 and the Grand Canyon III in May 2017. The Grand Canyon series of vessels are purpose built Offshore Construction / ROV / Survey vessel specially designed for operation under severe weather conditions with high manoeuvrability and station keeping capabilities.

Figure 7-9 – Grand Canyon 2 – Potential jet trenching support vessel

The vessel is equipped with:

- Dual redundant Dynamic Positioning system (AUTR/DP 3) making the Grand Canyon a highly technological vessel for advanced worldwide service;
- Available deck space of 1,650m2;
- Helicopter Platform (diameter approx. 26m) for Sikorsky S92 or equal;
- One passive anti rolling tank, Interring, combined heeling and anti-rolling system offering very comfortable conditions in severe weather;
- Under deck stiffening in key locations to accommodate lay carousels/reels;
- 1 x 250T AHC Offshore Crane with 3,000m of wire, 1 x 15T Auxiliary Crane starboard side and 1 x 2T Auxiliary Crane for provision handling; and,
- Air conditioned accommodation of the highest standard for a total of 104 persons. Vessel also includes mess room with self service area, 4 lounges, meeting rooms / offices on various decks, hospital, recreation area, laundries and cinema.

7.9.2 Jet Trencher – T1200

T1200 is configured for post lay burial of submarine cable products to a depth of burial of 3 meters in water depths of up to 3000m. The design of T1200 is based on the hugely successful T750 trencher and once delivered has become one of the most technically advanced trenching systems available in the global Oil and Gas/Renewable marketplace.

Figure 7-10 – T1200 – potential jet trenching ROV

The system will specialise in rapid post-lay burial of submarine installed products, in varying soil strengths up to 100kPa. The system comprises of:

- T1200 ROV trenching package (including all subsea sensors, survey and positioning equipment and spares);
- Launch and Recovery System (Sea State 5);
- A-frame;
- Umbilical Winch;
- 20ft Control Cabin;
- Associated Power Cabins;
- Associated Workshop/Spares Cabins.

7.9.3 Survey of jet trenched cable sections

A full survey / workclass ROV system will be mobilised to the trenching vessel from the subcontractor's fleet of workclass ROVs. For the purposes of performing the post-lay / pre-trench surveys, and the post-burial surveys, the ROV will be fitted with the following sensors and equipment: The ROV is expected to be either a Triton XLS or Schilling UHD system.

- Centre SIT camera;
- Centre colour zoom camera
- Obstacle avoidance sonar
- Dual Head Scanning Sonar (MBES)
- TSS 440 Pipetracker (with spare)
- North Seeking Gyro (Octans Gyro) (with spare)
- Pitch and Roll sensor
- Bathymetric Unit
- USBL responders

Triton XLX / Schilling UHD

Figure 7-11 – Potential Jet Trenching Survey ROV

7.9.4 Backfill of jet trenched cable

The primary backfill method for the jet trenched cable will be natural backfill. However, depending on the achieved Depth of Lowering, rock placement may be required. A description and estimate of the rock placement planned for of the jet trenched cable is described in Section 6.2.

8 Potential Cable Replacement KP 83-86 (If extensive damage identified during inspection process)

The cable section KP83-86, has been pre-cut ploughed and backfilled using the same equipment and techniques as the section KP11-16. It is planned to inspect section(s) of this cable identified as at high risk of damage using the methodology described in in Section 4. If

extensive damage is identified during the inspection(s), this section may also have to be replaced. The method of replacement will be the same as described for KP11-16, with the exception that there will be no prior repair to recover. An allowance for remedial rock placement in this section is included in Table 6.1.

REVISION

Rev. ind.	Chapt (C)	Description	Date/Dept/Name
-		First Issue	2018/07/24 Installation O.Landen
A	All	Updated as per SHET RRR	2018/07/26 Installation J. Hartley
B		amended reference errors	2018/07/27 C. Ternström

APPENDIX A Example equipment for Depth of Lowering / Depth of Cover Survey

EDT Kennedy

ROGE ROV

Pangeo Sub Bottom Imager / cable tracker

TSS440 / 350 cable trackers

RD8100 Diver Held cable tracker

Bibby Athena

EDT KENNEDY

DESIGN	DP II PLATFORM SUPPORT VESSEL (PSV)
OWNER	EDT KENNEDY AS
OPERATOR	EDT SHIPMANAGEMENT LTD
BUILT	2014, FUJIAN SOUTHEAST SHIPYARD
FLAG	CYPRUS
CALL SIGN	5BAJ4

GENERAL INFORMATION		
Classification	ABS,+A1, FFV1, OSR-C2, Offshore Support Vessel , SPS, Supply—HNLS, (E), + AMS, + ACCU, +DPS-2	
IMO Number	9671400	
MMSI Number	210779000	
Operation	World Wide	
Endurance	28 days plus	
Maximum Speed	About 13 knots	
DIMENSIONS		
Gross Tonnage	2948	
Net Tonnage	913	
Deadweight	3138.4t	
Length Overall	75.0m	
Breadth Moulded	17.25m	
Depth to Main Deck	8.0m	
Draft	6.5m	
Freeboard max draft	1.5m	
TANK CAPACITIES & DISCHARGE RATES		
Marine Diesel	765.7m³	2 pumps @ 150 m³ / hour each @ 80 m head
Fresh Water (water maker 2 x 10T/day)	546.4m³	1 pump @ 100 m³ / hour each @ 85 m head
Ballast / Drill Water	1521.3	1 pump @ 100 m³ / hour each @ 80 m head
Liquid Mud / Brine (MEG) (SG 2.8)	739.4m³	2 pumps @ 75 m³ / hour each @ 90 m head
Dry Bulk	226m^3 (4 tanks)	2 Air Compressors Capacity 20 m³ / hour @ 80 psi
Methanol	147.9m³	1 pumps @ 75 m³ / hour @ 90m head
Foam	12.7m^3	
Dispersant	12.7m^3	
Mud Agitators	*Hydraulic driven submerged agitators in mud tanks*	
DP SYSTEM		
DP System	Kongsberg K-POS	
Notation	DPS– 2	
Portable Joystick	Kongsberg C-Joy	
Reference systems	2 x DGPS 1 x Laser Beam reference system	
Gyros	3 x Anschutz 110 –233	
HiPAP	HIPAP 501	

DECK EQUIPMENT	
Deck Load	1200 t - 5.5 t/m^2
Deck Area	700 m2 Clear Deck (48.62x 14.4 m)
Deck crane	7.5t @ 10m
Tugger winch	2 x 10t
Capstan	2 x 10t
PROPULSION & MACHINERY	
Main Engines	2 x Nigata 8L28HX 2206 KW each
Main propellers	2 x Nigata ZP-41 Azimuth Thrusters 2206 KW each
Auxiliary Generators	3 x 450 kW Caterpillar C18 plus 2 Shaft Generators 1000 kw each
Emergency Generator	1 x 80 kW Caterpillar C6.4
Bow Thrusters	2 x 600 kW Kawasaki KT 88B3 CPP Electric driven
NAVIGATION	
Radars	1 x X Band Furuno RSB-096 1 x S Band Furuno RSB-098
AIS	Furuno FA-150
Gyro Compass	3 x Anschutz 110 –233
Auto Pilot	Anschutz
Echosounder	Furuno FE-700
Speed Log	Furuno DS 80
FIRE FIGHTING EQUIPMENT	
Fi-Fi Class	ABS Fi-Fi Class 1
Pumps	2 x 1790 m^3/hour
Monitors	2 X 1200 m^3/hour
Dispersant System	2 x 6 m Spray booms
ACCOMMODATION	
Total Accommodation	48 bunks
Other Facilities	Hospital Room
	Fully Air Conditioned
COMMUNICATION	
Primary	Fleet BB
Secondary	Iridium Open Port
GMDSS	As Per GMDSS A1, A2 and A3

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& Aviation LTD

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Hove, Sussex, BN41 1WR
Phone: 01273 248800
Fax: 01273 248700
E-Mail: paul@atlantic-marine.co.uk
Web: www.atlantic-marine.co.uk

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E.xcavator

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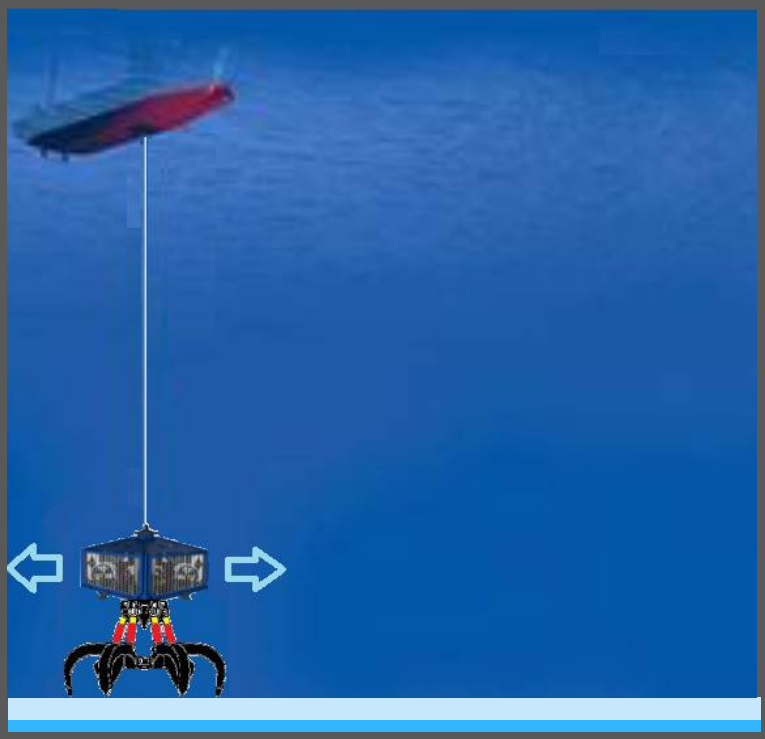
- **Deep water Geotechnical**
- **Mattress Lay**
- **Seabed Clearance**
- **Boulders / UXO removal**
- **Subsea Salvage**



ROGE WROV

Rev. 04.07.2016

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OFFSHORE R.O.G.E. WROV

Subsea Solutions

Overview

For over 25 years, Atlantic Marine & Aviation LLP have provided specialist offshore vessels for charter for offshore survey, route clearance, inspection and construction support roles. Specialist in subsea and surface diving, cables and installation support roles, with experience in offshore supply and subsea operations and specialists in subsea boulder removal.

Atlantic Marine and ROGE Systems Ltd operate from the Atlantic Marine North Sea Operations base alongside the river in Great Yarmouth. Atlantic Marine are owners and operators of a fleet of offshore vessels and ROGE systems operate the largest rental fleet of ROGE WROV systems currently available worldwide. This ability to offer a combination of vessel hire and ROGE WROV hire from within a fleet of vessels and subsea ROGE units, from the same company, is unique in the market. We offer the ability to support the systems and vessels with the ability to pull on a fleet of units in case of any need to increase production or replacement.

The ROGE ROV system is based around the ROV technology combined with subsea hydraulic power pack and a heavy duty galvanized steel frame capable of the toughest subsea jobs. The ROGE ROV is subsea hydraulic tool platform that is designed to transfer the 20T lift capacity of the umbilical winch through to the chosen tool fitted to the ROGE ROV such as a subsea Grab or cutter. The lift capacity far exceeds that of a Work Class ROV but gives greater control and manoeuvrability than utilising a vessel crane and a Work Class ROV combination.

The ROGE ROV

The ROGE ROV performs many of the tasks that a Work Class ROV can perform including as- found and as-left site surveys which can be achieved in concurrently with the tooling work-scope. The ROGE ROV system is supplied fully mobilized as a complete spread onto an Atlantic Marine fleet vessel and can be included within the charter party agreement, thereby de-risking a separate charter and equipment hire set up. i.e. if the ROGE ROV system is not operational for any reason, the ship can also be taken off hire and so reduces the risk for the contractor.

The ROGE ROV can be deployed by crane with a separate umbilical OR on a steel wire anti-rotation main lift umbilical, providing the lifting capabilities, power and fibre optic supplies to the ROGE ROV. Depending on which of the fleet of ROGE ROV's is used, we also offer the option of heave compensation via the hydraulically operated winches which have tension control reducing the effect of vessel heave and roll on the ROGE ROV by hauling in and paying out on the umbilical line as the vessel heaves.

The ROGE ROV is hangs vertically by the umbilical or crane wire and the four vectored thrusters manoeuvre it subsea or hold it's heading like an WROV. The vertical movement is also controlled by the joystick and surface winch, so the effect of the thrusters and the winch combined is virtually identical to a free flying ROV. Vessel DP positioning and position moves combined with the ROGE ROV thrusters provide cm accuracy of positioning for both the ROGE ROV sensors and of the associated tooling at the subsea location.

The ROGE ROV provides interchangeable subsea tools from its on-board hydraulic power supply. This range of tooling permits multiple tasks within subsea projects to all be carried out from the single vessel and system, and removes the requirement for multiple mobilisations, ROV or diver intervention.

The ROGE ROV tooling

The ROGE ROV system is a multi-functional subsea power pack and ROV, which can perform multiple subsea tasks from a single unit through use of interchangeable hydraulic, tooling, survey electronics and subsea sensors. This is a tough diver-less system which is a revelation in subsea capabilities all in one package

Atlantic Marine Fleet - 30 years of Marine experience

Since 1985 (over 30 years), Atlantic Marine (AM) has owned and operated a total of 46 ships and vessels from the UK into North Sea and Atlantic waters. AM are a fleet owner and operator, providing a "one stop shop" of vessel management including crewing, technical management and also sub-charter of suitable vessels from third parties to include audit and charter management. At the time of this proposal, the fleet includes 6 ships.

- Walk to Work vessels
- Offshore Accommodation
- Subsea CABLE LAY and Installation
- PLGR (Pre Lay Route Clearance)
- Cable route survey (Geotechnical/Geophysical)
- Personnel transfer
- Guard-ship and safety standby
- SUBSEA survey and ROV

Atlantic Marine's ship MV Bremen (1999-2003)

Atlantic Enterprise

Atlantic Tonjer

Track History

Offshore Wind subsea and ROGE WROV boulder/subsea projects 2010-2016:

Yr. WIND FARM	ROLE	Client	Vessel	*Boulder No.
• 2010 Sheringham Shoal	PLGR Route clearance	Statoil/Red 7	Guardian	
• 2013 Humber Gateway:	Boulder removal	EON Renewables	Explorer	>8,500
• 2013 Humber Gateway:	Inter array cable lay	EON Renewables	Carrier	
• 2011 London Array:	Offshore Trenching / Diving	London Array	Surveyor	
• 2012 Westernmost Rough	Boulder and UXO removal & Survey	VBMS	Explorer	>3,700
• 2013 Baltic 2	Subsea cables ROV inspection	Alstom	Surveyor	
• 2012 Rampion	Subsea Geotechnical	Fugro	Surveyor	
• 2013 St Nazaire	Subsea Geotechnical Survey	Fugro	Surveyor	
• 2015 S.North Sea	Pipeline inspection with ROGE	Pangeo Subsea	Explorer	>20 klms
• 2015 Western Aldegrund	Boulder/UXO removal	Prysmian/OMM	Tonjer	>5,900
• 2015 Race Bank	Boulder/UXO removal	DONG Energy	Explorer	>3,200
• 2016 Rampion	Boulder / UXO removals	EON	Explorer	>2,600
• 2016 Western Aldegrund	Boulder/UXO removal	Prysmian/OMM	Carrier	>1,400
• 2016 Race Bank	Boulder/UXO removal	DONG Energy	Carrier	>800
• 2016 RB export route	ROV Survey of cable trench & UXO	DONG Energy	Carrier	>12 klms

Total subsea Boulder removal 2013/16 = 26,200*

*approximate number of boulder and UXO targets removed 2013-2016

Unique market experience and track history.

Certification & Approvals

IACS class members, DNV and RINA, approve Atlantic Marine vessels and management systems. Atlantic Marine is an ISM certified company holding two ISM DOC's (Document of Compliance) from both Panama and Liberia international (white) flag authorities, and is authorised to operated full service ship management ISM and ISPS systems on board and ashore. AMcarries out independent and regular audits on board all vessels, and operates and IMCA compliant ISM/HSE internal policy. AM and complies with all international IMO/ISM requirements. AM carries and applies UK approved HSE and D&A policy documents. IMCA audits and MCA inspection reports are available for individual ships. All vessels are compliant to UK MCA and international requirements and operate from UK ports with all Western/European crew.

ROGE WROV SYSTEM

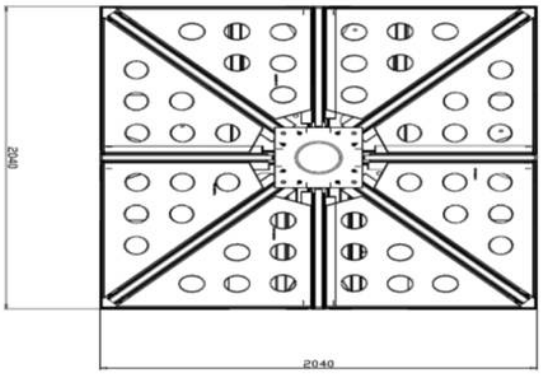
Photos – in operation

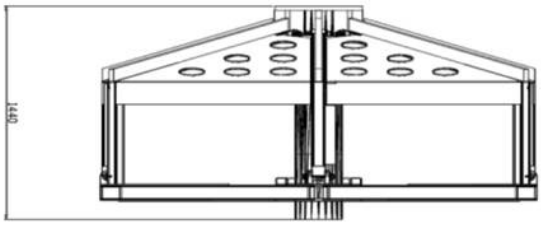
ROGE ROV THRUSTER HEAD UNIT

ROGE 1 / 2 Generic information

Model ROGE 1 / 2

Size / Weight 2040mm x 2040mm x 1440mm, 3 ½ Ton with the Grab attached, 2 Ton when not fitted





Depth Rating Max depth is rated to approx. 4000m but determined by winch and umbilical, ROGE 1 currently approx. 2000m ROGE 2 approx. 250m

Max Lift Approx. 20 Ton dependant on the umbilical, tooling and application

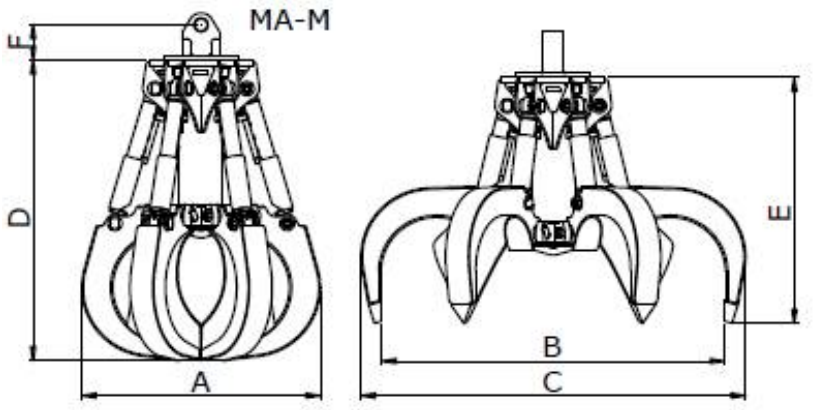
Camera Optional camera fitment is dependant on tasking e.g.1 x Tritech Typhoon colour cameras, 2 x Tornado B&W low light camera

Thrusters 4 x horizontal Sub Atlantic SA380 thrusters

Sonar Blueview P900

Lights 4 x Rovtech Seabeam dimmable 3 pin 110v lights

Control	Field proven Tritech control system
Power Requirements	**ROGE 1**:2000v supplied by umbilical and stepped down to 110v and 440v 3 phase by subsea transformer **ROGE 2** 440v supplied by umbilical
HPU Output	Producing a pressure of approx. 220bar – flow rate of 60 Ltrs per minute 4000 meter
Grab	1000 ltr capacity 6 tyne grab measuring 2.5m open (B) (see pic 1) and 1.7m fully closed (A) (see pic 2) Other tooling options are available upon request



ROGE ROV TOPSIDE CONTROL – *(upgraded August 2016)*

Heading, pitch & roll

Depth (pressure and umbilical line out)

Altitude (above seabed)

Subsea position – USBL System (optional extra)

Up to 4 x visual cameras (additional can be supplied if required)

Blueview acoustic Imaging Sonar (Multibeam option)

Various sensors to monitor the performance and health of the ROGE ROV

Intelligent Valve Pack (IVP)

Joystick control

VESSEL FLEET & ROGE ROV Utilisation:

Atlantic Marine and ROGE Systems ltd operate a fleet of three complete ROGE WROV spreads.

ROGE 1 is permanently installed on board the Atlantic Explorer. ROGE 2 and ROGE 3 are portable / containerised systems, capable of launch from any offshore vessel equipped with a large crane and moon pool (or over side crane 30T+), including Atlantic Marine's fleet vessels Atlantic Carrier or Atlantic Tonjer:

Primary Roles

- Subsea boulder removal
- Subsea wreck and debris salvage
- UXO survey and removal
- Trenching and seabed preparation works
- ROV survey (pipelines / cable)
- Rock bag placement or recover
- Mattress protection lay or recovery
- Soil and seabed sampling
- Seabed excavations
- Deep ocean survey and recovery missions

Using a ROGE2 WROV to pick up and move ROGE1

Operating Parameters – Fleet Options

Operating parameters for vessel + ROGE ROV spread are detailed below:

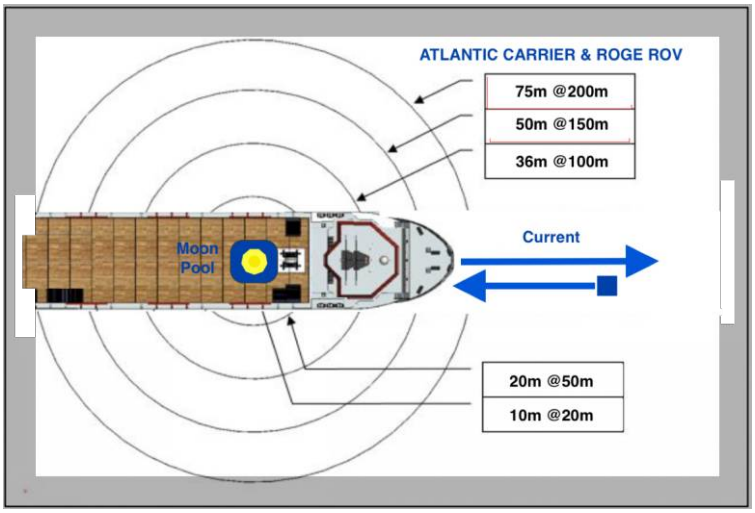
Operating and Recovery Limits			
	Wave Height (Hs)	**Wind limit: Knots**	**Current: Knots**
Atlantic Carrier	2-2.5	25	2.5
Atlantic Explorer	2	25	2
Atlantic Tonjer	2-2.5	30	2.5
Note: Vessel limits are for operating in DP with the ROGE ROV system			

Wave Height: The ROGE operates in up to Hs 2.5m. (this maybe reduced to Hs 2M when several environment factors combine).

Currents: The ROGE ROV operates in currents up to 3 knots as current has a reduced effect upon the ROGE ROV due to the supporting vertical tether (umbilical) and the weight of the unit (around 4.5 tons) which even in strong currents, will push the ROGE ROV away from the vertical but does not hinder the tooling and survey operations subsea in the same way as a free flying ROV.

Depth: Depending on which of the fleet of ROGE ROV systems is used, we can offer depth ratings down to 4,000 meters but also offer a shallow water reduced power system for use on small inshore vessels for shallow coastal or estuary operations.

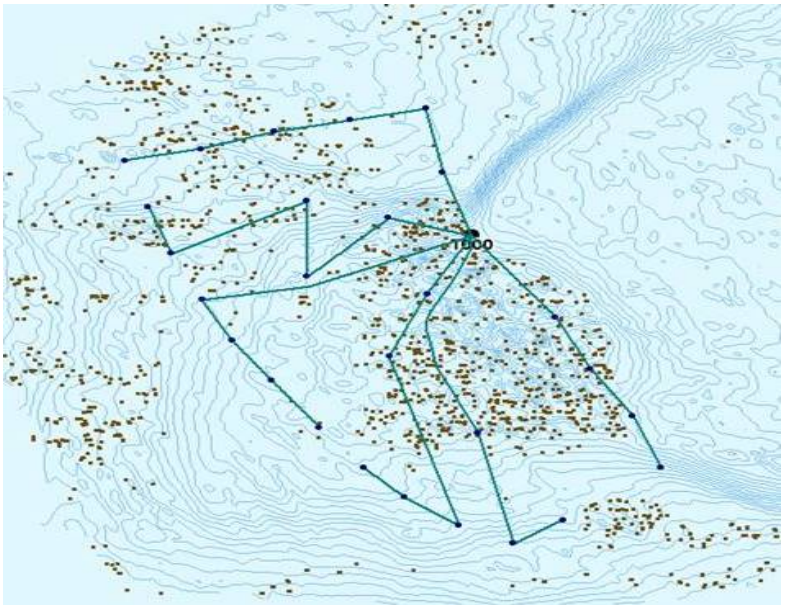
Excursion: This is a circle around the vertical umbilical, which forms the center of the circle,. The diameter of the working circle of excursion is a function of the depth and thruster power. The lateral excursion is then extended easily outside the working circle of thruster excursion by simply moving the vessel above using the DP (dynamic positioning). This allows the ROGE ROV to work around a single location using thrusters (see diagram below) OR to move off along a track for route, cable or pipeline surveys or operations.



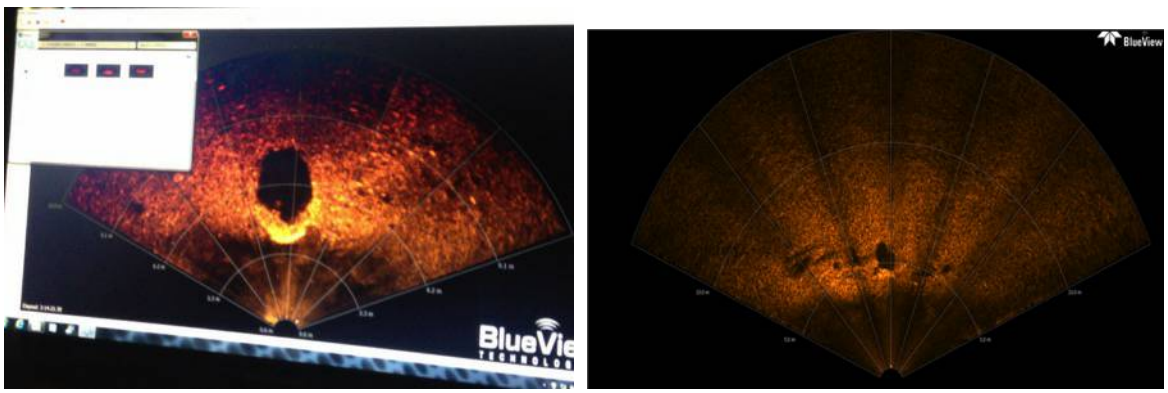
USE 1. BOULDER GRAB REMOVALS / UXO and BOULDER SURVEY

Target removal – Methodology

Subject to client specific procedure for the removal of boulders, debris or lost assets. Below is an example of the system directed by a number of our clients:



- Surveyor gives target location to bridge and ship moves to location
- Arrive at location and Deploy ROGE WROV
- Surveyor gives approximate heading and range to target
- ROGE deploys blueview SONAR using hydraulic action arm, surveys the area and locates target (if no target found a north, south, east, west blueview screenshot is taken and vessel moves on to next target).

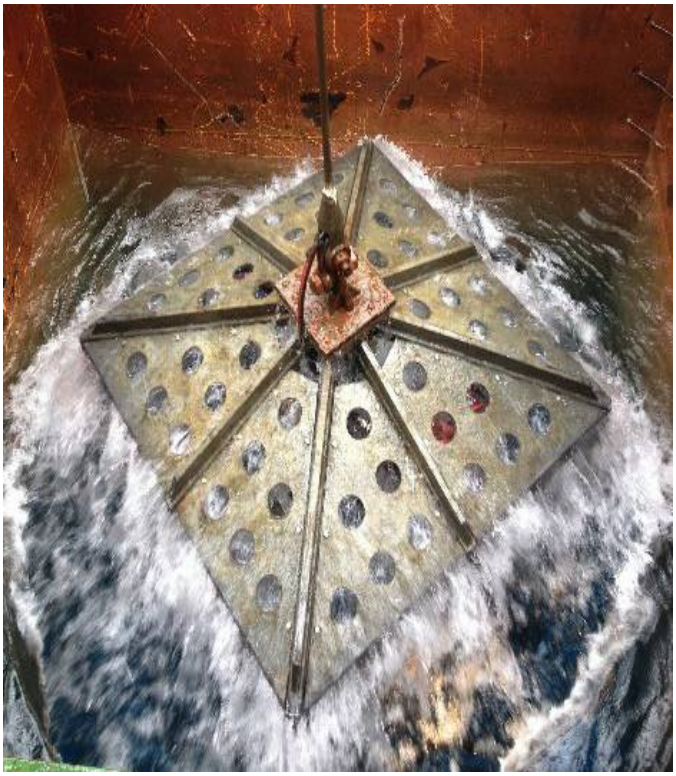


Boulders located on sonar

- ROGE pilot takes an “as found” picture of target
- ROGE gives heading and distance to bridge
- ROGE pilot tracks boulder, and passes vessels movement to bridge until ready to make a grab
- ROGE pilot grabs boulder and raises off the sea bed, co-ordinates are logged as well as approx. size and weight (from load cell). (max 15 tons)
- ROGE / vessel moves approx. 2-5 meters and swings round taking an as left screen shot (proof of pickup)
- Surveyor gives dump coordinates to bridge and vessel moves to that location
- ROGE takes a “pre-Dump” picture
- ROGE releases boulder
- ROGE takes a “post dump picture”
- Process is repeated

The above example can be shortened if this level of evidence is not required.


Boulder removal


WROV ROGE Moon Pool recovery

Example of dive log (showing 5 targets picked up):

		Time	Location	Photo	Remarks
1	Vessel Move	10:11			**RPL281-0824F**
	As Found	10:15	E423606.62 N6018172.01	2016-05-31-10-15-24	Photo of target on approach
	As Left	10:18		2016-05-31-10-18-42	photo of target after pickup
	As Dropped	10:27	E423620.08 N6018170.59	2016-05-31-10-27-29	photo of dump location
2	Vessel Move	10:27			**RPL281-0824G**
	As Found	10:41	E423607.42 N6018173.05	2016-05-31-10-41-19	Photo of target on approach
	As Left	10:49		2016-05-31-10-49-50	photo of target after pickup
	As Dropped	10:50	E423620.28 N6018170.94	2016-05-31-10-50-26	photo of dump location
3	Vessel Move	10:50			**RPL281-0824H**
	As Found	10:58	E423608.62 N6018170.40	2016-05-31-10-58-25	Photo of target on approach
	As Left	11:04		2016-05-31-11-04-44	photo of target after pickup
	As Dropped	11:06	E423620.18 N6018170.85	2016-05-31-11-06-37	photo of dump location
4	Vessel Move	11:06			**RPL281-0824I**
	As Found	11:14	E423609.87 N6018171.29	2016-05-31-11-14-24	Photo of target on approach
	As Left	11:16		2016-05-31-11-16-55	photo of target after pickup
	As Dropped	11:24	E423620.26 N6018170.94	2016-05-31-11-24-53	photo of dump location
5	Vessel Move	11:24			**RPL281-0824J**
	As Found	11:32	E423606.78 N6018171.01	2016-05-31-11-32-41	Photo of target on approach
	As Left	11:35		2016-05-31-11-35-52	photo of target after pickup
	As Dropped	11:44	E423619.98 N6018171.08	2016-05-31-11-44-30	photo of dump location

Time scope & Production

These values are approximate and are determined by a number of different factors. The above log illustrates that

- Location of boulder 5 min
- Vessel move and pick up of target 5 min
- Vessel transit, usually 15 meters per second. so 90 meters in 6 min
- Drop off of boulder 1 min

So on average with a 90 meter move the process would take 15 – 20 minutes for each Boulder.

Extract from ROGE daily spreadsheet (DONG project June 2016):

Date	ROGE state	ROGE Downtime (Due to fault)	Nature Of fault	ROGE Downtime (Not Fault Related)	Link to fault Report	Boulder Count
14th	SITE	0		2.5VM 8.5WOW		20
15th	SITE	0		1 (Maintenance)		77
16th	SITE	0		1.24 (Maintenance)		72
17th	SITE	0		1HR 4min (CTV) 37min (VM)		106
18th	SITE	0		3hr 15mins VM		90
19TH	SITE	0		46mins (Maintenance) 42minsWOW		55
20th	SITE	0		15hr 50mins WOW		14

Survey spread

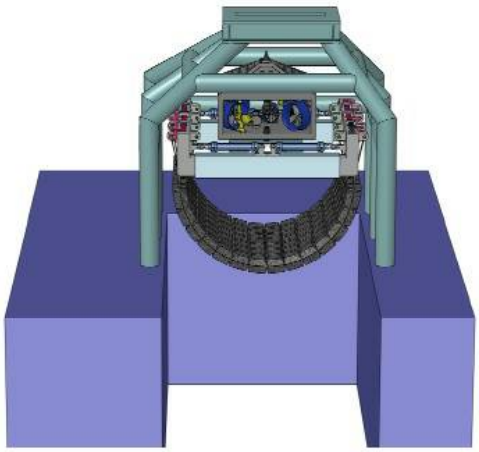
Atlantic Marine do not usually supply the survey equipment or personnel, the survey spread and manning have allocated spaces within the control cabin, plus fixed cabling and infrastructure.

Launch and recovery

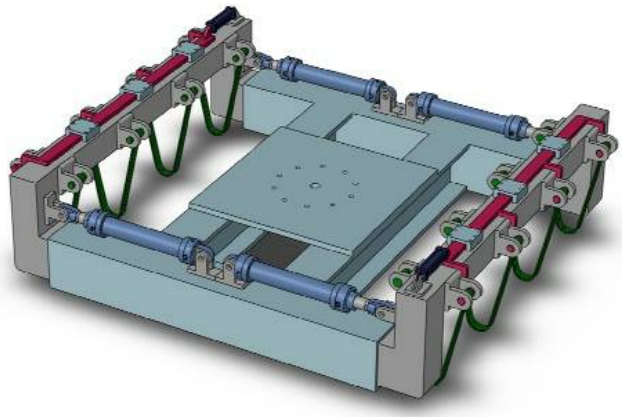
RGOE 1 is currently located on the Atlantic Explorer, and can only be launched and recovered through the moonpool. ROGE 2 is currently located on the Atlantic Carrier and also launched through the moonpool, but also has the option of working over the side.

USE 2. SUBSEA MATTRESS PROTECTION; POSITION AND LAY

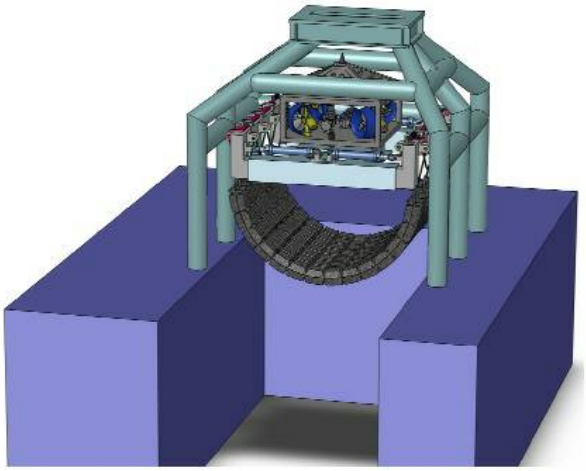
Pick up subsea mattress to position, lay or recover

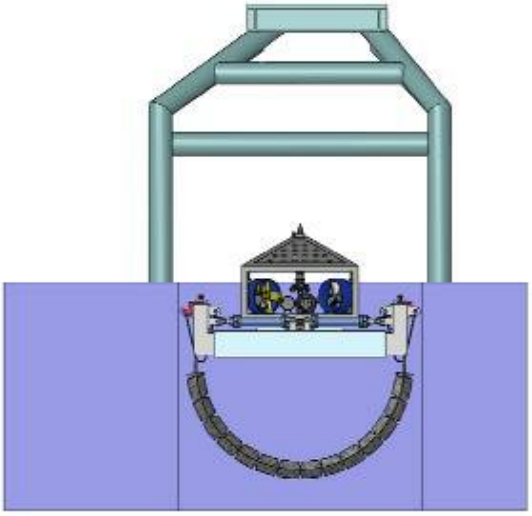


Mattress prepared above moon pool



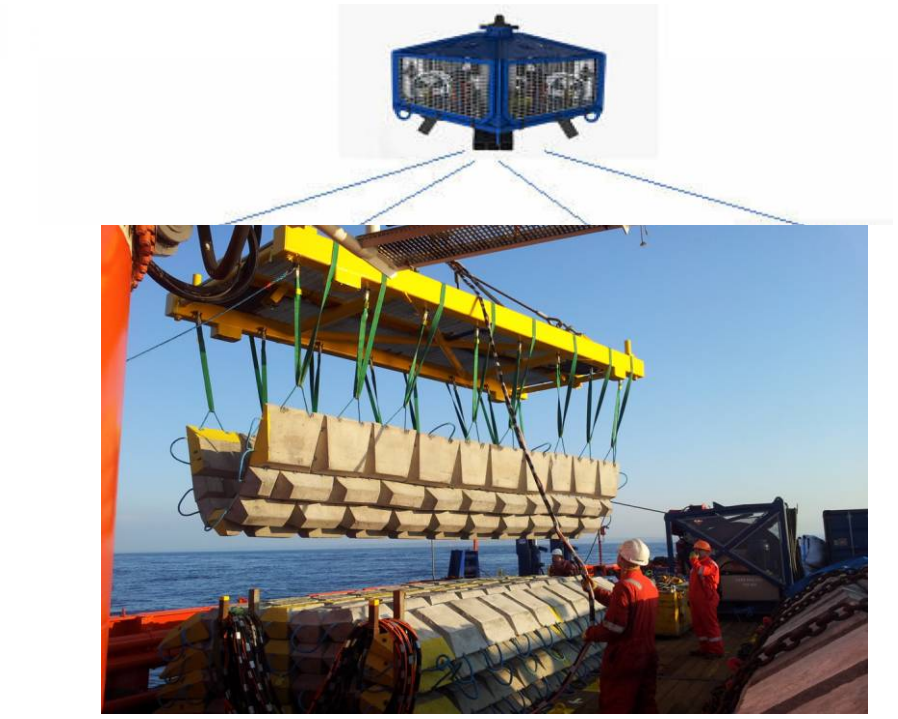
Mattress – hydraulic spreader





Deployed via moon pool

Use 2. (cont) SUBSEA MATTRESS LAY – OVERSIDE FRAME DEPLOYMENT

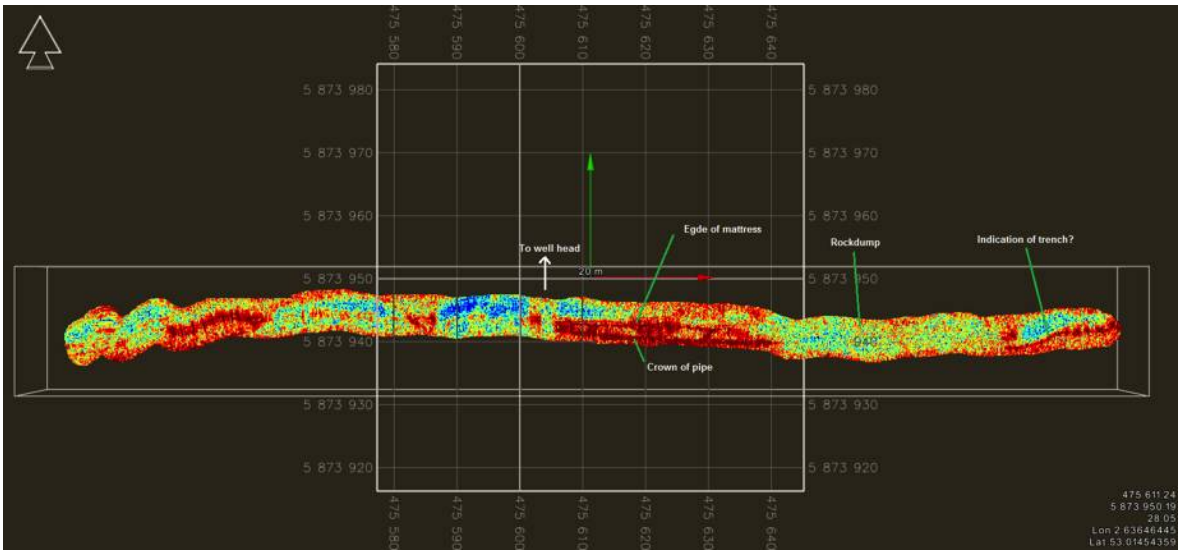


USE 3. SUB BOTTOM AND CABLE / PIPELINE ROUTE SURVEYS

This operation may use the following third party equipment:

- RESON MULTIBEAM SONAR (Seabat)
- PANGEO SUBSEA Sub Bottom Profiler
- Side Scan Sonar
- Blueview Sonar (Included)
- HD Video Cameras (Included)
-

Pangeo Sub bottom survey with ROGE



Data / results using Pangeo Sub bottom profiling system on ROGE WROV

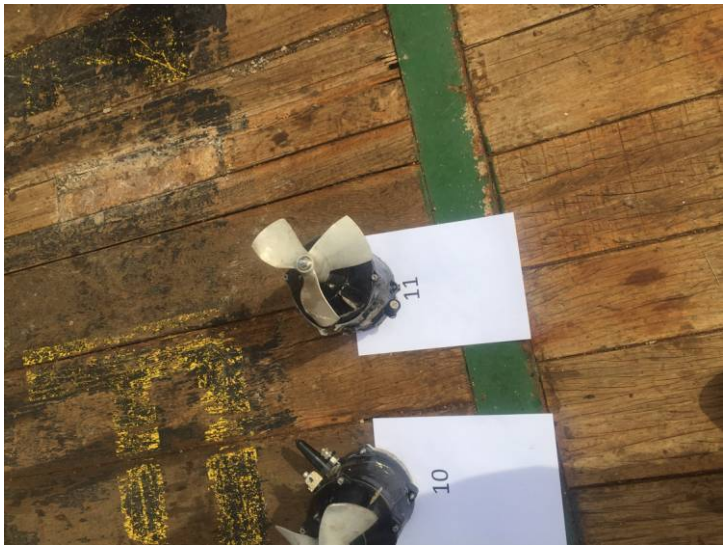
USE 4. SUB SEA MASS FLOW EXCAVATOR CONTROL HEAD

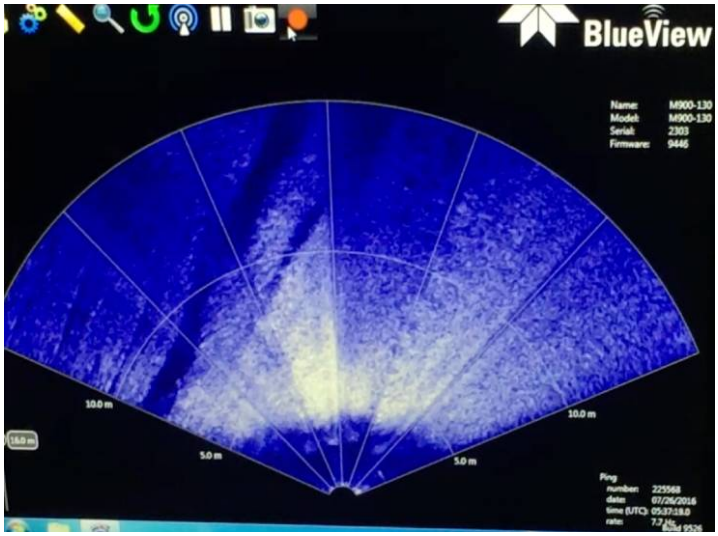
- Using the Atlantic Marine provided SEAVEX system, the ROGE WROV can be used to position and orientate the Mass Flow Excavator system accurately over subsea targets in order to expose them for removal or to trench in cables, pipelines etc, or also for scour and seabed manipulation:

Mass Flow Excavator System using ROGE WROV

USE 5. DEBRIS SALVAGE AND REMOVAL:

- In spring 2016, the Atlantic Carrier combiner with the ROGE ROV was tasked several times to locate and remove sub sea salvage and debris: The most accurate results occurred following in incident where an inspection class ROV had entered the propeller of another owners vessel. The ROGE ROV was tasked with locating the lost ROV components with cm accuracy using SONAR and HD cams, and was then tasked to use the GRAB excavator with high precision to remove the pieces from the seabed and recover them to deck.





Recovery of ROV Debris from the seabed in the Wash

ATLANTIC CARRIER with ROGE WROV

Quick specification

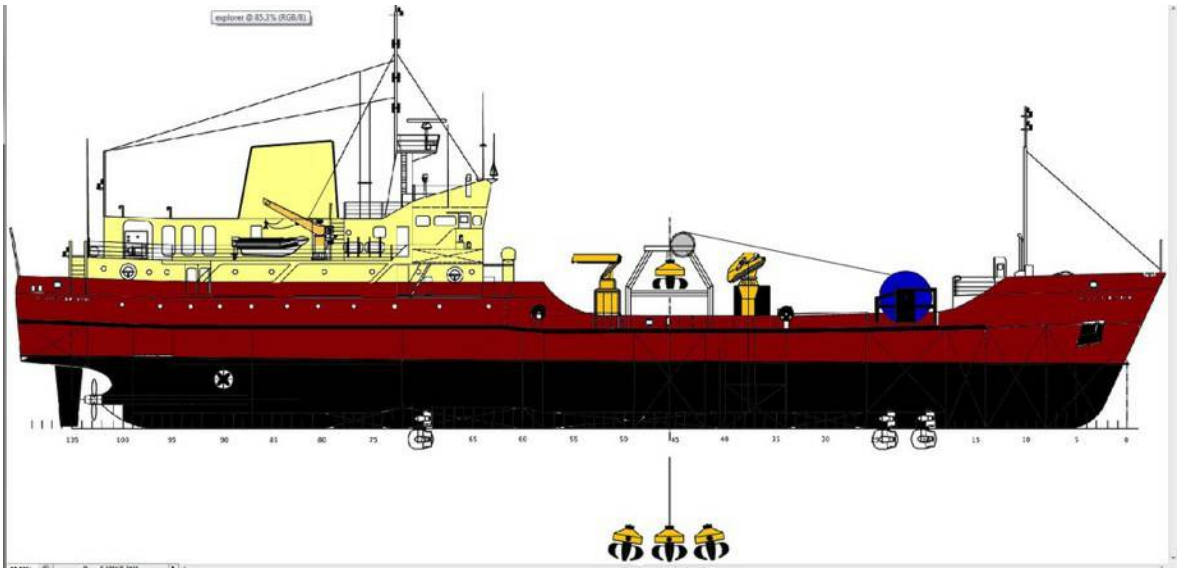
- **Ship: 82M LOA * 700 M2 deck * 1500 tons cargo.**
- **Only 7.5 tons/ day fuel consumption on DP operations**
- **Moon Pool: ROGE WROV operated via 3.2M x 3.2M Moon Pool**
- **Lift: ROGE WROV can lift 15 tons from seabed, excavate / move boulders or debris & pre/post survey**
- **Depth: 300m umbilical subsea high speed winch**
- **DP: Dynamically positioned DP2 (Kongsberg) + 6 point mooring system.**
- **4 x tunnel thrusters & two propellers with independent rudders**
- **Crane: 1 x 40 T/M crane for over-side or moon pool operations**
- **Gantry docking station for ROGE-ROV SUBSEA Deployment via Moon Pool**
- **ROGE INSPECTION: Blue View + SONAR+GAP USBL+CCTV+LIGHTS+VIDEO Link+FIBRE OPTICS**
- **ROGE TOOLS: Tone Grab + Clamshell Grab + Shear Grab + Mass Flow Excavator**
- **Water Depth Operations 10m to 150m.**

ATLANTIC EXPLORER with ROGE WROV

Offshore multi-role ship MV Atlantic Explorer: 71M offshore specialist recovery, subsea operations and survey vessel.

Atlantic Explorer can accommodate 16 to 18 clients in addition to her 12 marine crew. There are normally 5 persons in the ROV-ROGE operations team. There is a moon pool, with ROGE-ROV subsea system, and a large crane with 360 degree 15 Ton SWL over-side launch and recovery capability. There is a high degree of fuel economy with her ability to operate her two main engines or only on her three azimuth thrusters and single tunnel thrusters when operating in DP mode (depending on duties).

The two ships Holds can accommodate up to 300 tons of salvage cargo, boulders or subsea equipment.



ATLANTIC EXPLORER (cont)

Quick specification

- **Ship: 71M LOA - DP system installed**
- **Only 2.5 tons/ day fuel consumption on DP operations**
- **ROGE ROV can lift 15 tons from seabed, excavate / move boulders or debris & survey**
- **4000m umbilical subsea high speed winch – 25 tons lift – twin hydraulic drives**
- **Dynamically positioned DP1 – Nautronix NM6000 DP (not classed)**
- **3 x 360 degree azimuth thrusters & one x tunnel thrust with independent power source and control system, designed to provide 100% redundancy for close quarters offshore "zone" operations.**
- **1 x 68 T/M crane for over-side operations**
- **20/25Ton Gantry for ROGE-ROV SUBSEA Deployment via 4.2M x 4.5M Moon Pool**
- **ROGE INSPECTION: Blue View + SONAR+GAP USBL+CCTV+LIGHTS+VIDEO Link+FIBRE OPTICS**
- **ROGE TOOLS: Tone Grab + Clamshell Grab + Shear Grab + Mass Flow Excavator**
- **Water Depth Operations 10m to 4000m.**

Atlantic Explorer - multi-purpose support

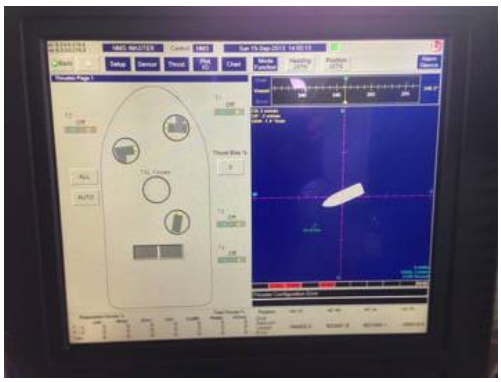
Dynamic Positioning

ROV-ROGE Control room

Close Proximity operations

ROGE W.ROV with GRAB

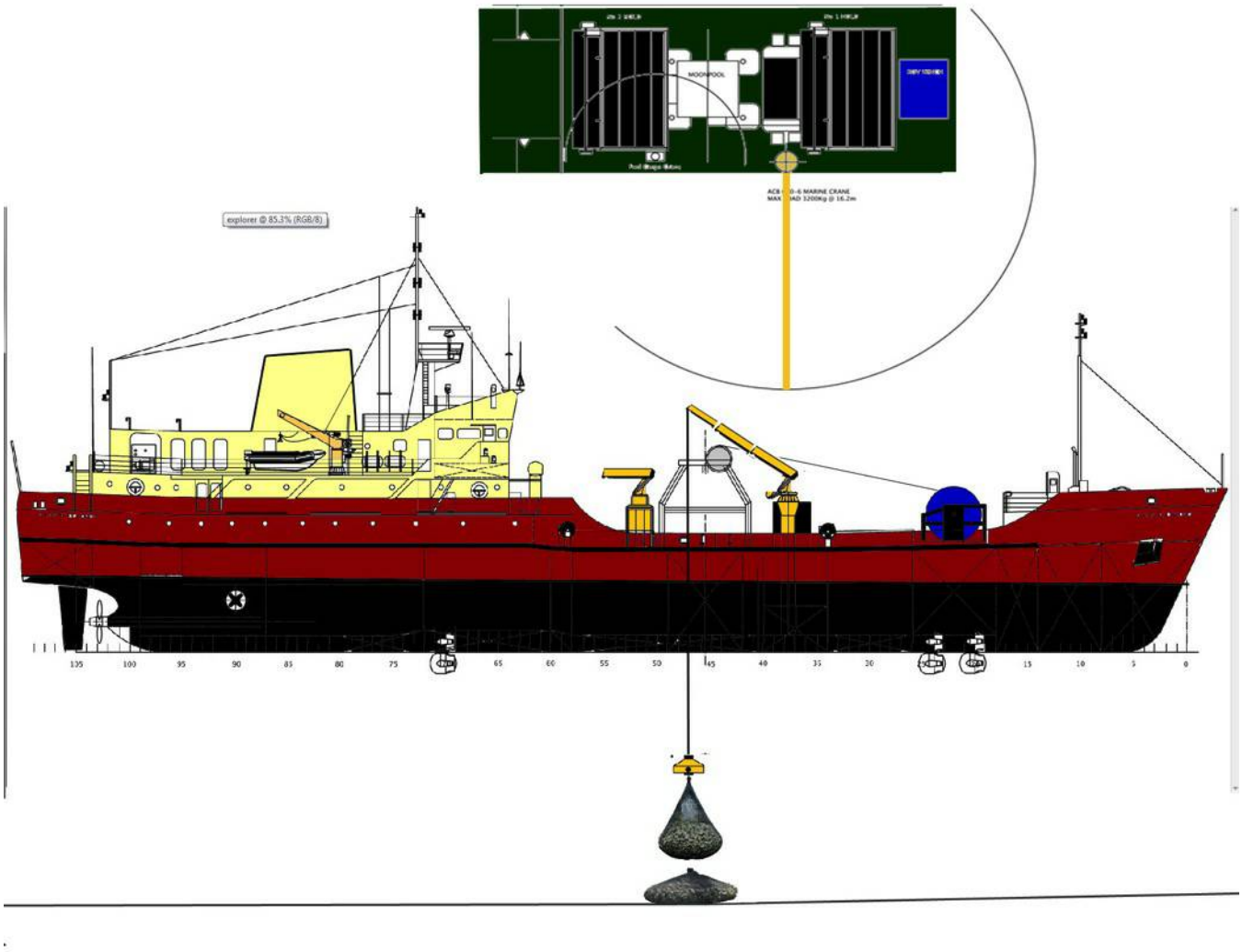
ROGE W.ROV Telemetry



Nautronix DP System

OVERSIDE ROCK BAG DEPLOYMENT & PLACEMENT

ROGE ROV over the ship's side by crane and accurately placed using the ROGE W.ROV



ROGE-ROV EQUIPMENT HIRE TERMS

- SYSTEM provided by ROGE SYSTEMS LIMITED in association with Atlantic Marine & Aviation LLP
- ROGE-ROV 5 man operational Team (4 pilots + 1 supervisor)
- 22 hour operations PD + 2 hours per 24 hour cumulative allowance for repairs and maintenance
- Breakdown:
  - ROGE breakdown: 50% of vessel hire remains payable up to 48 hrs.
  - Vessel breakdown: 50% of ROGE hire remains payable up to 48 hrs
- Operational limits - Maximum 2M Sig Wave + 2 knots current
- Knock for Knock liability on all equipment
- Seabed operations and Crown license liability/responsibility for charterers only
- Charterers to indemnify and hold harmless Ocean Force and Atlantic Marine in event of subsea accident, claim, legal proceedings from fisheries groups or local/national authority in respect seabed destruction or disturbance.
- Weather time that cannot be worked at sea shall entitle the ship to return to port in order to facilitate equipment repairs and maintenance.
- All port calls or transfers to/from the vessel at sea for parts and service provision, crew changes, personnel transfer and reporting / HSE audits, including port call costs during ROGE breakdown, to charterers account.
- Other terms and conditions subject to contract.
- BIMCO STANDARD ROV CONTRACT CONDITIONS APPLY

VESSEL CHARTER

- Vessel charter subject to Atlantic Marine standard terms and conditions
- BIMCO Supplytime 2005 charter party

Client reviews

WESTERNMOST ROUGH OFFSHORE WINDFARM: BOULDER REMOUVAL OPERATIONS. Summer 2014:

"Please accept the following as a true statement of facts Atlantic Explorer on WMR Wind Farm.

DONG Energy WMR are pleased to acknowledge that the boulder clearance vessel "Atlantic Explorer" and associated ROGE WROV system which was contracted by DONG Energy WMR to performed boulder clearance works offshore WMR Wind Farm, between June and Sept 2014. The vessel "Atlantic Explorer performed all associated task in the removal of boulders too the complete satisfaction of DONG Energy WMR.

The vessel "Atlantic Explorer and the crew performed all tasks with excellent leadership from the onboard master and the management team based onshore, a prime example was the ability to continue working in very strong currents and sea state above 2 meters, with little or no down time due to current or weather.

The vessels station keeping was demonstrated with close proximity workings around the WMR Foundations and within close proximity to subsea cables. The ROGE ROV system with subsea Grab removed a total of 1659 boulders and targets from the Westermost Rough Wind Farm, quickly and efficiently.

DONG Energy WMR was very pleased to say the least with the service provided by Atlantic Marine, and would not hesitate to use the system again for seabed clearance should the need arise.

I would personally like to thank Paul and everyone at Atlantic Marine for a job excellently executed with little or no fuss, whilst maintaining a complete professional approach to offshore subsea operations"

PM Offshore Installation
WMRI Management
DONG Energy

offshore marine management

BOULDER REMOVAL OPERATIONS – WEST ADLERGRUND CLUSTER

OMM REF: OMP150274

Atlantic Marine and Aviation LLP
Maritime House
Brighton
BN41 1WR

For the attention of: Mr. P Crowther

Ref: Atlantic Carrier Testimonial
Date: 12/07/2016

Offshore Marine Management (OMM) are pleased to acknowledge that the boulder clearance vessel "Atlantic Carrier" and associated ROGE WROV system, which was contracted by OMM to perform boulder clearance works on the West Adlergrund Windfarm Cluster in the German Baltic Sea, has successfully completed operations. The overall project ran between November 2015 and June 2016 and the Atlantic Carrier performed all associated task in the removal of boulders to the complete satisfaction of OMM.

The Atlantic Carrier and the crew performed all tasks with excellent leadership from the on-board master and the management team based onshore, with excellent communications between all parties ensuring that the project was a success. Throughout the project the vessel utilisation was around the 90% mark (inclusive of weather downtime) and the boulder removal rate averaged in excess of 55 boulders per day for the project, frequently operating as high as 85 boulders depending upon boulder concentration.

The vessels station keeping was demonstrated with excellent control within tight working corridors, allowing the ROGE ROV system with subsea Grab to remove in excess of 6000+ boulders and targets from the cable routes, quickly and efficiently.

OMM are very satisfied with the service provided by Atlantic Marine, and would not hesitate to use the system again for seabed clearance. I would personally like to thank Paul and the team at Atlantic Marine for a job excellently executed with a positive attitude, whilst maintaining a complete professional approach to offshore subsea operations

Best regards,

Rob Grimmond
Chief Executive Officer

Sept 2013: LONDON ARRAY - DIVING AND TRENCHING OPERATIONS SUPPORT: ATLANTIC GUARDIAN

"Herewith I like to thank all for a job well done on a very challenging work site with strong currents and areas that fall dry.

The key to the success of this project has been the dedication and commitment of all whom have worked hard in ensuring that the project has been completed safely and to a very high standard."

Project Manager
VSMC

RACE BANK OFFSHORE WINDFARM: BOULDER REMOUVAL OPERATIONS. WINTER/SPRING 2016:

I am the PM for Race Bank and have had Atlantic Marine vessels on hire for the boulder removal works over the past 4 months. Atlantic Marine record with Race Bank is exceptional with over 55,000 man hours worked on project without any HSE issues, I also had your vessels on WMR and again I can say your vessels and crews were excellent and extremly professional.

Regards
PM ROW Installation

HUMBER GATEWAY OFFSHORE WINFARM 2014/15: CABLE LAY OPERATIONS

"In my opinion Atlantic Carrier's vessel and shore based men have done fine work and can compare themselves favourably to any cable pulling vessel we have had on this site. Taking account of the fact that the competition on this site included well experienced cable contractors SIEM, VSMC and well experienced subsea/trenching contractor Fugro, it is an achievement of note.

Starting a cable laying entity from scratch is a tall order, having the forbearance to stick with the trials and tribulations as it develops from nothing to a cable laying machine requires quality men and machines and the Atlantic Carrier team has delivered".

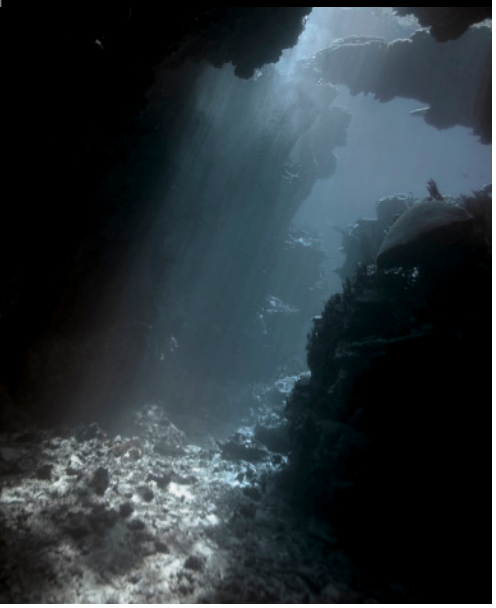
EON Construction Manager
Humber Gateway

Atlantic Carrier in DP Cable Lay Operations – Humber Gateway OWF 2014

pangeosubsea
sounding out risk

Sub-Bottom Imager Dolphin™ (SBI™)

The evolution of sub-seabed cable and pipeline imaging



The SBI Dolphin™ for light work class ROV's uses advanced acoustics to provide a real-time view of the sub-seabed in full 3D in a continuous longitudinal path 4m wide by 3m depth of seabed penetration. The SBI Dolphin™ integrates with industry standard EIVA survey software to delineate linear features, significant discrete objects, and geohazards with decimeter resolution. The SBI Dolphin™ can be operated from a surface vessel for shallow water, or from a light work class ROV (e.g. Panther XT Plus, SAAB Leopard) for deep water.

Applications and Capabilities

Engineering and Decommissioning Surveys

• Identification of man-made objects and items buried along survey route

Integrity Surveys

• Accurate detection burial depth variation along pipeline/cable indicating areas requiring potential remedial action

As-Laid/As-Built Surveys

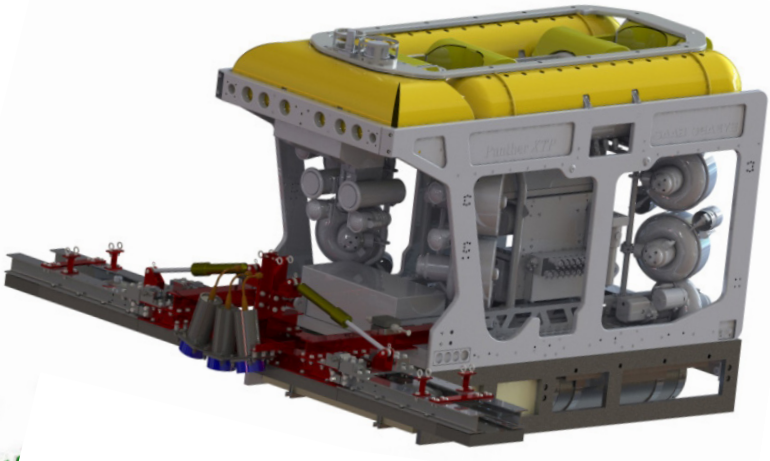
• Accurate imaging of pipeline/cable and surrounding seabed to burial depths of 3m
• Clearly images "stealth" flowlines and umbilicals
• Pure acoustic imaging with no magnetization and/or tone required
• Surveys energized cables, both HVDC and HVAC with no degradation of performance

Benefits

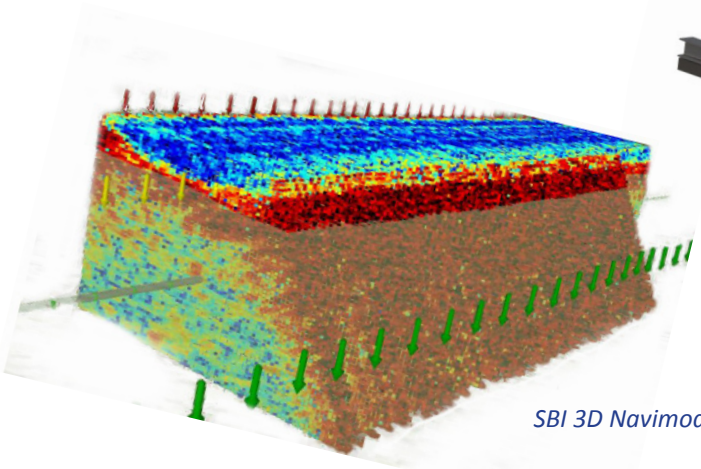
• Locates buried pipelines and cables down to 3 metres DBS to confirm cover, monitor movement, and comply with regulations.
• Can qualify buried magnetometer targets for size and shape prior to support decision making regarding excavation and removal
• Highly accurate (+/-5cm DOB accuracy) and records both raw data and processed images.
• Data QC views available on board in real time. Data deliverables available on board in as little as 6 hours when supported by GIS survey crew.

Deliverables

• Depth of cover for pipelines and cables buried to depths of up to 3m
• Data output in numerical .rep file in standard or customer format
• 3D data set for visualization in industry-standard EIVA NaviModel software



SBI Dolphin™ mounted onto light work class ROV



SBI 3D Navimodel Dataset

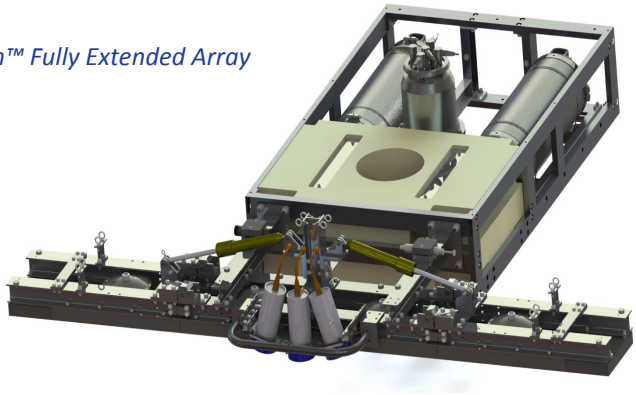
SBI Dolphin™ Payload Package:

- 4 x 8 channel hydrophone arrays
- 3 x HF chirp projectors: 4 -14 kHz
- INS/DVL – IXBLUE PHINS or similar
- Folding array for launch/recovery

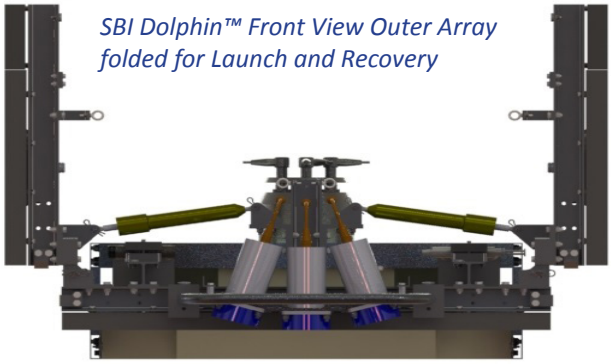
SBI Dolphin™ ROV Fitments:

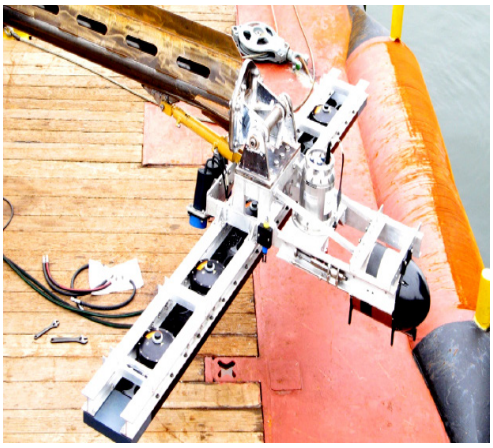
- Light Work Class ROV i.e.
- Panther XT Plus
- SAAB Leopard

SBI Dolphin™ Fully Extended Array

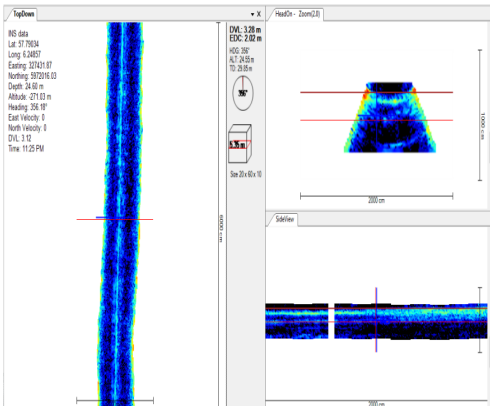


SBI Dolphin™ Front View Outer Array folded for Launch and Recovery





SBI™ Shallow Water Front Frame for trailing arm mount on surface vessel



SBI™ ROV Pilots Console Display

General Specifications for SBI Dolphin™

Item	Weight in air (kg)	Weight in water (kg)	Height (mm)	Length (mm)	Width (mm)
SBI Front Frame (incl. Hydrophones/Projectors)	141.5	77	459.6	934.9	2800
SBI Subsea electronic bottles, rack, skid and bouyancy	244.7	-80.2	355.6	1768	1060
SBI INS/DVL	45	26.2			
SBI Total	431.2	23			

Operating Specifications

- Minimum operating water depth on trailing arm: 3m
- Maximum operating water depth: 1,000m*
- Survey altitude: 3.5m +/- 0.5m above seabed (nominal)
- Survey speeds: up to 2 knots

*with 1,000m rated bouyancy

Launch & Recovery

- ROV: Most ROV LAR systems
- Vessel: Trailing Arm Mount

ROV Interface

- 115 volts AC, 50/60 Hz, 5 amps
- 1000 Base-T 1 Gb Ethernet (or Spare Optical Fibre)
- 1 hydraulic JIC4 port @ 2500 spi

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TELEDYNE TSS WORLD LEADERS IN MARINE NAVIGATION

350

SUBSEA CABLE TRACKING SYSTEM

Detection and survey of tone carrying underwater cables.

With modern subsea cable systems becoming increasingly sophisticated and their deployment, recovery and repair a more exacting science, there is a need for accurate subsea cable location. The TSS 350 cable survey system has been developed to meet this requirement in a compact modular system that provides enhanced features whilst remaining easy to use.

The TSS 350 system is designed specifically for the detection and survey of tone-carrying cables. Featuring a comprehensive software display and menu structure, real-time information is presented in a clear graphical format and provided as a digital output for storage and subsequent processing.

This fully integrated system provides accurate survey data, verifying location and burial status of a cable as well as providing operators with fault location, vehicle skew angle and look-ahead information.

The TSS 350 provides today's specialist operating companies with a system that will significantly improve their subsea operations allowing cable detection at greater burial depths for a variety of applications.

- Cable location data and depth of burial data
- Cable fault location
- Vehicle skew angle data
- Look-ahead information
- Tone discrimination

Features

- Accurate and reliable survey data with quality control envelope
- Combination of advanced DSP technology and proven tone-detection techniques
- Tone frequency discrimination

WORLD LEADERS IN MARINE NAVIGATION

TELEDYNE TSS
A Teledyne Technologies Company

350

SUBSEA CABLE TRACKING SYSTEM

TECHNICAL SPECIFICATIONS

System performance (dependent on tone – stated performance is based on 25Hz tone at 30mA current)	Vertical measurement accuracy	5cm or 5% of slant range whichever is greater Stated accuracy applies within an envelope approximately 4.2m wide and 4.0m deep
	Maximum detection range	Cable detected at vertical range up to 10m and within a total horizontal swath width of 20m centred on the coil array
Subsea electonics pod (SEP)	Material	3000m hard anodised aluminium housing as standard (6000m stainless steel optional)
	Dimensions	140mm (d) x 470mm (h)
	Weight	10 Kg in air; 2 Kg in water
	SDC communication	2-wire 20mA digital current loop or 4-wire 20mA digital current loop, RS232 or RS422 via multiplexer
	ROV connection	Via 8 way impulse connection, 3m tail
	Voltage input	110V ac (input range 98-135V ac) Optional : 240V ac (input range 198-270V ac)
	Input frequency	57-63 Hz @ 100/132V 47-53 Hz @ 180/264V
SDC	SDC hardware	102 key keyboard, pointing device, 15" TFT, XGA monitor, standard 19" rack mounting
		Overall size (mm): 555 (w) x 455 (h) x 378 (d) inc. transit case
	Weight	34.8Kg
	Description	Pentium 4 running Windows™ 2000
	Disk size	Hard disk: 20Gb Floppy disk: 1.44Mb 3.5" DS-HD CD: 52 x Read
	Ports	6 serial, 1 USB (front)
	Interface	20mA current loop, data logger, altimeter, printer, video overlay PAL/NTSC format
	Voltage input	85-265V AC
	Input frequency	48-62 Hz
	Power consumption	250 watts (max)
	Shock resistance	Operating: better than 5g for <10ms Non-operating: better than 40g for <10ms
Altimeter	Dimensions	75mm (d) x 205mm (h)
	Frequency	250 kHz
	Range	Minimum 30cm – maximum 30m
	Beamwidth	9º conical
	Connection cable	4m length (optional 7m length)
	Connection to	Subsea electronics pod
Depth rating	All subsea components are depth-rated to 3000m	
Physical	Weight	Triaxial coils & mounting bar: 70 Kg
Field support kit	Supplied as part of the system	
Warranty	12 months international warranty including parts and labour	

Due to continuous development, specifications may vary from those listed above.

WORLD LEADERS IN MARINE NAVIGATION

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A Teledyne Technologies Company

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Pipe & Cable Survey

Subsea Detection & Tracking Systems

Industry standard subsea pipe and cable detection

There are thousands of miles of pipes and cables beneath our oceans. Commercial, legal, operational and environmental consideration demand that these remain in good order. This requirement creates a constant need to verify location, condition and burial status – operations that are complicated by the ever-changing seabed topography.

TSS is the world leader in developing and supplying technologies to meet these demands. Having developed the world's first commercial pulse induction pipe and cable survey system (TSS 340) in 1991, followed by the release of the TSS 350 AC tone cable survey system, TSS has gone from strength to strength and become the industry standard.

PRODUCT FEATURES

- Suitable for pipe and cable tracking, burial and survey requirements
- Excellent detection and tracking performance
- High accuracy repeatable range data
- Pulse induction technology allows autonomous operation
- System design facilitates quick and easy mobilisation
- AC tone detection mode for measurement at increased burial depths
- Forward search mode for target location

TELEDYNE TSS
Everywhereyoulook™

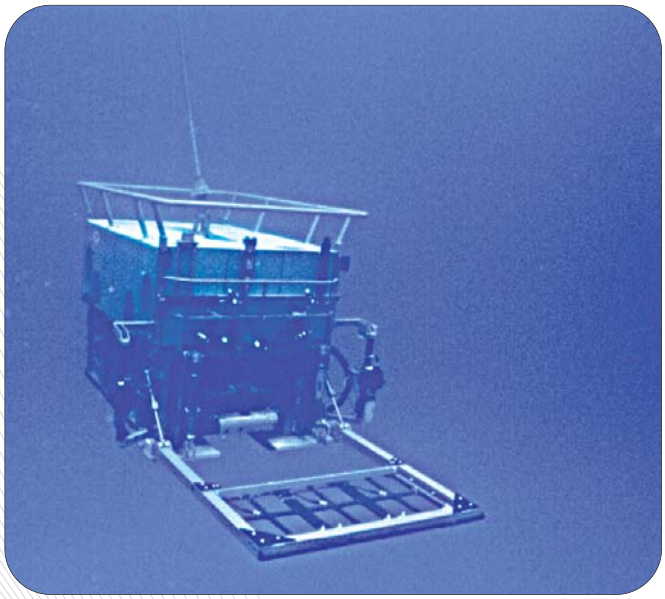
A Teledyne Marine Company

440

Subsea Pipe & Cable Tracking System

TSS technologies are proven in operation in some of the most exacting environments world-wide, and its equipment is established as the most accurate means of obtaining pipe and cable burial data.

There is a need for a system that can detect the presence of both pipes and cables, and can provide accurate and reliable survey data, which describes the position of these cables on or beneath the seabed. The system needs to be flexible in its range of uses and in the variety of vehicles on which it can be installed to complete survey work.



	440	350	Dualtrack
Surface Display Console	•	•	•
440 Subsea Electronics Pod	•		•
350 Subsea Electronics Pod		•	•
Power Supply Pod	•		•
Deepview Software	•	•	•
ALT250 Altimeter	•	•	•
3-Axis Coil Cable Ass		•	•
Pod to ROV Cable	•	•	•
350 Coil Assy x 2		•	•
Coil Mounting Frame	•	•	•
Spare 350 Coil		•	•
440 Coil Assy x 4	•		•
Transit Cases	•	•	•
System Manuals	•	•	•
Field Service Kit	•	•	•

PRODUCT FEATURES AND BENEFITS

- Pulse induction technology allows accurate survey information regardless of vehicle heading
- Windows™ based display and control software
- DSP techniques give quality control information
- Long range detection of buried subsea targets
- Fully integrated system with altimeter, spares and documentation
- No time-consuming vehicle calibrations required
- Easy to operate
- Simple to install and service

350

Subsea Pipe & Cable Tracking System

With modern subsea cable systems becoming increasingly sophisticated and their deployment, recovery and repair a more exacting science, there is a need for accurate subsea cable location. The TSS 350 cable survey system has been developed to meet this requirement in a compact modular system that provides enhanced features whilst remaining easy to use.

The TSS 350 system is designed specifically for the detection and survey of tone-carrying cables. Featuring a comprehensive software display and menu structure, real-time information is presented in a clear graphical format and provided as a digital output for storage and subsequent processing.

This fully integrated system provides accurate survey data, verifying location and burial status of a cable as well as providing operators with fault location, vehicle skew angle and look-ahead information.

The TSS 350 provides today's specialist operating companies with a system that will significantly improve their subsea operations allowing cable detection at greater burial depths for a variety of applications.

PRODUCT FEATURES AND BENEFITS

- Cable location data and depth of burial data
- Cable fault location
- Vehicle skew angle data
- Look-ahead information
- Tone discrimination
- Accurate and reliable survey data with quality control envelope
- Combination of advanced DSP technology and proven tone-detection techniques
- Tone frequency discrimination

Pipe & Cable Survey

Subsea Detection & Tracking Systems

TECHNICAL SPECIFICATIONS

		350	440
System Performance		A C Tone	Pulse Indication
	Detection Range	Cable detected at vertical range up to 10m and within a total horizontal swath width of 20m centred on the coil array	3cm armoured cable depth and tracking at 1.2m; 1cm unarmoured cable depth and tracking at 0.6m
	Vertical measurement accuracy (in a low noise environment)	**RMS** 5cm or 5% of slant range – whichever is greater. Stated accuracy applies within the quality envelope of 4m. 3cm armoured cable depth and tracking at 1.2m; 1cm unarmoured cable depth and tracking at 0.6m	**RMS** 5cm or 5% of slant range – whichever is greater
Subsea Electronics Pod (SEP)	Dimensions	140mm (dia) x 450mm (h) (440 – 2 pods, 350 – 1 pod)	
	Weight per pod	10Kg in air; 2Kg in water	
	SDC communication	2-wire 20mA digital current loop or 4-wire 20mA digital current loop RS232 via a multiplexer	
	Voltage input	Standard 110V AC (input range 98-135V AC); Optional 240V AC (input range 198-270V AC)	
	ROV connection	Via 8-way waterproof connector	
	Voltage input	Standard 110V AC (input range 98-135V AV); Optional 240V AC (input range 198-270V AC)	
	ROV connection	Via 8-way waterproof connector	
SDC	Hardware	19" military grade touch screen panel PC Rear mounted comms endorse for all external interfaces	
	Display resolution	1280 x 1080	
	Dimensions	599 x 480 x 345mm (including transit case)	
	Power consumption	250W max	
	Shock resistance	Operating: better than 5g for <10ms Non-operating: better than 40g for <10ms	
Altimeter	Dimensions	140mm (dia) x 290mm (h)	
	Frequency	200kHz	
	Range	30cm to 30m	
	Connection cable	4m length (7m length optional)	
	Connection to	Subsea electronics pod	
Depth Rating	All subsea components are depth rated to 3000m (optional 6000m)		
Field Support Kit	Supplied as part of the recommended system		
Warranty	12 months international warranty including parts and labour.		

COMPANY WITH MANAGEMENT SYSTEMS CERTIFIED BY DNV
= ISO 9001 =
= ISO 14001 =

TELEDYNE TSS
Everywhereyoulook™

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RADIODETECTION®

RD8100®

Precision locators – optimum precision for damage prevention

SPX®

Since Radiodetection launched the first commercial, twin antenna, cable and pipe locators over 40 years ago, we have pioneered many technologies that are used widely in the location industry today. Behind developments such as depth measurement, Strike*Alert*® and Current Direction® is a drive to protect utilities from damage, making excavation easier and safer.

RD8100, our most advanced precision locator range, is built on this pedigree for performance, quality and durability. Containing a unique arrangement of 5 antennas, it allows you to choose the optimum level of precision for the job in hand. Integrated GPS and usage-logging options automatically generate data for customer reports, or in-house quality and safety audits to promote best working practices.

High contrast screen provides clarity even in bright sunlight

Simultaneous display of depth and current gives more confidence you are following the target line

Light weight and ergonomic design for comfortable use

Custom Frequencies

Program up to 5 extra frequencies to customize the RD8100 to signals found on your network

High visibility reflective design helps protect operators and equipment

Survey Measurements with Bluetooth® Connectivity

Store up to 1000 records and send wirelessly to a mobile device or PC using Bluetooth

Optional integrated GPS adds positional data without requiring an external device

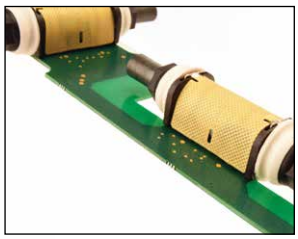
Built for on-site use – IP65

Shock resistant, ingress protected casing protects against knocks, drops, water and dust

Locate over longer distances

90V signal output and automatic impedance matching

iLOC™



Precision by design

A unique arrangement of five custom manufactured, precision ground antennas deliver locate accuracy and repeatability

4 kHz frequency with Current Direction for locating and tracing higher impedance cables over longer distances

Base tray for accessories

3 YEAR WARRANTY ON REGISTRATION AND A GLOBAL SERVICE NETWORK PROVIDE PEACE OF MIND

Upgrade to get more from your locator system:

Li-Ion Battery Pack

Lithium-Ion rechargeable battery options for both locator and transmitter provide extended runtime with reduced running costs.

GPS and Usage-Logging

Integrated GPS and automatic usage-logging allow managers to review locate history to ensure compliance with best practice.

iLOC

Save time on site by controlling your transmitter from distances of up to 1400 feet / 450 meters.

Simultaneous depth and current readout

Consistency of depth and current measurements gives confidence the correct line is being followed.

Dynamic Overload Protection

Filters out interference, enabling use in electrically noisy environments such as near substations or overhead power lines.

SideStep™ interference evasion

Adjusts frequency slightly enabling locates in areas prone to interference or where more than one operator is working.

Responsive by design

Sophisticated circuitry enables operators to detect and react to the weak signals associated with difficult to locate utilities.

Making complex locates simpler

With utility infrastructures becoming more complex, locate professionals require more powerful tools to simplify the task of distinguishing between and tracing different utilities.

CD (Current Direction)

Identify your target amongst a number of parallel utilities by applying a specialized CD signal from the Tx-10 transmitter. CD arrows displayed on the locator confirm you are tracing your target.

Trace high-impedance utilities with 4 kHz

The 4 kHz locate frequency enables lines such as twisted pair telecoms or street lighting to be traced over longer distances. Since such utilities are often found in areas of dense infrastructure, you can combine 4 kHz with CD to improve trace accuracy.

Use Power Filters™ to pinpoint and discriminate between power cables

When a signal transmitter can't be connected, tracing individual power lines through dense networks can be a real challenge. Conflicting or powerful signals confuse or combine to create a wash of signal.

A single key press uses the harmonic properties of power signals to establish if a signal comes from one source, or from multiple cables which you can then trace and mark.

Speed combined with accuracy – Peak+ Mode

Peak+ mode allows you to add either Guidance or Null locating to the accuracy of Peak mode.

- Adding Guidance gets you to the Peak position faster.
- Adding Null to Peak lets you check for the distortion caused by other utilities, spurs or interference.

Supporting your business

Every locating operation needs to meet the continuing challenges of delivering on-time, high quality work and increasing value to customers.

Automatic usage-logging with GPS positioning

When equipped with GPS, RD8100 locators automatically capture key locate parameters every second, providing a comprehensive picture of individual locates and allowing you to assess usage patterns over extended periods.

The data generated can be used to ensure adherence to best-practice, or to identify training needs before poor work habits develop.

Additionally, the information can be used for internal audits or shared with partners or clients to evidence task completion, or compliance to service requirements.

Usage data can be exported in multiple file formats – for example KML for Google Maps to confirm where and when work was performed.

eCert™ – Remote calibration without downtime

Verify and certify the calibration of your locator over the internet using the RD Manager™ PC software package without returning the unit to a service center. Have confidence that the RD8100 is ready for action whenever you are.

CALSafe™

Choose to automatically enforce maintenance or lease schedules by providing a 30 day countdown before the calibration certificate expires.

Support when you need it

The RD8100 is backed with an industry leading 3 year warranty on registration. Our global sales and service network delivers comprehensive technical support and training tailored to your needs.

Operator confidence on-site

Enhanced self-test

The integrity of the measurement system can be confirmed on-site. Self-test applies signals to the locating circuitry as well as checking display and power functions.

Strike*Alert*™ in active and passive locating modes

Visual and audio warnings of shallow cables reduces the risk of accidents.

TruDepth™

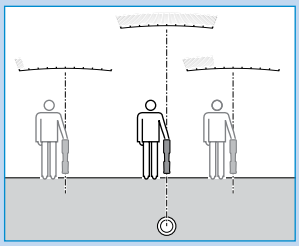
As depth readings are only given when the RD8100 is correctly oriented, you can be confident in the result.

High sensitivity

Sophisticated circuitry enables operators to detect and react to the weak signals associated with difficult to locate utilities.

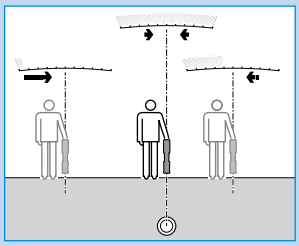
The RD8100 offers a choice of locate modes, each of which is optimized for specific tasks

Peak
Displays the strongest response when directly above a cable. Depth and current measurements are also shown.



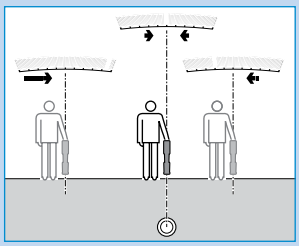
Use for: Precise locating prior to and during excavation. Many professionals have trained in this mode and appreciate the simplicity of the display.

Peak+
Add Guidance or Null modes to Peak and alternate between them.



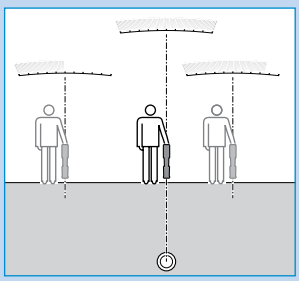
Use for: Finding Peak response quickly while checking for the presence of multiple lines or other features which may require extra vigilance.

Guidance
Proportional guidance arrows and differentiated audio tones indicate if utility is to left or right of user.



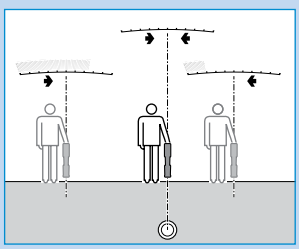
Use for: Checking general direction of utilities as part of a pre-locating sweep. Better for congested areas than null mode alone.

Broad Peak
Operating similarly to Peak mode but more suited to locating weaker signals.



Use for: Locating deep lines, or when weak signal levels or interference makes conventional peak locating difficult.

Null
Arrows and audio signals indicate where the cable is relative to the operator. A null response is displayed above the cable.



Use for: Long distance marking of single utilities in non-congested areas. Audio response allows users to rely on sound rather than the screen.

Getting more from your RD8100 system...

Customize the locator to your network frequencies

Up to 5 additional frequencies can be programmed into all RD8100 locators to match it to the signals found on your target telecoms networks.

Accurate surveying with integrated or external GPS

Save up to 1,000 survey measurements, capturing utility depth, and send to a mobile device using Bluetooth. Add positional data with the integrated GPS option, or combine with external GNSS device using the wireless Bluetooth link to get the accuracy that you need.

Fault Find

Combine the RD8100 locator with an accessory A-frame to identify and pinpoint insulation sheath faults to within 4" (10cm).

RD Manager PC software

Set-up, calibrate and update your locator from a PC. Download usage logging and survey measurement data for analysis.

Passive Avoidance

Rapidly check an area before excavation using simultaneous detection of the Passive Power and Radio signals carried on underground cables or pipes.

90V Transmitter output

More locate signal on high impedance target lines – detect deeper and further.

Multimeter function

Assess the target utility using your transmitter – quickly measure line voltage, current and impedance.

Choose the optimum mode for your locate

Our unique arrangement of 5 antennas allows you to optimize your RD8100 for different tasks. Each mode uses a different combination of antennas. At the heart of each of our locating antennas is a custom manufactured, precision-ground ferrite to ensure the accuracy and precision of our measurements.

iLOC

iLOC is an advanced Bluetooth link between the RD8100 locator and Bluetooth enabled transmitter, which allows you to control the locate signal's power and frequency from up to 1400' / 450m away. Spend less time walking and more time locating.

Accessories to optimize the system to your needs

Whether you are locating telephone cables in a bundle or underwater power cables, Radiodetection's accessory range extends the precision locate capabilities of the RD8100 and transmitters to your application.

Visit **www.radiodetection.com/accessories** for more information.

RD8100 range options:

RD8100 locators:	PXL	PXLG	PDL	PDLG	PTL	PTLG
Locate Frequencies	13	13	18	18	22	22
Sonde Frequencies	4	4	4	4	4	4
Passive Modes	2	2	5	5	5	5
On-board GPS		✔		✔		✔
Power Filters	✔	✔	✔	✔	✔	✔
Usage-Logging		✔		✔		✔
CALSafe™		■		■		■
4 kHz	✔	✔	4k+CD	4k+CD	4k+CD	4k+CD
Current Direction			✔	✔	✔	✔
Fault Find			✔	✔	✔	✔
Depth in Power			✔	✔	✔	✔
Passive Avoidance			✔	✔	✔	✔
iLOC	✔	✔	✔	✔	✔	✔
Lithium-Ion Battery	●	●	●	●	●	●
3 year warranty on registration*	✔	✔	✔	✔	✔	✔

Transmitters	Tx-1	Tx-5	Tx-5B	Tx-10	Tx-10B
Max. Output Power	1W	5W	5W	10W	10W
Active Frequencies	16	16	16	16	36
Induction frequencies	8	8	8	8	8
Current Direction Frequencies				6	14
iLOC remote control			✔		✔
Fault Find		✔	✔	✔	✔
Induction field strength	0.7	0.85	0.85	1	1
Eco Mode		■	■	■	■
Lithium-Ion Battery	●	●	●	●	●
3 year warranty on registration*	✔	✔	✔	✔	✔

*Locators and transmitters only. Does not include battery packs and accessories.

Other features described are standard on the RD8100 Locators and Tx transmitters unless otherwise noted.

✔ Available, enabled by default. ● Option. ■ Available, disabled by default.

Download the full Product Specifications at **www.radiodetection.com/RD8100**

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SPX

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Radiodetection is a leading global developer and supplier of test equipment used by utility companies to help install, protect and maintain their infrastructure networks.

90/RD8100/ENG/02

Bibby Athena

Bibby Athena is a 27.5m purpose built, DP1 semi-swath coastal survey vessel, entering service in December 2014. Bibby Athena is the latest evolution of the successful sister vessel Bibby Tethra, introduced in 2011. The vessel will build upon the capabilities of Bibby Tethra with a number of subtle changes to reflect the company's development into a more challenging offshore market.

The vessel provides an exceptionally stable working platform due to her advanced hull design and ultra-quiet, extremely economical operating profile, due to her diesel electric Shottel propulsion system. Bibby Tethra has proven the effectiveness of the semi SWATH (small waterplane area twin hull) design for this class of vessel, maximising stability and seakeeping ability in challenging conditions.

BIBBY HYDROMAP

Committed to Quality and Innovation

Specifications

Builder:	Socarenam Boulogne, France
Designer:	Bureau Mauric, Marseilles
Launched:	2014
Length:	27.50m
Beam:	10.00m
Draught:	3.50m
Tonnage:	145 GT
Operating Code:	UK MCA SCV Category 1 (150 miles)
Class:	Lloyd's Register 100A1SSC Catamaran, G6, DP1
Flag:	UK

Propulsion

Main propulsion:	2 x Cummins KTA19 M3 (447kW each) marine diesels driving 5 blade fixed pitch propellers through Twin Disc MG516C hydraulic gearboxes.
Secondary/Survey Propulsion:	2 x Schottel SPJ57 azimuth pump jets with (175kW each) electric motors
Bow Thrusters:	2 x Schottel SPJ15 azimuth pump jets with (60kW each) electric motors

Performance

Maximum Speed:	12 knots
Economical Speed:	10 knots
Survey Speed (max):	6 knots
Endurance:	>10 days

Fuel Consumption

Transit:	2.5m^3 / day
Survey Speed:	1.2m^3 / day
DP:	1.8m^3 /day

Generators

Main Generators:	2 x Scania DI13-074M (340kVa each)
Harbour Generator:	1 x Cummins Onan 35 kVa
Deck Power Connection:	1 x 175kVA and 1 x 50kVA

Tank Capacities

Gas Oil:	24m^3
Fresh Water:	8.0m^3
Water Maker:	2.0m^3 / day

Physical Properties

A-Frame:	8 Tonne capacity with 7.0m clearance.
Crane:	Palfinger PK23500-M 4.6T @4.70m

DP1 System

	Sirehna EasyDP BV - AM/AT – DP Class 1
Modes:	Station keeping, ROV follow, slow speed line keeping, high speed line keeping, Auto heading.
Ref Sensors:	2 x dGPS, 2 x MRU (Hydrins and Quadrans), 2 x heading sensors, dual axis log, 2 x wind sensors, Sonardyne Mini-Ranger 2 USBL acoustic navigation system

Navaids & Communication

Radar:	2 x 94m Furuno FAR 2117 Black Box
Autopilot:	Navico AP50 with remote control
ECDIS:	Navmaster
AIS:	Furuno FA150
dGPS:	C&C Tech C-Nav 3050 and Furuno GP150
Echo Sounder:	Furuno FE700
Heading:	iXBlue Quadrans
Heading 2:	iXBlue Hydrins
Speed Log:	Skipper Electromagnetic Speed Log
Navtex:	Furuno700B
Weather:	2 x Furuno WS200
VHF:	2x Icom 603 DSC
MF:	Furuno FS1570
Satellite Comms:	Furuno 250 Fleet Broadband Furuno Felcom 15 Sat C

Crane & Deck Equipment

Crane:	Palfinger PK23500-M
Max Lift:	5450kg at 4.2m
Max Outreach:	8m with 2300kg capacity
Remote:	Fully functional radio remote
Moonpool:	2.05m x 2.30m central moonpool
"A" Frame:	Hydraulic 8000kg SWL with 6.5m deck clearance will lift over stern or through moonpool.
Winch:	8000kg line pull hydraulic winch
Sonar Winch:	MacArtney "Cormac" 4 stainless steel sonar winch with remote control and programmable level wind. 1500m of 8.2mm side scan sonar cable.
Sonar Wells:	2 x 600mm x 540mm, 1 x 310mm diameter USBL shaft
Containers:	Locking points for one ISO 20 foot container or one ISO 10 foot container on back deck.
Capstans:	2 x 2000kg line pull deck mounted capstans.

Bibby Athena offers a number of advanced features for a vessel of this size, including powerful Dynamic Positioning (DP1), high grade permanent survey installation, large A-frame, multiple moon pools and endurance of >10 days with comfortable air-conditioned accommodation for up to sixteen. Although Bibby Athena is the same overall length as Bibby Tethra at 27.5m, the vessel benefits from subtle enhancements, including an enlarged bridge which houses the on-line and off-line survey rooms and improved layout of the living space. The addition of two forward Schottel pump jets, giving a total of four, and larger aft electric Schottel drive motors will provide an even more capable DP1 capacity and an increased generator size now provides over 850kVa of electrical power for on board systems.

The permanent survey spread features industry-standard offerings from the company's regular suppliers including Teledyne RESON, C-NAV, Edgetech and iXBlue, maintaining consistency with the remainder of the fleet. Bibby Athena will be permanently mobilised with a full rate dual-head Teledyne RESON 7125 SV2 multibeam system, greatly improving the productivity of bathymetric data acquisition.

BIBBY HYDROMAP

Committed to Quality and Innovation

www.bibbyhydromap.com| enquiries@bibbyhydromap.com +44(0)151 328 1120 |
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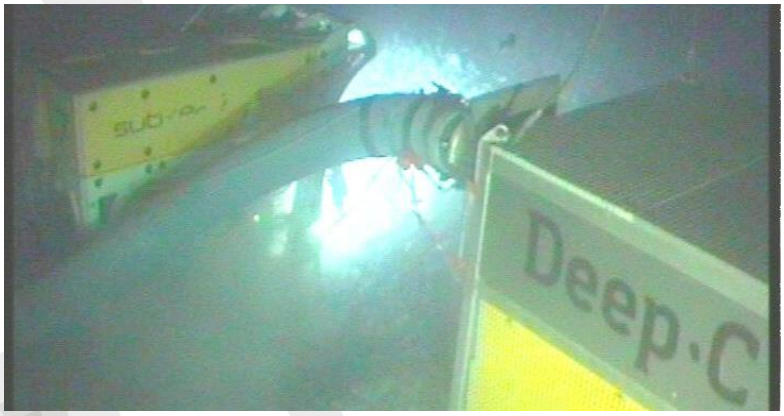
APPENDIX B Examples of Subsea Standalone Dredgers

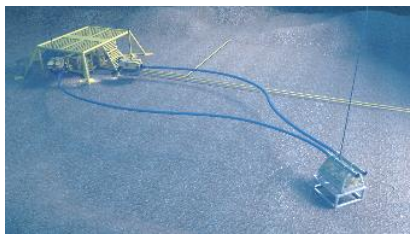
Deep C® Subsea Dredge



The Deep C® Subsea Dredge is a powerful stand alone dredging unit, powered through an electrical umbilical from surface. The system requires minimum deck space and offshore manning, and is designed for seamless operation by ROV or diver. The Deep C Subsea Dredge offers unrestricted dredge size up to 16”, extensive outreach and long transport distances.

KEY FEATURES:

- Powerful dredge up to 16” unrestricted diameter
- Onboard jetting systems for clay disintegration
- Range of suction heads for various tasks
- Dual dredge capacity (two suction hoses)
- Subsea quick connector for suction hoses and exhaust hoses
- Remotely operated backflush function
- Integrated subsea HPU availability
- Crane or moon pool deployment
- Designated ROV manipulator for hose handling
- Interface for lights, camera, sonars etc



Deep·C®

TECHNICAL SPECIFICATIONS:

Physical dimensions:

Length:	2 700 mm
Width:	2 100 mm
Height:	2 600 mm
Weight (air):	3 200 kgs*
Weight (water):	2 500 kgs*

*) typical configuration

.

Power Sources:
Up to 285 kW available in system without need for additional topside equipment or downlines. Power can be freely utilized for dredging, jetting and hydraulics

Dredging System:
Up to 16" unrestricted flow
Standard power on dredge 95 kW, with possibility to run twin pumps (2x 95 kW) to allow in-built redundancy, more power on dredge (two separate suction hoses)
Remotely operated backflush

Clay Cutting:
Seabed specific configurations
190 kW electrical power available with no need for additional topsie equipment or downlines.

HPU:
The Deep C® Subsea Dredge can carry up to 190 kW integrated subsea HPU with no need for additional topside equipment or downlines

Hose Handling:
Designated basket for storage of hoses
Reinforced hoses for safe launch and recovery
Subsea quick connectors for suction hoses and exhaust hoses

Navigation:
Output available for extensive use of lights, cameras, sonars,and other instrumentation

Deployment:
Deployment to seabed by vessel crane
Guide funnels available for deployment through moon pool

Selection of relevant equipment:
Deep C ROV Manipulator for hose handling, range of various suction head designs, clump weights for positioning of exhaust hose, mud mats for soft seabed, bespoke solutions

TOPSIDE SPREAD:

PDU Container (Lx W x H)	6000 mm x 2400 mm x 2700 mm
Weight	9000 kg
Umbilical Winch (Lx W x H)	2400 mm x 3500 mm x 2500 mm
Weight	13000 kg
Umbilical Chute (Lx W x H)	2200 mm x 900 mm x 1800 mm
Weight	1000 kg

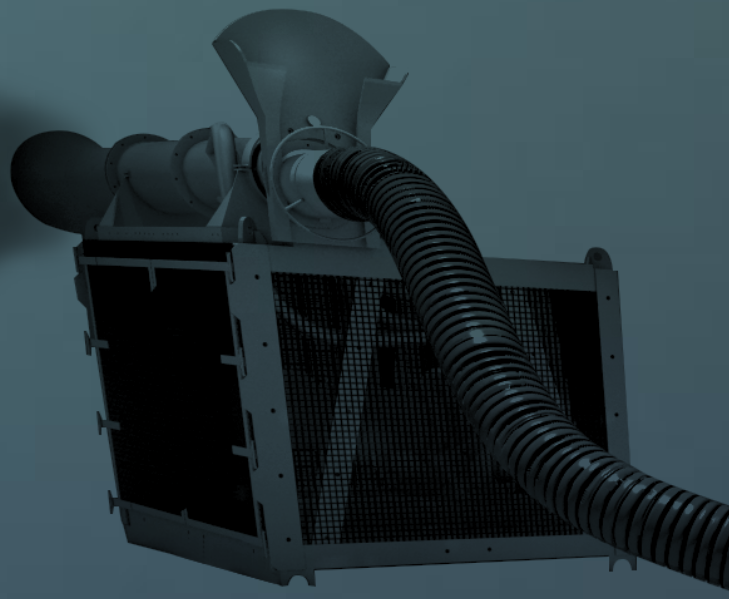
Several Deep C® Systems can be operated from one single topside spread, allowing you to bring a tool box offshore with minimum mobilization

Deep C® Systems consists of standardized and interchangeable components

Deep C® Systems are very flexible for project specific configurations and will be optimized to meet your actual requirements

SCANMUDRING

STANDALONE DREDGE



ROV, DIVER AND CRANE OPERATED

This power unit is a standalone subsea dredger operated by customer's divers, ROV or vessel crane. The Standalone Dredge effectively relocates installed rock and soil.

Decades of operational experience, combined with a continuous improvement program ensures maximum safety, reliability and performance of the Standalone Dredge, to provide a superior working environment for projects at an increased depth rating.

SERVICES

- Seabed preparation for installation and decomissioning of subsea installations
- Subsea precision excavation for repairs, hot-tapping, pile cutting and inspection
- Seabed intervention work like dredging,deburial and backfilling
- Rock removal/relocation
- Pipeline and cable remedial work such as deburial for maintenance
- Sections of hoses with subsea quick connectors allow customized relocation distances (up to 140m)

KEY CAPABILITIES

- Optimized jetting system for clayey material
- Power & signal in/outlets for 3rd party equipment
- Various shaped dredging nozzles
- Project customized solutions

SCANMUDRING

GENERAL

Type:	Skid with ejector pump system, powered by a 3kV/95kW motor
Manufacturer:	Scanmudring
Hydraulic power:	
Available tools:	8'', 10'', 12'' and 14'' ejector systems Hydraulic operated backflush

DIMENSIONS AND WEIGHT

Length (m):	2.3 (3.1 included ejector exhaust)
Width (m):	1.8
Height (m):	2.5 (depending on ejector)
Weight in air/ water (ton):	4,5/ 3,8

OPERATING PARAMETERS

Operating depth (m):	Rated to 1000m
Relocation range:	Customized

SHIPBOARD SUPPORT

Deck space requirements:	• Landing space min 5x5m • 1 20 ft power & control container • 1 umbilical winch • Sheave/chute wheel
Power supply requirements:	440V: 200A/60Hz 230V: 32A/60Hz
Operators*:	2-3 operators

*) Based on client requirements and project complexity.

Merlin

Excavation and Jetting

The new 35 - 60 h.p. Merlin excavation pump is the must have successor to the Excalibur. Merlin incorporates many of the improved design features introduced on the small Super ZipJet pump which has proven to be so successful.

The pump is smaller, lighter and more robust with greater performance in both excavation and jetting functions. It features the same double seal arrangement as the Super ZipJet and a modular design provides great ease of maintenance.

There are significant efficiency increases in both the impeller and educator making this the tool that no WROV should be without.

Robust excavation pump design that will not block or jam

Like all Tritech excavation pumps the Merlin will not block or jam because there are no moving parts in the suction flow path. The flow reversal valve can be operated to back flush the suction nozzle should there be an obstruction. Power is derived from a stream of high velocity fluid creating a low pressure region behind the suction nozzle. The pump may be rapidly switched from suction to jetting, or be configured to an intermediate position allowing jetting and excavation to be carried out simultaneously.

Benefits

- Robust proven design
- Small and light
- Rapid switching from suction to jetting

Features

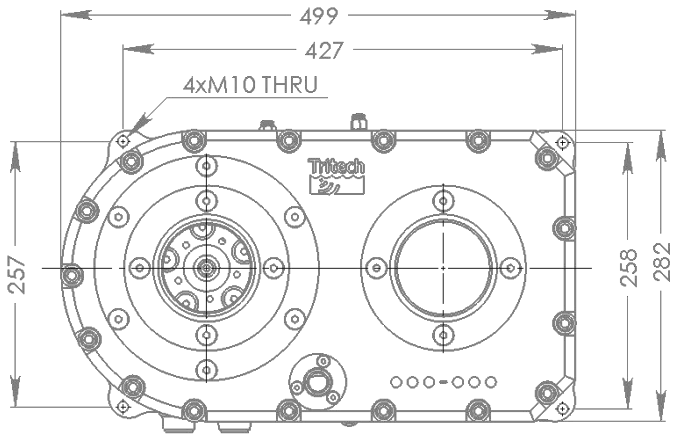
- Modular pump core
- Reverse flush for suction nozzle
- Double shaft seal
- Option of close fitting inlet strainer

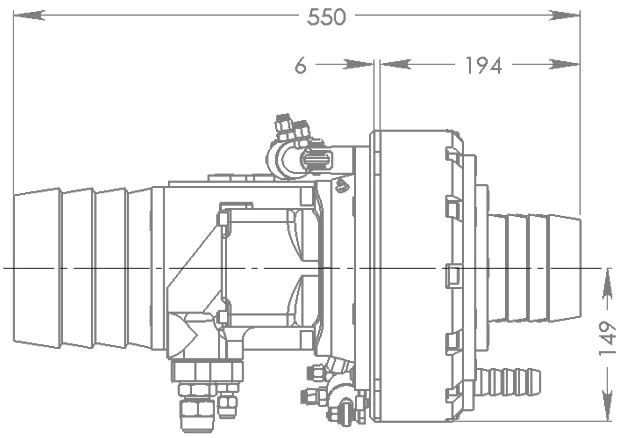
Applications

- Fitted to most work class ROVs
- Break up and excavation of seabed
- Removal of drill cuttings
- Clearing of subsea manifolds
- Removal of soft marine growth
- Marine archaeology
- Treasure hunting and salvage

Document: 0711-SOM-00002, Issue: 03

Specification





Not to scale, dimensions in mm.

Hydraulic Motor Input	
Pressure	170 to 250 Bar (2450 to 3600 psi)
Flow	65 to 110 litres per minute (17 to 29 USgpm)
Actuator	
Minimum pressure	120 Bar (1740 psi)
Maximum pressure	240 Bar (3480 psi)
Hydraulic Fittings	
Motor A & B	No. 12 JIC male
Motor case drain	No. 6 JIC male
Actuator connection	No. 4 JIC male
Output	
Jetting performance	Up to 600 litres per minute @ 8 Bar (160 USgpm @ 115 psi)
Suction flow	2000 - 4000 litres per minute (500 - 1000 USgpm)
Solids removal rate	10 - 40 tonnes per hour (350 - 1500 lb per minute)
Nozzle and Hose Dimensions	
Jetting hose	1" BSP Hose barb
Jet nozzle diameter	20mm (0.8”)
Discharge hose diameter	150mm (6”)
Suction hose diameter	100mm ID (4")
Weight and Materials	
Weight in air	40kg (90lb)
Weight in water	17kg (38lb)
Materials	Stainless steel, Nylacast, UHMWPE

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APPENDIX C Examples of Subsea Excavation Vehicles

Deep C® Subsea Utility Vehicle

The Deep C® Subsea Utility Vehicle (SUV®) is a powerful and remotely operated subsea tracked vehicle. The Deep C® SUV® has great capacity to execute numerous tasks, and shift between working modes while being submerged. Its low ground pressure and stability makes it very mobile on seafloor and stable in operation.

KEY FEATURES:

- Powerful dredging and excavation systems
- High pressure jetting, such as for concrete removal
- Interchangeable purpose designed manipulators
- Live 3D Visualization system
- Wide range of demolishing tools
- Cutting and grinding
- Operates a wide range of tooling
- Operates sophisticated sonars and survey kits

Deep·C®

TECHNICAL SPECIFICATIONS:

Physical dimensions:

Length:	4 500 mm
Width:	3 200 mm
Height:	3 000 mm
Weight (air):	9 000 kgs*
Weight (water):	7 500 kgs*

*) typical configuration

Power Sources:
Various configurations up to 490 kW electrical power
Can freely be utilized for dredging, hydraulics and jetting

Manipulator configuration:
Interchangeable manipulators for various purposes (i.e long reach, heavy duty ops, interchangeable tooling etc)

Traction and turret:
360 degree rotation on turret
Low ground pressure for soft seabed (typically 10 kPa)
Step less speed 0 – 6 km/h

Navigation/ Sensors:
Lights and cameras
Gyro
Pitch/ Roll sensors
Sonars
Compass
Live 3D Visualization System

Dredging System:
Up to 16" unrestricted dredging system
Remotely operated backflush
Quick connect for suction and exhaust hose
Available mechanical aids and jetting systems for disintegration of clay

Other available features:
Range of SUV® tooling
Extensive electronic interface (i.e survey kits, additional instrumentation etc)
Very flexible for project specific configuration

TOPSIDE SPREAD:

PDU Container (Lx W x H)	6000 mm x 2400 mm x 2700 mm
Weight	9000 kg
Umbilical Winch	2400 mm x 3500 mm x 2500 mm
Weight	13000 kg
Control Cabin	4200 mm x 2400 mm x 2700 mm
Weight	7000 kg
Umbilical Chute	2200 mm x 900 mm x 1800 mm
Weight	1000 kg

Several Deep C® Systems can be operated from one single topside spread, allowing you to bring a tool box offshore with minimum mobilization

Deep C® Systems consists of standardized and interchangeable components

Deep C® Systems are very flexible for project specific configurations and will be optimized to meet your actual requirements

SCANMUDRING

SCANMACHINE

SUBSEA EXCAVATOR & TOOL-CARRIER

The Scanmachine subsea excavator and tool-carrier systems are based on modified excavators combined with state-of the-art ROV technologies with open tool interfaces.

Decades of operational experience, combined with a continuous improvement program ensures maximum safety, reliability and performance of the Scanmachines, to provide a superior working environment for projects at an increased depth rating.

SERVICES

- Seabed preparation for installation and decomissioning of subsea installations
- Subsea precision excavation for repairs, hot-tapping, pile cutting and inspection
- Seabed intervention work like dredging, precision leveling, deburial and backfilling
- Rock removal/relocation/dump, drillcut, boulder and debris
- Pipeline and cable remedial work such as de-burial for maintenance and free-span correction
- Grouting removal
- Operates in soft to very hard seabed condition

KEY CAPABILITIES

- 4 machines - different sizes, same functionality
- IMCA ROV class IV
- 8''-16'' ejector available
- Arm reach 5,5-11m
- Monitoring system
- Seabed condition 5kPa - 45MPa
- Quick connection interface to various hydraulic tools (drumcutter, drill-rig)

SCANMUDRING

GENERAL

Type/model:	Scanmachine 1000 (1-3) & 2500 (4)
Manufacturer:	Scanmudring
ROV class:	IMCA ROV class IV/ Tracked (bottom crawling) ROV system
Available tools:	8", 10", 12", 14" and 16" suction ejector systems Excavator and special hydraulic operated tools (bucket, gripper, water jet, drill, cutter, blower, drum cutter, back flush). Excavator monitoring system (MoS) for accurate levelling and construction work. Several configurations of arms and undercarriages available.

DIMENSIONS AND WEIGHT

Scanmachine:	No. 1	No. 2	No. 3	No. 4
Length* (m):	7.2	11.0	8.5	11.0
Width (m):	2.4	3.1	2.4	3.0
Weight in air/ water (ton):	9,5/8	17,5/ 14,9	13/11	18,5
Max arm reach (m):	5.5	9,5	9.5	11.0

OPERATING PARAMETERS

Operating depth (m):	5 - 1000	5 - 1000	5 - 1000	5 - 2500
Relocation length with standard ejector (m):	13	19	17	19
Water capacity (m3/h)**:	2150	2150	2150	2150-4300
Navigation:				
Cameras: BW/Colour/Low light:	3/1/1	3/1/1	3/1/1	3/3/1
Sonar:	Optional	Optional	Optional	Optional
Gyro:	1	1	1	1
Base calibration tolerances (cm):	+/-5	+/-5	+/-5	+/-5

SHIPBOARD SUPPORT

Wooden landing area (m):	10x10	10x15	10x10	10x15
Umbilical winch footprint (m):	4.5x2.2	4.5x2.2	4.5x2.2	4.5x2.2 / 5,7x3
Number of 20' containers:	2	2	2	2
Number of 10' containers:	0	0	0	1
Number of baskets:	(Project depending)	(Project depending)	(Project depending)	(Project depending)
Power supply requirements:	440V: 250-420A/60Hz, depending on tools fitted 230V: 32A/60Hz			
Operators:	6 operators for 24 hours operation supplied by Scanmudring			

* Stated dimensions in storage position with arm folded and with standard ejector.

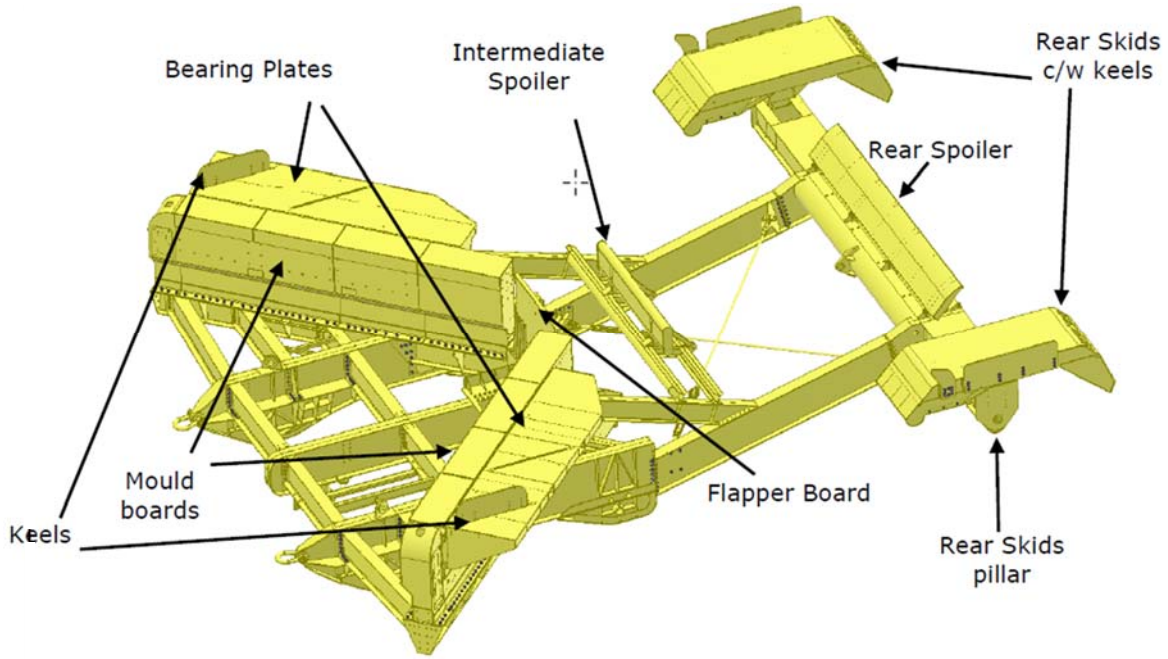
** Practical dredging capacity is pending on project and soil parameters.

*** Subject to system tool and project configuration. Different umbilical winches and container spreads will have an effect. To be included in mobilisation procedure.

APPENDIX D Backfill equipment

SCAR Plough
TRS2
Example TSHD – Pearl River
Example BHD - Vitruvius
Example Cable Crane Dredger - Tiger

SCAR Plough



Note: SCAR plough is shown inverted for clear labelling of the soil-engaging parts.

SCAR Plough

Length:	15.0m
Width:	13.5m (planned for project) 15.5m (maximum)
Weight:	70te (+ 10te ballast for hard soil areas)

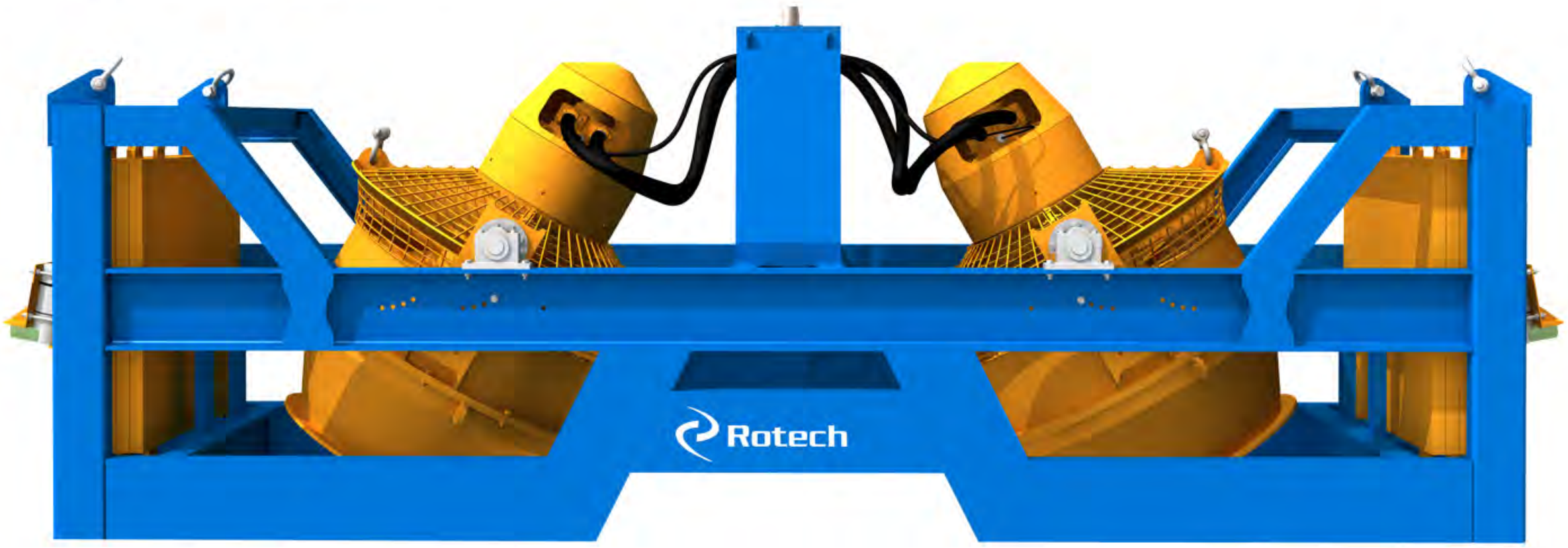
Rotech SUBSEA

World leaders in excavation since 1994

TRS2 / Shallow Water

Controlled flow excavation system

For over two decades Rotech have pioneered the development of cutting-edge subsea controlled flow excavation technology. A dedication to innovation has seen Rotech continually evolve and enhance our specialised equipment to meet demand and deliver for the needs of many major clients in the subsea oil & gas and energy sectors.



patents pending

Applications :

- Cable/Pipeline/Umbilical Trenching
- Cable/Pipeline/Umbilical Deburial
- Freespan & Sandwave Clearance
- Backfilling & Burial
- Jack Up Spud Can Clearing & Cleaning
- UXO & Salvage Deburial
- Rock Dump & Drill Cutting Removal
- Harbour Clearance
- Subsea Structure Foundation Access

Rotech Personnel :

- 6 operators for 24hr operations
- 2 additional operators are supplied to operate the jetting system for soils in excess of 60kPa

Services :

- Safer non-contact methods
- Controlled & Mass Flow Excavation
- Highly qualified & experienced operators
- Real time sonar monitoring of service
- Rotech Engineering & Fabrication

TRS2 Capabilities :

- Operating depths	1.5m - 300m*
* 3000m with additional electric power unit.	
- Excavator Outlet Pressure	0 to 60kPa
- Velocity	0 -10m/s
- TRS2 Cutting of soils	180kpa

see deck plan on other side

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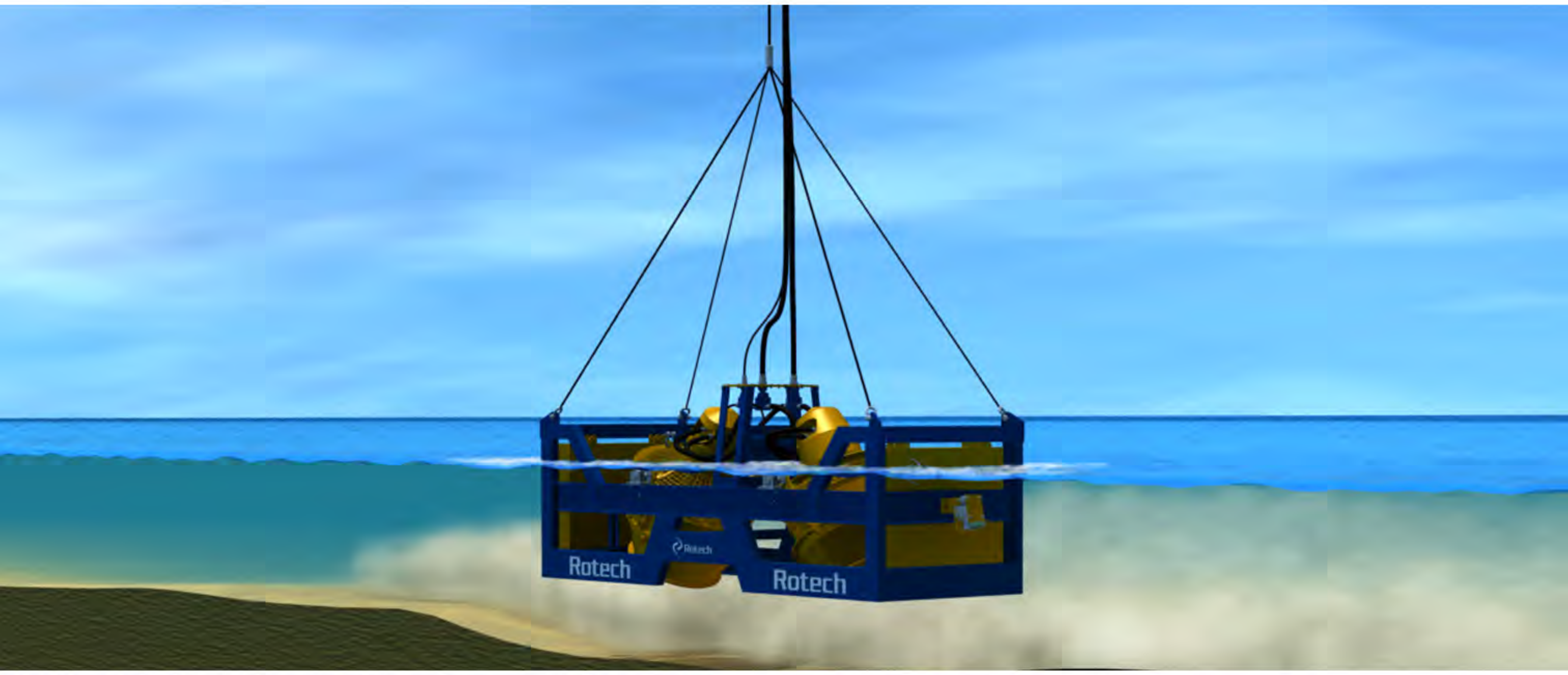
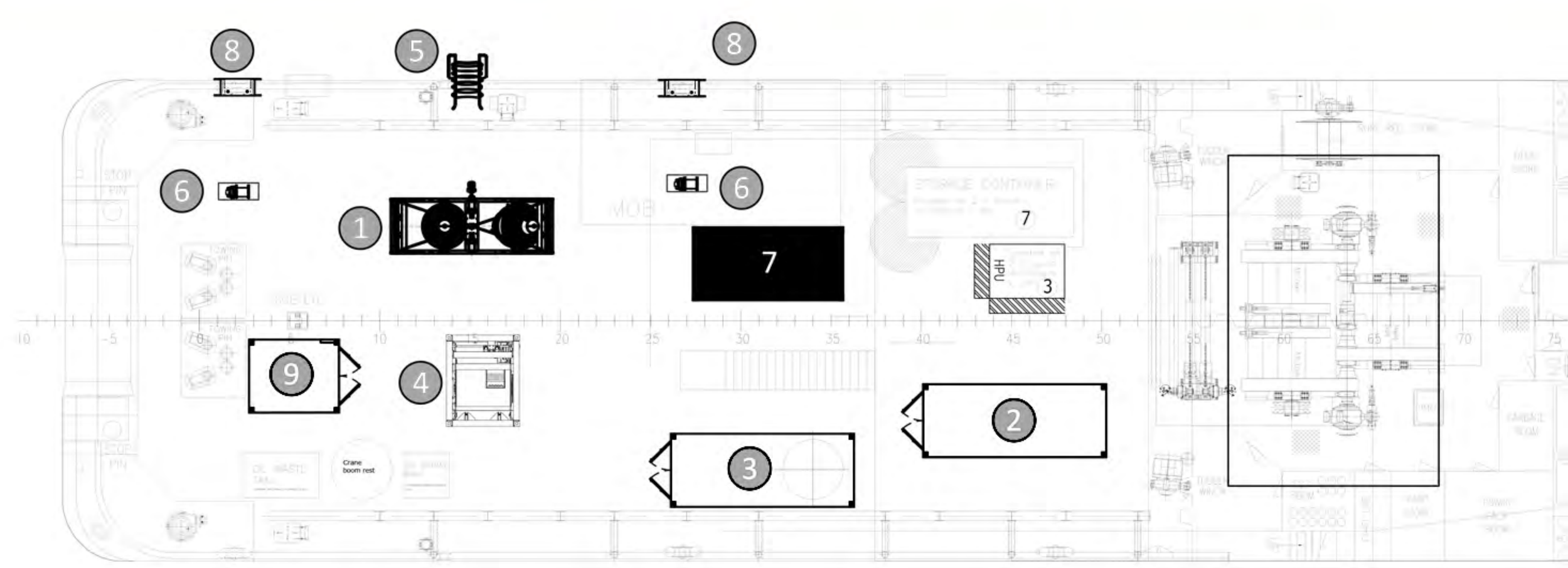
Rotech SUBSEA

World leaders in excavation since 1994

TRS2 DECK PLAN

Controlled flow excavation system





Rotech Subsea Equipment			
Item	Item	Dimensions (m)	Weight (kg)
1	TRS2 Tool	5.4 x 1.83 x 2.24	12000
2	Tool HPU	6.10 x 2.45 x 2.40	16000
3	Spares container (Rotech)	6.10 x 2.45 x 2.70	12000
4	Hydraulic Umbilical Winch	2.26 x 2.56 x 2.42	10000
5	Umbilical Chute	2.90 x 0.84 x 1.17	1000
6	Deck Tugger	1.34x0.56 x 0.69	1100
7	Tugger Compressor	5.02 x 2.45 x 2.51	10000
8	Universal Roller Fairlead (Option)	1.55 x 0.56 x 1.14	500
9	Control Shack (Option)	3.05 x 2.45 x 2.60	5000

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Tideway

Offshore Solutions

D.P. TRAILING SUCTION HOPPER DREDGER
‘PEARL RIVER’

D.P. TRAILING SUCTION HOPPER DREDGER

‘PEARL RIVER’

Main data

Length overall	182.22 m.
Breadth	28.00 m.
Moulded depth	11.90 m.
Draught loaded max.	10.77 m.
Max. speed loaded	15 knots
Hopper capacity	24,146 m3
Loading capacity	35,025 tons
Dredging depth	
normal suction pipe	30.00 m.
long suction pipe	60.00 m.
extra long suction pipe	135 m.
Number of suction pipes	2
Diameter of suction pipes	1,200 mm.
Power:	
on suction pumps	2 x 3,000kW
on discharge pump (SB)	4,700 kW
on discharge pump (PS)	7,200 kW
Main engines	2 x 8,640 kW
Total installed power	19,050 kW

VITRUVIUS

Backhoe Dredger

Jan De Nul
GROUP

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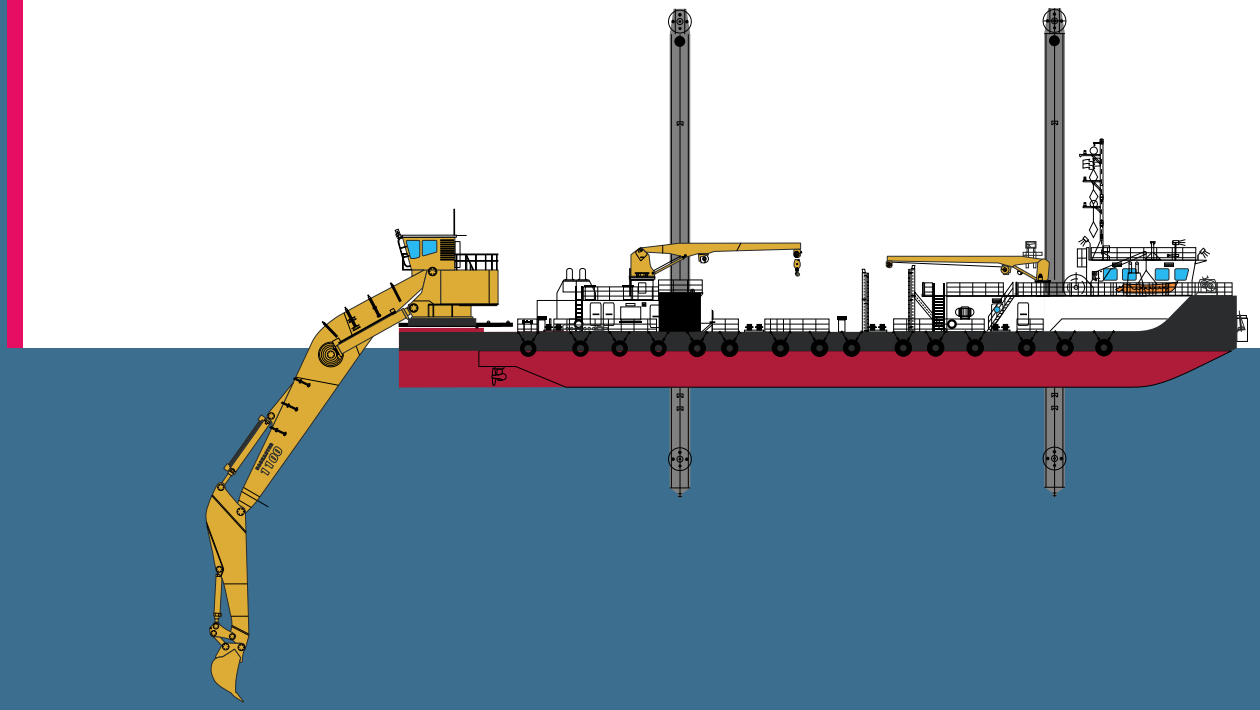
VITRUVIUS

Length o.a.	64.9 m
Breadth	20.4 m
Draught	3.35 m
Dredging depth	18 / 26 / 32 m
Excavator type	Backacter 1100
Bucket / Grab capacity	15 / 25 / 40 m³
Total installed diesel power	4,100 kW
Installed power excavator	3,800 kW
Propulsion power	2 x 500 kW
Built in	2007



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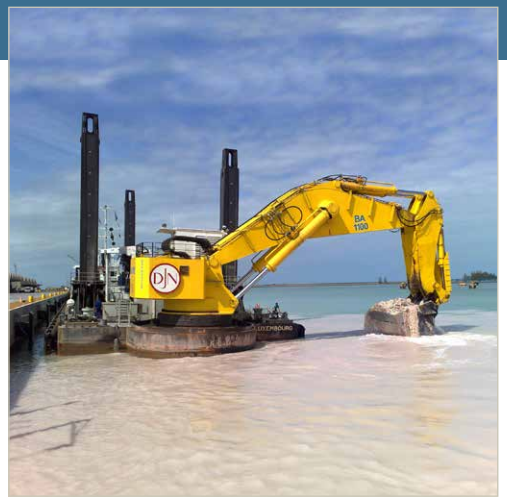

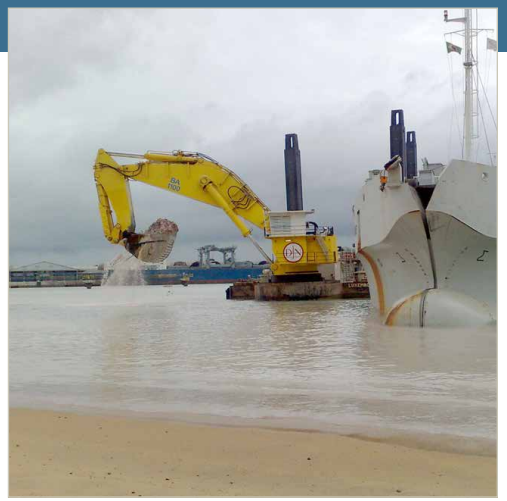

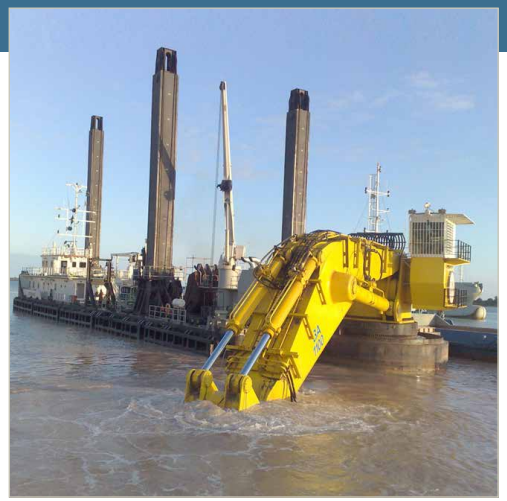

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TIGER

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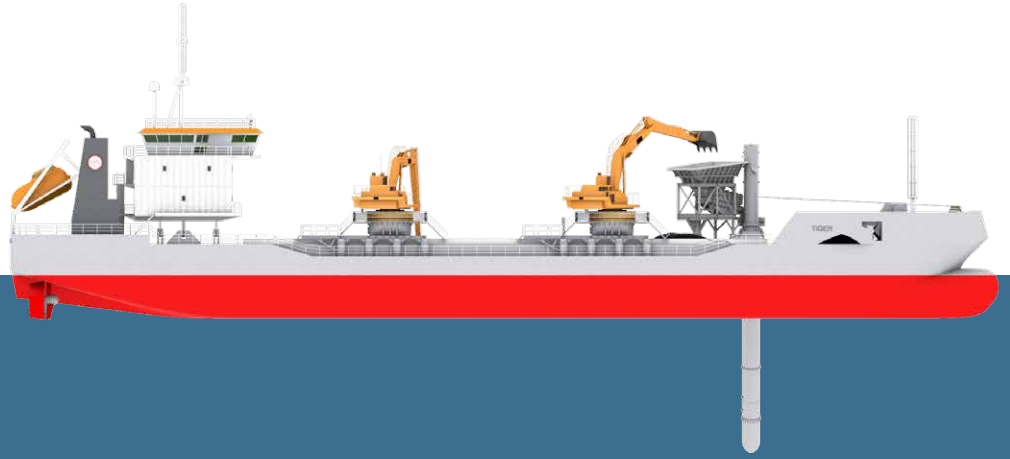
DP Rock Installation
Vessel with Inclined Fall Pipe

TIGER

Hopper capacity	3,700 m³
Rock carrying capacity	3,500 ton
Deadweight	6,310 ton
Length o.a.	99.5 m
Breadth	19.4 m
Draught loaded	5.85 m
Propulsion power	2 x 1,850 kW
Bow thruster power	550 kW
Dynamic positioning	DYNAPOS AM/AT Class 1
Self loading capacity	2 Liebherr 984 excavators
Inclined fall pipe length	21 m
Inclined fall pipe diameter	1,800 mm
Rock size range	0 – 300kg
Equipped in moonpool	HIPAP DGPS, Multibeam
Speed	13.0 kn
Accommodation	20
Built in	2012



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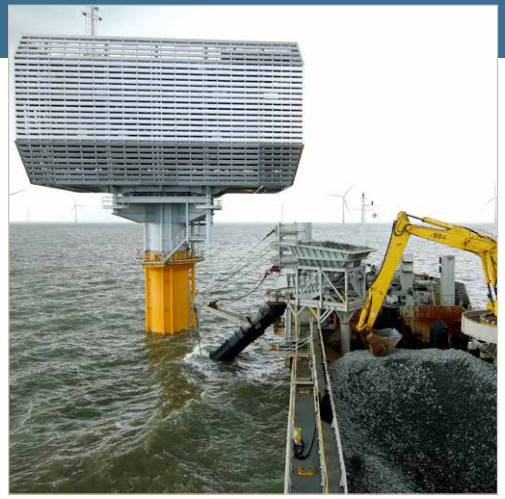

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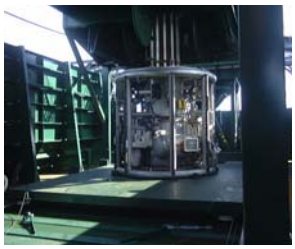
APPENDIX E Rock Placement Vessels – Seahorse and Atlantis

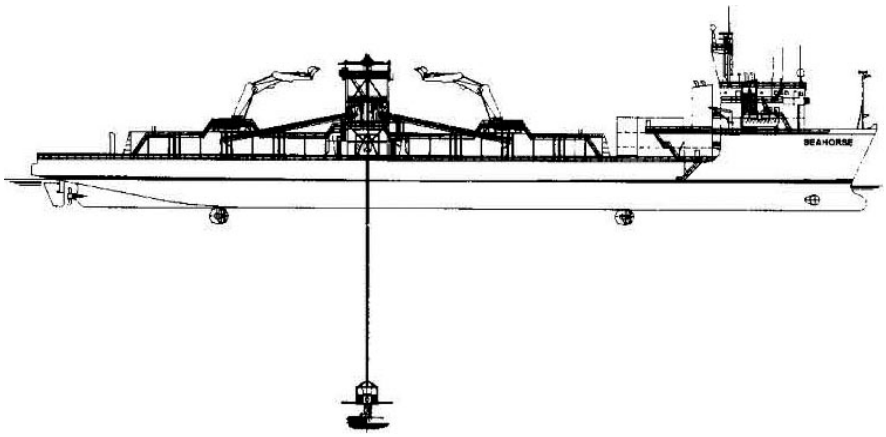
Tideway
Offshore Contractors

D.P. FALL PIPE VESSEL ‘SEAHORSE’



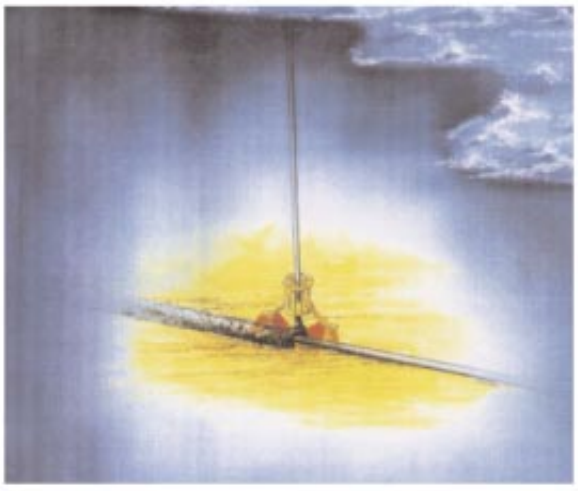
D.P. FALL PIPE VESSEL ‘SEAHORSE’

The D.P. Fall Pipe Vessel ‘Seahorse’ is the largest rockdumping vessel in the world with a loading capacity of approx. 19,000 tons and has been in service since the year 2000. The vessel is a fully certified Class II D.P. vessel and can therefore operate within 500 metre zones and close to platforms / structures without tug assistance. The survey system with active heave-compensated ROV, including multi-beam echosounder, and the on-line processing system are considered the most advanced in the industry..



Main data

Length overall	162.00	m.
Breadth	38.00	m.
Draught loaded	6.34	m.
Loading capacity	19,000	tons
Main propellors	2 x 3,220	kW
Azimuth thruster	(retractable) 4 x 1,000	kW
Bow thruster	(tunnel) 1 x 600	kW
Cruising speed	12	kts



Dynamic Positioning	Kongsberg Simrad SDP 2 Dynamic Positioning System with Auto Track, Auto Heading and Follow ROV mode
Fall Pipe	Fall Pipe Steel pipe section (8 m.) with internal rubber lining deployed through moonpool Diameter 1,000 / 680 mm. depth up to 1,500 / 2,000 m.
ROV	Active heave compensated on wire, controlling lower Fall Pipe end. Equipped with cameras , pro-filers, pipe tracker and other sensors as required. power 300 kW
Classification	LR 00 AI * LMC * UMS * DP (AA) Rock Dumping Vessel IMO / ISM - Code

Tideway
Offshore Contractors

MULTI-PURPOSE MARINE WORKING VESSEL
‘ATLANTIS’

MULTI-PURPOSE MARINE WORKING VESSEL

‘ATLANTIS’

Multi-purposes:

Stone dumping works

Heavy lifting or pilling works

Fibre optic cable laying works in shallow waters

Subsea power cable laying works

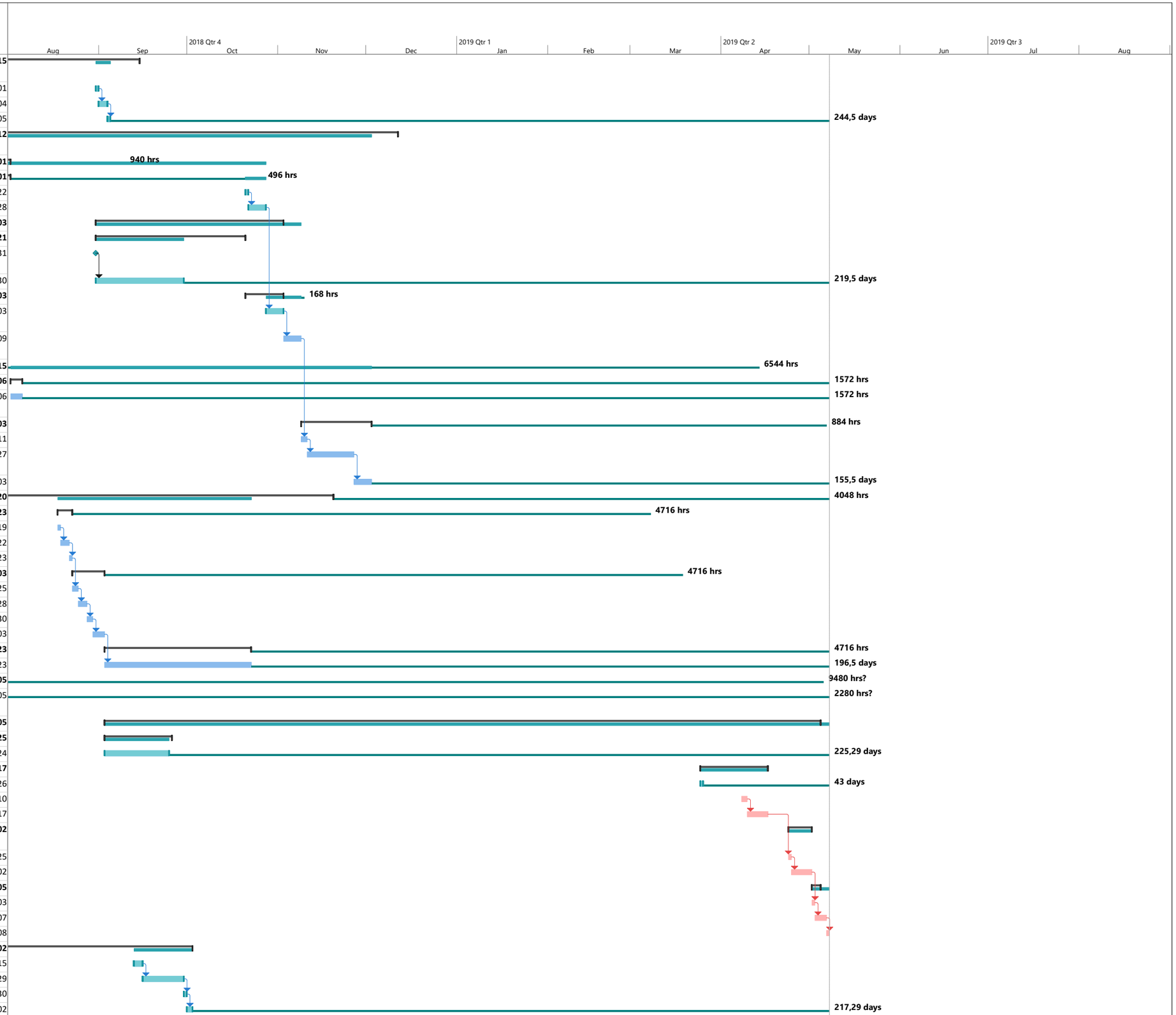
Heavy transport and diving support vessel

Main data

Year of Built	1997
Length overall	80 m.
Breadth	22 m.
Loading capacity	2,000 tons
Loading deck	4 x 15 x 9.70 m.
Discharging time	11 min.
Propulsion:	
2 Azimuth thrusters	2 x 800 Hp
1 bow thruster	500 Hp
Mooring system	4 x 300 m.
Max. p.F.	30 tons
Max. h.F.	68 tons
Dynamic positioning:	
Simrad Albatros	ADP 701
	MK 1
Classification:	Lloyd’s Register of Shipping
	+ 100A1 LMC UMS

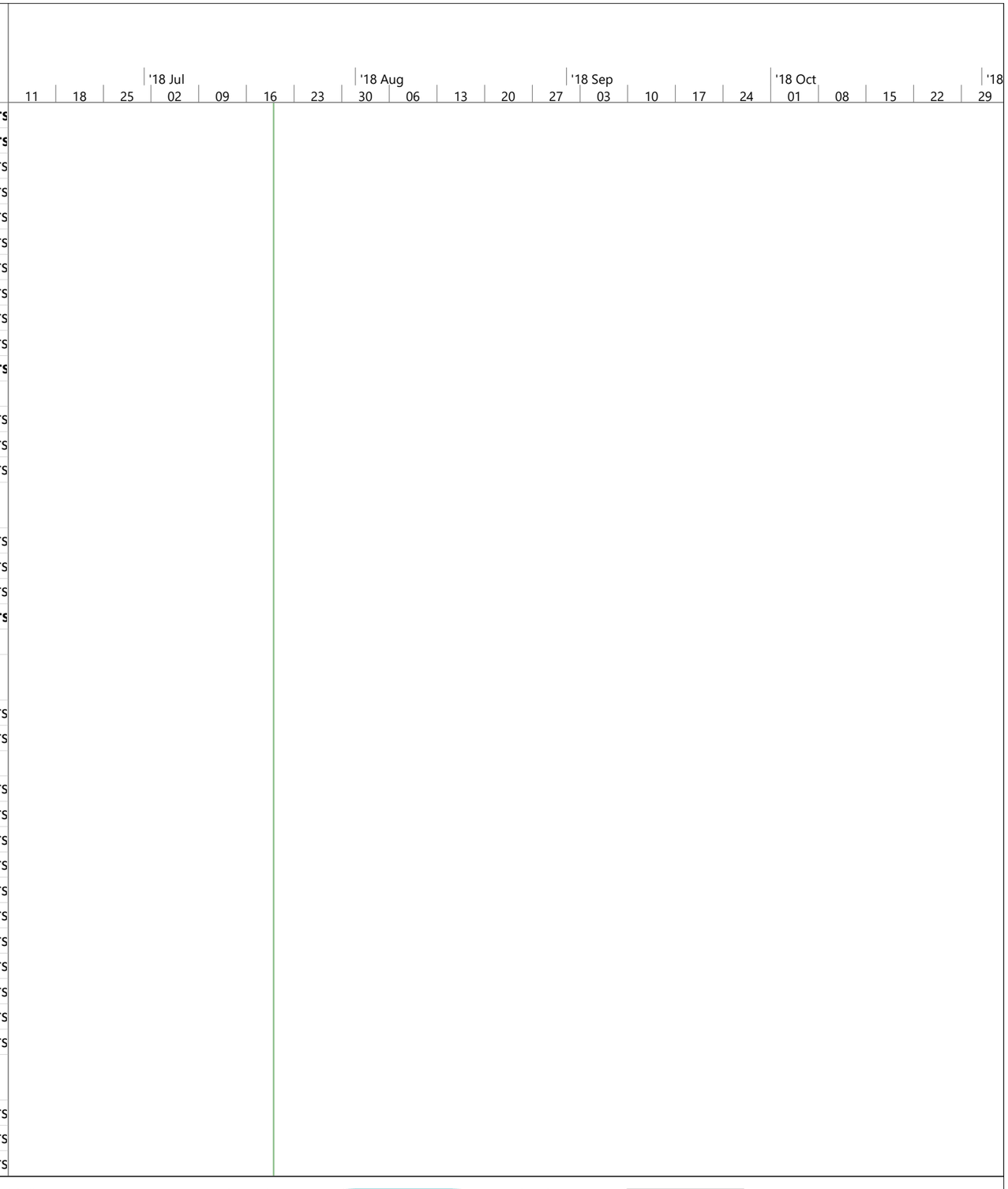
APPENDIX F – Project Schedule

ID	Task Mode	Name	Duration	Start	Finish
1		**KP 1.6 - 3.5 Cable burial survey - Pangeo / Diver Survey**	**2284 hrs**	**2018-06-12**	**2018-09-15**
2		Vessel mobilisation	1 day	2018-08-31	2018-09-01
3		Pangeo tracker survey	3 days	2018-09-01	2018-09-04
4		Vessel demob	1 day	2018-09-04	2018-09-05
5		**Rock Campaign**	**4540 hrs?**	**2018-06-06**	**2018-12-12**
6		**KP 100.087-112.467 Remaining works**	**1353 hrs**	**2018-06-06**	**2018-08-01**
7		**Seahorse Rock Campaign**	**108 hrs**	**2018-07-15**	**2018-08-01**
8		Mobilisation Seahorse	1 day	2018-10-21	2018-10-22
9		Offshore Rock Campaign (1 Load)	6 days	2018-10-22	2018-10-28
10		**KP 1.6 - 3.6 (Pop out & Omega)**	**1536 hrs**	**2018-08-31**	**2018-11-03**
11		**Campaign Pre work**	**288 hrs**	**2018-08-31**	**2018-10-21**
12		Confirmation of MFE Results (As trenched)	0 days	2018-08-31	2018-08-31
13		Remedial Trenching (If required)	30 days	2018-08-31	2018-09-30
14		**Seahorse Rock camapign (2 Loads)**	**312 hrs**	**2018-10-21**	**2018-11-03**
15		KP 1.622-2.8 (worst case 18,000t based on 2 layer berm 15t/m, no	6 days	2018-10-28	2018-11-03
16		KP 2.8-3.6 (worst case 12,000t based on 15t/m, no backfill)	6 days	2018-11-03	2018-11-09
17		**All remaining Rock**	**0 days**	**2018-07-15**	**2018-07-15**
18		**Campaign Pre Work**	**24 hrs**	**2018-08-01**	**2018-08-06**
19		Clarification of acope (deburial areas etc.)	24 hrs	2018-08-01	2018-08-06
20		**Seahorse rock Campaign (Continued)**	**128 hrs**	**2018-11-09**	**2018-12-03**
21		Kp 3,8-7.2 (Areas S3-16) 8,200t	2 days	2018-11-09	2018-11-11
22		KP 100.925-111.345 (areas not completed in July)	16 days	2018-11-11	2018-11-27
23		KP 13.158 +-400m plus omega loops	6 days	2018-11-27	2018-12-03
24		**Backfill Campaign**	**5472 hrs**	**2018-04-06**	**2018-11-20**
25		**KP 83-86 Excavation & Inspections**	**120 hrs**	**2018-08-18**	**2018-08-23**
26		Mobilise Excavation spread	24 hrs	2018-08-18	2018-08-19
27		Excavation works	72 hrs	2018-08-19	2018-08-22
28		Survey / Inspection	24 hrs	2018-08-22	2018-08-23
29		**Backfill Trial**	**264 hrs**	**2018-08-23**	**2018-09-03**
30		Mobilise trenching plough	48 hrs	2018-08-23	2018-08-25
31		Trenching	72 hrs	2018-08-25	2018-08-28
32		Mobilise backfill plough	48 hrs	2018-08-28	2018-08-30
33		Trial backfill	96 hrs	2018-08-30	2018-09-03
34		**Offshore Works**	**1200 hrs**	**2018-09-03**	**2018-10-23**
35		Backfill Operations	50 days	2018-09-03	2018-10-23
36		**Excavate Cable at KP 14 & 16**	**57 hrs?**	**2018-04-03**	**2018-04-05**
37		Works postponed pending discussions on cable replacement KP 11-16	24 hrs?	2018-04-03	2018-04-05
38		**KP 11-16 Cable Replacement**	**5863 hrs**	**2018-09-02**	**2019-05-05**
39		**Cable Manufacturing**	**136 hrs**	**2018-09-02**	**2018-09-25**
40		Manufacturing 12km	22 days	2018-09-02	2018-09-24
41		**Cable Lay Campaign**	**552 hrs**	**2019-03-25**	**2019-04-17**
42		Mobilisation	1 day	2019-03-25	2019-03-26
43		Cable Lay Campaign	2 days	2019-04-08	2019-04-10
44		Omega Joint & laydown	7 days	2019-04-10	2019-04-17
45		**Cable burial campaign Jet Trenching KP 11-16**	**192 hrs**	**2019-04-24**	**2019-05-02**
46		Mobilisation Jet trenching vessel	1 day	2019-04-24	2019-04-25
47		Trenching campaign	7 days	2019-04-25	2019-05-02
48		**Remedial Rock (if required)**	**72 hrs?**	**2019-05-02**	**2019-05-05**
49		Mobilisation	24 hrs	2019-05-02	2019-05-03
50		Rock placement	96 hrs	2019-05-03	2019-05-07
51		Demob	24 hrs?	2019-05-07	2019-05-08
52		**TZ1 Rework (provisional)**	**2169 hrs**	**2018-07-04**	**2018-10-02**
53		Vessel Mobilisation	3 days	2018-09-12	2018-09-15
54		Rock placement & survey	14 days	2018-09-15	2018-09-29
55		Final Survey	1 day	2018-09-29	2018-09-30
56		Demob	2 days	2018-09-30	2018-10-02



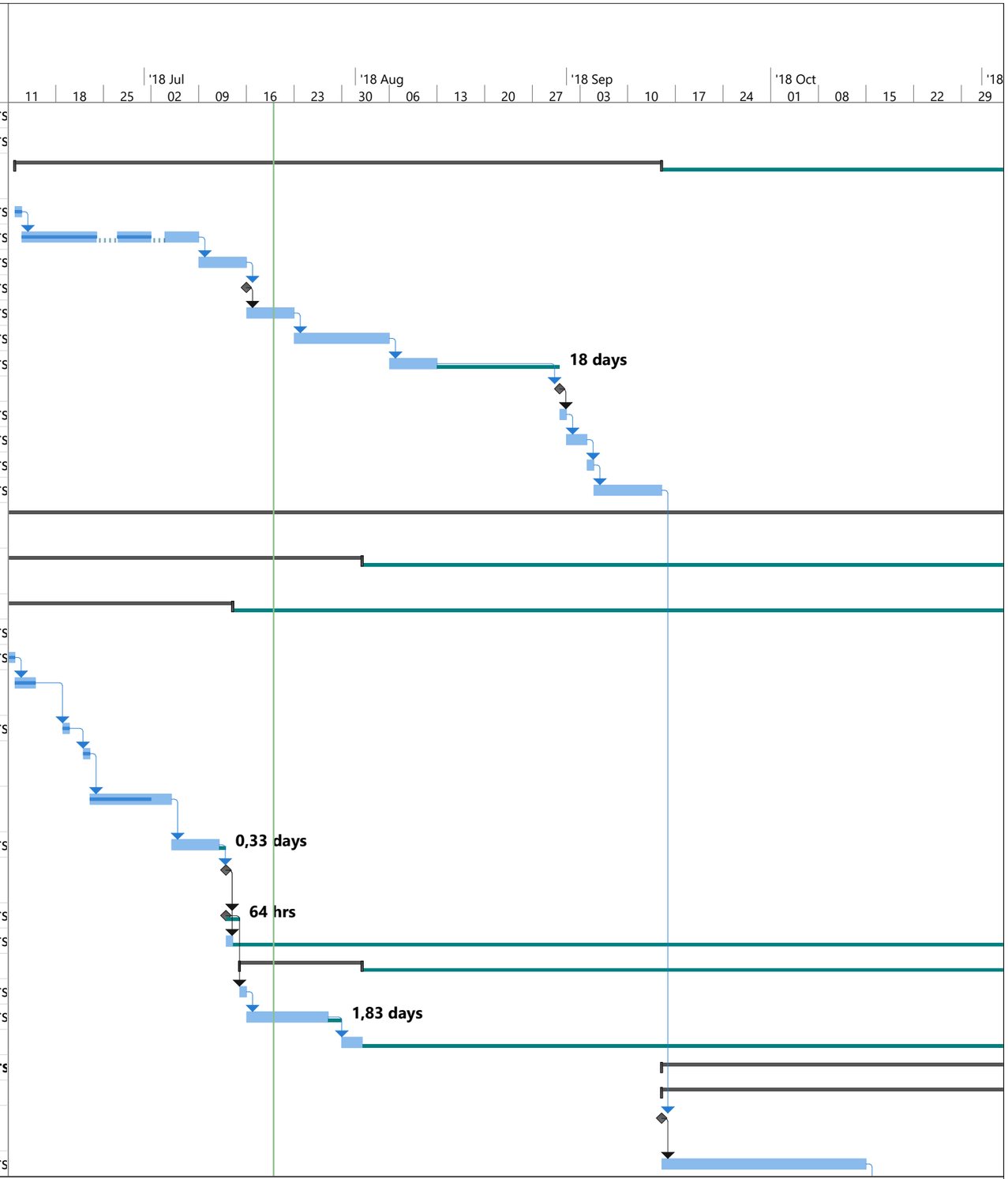
Critical, Critical Split, Task, Split, Milestone, Slack, Slippage, Summary, Project Summary, Rolled Up Critical, Rolled Up Critical Split, Inactive Task, Inactive Milestone, Inactive Summary, Manual Task, Duration-only, Manual Summary Rollup, Manual Summary, Start-only, Finish-only, External Tasks, External Milestone, Deadline, Progress

ID	Task Mode	Name	Duration	Start	Finish	Predecessors	Task Calendar
1		**Portgordon Pull In**	**144 hrs**	**Apr 03 08:00**	**Apr 09 08:00**		**24 Hours**
6		**Caldive PG Works**	**172 hrs**	**Apr 23 08:00**	**Apr 30 12:00**		**24 Hours**
7		Bundling works	24 hrs	Apr 23 08:00	Apr 24 08:00		24 Hours
8		Pick up and place rock filter bag on FO cabl	24 hrs	Apr 24 08:00	Apr 25 08:00	7	24 Hours
9		Air lift around HDD2- remove bend restricti	36 hrs	Apr 25 08:00	Apr 26 20:00	8	24 Hours
10		Air lift around HDD3 and fit seal. 8hrs.	8 hrs	Apr 26 20:00	Apr 27 04:00	9	24 Hours
11		Air lift around HDD4- remove bend restricti	24 hrs	Apr 27 04:00	Apr 28 04:00	10	24 Hours
12		Recover rock bags and concrete mats. 8hrs	24 hrs	Apr 28 04:00	Apr 29 04:00	11	24 Hours
13		Recover any operational materials and as le	8 hrs	Apr 29 04:00	Apr 29 12:00	12	24 Hours
14		Demob. 1 day.	24 hrs	Apr 29 12:00	Apr 30 12:00	13	24 Hours
15		**MFE Works (Relume / Hercules Campaign 1)**	**1608 hrs**	**Apr 03 08:00**	**Jun 09 08:00**		**24 Hours**
16		**Preparatory Work**	**280 hrs**	**Apr 03 08:00**	**May 22 08:00**		**None**
17		Rotech Contract	13 days	Apr 03 08:00	Apr 16 08:00		24 Hours
18		I-Survey Contract	13 days	Apr 03 08:00	Apr 16 08:00		24 Hours
19		Vessel Contract	13 days	Apr 03 08:00	Apr 16 08:00		24 Hours
20		Spread contracted 4 weeks in advance of Mob	0 days	Apr 16 08:00	Apr 16 08:00	17;18;19	24 Hours
21		Engineering Procedures and review	28 days	Apr 24 08:00	May 22 08:00	17;18;19	24 Hours
22		Vessel Inspection (Relume)	1 day	Apr 26 08:00	Apr 27 08:00		24 Hours
23		MFE - HIRA (Aberdeen)	8 hrs	May 08 09:00	May 08 17:00	22	24 Hours
24		**Offshore Operations**	**704 hrs**	**May 11 00:00**	**Jun 09 08:00**		**24 Hours**
25		**KP 13.15 Fault Search**	**8 hrs**	**May 11 00:00**	**May 13 22:00**		**None**
26		KP 13.150 Fault search ROV Mobilisation	32 hrs	May 11 00:00	May 12 08:00		24 Hours
27		Fault search	14 hrs	May 12 08:00	May 12 22:00	26	24 Hours
28		Demob Fault ROV	24 hrs	May 12 22:00	May 13 22:00	27	24 Hours
29		**MFE Campaign**	**160 hrs**	**May 14 08:00**	**Jun 09 08:00**		**None**
30		MFE Mobilisation	2 days	May 14 08:00	May 16 12:00	28	24 Hours
31		Transit to site	1 day	May 16 12:00	May 17 12:00	30	24 Hours
32		KP 1,722 - 2,8	2 days	May 17 12:00	May 22 00:00	31	24 Hours
33		Omega Joints	6 days	May 22 08:00	May 28 08:00		24 Hours
34		KP 1.622 - 1.722	6 days	May 22 08:00	May 28 08:00	33	24 Hours
35		MFE trench survey	1 day	May 28 20:00	May 29 20:00	45	24 Hours
36		Rework	2 days	May 29 08:00	May 31 08:00	46	24 Hours
37		Backfilling	3 days	May 31 08:00	Jun 03 08:00	36	24 Hours
38		Post Backfill Survey	1 day	Jun 03 08:00	Jun 04 08:00	37	24 Hours
39		Demobilisation	1 day	Jun 04 08:00	Jun 05 08:00	38	24 Hours
40		As trenched survey processing	4 days	Jun 05 08:00	Jun 09 08:00	39	24 Hours
41		**De-burial and cable inspection KP 11.156-11.300**	**72 hrs**	**May 26 08:00**	**May 29 08:00**	**34**	**24 Hours**
42		ROV GVI of work area	4 hrs	May 28 04:00	May 28 08:00	34	24 Hours
43		TRS1 Excavation pass 1	1 day	May 26 08:00	May 27 08:00	42	24 Hours
44		TRS1 Excavation pass 2	1 day	May 27 08:00	May 28 08:00	43	24 Hours



Critical
Critical Split
Task
Split
Milestone
Slack
Slippage
Summary
Project Summary
Rolled Up Critical
Rolled Up Critical Split
Inactive Task
Inactive Milestone
Inactive Summary
Manual Task
Duration-only
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
External Tasks
External Milestone
Deadline
Progress

ID	Task Mode	Name	Duration	Start	Finish	Predecessors	Task Calendar
45		ROV Inspection of cable	1 day	May 27 20:00	May 28 20:00	44	24 Hours
46		MBES Survey	12 hrs	May 28 20:00	May 29 08:00	45	24 Hours
47		**KP 1.6 - 3.5 Cable burial survey - Pangeo / Diver Survey**	**2284 hrs**	**Jun 12 08:00**	**Sep 15 12:00**		**24 Hours**
48		Pangeo - supplier / concept discussions	1 day	Jun 12 08:00	Jun 13 08:00		24 Hours
49		Pangeo - Supplier proposal	20 days	Jun 13 08:00	Jul 09 12:00	48	24 Hours
50		Pangeo NKT / Shet review of proposal	7 days	Jul 09 12:00	Jul 16 12:00	49	24 Hours
51		NKT / Shet acceptance of proposal	0 days	Jul 16 12:00	Jul 16 12:00	50	24 Hours
52		Marine scotland acceptance	7 days	Jul 16 12:00	Jul 23 12:00	51	24 Hours
53		Documentation preparation	14 days	Jul 23 12:00	Aug 06 12:00	52	24 Hours
54		Documentation Review and acceptance	7 days	Aug 06 12:00	Aug 13 12:00	53	24 Hours
55		Vessel availability	0 days	Aug 31 12:00	Aug 31 12:00	54	None
56		Vessel mobilisation	1 day	Aug 31 12:00	Sep 01 12:00	55	24 Hours
57		Pangeo tracker survey	3 days	Sep 01 12:00	Sep 04 12:00	56	24 Hours
58		Vessel demob	1 day	Sep 04 12:00	Sep 05 12:00	57	24 Hours
59		Data & report preparation	10 days	Sep 05 12:00	Sep 15 12:00	58	24 Hours
60		**Rock Campaign**	**4540 hrs?**	**Jun 06 08:00**	**Dec 12 12:00**		**24 Hours**
61		**KP 100.087-112.467 (Premature backfill area & West of HMB) Campaign 1**	**1353 hrs**	**Jun 06 08:00**	**Aug 01 17:00**		**24 Hours**
62		**Pre Campaign Tasks**	**232 hrs**	**Jun 06 08:00**	**Jul 13 20:00**		**None**
63		Re-survey trench Kp 100-112	1 day	Jun 06 08:00	Jun 07 08:00		24 Hours
64		Survey data processing	5 days	Jun 07 08:00	Jun 12 08:00	63	24 Hours
65		Re-design rock areas NKT / OEC (Based on 8927 principles)	3 days	Jun 12 08:00	Jun 15 08:00	64	24 Hours
66		NKT Shet joint review (EW 41420)	1 day	Jun 19 08:00	Jun 20 08:00	65	24 Hours
67		Re-design rock berm based on revised principles (Not 8927)	1 day	Jun 22 12:00	Jun 23 12:00	66	24 Hours
68		Tideway preparation of rock berm design	12 days	Jun 23 12:00	Jul 05 12:00	67	24 Hours
69		SHEt application to MS	7 days	Jul 05 12:00	Jul 12 12:00	68	24 Hours
70		Confirmation of scope acceptance SHET / MS	0 hrs	Jul 12 20:00	Jul 12 20:00	69	24 Hours
71		NKT Confirm SOW for Seahorse	0 hrs	Jul 12 20:00	Jul 12 20:00	70	24 Hours
72		NKT Issue NTM for Seahorse	1 day	Jul 12 20:00	Jul 13 20:00	70	24 Hours
73		**Seahorse Rock Campaign**	**108 hrs**	**Jul 15 12:00**	**Aug 01 17:00**		**None**
74		Mobilisation Seahorse	1 day	Jul 15 12:00	Jul 16 12:00	71	24 Hours
75		Offshore Rock Campaign (2 Loads)	12 days	Jul 16 12:00	Jul 28 12:00	74	24 Hours
76		Demob Seahorse	1 day	Jul 30 08:00	Aug 01 17:00	75	None
77		**KP 1.6 - 3.6 (Pop out & Omega)**	**1536 hrs**	**Sep 15 12:00**	**Nov 18 12:00**		**24 Hours**
78		**Campaign Pre work**	**284 hrs**	**Sep 15 12:00**	**Nov 05 12:00**		**None**
79		Confirmation of MFE Results (As trenched)	0 days	Sep 15 12:00	Sep 15 12:00	59	24 Hours
80		Remedial Trenching (If required)	30 days	Sep 15 12:00	Oct 15 12:00	79	24 Hours



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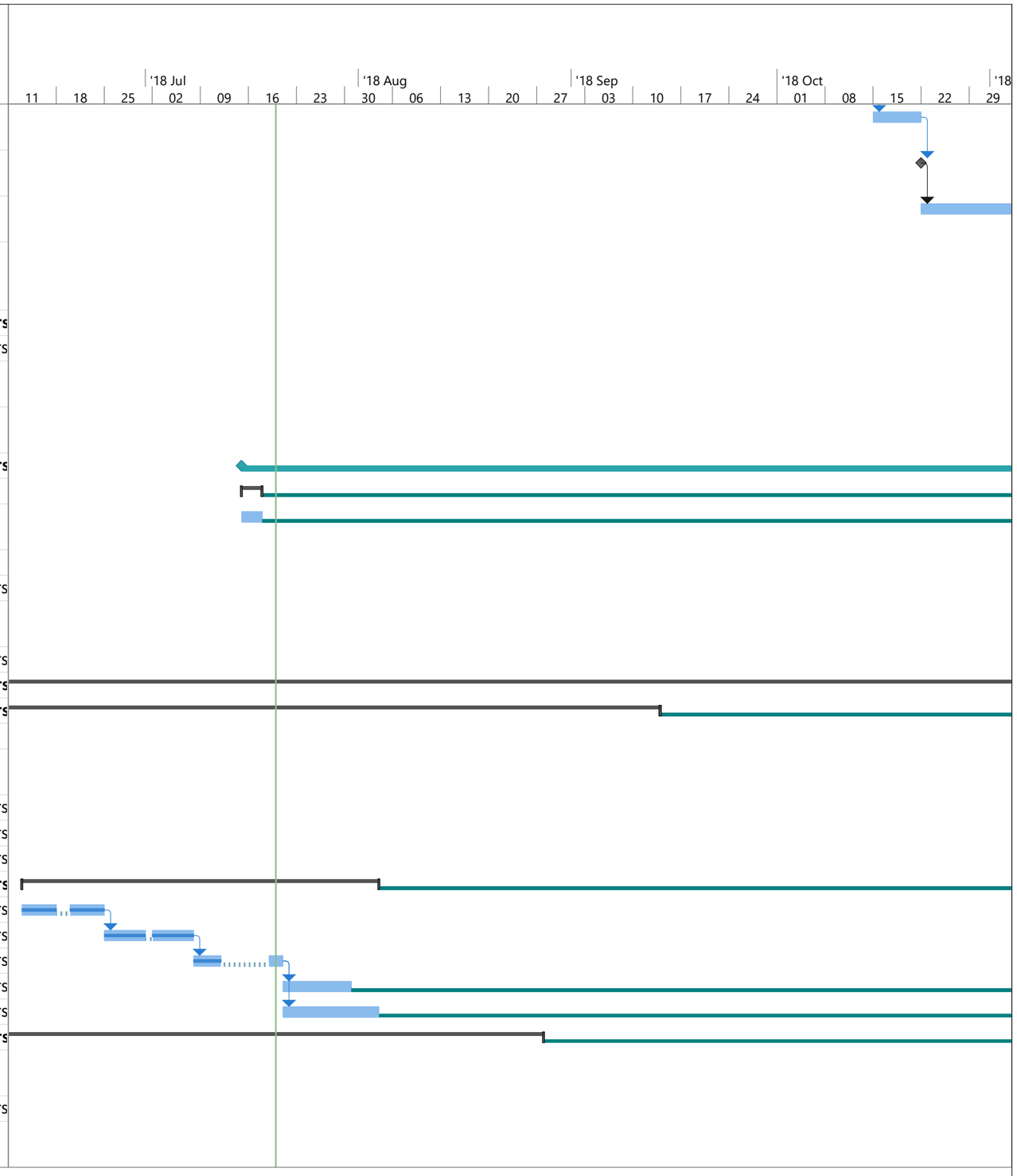
ID	Task Mode	Name	Duration	Start	Finish	Predecessors	Task Calendar
81		Design of Rock berm for MFE trench KP 1.622-1.6, 11.158-11.300	7 days	Oct 15 12:00	Oct 22 12:00	80	24 Hours
82		Confirmation MS Permit Volume not exceeded	0 days	Oct 22 12:00	Oct 22 12:00	81	24 Hours
83		Application to MCA if 5% depth reduction exceeded	14 days	Oct 22 12:00	Nov 05 12:00	82	24 Hours
84		Confirm Rock design Accepted by MS & MCA (applicable to Seahorse scope only)	0 days	Nov 05 12:00	Nov 05 12:00	83	24 Hours
85		**Seahorse Rock camapign (2 Loads)**	**312 hrs**	**Nov 05 12:00**	**Nov 18 12:00**		**24 Hours**
86		Seahorse Mobilisation	1 day	Nov 05 12:00	Nov 06 12:00	84	24 Hours
87		KP 1.622-2.8 (worst case 18,000t based on 2 layer berm 15t/m, no	6 days	Nov 06 12:00	Nov 12 12:00	86	24 Hours
88		KP 2.8-3.6 (worst case 12,000t based on 15t/m, no backfill)	6 days	Nov 12 12:00	Nov 18 12:00	87	24 Hours
89		**All remaining Rock**	**0 days**	**Jul 15 08:00**	**Jul 15 08:00**		**24 Hours**
90		**Campaign Pre Work**	**24 hrs?**	**Jul 15 08:00**	**Jul 17 17:00**		**None**
91		Clarification of acope (deburial areas etc.)	24 hrs?	Jul 15 08:00	Jul 17 17:00		None
92		**Seahorse rock Campaign (Continued)**	**140 hrs**	**Nov 18 12:00**	**Dec 12 12:00**		**None**
93		Kp 3,8-7.2 (Areas S3-16) 8,200t	2 days	Nov 18 12:00	Nov 20 12:00	88	24 Hours
94		KP 100.925-111.345 (areas not completed in July)	16 days	Nov 20 12:00	Dec 06 12:00	93	24 Hours
95		KP 13.158 +-400m plus omega loops	6 days	Dec 06 12:00	Dec 12 12:00	94	24 Hours
96		**Backfill Campaign**	**5472 hrs**	**Apr 06 08:00**	**Nov 20 08:00**		**24 Hours**
97		**Pre Work due KP 11.2 Incident**	**3864 hrs**	**Apr 06 08:00**	**Sep 14 08:00**		**24 Hours**
98		**RCA1 - KP 11.2 only**	**184 hrs**	**Apr 13 08:00**	**May 16 08:00**		**None**
99		Backfill incident KP 11.2 RCA Received NKT	0 hrs	Apr 13 08:00	Apr 13 08:00		24 Hours
100		RCA Review & Comment	3 days	Apr 13 08:00	Apr 16 08:00	99	24 Hours
101		RCA Rework	24 days	Apr 22 08:00	May 16 08:00	100	24 Hours
102		RCA review & NKT acceptance	7 days	May 09 08:00	May 16 08:00	101	24 Hours
103		**RCA2 - KP 11.2 & 13.3**	**1230 hrs**	**Jun 13 08:00**	**Aug 03 14:00**		**24 Hours**
104		Ecosse 1st Draft	9 days	Jun 13 08:00	Jun 25 00:00		24 Hours
105		NKT review	12 days	Jun 25 00:00	Jul 08 12:00	104	24 Hours
106		Ecosse Rework	5 days	Jul 08 12:00	Jul 20 14:00	105	24 Hours
107		NKT acceptance	10 days	Jul 20 14:00	Jul 30 14:00	106	24 Hours
108		SHEt & MWS acceptance	14 days	Jul 20 14:00	Aug 03 14:00	106	24 Hours
109		**Backfill plough Modifications**	**3450 hrs**	**Apr 06 08:00**	**Aug 28 02:00**		**24 Hours**
110		Backfill Plough modifications Engineering	21 days	Apr 06 08:00	May 17 12:00	99FS-7 days	24 Hours
111		NKT acceptance of modifications	7 days	May 15 20:00	May 23 08:00	110	24 Hours
112		Backfill Plough modifications (steelwork)	10 days	May 18 08:00	Jun 02 08:00	111	24 Hours



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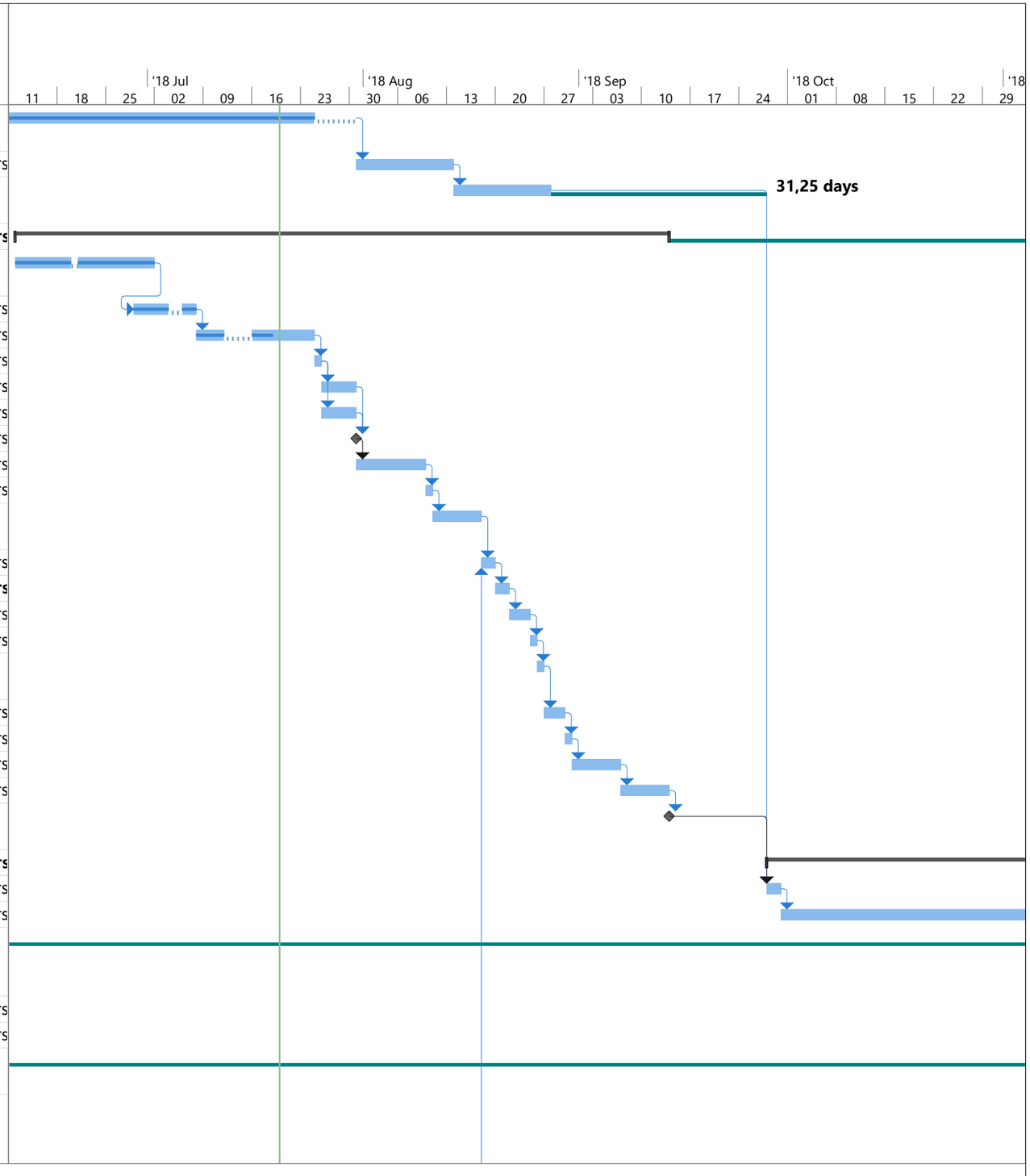
ID	Task Mode	Name	Duration	Start	Finish	Predecessors	Task Calendar
113		Revision of Associated Engineering docs	45 days	Jun 10 00:00	Jul 31 02:00	99	24 Hours
114		NKT & review and comment process	14 days	Jul 31 02:00	Aug 14 02:00	113	24 Hours
115		SHEt & MWS Acceptance of revised procedures	14 days	Aug 14 02:00	Aug 28 02:00	114	24 Hours
116		**Backfill Plough Trials**	**2252 hrs**	**Jun 12 12:00**	**Sep 14 08:00**		**24 Hours**
117		Prepare backfill plough trial proposal KP 83	19 days	Jun 12 12:00	Jul 02 08:00		24 Hours
118		NKT review of trial program	7 days	Jun 29 00:00	Jul 08 02:00	117	24 Hours
119		Trial Program revisions	13 days	Jul 08 02:00	Jul 25 08:00	118	24 Hours
120		NKT 2nd review of trial program	1 day	Jul 25 08:00	Jul 26 08:00	119	24 Hours
121		Employer review of trial program	5 days	Jul 26 08:00	Jul 31 08:00	120	24 Hours
122		MWS Review of trial program	5 days	Jul 26 08:00	Jul 31 08:00	120	24 Hours
123		Acceptance of trail al parties	0 days	Jul 31 08:00	Jul 31 08:00	121;122	24 Hours
124		Procedures drafted	10 days	Jul 31 08:00	Aug 10 08:00	123	24 Hours
125		HIRA	1 day	Aug 10 08:00	Aug 11 08:00	124	24 Hours
126		<New Task>Procedures updated after HIRA (final acceptance)	7 days	Aug 11 08:00	Aug 18 08:00	125	24 Hours
127		Mobilisation of Siem Ruby (trenching)	2 days	Aug 18 08:00	Aug 20 08:00	126;188	24 Hours
128		**KP 83-86 Excavations / Inspections**	**2 days**	**Aug 20 08:00**	**Aug 22 08:00**	**127**	**24 Hours**
129		Trial trenching	3 days	Aug 22 08:00	Aug 25 08:00	128	24 Hours
130		Survey of trench	1 day	Aug 25 08:00	Aug 26 08:00	129	24 Hours
131		Siem Ruby mobilisation of backfill plough	1 day	Aug 26 08:00	Aug 27 08:00	130	24 Hours
132		Backfill trail works	3 days	Aug 27 08:00	Aug 30 08:00	131	24 Hours
133		Backfill trial survey	1 day	Aug 30 08:00	Aug 31 08:00	132	24 Hours
134		Data process and report preparation	7 days	Aug 31 08:00	Sep 07 08:00	133	24 Hours
135		Review of Backfill results	7 days	Sep 07 08:00	Sep 14 08:00	134	24 Hours
136		NKT / MWS / SHET decision on use of modified backfill plough	0 hrs	Sep 14 08:00	Sep 14 08:00	135	None
137		**Offshore Works**	**1272 hrs**	**Sep 28 08:00**	**Nov 20 08:00**		**24 Hours**
138		Mobilisation of Siem Ruby	2 days	Sep 28 08:00	Sep 30 08:00	136FS+14 days;11	24 Hours
139		Backfill Operations	51 days	Sep 30 08:00	Nov 20 08:00	138	24 Hours
140		**Excavate and examine cable at KP 11.2 - Using MV Relume (Already mobilised to MFE Campaign)**	**509,5 hrs**	**May 10 12:00**	**May 31 17:30**		**24 Hours**
141		Ecosse prepare proposal	7 days	May 10 12:00	May 17 12:00		24 Hours
142		NKT initial review (concept)	7 days	May 10 12:00	May 17 12:00	141	24 Hours
143		Ecosse prepare procedures and program	4 days	May 17 12:00	May 23 00:00	142	24 Hours
144		Environment Assessment for Excavation & rock berms at KP 11.2 & KP 13.15 - Marinespace	4 days	May 14 08:00	May 21 08:00		24 Hours



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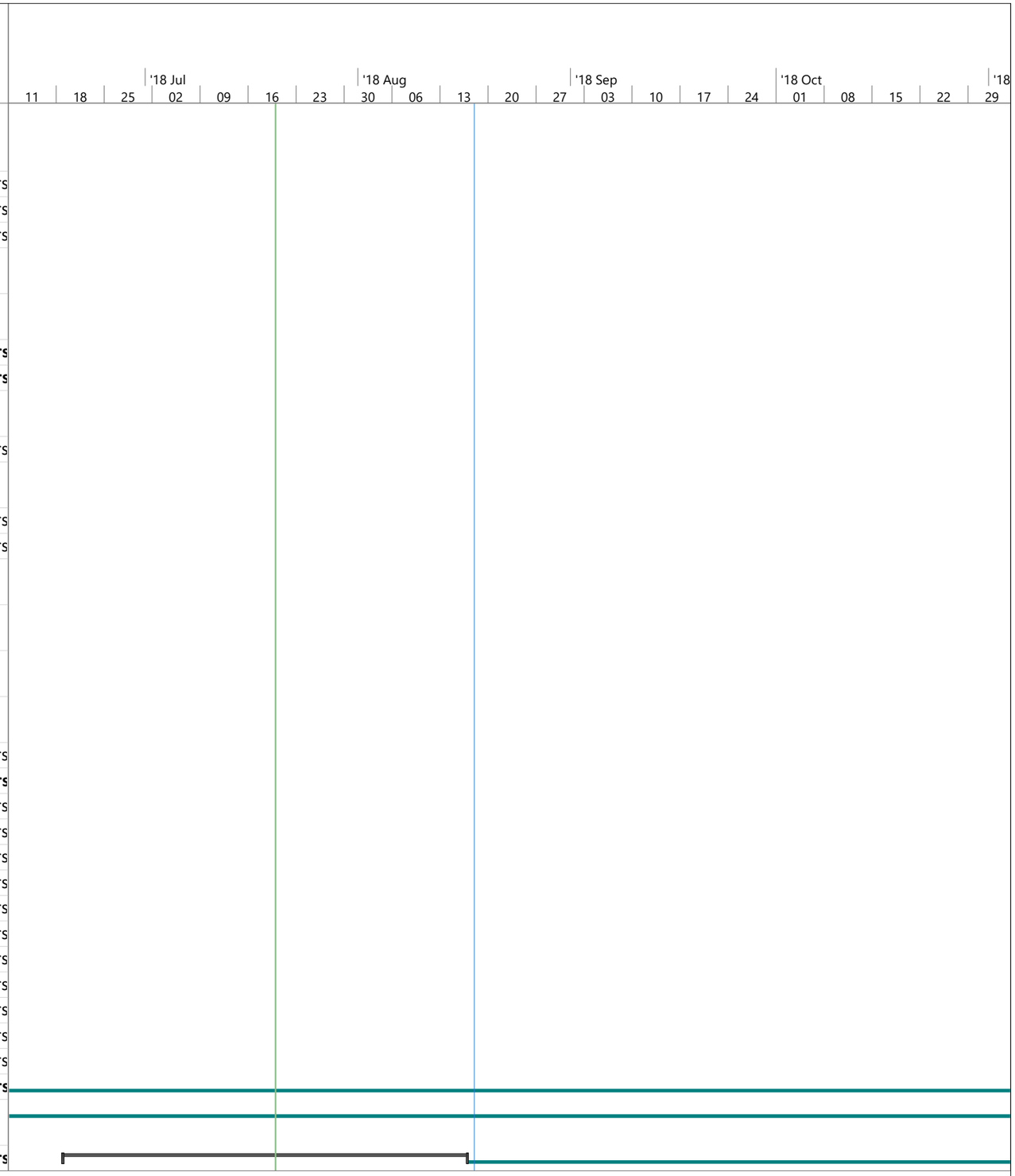
ID	Task Mode	Name	Duration	Start	Finish	Predecessors	Task Calendar
145		Marine Scotland Acceptance Environmental Assessment (Permission for additional works)	3 days	May 21 08:00	May 24 08:00	144	24 Hours
146		NKT Review & Accept procedures	3 days	May 23 00:00	May 26 00:00	143	24 Hours
147		MWS Review & Accept Procedures	3 days	May 23 00:00	May 26 00:00	143	24 Hours
148		Shet Review & Accept procedures	3 days	May 23 00:00	May 26 00:00	143	24 Hours
149		Confirmation to Start Excavation at KP 11.156-11.300	0 days	May 26 00:00	May 26 00:00	146;147;148;145	24 Hours
150		KP 11.156-11.300 Excavate and examine cable	3 days	May 28 17:30	May 31 17:30	149	24 Hours
151		**Excavation & Cable repair KP 13.158**	**568 hrs?**	**May 14 08:00**	**Jun 07 00:00**		**24 Hours**
152		**Pre Excavation documentation**	**224 hrs?**	**May 14 08:00**	**May 23 16:00**		**24 Hours**
153		Environmental Assessment Preparation (Marinespace)	7 days	May 14 08:00	May 21 08:00		24 Hours
154		Andrews Survey procedure inc. UXO	2 days	May 20 17:00	May 23 08:00		24 Hours
155		Rotech Mobilisation Procedure inc. deck plan	2 days	May 18 08:00	May 22 20:00		24 Hours
156		MV Hercules - HIRA Pre Mobilisation	8 hrs	May 21 00:00	May 21 08:00		24 Hours
157		Rotech HSE Plan – 1JND14006D006191	5 days	May 16 08:00	May 21 08:00		24 Hours
158		RS2 Debrial & Cable Recovery / Lay down - 1JND14006D006234	5 days	May 16 08:00	May 21 08:00		24 Hours
159		HIRA Draft Report - 1JND14006D006237	5 days	May 16 08:00	May 21 08:00		24 Hours
160		ITP for Rotech Subsea - 1JND14006D006240	129 hrs?	May 16 08:00	May 21 17:00		24 Hours
161		Rotech Technical Spec - 1JND14006D006264	5 days	May 16 08:00	May 21 08:00		24 Hours
162		Document Review SHEt	8 hrs	May 23 08:00	May 23 16:00	153;154;155;156;	24 Hours
163		**Excavation Cut & Seal (Hercules)**	**344 hrs**	**May 23 16:00**	**Jun 07 00:00**		**24 Hours**
164		OSV Hercules Mobilisation	1 day	May 23 16:00	May 24 16:00	162	24 Hours
165		Employer HIRA (On board Hercules)	8 hrs	May 23 16:00	May 24 00:00	162;164SS	24 Hours
166		Transit from Montrose	8 hrs	May 24 16:00	May 25 00:00	165;164	24 Hours
167		Equipment Calibration	4 hrs	May 25 00:00	May 25 04:00	166	24 Hours
168		As found Survey	8 hrs	May 25 04:00	May 25 12:00	166;167	24 Hours
169		De-burial	48 hrs	May 25 12:00	May 27 12:00	168	24 Hours
170		Recovery, Cut & Seal	36 hrs	May 27 12:00	May 29 00:00	169	24 Hours
171		UXO	48 hrs	May 29 00:00	May 31 00:00	170	24 Hours
172		Transit to Montrose	8 hrs	May 31 00:00	May 31 08:00	171	24 Hours
173		Demob	24 hrs	May 31 08:00	Jun 01 08:00	172	24 Hours
174		Process UXO Data	7 days	May 31 00:00	Jun 07 00:00	171	24 Hours
175		**Excavate Cable at KP 14 & 16**	**57 hrs?**	**Apr 03 08:00**	**Apr 05 17:00**		**24 Hours**
176		Works postponed pending discussions on cable replacement KP 11-16	24 hrs?	Apr 03 08:00	Apr 05 17:00		None
177		**Excavate Cable KP 83-86**	**1416 hrs**	**Jun 19 08:00**	**Aug 17 08:00**		**24 Hours**



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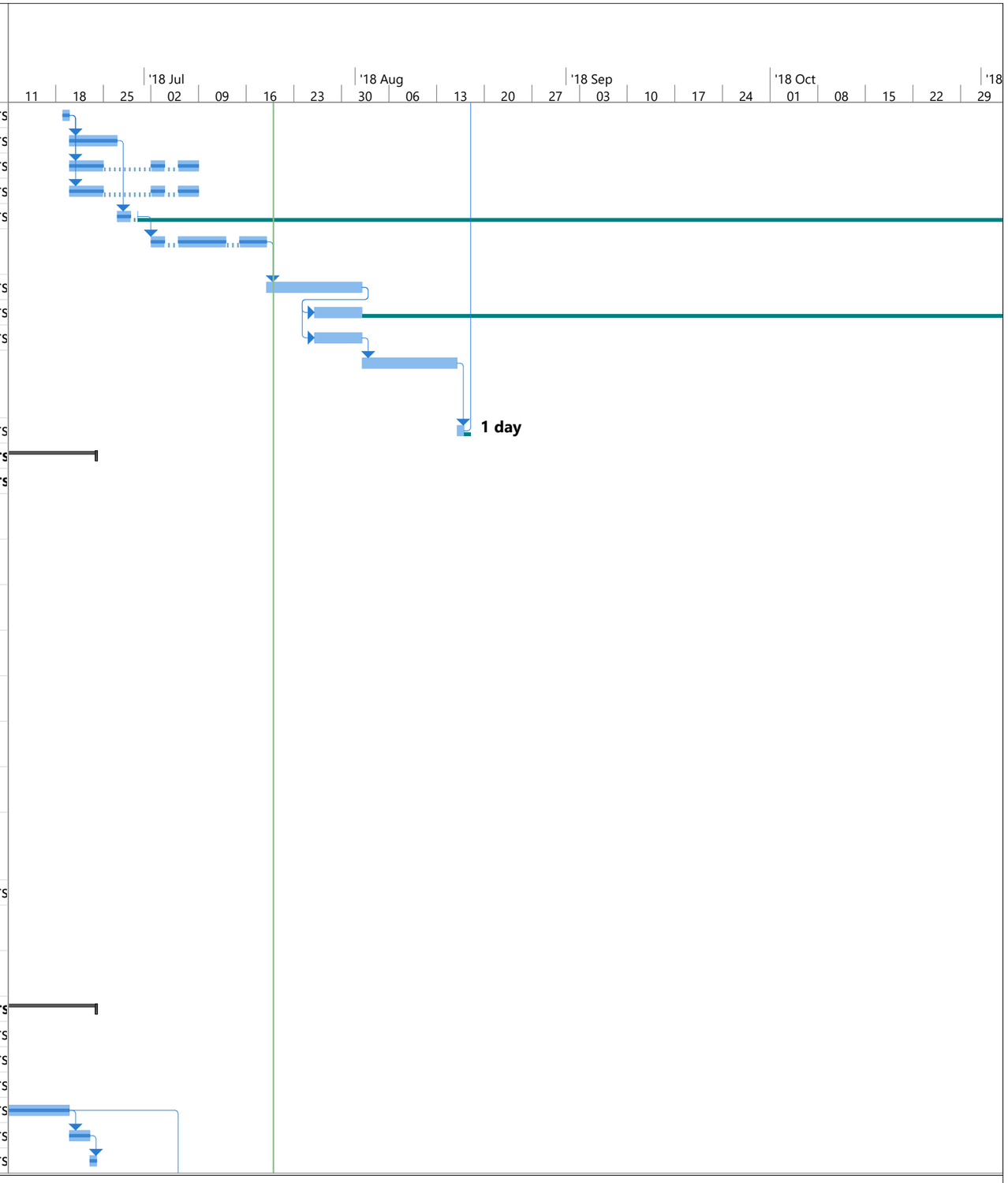
Task	Summary	Inactive Milestone	Manual Summary	Deadline	
Split	Project Summary	Inactive Summary	Start-only	Progress	
Milestone	Rolled Up Critical	Manual Task	Finish-only		

ID	Task Mode	Name	Duration	Start	Finish	Predecessors	Task Calendar
178		Initial identification of Risk Areas x 15	1 day	Jun 19 08:00	Jun 20 08:00		24 Hours
179		More detailed review and ID of areas	7 days	Jun 20 08:00	Jun 27 08:00	178	24 Hours
180		Development of method	10 days	Jun 20 08:00	Jul 08 16:00	178	24 Hours
181		Contact suppliers assess feasability	10 days	Jun 20 08:00	Jul 08 16:00	178	24 Hours
182		Prepare Excavation Proposal	3 days	Jun 27 06:00	Jun 30 08:00	179	24 Hours
183		Employer / Contractor Meeting - Agree scope & Method	14 days	Jul 02 00:00	Jul 19 08:00	182	24 Hours
184		Prepare & Accept Procedures	14 days	Jul 19 08:00	Aug 02 08:00	183	24 Hours
185		MWS Review of Procedures	7 days	Jul 26 08:00	Aug 02 08:00	184FS-7 days	24 Hours
186		Update environmental assessment (Mspac	7 days	Jul 26 08:00	Aug 02 08:00	184FS-7 days	24 Hours
187		Application to Marine Scotland (Emergency Works) - 48Hrs but 14 days allocated	14 days	Aug 02 08:00	Aug 16 08:00	186	24 Hours
188		Confirm Campaign Start	1 day	Aug 16 08:00	Aug 17 08:00	187	24 Hours
189		**Cable Repair (NKT Victoria)**	**1156 hrs**	**May 07 08:00**	**Jun 24 12:00**		**24 Hours**
190		**Pre Repair Documentation**	**564 hrs?**	**May 07 08:00**	**May 30 20:00**		**24 Hours**
191		Cable Repair Execution plan (Incl Review)	120 hrs?	May 07 08:00	May 25 17:00		None
192		Mobilisation and demobilisation procedure - Repair (Incl Review)	432 hrs?	May 07 08:00	May 25 20:00		24 Hours
193		Loading procedure - Repair (Incl Review)	432 hrs?	May 07 08:00	May 25 20:00		24 Hours
194		Cable Recovery and Lay procedure - Repair (Incl Review)	432 hrs?	May 07 08:00	May 25 20:00		24 Hours
195		Cable handling procedure - Inline Joint - Repair (Incl Review)	432 hrs?	May 07 08:00	May 25 20:00		24 Hours
196		Cable handling procedure - Omega joint - Repair (Incl Review)	432 hrs?	May 07 08:00	May 25 20:00		24 Hours
197		Offloading Procedure - Repair (Incl Review)	432 hrs?	May 07 08:00	May 25 20:00		24 Hours
198		Revise of - Cable Loadout Procedure - from facility to vessel CMS (Incl Review)	0 days	May 25 20:00	May 25 20:00	192;193;194;195;	24 Hours
199		Documentation submitted Employer	0 days	May 25 20:00	May 25 20:00	192;193;194;195;	24 Hours
200		Documentation review & accepted MWS & Employer	5 days	May 25 20:00	May 30 20:00	199	24 Hours
201		NTM Issued for NKT Victoria Campaign (Cable works)	8 days	May 12 08:00	May 28 08:00	203FS-7 days	24 Hours
202		**NKT Victoria Repair Campaign**	**532 hrs**	**Jun 02 08:00**	**Jun 24 12:00**		**24 Hours**
203		Mobilisation at Karlskrona	1 day	Jun 02 08:00	Jun 03 08:00	200	24 Hours
204		Cable Loading	1 day	Jun 03 08:00	Jun 04 08:00	203	24 Hours
205		Transit to KP 13.158	3 days	Jun 04 08:00	Jun 07 08:00	204	24 Hours
206		Cable Repair Operations	14 days	Jun 06 12:00	Jun 20 12:00	205	24 Hours
207		Transit back to Karlskrona	3 days	Jun 20 12:00	Jun 23 12:00	206	24 Hours
208		Offload of remaning spare cable	1 day	Jun 23 12:00	Jun 24 12:00	207	24 Hours



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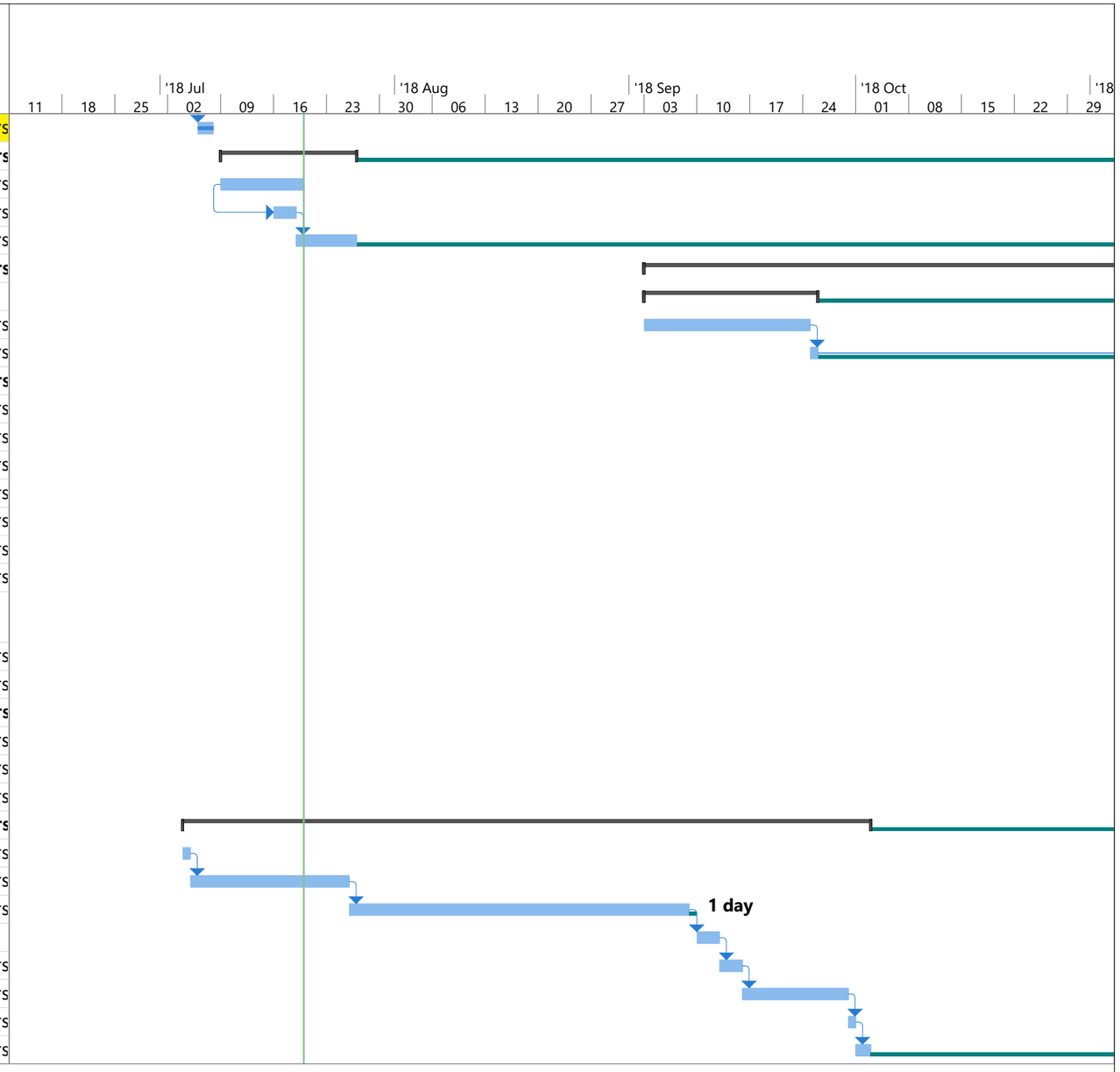
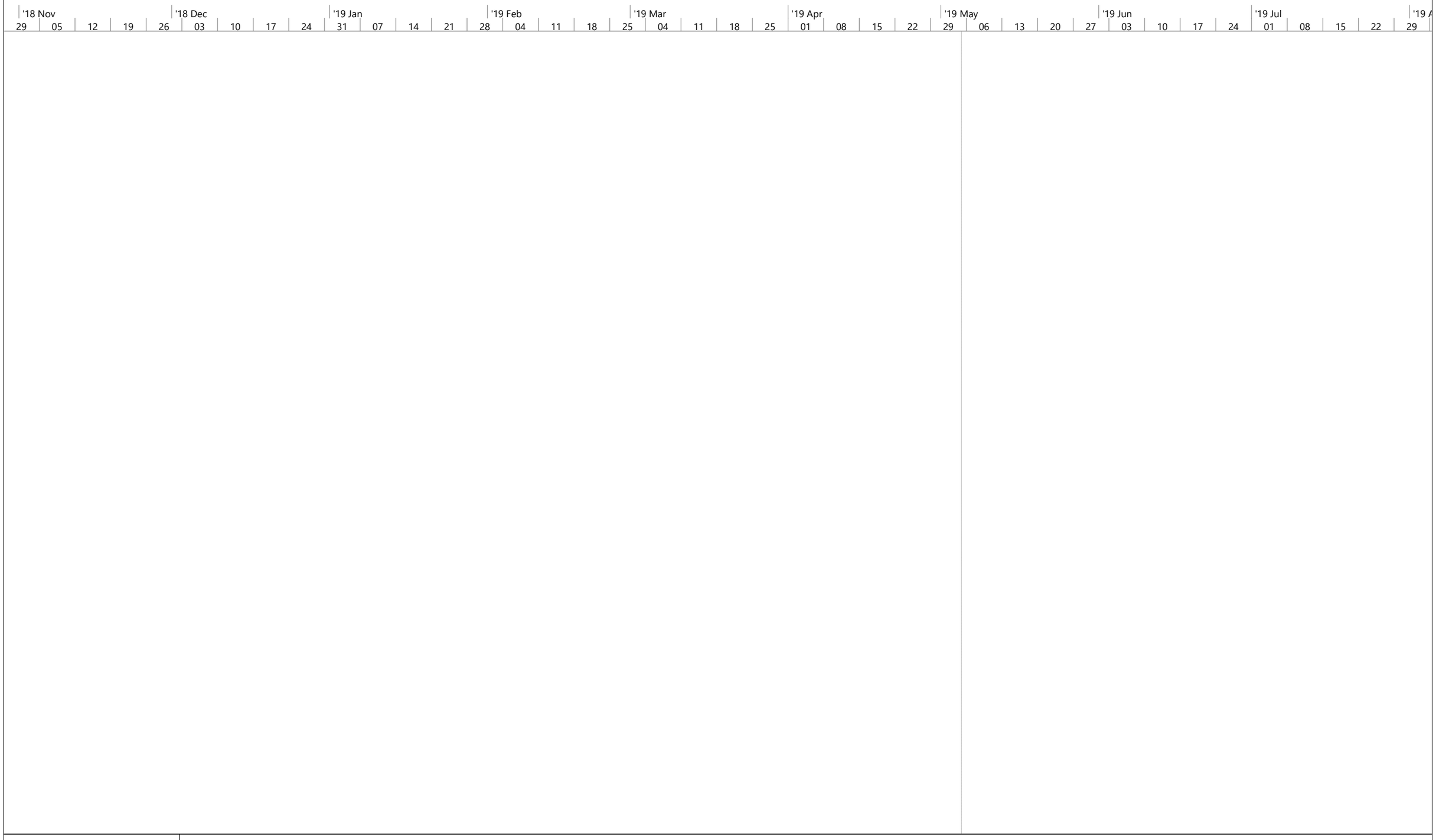
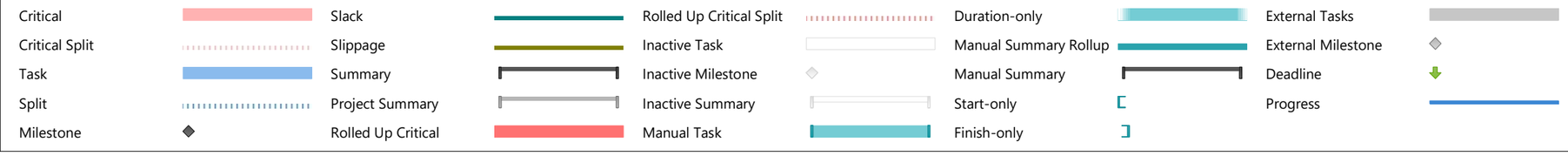
Milestone	Rolled Up Critical	Manual Task	Finish-only	

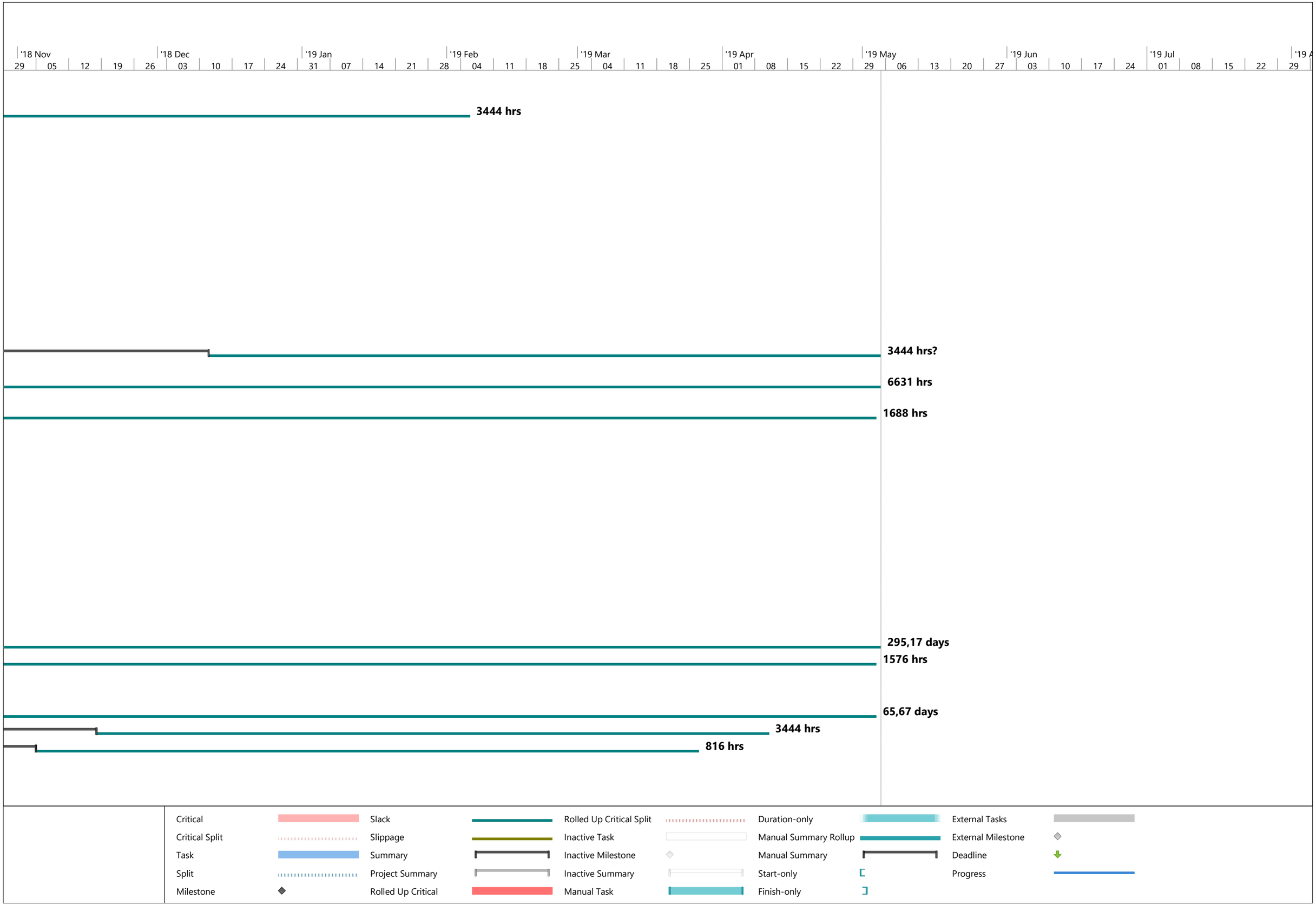
ID	Task Mode	Name	Duration	Start	Finish	Predecessors	Task Calendar
209		HV Cable test	2 days	Jul 06 12:00	Jul 08 12:00	206	24 Hours
210		**HDD Grouting Works**	**432 hrs**	**Jul 09 08:00**	**Jul 27 08:00**		**24 Hours**
211		Woodstock - Grouting Preparations	11 days	Jul 09 08:00	Jul 20 08:00		24 Hours
212		Dekeerkring - Grouting Ops	3 days	Jul 16 08:00	Jul 19 08:00	211SS+7 days	24 Hours
213		Reinstatement Portgordon - NKT	8 days	Jul 19 08:00	Jul 27 08:00	212	24 Hours
214		**KP 11-16 Cable Replacement**	**5863 hrs**	**Sep 02 17:00**	**May 05 00:00**		**24 Hours**
215		**Cable Manufacturing**	**136 hrs**	**Sep 02 17:00**	**Sep 25 17:00**		**None**
216		Manufacturing 12km	22 days	Sep 02 17:00	Sep 24 17:00		24 Hours
217		Cable FAT	1 day	Sep 24 17:00	Sep 25 17:00	216	24 Hours
218		**Cable Lay Campaign**	**552 hrs**	**Mar 25 00:00**	**Apr 17 00:00**	**217**	**24 Hours**
219		Mobilisation	1 day	Mar 25 00:00	Mar 26 00:00	217	24 Hours
220		Cable loading	2 days	Mar 26 00:00	Mar 28 00:00	219	24 Hours
221		Transit	3 days	Mar 28 00:00	Mar 31 00:00	220	24 Hours
222		Pre Lay survey	1 day	Mar 31 00:00	Apr 01 00:00	221	24 Hours
223		Recover & in line joints	7 days	Apr 01 00:00	Apr 08 00:00	222	24 Hours
224		Cable Lay Campaign	2 days	Apr 08 00:00	Apr 10 00:00	223	24 Hours
225		Omega Joint & laydown	7 days	Apr 10 00:00	Apr 17 00:00	224	24 Hours
226		**Cable burial campaign Jet Trenching KP 11-16**	**192 hrs**	**Apr 24 00:00**	**May 02 00:00**		**24 Hours**
227		Mobilisation (Grand Canyon)	1 day	Apr 24 00:00	Apr 25 00:00	225FS+7 days	24 Hours
228		Trenching campaign	7 days	Apr 25 00:00	May 02 00:00	227	24 Hours
229		**Remedial Rock (if required)**	**72 hrs?**	**May 02 00:00**	**May 05 00:00**		**24 Hours**
230		Mobilisation	24 hrs?	May 02 00:00	May 03 00:00	228	24 Hours
231		Rock placement	24 hrs?	May 03 00:00	May 04 00:00	230	24 Hours
232		Demob	24 hrs?	May 04 00:00	May 05 00:00	231	24 Hours
233		**TZ1 Rework (provisional)**	**2169 hrs**	**Jul 04 08:00**	**Oct 02 17:00**		**24 Hours**
234		Initial Assessment Employer / Contractor	24 hrs?	Jul 04 08:00	Jul 05 08:00		24 Hours
235		Quotation & CE Process	21 days	Jul 05 08:00	Jul 26 08:00	234	24 Hours
236		Engineering & Campaign planning	45 days	Jul 26 08:00	Sep 09 08:00	235	24 Hours
237		HIRA	24 hrs?	Sep 10 08:00	Sep 12 17:00	236	None
238		Vessel Mobilisation	3 days	Sep 12 17:00	Sep 15 17:00	237	24 Hours
239		Rock placement & survey	14 days	Sep 15 17:00	Sep 29 17:00	238	24 Hours
240		Final Survey	1 day	Sep 29 17:00	Sep 30 17:00	239	24 Hours
241		Demob	2 days	Sep 30 17:00	Oct 02 17:00	240	24 Hours

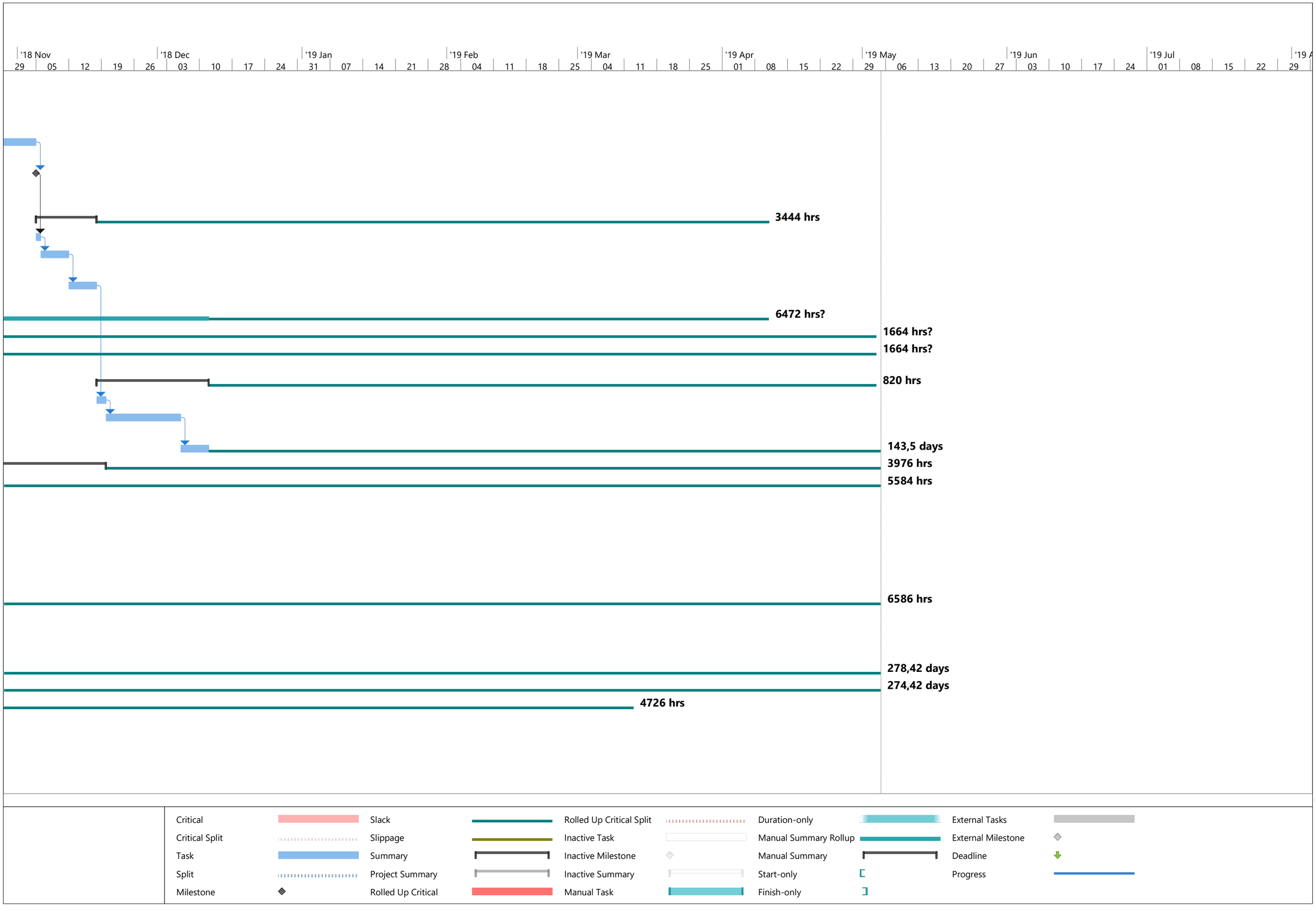


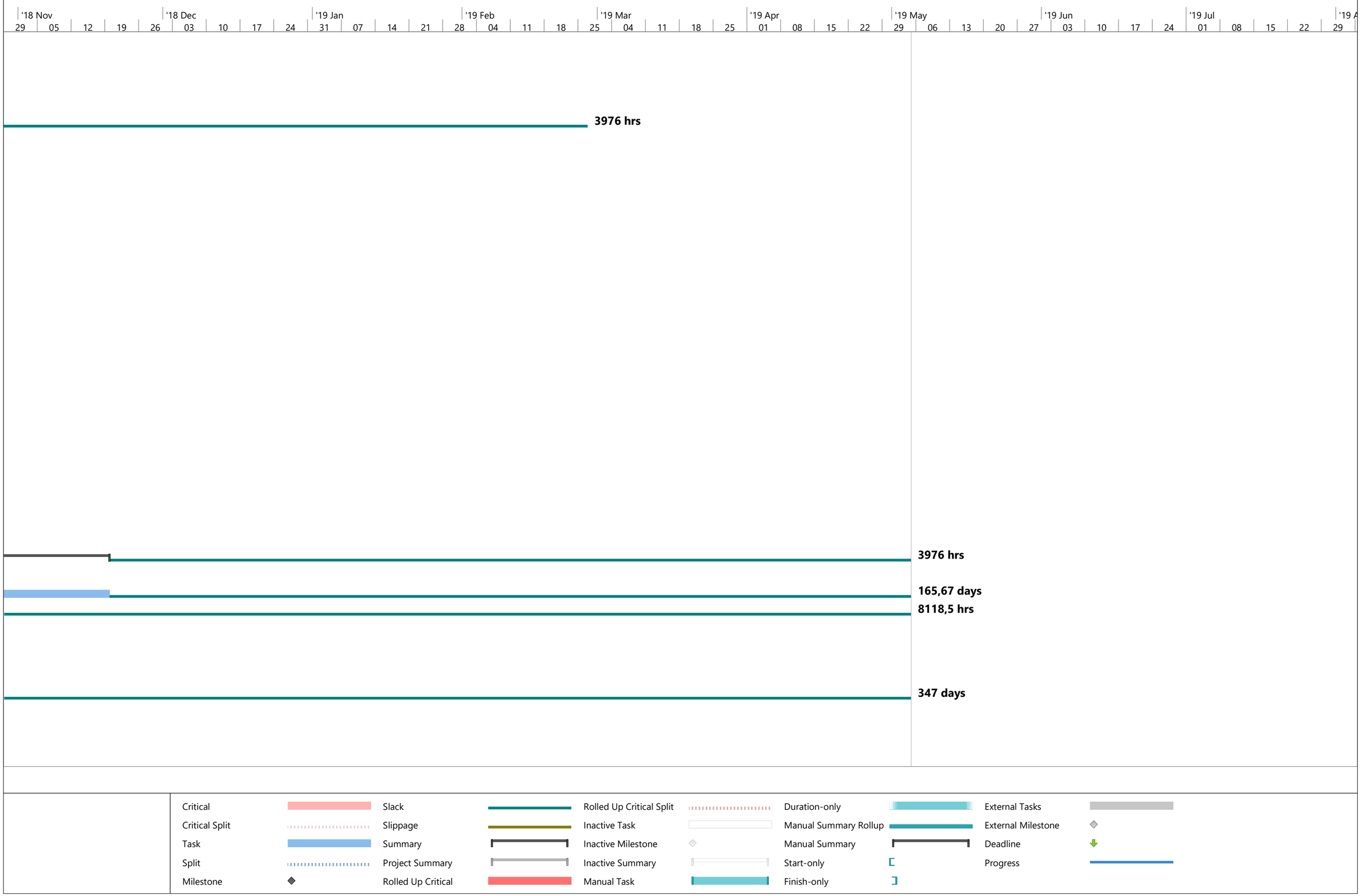
Critical		Slack		Rolled Up Critical Split		Duration-only		External Tasks	
Critical Split		Slippage		Inactive Task		Manual Summary Rollup		External Milestone	
Task		Summary		Inactive Milestone		Manual Summary		Deadline	
Split		Project Summary		Inactive Summary		Start-only		Progress	
Milestone		Rolled Up Critical		Manual Task		Finish-only			

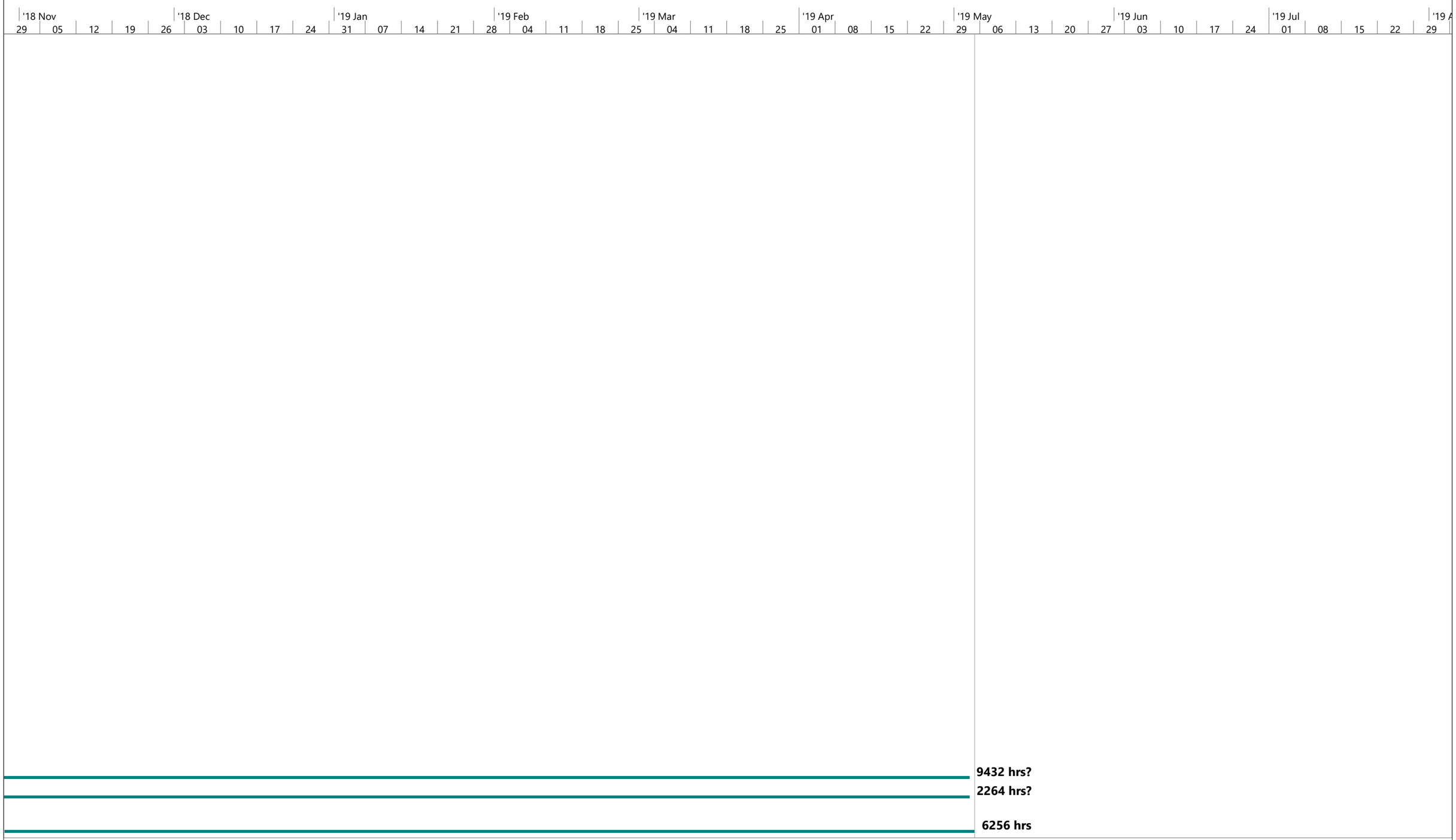

'18 Nov
'18 Dec
'19 Jan
'19 Feb
'19 Mar
'19 Apr
'19 May
'19 Jun
'19 Jul
29 05 12 19 26 03 10 17 24 31 07 14 21 28 04 11 18 25 04 11 18 25 01 08 15 22 29 06 13 20 27 03 10 17 24 01 08 15 22 29


Critical
Critical Split
Task
Split
Milestone
Slack
Slippage
Summary
Project Summary
Rolled Up Critical
Rolled Up Critical Split
Inactive Task
Inactive Milestone
Inactive Summary
Manual Task
Duration-only
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
External Tasks
External Milestone
Deadline
Progress

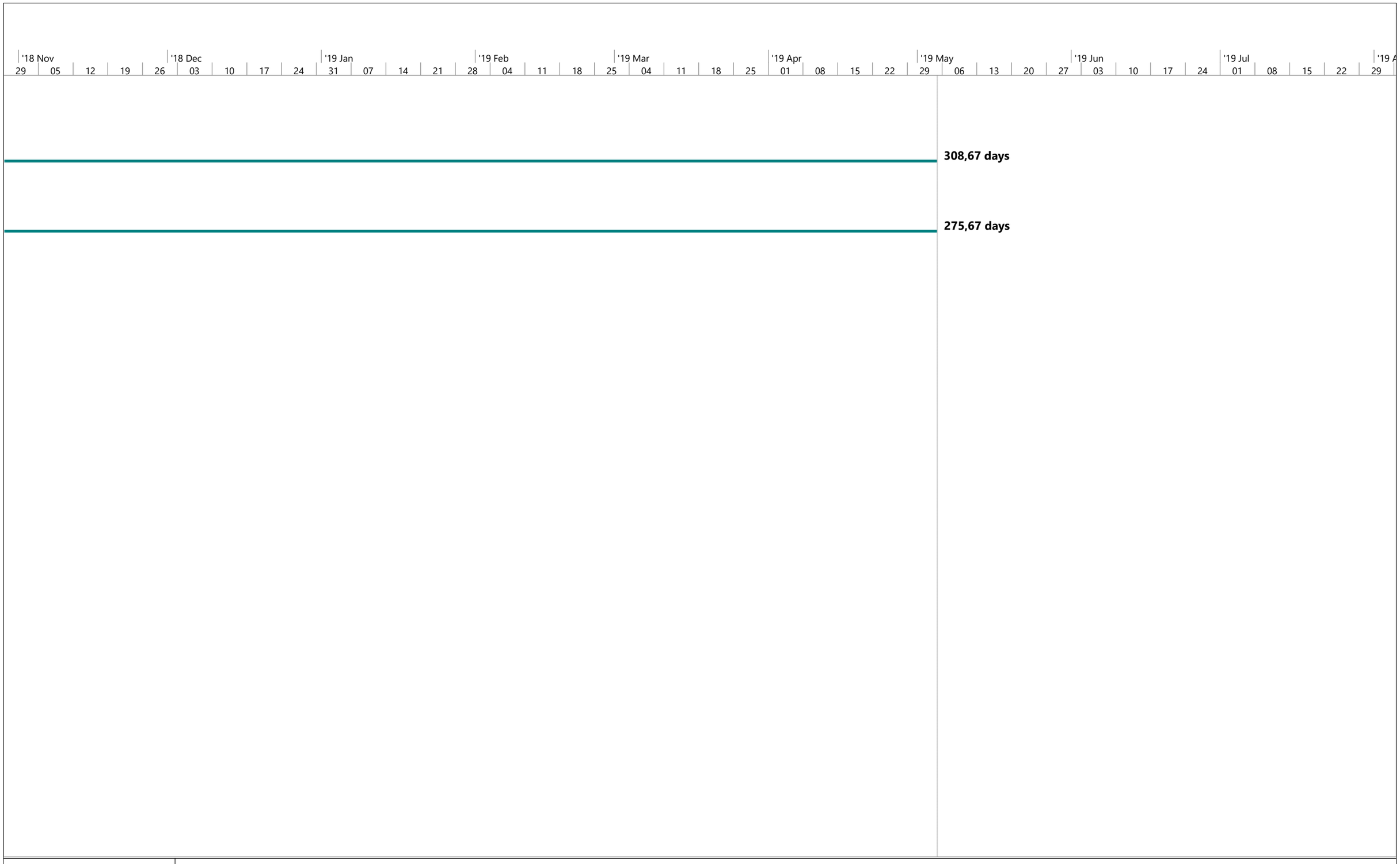

'18 Nov
'18 Dec
'19 Jan
'19 Feb
'19 Mar
'19 Apr
'19 May
'19 Jun
'19 Jul
29 05 12 19 26 03 10 17 24 31 07 14 21 28 04 11 18 25 04 11 18 25 01 08 15 22 29 06 13 20 27 03 10 17 24 01 08 15 22 29
3444 hrs
3444 hrs?
6631 hrs
1688 hrs
295,17 days
1576 hrs
65,67 days
3444 hrs
816 hrs
Critical
Slack
Rolled Up Critical Split
Duration-only
External Tasks
Critical Split
Slippage
Inactive Task
Manual Summary Rollup
External Milestone
Task
Summary
Inactive Milestone
Manual Summary
Deadline
Split
Project Summary
Inactive Summary
Start-only
Progress
Milestone
Rolled Up Critical
Manual Task
Finish-only


'18 Nov
'18 Dec
'19 Jan
'19 Feb
'19 Mar
'19 Apr
'19 May
'19 Jun
'19 Jul
29 05 12 19 26 03 10 17 24 31 07 14 21 28 04 11 18 25 04 11 18 25 01 08 15 22 29 06 13 20 27 03 10 17 24 01 08 15 22 29
3444 hrs
6472 hrs?
1664 hrs?
1664 hrs?
820 hrs
143,5 days
3976 hrs
5584 hrs
6586 hrs
278,42 days
274,42 days
4726 hrs
Critical
Critical Split
Task
Split
Milestone
Slack
Slippage
Summary
Project Summary
Rolled Up Critical
Rolled Up Critical Split
Inactive Task
Inactive Milestone
Inactive Summary
Manual Task
Duration-only
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
External Tasks
External Milestone
Deadline
Progress


'18 Nov
'18 Dec
'19 Jan
'19 Feb
'19 Mar
'19 Apr
'19 May
'19 Jun
'19 Jul
29 05 12 19 26 03 10 17 24 31 07 14 21 28 04 11 18 25 04 11 18 25 01 08 15 22 29 06 13 20 27 03 10 17 24 01 08 15 22 29
3976 hrs
3976 hrs
165,67 days
8118,5 hrs
347 days
Critical
Slack
Rolled Up Critical Split
Duration-only
External Tasks
Critical Split
Slippage
Inactive Task
Manual Summary Rollup
External Milestone
Task
Summary
Inactive Milestone
Manual Summary
Deadline
Split
Project Summary
Inactive Summary
Start-only
Progress
Milestone
Rolled Up Critical
Manual Task
Finish-only



Critical		Slack		Rolled Up Critical Split		Duration-only		External Tasks	
Critical Split		Slippage		Inactive Task		Manual Summary Rollup		External Milestone	
Task		Summary		Inactive Milestone		Manual Summary		Deadline	
Split		Project Summary		Inactive Summary		Start-only		Progress	
Milestone		Rolled Up Critical		Manual Task		Finish-only			


'18 Nov
'18 Dec
'19 Jan
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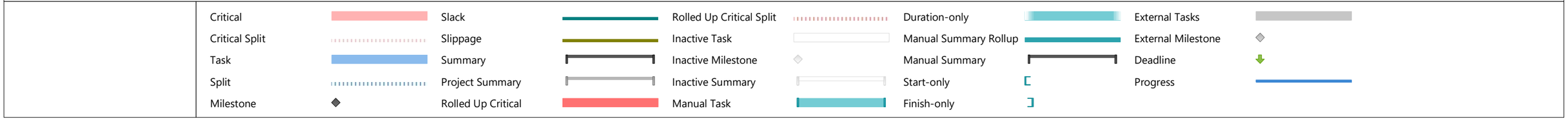
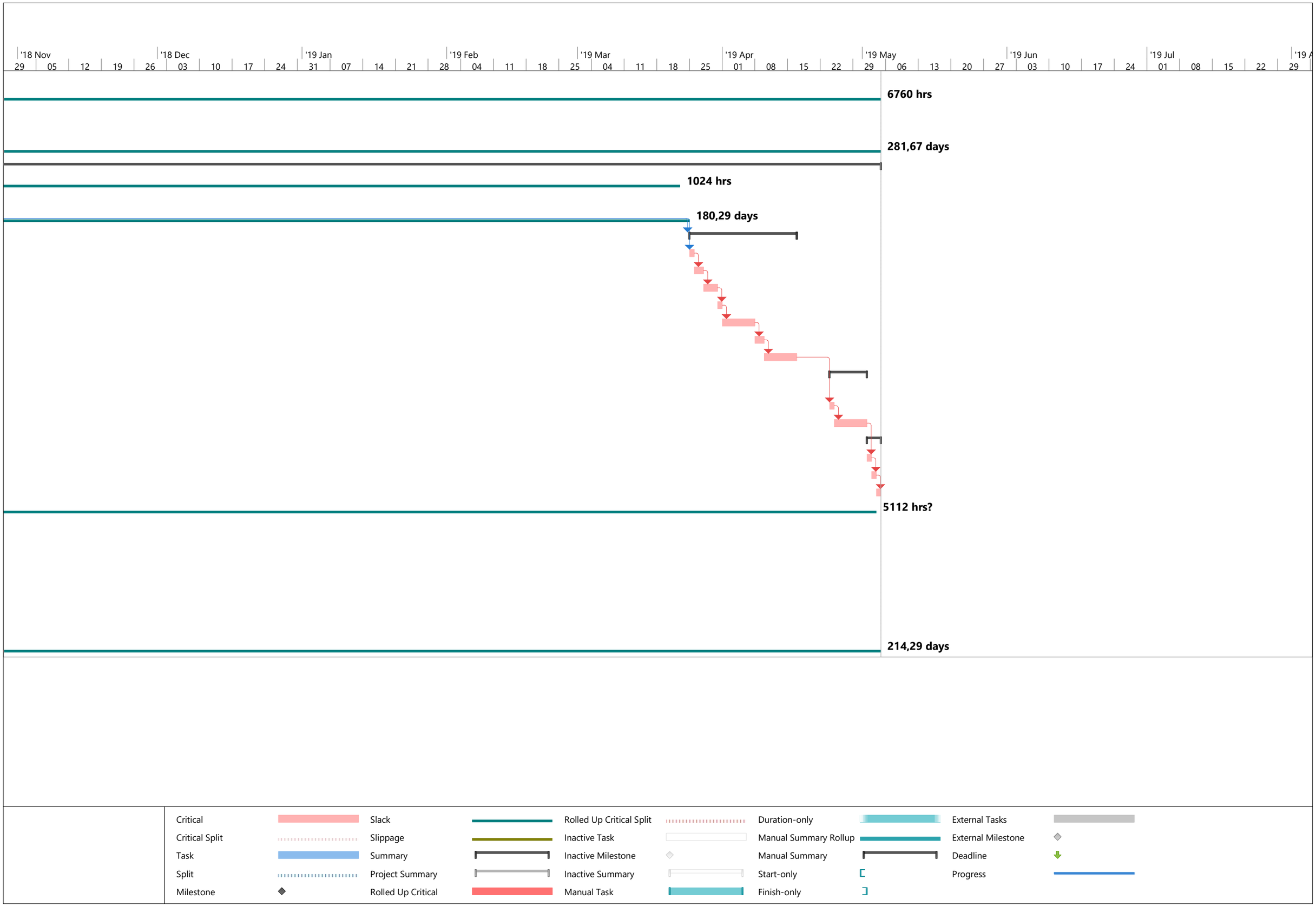
'19 Mar
'19 Apr
'19 May
'19 Jun
'19 Jul
29 05 12 19 26 03 10 17 24 31 07 14 21 28 04 11 18 25 04 11 18 25 01 08 15 22 29 06 13 20 27 03 10 17 24 01 08 15 22 29
308,67 days
275,67 days


Critical
Critical Split
Task
Split
Milestone
Slack
Slippage
Summary
Project Summary
Rolled Up Critical
Rolled Up Critical Split
Inactive Task
Inactive Milestone
Inactive Summary
Manual Task
Duration-only
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
External Tasks
External Milestone
Deadline
Progress


'18 Nov
29 05 12 19 26
'18 Dec
03 10 17 24
'19 Jan
31 07 14 21 28
'19 Feb
04 11 18 25
'19 Mar
04 11 18 25
'19 Apr
01 08 15 22
'19 May
29 06 13 20 27
'19 Jun
03 10 17 24
'19 Jul
01 08 15 22 29
'19 A
6760 hrs
281,67 days
1024 hrs
180,29 days
5112 hrs?
214,29 days
Critical
Slack
Rolled Up Critical Split
Duration-only
External Tasks
Critical Split
Slippage
Inactive Task
Manual Summary Rollup
External Milestone
Task
Summary
Inactive Milestone
Manual Summary
Deadline
Split
Project Summary
Inactive Summary
Start-only
Progress
Milestone
Rolled Up Critical
Manual Task
Finish-only