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Environmental Monitoring Report- 2011

Installation of monopile at Voith Hydro test berth, Fall of Warness, Orkney,

Report

Prepared by Aquatera on behalf of Voith Hydro

P362 Rev 2.0 – November 2011

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Revision record

Revision Number	Issue Date	Revision Details
1.0	13-10-11	First draft
2.0	23-11-11	Final report

Contents

1 Introduction

1.1 Purpose of this report

This report has been prepared to fulfil the requirements set out in the *Licence for Marine Construction Works* issued by Scottish government on 24 June 2011 (Licence Number: 03968/11/1 – 4807, Reference: FKB/A 1256) covering the installation of a monopile foundation at the Voith Hydro berth at the European Marine Energy Centre (EMEC) in Orkney.

This report contains the results of the monitoring work undertaken by Voith Hydro prior to, during and following the installation of its monopile foundation at the test site this summer.

1.2 Scope of the monitoring work

The scope of the environmental monitoring activities undertaken during the installation operations were detailed in a formal Environmental Monitoring Plan (EMP) prepared by Aquatera on behalf of Voith Hydro and agreed in advance with Marine Scotland (Aquatera, 2011b). Details of the protocols utilised and the data obtained from the monitoring activities are summarised in subsequent chapters:

Chapter 2	Marine mammal observations made from installation vessel During drilling activities
Chapter 3	Harbour seal monitoring programme on Seal Skerry
Chapter 4	Airborne and underwater acoustic measurements
Chapter 5	Post-installation ROV survey of seabed

Where appropriate, the individual detailed reports covering the monitoring tasks are annexed as supplementary information.

1.3 Project summary

Voith Hydro Ocean Current Technologies (VH) is planning a full scale demonstration of its Voith HyTide tidal energy converter (TEC) at the EMEC's tidal test facility at the Fall of Warness, Orkney. The proposed project will have an installed capacity of 1.0 megawatt (MW) and feed electricity into the grid via EMEC's pre-installed grid connection. The project is planned in two distinct phases; installation of the foundation (monopile) and installation of the turbine (nacelle and rotor).

Voith Hydro successfully completed the first phase of the project from 24 to 29 July 2011. The monopile was installed at their allocated test berth located in the northwest sector of the

EMEC test site (see Figure 1.1) using a large DP (dynamic positioning) vessel - *MV North Sea Giant*. Full technical details for the planned activities were provided previously (Aquatera, 2011a).

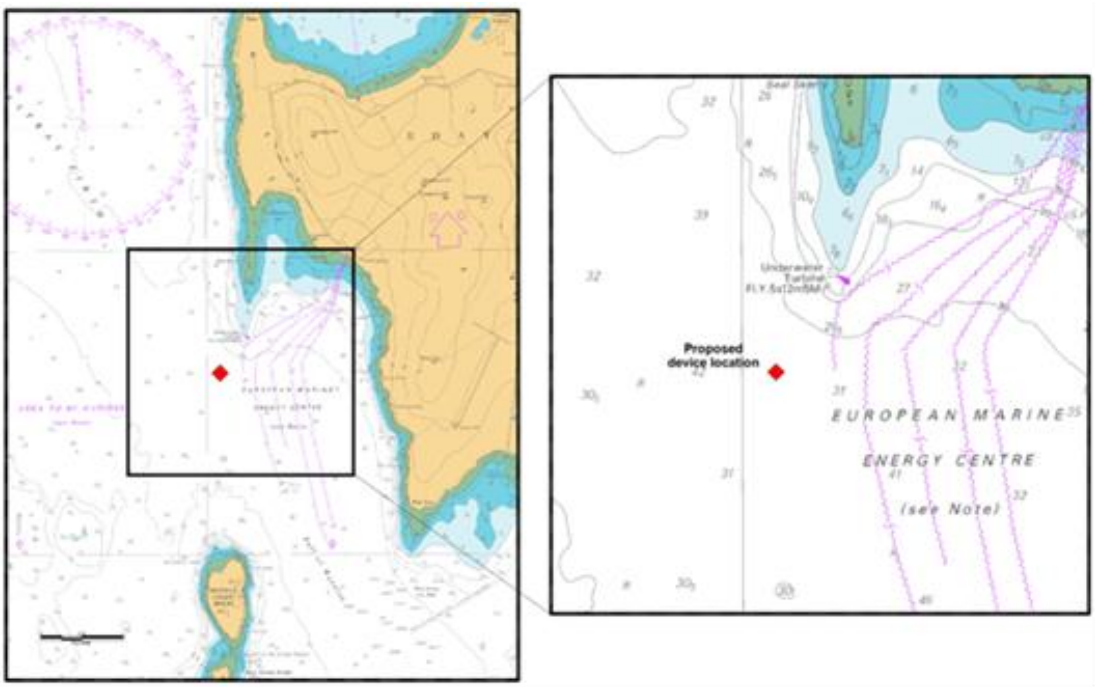

Figure 1.1 Voith Hydro test berth location, EMEC test site, Eday, Orkney

The installed monopile, approximately 2.3m in diameter with a total length of approximately 21m, is grouted into an 11m-deep drilled socket in the bedrock. The monopile protrudes approximately 10m above the seabed (refer to Figure 1.2).

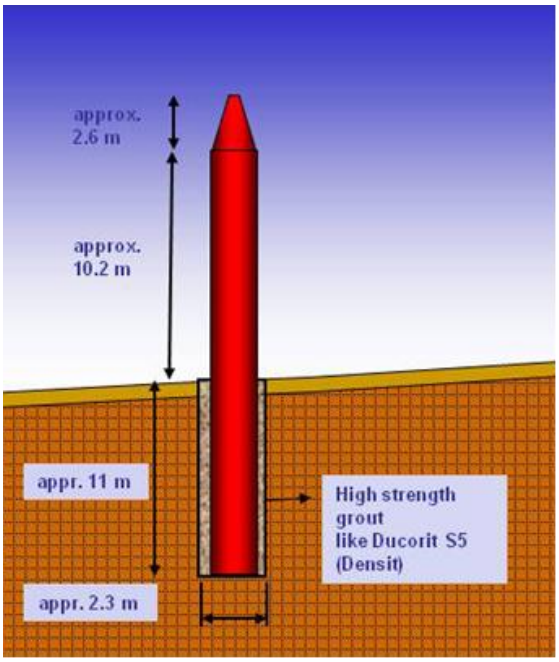

Figure 1.2 Voith Hydro monopile installation

1.3.2 Timetable of North Sea Giant Operations, July 2011

An outline timetable of Voith Hydro's operations at the test site is provided in the following table:

Date	Time	Activity
23 July	2000	*North Sea Giant* (NSG) departs Scrabster for EMEC test site
24 July	0220	NSG arrives on site
	0220-1900	Preparation for operations
	1900	Template deployed
	2020	Template recovered (communication fault)
25 July	0120	Template and ROV deployed
	0200	Template positioned on seabed
	1355	Conductor/drilling unit and ROV deployed
	1420	Conductor/drilling unit installed in template
	1510	Drilling commences – soft start, ROV recovery
	2000-2100	ROV inspection
26 July	0000-2400	Drilling
	1515-1915	ROV inspection
27 July	0645	Drilling completed
	0930-1040	ROV deployment
	1040	Conductor/drilling unit recovered
	1600-1715	ROV inspection
	2345	Monopile ready for deployment
28 July	0530	Monopile installed into conductor, grouting begins
	0835	Grouting completed
	1520	Recovery of grouting equipment
	1630-1740	ROV inspection
	2230-2320	ROV inspection
29 July	1010	Template prepared for lifting
	1300	Template recovered
	1455	NSG departs site

Drilling

1.4 Report content

The following is contained in this report:

- Results from marine mammal observations
- Results from harbour seal monitoring programme on Seal Skerry
- Results from acoustic survey work
- Results from post-deployment ROV seabed survey
- Summary of environmental monitoring results
- Discussion and recommendations

2 Results from marine mammal observations

2.1 Introduction

Monitoring for marine mammals (and basking sharks) prior to, and during, drilling operations was required to comply with the provisions outlined in the License for marine construction works issued by Marine Scotland for the project[1]:

20. Supplementary Conditions

a) The licensee shall ensure that all mitigation measures outlined within the ES and any subsequently agreed to through this or other responses for avoiding, mitigating or monitoring wildlife impacts must be adhered to in full.

b) The licensee will ensure that a Marine Mammal Observer (MMO) is in place on the installation vessel during all noisy installation operations likely to cause disturbance.

c) The licensee must ensure that the DP vessel operator follows the 'soft-start' drilling protocol to ensure that any basking sharks within the vicinity of the noisy works have sufficient time to move out with the 500m buffer zone.

The marine mammal and basking shark monitoring was carried out on behalf of Voith by appropriately trained (completion of a JNCC approved MMO induction course for UK waters) personnel working for the marine contractor.

2.2 Monitoring protocol

The Marine Mammal Observers (MMOs) were responsible for monitoring the occurrence and behaviour of marine mammals within a 1 km radius of the main installation vessel during subsea drilling (establishing a 500 m mitigation zone and a 1km observation zone around the vessel prior to and during drilling activities). The survey protocol and reporting format was compliant with current JNCC guidelines (JNCC, 2009) and EMEC's guidance for marine mammal observations (SOP-74-03-03 20100804).

The four key marine mammal observation tasks, as identified in the environmental monitoring plan (Aquatera, 2011b), were:

1. Monitoring during the approach to the test site
2. Pre-works survey (30 min)

[1] Licence Number: 03968/11/1 – 4807, Reference: FKB/A 1256

3. Initial monitoring during drilling activities, including 'soft-start' (2 hours)
4. Any subsequent pre-works surveys following any significant breaks of more than one hour in drilling activities

The planned observations during approach to the site (task 1) were curtailed slightly due to lack of daylight. It was necessary for the vessel to enter the test site during the early hours of the morning to make up time on an increasingly tight schedule. This allowed works to commence the following day within a relatively short operational window as determined by tide and weather.

The survey work relating to drilling activities (tasks 2 & 3) was conducted as planned and since the drilling activity progressed without a significant break, task 4 was not relevant to this project. The completed recording forms prepared by the MMOs during the project are provided in Appendix A of this report. A summary of the monitoring effort is provided in Table 2.1.

Table 2.1 Monitoring activity summary

Date	Observer name(s)	Start watch	End watch	Vessel activity
24 July	Scheller	0120	0150	NSG approaches test berth. Watch curtailed by nightfall. Vessel arrives on site at 0220.
24 July	Scheller	0630	0730	NSG on location, making preparations for installation work.
24 July	Scheller & Schmitz	0900	1000	NSG on location, continuing preparations for installation work.
24 July	Scheller & Schmitz	1038	1111	NSG on location, continuing preparations for installation work.
25 July	Scheller & Schmitz	1230	1715	Preparing for drilling operations, drilling soft-start procedure commenced at 1510.

2.3 Summary of results

The weather conditions varied throughout the survey period. Initial conditions were relatively poor with wind force estimated as between 7 to 8 and rough sea states this gradually improved over time with the final observations taking place in slight sea states and moderate wind speeds (force 4 to 5). Visibility was moderate throughout the observation periods

however, due to the vessel arriving on site in the early morning hours of 24 July, the observations made at this time were curtailed due to lack of daylight.

No cetaceans, seals or basking sharks were recorded in the observation zone at any time during the observation periods.

2.4 Conclusions

The absence of marine mammals in the immediate vicinity of the vessel whilst stationed in the Fall of Warness area is consistent with the findings of the work conducted during operations at this site previously (Aquatera, 2010b).

It is not considered likely that the presence of the vessel was causing a wider, area-avoidance behaviour in cetaceans, rather it can be simply concluded that no cetaceans were present in the Fall of Warness area during the operational period.

3 Results from harbour seal monitoring programme on Seal Skerry

3.1 Introduction

A monitoring programme was implemented to monitor the condition of the local Harbour seal (*Phoca vitulina*) community during the deployment operations at the site. This study follows on from a study conducted in 2010 during earlier installation activities at the test site (Aquatera, 2010b) and was deemed as being especially relevant since operations would be occurring close to the annual pupping season for this species (June-July).

3.2 Monitoring protocol

This study was focused on the Harbour Seal community located closest to the operational site: *Seal Skerry* on Eday (Figure 3.1).

Monitoring the behaviour of the Seal Skerry community during operations was conducted by experienced wildlife observers based on high ground overlooking the site. The survey area was intensively observed for two watches per day whist the North Sea Giant was on location (the exception being the 26 July where low tide occurred in the hours of darkness).

Additional observations were carried out prior to commencement of operations at the site and following completion of the works, details of the full observation schedule is provided in Table 3.1. Watches were carried out as near to low tide as daylight hours would allow. Information relating to the observer locations, equipment used and survey methods are detailed in Annex I – *P362 Harbour Seal Report 2011 - M Cockram*. The observation log is provided in Annex II - *P362 Harbour Seal observation records - JulyAugust 2011*.

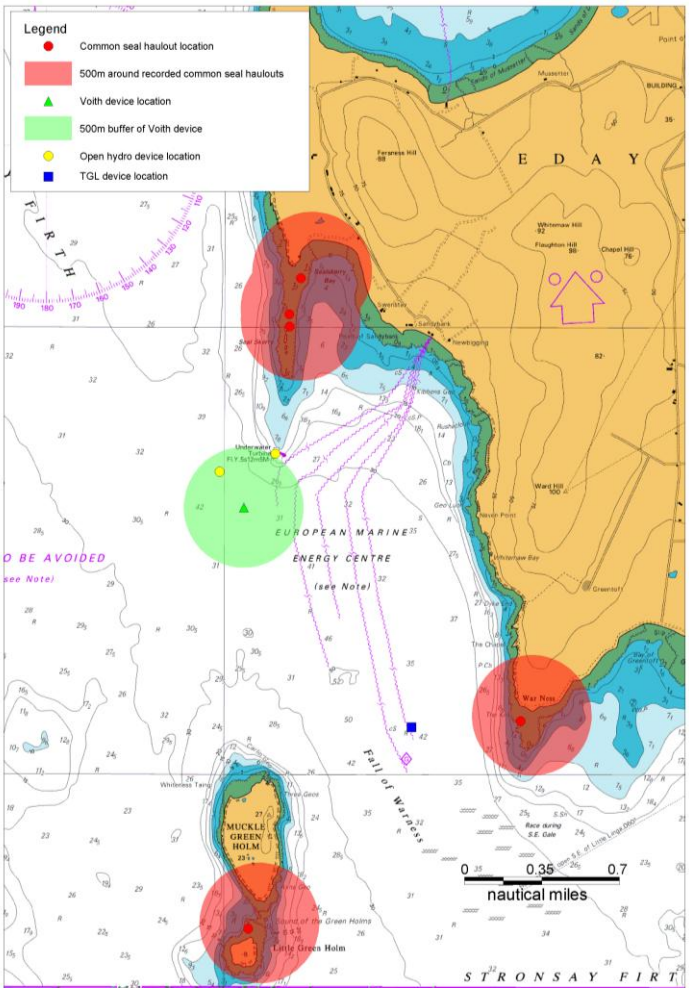

Figure 3.1 Harbour seal haul-out sites located in vicinity of EMEC test site.

Table 3.1 Seal Skerry observation schedule

Date	Number of watches	Vessel	Vessel operations
18 July	1	-	-
19 July	1	-	-
20 July	2	-	-
21 July	2	-	-
22 July	2	Boa Deep Sea (BDS)	Working at adjacent EMEC berth.
23 July	2	-	-
24 July	2	North Sea Giant	Arrival on site at 0220, preparation for installation
25 July	2	North Sea Giant	Installation of template, drilling commenced at 1510
26 July	1*	North Sea Giant	Drilling operations continued
27 July	2	North Sea Giant	Drilling completed at 0645 preparation of monopile
28 July	2	North Sea Giant	Installation of monopile and grouting in place
29 July	2	North Sea Giant	Recover template and depart site at 1430
30 July	2	-	-
31 July	1	-	-
1 August	1	-	-
3 August	1	-	-
6 August	1	-	-
10 August	1	-	-
14 August	1	-	-

* Low tides occurred in hours of darkness therefore reduced monitoring.

3.3 Summary of results

The observation programme was initiated on 18 July, approximately 1 week prior to commencement of installation activities at the site and was completed on 14 August (approximately 1 week following completion of operations). The total observation time for the 2011 monitoring programme was 61 hours and the total number of records entered was

249. The observational data obtained from the survey are summarised in Table 3.1 along with key operational events.

The average number of seals hauled out on *Seal Skerry* prior to the arrival of the NSG (12 individuals) appeared to be lower than that observed both during, and following operations at the site (29 and 24 individuals respectively). A plot of the number of seals recorded at different times of the day throughout the monitoring programme (Figure 3.3) showed a distinct diurnal pattern with greater numbers being recorded in the middle of the day (1000 to 1800) and since the majority of the pre-operational observations were conducted either early in the morning or late in the evening (Figure 3.4 and Figure 3.5) the reduced numbers recorded during these observations are therefore, most likely to be related to this natural behaviour pattern. The monitoring programme provided no evidence to indicate any disturbance arising from operations at the Voith site.

The observer recorded only three clear 'disturbance events'[2] over the entire monitoring period. At all other times the seals hauled out at the site appeared to be in a relaxed state. Summarised details of the three discrete disturbance events are provided in Table 3.2.

Table 3.2 Summary of Seal disturbance events observed,18 July to 24 August

Date	Time	Number of seals on Seal Skerry	Number of Seals on Seal Skerry Point	Description of disturbance
23 July	10:35	18	1	Injured seal (see below) present on Seal Skerry causing general agitation amongst the community.
3 August	16:50	3	6	Rigid Inflatable Boat (RIB) – not associated with Voith Hydro's operations - moored close to Seal Skerry causing disturbance to seal community.
10 August	14:19	34	1	Five seals rushed into sea. Reason Unknown.

[2] Instances where the seal community deviated from natural, relaxed, state.

As outlined above, an injured seal was first seen hauled out on Seal Skerry on 23 July, the day prior to the arrival of the North Sea Giant on site. Judging by the seals behaviour and the wound appearance the injury was recent and superficial. The wound was a relatively clean slash of approximately 23-24cm in length on the right flank of the seal (see Figure 3.2). The injured seal was seen frequently over the period of the observations with little effect on its behaviour except it spent much of the time on its side when hauled-out.

Figure 3.2 Photograph of injured seal, first observed at *Seal Skerry* on 23 July, 2011

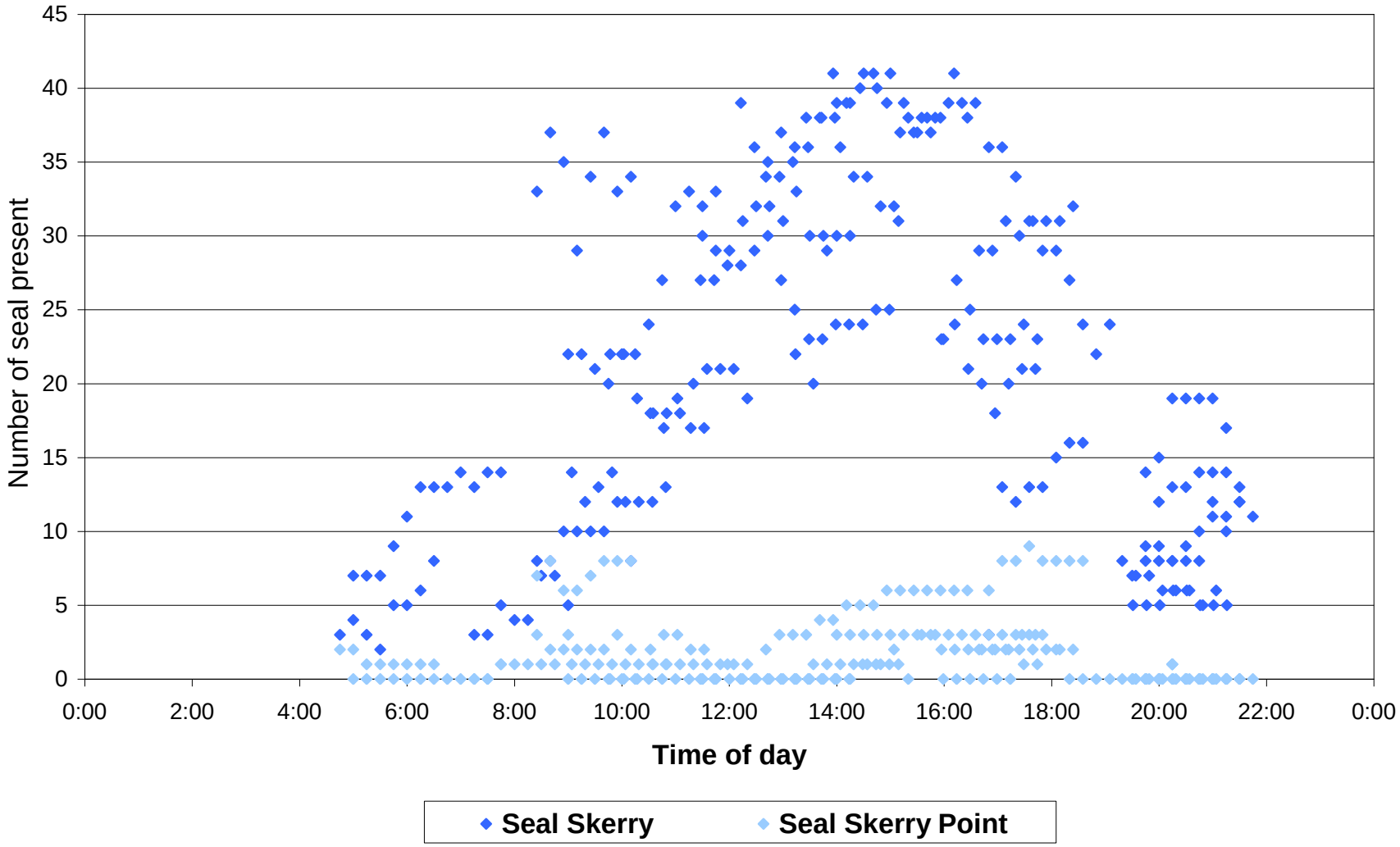

Figure 3.3 Diurnal variation in the numbers of seals observed on Seal Skerry and Seal Skerry Point, July-August 2011

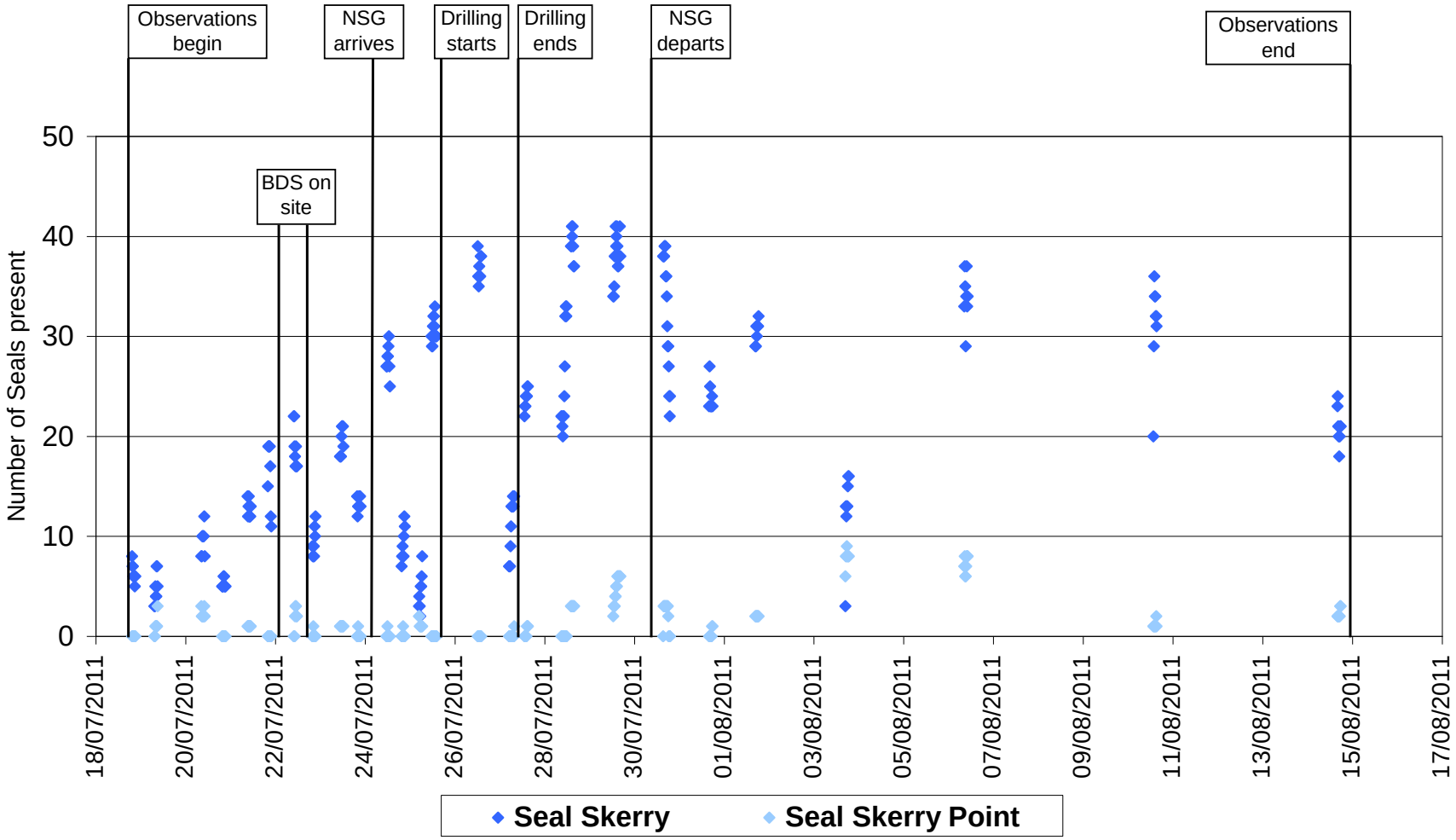

Figure 3.4 Summary of Harbour Seal numbers observed at Seal Skerry and Seal Skerry Point, July-August 2011

(Vessel abbreviations: BDS – Boa Deep Sea NSG – North Sea Giant)

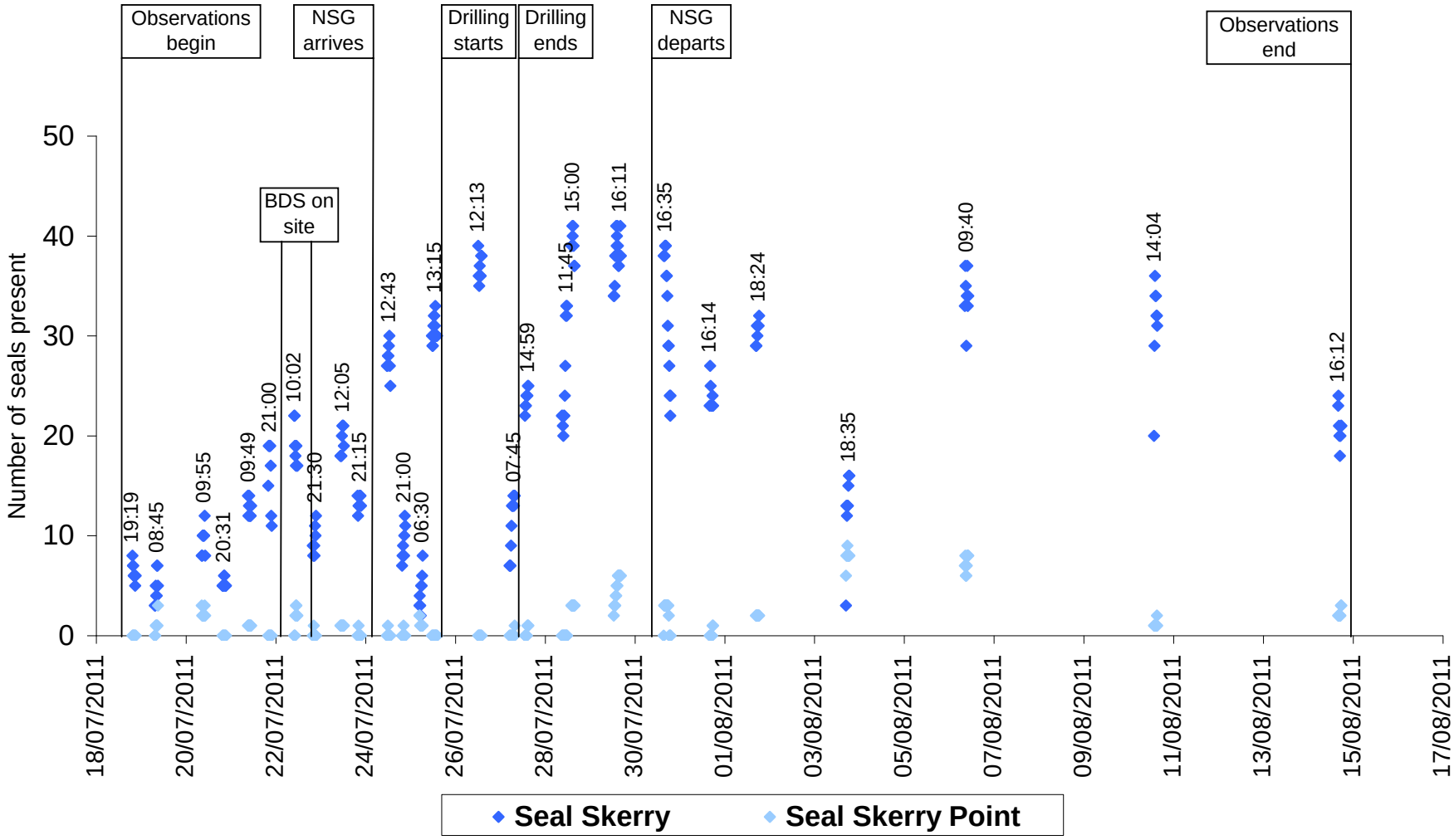

Figure 3.5 Harbour Seal numbers observed at Seal Skerry and Seal Skerry Point – Annotated with time of watch, July-August 2011

3.4 Conclusions

There was no evidence to suggest any disturbance of the Harbour seal communities hauled-out around Seal Skerry occurred during the monopile installation operations carried out at the Voith site in July 2011.

As was the case in 2010, Seal Skerry was primarily used for haul-out and moulting, not for pupping, probably due to fast running tides in the area. Juvenile seals also use the skerry to haul-out however it is not possible to accurately distinguish these animals from a distance therefore all seals were recorded as adults during the 2011 survey.

The harbour seal behaviour at the *Seal Skerry Point* appeared to differ from that observed during the 2010 monitoring survey. The sheltered shoreline at the east side of *Seal Skerry Point* where 15-20 Harbour Seals gave birth during the 2010 season was only used as an occasional haul-out area in 2011. The reason for this is not clear and could be attributed to natural variability. However, the wildlife observers noted that a recent change in the mooring location used by certain work boats operating in the area, from a site across the bay to a site much nearer Seal Skerry Point, may have increased the general level of disturbance at the site and led to seals seeking a quieter pupping venue such as the Green Holms located to the south of the area.

4 Results of acoustic survey work

4.1 Introduction

The potential impact of noise (both air and water-transmitted) from installation operations on seals hauled out on *Seal Skerry* was provisionally assessed in the Environmental Statement prepared to support Voith's original licence application in 2010. A series of measurements were collected during the deployment of a jack-up barge at the site in July 2010 to increase the level of understanding of any potential issues. The results of the study provided no evidence to indicate that the harbour seal (*Phoca vitulina*) community, located approximately 1.3km away, would be disturbed by air-transmitted or waterborne noise emanating from the site (Aquatera, 2010).

In 2011 the installation operations utilised a subsea drilling unit operated from a large Dynamic Position (DP) vessel rather than the jack-up barge used previously therefore the noise signature was likely to differ significantly from that measured in 2010. The seabed drilling activities were identified as having the highest potential for noise generation (both air and water-borne) therefore the acoustic survey operations were focused on the initial operational period of the subsea drilling unit (25 July).

A full interpretive report discussing the findings of the acoustic survey work (both air and water-borne) is provided as a supplementary document.

4.2 Acoustic measurements – background information

The decibel (dB) is the most commonly used unit to quantify sound pressure levels. The decibel is a logarithmic measure of sound pressure relative to a reference value (typically 20 µPa, which is considered the threshold of human hearing). Since the scale is logarithmic, an increase in sound pressure by a factor of 10 is equivalent to a 10 dB change. Some examples of sound pressure values are provided below:

Source	Sound pressure level
Jet engine at 30 m	150 dB
Threshold of pain	130 dB
Jet engine at 100 m	110 – 140 dB
Car at 10 m	60 – 80 dB
EPA threshold for potential hearing loss and other disruptive effects.	70 dB
Normal conversation at 1 m	40 – 60 dB
Light leaf rustling	10 dB
Human auditory threshold	0 dB

4.3 Airborne sound - monitoring protocol

Handheld sound level meters were used to collect air sound pressure readings immediately prior to, and during drilling operations. The sound pressure readings were recorded as dB(A) units (the 'A' refers to the algorithm used to adjust the measured sound response to take into account human hearing frequencies). Two sets of measurements were taken:

1 Fixed point measurements were taken from the bridge area of the *North Sea Giant* located approximately 50 m from the heavy equipment positioned on the back deck of the vessel.

2 Air-borne sound pressure levels were also measured at different ranges from the *North Sea Giant* during drift transects conducted as part of the underwater acoustic survey operations (See section 5).

4.4 Airborne sound - results

Fixed point measurements were taken from the bridge of the NSG at an estimated 50m from the principal noise sources. The background levels on board prior to drilling were around 70dBA. Quite a large variation was apparent during the soft-start and during drilling but mean values remained less than 76dBA. It was likely that some of the variability measured would be related to intermittent crane and hydraulic system operations.

Background values obtained during drift transects prior to the drilling soft start ranged from 62.5dBA at 450m to 66.0dBA at 900m from the NSG, on the western side, and 62.0dBA at 560m to 67.3dBA at 700m, on the eastern side. At the closest point to the NSG, circa 100m on the western side during the soft start, 60.3dBA was recorded.

Similar sound pressure levels of 61.3dBA at 1.5km, 58.7dBA at 1.4km, 59.1dBA at 800m and 58.5dBA at 750m were recorded during drilling operations. Although sounds from the vessel were faintly audible at all times during the survey, the measurements appeared to be primarily influenced by wind, or the presence of the other vessels in the area.

A simple spherical spreading model ($20 \log_{10} r$) was applied to the mean values recorded on the *North Sea Giant* bridge. Based on this, the sound source level for the deck-based equipment was estimated as being approximately 107dBA at 1m.

4.5 Airborne sound - conclusions

The sound levels recorded on the *North Sea Giant* were variable, being influenced by the various operations being carried out at the time of measurement. Based on these

measurements, a source level of approximately 107dBA at 1m was estimated for the deck-based equipment during drilling operations. The data collected during the survey vessel drift transects were primarily influenced by wind and other vessel activity and showed no clear trends.

A basic analysis of the airborne sound data collected indicated that background levels would be expected to be achieved within a 100m radius of the *North Sea Giant*.

4.6 Waterborne sound - monitoring protocol

Data acquisition was carried out using a floating hydrophone system (ICIT's *Hydata sonobuoy*). Measurements were taken around slack water to minimise the influence of sounds related to turbulence caused by the hydrophone drifting through the water column. The equipment was deployed at set locations from one of two vessels (*Scapa Pioneer,* 1100-1400 or *Agricola, 1430*-1630) and allowed to drift on a track adjacent to the drilling vessel on the prevailing tidal current. A continuous dataset of one second positional coordinates of the sonobuoy were taken using an on-board GPS (Global Positioning System) data logger.

The water depth within the study site is approximately 35 m below chart datum and the hydrophone depth was set at four metres below sea level. Recordings were taken at a 44.1 kHz sample rate and a 16 bit depth giving a theoretical maximum dynamic range of 96 dB and a frequency detection rate of up to 22 kHz. The data were stored on the on-board computer system as .wav files.

A total of eight drift transects were conducted: three recording runs were made prior to slack water (1-3), one around slack water during the soft-start to drilling operations (4) and a further four as the tide was running to record the drilling operations (5-8). A plot of the drift transects are provided in Figure 4.1.

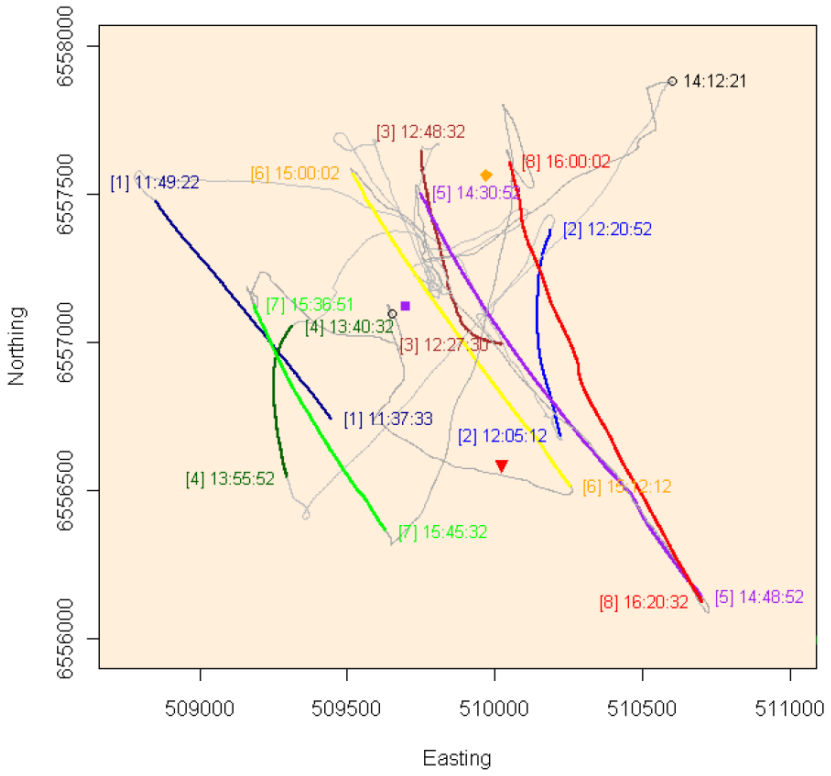

Figure 4.1 Plot of hydrophone drift transects, 25 July 2011.

4.7 Waterborne sound - results

Prior to drilling activity, the ambient underwater noise levels in the area (originating from a combination of natural sources, the *North Sea Giant*, and other vessel traffic operating in the area at the time of the survey) ranged from 123.9dB re 1µPa at 534m from the drilling vessel to 126.4dB re 1µPa at 310m. The lowest background levels, 122dB re 1µPa were recorded at a distance of 1.5km from the drilling template immediately following the soft-start. These were consistent with the estimated background noise level range of 115-125dB re 1µPa selected as the threshold for the coastal waters in the Fall of Warness area in the initial desk-based assessment carried out to support the Environmental Statement for the project (Side, 2010).

The measurements collected during drilling operations showed increased levels of low frequency noise originating from the drill. These data were used to provide an estimate of the drilling source level and transmission loss with distance indicating a drilling source sound pressure level of 168dB re 1µPa at 1m, and a transmission loss of 16.62 $\log_{10}$ r. Further investigation of these data revealed the influence of the North Sea Giant's thrusters on either side of the drilling centre, so this analysis reflects the noise contribution directly related to the drilling operations with an additional contribution from the vessel thrusters.

The sound measurements taken during the drilling 'soft-start' (as outlined in section 2.2) were dominated by a number of short metallic rasps and creaks as the drilling equipment bedded into the bedrock however, in general the sound source levels appeared to be lower than those recorded during drilling indicating that the soft-start method applied was effective in gradually building up the noise levels related to drilling.

Additional acoustic signals originating from various subsurface beacons, positioning devices and fish farm seal scarers were recorded in all measurements, however these did not interfere with the analysis of the operational noise levels at the site.

4.8 Waterborne sound - conclusions

The measured ambient levels on site were influenced by a combination of the NSG and the presence of other vessel traffic during the survey. GPS data collected from drift tracks during drilling were used to provide an estimate of the drilling source level and transmission loss with distance. These suggested a drilling source sound pressure level of 168dB re 1µPa at 1m and a transmission spreading loss of 16.62 $\log_{10}$ r. The model derived from this study is displayed graphically in Figure 4.2 (red line) alongside the worst-case scenario model used in the preliminary Environmental Statement study – green line (Side, 2010) and, in the absence of baseline data for the Fall of Warness, a model based on measured data from Strangford Lough - purple (Nedwell et. al., 2008).

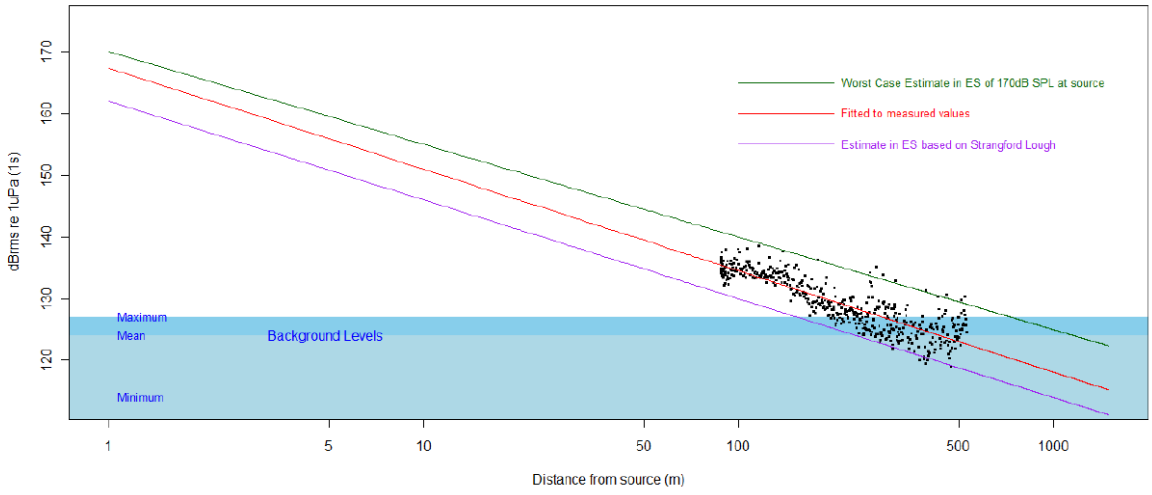

Figure 4.2 Comparison of model derived from July 2011 data with those used in other studies.

The data collected during the survey suggest that background sound pressure levels would be achieved within 100m of the *North Sea Giant* vessel thrusters whilst holding position at

the site and within 500m of the subsea template during drilling operations. There are limited specific data describing the sensitivity of seals to underwater noise, however disturbance and auditory impairment threshold values of around 160-180 re 1µPa at 1m would be expected (Side, 2010). It is therefore possible to conclude from the results that there would be little risk of any auditory impairment of harbour seals with the zone of mild disturbance being limited to, at most, a few metres from the drill bit.

5 Results of post-deployment ROV seabed survey

5.1 Introduction

A post-installation seabed survey was required to comply with provisions of the Licence for Marine Construction Works issued by Marine Scotland for the project, specifically:

Condition 15

The licensee shall, where appropriate, undertake monitoring of the area pre and post installation and post decommissioning of the deposits on the sea bed subject to this licence e.g. deployment of a remotely operated vehicle. The monitoring shall incorporate, if deemed to be necessary by the licensing authority, physical, chemical and biological investigations, to access the status of the authorised deposits and their impact in the receiving environment. The scope, frequency and spatial extent of the investigations shall be approved by the licensing authority. Successive operations at each of the berth sites will only require monitoring to be undertaken if the new operation results in any additional deposits on the sea bed.

A remotely operated vehicle (ROV) survey of the immediate vicinity of the installed monopile was carried out on 10 August 2011 following the completion of operations at the site.

5.2 Monitoring protocol

A *Seaeye Falcon* observation-class ROV operated on behalf of MojoMaritime by DNAC ROV services was deployed from the survey vessel *MV C-Odyssey* on 10 August 2011.

5.3 Results

Representative images captured from the post-installation video footage are provided in Figure 5.1. Pre-installation video footage of the seabed was collected previously as part of a baseline survey carried out on 6 May 2010 (reported in the project Environmental Statement, Aquatera 2010a) and on 30 July 2010 following two attempted barge deployments at the site (reported in Aquatera, 2010b). Representative still images captured from these pre-operational surveys, showing typical seabed conditions, are displayed in Figures 5.2 and 5.3.

The video collected in August 2011 indicated a relatively limited degree of seabed disturbance outside the immediate physical footprint of the monopile installation. Impacts appeared to be primarily related to the deposition of small quantities of excess grout within a few meters of the monopile. The seabed communities observed outside the immediate

monopile footprint (typified by the image captured at 16:14) showed no evidence of major modifications, being primarily comprised of sponges, anemones and other encrusting fauna.

A displaced aluminium anode was observed on the seabed a few meters to the north of the monopile (as shown in the images captured at 16:16 and 16:24).

Figure 5.1 Images of seabed conditions in the vicinity of the installed monopile, August 2011

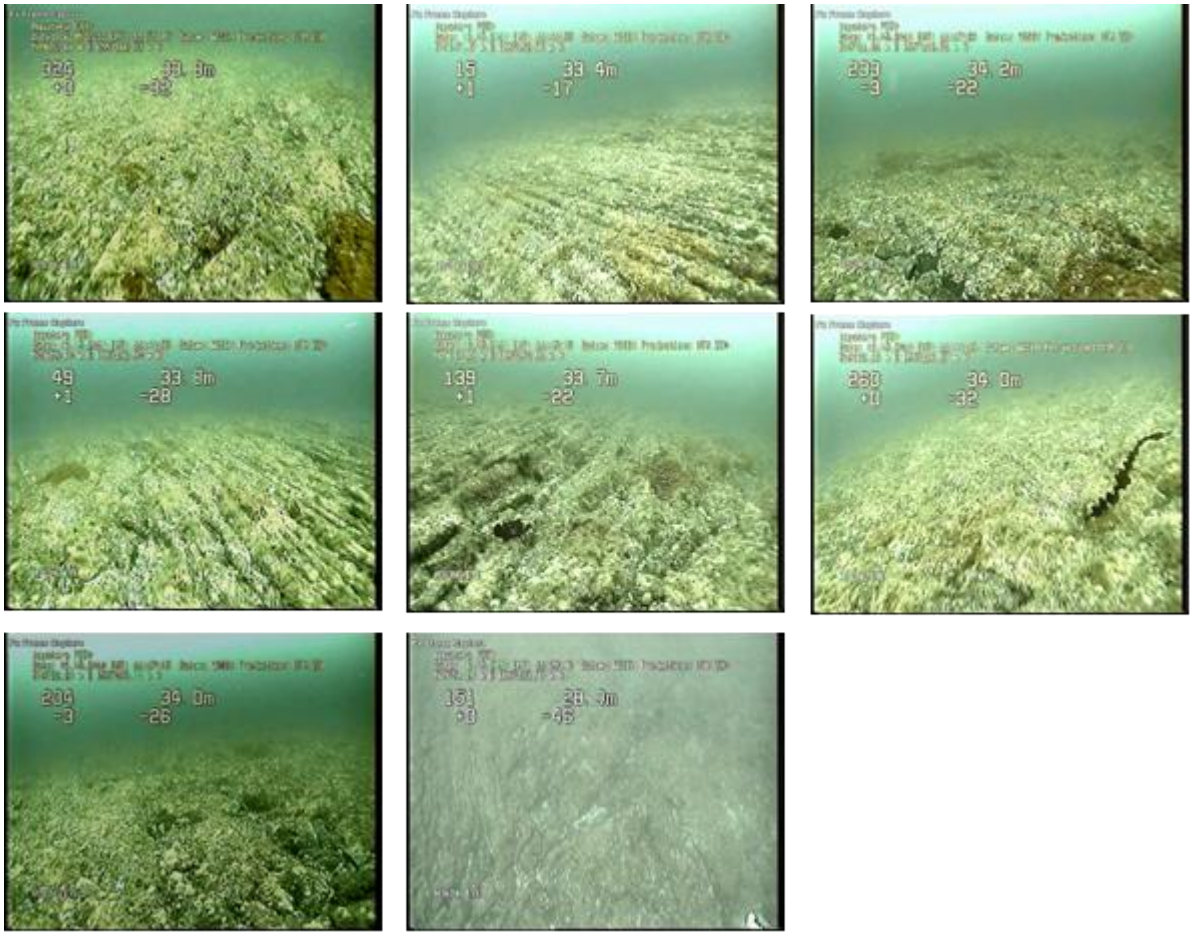

Figure 5.2 Still images captured from baseline ROV footage collected in May 2010

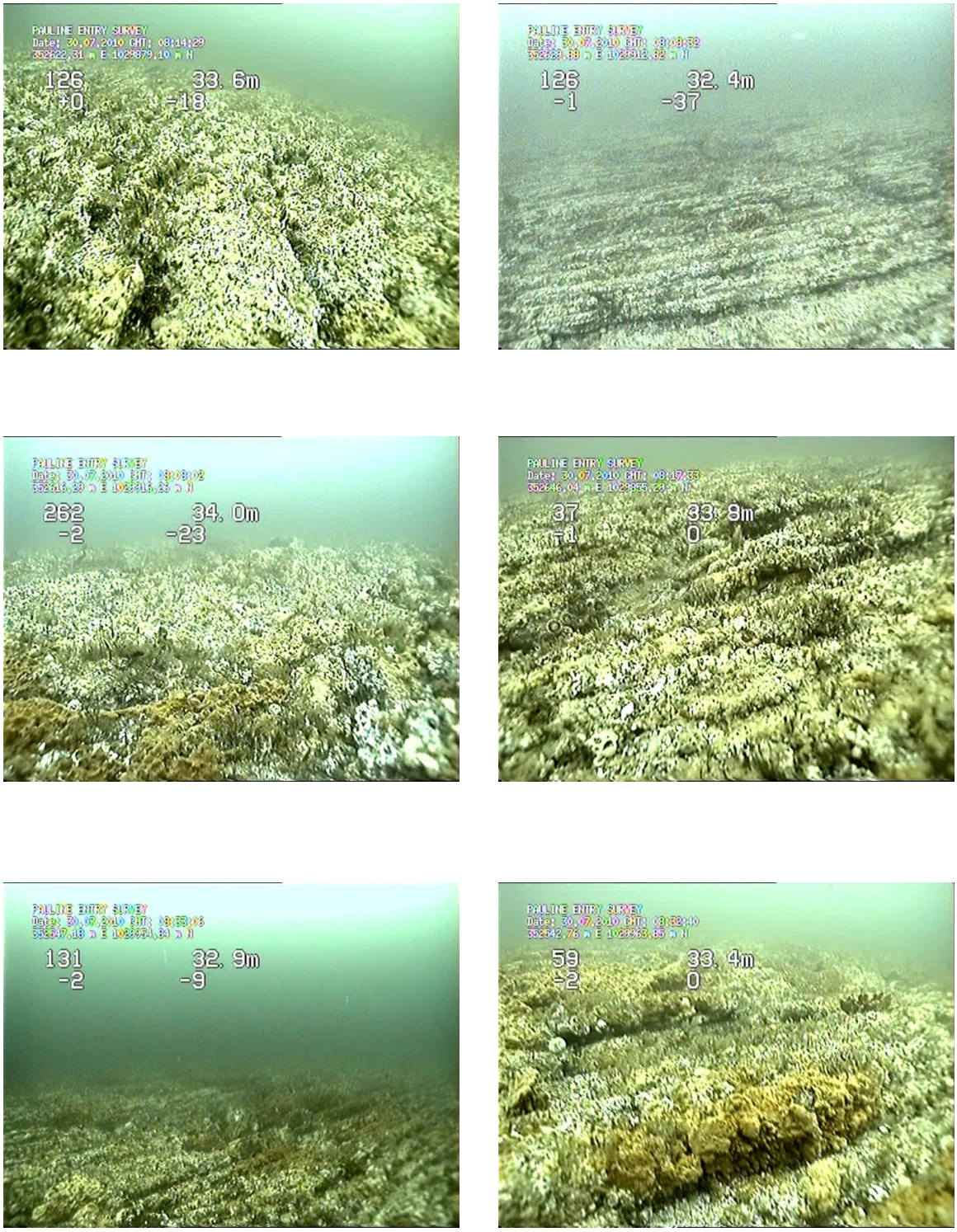

Figure 5.3 Still images captured from post-deployment ROV footage collected on 30 July 2010.

5.4 Conclusions

The seabed in the vicinity of the Voith installation site is primarily tide-scoured bedrock slabs with areas of boulders and cobbles. The faunal communities observed in the area are composed of a range of sponges, bryozoans, anemones, urchins and other encrusting fauna including barnacles. This type of habitat can be categorised using JNCC classification system (Connor et. al., 2004) as: *mixed faunal turf communities* (biotope code - CR.HCR.XFa).

Impacts to the seabed arising from the installation procedures appear to be restricted to immediate vicinity of the monopile. The seabed communities observed 1-2 m away from the installation showed no evidence of disturbance and were typical of those recorded in the pre-installation baseline surveys of the site.

6 Summary of environmental monitoring results

1 No marine mammals were observed within the observation zone whilst the North Sea Giant was stationed in the Fall of Warness area. It is not considered likely that the presence of the vessel was causing a wider, area-avoidance behaviour in cetaceans, rather it can be simply concluded that no cetaceans were present in the Fall of Warness during the operational period.

2 There was no evidence to suggest any disturbance of the harbour seal communities hauled-out around *Seal Skerry* occurred during the monopile installation operations carried out at the Voith site in July 2011. It was noted that the seals did not use *Seal Skerry Point* for pupping in 2011 and that this could be linked to a recent change in the mooring location used by work boats operating within area.

An injured harbour seal was observed prior to the arrival of the North Sea Giant on site during the 2011 survey. Injuries on seals and other marine species are common although it is not possible to reach any conclusion as to the source of this particular injury. The seal was observed throughout the remainder of the monitoring programme and the injury did not appear to be altering normal behaviour patterns.

3 A source level of approximately 107dBA at 1m was estimated for the deck-based equipment during drilling operations. A basic analysis of the airborne sound data collected indicated that background levels would be expected to be achieved within a 100m radius of the *North Sea Giant*.

4 The underwater acoustic data collected during the survey suggest that background sound pressure levels would be achieved within 100m of the *North Sea Giant* vessel thrusters whilst holding position at the site and within 500m of the subsea template during drilling operations. It was concluded that there would be little risk of any auditory impairment of harbour seals with the zone of mild disturbance being limited to, at most, a few metres from the drill bit.

5 Impacts to the seabed arising from the installation procedures appeared to be restricted to the immediate physical footprint of the monopile. The seabed communities observed a few meters away from the installation were relatively undisturbed and typical of those recorded in the pre-installation baseline surveys of the site.

7 Discussion and recommendations

7.1 Discussion

The monitoring studies conducted in July 2011 to coincide with the installation of the monopile at Voith's test berth were designed in consultation with all relevant stakeholders to assess the potential significance of the environmental impacts identified in the initial Environmental Statement prepared for the project (Aquatera, 2010a).

The results obtained from the 2011 monitoring programme indicated that any effects arising from operations (primarily related to noise and physical disturbance) would be highly localised and did not appear to have an affect on the wider environment. However, it should be noted that the spatially-focused/relatively short-scale studies conducted only provide a rudimentary snapshot of relatively complex environmental processes. Whilst these results do provide a basic insight into the environmental interactions occurring at the site, the robustness of assessment process could be improved by using a more long-term, integrated approach for the collection of environmental data.

This is especially important when monitoring the cetacean and seal populations where data can not only be influenced by specific anthropogenic activities but be driven by a wide range of different natural fluctuations, such as seasonal feeding and breeding behaviour, weather and hydrographical conditions.

It is therefore recommended that future marine mammal studies should be focused on the wider area (not just in the immediate vicinity of operations) and conducted throughout the year, thus providing a better understanding of the dynamics of the populations present. It is envisaged that this work would be undertaken as part of a strategic approach to monitoring across the test site and not by individual developers following discrete EMP's.

Based upon the results presented within this report it is further recommended that:

- Individual DP operators need not establish mitigation or observation zones around DP vessels during works at the test site in the future.
- No further work to characterise the noise signature of DP vessels is required at the test site.
- Marine mammal activity should be monitored across the wider area using EMEC's existing monitoring protocol and that this should be expanded to include the seals on Seal Skerry and Skerry Point.
- A control site should be established so that a valid assessment can be undertaken.

8 References

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Appendix A – MMO deck forms

MARINE MAMMAL RECORDING FORM - COVER PAGE

Regulatory reference number (e.g. DECC no., BOEMRE permit no., OCS lease no., etc.) **MS EPS 04/2011**	**Country** **Scotland, UK**	**Ship/ platform name** **North Sea Giant**
Client **Voith Hydro Ocean Current Technologies** **Heidenheim, Germany**	**Contractor** **BAUER Renewables Ltd.** **Bishops Stortford, UK**	**Survey type** ☐ site ☐ VSP ☐ 2D ☐ WAZ ☐ 3D ☐ piling ☐ 4D ☐ explosives ☐ OBC X other ☐ 4C
Start date **24 July 2011**	**End date** **25 July 2011**	

Number of source vessels **1**	**Type of source** (e.g. airguns) **Seabed Drilling**	**Number of airguns** (only if airguns used)	**Source volume** (cu. in.)
Source depth (metres) **37m**	**Frequency** (Hz)	**Intensity** (dB re. 1µPa or bar metres)	**Shot point interval** (metres)
Method of soft start ☐ increase number of guns ☐ increase pressure (where permitted) ☐ increase frequency (where permitted) X other			

Visual monitoring equipment used (e.g. binoculars, big eyes, etc.) **binoculars**	**Magnification of optical equipment** (e.g. binoculars) **7.5 x 10**	**Height of eye** (metres) **Bridge: 28.85** **06 Acc Deck: 24.15;** **04 Acc Deck: 17.95;**	**How was distance of animals estimated?** ☐ by eye ☐ with laser rangefinder ☐ with rangefinder stick/ callipers X with reticle binoculars ☐ by relating to object at known distance ☐ other
Number of dedicated MMOs **2**	**Training of MMOs** X JNCC approved MMO induction course for UK waters ☐ PSO training course for the Gulf of Mexico ☐ MMO training course for Irish waters ☐ other ☐ none		

Was PAM used? ☐ yes X no	**Number of PAM operators**	
Description of PAM equipment		
Range of PAM hydrophones from airguns (metres)	**Bearing of PAM hydrophones from airguns** (relative to direction of travel)	**Depth of PAM hydrophones** (metres)

Deckforms/cover/rev.03

MARINE MAMMAL RECORDING FORM - OPERATIONS

Regulatory reference number MS EPS 04/2011 **Ship/ platform name North Sea Giant**
(e.g. DECC no., BOEMRE permit no., OCS lease no., etc.)

Complete this form every time the airguns are used, including overnight, whether for shooting a line or for testing or for any purpose.
Times should be in UTC, using the 24 hour clock.

Date	**Reason for firing** l = line t = test x = test followed immediately by line	**Time soft start/ ramp-up began**	**Time of full power**	**Time of start of line**	**Time of end of line**	**Time of reduced output** (if relevant)	**Time airguns/ source stopped**	**Time pre-shooting search began**	**Time search ended**	**Time PAM began**	**Time PAM ended**	**Was it day or night in period prior to firing?** d = day n = night w = dawn k = dusk	**Was any mitigating action required?** (yes/ no)

Deckforms/operations/rev.03

MARINE MAMMAL RECORDING FORM - EFFORT

Regulatory reference number MS EPS 04/2011 **Ship/ platform name North Sea Giant**
(e.g. DECC no., BOEMRE permit no., OCS lease no., etc.)

Please record the following for all watches, even if no marine mammals are seen. **Enter data at least every hour.**

										Start a new line on form if any one of these changes						
Date	**Visual watch or PAM** v = visual watch p = PAM	**Observer's/ operator's name(s)**	**Time of start of watch** (UTC, 24hr clock)	**Time of end of watch** (UTC, 24hr clock)	**Start position** (latitude and longitude)	**Depth at start** (m)	**End position** (latitude and longitude)	**Depth at end** (m)	**Speed of vessel** (knots)	**Source activity** f = full power (from SOL) s = soft start & run-in r = reduced power (not soft start) n = not active v = variable (e.g. tests)	**Wind direction**	**Wind force** (Beaufort scale)	**Sea state** g = glassy (like mirror) s = slight (no or few white caps) c = choppy (many white caps) r = rough (big waves, foam, spray)	**Swell** o = low (< 2 m) m = medium (2-4 m) l = large (> 4 m)	**Visibility** (visual watch only) p = poor (< 1 km) m = moderate (1-5 km) g = good (> 5 km)	**Sun glare** (visual watch only) n = none wf = weak forward sf = strong forward vf = variable forward wb = weak behind sb = strong behind vb = variable behind
24.7.11	v	Scheller	01:20	01:50	59°02.280N 2°40.875W	33	59°05.850N 2°45.880W	32	10	n	NNW	7-8	c-r	m	m	n
24.7,11	v	Scheller	06:30	07:30	59°09.160N 2°49.810W	34	59°09.100N 2°49.840W	34	0-2	n	NNW	7	c	m	m	n
24.7.11	v	Scheller + Schmitz	09:00	10:00	59°09.100N 2°49.840W	35	59°09.100N2°49.840W	35	0	n	NNW	7	c	m	m	n
24.7.11	v	Scheller + Schmitz	10:38	11:11	59°09.073N 2°49.870W	36	59°09.166N 2°49.799W	35	0-2	n	NNW	6	c	m	m	n
25.7.11	v	Scheller + Schmitz	12:30	14:30	59°09.212N 2°49.899W	35	59°09.212N 2°49.899W	35	0	n	NNW	5	s-c	o	m	n
25.7.11	v	Scheller + Schmitz	14:30	15:15	59°09.212N 2°49.899W	35	59°09.212N 2°49.899W	35	0	s	NNW	4-5	s	o	m	n
25.7.11	v	Scheller + Schmitz	15:15	17:15	59°09.212N 2°49.899W	35	59°09.212N 2°49.899W	35	0	f	NNW	4-5	s	o	m	n

Deckforms/effort/rev.03

MARINE MAMMAL RECORDING FORM - SIGHTINGS

Regulatory reference number (e.g. DECC no., BOEMRE permit no., OCS lease no., etc.) **MS EPS 04/2011**	**Ship/ platform name** **North Sea Giant**	**Sighting number** (start at 1 for first sighting of survey)	**Acoustic detection number** (start at 500 for first detection of survey)
Date **24 + 25 July 2011** **No sightings**		**Time at start of encounter** (UTC, 24hr clock)	**Time at end of encounter** (UTC, 24hr clock)

Were animals detected visually and/ or acoustically? ☐ visual ☐ acoustic ☐ both	**How were the animals first detected?** ☐ visually detected by observer keeping a continuous watch ☐ visually spotted incidentally by observer or someone else ☐ acoustically detected by PAM ☐ both visually and acoustically before operators/ observers informed each other

Observer's/ operator's name	**Position** (latitude and longitude)	**Water depth** (metres)

Species/ species group	**Description** (include features such as overall size; shape of head; colour and pattern; size, shape and position of dorsal fin; height, direction and shape of blow)
Bearing to animal (when first seen or heard) (true bearing from north) **Range to animal** (when first seen or heard) (metres)	

Total number	**Number of adults** (visual sightings only)	**Number of juveniles** (visual sightings only)	**Number of calves** (visual sightings only)

Behaviour (visual sightings only)

Direction of travel (relative to ship)		**Direction of travel** (compass points)	
☐ towards ship	☐ variable	☐ N	☐ W
☐ away from ship	☐ milling	☐ NE	☐ NW
☐ parallel to ship in same direction as ship	☐ stationary	☐ E	☐ variable
☐ parallel to opposite direction to ship	☐ other	☐ SE	☐ stationary
☐ crossing perpendicular ahead of ship	☐ unknown	☐ S	☐ unknown
		☐ SW	

Airgun (or other source) activity when animals first detected ☐ full power ☐ not firing ☐ soft start ☐ reduced power (other than soft start)	**Airgun (or other source) activity when animals last detected** ☐ full power ☐ not firing ☐ soft start ☐ reduced power (other than soft start)	**Time animals entered mitigation/ exclusion zone** (UTC, 24hr clock)	**Time animals left mitigation/ exclusion zone** (UTC, 24hr clock)
		Closest distance of animals from airguns (or other source) (metres)	**Time of closest approach** (UTC, 24hr clock)

If seen during soft start give: **First distance** **Closest distance** **Last distance** during soft start (metres)	**What action was taken?** (according to requirements of guidelines/ regulations in country concerned) ☐ none required ☐ delay start of firing ☐ shut-down of active source ☐ power-down of active source ☐ power-down then shut-down of active source	**Length of power-down and/ or shut-down** (if relevant) (length of time until subsequent soft start, in minutes)	**Estimated loss of production (if relevant) due to mitigating actions** (km)

Deckforms/sightings/rev.03