Biscay Gulf Western Interconnector

Mission 2.10 – Canyon Head Bypass Feasibility Study

Request for Contractor Information

12th September 2017

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Project Manager	Jim Hodder		12th September 2017
Company Director	Peter Worrall		12th September 2017

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EXECUTIVE SUMMARY

Red Penguin was requested by INELFE to canvass the views of independent industry professionals to establish whether it is feasible to install submarine power cables inshore from the head of the Capbreton Canyon, located in the Bay of Biscay, off the southern Aquitaine coast in France. This report presents the findings of this feasibility study.

A total of seven contractors were contacted, all of whom are experienced in shallow water power cable installations. Those which responded were:

- LD Travocean (France)
- VBMS (Netherlands)
- AssoDivers (Greece)
- Jan de Nul (Belgium)
- JD Contractors (Denmark).

The other two contractors (Bohlen & Doyen and Global Marine Systems) did not respond fully to the enquiry.

The views expressed by the contractors who responded were highly variable. This is due to a number of factors, including the varying degrees of experience and knowledge of the local area; such as for example, the perceived risk of potential slumping of the canyon head which may be introduced by installation operations. The other major factor, however, was the open and exposed nature of the coastline and highly complex nature of the challenge.

Based on the responses received, Red Penguin offer the following conclusions:

- Whilst one of the contractors (VBMS) demonstrates a certain confidence that the route is viable, two other contractors (AssoDivers and LD Travocean) have given emphatically negative responses. Sufficient doubts have been raised by them to highlight key risks to both installation and operation of the cables from an almost constant Atlantic swell and the potential for slumping of the seabed into the nearby canyon during the burial process;
- Both AssoDivers and LD Travocean have suggested less risky alternatives, such as landing the cables at Capbreton, and hence by-passing the canyon;
- All contractors raised concerns about the proximity of cables to the canyon head and have recommended further engineering studies to assess the viability of the risks associated with this placement;
- Further clarification from VBMS advised that the size of anchor pattern required to stabilise the barge would very likely close the Capbreton port for the period of cable installation. The installation work would also be likely to have a significant impact on the activities of local fishermen, other marine traffic using the port and surfers, for the duration of the works;
- It is clear from the responses that further data on wave climate, local currents and seabed changes over time, together with further bathymetry and soil data would be required to engineer a solution, if deemed possible; and
- VBMS have provided some indicative costs and an indicative programme, which would be subject to further clarification. However, the others have not provided any information in this regard.

Other considerations for the project at this stage are that:

- Proper consideration should also be given to system maintenance throughout the entire operational lifecycle.

- From an insurance perspective - and in consideration of marine procedures - the complexities of obtaining necessary approvals required to conduct operations in this environment would also present a significant challenge.

In summary, it is clear from the above that installation of the cables along the proposed nearshore bypass route would be highly risky, if indeed possible.

TABLE OF CONTENTS

TABLE OF FIGURES

LIST OF ABBREVIATIONS

DP	dynamic positioning
FO	fibre optic
HDD	horizontal directional drill
Hs	significant wave height
LAT	lowest astronomical tide
PLB	post lay burial
RFI	request for information
UXO	unexploded ordnance
WOW	waiting on weather

1 INTRODUCTION

Red Penguin has canvassed the views of independent industry professionals to establish whether it is feasible to install submarine power cables inshore from the head of the Capbreton Canyon, which is located in the Bay of Biscay, off the southern Aquitaine coast in France, and hence enable comparison against other available solutions. An overview of the area of interest is shown in Figure 1.

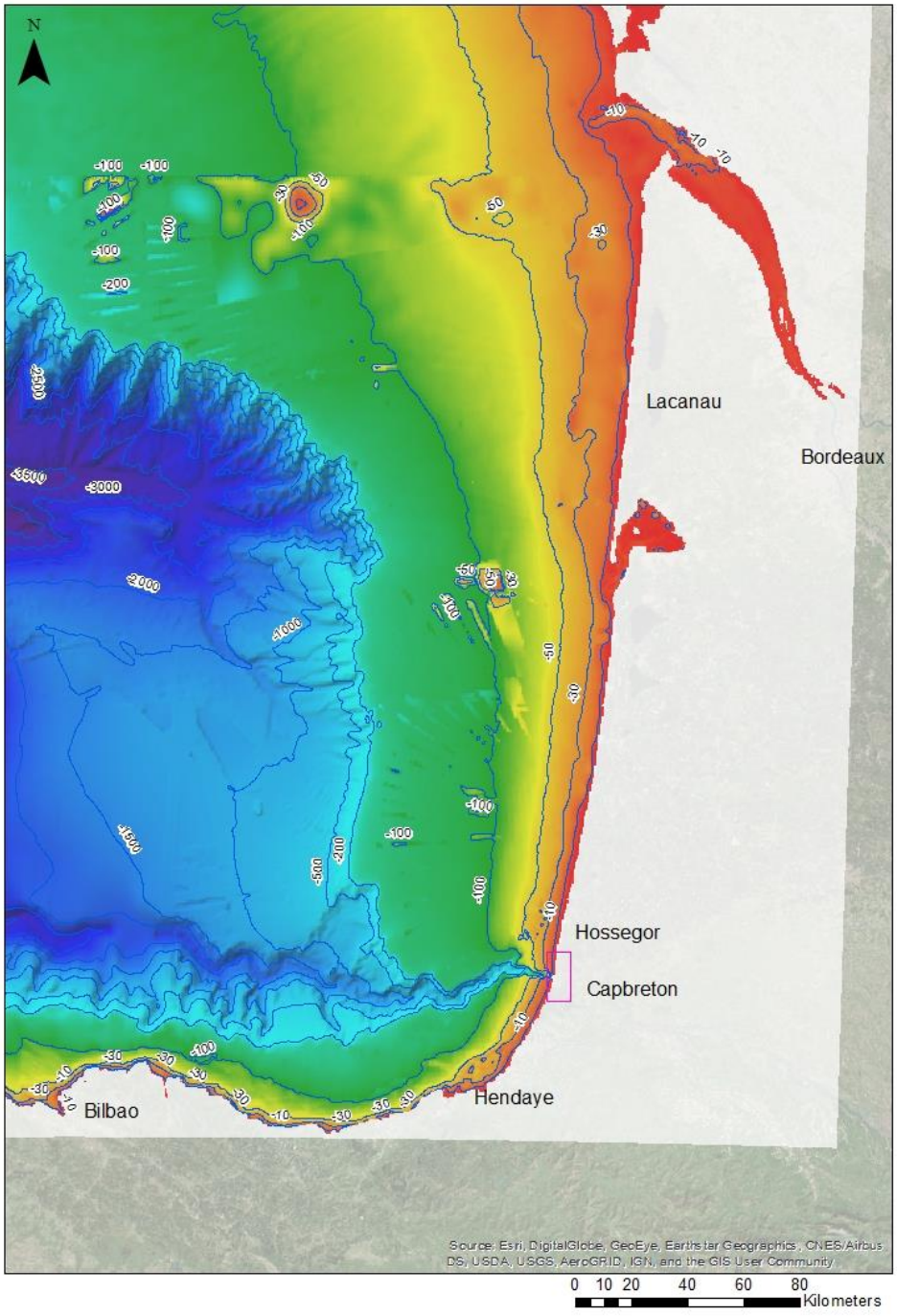

Figure 1 – Overview of Project Area

The outline specification is to install up to 6 cables, comprising 4 power cables and 2 fibre optic cables in a corridor at the head of the Capbreton Canyon as shown in Figure 2. The shallow water section is 3km long and is located between KP 154.5 (north) and KP157.5 (south) of the overall cable route. The corridor is located in the vicinity of the 10m depth contour. However, the bathymetry shelves away steeply at the head of the Canyon and the available corridor width is very narrow in the area. Further details are given in the technical note ("BGW RFI Canyon Head Bypass Technical Note Rev).

A secondary aim of the exercise has been to gain further information as to:

1. the tools and installation methodologies that could be adopted;
2. outline costs;
3. outline programme.

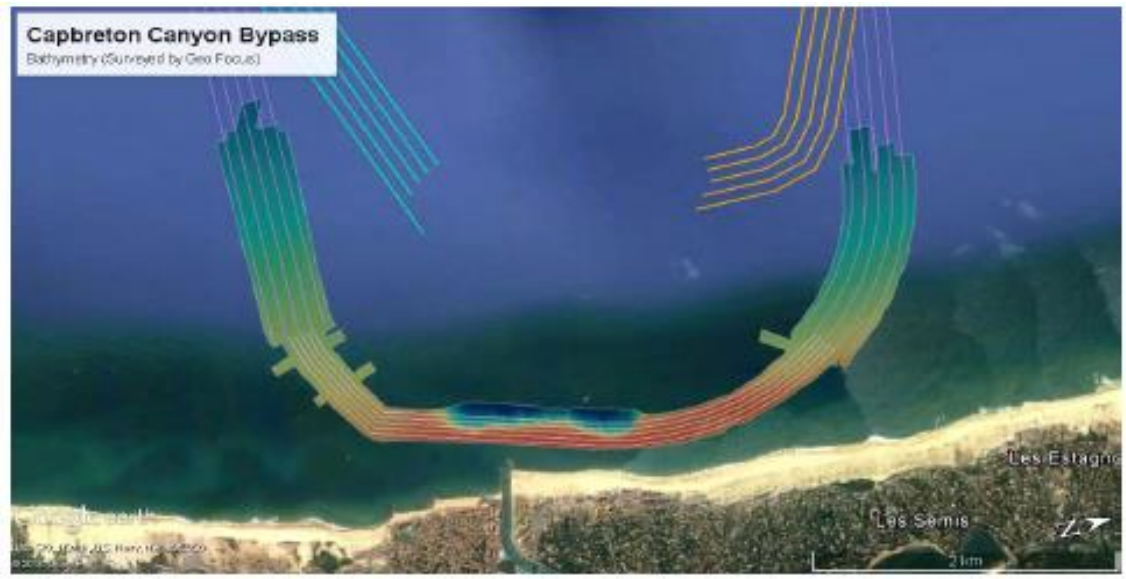

Figure 2 – Detail of Proposed Inshore Cable Corridor at Capbreton

To achieve the study objectives, Red Penguin proposed to issue a Request for Information (RFI) to a number of submarine cable installation contractors, experienced in the installation of cables in shallow water. A Technical Note was prepared, summarising the following key project information and sent to the contractors along with the RFI:

- an outline of the cable specification;
- maps of the present route, including a route alignment chart from the recent MMT survey, which included bathymetry, seabed sediments and sub bottom profile;
- a description of the canyon head bypass area focussing on bathymetry, metocean regime and complex nearshore dynamics;
- relevant extracts from papers concerning canyon morpho-dynamics.

The following installation contractors were chosen for this exercise based on their track record and ability to meet the challenges that this project offers:

- LD Travocean
- VBMS

- Asso Divers
- Jan de Nul
- JD Contractors
- Bohlen and Doyen
- Global Marine Systems

All these organisations are well known to Red Penguin.

The updated revision (D1) of this report includes the results of supplementary discussions with two of the contractors (VBMS and JD Contractors) who were more positive about the installation, to clarify some further points on risks to the operations.

2 REQUEST FOR INFORMATION AND CONTRACTOR ENGAGEMENT

Red Penguin engaged with each contractor in the following manner in order to maximise the level of responses:

- initial telephone contact with relevant personnel to explain the purpose of the RFI and to engage their participation in the study;
- RFI and Technical Note issued by email;
- follow up call with each contractor to obtain their feedback and answer any questions;
- further follow up calls as necessary.

The following tables list the contacts with each organisation, their contact details and dates of engagement, together with the dates of responses received.

Appendix A sets out the Request for Information response and Appendices B – H the contractor responses received and includes the supplementary discussion where appropriate.

Organisation	Contact Name	Position	Telephone	Email
LD Travocean	Sylvain Gouillon	Sales & Projects Director	M: +33 671 580 092	sgouillon@ldtravocean.com
VBMS	Arnoud Roels	General Manager Nearshore & Repairs	M: +31 629 603 465	a.roels@vbms.com
Asso Divers	Alexandros Tziotakis	General Manager	M: +30 694 698 0479	atziotakis@assodivers.com
Jan de Nul	Bart Moens	Offshore Department	M: +32 474 666 192	bart.moens@jandenul.com
JD Contractors	Rasmus Normann Andersen	Director		rna@jdcon.dk
Bohlen and Doyen	Rene Fischer	Business Development Manager		r.fischer@bohlen-doyen.com
Global Marine Systems	Simon Hibberd	Operations and Maintenance Manager		siimon.hibberd@globalmarinesystems.com

Table 1 - Details of Contractors Contacted

Organisation	Initial Telephone Contact and Email	Follow Up Call / Supplementary Call	RFI Response Received	Response
LD Travocean	11th / 19th April 2017		No RFI received. Telephone response logged.	Negative
VBMS	7th April 2017	2nd May 2017 22nd June 2017	7th May. Received RFI response. 5th July. Received additional email response.	Positive
Asso Divers	11th April 2017	12th April 2017	12th and 19th April. Received RFI response.	Negative
Jan de Nul	6th / 7th April 2017	9th May 2017	12th May. Received RFI response. 10th July. Received additional email response.	Qualified
JD Contractors	11th April 2017	20th April 2017 27th June 2017	15th May. Received RFI response. 10th July. Received additional email response.	Qualified
Bohlen and Doyen	6th April 2017	10th May 2017	22nd May. Received telephone response.	No written response received
Global Marine Systems	6th / 10th April 2017	17th May 2017	21st May. Telephone contact general discussion only.	No written response received

Table 2 - Log of Emails and Responses Received

3 RESULTS

Based on the responses received to date, the views of the contractors are highly variable. This is due to the following factors:

- Varying degrees of experience of shallow water experience;
- Open ocean, exposed coastline of Capbreton recognised as a significant challenge for which little or no experience is held;
- Highly complex nature of the challenge to install up to 6 cables in the nearshore Canyon Head bypass area;
- Varying degrees of knowledge of the Capbreton canyon itself and the potential for "slumping" of the canyon head which may be introduced by installation operations;
- Different installation spreads available.

The following table summarises the responses received to date:

Positive	Qualified	Negative
1	2	2

Table 3 Summary of Responses Received

Further detail on each reponse is given as follows:

3.1 Positive Response

VBMS think that the installation is feasible and propose a cable lay barge and burial using a jetting technique. VBMS anticipate workability up to 50% in summer months but comment that further information on the metocean climate is **vital** to confirm this.

VBMS state that the minimum operational limit for the barge is 1.5m Hs, but are not clear as to whether they have properly considered its operability in low water depths (eg 4m LAT). VBMS made the comment in the call with Red Penguin that availability of suitable tidal windows (i.e. high water) was of key importance, ***but it is not clear whether they have considered potential "slamming" of the barge on to the seabed in periods of swell activity during low water periods.***

The track record of this company has been gained primarily in Northern Europe from work associated with offshore wind farms and recent interconnector projects. ***There is no known experience of open seas/ocean type operations.***

VBMS propose a simultaneous lay and burial solution using a jet hydroplow/jet lance, ***but this does not take into consideration the risks associated with increasing wave height whereby the barge has to cut the cable and leave site.***

VBMS propose bundling the cables in the narrow corridors, down to 20m in width.

VBMS propose deep burial (eg >3m) to avoid maintenance issues from external aggression. The need for this should be confirmed from further studies on seabed mobility and external aggression presently being undertaken by INELFE.

VBMS request a lot more data in their response to Q5. ***Most notably, they request the minimum distance between the canyon head and installation works to avoid a landslide into the canyon.*** This is clearly an issue in their minds.

Further discussions have been held with VBMS in order to clarify a number items relating to the installation methodology. The results are given in Appendix C. VBMS advise that:

- The barge would need an anchor pattern of up to 2000m (north south) and 1000-1500m (east west). This would require some of the seaward anchors to be laid in/around the canyon, whilst the landward anchors would need to be located on or close to the beach/harbour area. The possible extent of the anchor patterns is shown in Figure 3.
- The barge could operate in a minimum water depth of 4m chart datum. This would restrict operations in shallower water to high water periods.
- The weather window required would be 3 full days for the installation of each cable pair.
- ***As shown in Figure 3, it is likely that the harbour entrance would need to be closed for the installation period, since vessels would not be allowed to come within a minimum of 500m of the barge operations for safety reasons.***
- ***It is also likely that the activities of local fishermen, other marine traffic and surfers would also be significantly impacted during this period.***
- Stability of the canyon head is of concern and VBMS recommend a specific geotechnical stability study to look at this further once more survey/engineering data are available.
- A minimum of 10 years time series of wave data is required to undertake the necessary weather windows analysis (to give a P50 level of confidence). A longer data set would be required to give increased levels of confidence.
- ***The canyon head bypass route would need to have significant advantages over other options, to warrant the additional effort required for installation of the cables.***

3.2 Qualified Responses

Jan de Nul (JdN) have provided a preliminary response only. This is based on a barge solution with an operational limit of 1.5m Hs.

Further discussions have been held with JdN in order to clarify some outline engineering parameters. The results are given in Appendix E. JdN advise that, concerning the proposed Moonfish trencher:

- The supplied CPT data indicate that the soils have sufficient bearing capacity for the proposed trencher.
- Slopes are acceptable for use of Moonfish (only a single location where the perpendicular slope exceeds 5°).

Red Penguin advise that these are **preliminary studies only** and that further detailed engineering would need to be undertaken to confirm a number of points:

- Overall feasibility of proposed cable installation and further details of the proposed spreads for cable lay and burial – these points were not answered in the original RFI response.
- Impact of the proposed burial tool, Moonfish, on local seabed stability, since it has a weight of 130te. Studies would need to confirm whether an application of this weight could set off a slump at the head of the canyon.
- Likewise, any grounding of the shallow water barge (possibly 2-5,000te in weight).

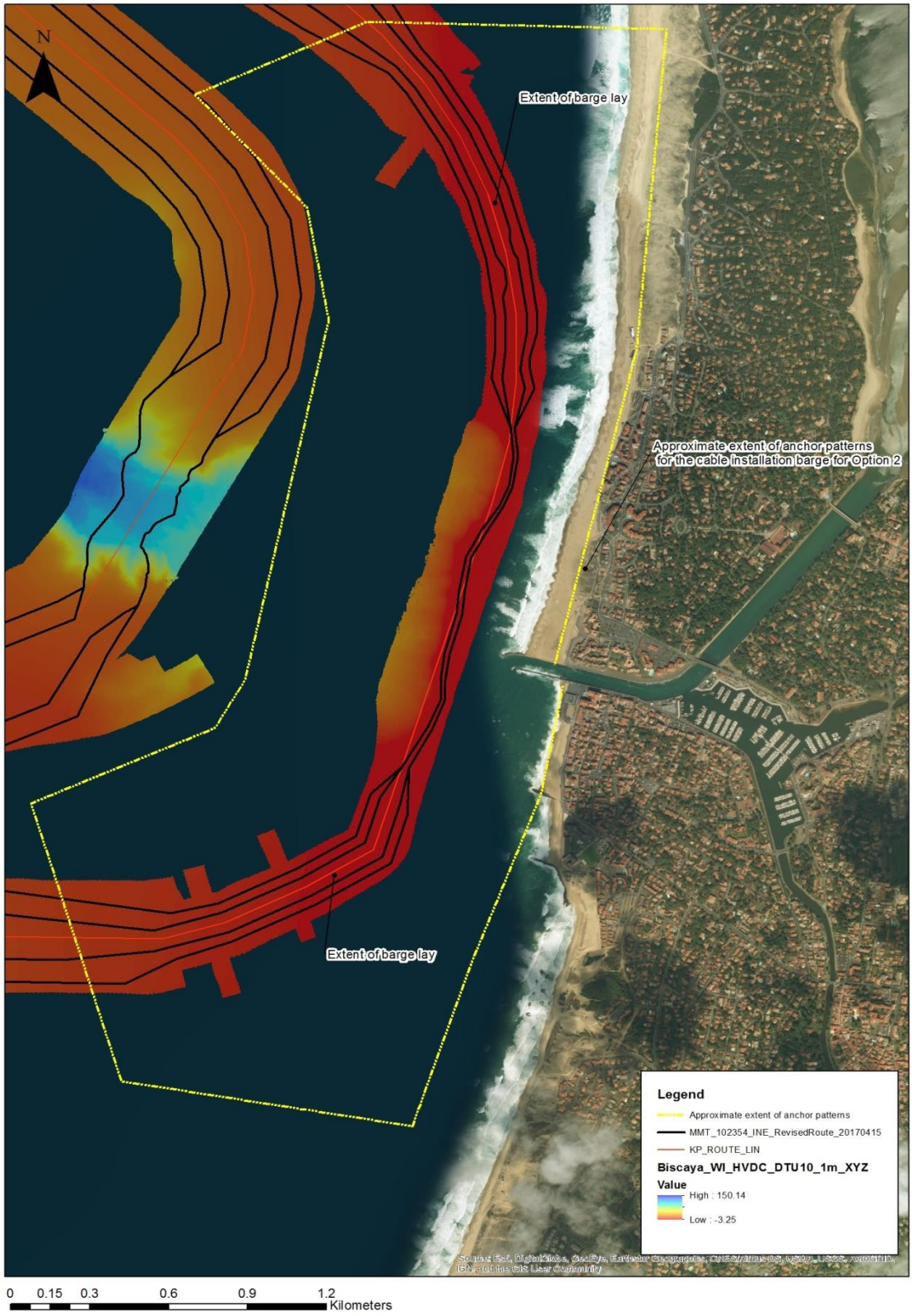

Figure 3 – Approximate Extent of Anchor Patterns for the Cable Installation Barge for Option 2

JD Contractors have provided a preliminary response only. JD propose a shallow water barge (HP Lading - HPL), which has a draft up to 3m but this vessel is not able to take to the ground, thus limiting conditions for operations would be very restrictive. It is also not clear whether they have fully considered and appreciated the nature of the marine conditions at this location. JD propose two options for post lay trenching of the cables. One of these is quoted to be hosted from a DP vessel, which would not be applicable for the shallow water section. The other, "Subject IV", would be operated from HPL in shallow water.

JD identify ***prolonged cable repair times as an issue for bundled cables***, which needs to be considered further.

Further discussions have been held with JD in order to clarify a number items relating to the installation methodology. The results are given in Appendix F. JD advise that:

- They favour a post lay burial solution, since will offer a greater flexibility in installation approach.
- A limiting wave condition of 0.8-1.0m Hs is required, which indicates an overall operability of 50% of the time at best during the summer season (June-August). This would be further reduced by any water depth and current limitations.
- A minimum water depth of 5m is required for the vessel. Given that she is not able to take the ground, this would indicate the need for longer installation weather windows that that using the proposed VBMS barge.
- They have a preference for local wave measurements (these could also be provided by a wave model prediction) and tidal current data, to undertake the weather windows analysis.
- More engineering is required to assess the stability of the canyon head shelf break.

3.3 Negative Responses

LD Travocean (LDT) did not provide a written response to the RFI. A telephone call was held on 19th April during which it became clear ***that LDT did not think that the proposed route was viable.*** The following is a record of the conversation:

'The proposed route is not feasible in such a shallow water depth. 2m LAT is too shallow. A Multicat would require a minimum of 3m LAT to work and even then it would need a swell allowance on top of that.

We recommend that you bring the cables ashore and by-pass the canyon using a land route through Capbreton'.

It is significant to note that LDT are highly experienced in the installation of shallow water cables, that they are the only French contractor contacted and that they have local knowledge of the area.

AssoDivers provided brief written responses to the RFI on 12th and 19th April, which are copied in Appendix D. In summary, ***AssoDivers do not believe that the installation would be possible for the following reasons***:

1. The high risk of operations "in the shallow water depth combined with the high energy of the incoming splash zone waves". ***This would not pass risk assessment.***
2. ***The use of jetting techniques for burial would result in the soil stability being compromised and the risk of all the sand being dragged into the canyon.*** AssoDivers have witnessed a

similar type event during installation of a cable system in the Mediterranean (photo evidence is provided).

3. ***Alternative, less risky, options exist for the project***. For example, landing the cables and bypassing on land, or finding a more stable ground offshore to make the crossing.

AssoDivers also comment that the proposed turns (alter-courses) on the nearshore route would be difficult to achieve without running the risk of damaging the neighbouring cables.

4 RED PENGUIN REVIEW AND RECOMMENDATIONS

Based on the responses received, Red Penguin make the following conclusions:

1. **The overall viability of the proposed route.** Whilst one of the contractors (VBMS) appears confident that the route is viable, two other contractors (AssoDivers and LD Travocean) have given emphatically negative responses. Sufficient doubts have been raised by them to highlight key risks to both installation and operation of the cables from an almost constant Atlantic swell and the potential for slumping of the seabed into the nearby canyon during the burial process.
2. Both AssoDivers and LD Travocean have suggested less risky alternatives, such as landing the cables at Capbreton, and by-passing the canyon that way.
3. All contractors have raised concerns about the proximity of cables to the canyon head and have recommended further engineering studies to assess the viability of this.
4. **Overall viability of the equipment and methodology proposed**. Whilst three of the contractors (VBMS, JD and Jan de Nul) proposed shallow water barges, further work is required to demonstrate how the risks to barge operations, particularly where wave action creates risk of "slamming" or grounding during low water periods, will be mitigated.
5. **Further clarity from VBMS advises that the size of anchor pattern required to stabilise the barge would very likely close the Capbreton port for the period of cable installation.** The installation work would also likely have a significant impact on the activities of local fishermen, other marine traffic and surfers for the duration of the works.
6. Concerning burial, the contractors offer either a post lay solution, or (with VBMS) simultaneous lay and burial using a hydroplow. The latter approach is considered as higher risk, with the potential need to cut the cables and depart site should wave conditions become too adverse. A post lay burial solution would appear to be more feasible.
7. The depth of burial has yet to be determined, but VBMS have suggested deeper burial (perhaps >3m), the need for which is yet to be fully explored.
8. **Additional information required**. It is clear from the responses that further data on wave climate, local currents and seabed changes over time, together with further bathymetry and soil data would be required to engineer a solution, if deemed possible.
9. **Outline costs and programme.** VBMS have provided some indicative costs and an indicative programme, which would be subject to further clarification. However, the others have not provided any information in this regard.

In summary, it is clear from the varied nature of the responses received to date, that installation of the cables along the proposed nearshore bypass route would be highly risky, if indeed possible and with particular view to the longevity and reliability of the cables in the environment, for the duration of the system lifetime.

Proper consideration should also be given towards system maintenance. Any repair operations that may be required during the service life of the cable would be challenging and, assuming a suitable repair spread could be readily commissioned, the risk to the vessel or barge during an HVDC jointing programme (typically 4-5 days for the jointing alone) needs to be properly understood. It is also probable that significant interruption & impedance of the Capbreton port would result by such an operation. Replacement of any faulted cables in the shallow water area may be more practical solution.

Support logistics for any installation or repair work would require services and facilities of an appropriate commercial port. In this regard the ability of Capbreton port to support such an operation would require close investigation. Bayonne would seem to offer better conditions but is at some distance from the worksite, some 11nm (20kms) distant.

From an insurance perspective - and in consideration of marine procedures - the complexities of obtaining necessary approvals required to conduct operations in the environment would also present a significant challenge.

Over and above this, obtaining appropriate insurance cover for the cable itself during the construction phase would most probably represent a very significant challenge as - with little or no precedent in the market and the probable perceived likelihood of a claim – the risk may not be attractive to underwriters.

It would therefore be prudent to investigate alternative options for this area in order to help de-risk the project going forward.

Note, however, that we consider it sensible to proceed with the planned offshore and nearshore geotechnical survey, as planned for June – August 2017, since most of this data is required to prove the viability of the offshore route and also that this maintains the overall project programme. The survey will also provide a more definitive picture of the nature of the seabed in the shallow water area at Capbreton and hence assist in the future assessment of the options available.

Appendices

5 APPENDICES

5.1 Appendix A Request for Information as Issued

Canyon Head Bypass Feasibility – Technical Questions	
Technical Question	**Contractor Response**
1. Based on the available information (given in the attached Technical Note), is it possible to install up to 6 cables in the canyon head bypass area (4xHVDC single core and 2xfibre)? Proposed length is around 3km (KP154.5 – KP157.5).	
2. If it is possible, what are the specific challenges associated with: a) Installation; b) Protection; c) Operation and maintenance	
3. Which broad scale methodology would you propose to achieve successful installation and cable protection, given an operational lifetime of 40 years? This should include an indication of vessel types, installation strategy (i.e. lay and burial), burial tools and requirements for any external protection.	
4. Would divers be required for the proposed installation works?	
5. What additional information is required in order to prepare a detailed assessment/installation strategy?	
6. Please provide outline cost estimation.	
7. Please provide an outline programme of installation.	

5.2 Appendix B LD Travocean

Contact was made with:

Sylvain Gouillon
Sales & Projects Director
Louis Dreyfus Travocean
Mob : +33 6 71 58 00 92
fix : +33 (0)4 42 18 34 17
Web : http://www.ldtravocean.com

LD Travocean did not provide a written response.

In a telephone call on 19th April their response was :

'The proposed route is not feasible in such a shallow water depth. 2m LAT is too shallow. A Multicat would require a minimum of 3m LAT to work and even then it would need a swell allowance on top of that.

We recommend that you bring the cables ashore and by-pass the canyon using a land route through Capbreton'.

5.3 Appendix C VBMS

Technical Question	Contractor Response
1. Based on the available information (given in the attached Technical Note), is it possible to install up to 6 cables in the canyon head bypass area (4xHVDC single core and 2xfibre)? Proposed length is around 3km (KP154.5 – KP157.5).	Yes, this looks well feasible. The works should be planned in a favourable season: i.e. summer to avoid excessive difficulties with waves and swell. Given the water depth the use of pontoon / vessels with anchor systems seems the way forward, but given the ground conditions anchoring looks well feasible.
2. If it is possible, what are the specific challenges associated with: a) Installation; b) Protection; c) Operation and maintenance	Ad a): obviously the long swell and significant wave height will determine feasibility for the installation. VBMS would propose a cable lay barge and a burial tool based on fluidisation of the local soil. This cable installation spread normally operates up to 1,5 m significant wave height. The impression is that workability in summer could be up to 50% and therefore this proposed solution could work out still quite cost efficient. Recommendation is to mobilise a shallow water cable installation spread with a minimum operability limit around 1,5 m significant wave height to avoid excessive downtime. Approval from the developer to simultaneously lay and bury could be needed; especially if relatively deep burial is required. To reduce the required cable corridor width, bundling of a cables pair + FO could be considered; by doing so, the separation between the two circuits could be as close as 20 m. For a seabed following tool slopes in the laying direction should be limited to about 15 degrees, perpendicular to the laying direction approx. 10 degrees. Ad b): Considering the soil and environmental conditions cable protection by trenching is proposed. Depending on seabed mobility on long term and the effects of storms on short term in conjunction with the risk of mechanical impact (e.g.. anchor strikes) would determine the required burial depth. It's good practice to bury the cables so deep that maintenance (remedial burial) can be avoided. Also around the harbour entry increased burial depth might be advised to protect the cable better an avoid conflicts if dredging of the harbour entry were to take place in future. Ad c): Deeper burial of the circuits has upsides as well as downsides. The market trend is that the upsides are considered more important. Deeper burial could avoid remedial burial during the lifetime of the circuit in morphological active areas as well as it avoids exposure to mechanical impact (e.g. anchor strike). The downside is that in case of a repair it is more difficult to expose the damaged section. Cable exposure up to 3 m burial depth is quite achievable under normal conditions. When the cable is buried deeper, then it becomes more challenging. In this specific case it might be considered to replace the core completely over the section which is buried deeper than 3 m as being more cost effective. On the 3 km section for example 2 locations can be chosen with a local burial depth of 2,5 m which could act as future designated repair joint location. The rest of the cable can then be buried deep (i.e. 5 m or so).

3. Which broad scale methodology would you propose to achieve successful installation and cable protection, given an operational lifetime of 40 years? This should include an indication of vessel types, installation strategy (i.e. lay and burial), burial tools and requirements for any external protection.	VBMS would propose a cable lay barge with two large diameter reels for the power cores and a small powered reel for the FO cable. VBMS would propose to bury 2 cores and a FO simultaneously with a fluidisation lance. Fluidisation disturbs the seabed to a minimum extend. External protection is not likely to be needed; given the seabed conditions. Example of large diameter reels: 

Example of Cable Lay Barge:

	Example of seabed following fluidisation lance: 

	 A visualisation of the proposed method can be found at: https://youtu.be/grtRa4ZGp0w
4. Would divers be required for the proposed installation works?	Not required under planned conditions. However, for remote unforeseen situations (which has never occurred as of yet) diver intervention might be preferred (i.e. to remove an object if it were caught by the burial tool or when a simple breakdown could be corrected by a diver rather than recovering the whole tool and remain with a part of unburied cable subsequently).

5. What additional information is required in order to prepare a detailed assessment/installation strategy?	More information on the environmental conditions (Metocean) is vital. Time series from wave model or wave buoy data between the "shelf" of the subsea valley and the beach will allow to make sufficient workability estimates and helps the Contractor to select the right installation platform (asses feasibility). Time series shall have a resolution of maximum 3 hours (else we cannot determine persistency any more) and shall contain wave and swell data separately (Hs swell & Hs wind separately). If you are interested we have in house capabilities to make this assessment (Swan model). Reliable indication of current when currents stronger than 3 knots should be expected. Morphological activity data over time to determine suitable burial depth for the life time of the cable. Accurate bathymetry for corridor up to 350 m west of the route to determine anchor handling possibilities. UXO studies Confirmation of soil data over the burial depth (required for cable design as well as choice of burial method). It needs to be determined what the minimum distance is between the subsea valley and the installation works to avoid a landslide into the valley (which would obviously jeopardise the cables and possibly initiate morphological changes in the area). This can be determined by a ground engineering bureau. VBMS has also access to MSTAB software which could possibly be used to do this investigation. MBR of the products to be 4 m or less. (larger MBR is of course possible, but then significant modifications to the burial tool would be required)
6. Please provide outline cost estimation.	Project Management & Engineering: approx. EUR 400 – 500 k Mobilisation and cable collection: approx. EUR 1400 - 1800 k Sea trials (optional pre-run over the route): approx. EUR 500 – 600 k Installation: approx. EUR 1500 k Demobilisation and as built: approx. EUR 800 – 900 k Total Approx: EUR 5 – 5.5 mln (excluding W.O.W.)
7. Please provide an outline programme of installation.	Mobilisation and cable collection: approx. 2 – 3 weeks Sea trials (optional pre-run over the route): approx. 4 days Installation: approx. 3 days per cable run Demobilisation and as built: approx. 2 weeks

	Total Approx: 7 weeks (excluding W.O.W.)

Supplementary response received from VBMS following phone call on 22nd June 2017:

5th July 2017

Hi Jim,

Please find the answers below in red to the extent we can supply responses at this moment in time. We have currently a lot of work ongoing, so although we find this project very interesting and are very willing to support wherever we can we have to give priority to the ongoing projects.

Please let me know whether this suits your expectations.

Kindest,

Arnoud

Kindregards,
Metvriendelijkegroet,

A.(Arnoud)Roels,Msc
General Manager Nearshore & Repairs

22nd June 2017

Hi Arnoud,

Many thanks for your time earlier today and that of your colleague Ruud.

It would help us if you could set down in writing some responses to the following questions we discussed:

1. What would be the working limit (Hs) of the proposed barge in swell conditions (eg period typically 10-12s or greater)? Assume that the barge will be beam on to the swell. It currently looks like our naval architect can have a preliminary motion and mooring analysis ready around July 19th. Currently we have a lot of projects ongoing which have priority. We believe bow on is a better orientation for this work and we believe that that orientation is possible.
2. Given that simultaneous lay and burial of the cables may have a higher risk to the cables in marginal sea states, could you suggest a post lay burial solution? Would this be comparable in cost to the simultaneous method? If not, approximately what would the cost increase be? As indicated before, our experience is that there is no significant difference in speed between surface laying on anchors and simultaneous lay and burial on anchors with the proposed burial tool. I can only really answer this question regarding post lay burial if the required burial depth is known; but as a personal judgement I would allow a cost increase of EUR 750 k to 1 mln.
3. What would be the minimum operating water depth for the barge and what would be the minimum bottom clearance required? In the planning stage of the project you should allow for 1 m bottom clearance and a draft of 2,8m. Let's assume 4 m water depth required at this stage of the planning. Detailed engineering is required to get the exact figure (give or take 20 – 30 cm). Bear in mind that we can use high water tides to go over shallows and wait in slightly deeper water on low tide (move off-route); to continue again on high tide. Detailed engineering can discover the optimum for the project (balance between closest to shore and still enough installation time)
4. What would be the limiting sea state for the barge (Hs) when it is sitting on the seabed? Normally Hs = 0,5m on the weather forecast, which leaves some leeway for the alpha factor.

5. What would be the approx time to install one bundle of cables (assume two HVDC and one fibre cable bundled)? We typically assume a production between 1300 and 2000 m per 24 hours. So to allow for some contingency I would look for a minimum window of 3 full days in the weather forecast; when everything goes fine it should be well possible in two full days.
6. We talked about stability of the canyon head seabed. You mentioned you could pass on a contact who might be able to assist in terms of the geotechnical stability of this area? The engineering company is called Hydronamics, the contact person is Bas Vos: bas.vos@boskalis.com. I can explain the background of the project a bit to Bas (or we organise a conference call) if you were willing to pursue this further.
7. In terms of the wave climate, thank you for your input on the requirements for time series from the wave model. I will pass these on to a colleague see what can be produced.

Thanks in advance for your responses.

Best regards

Jim

5.4 Appendix D Assodivers (as email)

19th April 2017

Dear Peter,

Thank you very much for a very interesting telephone conversation this morning.

To summarize our discussion there are several aspects of the case that will present difficulties and dangers that will prevent the safe execution of the described operation and these would indicatively include:

1. Based on the location of the proposed area for the crossing of the canyon in the shallow water, some photographs seen from google earth on the size and extend of the surf zone, we can safely assume that any kind of installation/protection vessel will not be able to operate in this area. The shallow water depth combined with the high energy of the incoming splash zone waves, would make it impossible to pass any kind of risk-assessment.
2. Further to the above, even if a marine spread could work in this area, the fact that the cables would have to be buried in sandy soil conditions with the use of jetting techniques, effectively fluidizing the soil in order to protect the cables. This would action would result in the soil stability being compromised and run the risk of all of the sand being "dragged" towards the deeper parts of the canyon, in effect leaving the cables once again unprotected.
3. Big and heavy HVDC cables are always difficult to handle and arrange in a very tight and highly dangerous area like the one suggested. Personally I cannot think how the shown turns on the cable routes can be achieved without running the risk of damaging the neighboring cables.

According to our experience, in similar occasions, the solution of actually crossing the canyon has been chosen by carefully evaluating the best crossing location, where:

- The sides of the canyon have the smallest slope
- The sides of the canyon have the more stable soil conditions.
- The downhill and uphill passage of the cables can be secured with the use of external protection measures like CIS, mattresses, rock dumping etc.

As mentioned in my previous email also, the most safe and technically viable solution of course is to actually land the cables and join them in jointing pits inshore. Even this operation has to be timed properly since the passing through the splash zone would be a problem again, but in this case it would only be a straight landing approach as done in many other similar situations.

I hope the above covers your request, and as mentioned in the phone call we remain at your disposal for any further assistance on the subject.

Kind regards,

assodivers
underwater contractors

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General Manager

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12th April 2017

Dear Peter,

I have read the below requirement and the discussion you have been having with Aggelos and could not resist in asking a few key important questions about the described challenge.

1. What is the purpose of trying to bypass the Canyon in so shallow water area with the most intense possible wave actions and very unstable soil conditions? I would imagine that the crossing of the Canyon from the side on a more stable and firm ground has been already excluded?
2. The solution for the installation and the protection of the cables is feasible but the main problem according to my opinion, as a first approach, is the fact that the installation of cables and especially the protection of them by burial in sand/gravel conditions, would add more instability to the seabed ramp already created at the entrance of the canyon, which will result in the soft soil being moved to deeper water inside the Canyon, exposing once again the cables. We have witnessed this happening in similar occasion.
3. My question therefore is simple. Why try to install 3km of cables in quicksand when you can land the cables and do the bypass on dry ground?

Of course we will gather more opinions on the matter and answer your matrix, but I really wanted to understand a little bit the constraints that have produced this case study.

I have attached an ROV image from an old project that jetting caused avalanche effect in a canyon.

Thank you in advance and remaining at your disposal for any clarifications.

Best Regards,

assodivers
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5.5 Appendix E Jan de Nul (as email)

12th May 2017

Dear Jim,

As discussed, please provide us with native data. We cannot perform any further analysis from these pdfs.
If no further data is available, then we can only confirm that it might be tight indeed.

Technical Question	Contractor Response
1. Based on the available information (given in the attached Technical Note), is it possible to install up to 6 cables in the canyon head bypass area (4xHVDC single core and 2xfibre)? Proposed length is around 3km (KP154.5 – KP157.5).	More detailed GIS data of bathymetry (xyz) and route data (RPL's) need to be available to perform a detailed installation analysis.
2. If it is possible, what are the specific challenges associated with: a) Installation; b) Protection; c) Operation and maintenance	In view of the available bathymetric levels, a barge is to be used. Such barge can operate in waves up to 1.5 m. Alternatively, Jan De Nul could dredge a channel that allows for sufficient / improved water depth and access. Please specify the required protection measures. The product could be trenched by using one of our trenchers such as the Moonfish. This trencher can work both in dry and submerged conditions. See attached leaflet.
3. Which broad scale methodology would you propose to achieve successful installation and cable protection, given an operational lifetime of 40 years? This should include an indication of vessel types, installation strategy (i.e. lay and burial), burial tools and requirements for any external protection.	As a marine contractor, we would propose a barge to perform the cable installation works in shallow water conditions.
4. Would divers be required for the proposed installation works?	For the installation works, no divers would be required.
5. What additional information is required in order to prepare a detailed assessment/installation strategy?	See item 1. Above.
6. Please provide an outline cost estimation.	Cost estimation can only be performed once the project feasibility has been fully studied. Important cost driver is also the port of loading.
7. Please provide an outline programme of installation.	Please specify when the cables are available for loading and please specify each cable length. Please also advise if the schedule should allow for jointing and if so, please specify the required OEM jointers jointing time so that we can develop a schedule. Please also specify the installation season.

Best,
BartMoens
DepartmentOffshore JanDeNul
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10th July 2017

Good morning Jim,

We have now also reviewed the supplied CPT data and we can conclude as follows:

The supplied CPT data indicate that the soils have sufficient bearing capacity for the Moonfish trencher. As from a depth of 0.5m, the soil consists of average to very dense packed sand, leading to sufficient bearing capacity. The top 0.5m consists of looser packed sand. There we can expect some settlement of the tracks. This settlement will be limited and does not results in any issues towards the global bearing capacity.

Together with our earlier communicated conclusions to the slopes (only a single location where the perpendicular slope exceeds 5°), we believe that the Moonfish trencher can trench the cable to the required trenching depth.

Best regards,

Bart Moens

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Notes from Red Penguin – The proposed burial tool, Moonfish, has a weight of 130te. Engineering studies need to be made as to whether application of this weight could set off a slump at the head of the canyon. Likewise, any grounding of the shallow water barge (possibly 2-5,000te).

5.6 Appendix F JD Contractors

Technical Question	Contractor Response
1. Based on the available information (given in the attached Technical Note), is it possible to install up to 6 cables in the canyon head bypass area (4xHVDC single core and 2xfibre)? Proposed length is around 3km (KP154.5 – KP157.5).	Yes that should be possible by a shallow drafted barge with a turn table than can accommodate the cables – either all 6 cable or in two laying campaigns with 2 x 3 bundled cables (2 power cables on the turntable for each campaign and one FO on drum)
2. If it is possible, what are the specific challenges associated with: a) Installation; b) Protection; c) Operation and maintenance	Protection of the cable are likely to be the most challenging part as a heavy jetting trencher will be required in the relatively strong current – and for this a relatively large DP vessel will be required – however they will have a larger draft than the 2-3 m shown in some areas. Maintenance – cable repairs are possible from shallow drafted barges but will often require personnel to be shuttled in/out to the barge. A challenge is also the pro-longed cable repair time required when cables are bundled – this calls for max 3 bundled cables for each campaign – however the two bundles can be crossed during laying due to the narrow corridor and strong current
3. Which broad scale methodology would you propose to achieve successful installation and cable protection, given an operational lifetime of 40 years? This should include an indication of vessel types, installation strategy (i.e. lay and burial), burial tools and requirements for any external protection.	JDC would propose our shallow drafted cable laying barge Henry P Lading. The barge has a draft of less than 3 m fully loaded. In this case we would propose two laying campaigns (2 power and one FO) for each laying campaign. There is not sufficient information of the surrounding area to determine whether cable laying would be performed in anchors or in free-laying mode with the barge supported by 3 shallow drafted supporting tugs. Burial could be performed by our power sub-Jet IV jetting tool operated from the installation barge Henry P lading AFTER the installation. The barge is big enough to support the jetting trencher yet at the same time have a shallow draft
4. Would divers be required for the proposed installation works?	Divers would be required for the shore end landing operation and for embedding in the nearshore areas
5. What additional information is required in order to prepare a detailed assessment/installation strategy?	Site visit and full survey information/charts
6. Please provide an outline cost estimation.	To be discussed
7. Please provide an outline programme of installation.	To be discussed

Note from Red Penguin – for item 4 above, divers would be required for the operation of shallow water jet sleds and potentially to support the cable landing.

Supplementary response received from JD Contractors following phone call on 27th June 2017:

10th July 2017

Hi Peter

See my quick feedback in red below.

I will call you later.

Mvh, Rasmus

27th June 2017

Rasmus, good afternoon,

We continue to work with the Client consortium on the options for the Capbreton Canyon crossing that we have been discussing.

From our conversations on the subject, you know that there are a number of concerns as to the viability of working in close proximity to the canyon head and within the inshore zone. Based on your outline proposal, may we seek your views on the following in order for us to conclude our response to the consortium.

1. Working limit (Hs) of the proposed barge in swell conditions (eg period typically 10-12s or greater). Probably best to assume that the barge will be beam on to the swell. A closer analysis is needed but of the top of my head I would say significant wave height 0,8-1m, wind 10m/S

2. Minimum operating water depth for the barge and what would be the minimum bottom clearance required. HPL (HP Lading – proposed barge) has a max draft less than three meters, and depending on the swell I would say we need a bottom clearance of 1-2 meters.

3. Burial – simultaneous or post lay? We would do post lay burial – simultaneous ops is to risky and difficult in this site – especially because you want to use slack water periods to do quick installations?

4. Proximity to the canyon head shelf break. Cannot say without a more in depth desk-top study

5. What wave data would they need to further assess the project? Ideally we would like valid wave statistic from a wave buoy place closed to site, and also table for tidal current and ideally diagrams showing how the current runs in the area.

Also, please confirm my understanding the HPL is not able to take to the ground. Correct - HPL is not able to ground.

Hoping you may be of further assistance and thanking you in anticipation.

Kind regards.

Peter

5.7 Appendix G Bohlen & Doyen

No written response was received from Bohlen & Doyen.

5.8 Appendix H Global Marine Systems

No written response was received from Global Marine System.