Beatrice Offshore Wind Farm Consent Plan

Construction Method Statement

November 2016

Beatrice
Offshore Windfarm Ltd

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Project Title/ Location	Beatrice Offshore Wind Farm
Project Reference Number	LF0000005
Date:	November 2016

Beatrice Offshore Wind Farm

Construction Method Statement

(Wind Farm)

Pursuant to Section 36 Consent Condition 11 and the Marine Licence (Offshore Transmission Works) Condition 3.2.2.4 (Partial)

For the approval of the Scottish Ministers

Rev	Prepared By	Sign Off	Checked By	Sign Off	Approved By	Sign Off	Date of Issue
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Construction Method Statement (Wind Farm) Overview

Purpose of the Plan

This Wind Farm Construction Method Statement (CMS) has been prepared to address the specific requirements of the relevant conditions attached to Section 36 Consent and Marine Licences issued to Beatrice Offshore Windfarm Limited (BOWL).

The overall aim of the CMS is to set out construction procedures and good working practices in relation to the installation of the Wind Farm and Offshore Transformer Modules (OTMs), noting that a separate CMS will set out the equivalent for the offshore export cable.

The CMS confirms that the construction procedures to be employed align with those considered in the original Application, and that construction-related mitigation measures detailed in the Application will be applied during installation.

All method statements developed by contractors involved in the Beatrice Project must comply with the procedures set out in this CMS.

Scope of the Plan

The CMS covers, in line with the requirements of Section 36 Consent and Marine Licence conditions, and in line industry standards and good practice, the following:

- Construction procedures in relation to foundations and substructures, wind turbines, OTMs and inter-array cables;
- Good working practices to be employed during construction;
- Identification of key contractors and vessels involved in construction;
- The roles and responsibilities of key Project personnel and contractors during construction with respect to environmental management; and
- Confirmation that the construction methods described within the CMS align with those considered in the original Application.

Structure of the Plan

The CMS is structured as follows:

Sections 1 to 4 set out the scope and objectives of the CMS, provide an overview of the Project, set out broad statements of compliance and detail the process for making updates and amendments to this document.

Section 5 provides detail around construction procedures, describing the vessels and equipment to be utilised and sequence of installation works.

Section 6 presents the good working practices to be applied by BOWL and contractors during construction.

Section 7 and Appendices A and B demonstrate compliance with the original Application.

Plan Audience

This CMS is intended to be referred by personnel involved in the construction of the Beatrice Project, including BOWL personnel, Key Contractors and Subcontractors. All method statements and work plans produced in relation to the Project must comply with this CMS.

Compliance with this CMS will be monitored by the BOWL Consents and Licensing Team, the BOWL ECoW, and the Marine Scotland Licensing and Operations Team.

Plan Locations

Copies of this CMS are to be held in the following locations:

- At BOWL Head Office;

- At the premises of any agent, Key Contractor or Subcontractor (as appropriate) acting on behalf of BOWL;

- The BOWL Marine Coordination Centre at Wick;

- With the Ecological Clerk of Works (ECoW(s)).

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List of Abbreviations and Definitions

Term	Definition / Description
ALARP	As Low As Reasonably Possible.
Application	The application letters and Environmental Statement submitted to the Scottish Ministers by BOWL on 23 April 2012 and Supplementary Environmental Information Statement submitted to the Scottish Ministers by BOWL on 29 May 2013.
BOWL	Beatrice Offshore Windfarm Limited (Company Number SC350248) and having its registered office at Inveralmond House, 200 Dunkeld Road, Perth, PH1 3AQ
CaP	Cable Plan as required for approval under Condition 19 of the Section (S36) Consent and Condition 3.2.2.10 of the OfTW Marine Licence.
CCTV	Closed Circuit Television.
CLV	Cable Lay Vessel
CMS	Construction Method Statement as required for approval under Condition 11 of the Section 36 (S36) Consent and Condition 3.2.2.4 of the OfTW Marine Licence.
Commencement of the Wind Farm/OfTW	The date on which Construction begins on the site of the Wind Farm or the OfTW (as appropriate) in accordance with the Section 36 Consent or OfTW Marine Licence (as appropriate).
CoP	Construction Programme as required for approval under Condition 10 of the Section 36 (S36) Consent and Condition 3.2.2.3 of the OfTW Marine Licence.
COSHH	Control of Substances Hazardous to Health (under the Control of Substances Hazardous to Health Regulations 2002).
CPS	Cable Protection System.
Development	The Wind Farm and the OfTW.
Development Area	The marine area associated with the Wind Farm and OfTW corridor.

Term	Definition / Description
DOL	Depth of Lowering (of buried cables).
DP	Dynamic Positioning.
DS	Design Statement as required for approval under Condition 14 of the Section 36 (S36) Consent and Condition 3.2.2.7 of the OfTW Marine Licence.
DSLP	Development Specification and Layout Plan as required for approval under Condition 13 of the Section 36 (S36) Consent S36and Condition 3.2.2.6 of the OfTW Marine Licence.
ECoW	Ecological Clerk of Works as required for approval under Condition 30 of the Section 36 (S36) Consent and Condition 3.2.2.12 of the OfTW Marine Licence.
EMP	Environmental Management Plan as required for approval under Condition 15 of the Section 36 (S36) Consent and Condition 3.2.1.2 of the OfTW Marine Licence.
EPCI	Engineering, Procurement, Construction and Installation.
ERCoP	Emergency Response Cooperation Plan.
ES	The Environmental Statement submitted to the Scottish Ministers by the Company on 23 April 2012 as part of the Application as defined above.
FLO	Fisheries Liaison Officer
GI	Ground Investigation.
HAZID	Hazard Identification.
HLV	Heavy Lift Vessel.
HSE	Health and Safety Executive (or Health, Safety and Environment).
Inter-array cables/cabling	The AC electrical cables that connect the WTGs to the OTMs (and OTM to OTM).
ISO	International Standardisation Organisation.
ISV	Installation Support Vessel

Term	Definition / Description
JNCC	Joint Nature Conservation Committee.
Key Contractors	The Contractors appointed for the individual work steams of Marine Installation; Transmission; and WTGs.
KP	Kilometre Post.
LAT	Lowest Astronomical Tide.
Licensing Authority	The Scottish Ministers.
LMP	Lighting and Marking Plan as required for approval under Condition 20 of the Section 36 (S36) Consent and Condition 3.2.2.14 of the OfTW Marine Licence
Marine Co-ordination	The management and surveillance of people, vessels and offshore structures to ensure the safe preparation and execution of offshore activities, in order to minimise the probability of an incident, and to provide effective response if an incident does occur.
Marine Licences	The Wind Farm Marine Licence and the OfTW Marine Licence.
MCA	Maritime and Coastguard Agency.
MSBL	Mean Sea Bed Level.
MS - LOT	Marine Scotland Licensing Operations Team.
MMO	Marine Mammal Observer.
NLB	Northern Lighthouse Board.
NSP	Navigational Safety Plan as required for approval under Condition 18 of the Section 36 (S36) Consent and Condition 3.2.2.9 of the OfTW Marine Licence.
NtoM	Notice to Mariners.
OfTW	The Offshore Transmission Works. The OfTW includes the transmission cable required to connect the Wind Farm to the OnTW. This covers the OTMs and the cable route from the OTMs to the Mean High Water Springs (MHWS) at the landfall west of Portgordon on the Moray coast.
OfTW CMS	The Construction Method Statement in respect of the export cable installation and OTM commissioning to be submitted

Term	Definition / Description
	for approval under Condition 3.2.2.4 of the OfTW Marine Licence.
OfTW Marine Licence	The written consent for the OfTW granted by the Scottish Ministers under Section 20(1) of the Marine (Scotland) Act 2010 and Section 65 of the Marine and Coastal Access Act 2009, issued on 2 September 2014, as revised by the issue of licence 04461/16/0 on 27 April 2016.
OHSAS	Occupational Health and Safety Assessment Series.
OSP	Offshore Substation Platform.
OTM	Offshore Transformer Module means an alternating current (AC) OSP which is a standalone modular unit that utilises the same substructure and foundation design as a wind turbine generator.
PAD	Protocol for Archaeological Discoveries.
PAM	Passive Acoustic Monitoring.
PEMP	Project Environmental Monitoring Plan as required for approval under Condition 27 of the Section 36 (S36) Consent and Condition 3.2.2.1 of the OfTW Marine Licence
PIF	Pile Installation Frame.
PLGR	Pre-lay Grapnel Run.
PS	Piling Strategy as required for approval under Condition 12 of the Section 36 Consent S36and Condition 3.2.2.5 of the OfTW Marine Licence.
ROV	Remotely Operated Vehicle.
RSPB Scotland	Royal Society for the Protection of Birds, Scotland.
S36 Consent	Consent granted by the Scottish Ministers under Section 36 of The Electricity Act 1989 to construct and operate the Beatrice Offshore Wind farm electricity generating station, dated 19th March 2014.
SCADA	Supervisory Control and Data Acquisition.
SEIS	The Supplementary Environmental Information Statement submitted to the Scottish Ministers by the Company on 29 May 2013 as part of the Application as defined above.

Term	Definition / Description
SEPA	Scottish Environment Protection Agency.
SHE	Safety, Health and Environment.
SHL	Seaway Heavy Lifting Offshore Contractors B.V.
SNH	Scottish Natural Heritage.
Soft start piling	The gradual increase of piling power, incrementally over a set time period, until full operational power is achieved.
Spudcan	Base cones on mobile-drilling jack-up platform, which provide stability to lateral forces on the jack-up rig when deployed.
SWPL	Siemens Wind Power Ltd.
Subcontractor	Subcontractors to the Key Contractors.
T&I	Transportation and Installation.
VMP	Vessel Management Plan as required for approval under Condition 16 of the Section 36 (S36) Consent and Condition 3.2.2.8 of the OfTW Marine Licence.
Wind Farm	The offshore array development as assessed in the ES including wind turbines, their foundations, inter-array cabling and meteorological masts.
Wind Farm Marine Licence	The written consent for the Wind Farm granted by the Scottish Ministers under Section 20(1) of the Marine (Scotland) Act 2010, issued on 2 September 2014, as revised by the issue of licence 04462/16/0 on 27 April 2016.
WSI	Written Scheme of Investigation.
WTG	Wind Turbine Generator.

1 Introduction

1.1 Background

1.1.1 The Beatrice Offshore Wind Farm received consent under Section 36 of the Electricity Act 1989 from the Scottish Ministers on 19 March 2014 (the S36 Consent) and was granted two Marine Licences from the Scottish Ministers, for the Wind Farm and associated Offshore Transmission Works (OfTW), on 2nd September 2014 (the Marine Licences) and revised by the issue of licences on 27 April 2016 (Reference: 04461/16/0 and 04462/16/0 respectively.

1.2 Objectives of this Document

1.2.1 The S36 Consent and Marine Licences contain a variety of conditions that must be discharged through approval by the Scottish Ministers prior to the commencement of offshore construction. One such requirement is the approval a Construction Method Statement (CMS), the purpose of which is to set out offshore construction procedures and good working practices.

1.2.2 The relevant conditions setting out the requirement for a CMS for approval, and which are to be discharged by this CMS, are set out in full in Table 1.1.

1.2.3 It should be noted that this CMS is intended to provide full details to allow the complete discharge of the relevant S36 Consent condition (Wind Farm construction) and the discharge of the OfTW Marine Licence condition only in so far as it relates to the offshore substation platforms (or offshore transformer modules (OTMs)).

1.2.4 A separate CMS has been prepared for the remainder of the OfTW assets (i.e. the installation of the export cables).

Table 1.1 - Consent Conditions to be discharged by this Wind Farm CMS

Consent Document	Condition Reference	Condition Text	Reference to relevant Section of this CMS
Section 36	Condition 11	The Company must, no later than 6 months prior to the Commencement of the [Wind Farm] submit a Construction Method Statement ("CMS"), in writing, to the Scottish Ministers for their written approval.	This document sets out the CMS for approval by the Scottish Ministers
		Such approval may only be granted following consultation by the Scottish Ministers with the JNCC, SNH, SEPA, MCA, NLB, RSPB Scotland, [*the Moray Council*] and any such other advisors or organisations as may be required at the discretion of the Scottish Ministers.	Consultation to be undertaken by the Scottish Ministers
		The CMS must set out the construction procedures and good working practices for installing the [Wind Farm].	Sections 5.0 and 6.0

Consent Document	Condition Reference	Condition Text	Reference to relevant Section of this CMS
		The CMS must be in accordance with the construction methods assessed in the ES and must include details of how the construction related mitigation steps proposed in the ES are to be delivered.	Sections 7.0 and Appendices A and B
		The [Wind Farm] must, at all times, be constructed in accordance with the approved CMS (as updated and amended from time to time by the Company).	Section 2.0
		Any updates or amendments made to the CMS by the Company must be submitted, in writing, by the Company to the Scottish Ministers for their written approval.	Section 3.0
		The CMS must, so far as is reasonably practicable, be consistent with the DS, the EMP, the VMP, the NSP, the PS, the CaP and the LMP.	Section 1.4 and cross-references to other consent plans throughout this CMS
Marine Licence (OfTW)	Condition 3.2.2.4	The Licensee must, no later than 6 months prior to the Commencement of the [OfTW] submit a CMS, in writing, to the Licensing Authority for their written approval.	This document sets out the CMS for approval by the Licensing Authority
		Such approval may only be granted following consultation by the Licensing Authority with the JNCC, SNH, SEPA, MCA, NLB, the Highland Council, Moray Council and any such other advisors or organisations as may be required at the discretion of the Licensing Authority.	Consultation to be undertaken by the Licensing Authority
		The CMS must set out the construction procedures and good working practices for constructing the OfTW.	Section 6.0
		The CMS must be in accordance with the construction methods assessed in the Application and must include details of how the construction related mitigation steps proposed in the Application are to be delivered.	Sections 7.0 and Appendices A and B
		The CMS must, so far as is reasonably practicable, be consistent with the Design Statement (“DS”), the EMP, the Vessel Management Plan (“VMP”), the Navigational Safety Plan (“NSP”), the Piling Strategy (“PS”) (if required), the Cable Plan (“CaP”) and the Lighting and Marking Plan (“LMP”).	Section 1.4 and cross-references to other consent plans throughout this CMS

1.3 Linkages with Other Consent Plans

1.3.1 This CMS document sets out the proposed offshore construction methods for the Wind Farm and the offshore transmission modules. However, ultimately it will form part of a suite of approved documents that will provide the framework for the construction process – namely the other consent plans required under the Section 36 and OfTW marine licence.

1.3.2 Indeed Condition 11 of the S.36 Consent and Condition 3.2.2.4 of the OfTW Marine Licence (see Table 1.1 above) requires this CMS to be, so far as is reasonably practicable, consistent with a number of other specifically named consent plans, namely (in the order listed in the consent condition):

- The design statement (DS) (LF000005-PLN-167) (required under Condition 14 of the S36 consent and Condition 3.2.2.7 of the OfTW Marine Licence);
- The environmental management plan (EMP) (LF000005-PLN-144) (required under Condition 15 of the S36 consent and Condition 3.2.1.2 of the OfTW Marine Licence);
- The vessel management plan (VMP) (LF000005-PLN-168) (required under Condition 16 of the S36 consent and Condition 3.2.2.8 of the OfTW Marine Licence);
- The navigational safety plan (NSP) (LF000005-PLN-128) (required under Condition 18 of the S36 consent and Condition 3.2.2.9 of the OfTW Marine Licence);
- The piling strategy (PS) (LF000005-PLN-142) (required under Condition 12 of the S36 consent and Condition 3.2.2.5 of the OfTW Marine Licence);
- The Wind Farm cable plan (CaP) (LF000005-PLN-183) (required under Condition 19 of the S36 consent and Condition 3.2.2.10 of the OfTW Marine Licence); and
- The lighting and marking plan (LMP) (LF000005-PLN-128) (required under Condition 20 of the S36 consent and Condition 3.2.2.14 of the OfTW Marine Licence).

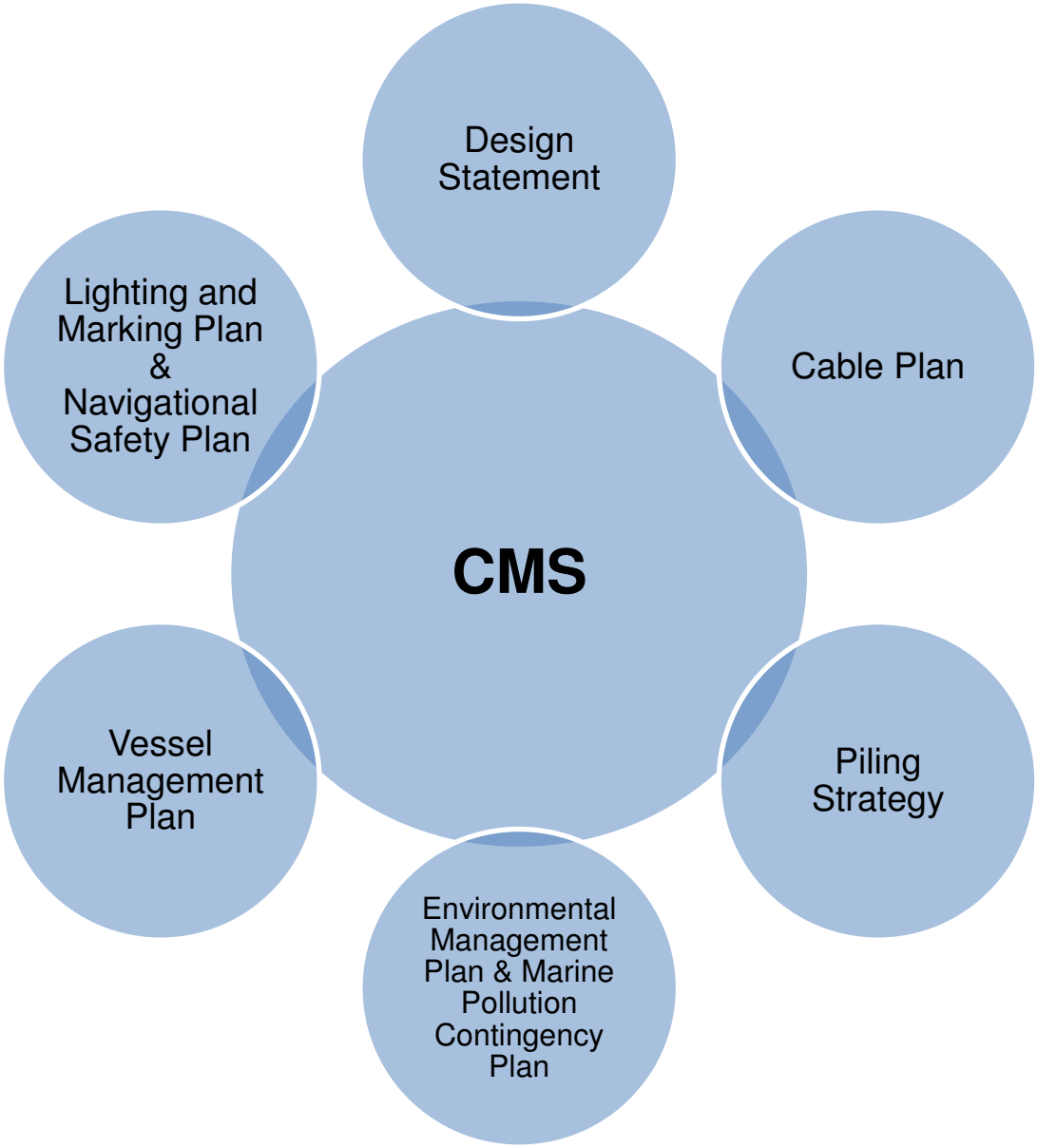
1.3.3 The other plans named in the consent clearly have a link to the CMS in so far as they either provide additional details on the construction methodology (for example the PS, the CaP, the DS and the VMP) and/or provide details on the control of construction to mitigate or manage potential environmental impacts and impacts on other marine users (for example the EMP, the NSP, the LMP, but also the PS).

1.3.4 Some of these documents will be submitted for approval by the Scottish Ministers subsequent to the approval of the CMS. Consistency between these documents and the CMS will be achieved by ensuring that the later documents are consistent with the terms of the already approved CMS.

1.3.5 Figure 1.1 summarises the Consent Plans that have some overlap with the CMS in terms of either construction methodology or the mitigation and management of construction so as to reduce or avoid impacts on the environment or other marine users.

1.3.6 Note that other relevant consent plans are cross-referenced as appropriate in this CMS but the detail from those other plans is not repeated here.

Figure 1.1 – CMS Related Consent Plans as Noted in the CMS Condition



1.3.7 The interaction of this CMS with those consent plans specifically listed in S36 Consent condition 11 and OfTW Marine Licence condition 3.2.2.4 is detailed in Table 1.2 below.

Table 1.2 – Wind Farm CMS linkages with other Consent Plans

Other named Consent Plan	Consistency with and linkage to CMS
DS	The DS includes representative Wind Farm visualisations from key viewpoints based upon the final DSLP and must be prepared and signed off by at least one qualified landscape architect; its purpose is to inform interested parties of the final Wind Farm scheme proposed to be built. This CMS presents the construction methods, good practice and mitigation measures for the Wind Farm as described in the DS (and the DSLP) produced for the Wind Farm. An outline of the Wind Farm is set out this CMS, which is in line with that detailed in the DS.
EMP	The EMP sets out the environmental management framework for the construction and operation of the Wind Farm. The installation and construction described in this CMS will be undertaken in line with the environmental management measures described in the EMP. In addition, specific good practice measures and mitigation measures are detailed within this CMS (these being consistent with the measures described in the EMP where relevant).
VMP	The purpose of the VMP is to mitigate disturbance or impact to marine mammals and birds throughout the construction period of the Development, and the VMP will also consider operational management and coordination of vessels. The VMP details how vessel movements will be managed during construction of the Wind Farm. This CMS refers to the same indicative construction vessels which are included in the VMP. The VMP will be implemented in parallel with this CMS and the measures described in the VMP will apply to the vessels undertaking the activities described in this CMS. This CMS will therefore be implemented in accordance with the approved VMP for the Development.
NSP	Sets out the navigational safety measures to be applied for the Project including matters related to marine co-ordination, safety zones, routing, anchorages and notifications and communications for other sea users. The NSP also sets out emergency response procedures. The NSP will apply to all vessels undertaking the activities described in this CMS. This CMS will therefore be implemented in accordance with the approved NSP for the Development.
PS	The PS contains further and greater detail on how the piling methods and programme have been developed to reduce effects on noise sensitive species. It provides the more detailed description of the piling procedures (and associated mitigation and monitoring) adding to the information contained in this CMS. The detailed information contained within the PS is not repeated within this CMS but the piling operations described in this CMS will be undertaken in compliance with the more detailed procedures set out in the PS.
CaP	Provides the more detailed specification of the cables, their installation, burial and/or protection, their interactions with the environment and safety considerations, adding to the information contained in this CMS. The detailed information contained within the CaP is not repeated within this CMS but the cable installation operations described in this CMS will be undertaken in compliance with the more detailed procedures set out in the CaP.
LMP	Provides details of lighting and marking of the Wind Farm structures during construction and operation is provided in the LMP. This detail is not repeated

Other named Consent Plan	Consistency with and linkage to CMS
	within this CMS; however this CMS will be implemented in accordance with the approved LMP for the Wind Farm.

1.4 Structure of this CMS

1.4.1 In response to the specific requirements of the S36 Consent and the OfTW Marine Licence conditions, this CMS has been structured so as to be clear that each part of the specific requirements have been met and that the relevant information to allow the Scottish Ministers to approve the CMS has been provided. The document structure is set out in Table 1.3.

Table 1.3 – CMS document structure

Section	Title	Overview
1	Introduction	Background to consent requirements and overview of the CMS scope and structure; and Identifies those other consent plans relevant to the construction/installation process and provides a statement of consistency between the CMS and those plans.
2	BOWL Statements of Compliance	Sets out the BOWL statements of compliance in relation to the CMS consent conditions and the broader construction process.
3	Updates and amendments to this CMS	Sets out the procedures for any required updating to or amending of the approved CMS and subsequent further approval by the Scottish Ministers.
4	Project Construction Overview	Provides an overview of the project, identifies Key Contractors and construction roles and responsibilities.
5	Construction Methods and Procedures	Provides further detail on each step of the Wind Farm installation process.
6	Good working practices	Sets out the good working practices that will be applied during the Wind Farm installation process.
7	Compliance with the Environmental Statement (Construction methods and mitigation)	Sets out confirmation that the details set out in this CMS are in accordance with those assessed in the ES; and Sets out how the mitigation measures related to construction identified in the ES are to be delivered (by reference to this CMS or other relevant consent plans).

2 BOWL Statements of Compliance

2.1 Introduction

2.1.1 The following sections are intended to re-affirm the BOWL commitment to ensuring that the Development is constructed in such a manner as to meet the relevant legislative requirements set out by the project consents but also broader legislative requirements; specifically it sets out:

- A number of statements of compliance relating to this CMS and the broader requirements of the project consents;
- Matters related to Safety, Health and Environmental (SHE) management;
- Matters related to equipment and materials;
- Matters related to construction personnel, including training and competence;
- Matters related to construction vessels; and
- Matters related to good working practices.

2.1.2 Reference is made throughout to other, relevant consent plans required by the project consents and to other sections of this CMS where further detail is provided.

2.2 Statements of Compliance

2.2.1 BOWL in undertaking the construction of the project will ensure compliance with this CMS as approved by the Scottish Ministers (and as updated or amended from time to time following the procedure set out in Section 3 of this CMS).

2.2.2 Where updates or amendments are required to this CMS, BOWL will ensure the Scottish Ministers are informed as soon as reasonably practicable and where necessary the CMS will be updated or amended (see Section 3 below).

2.2.3 BOWL in undertaking the construction of the project will ensure compliance with other, relevant consent plans as approved by the Scottish Ministers including, as set out in Section 1.4 above.

2.2.4 BOWL in undertaking the construction of the project will ensure compliance with the limits defined by the original application and the project description defined in the Environmental Statement and SEIS and referred to in Annex 1 of the Section 36 consent except in so far as amended by the terms of the S36 Consents (unless otherwise approved in advance by the Scottish Ministers) (see section 7 and Appendix B (ES Rochdale envelope compliance) and Appendix A (relevant mitigation identified in the ES)).

2.2.5 BOWL in undertaking the construction of the project will require compliance with BOWL Company SHE systems and standards, the relevant SHE legislation and such other relevant legislation and guidance so as to protect the safety of the Wind Farm construction personnel and other third parties.

2.2.6 BOWL will, in undertaking the construction of the project, ensure compliance with all other relevant legislation and require that all necessary licences and permissions are obtained by the key contractors and sub-contractors through condition of contract and by an appropriate auditing process.

2.2.7 It is also a condition of both of the Marine Licences (condition 3.2.12) that BOWL must supply Third Party Certification (TPC) of the works:

> *The Licensee must, no later than 3 months prior to the Commencement of the Works, provide the Licensing Authority (unless otherwise agreed, in writing, with the Licensing Authority) with TPC (or suitable alternative as agreed, in writing, with the Licensing Authority) for all WTG foundations, jacket and topside platform structures.*

2.3 SHE and Environmental Management

2.3.1 Further detail on SHE and environmental management is set out, for approval, in the EMP; the installation of the Development described by this CMS will be undertaken in line with the procedures and practices set out in the EMP. The following section summarises the key BOWL commitments.

2.3.2 The Development project is a notifiable project for the purposes of the Construction (Design and Management) Regulations 2015 (CDM regulations). BOWL will ensure compliance with the CDM regulations in the design of the project and through the completion of the construction process.

2.3.3 The BOWL company SHE standards and risk management procedures will be applied in completing the construction of the proposed project and will be applied as minimum standards through conditions of contract with the key contractors and sub-contractors.

2.3.4 Management standards in line with ISO 9001, 14001 and OHSAS 18001 will be applied for the overall BOWL project management system, and the management systems of all contractors will be required to concur with the same principles.

2.3.5 BOWL will require compliance with the Control of Substances Hazardous to Health Regulations 2002, (COSHH) in ensuring that the risk to health from workplace exposure to hazardous substances is appropriately assessed and that exposure is prevented or, where this is not reasonably practicable, adequate controls are implemented and exposure monitored and managed to within acceptable levels in line with relevant regulations.

2.3.6 BOWL will require that all key contractors and subcontractors have completed adequate risk assessments for all aspects of the construction.

2.4 Equipment and materials

2.4.1 All materials, plant or equipment will require to be inspected, either during manufacture or prior to despatch from the suppliers' premises, by a suitably qualified discipline inspector or engineer. BOWL shall be satisfied that any vendor or contractor supplying goods which require traceability has an adequate system of unique identification to satisfy these requirements.

2.4.2 All goods and materials loaded on board construction vessels shall require to be checked against the relevant documentation such as services reports, repair orders, packing list, cargo manifests, purchase orders, material certificates, test reports or material specifications or such other documentation as may be relevant. Inspections will include consideration of quality, quantity, identification numbering, damage in transit and general dimensions (and if such inspections are not or, due to circumstances, cannot be inspected in part or whole this will be noted).

2.4.3 If doubt arises as to the fitness for purpose of any supplied product it shall require to be clearly marked and quarantined until the suspected non-conformance can be resolved.

2.4.4 An appropriate system for the logging, storage, and marking of all equipment and materials will be required on each vessel. The supplier's special instructions and delivery notes will require to be complied with during handling, storage and installation with appropriate training or notification of personnel. The correct lifting procedures will require to be followed to ensure safe, efficient handling.

2.5 Construction personnel – training and competence

2.5.1 BOWL will require that all personnel engaged in the construction process have adequate experience to perform the activities executed under their responsibility or in their scope in a safe manner for themselves and others and are adequately supported at all levels.

2.5.2 BOWL will require that all key contractors and sub-contractors have sufficient manpower resources of the required competence to meet the contractual requirements. Safe manning levels for all onshore and offshore activities will be determined by industry guidance and past experience.

2.5.3 Personnel performing specific assigned tasks on the project will be qualified on the basis of appropriate education, training, competence and experience. Records of training or relevant certification will be required to be made available to BOWL for auditing where necessary.

2.5.4 BOWL will ensure that a project organogram (see Section 4.9) is in place and that the roles and responsibilities of all named personnel are clear and that clear project management procedures are in place for all aspects of the construction.

2.5.5 BOWL will require, through condition of contract, that welfare facilities are provided and maintained to the requirements of the Construction (Design and Management) Regulations 2015 and Workplace (Health, Safety & Welfare) Regulations 1992.

2.5.6 BOWL will require through condition of contract that suitable and sufficient First Aiders are in place and that first aid provision meets, or surpasses, recommendations as laid down in the Health & Safety (First Aid) Regulations 1981 and that all first aid personnel hold a valid qualification.

2.5.7 BOWL will require that all construction personnel attend inductions including, but not necessarily limited to, matters related to Site Rules, Health and Safety requirements, arrangements for First Aid and Emergency Response, and Environmental Management.

2.5.8 Further information relating to construction personnel training and competence is set out in the EMP submitted for approval by the Scottish Ministers.

2.6 Construction vessels

2.6.1 BOWL will require that all construction vessels meet the required, recognised standards and will comply with the international maritime rules (as adopted by the flag state) and regulations. Where necessary, BOWL will conduct appropriate independent vessel audits on all construction vessels to ensure they meet these standards and are fit for purpose for their prescribed roles.

2.6.2 All construction vessels will comply with the procedures and requirements set out in other relevant consent plans such as the VMP, the NSP, the LMP and the EMP.

2.7 Good working practices

2.7.1 Good working practices are set out separately under Section 6 of this CMS and in respect of the specific reference made in the consents in this regard.

2.7.2 BOWL will require all possible good working practice is applied by the key contractors and sub-contractors throughout the construction process in seeking to minimise the risks to personnel, other sea users and the environment.

3 Updates and Amendments to this CMS

3.1.1 This CMS sets out the proposed methods for construction and installation of the Development.

3.1.2 The S36 consent condition recognises that updates or amendments to this CMS may be required, stating that:

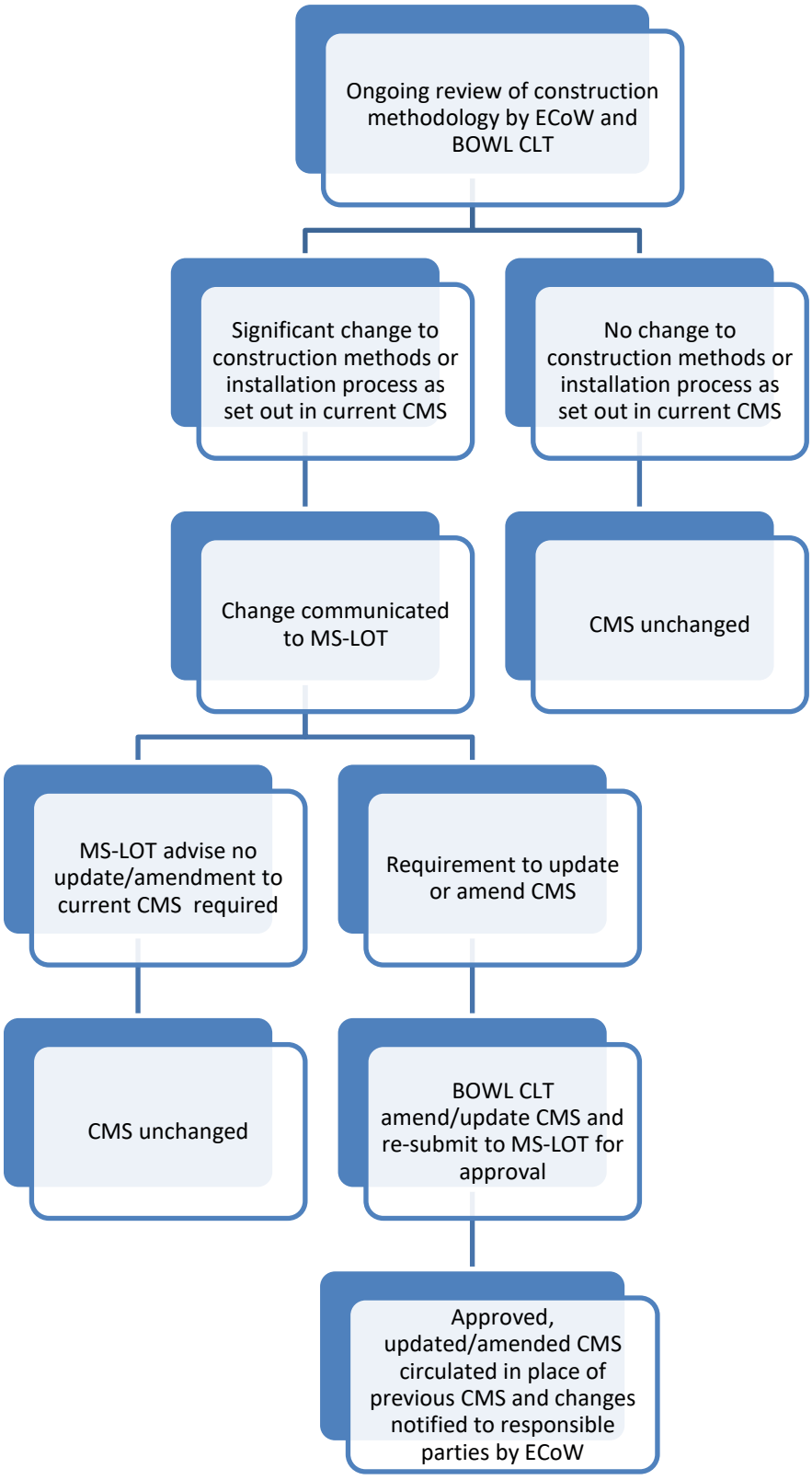
The Development [Wind Farm] must, at all times, be constructed in accordance with the approved CMS (as updated and amended from time to time by the Company [BOWL]). Any updates or amendments made to the CMS by the Company [BOWL] must be submitted, in writing, by the Company [BOWL] to the Scottish Ministers for their written approval.

3.1.3 The main approach to the construction process is described in this CMS including:

- Number and locations of turbines;
- Turbine specifications;
- Foundation and substructure types; and
- Inter-array cable layout.

3.1.4 Where it is necessary to update this CMS in the light of any significant new information, related to the construction and installation methods, BOWL propose to use the change management process set out in Figure 3.1 in identifying such information, communicating such change to the Scottish Ministers, re-drafting the CMS, seeking further approval for the necessary amendments or updates and disseminating the approved changes/amendments to responsible parties.

Figure 3.1 CMS Change Management Procedure



4 Project Construction Overview

4.1 Introduction

4.1.1 This section of this CMS provides an overview of the Development and construction timing assumptions. It identifies relevant Key Contractors, briefly describes the main construction vessels, and sets out, in relation to BOWL and the Key Contractors, main roles and responsibilities.

4.1.2 This section also cross-references to a number of the other consent plans where further information on these matters will be provided in satisfaction of the consent condition relating to the relevant consent plan (see also Section 1.4 of this CMS for relationship with other consent plans).

4.1.3 The specific detail on the construction and installation process is then provided in Section 5 of this CMS.

4.2 Development Overview

4.2.1 The Development will consist of the following main components:

- A total generating capacity of not less than 588MW;
- Up to 84 wind turbines of 7MW rated generating capacity;
- Jacket foundations each installed on four pin piles driven into the seabed;
- Two AC substation platforms, referred to as offshore transformer modules (OTMs) to collect the generated electricity and transform the electricity from 33kV to 220kV for transmission to shore;
- A network of circa 140km of inter-array, buried or (if burial is not possible) mechanically protected, subsea cables to connect strings of turbines together and to connect the turbines to the OTMs;
- Two buried or mechanically protected, subsea export cables, totalling circa 140km in length, to transmit the electricity from the two OTMs to the land fall at Portgordon and connecting to the onshore buried export cables for transmission to the onshore substation and connection to the National Grid network;
- One Interconnector Cable of circa 1.2km in length that links the OTMs to one another; and
- Minor ancillary works such as the deployment of met buoys (if required) and permanent navigational marks as defined in the LMP.

4.2.2 Figure 4.1 below sets out the Wind Farm layout. The installation sequence of structures across the Wind Farm area will be predominantly determined by water depth and ground conditions. Installation of the piles for the jacket foundations is expected to commence in the shallower southern and eastern areas of the site and progress to the deeper northern and western areas. Further detail on the installation sequence is provided in the PS.

4.2.3 The construction of the Wind Farm components will be limited to within the Project boundary as defined in the Wind Farm Marine Licence (and as shown in Figure 1 of the S36 Consent) according to the co-ordinates set out in Appendix C.

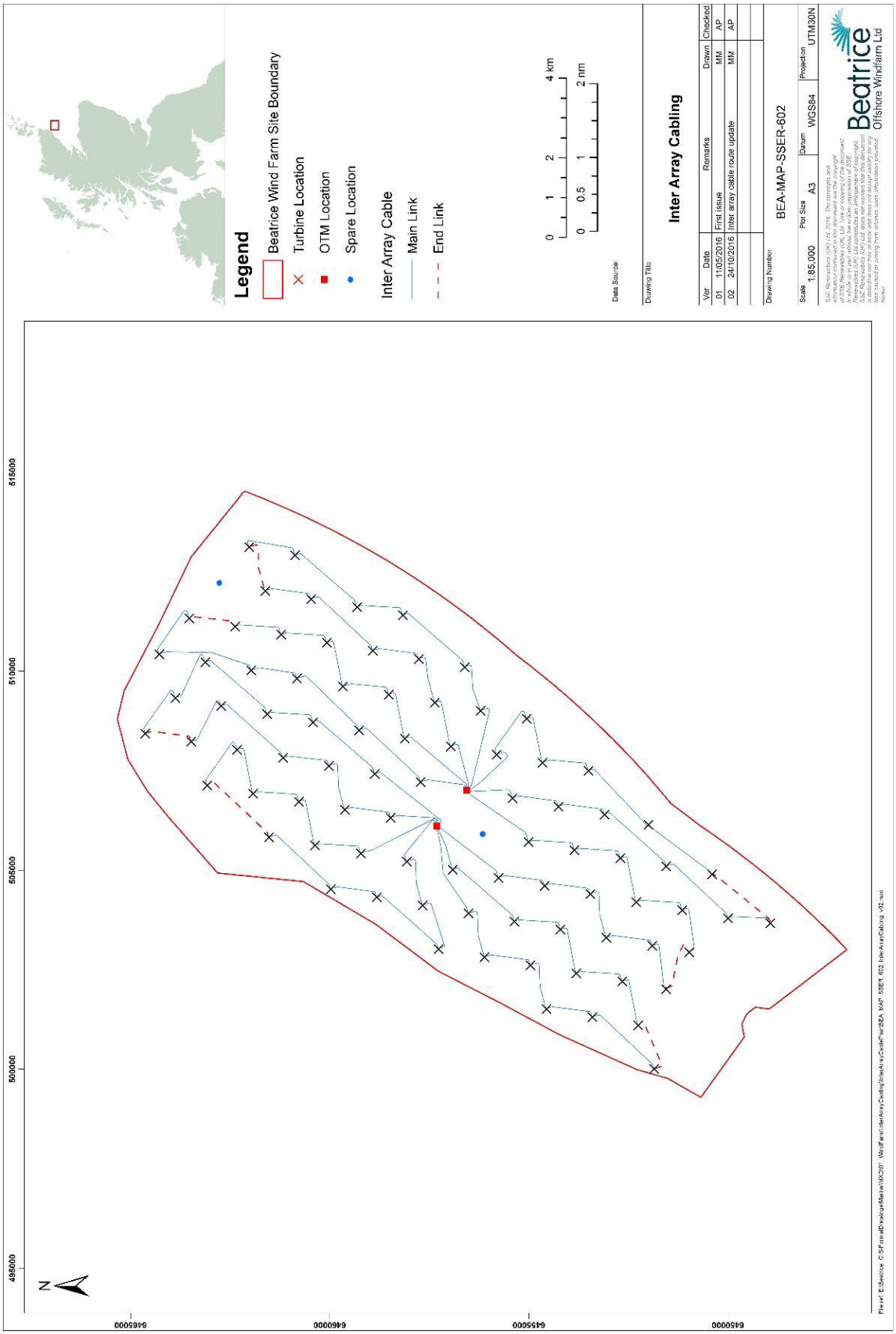


Figure 4.1. Wind turbine, OTM and inter-array cable layout.

4.2.4 The final layout and more detailed design specification of the Wind Farm is set out in the approved Design Specification Layout Plan (DSLP) (LF000005-PLN-152) (required under Condition 13 of the S36 consent and Condition 3.2.2.6 of the OfTW Marine Licence).

4.2.5 Information on the subsea cabling layout, specification and installation is set out in the approved Wind Farm CaP for inter-array cables and the OfTW Cable Plan (OfTW CaP) (required to discharge the remaining elements of S36 Condition 3.2.2.10 of the OfTW Marine Licence) for the export cables and OTM interconnector cable.

4.2.6 The export cable layout, specification and installation process is set out in the OfTW CMS (LF000005-PLN-184) (required to discharge the remaining elements of Condition 3.2.2.4 of the OfTW Marine Licence).

4.3 Timing of Construction Works

4.3.1 Details of the construction programme for the works described in this CMS are provided in the approved Construction Programme (CoP) consent plan (required under Condition 10 of the Section 36 Consent and Condition 3.2.2.3 of the OfTW Marine Licence) (LF000005-PLN-138). It is currently anticipated that the offshore construction works will be carried out year-round and around the clock (i.e. 24 hour working, 7 days a week unless noted otherwise).Key Contractors

4.4 Key Contractors

4.4.1 BOWL has appointed three Key Contractors to install the main components of the works described in this CMS. The roles and responsibilities of the Key Contractors and the interface with the BOWL project team are set out under Section 4.8 below.

4.4.2 The Key Contractors are described in the following sections, providing a brief overview of the companies and their experience in offshore Wind Farm construction.

4.4.3 In line with the requirements of the Marine Licences (Conditions 2.5, 2.6 and 3.1.2) the final identities of the persons responsible for making deposits, acting on behalf of the licensee, vessels, contractors and subcontractors will be notified to the Licensing Authority prior to their engagement in the works.

Seaway Heavy Lifting Offshore Contractors B.V. (SHL)

4.4.4 SHL is a leading offshore contractor in the global Oil & Gas and Renewables industries, offering tailored Transport and Installation (T&I) and Engineering, Procurement, Construction and Installation solutions (EPCI). SHL operates globally and services a diverse client portfolio including the major operators in the offshore Oil & Gas and Offshore Renewables industry.

4.4.5 Previous projects in Renewables include T&I for Wind Turbine Generator (WTG) foundations at Riffgat, Gwynt y Môr and Sheringham Shoal and offshore substation T&I at Sheringham Shoal, Galloper, Thanet and Greater Gabbard.

4.4.6 SHL is a Subsea 7 joint venture company and as such benefits from the consolidation of Subsea 7's Renewable Energy business into SHL through adopting Subsea 7's EPCI systems and processes across the organisation and secondment of Subsea 7 personnel into the project team. This reflects their extensive EPCI experience of deep water Oil & Gas projects.

4.4.7 SHL will be responsible for procuring and installing the piles and jacket substructures for the WTGs and OTMs, and will perform the heavy lift of the OTM topsides SHL will use a subcontractor to complete inter-array cable installation and manufacture (See Section 4.5 below).

Siemens Wind Power Ltd (SWPL) and Siemens Transmission and Distribution Ltd (STDL)

4.4.8 Siemens is a market leader when it comes to offshore wind power with a 20 year proven track record, in the supply of turbines, grid and service for offshore wind turbines. Having built the first offshore wind farm in 1991 at Vindeby in Denmark, Siemens has been growing in size and technical expertise ever since. Siemens has been the supplier for 12 of the current offshore development sites and provided wind turbines at 11 of these.

4.4.9 Siemens has delivered more offshore grid connections than anyone else, including 6 High Voltage Alternating Current (AC) offshore grid connections in the UK and including 8 offshore substations.

4.4.10 SWPL will be responsible for installing the wind turbines. SWPL is also responsible for identifying and procuring a suitable construction port for turbine component laydown and assembly/pre-commissioning prior to installation offshore. SWPL will also be responsible for the commissioning of the turbines.

4.4.11 STDL will be responsible for supply of the OTMs, installing the export cable from the OTMs to the onshore substation at Blackhillock and for the electrical connection of the OTMs and associated commissioning works (the works related to export cable installation and OTM commissioning will be set out separately in the OfTW CMS).

4.5 Subcontractors

4.5.1 The Key Contractors will be responsible for identifying and contracting Subcontractors such as may be required to provide services for the completion of the construction works. Inter-array cable installation will be undertaken by Siem Offshore Inc. on behalf of SHL and inter-array cables will be manufactured by JDR Cables. Examples of other services that may need to be sub-contracted include provision of support vessels, guard vessels, survey services, transport services, supply of minor components, waste services, vessel provisioning and bunkering services and provision of equipment to be used in the construction worksMain Construction Vessels

4.6 Main Construction Vessels

4.6.1 The main construction vessels that will be used to complete the construction works described in this CMS are presented within the Vessel Management Plan (VMP) (LF000005-PLN-168) (required under Condition 16 of the S36 Consent and Condition 3.2.2.8 of the OfTW Marine Licence). In addition, the VMP provides details of additional support vessels that may be required throughout the construction phase of the Development.

4.7 Marine Co-ordination

4.7.1 BOWL will obtain competent marine advice and assistance in relation to marine co-ordination and planning which includes but will not be limited to:

- Provision of marine input into project risk assessments (HAZIDS, etc);
- Assisting in demonstrating that all marine activity hazards have been mitigated to ALARP including any metocean and ground conditions; and
- Carrying out audits and assessments of vessels and their operators (company and vessel audits) to check they are fit for purpose for the project.

4.7.2 BOWL recognises that the extent of the Marine Co-ordination is critical to the control of the construction process. It will define all the requirements for the safe and effective working of the onshore and offshore construction sites, aiming to ensure the safety and security of all equipment, assets and personnel.

4.7.3 Main topics which will require detailed arrangements to be developed, communicated and audited are as follows;

- Work Package Management;
- Marine Co-ordination Management;
- Weather Forecasting and Met Ocean Data;

- Navigational Marking;
- Vessel Chartering and Marine Support;
- Marine Logistics and Marshalling;
- Personnel Training and Certification;
- Marine Co-ordination Centre; and
- Marine Warranty Survey.

4.7.4 Prior to and throughout the construction phase, a Marine Co-ordination Centre will be established at Wick to control all offshore works and vessel movements.

4.8 Construction Ports

4.8.1 Nigg Energy Park and Invergordon in the Cromarty Firth will be used for construction activities by SWPL and SHL respectively. Crew transfer to the Development Area will take place from Wick Harbour during Construction. Buckie Harbour has also been identified as an alternative harbour facility for use during construction if required. The Marine Coordination Centre will be based at Wick Harbour on the Caithness Coast.

4.8.2 Full details of the construction ports are provided in the approved VMP.

4.9 Wind Farm Helicopter Operations

4.9.1 Helicopter operations will be used primarily for crew transfer to and from construction vessels during the construction period. If required helicopters may also transfer equipment and supplies to construction vessels.

4.9.2 It is anticipated that 6 return flights will be required per week originating from two airports. Each flight will transfer 6 passengers to and from the Development Area. Helicopter operations contracted by SHL will operate from Aberdeen Airport. All other helicopter operations will operate from Wick Airport.

4.9.3 Take-off and landing will be managed from the relevant airport. Helicopters operations on approach to the Development Area will be managed and coordinated from the MCC.

4.10 BOWL and Key Contractor Roles and Responsibilities

Introduction

4.10.1 The following sections set out the key roles and responsibilities for each of the main parties involved in the construction and installation process. The organisational arrangements and interfaces for BOWL and the Key Contractors are set out in organograms and the main roles and responsibilities within BOWL and the three Key Contractor organisations in relation to the main, overarching construction process are then described.

4.10.2 Further information on organisational responsibilities and interfaces (and the 'chain of command') in relation to environmental management is set out in the approved EMP.

4.10.3 Organisational arrangements and responsibilities in relation to vessel management are also set out in the VMP.

4.10.4 Organisational arrangements, roles and responsibilities in relation to navigational safety are also set out in the NSP.

4.10.5 Roles and responsibilities and organisational arrangements related to piling operations are additionally set out in the PS.

Organisational roles and responsibilities

4.10.6 Organisational charts illustrating the BOWL teams interface with the Key Contractors are set out below.

BOWL - Key Roles and Responsibilities

4.10.7 A summary of the BOWL organisational structure and the key roles during the construction of the Development is set out in Figure 4.2 below. The main BOWL roles and responsibilities are described in Table 4.3. The interface with the Key Contractors is indicated by reference to Figures 4.3 to 4.5 below which show further detail of the Key Contractor organisational structure.

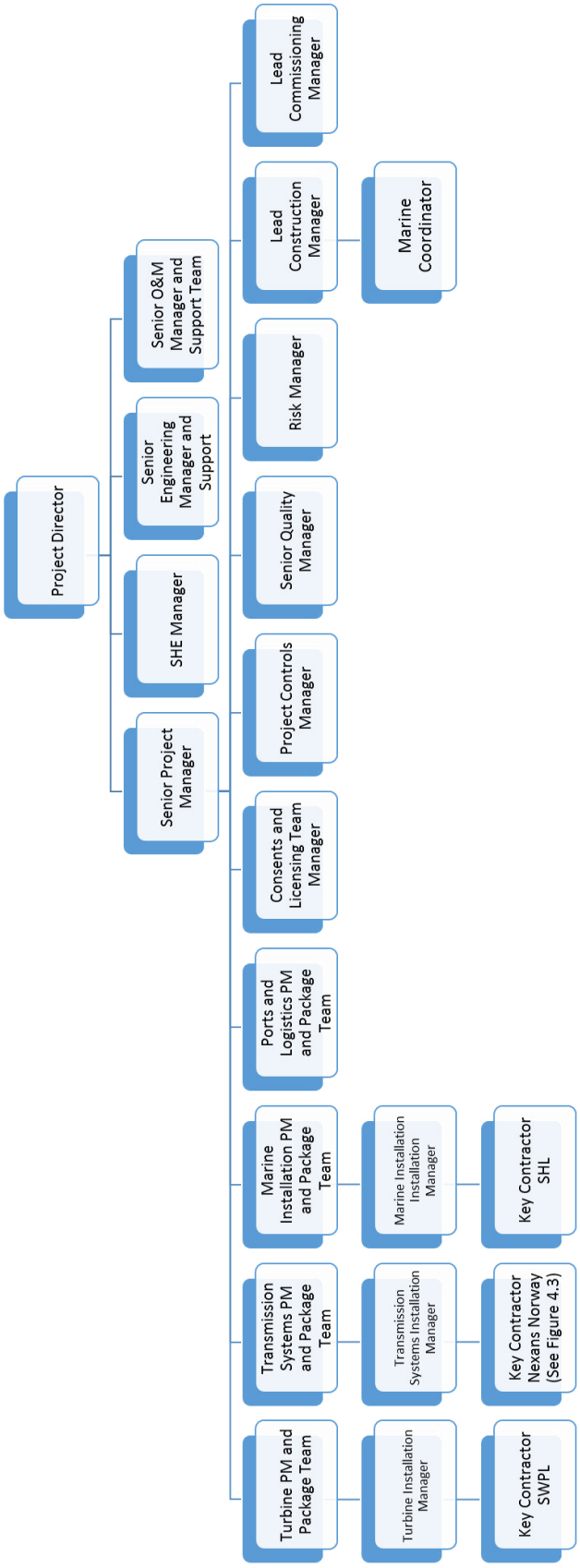


Figure 4.2 – BOWL organisational structure and key roles, and interface with Key Contractors

Table 4.3 – Key BOWL roles and responsibilities

Role	Responsibility
Project Director	The Project Director is accountable to the BOWL Board for the overall project delivery strategy and the effective governance of the Development
Senior Project Manager	Employed by BOWL to oversee the effective delivery of the construction phase or of the whole Project.
SHE Manager	The Project SHE Manager is a member of the project management team responsible for providing support, advice and guidance on all aspects of Safety Health & Environmental management on the project.
Senior Engineering Manager and support team	The Senior Engineering Manager is responsible for overall technical integrity of the Wind Farm design and the associated construction and installation engineering.
O&M Manager and support team	The Operations and Maintenance Manger works as an integrated member of the project team to ensure that both the final Wind Farm design and its as-built condition meet all requirements and specifications defined by the Operator.
Package Manager and Package Teams	The Package Managers have similar responsibilities as the Senior Project Manager but for their individual sub-packages of the project.
Installation Managers	The installation managers are responsible for the successful delivery of their individual sub-packages by the Key Contractor, ensuring design, delivery, commissioning and reporting meets with the contractual requirements and programme.
Consents and Licensing Team Manager	The Consents and Licensing Team Manager is responsible for the effective management of all consent, planning permission and land related activities through the Refinement and Execution phases of the project. Manages the Ecological Clerk of Works (ECoW).
Project Controls Manager	The Project Controls Manager is responsible for the leadership and management of the project controls team and ensuring all project controls functions are effectively integrated at all levels of project management and delivery.
Senior Quality Manager	The Senior Quality Manager is responsible for ensuring that the Project Quality Plan is developed and implemented, and Quality risks to the project are identified, assessed, managed, reviewed and reported effectively and efficiently.
Risk Manager	The Risk Manager supports the Senior Project Manager, the Project Controls Manager and the Package Managers to ensure that the risks to the project are identified, assessed, managed, reviewed and reported effectively and efficiently.

Role	Responsibility
Lead Construction Manager	The Lead Construction Manager is responsible for developing and implementing the construction plan in conjunction with Package Managers and Key Contractors. Manages and monitors construction interfaces and monitors all construction and installation activities.
Marine Coordinator	The Marine Coordinator will coordinate all activities on site including all vessel and personnel movements and site surveillance.
Lead Commissioning Manager	The Lead Commissioning Manager is responsible for the development and implementation of the commissioning and handover plan for the Development, in conjunction with the Package Managers and Key Contractors. Manages all testing, inspection and commissioning activities.

4.10.8 In addition, the ECoW will have a role in terms of ensuring that the Project is constructed in compliance with this CMS and other relevant consent plans. The ECoW will report directly to the Consents and Licensing Team Manager (a member of the BOWL Consents and Licensing Team), and will interface with the Package Manager and directly with relevant Key Contractors as appropriate. The role of the ECoW in terms of monitoring and reporting on consent plan compliance and the organisational structure relating to environmental management is set out in more detail in the EMP.

4.10.9 A Marine Co-ordinator will be appointed prior to construction commencing. The Marine Co-ordinator will be based at the Marine Co-ordination centre (see Section 4.7). The Marine Co-ordinator will liaise with Key Contractors and Subcontractors to enable a plan of operations to be formulated and promulgated. They will monitor movements of vessels, people and equipment offshore, monitor weather conditions, co-ordinate permits to work and act as a first point of contact for emergency response and marine assistance.

SHL - Key Roles and Responsibilities

4.10.10 A summary of the SHL organisational structure and the key roles during the construction of the Project is set out in Figure 4.3 below. The interface with the BOWL team is indicated by reference to Figure 4.2 above. The main SHL roles and responsibilities are described in Table 4.4 below.

Figure 4.3 - SHL organisational structure and key roles

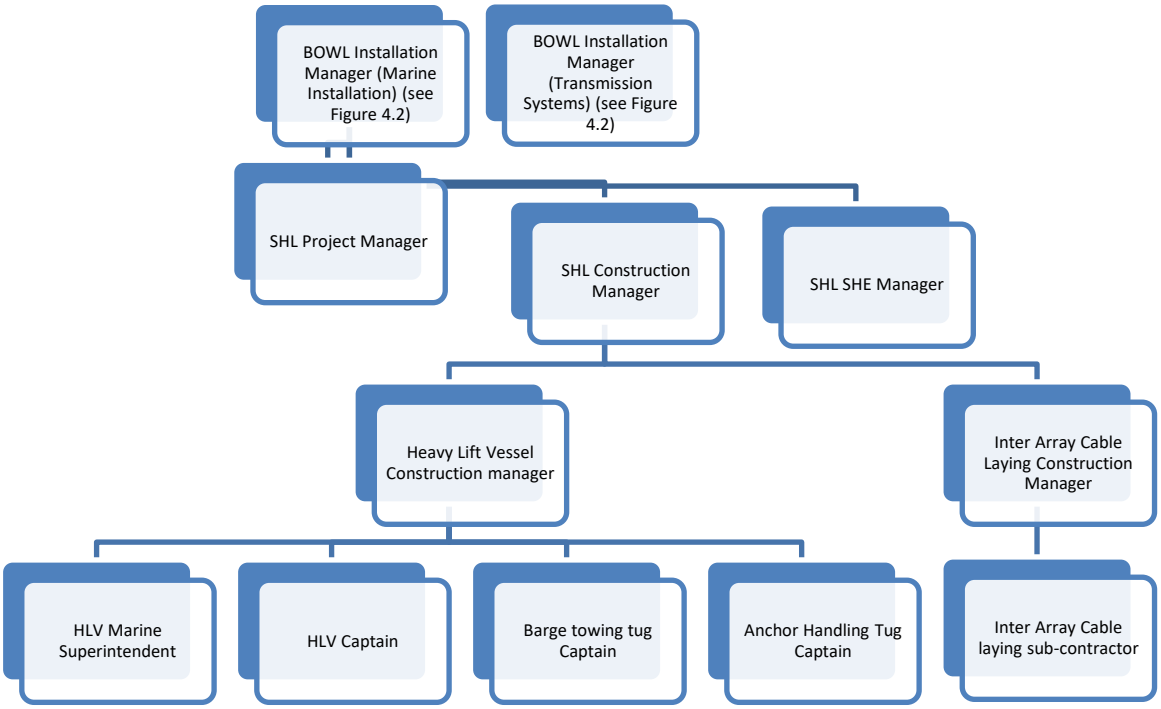


Table 4.4 – Key SHL roles and responsibilities

Role	Responsibility
SHL Project Manager	Person with responsibility for delivering the construction phase. Liaises with the BOWL Package Managers.
SHL SHE Manager	Responsible for the management of SHE matters.
SHL Contractor Construction Manager	Person in charge of day to day construction activities and decision making. Reports to the SHL Project Manager.
SHL Heavy Lift Vessel Manager	Manages activity of the heavy lift vessel. Office based. Reports activity to Construction Manager.
SHL Marine Superintendent	Manages construction activity on board SHL's heavy lift vessel. Liaises with vessel captain and responsible for construction activities including the activities of tugs and support vessels.
SHL Heavy Lift Vessel Captain	Responsible for the safety of the crew and vessel. Liaises with Vessel Manager and Vessel Superintendent to ensure construction activity is carried out safely within the limits of the vessel and equipment.
SHL Barge Towing Tug Captain	In charge of the barge towing tug(s), ensuring operations are safe. Liaises with SHL Vessel Captain and SHL Vessel Superintendent.
SHL Anchor Handling Tug	In charge of anchor handling tugs, ensuring operations are safe.

Role	Responsibility
Captain	Liaises with SHL Vessel Captain and SHL Vessel Superintendent.
SHL Inter-Array Cable Lay Construction Manager	Manages laying and connecting the inter-array cables. Liaises with cable lay vessel captain to ensure safe operations within vessel limits. Reports activity to Construction Manager.
Inter array Cable Laying Sub-contractor	Sub-contracted by SHL for cable laying and trenching of the inter-array cables.

SWPL - Key Roles and Responsibilities

4.10.11 A summary of the SWPL organisational structure and the key roles during the construction of the Project is set out in Figure 4.4 below. The interface with the BOWL team is indicated by reference to Figure 4.2 above. The main SWPL roles and responsibilities are described in Table 4.5 below.

Figure 4.4 - SWPL organisational structure and key roles

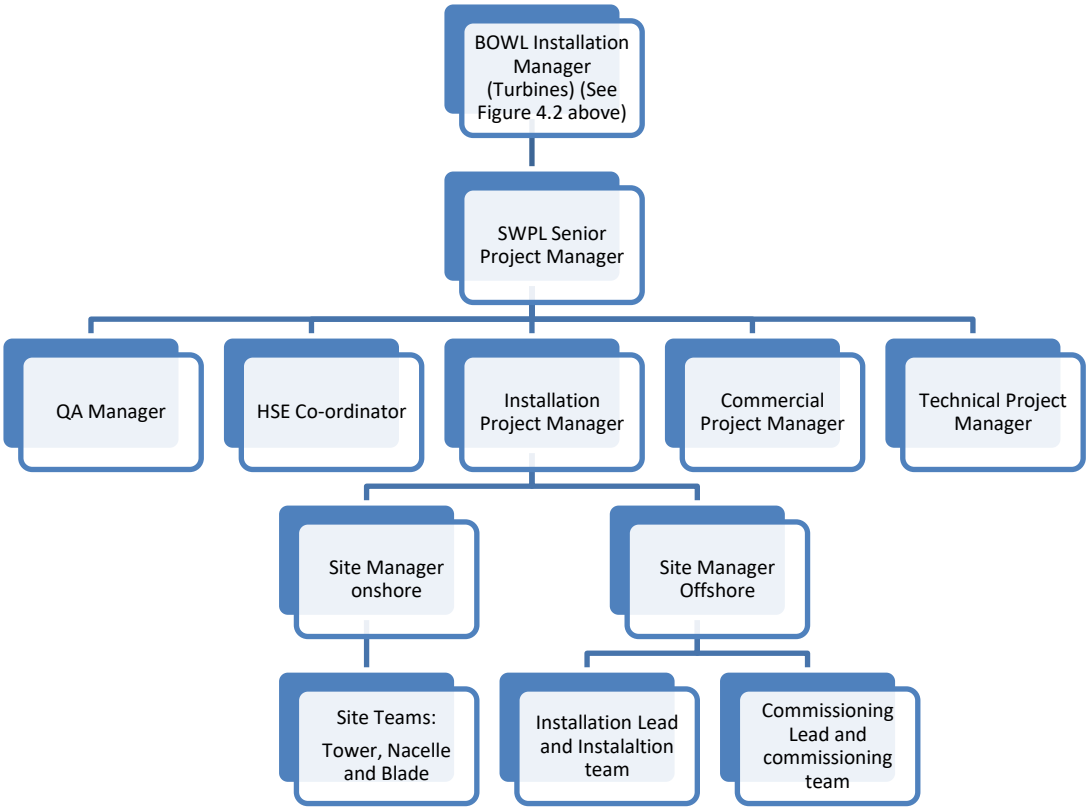


Table 4.5 – Key SWPL roles and responsibilities

Role	Responsibility
SWPL Senior Project Manager	Responsible for overseeing the effective delivery of the wind turbine supply and installation
QA Manager	Responsible of developing the QA plan and for QA checking and inspection
SHE Co-ordinator	Responsible for the management of health, safety and environmental issues
Commercial Project Manager	Responsible for matters relating to finance, contracting, reporting, insurances, budget control and risk management
Technical Project Manager	Responsible for structural and mechanical design, electrical and SCADA design, installation equipment design, engineering and technical documentation
Installation Project Manager	Responsible for site logistics and manning, WTG installation, commissioning and testing
Site Manager Onshore	Responsible for assembly of the wind turbines at the port and transport to quayside for loading on to the installation vessel
Site Manager Offshore	Responsible for offshore WTG installation, mechanical completion, commissioning and cable connection
Tower, Nacelle and Blade Teams	Onshore assembly and preparation of wind turbine components at the turbine marshalling port
Installation Lead and installation team	Offshore installation of the wind turbines
Commissioning Lead and commissioning team	Offshore commissioning of the wind turbines

4.10.12 In addition the SWPL onshore and offshore site managers will interface with the Installation Vessel construction manager and captain to facilitate wind turbine loading on to the installation vessel and the turbine installation process.

STDL - Key Roles and Responsibilities

4.10.13 A summary of the STDL organisational structure and the key roles during the construction of the Project is set out in Figure 4.5 below. The interface with the BOWL team is indicated by reference to Figure 4.2 above. The main STDL roles and responsibilities are described in Table 4.6 below.

Figure 4.5 - STDL organisational structure and key roles

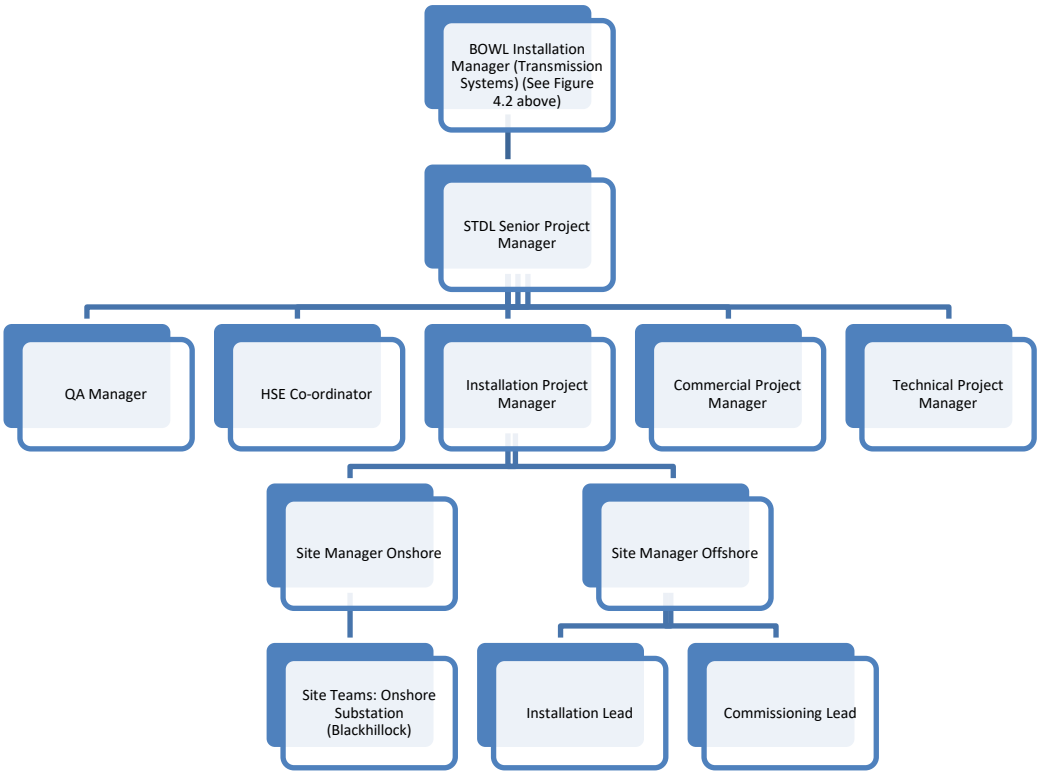


Table 4.6 – Key STDL roles and responsibilities

Role	Responsibility
Senior Project Manager	Responsible for overseeing the effective delivery of the Transmission System, supply and installation, from National Grid connection at Blackhillock substation to the two offshore OTMs
QA Manager	Responsible of developing the QA plan and for QA checking and inspection
SHE Manager	Responsible for the management of health, safety and environmental issues
Commercial Project manager	Responsible for matters relating to finance, contracting, reporting, insurances, budget control and risk management
Technical Project Manager	Responsible for structural and mechanical design, Electrical and SCADA design, Installation equipment design, engineering and technical documentation.
Installation Project Manager	Responsible for site logistics and manning, for both onshore and offshore installation, commissioning and testing.
Site Manager Onshore	Responsible for all onshore site activities including onshore export and substation. Activities include mechanical completion, commissioning, energisation and handover.

Role	Responsibility
Site Manager Offshore	Responsible for offshore site activities, for both offshore export cable and OTM installations. Activities include mechanical completion, commissioning energisation and handover

5 Construction Methods and Procedures

5.1 Introduction

5.1.1 The following sections set out the installation process for the main construction components covered by this CMS, namely:

- Pile foundations and jacket substructures;
- Wind turbine generators (including tower sections);
- Inter-array cabling;
- Offshore Transformer Modules (offshore substations); and
- Electrical connection and commissioning.

5.1.2 A simple overview of the construction sequence is provided in Section 5.2 below, followed by more detailed information for each of the main elements of the sequence.

5.1.3 Good working practices to be applied during construction are described separately under Section 6.

5.2 Overview of the Development Construction Process

5.2.1 Figures 5.1 and 5.2 show a simple flow diagram for the main stages in the installation of the wind turbine and OTM structures respectively. Cross references to the detailed sections that follow are provided.

Figure 5.1 – Overview of wind turbine installation process

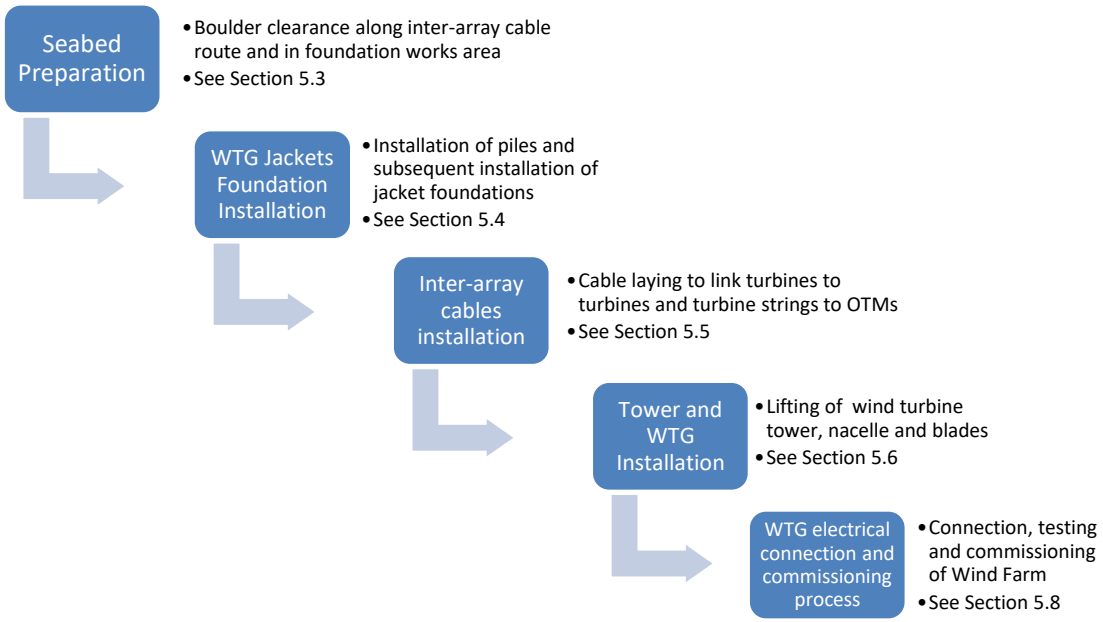
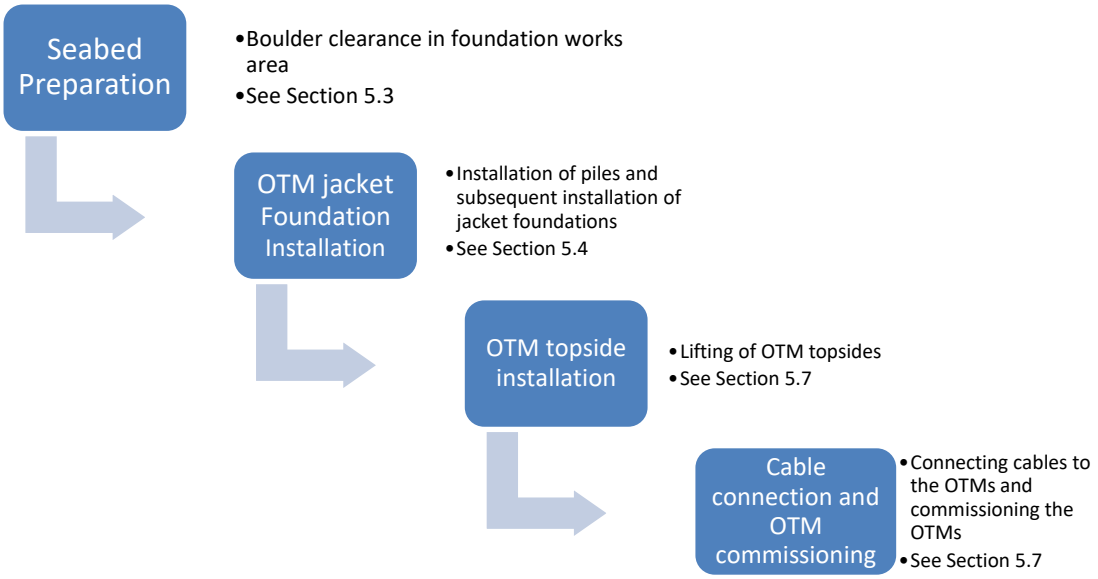


Figure 5.2 – Overview of OTM installation process



5.3 Seabed Preparation

5.3.1 Detailed analysis of ground conditions has identified distinct areas where there is potential for boulder presence to affect construction activities. Boulders have the potential to disrupt foundation installation operations and prohibit inter-array cable laying and burial. Further information on the location and density of boulders within the Wind Farm is provided in the Wind Farm CaP.

5.3.2 In areas where boulder presence may inhibit cable installation a 'displacement plough' will be deployed to clear boulders from the intended inter-array cable route. A SCAR plough tool will be configured for boulder displacement and will be deployed from a Platform Supply Vessel (PSV) (or equivalent). The SCAR plough tool is capable of displacing boulders up to 2m in diameter although it is anticipated that the majority of boulders identified within the inter-array cable route area will be between 0.5 to 1.3m in diameter (See Figure 5.3).

Figure 5.3 - SCAR plough configured for boulder clearance operations.

5.3.3 Boulder displacement using a SCAR plough will be undertaken along circa 15% of the inter-array cable route lengths. Boulder boards will be attached to the SCAR plough and will be guided along the seabed surface displacing boulders along either side of the 10m clearance path. Small temporary sediment berms of up to 20cm height will be formed by the plough. The SCAR plough campaign is expected to be completed within 2 weeks.

5.3.4 Boulders which are partially or wholly buried may not be displaced by the SCAR plough tool. Following deployment of the SCAR plough a Remotely Operated Vehicle (ROV) will be used to survey the cleared path and identify any remaining boulders. Where these remaining boulders have the potential to disrupt cable installation an orange peel grab will be used to relocate boulders from the inter-array cable routes. Grabbed boulders will be relocated immediately adjacent to the inter-array cable routes, where boulders displaced by the plough will also be present.

5.3.5 Boulders will also be cleared, again using the orange peel grab, from the works footprint areas immediately adjacent to wind turbine and OTM locations following an ROV survey to confirm boulder presence. Boulders will be removed from these locations to create a seabed free from obstructions that allows for the safe placement of jack-up vessel legs and accurate deployment of the Pile Installation Frame.

5.3.6 Clearance of boulders by grab will be undertaken immediately following completion of SCAR plough operations. The duration of grab clearance activities will be dependent on the number of boulders remaining following SCAR plough operations and the number of boulders present in works footprint areas.

5.3.7 Boulders will all be relocated within areas of existing high boulder density, directly adjacent to the cleared area and having given consideration to potential alternative uses, i.e. scour protection or cable protection.

5.4 WTG and OTM Support Structures (Foundations and Jacket Substructures)

Components to be installed

5.4.1 The main components will be deposited or installed are summarised in Table 5.1.

Table 5.1 – Summary of foundation components to be deposited or installed

Component	Number	Key dimensions
Foundation piles	86 x 4 piles (84 wind turbine foundations plus 2 OTM foundations)	Pile diameter: 2.2m Pile length: variable estimated 35 to 60m
Jacket Substructure (including Flanged WTG/jacket transition piece	86 four leg jacket structures (84 wind turbine foundations	Height: variable circa 57 to 77m Size at seabed (pile centre

Component	Number	Key dimensions
connection)	plus 2 OTM foundations)	to pile centre): 24m x 24m
Grouted pile connection	86 x 4 jacket leg connections	-

5.4.2 The transition piece forms the connection between the main jacket element of the support structure and the wind turbine tower. The substructure (jacket and transition piece) will be fully assembled onshore in the fabrication yard before being loaded-out for installation.

5.4.3 Further details on the key parameters for each of these components is provided in Appendix B by comparison to the maximum consented values as described in the application.

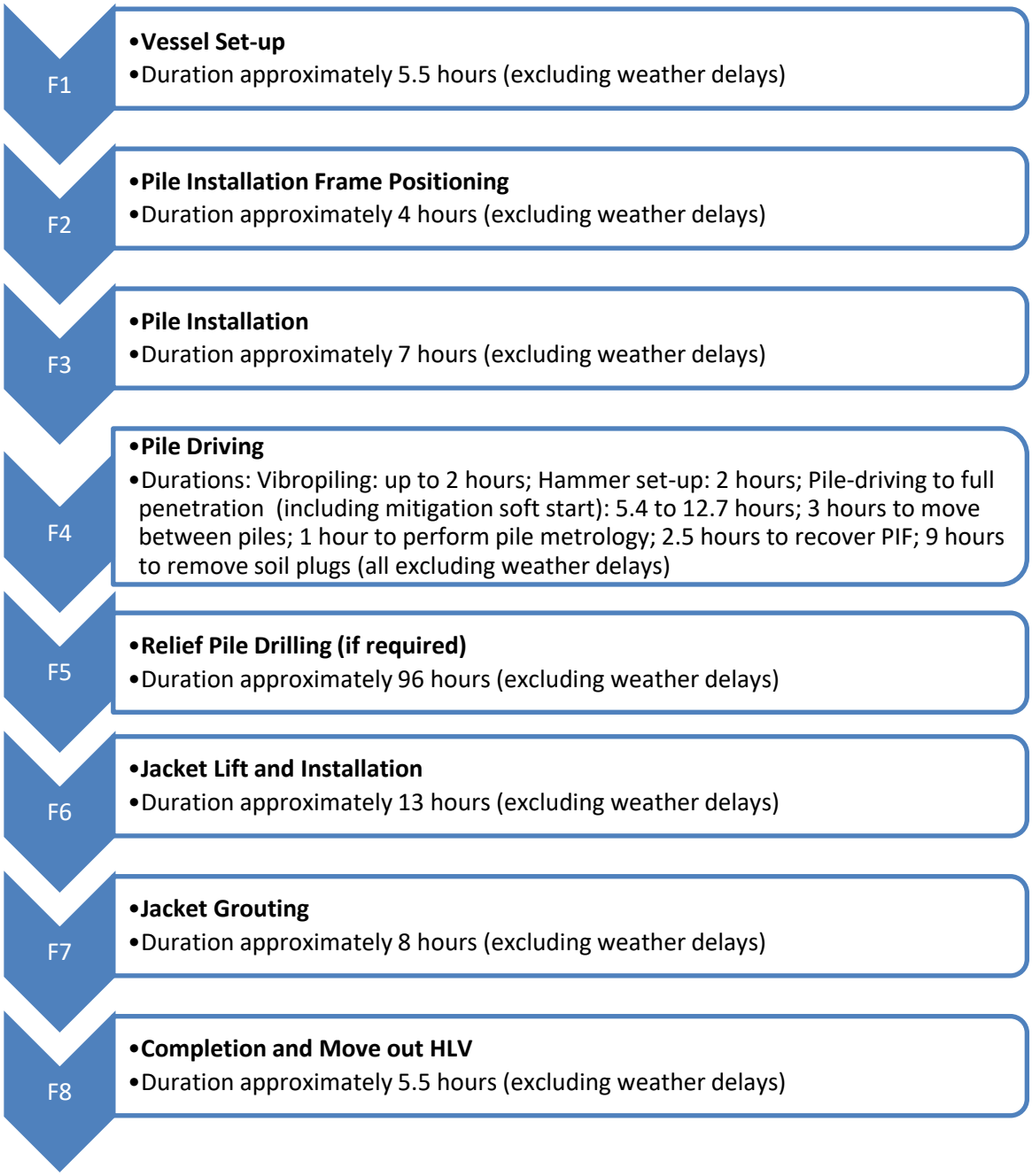
Delivery to the Construction Site

5.4.4 The major support structure components (piles and jacket structures) will be delivered directly to the Wind Farm site by sea transport from the site of fabrication.

Method and Process of Installation

5.4.5 An indicative Foundation and Substructure installation sequence is presented in Figure 5.4 below, including current indicative, approximate durations for the completion of each operation for each foundation. Greater detail on each of the stages in the installation process (F1 – F8) is then provided in the subsequent sections. Total duration for each foundation and substructure installation is estimated to be circa 67.9 – 75.2 hours (or circa 163.9 – 171.2 hours where relief drilling is required) excluding any weather delays.

Figure 5.4 Jacket Foundation and Substructure Installation Sequence following seabed preparation



Foundation Installation Stage F1 – Vessel Set Up

5.4.6 The vessel arrives at the proposed foundation installation location and is positioned in readiness for the foundation installation works. Note that seabed surveys may be performed prior to this to check the seabed prior to foundation installation.

5.4.7 Depending on which heavy lift vessel (HLV) is used this will involve either the placing of an anchor spread using a dedicated anchor handling tug (in the case of the HLV Stanislav Yudin) or positioning by use of a dynamic positioning (DP) system (in the case of the HLV Oleg Strashnov).

5.4.8 Summary details of the anchor spread/configuration for the HLV Stanislav Yudin are provided in Table 5.2.

Table 5.2 - HLV Stanislav Yudin Anchor Configuration

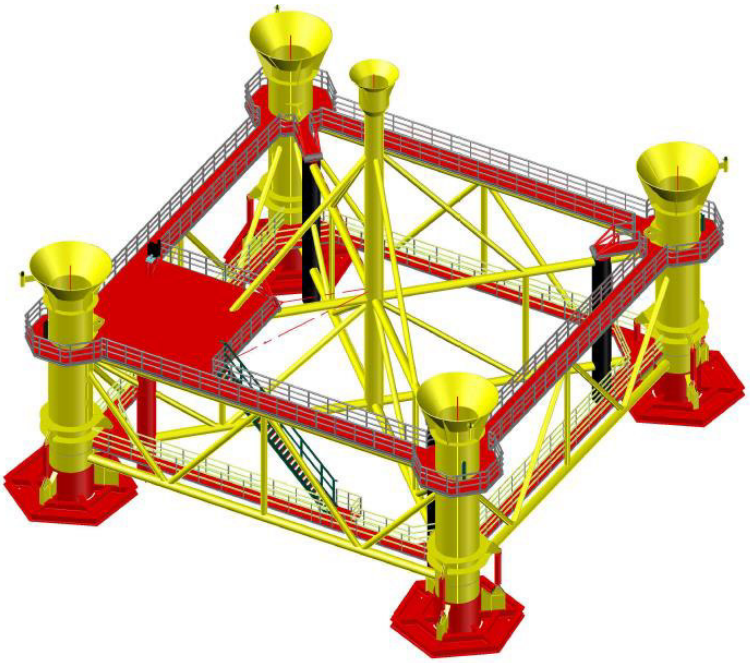
Parameter	Configuration
Anchor Size and Type	10 tonne Delta Flippers
Number of Anchors Used	Typically 4 or 8 depending on the length of operation
Anchor Drag	Anchor drag/scarring is not expected. In the event a mooring line becomes slack, the anchor(s) in question would normally be lifted and re-deployed
Mooring Line Pay-out (Vessel Fairlead to Anchor)	Typically 750 to 850 m depending on water depth (TBC)

Foundation Installation Stage F2 – Pile Installation Frame Positioning

5.4.9 Piles will be installed by the use of a Pile Installation Frame (PIF), an example of which is shown in Figure 5.5. Pile installation tolerances will be achieved through the use of a hydraulically operated PIF with sufficient travel to accommodate the worst case seabed slopes with jacket installation tolerances being achieved through shimming of the pile/jacket leg interfaces.

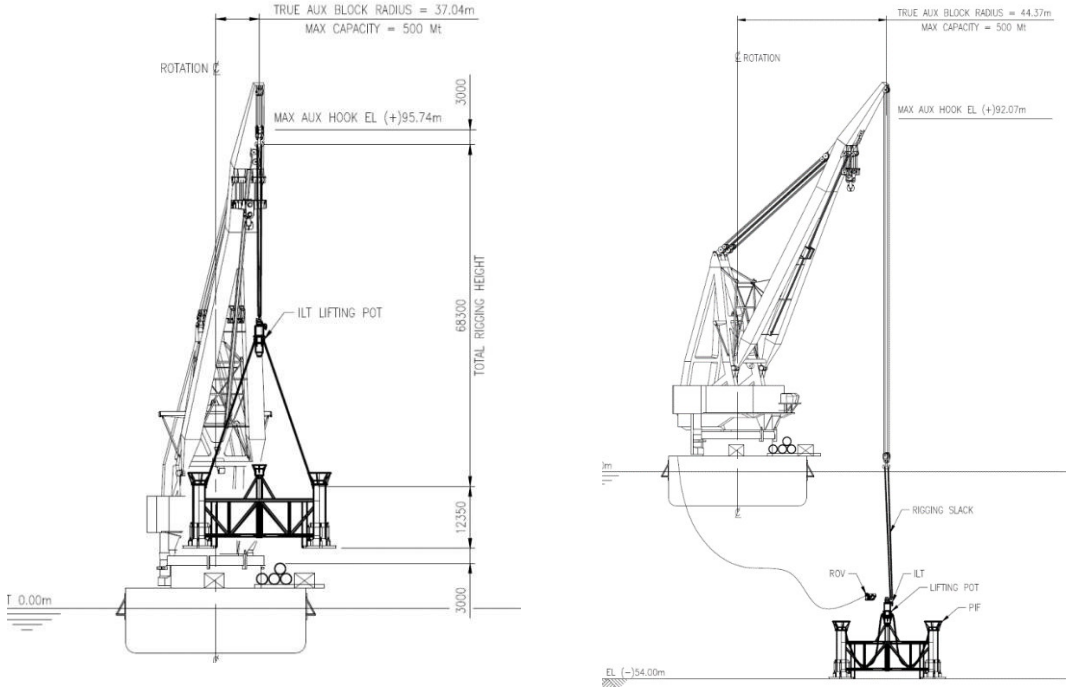
5.4.10 The PIF will have a footprint of approximately 26m x 26m and will weigh circa 500 tonnes.

Figure 5.5 – Example of a Hydraulically Operated PIF



5.4.11 The PIF is lifted from the HLV and lowered to the seabed in position ready for the piling operations (see Figure 5.6) and levelled hydraulically to take into account seabed slope.

Figure 5.6 – PIF being lifted from the deck of the HLV for lowering to the seabed

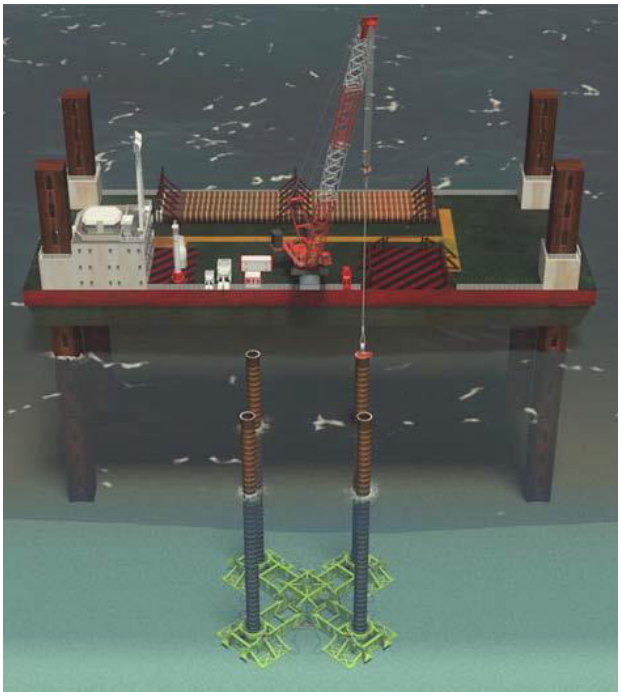


Foundation Installation Stage F3 – Pile Installation

5.4.12 The foundation piles are delivered to the HLV installation vessel by cargo barge. The cargo barge is moored alongside the HLV and the four piles are each lifted and transferred to the deck of the HLV. The cargo barge is then unmoored and departs. Note that piling operations will be conducted from only a single piling vessel.

5.4.13 Each of the four piles is then lifted, upended and lowered into the PIF in readiness for the piling operation. Each pile is vibropiled to a nominal penetration or refusal (whichever comes first), before the next pile is lifted until all four piles are seated in the PIF (Figure 5.7).

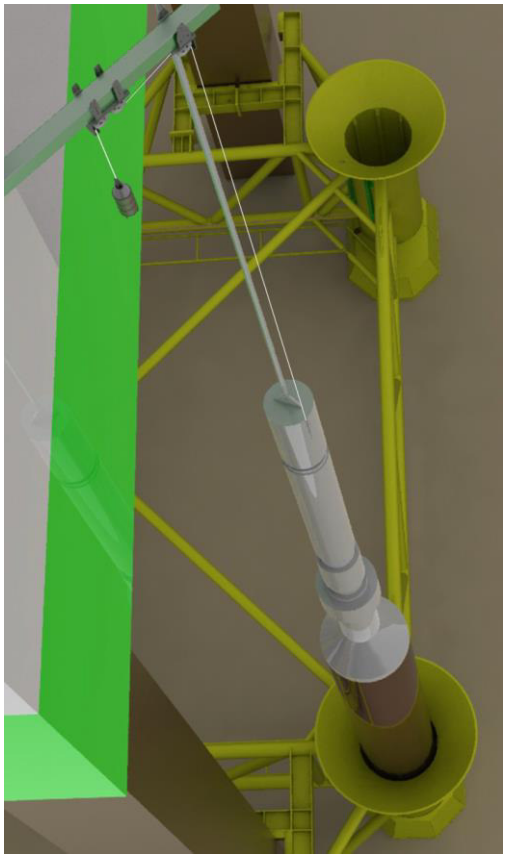
Figure 5.7 – Pile being up-ended ready for deployment and being deployed into the PIF



Foundation Installation Stage F4 – Pile Driving

5.4.14 The percussive piling hammer is lifted on to the top of each pile in turn and the piling hammer is used until the pile reaches the required penetration (or until pile refusal) (see Figure 5.8). More details on the piling operations are provided in the PS along with the Piling Mitigation Protocol to prevent injury or mortality to marine mammal and fish species. The piling operations will be carried out to comply with the procedures approved in the PS.

Figure 5.8 – Example of a piling hammer (with follower) and subsea hammer on pile and piling through the PIF



5.4.15 If pile penetration is not reached prior to pile refusal, relief drilling may be required prior to final pile driving to reach full penetration (see Stage F5 below) or alternatively micro-siting may be attempted.

5.4.16 Once all four piles have been driven to final penetration depths, pile metrology is performed (measurements to determine pile position and depth is satisfactory).

5.4.17 The soil inside the piles that lies below seabed level (the 'soil plug') is then removed where necessary and to a depth to allow the jacket 'stab in' (that part of the jacket structure that slots into the pre-installed pile) to be installed. The length of the 'stab-ins' is approximately 7m which exceeds the anticipated pile stick-up(s) (typically expected to be 2 – 6m). Therefore to accommodate the full length of the stab-ins soil has to be removed from inside the pile.

5.4.18 Removal of the soils from the pile will be achieved by a specialist dredging tool, based upon airlift technology (non-cohesive soils) or a combination of high pressure water jet and air lift (cohesive soils); the soil removed will be deposited around the foundation being worked on. The maximum volume of material that could be removed in each soil plug, assuming that soil accumulated inside the pile up to the pile top (i.e. up to 7m of soil depth (the length of the grouted connection)), would be 24m^3 per pile (for a 2.2.m diameter pile). This is, however, an unlikely case and in general, it is assumed that the soil inside the pile remains at the level of the surrounding seabed so that smaller volumes would be removed.

5.4.19 Spoil deposited on the seabed, if required can be measured using Remote Operated vehicle (ROV) sensors; the height of the soil mound will not exceed 4 m above mean sea bed level (MSBL) at each pile location.

5.4.20 Once piling is complete, the PIF is recovered back to the deck of the HLV in preparation for installation at the next foundation location.

Foundation Installation Stage F5 – Relief Pile Drilling (where required)

5.4.21 Where pile depth can't be achieved due to piling or ground conditions, the piling hammer would be withdrawn and a reverse circulation drilling unit would be inserted until the desired penetration depth is reached whereupon the piling is resumed to full depth.

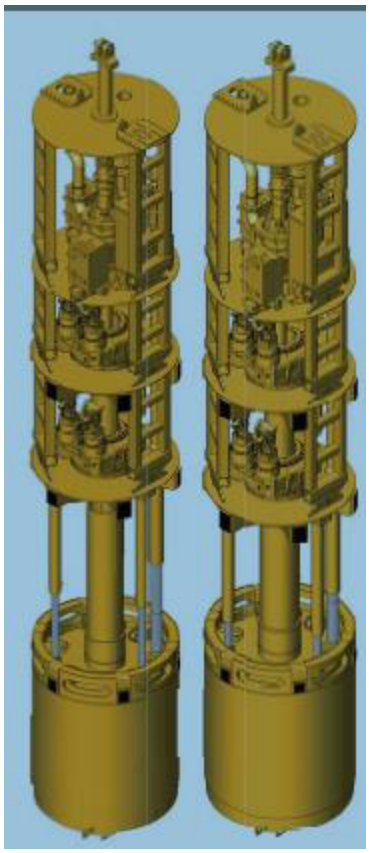
5.4.22 A subsea drilling tool would be lowered from the installation vessel, fitted over the partially installed pile and secured to the pile by a subsea gripper or similar. The process for relief drilling operations would be as follows:

- The installation vessel is converted to drilling mode (i.e. the pile hammer is demobilised and the drilling equipment is set up on the deck ready for drilling operations);
- The vessel is positioned above the foundation pile location that requires drilling;
- The subsea drill rig is overboarded and installed onto the refused pile;
- The material inside the pile is drilled out until the pile toe (the bottom of the pile) is reached (the spoil material is removed from the inside of the pile by the circulating seawater based drilling muds as drilling proceeds and is deposited on the seabed in the vicinity of the foundation);
- Drilling then continues outside the bottom of the pile to the required target depth/clear of obstruction or for as long as open-hole drilling is possible. It is possible that the pile may need to be driven multiple times if an open hole cannot be maintained;

- Once the target depth has been achieved, the drill rig is lifted from the pile and recovered to the surface and lifted back onto the installation vessel.

5.4.23 The pile hammer would then be redeployed and the pile would be re-driven to final, required, penetration depth. Quantities of soil to be removed by drilling are estimated to be up to circa 230m^3 per pile (depending on pile length and the depth of drilling required). The number of piles requiring remedial relief drilling is not currently quantifiable but will be estimated through the pile driving assessments performed during the ongoing engineering design work.

Figure 5.9 – Example of a relief drilling spread



5.4.24 Note that although relief drilling is one mitigation option where pile refusal occurs, another option exists whereby the foundation is micro-sited. For example if the third of four piles refuses, the PIF could be recovered, placed in back over the 2 piles already driven to penetration (thereby shifting the foundation location 24m) and piling attempted in the new location. The previously refused pile would then be cut off below the seabed and recovered.

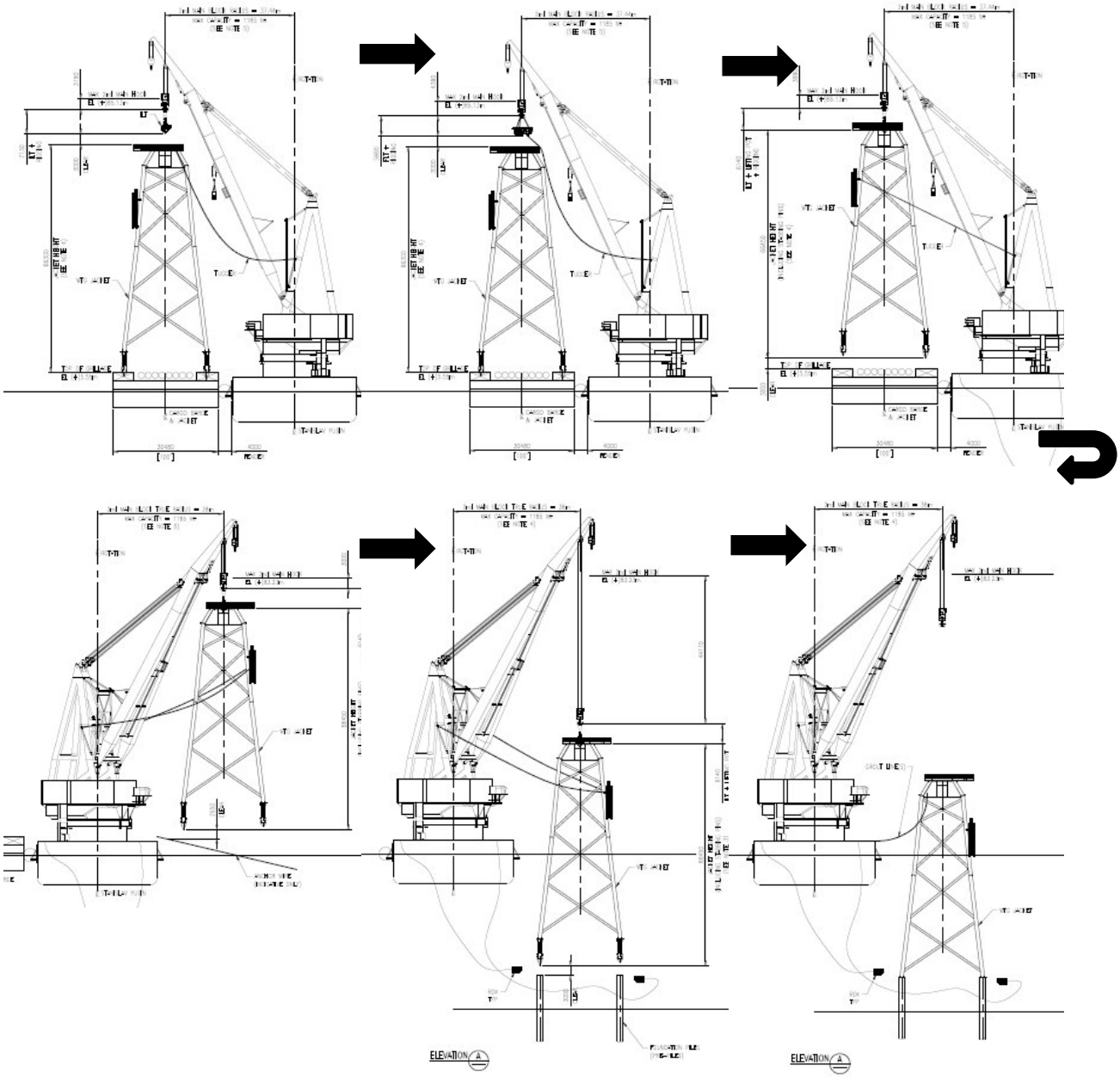
Foundation Installation Stage F6 – Jacket Lift and Installation

5.4.25 Once piling is complete at a number of locations, the HLV will prepare for the installation of the jacket substructures into the pre-installed piles. Further details on the installation sequence are provided in the PS.

5.4.26 Prior to jacket substructure installation, pile cleaning is undertaken to ensure there is no soil remaining on the inside surface of the pile after soil plug removal. The inside of the pile needs to be clean so that the grout bonds between the jacket stab in and the internal pile wall. Inside pile cleaning will be performed by means of a combination of steel brushes and high pressure water jets (nozzles).

5.4.27 The jacket substructures will then be delivered to site by cargo barge in a vertical position. The cargo barge will moor alongside the HLV and the substructures will be lifted in a vertical position and lowered to the seabed to make the connection with the piles. This process is illustrated in Figure 5.10 below.

Figure 5.10 - Example of sequential jacket installation procedure for a vertically mounted jacket substructure



5.4.28 Jacket legs will be fitted with hydraulically actuated 'grippers' to hold the jacket in the correct position during grouting operations. The grippers, which are attached to the bottom of the jacket legs, clamp onto the piles. They can be adjusted to ensure the correct jacket height and inclination prior to grouting.

5.4.29 With regard to scour, the base case for the support structure design (subject to final engineering design work) is to design for scour 'allowance'. It is assumed that local scour around a jacket leg and pile will only occur in the sand layers up to maximum depth of 1.3 x the diameter of the piles or to the top level of the underlying clay layer, whichever is greater. No reduction of soil stiffness is considered within these limits and as such no specific scour protection is expected to be required. The approach is based on the assumptions that BOWL will implement a scour assessment strategy (as described in the approved Project Environmental Monitoring Programme (PEMP) relying on an observational approach to seabed levels adjacent to the piles, carrying out any reinstatement of the sea bed levels if required. Should scour become an issue, scour protection may be deployed.

Foundation Installation Stage F7 – Jacket Grouting

5.4.30 The connection between the jacket substructure and each of the piles is grouted (cemented) once the jacket has been safely lowered into place and accurately held in position using the grippers.

5.4.31 Grout will typically consist of ordinary Portland cement, CEM I Type 60 or similar. Approximately $10m^3$ to $15m^3$ of grout will be required for each pile to grout the jacket leg/pile connections.

5.4.32 Grout will be mixed using fresh water on board the installation vessel and stored in grout silos ready for use (see Figure 5.11)

5.4.33 Grout is pumped using a high pressure system through high pressure grout delivery hoses connected to connectors on the jacket structure and into the joint between the jacket and the pile.

5.4.34 The grout cures and hardens over a period of approximately 8 hours.

Figure 5.11 - Example of grouting spread set up on a HLV

Foundation Installation Stage F8 – Completion and Move out HLV

5.4.35 Having completed the grouting operation the HLV then mobilises (by picking up anchors where necessary) and re-locates to the next wind turbine or OTM location to commence support structure installation.

5.5 Inter-Array Cable Installation

Components to be installed

5.5.1 The inter-array cables connect the turbines to the OTMs.

5.5.2 The main components to be deposited or installed are summarised in Table 5.3.

Table 5.3 – Summary of inter-array cabling to be deposited or installed

Component	Description	Image	Key dimensions
Inter-array cabling	3 core 33kV armoured submarine power cable consisting of: • 28 No. Type 1 (indicatively 630mm^2 cores); • 63 No. Type 2 (indicatively 300mm^2 cores).		Approximately 140km in total length

5.5.3 Further details on the key parameters for each of these components is provided in Appendix B by comparison to the maximum consented values as described in the application.

5.5.4 Further details of cable specification, burial risk assessment and installation of the inter-array cables are provided in the approved CaP (and for the export cables in the OfTW CaP).

Delivery to the Construction Site

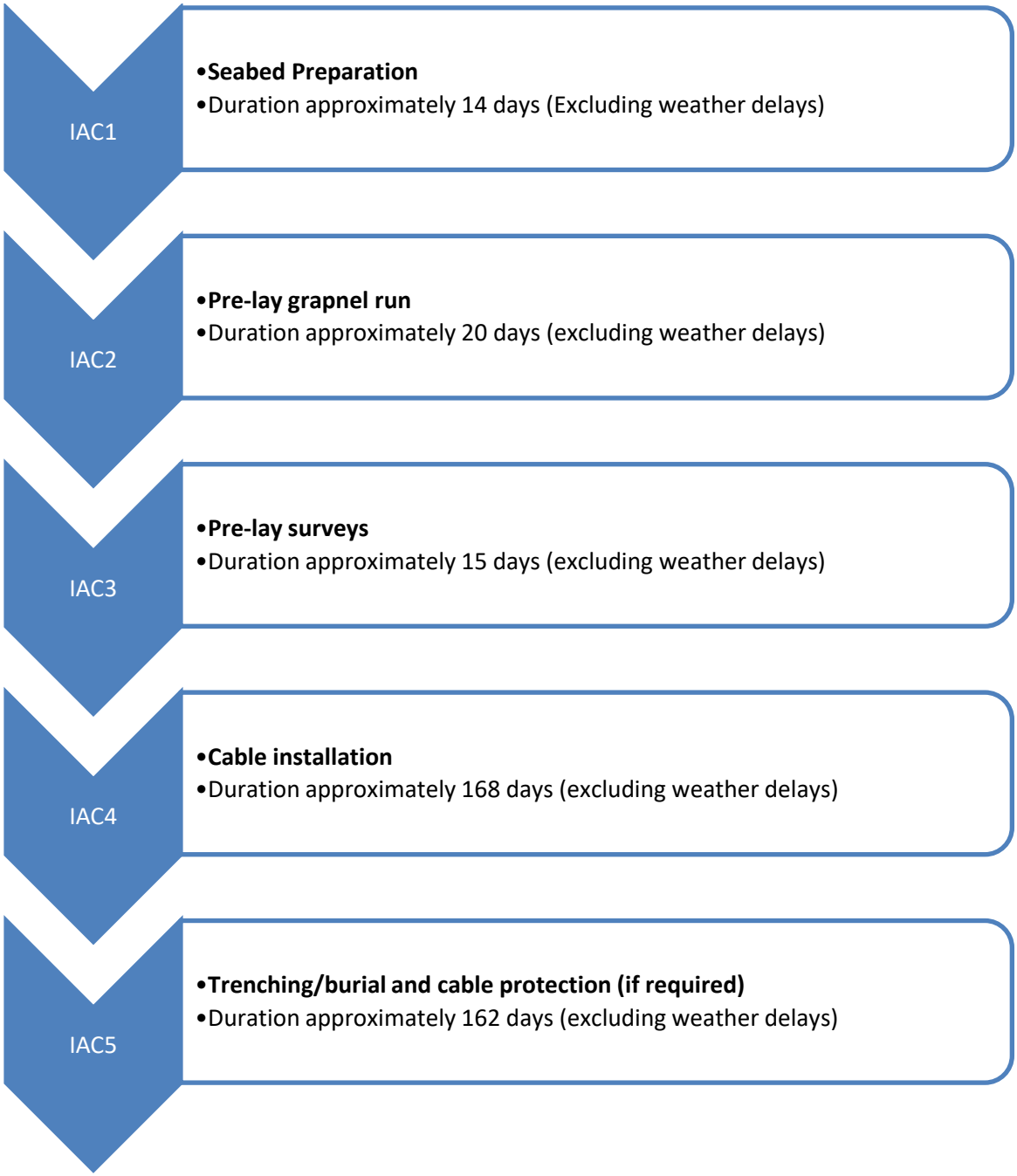
5.5.5 Inter-array cables will be delivered to site direct from the point of manufacture by sea transport.

Method and Process of Installation

5.5.6 An indicative inter-array cable installation sequence for all cables is presented in Figure 5.12 below, including current indicative, approximate durations for the completion of each operation. Greater detail on each of the stages in the installation process (IAC1 – IAC5) is then provided in the subsequent sections. Total duration for the installation of all of the inter-array cables is estimated to be circa 365 days excluding any weather delays.

5.5.7 Further detail on the cable installation process is provided in the approved CaP.

Figure 5.12 Inter-array Cable Installation Sequence



Inter array cable Installation Stage IAC1 – Seabed preparation

5.5.8 Seabed preparation for inter-array cable installation and support structure installation will be completed simultaneously and is described in full in Section 5.3.

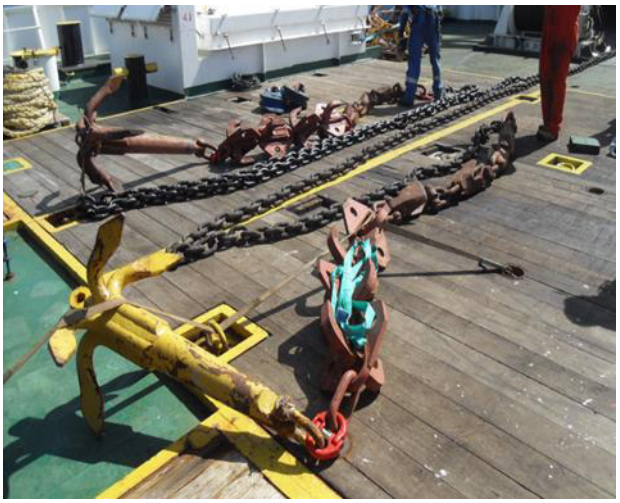
Inter-array Installation Stage IAC2 – Pre-lay grapnel run

5.5.9 Seabed debris or features (for example scrap trawler warps or ships' crane wires that may have been jettisoned by vessels onto the seabed etc.) can be detrimental to the trenching or burial tool. Therefore, after boulder clearance and before the start of cable laying operations the cable route will be cleared of any remaining obstructions by undertaking a pre-lay grapnel run (PLGR).

5.5.10 A specialised vessel will be mobilised together with any required survey and positioning equipment, and grapnel assembly (see Figure 5.13). The grapnel rig will be set-up to accommodate any change in soil conditions covering the entire array cable routes.

5.5.11 The PLGR vessel will tow the grapnel rig along the centreline of the cable route with a tolerance of +/- 5m giving a 10m corridor.. Any debris encountered will be recovered to the deck of the vessel for appropriate licensed disposal ashore.

Figure 5.13 - Example of a grapnel that may be used for the PLGR



Inter-array Installation Stage IAC3 – Pre-lay cable survey

5.5.12 The Cable Lay Vessel (CLV) will perform a pre-lay survey as part of the cable installations, this will be done after the vessel is loaded and has arrived at site to ensure no changes that will affect the cable installation has occurred since the previous surveys. A Remote Operated Vehicle (ROV) will be used to carry out the pre-lay survey.

Inter-array Installation Stage IAC4 – Cable installation

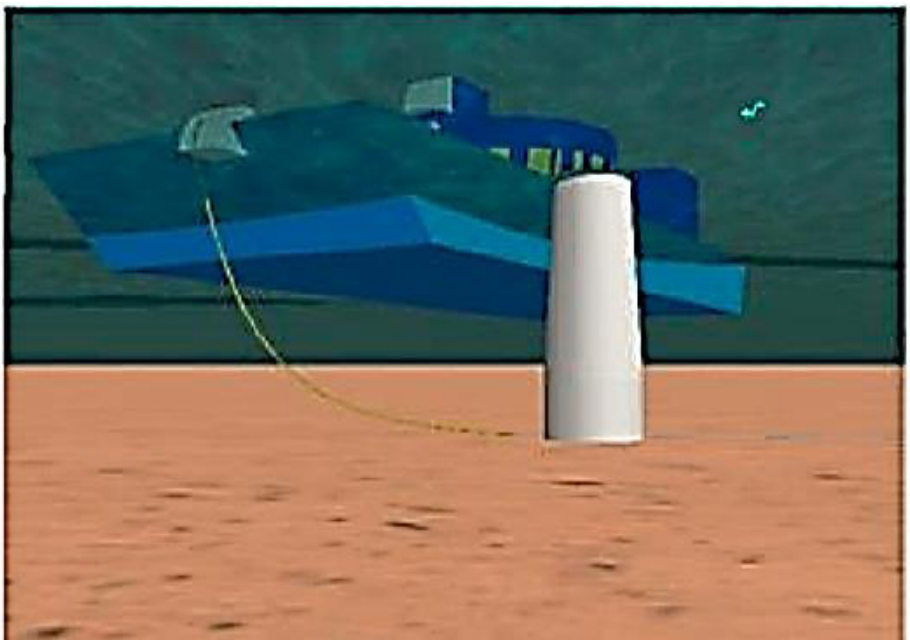
5.5.13 Cable installation is undertaken by the CLV which has been pre-loaded with the inter-array subsea cable lengths stored on cable carousels carried by the vessel. The cables are installed between the WTGs and between the WTGs and the OTMs to form the 'strings' of WTGs. The installation methodology from OTM to WTG is very similar to that of the WTG to WTG apart from the following aspects:

- OTM pull-in equipment will be mobilised onto the OTM onshore prior to the transport and installation works offshore; and,
- All OTM pull-ins will be performed as first end pull-ins as the OTM is a congested area due to multiple cable approaches and first end pull-ins allow greater control of the cable seabed approaches.

5.5.14 The CLV is positioned adjacent to the first wind turbine (or OTM) location and the following cable installation sequence is then followed:

- The Installation Support Vessel (ISV) will transfer pull-in equipment and personnel to the WTG or OTM (noting equipment will already be in place on the OTMs);
- Prior to pull-in, a Cable Protection System (CPS), which takes the form of a protective sleeve of polyurethane or ductile iron placed around the cable, will be fitted to the cable end on board the CLV. The CPS provides stability to the cable and protects its integrity both during and post-installation;
- The CLV will recover a pre-installed messenger wire using an ROV (pre-installed within the J-tube; for description of J-tube see below), winch the wire to deck and connect it to the CPS;
- The CLV will then pay out the cable as the pull-in team on the WTG/OTM pay in the messenger wire and the array cable on the winch (Figure 5.14);
- Cable payout from the CLV will continue until the CPS reaches the J-tube (or I-tube) bellmouth. J-tubes are steel tubes that allow the installation of cables by providing a conduit through which the cables can be pulled. The tubes run from the cable termination points on the WTG or OTM down the support structure and bend outwards in a 'J' shape terminating in a wide bell mouth at the seabed. A ROV will be used to monitor the position of the CPS in relation to the J-Tube bellmouth;
- When the CPS is orientated correctly, payout from the CLV will continue until the cable end is accessible at the deck of the WTG or OTM.

Figure 5.14 - Example of first end pull-in



Cable free-lay

5.5.15 The cable is laid by the CLV away from the J-tube on the first WTG towards the J-tube on the second WTG (or OTM) along the previously cleared route. The lay speed, vessel speed, cable departure angle and tension will be monitored and checked to ensure the cable integrity is maintained throughout the lay.

Figure 5.15 - Example of a cable laying operation (cables first end being over-boarded from the cable laying vessel)

Cable cutting and sealing

5.5.16 On completion of the route length, the end of the cable is then cut, sealed and prepared for second end installation operations. Cutting will take place on the deck of the CLV (Figure 5.16).

5.5.17 The second end is temporarily laid down in readiness for pull-in through the J-tube of the second WTG structure.

Figure 5.16 - Typical cable cutting and sealing process

Second end lay-down and pull-in

5.5.18 Once the CLV reaches the WTG at the second end the following procedure will be completed during second end pull-in operations:

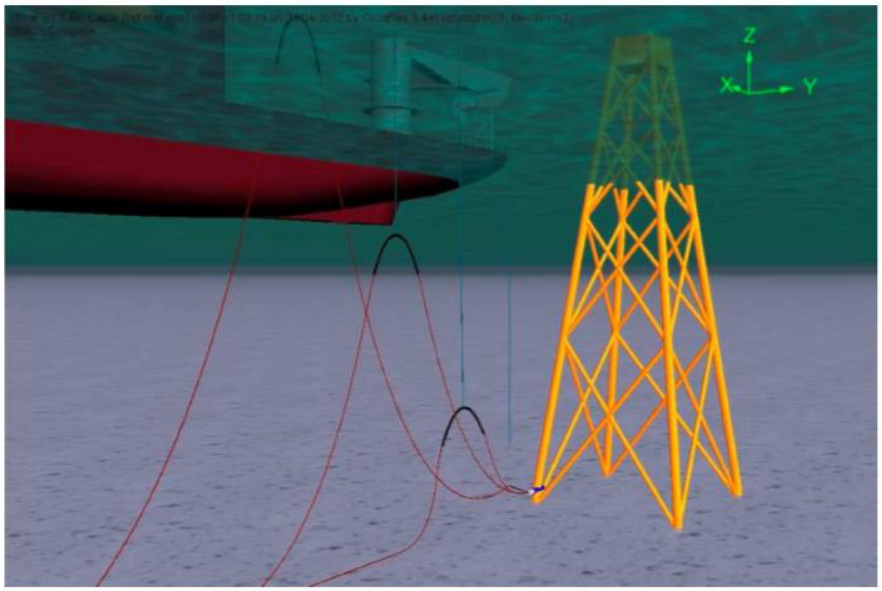
- As with first end pull-in the pull-in equipment and personnel will be mobilised to the WTG (or OTM) from the ISV;
- The CPS will be installed on the cut and sealed cable end on board the CLV;
- The CLV then recovers the messenger wire from the second wind turbine

and connects it to the cable end. The cable and subsea quadrant is then passed down the deck and over boarded;

- The cable is then fed through the J-tube bellmouth on the jacket structure and into the WTG (or OTM). The subsea quadrant is lowered as the cable is pulled in to the WTG (or OTM) (Figure 5.17). Finally, the quadrant is tilted in order that the cable is laid to the seabed. The quadrant is retrieved and final bight of cable is pulled in to the WTG (or OTM).

5.5.19 Cable testing will be performed at various stages during the cable lay operations and post terminations.

Figure 5.17. - Example of the cable being lowered from the vessel during second-end pull-in (the bend in the cable will be maintained using a subsea quadrant)



5.5.20 This process is then repeated for the remaining inter-array cable lengths, connecting turbines together in 'strings' and those strings of turbines to the OTMs.

Inter-array Installation Stage IAC5 – Cable trenching/burial and cable protection

5.5.21 Once the installation of surface laid inter-array cables is completed, they will then be trenched into the seabed to the target depth by a dedicated trenching vessel (Figure 5.18).

5.5.22 Where cables are left exposed on the sea bed prior to trenching or mechanical protection, guard vessel(s) will be strategically deployed along the cable route to deter vessels from the area that carry out activities that could damage the cables, or whose safety could be compromised by snagging on cables.

5.5.23 The seabed trenching tool will be launched from the cable trenching vessel. The surface laid cable will be loaded into the trencher. The seabed trenching tool then completes a first trenching run to bury the cable.

5.5.24 It is anticipated that cable burial will be primarily achieved by the use of a water jetting seabed trenching vehicle (see Figure 5.18). Such jet trenching vehicles will use nozzles mounted on jet swords to inject water at high pressure into the soil surrounding the cable which fluidises the seabed in the immediate vicinity allowing the cable to sink under its own weight, before the soil re-settles over the top. To maximise post-trenching cable cover and to minimise the disturbance of sediment away from the trench, site specific trencher settings will be derived based on the soil conditions to ensure disturbed sediment is monitored and managed efficiently throughout operations.

5.5.25 Based on the results of geotechnical investigation and Cable Burial Risk Assessment (CBRA) (reported in the Wind Farm CaP), BOWL propose a minimum target Depth of Lowering (DOL) of 0.6m to 0.8m as measured between the top of the cable and mean seabed level is anticipated. The seabed trenching tool will measure the trench depth.

Figure 5.18 –Seabed water jetting cable trenching tool being deployed from cable trenching vessel

Figure 5.19 – Examples of seabed water jetting cable trenching tools and cable plough that may be used for inter-array cable installation

Cable burial contingency

5.5.26 Cable burial by jet-trenching described above is considered the most reliable and cost effective form of cable protection. When seabed conditions are suitable it is also a relatively efficient process of installation. The majority of cables are expected to be installed by this method, however, in areas where jet-trenching may not be possible due to the presence of stiff sediments a hybrid tool capable of both chain cutting and jet trenching will be used.

5.5.27 Following the first trenching pass depressor depth data will be evaluated to determine whether the DOL has been reached. If necessary, a second trenching pass will be completed in either jetting or cutting mode of the hybrid tool to ensure the cable is adequately buried.

5.5.28 Cable burial is BOWL's preferred method of inter-array cable protection. It is not currently anticipated that cable protection will be routinely applied. However, where the target depth cannot be achieved due to resistant ground conditions, protection in the form of armouring, concrete mattressing or rock dumping may be installed.

5.5.29 These methods would be used where necessary and where short lengths of exposed cable could not otherwise be buried.

5.5.30 To protect the array cables between the seabed and the J-tubes, it is anticipated that a CPS will be used (as described in Section 5.5.13). For the inter-array cable-OTM/WTG interface, a system consisting of split pipes that form a protective sleeve of polyurethane or ductile iron around the cable will be installed from the J-tube to where the cable is buried into the seabed to protect the cables from dropped objects.

Figure 5.20 - Example of cable protection system at OTM or WTG J-tube

5.5.31 The design of the foundation support structures for the WTGs and OTMs means that it is unlikely scour protection will be required.

5.6 Wind Turbine Generator Installation

Components to be installed

5.6.1 The main components will be deposited or installed are summarised in Table 5.4.

Table 5.4 – Summary of wind turbine components to be deposited or installed

Component	Number	Key dimensions
Wind Turbine tower sections	Up to 84 wind turbine towers in 3 sections	Hub Height:110m Total tower height from jacket TP to hub height of approx. 87m Total Tower Height 85m (approx.) Tower diameter – Base: 6m Tower diameter - Top (below turbine): 4.145m

Wind turbine nacelles (housing the generator etc)	Up to 84 Siemens 7MW turbine nacelles	Size: 20.6m(l) x 9m(h) x 9.1m(w) (including hub)
Wind Turbine blades	Up to 84 x 3 rotor blades	Blade Length: 75m (154m Rotor Diameter) Maximum Chord:5m

5.6.2 Further details on the key parameters for each of these components is provided in Appendix B by comparison to the maximum consented values as described in the application.

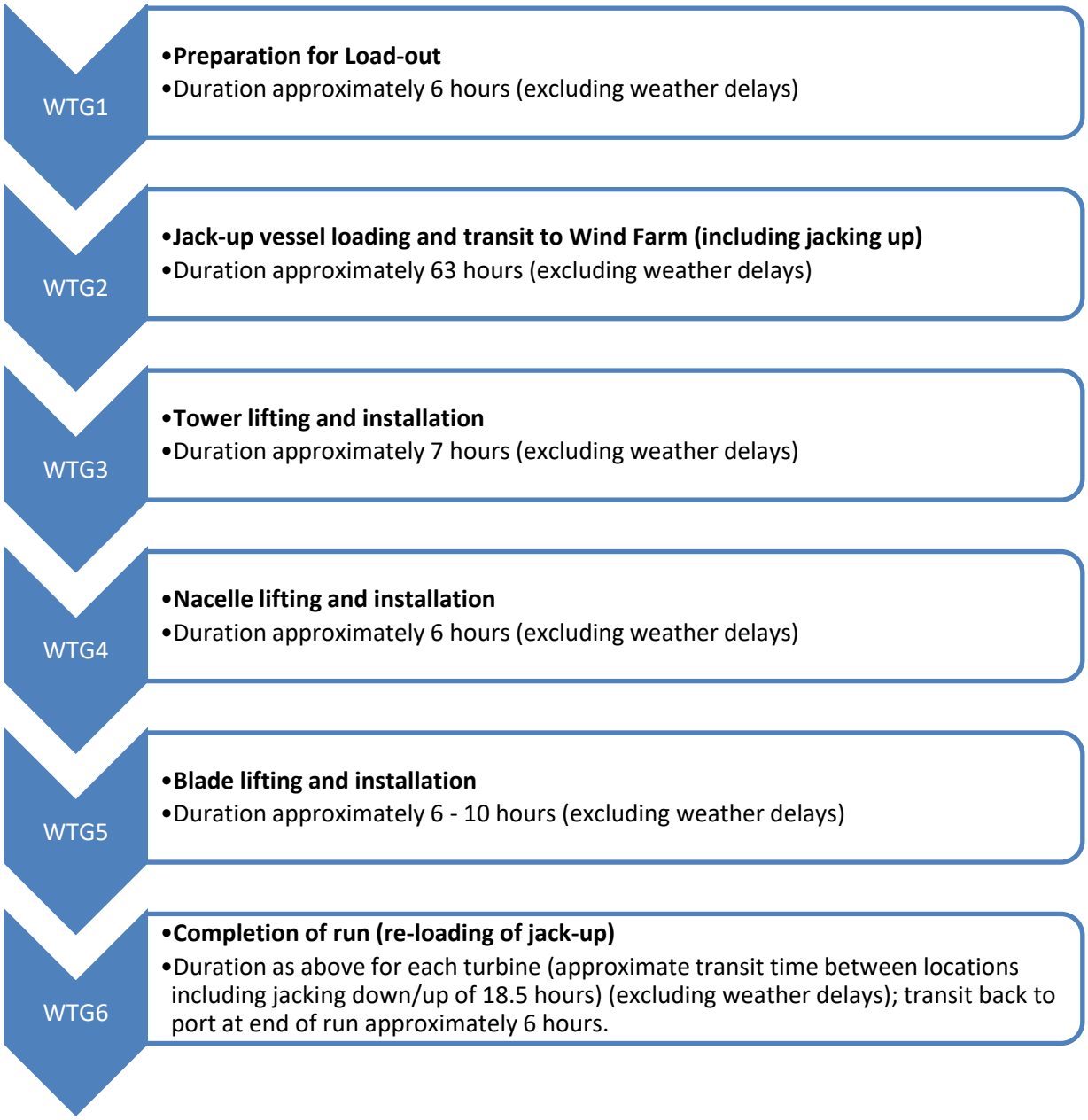
Delivery to the Construction Site

5.6.3 The wind turbine components will be transported by sea from the manufacturing facilities to the construction lay down area at Nigg Energy Park for pre-assembly.

Method and Process of Installation

5.6.4 An indicative wind turbine installation sequence is presented in Figure 5.21 below, including current indicative, approximate durations for the completion of each operation for each wind turbine. Greater detail on each of the stages in the installation process (WTG1 - 6) is then provided in the subsequent sections. Total duration for the installation of each wind turbine is estimated to be 36.5 hours (excluding loading and transit to/from port or between wind turbine locations) (and excluding any weather delays).

Figure 5.21 Wind Turbine Installation Sequence



WTG Installation Stage WTG1 – Preparation

5.6.5 Prior to the wind turbine installation process commencing the transition pieces of the jacket foundation structures will be surveyed and checked and cleaned ready to accept the tower sections.

5.6.6 At the lay-down construction port, the wind turbine components are readied for loading and installation. This includes:

- Pre-assembly of tower sections into complete towers;

- Preparation of the nacelles, and installation of single blade lift hydraulic turning gear;
- Preparation of blades;
- Preparation of all components for transport: provision of suitable weather protection, temporary fixing of assemblies, covering of hoses, cable ends and fibre optic-cables; and
- Preparation of all bolts, washers, nuts, specialist installation tools, bolt tensioning equipment etc. necessary to complete the wind turbine installation.

WTG Installation Stage WTG2 – Jack-up loading and transit

5.6.7 The wind turbine installation jack-up vessel will be jacked up at the Nigg Energy Park quayside and readied for loading. The turbine components are then loaded onto the jack-up vessel and fastened ready for sea transport (see Figure 5.22); 4 or 6 complete wind turbines are normally loaded at a time (i.e. tower sections, nacelles, and blades for 4 or 6 complete wind turbines).

5.6.8 Once the wind turbines components are loaded, the jack up vessel prepares for sea transportation and then jacks down and sails to site, to be positioned at the first wind turbine location, adjacent to the pre-installed jacket foundation.

Figure 5.22 - Example of jack up vessel being loaded with wind turbine components

WTG Installation Stage WTG3 – Tower lifting and installation

5.6.9 Once the jack-up vessel is positioned adjacent to the jacket foundation, the jack –up lowers its legs (each equipped with spud cans, which are inverted cones mounted at the base of the jack-up that provide stability) to the seabed. The vessel then jacks up until the hull of the vessel is just above the water level.

5.6.10 A preload operation then takes place which varies for each site and vessel but commonly consists of lifting two diagonal opposite legs so that the weight of the vessel is shared only over two legs. This applies a load that is equal to or greater than the predicted loads the leg will see during construction activities. The preload operation is repeated for the other two legs. Following pre-load the hull is jacked up further to the height above sea level as required for that particular vessel and the site conditions.

5.6.11 The vessel then prepares to lift the wind turbine tower (the tower having been pre-assembled at the construction port) (see Figure 5.23). The lifting and installation process then proceeds as follows:

- The temporary transition piece cover is removed;
- The rigging is prepared for the tower lift;
- The lifting gear is attached to the tower;
- Tag lines are attached to the tower base;
- The sea fastening bolts are dismantled;
- The wind turbine tower is lifted and guided into position on the foundation transition piece;
- The correct tower position is confirmed and the connecting bolts are secured using torque and impact wrenches; and
- The lifting gear is disconnected from the tower and recovered to the installation vessel.

Figures 5.23 - A typical tower lifting and installation process.

WTG Installation Stage WTG4 – Nacelle lifting and installation

5.6.12 Having completed the tower installation, the jack up vessel then prepares to lift the wind turbine nacelle. The nacelle is the main body of the wind turbine generator and house the main generating plant and control systems.

5.6.13 The nacelle is prepared for lifting and fitted with a power pack.

5.6.14 The nacelle is then lifted on to the top of the tower section as follows (see Figure 5.24):

- The nacelle is released from the transport frame;
- The rigging is prepared for the nacelle lift;
- The lifting gear is attached to the nacelle;
- Tag lines are attached to the nacelle;
- The bolts are removed at the transport frame;
- The nacelle is lifted from the deck of the vessel and guided into position on the top of the tower;
- The correct nacelle position is confirmed and the connecting bolts are secured using torque and impact wrenches; and
- The lifting gear is disconnected from the nacelle and recovered to the installation vessel.

Figures 5.24 - A typical nacelle lifting and installation process

WTG Installation Stage WTG5 – Blade lifting and installation

5.6.15 The jack-up vessel then prepares to lift the wind turbine blades.

5.6.16 The blades are lifted one at a time into position on the nacelle as follows (see Figure 5.25):

- The blade lifting yoke is prepared;
- Tag lines are attached to the yoke;
- Confirmation is sought that the personnel in the nacelle are ready for blade lifting and attachment;
- The lifting yoke is attached to the blade and the frame/sea fastenings are released;
- The blade is lifted into position and secured on the nacelle rotor hub and secured with bolts;
- The blade is released from the lifting yoke; and
- The lift rigging & slings (and blade yoke) are recovered back to the installation vessel.

5.6.17 The nacelle is then rotated using the pre-installed power pack and the second and third blades are then lifted in turn and attached to the nacelle following the preceding sequence. When complete, the pre-installed hydraulic blade turning gear is removed.

Figures 5.25 - A typical blade installation process

5.6.18 Once the blades are installed, the final turbine installation works are completed including:

- Installation of all electrical equipment in transition piece;
- Connection of terminated 33kV inter-array cables at termination equipment on turbine transition piece to wind turbine switchgear in the tower base; and
- Mechanical completion of all mechanical systems in the WTG structure.

WTG Installation Stage WTG6 – Completion of run

5.6.19 After completion of wind turbine installation, the jack up hull is jacked down to sea level and the legs jacked up, releasing the spudcans from the seabed (it may be necessary to use water jets to release the spudcans from the seabed). The jack up vessel will then move to the next jacket foundation to repeat the preceding wind turbine installation sequence (stages WTG 3 to 5).

5.6.20 Once all of the wind turbines on board have been installed, the jack-up will be prepared for the return to port (stowing equipment etc.) and return to the construction laydown port to load the next set of turbines.

5.7 Offshore Transformer Module Substation Platforms

Components to be installed

5.7.1 The main components will be deposited or installed are summarised in Table 5.5.

Table 5.5 – Summary of OTM components to be deposited or installed

Component	Description	Key dimensions
Offshore Transformer Module (OTM) (offshore substation platform)	Two offshore transformer modules (OTMs) comprising: • Two jacket substructures; and • Two OTM topside modules	Jacket substructures - see Section 5.3 OTM topsides: Size - see Section 5.3 33m (l) x 17.2m (w)

5.7.2 Further details on the key parameters for each of these components is provided in Appendix B by comparison to the maximum consented values as described in the application.

5.7.3 OTMs are a new solution for offshore AC grid transmission, intended to replace the conventional offshore substation platform. Their main feature is that OTMs are much smaller in size and weight reducing cost and importantly meaning that they can be installed on a standard wind turbine jacket foundation structure. This eliminates the need for a special heavy lift vessel and installation time is also shortened due to better availability of standard service operation vessels. The OTM topsides are comprised of transformers and associated switchgear.

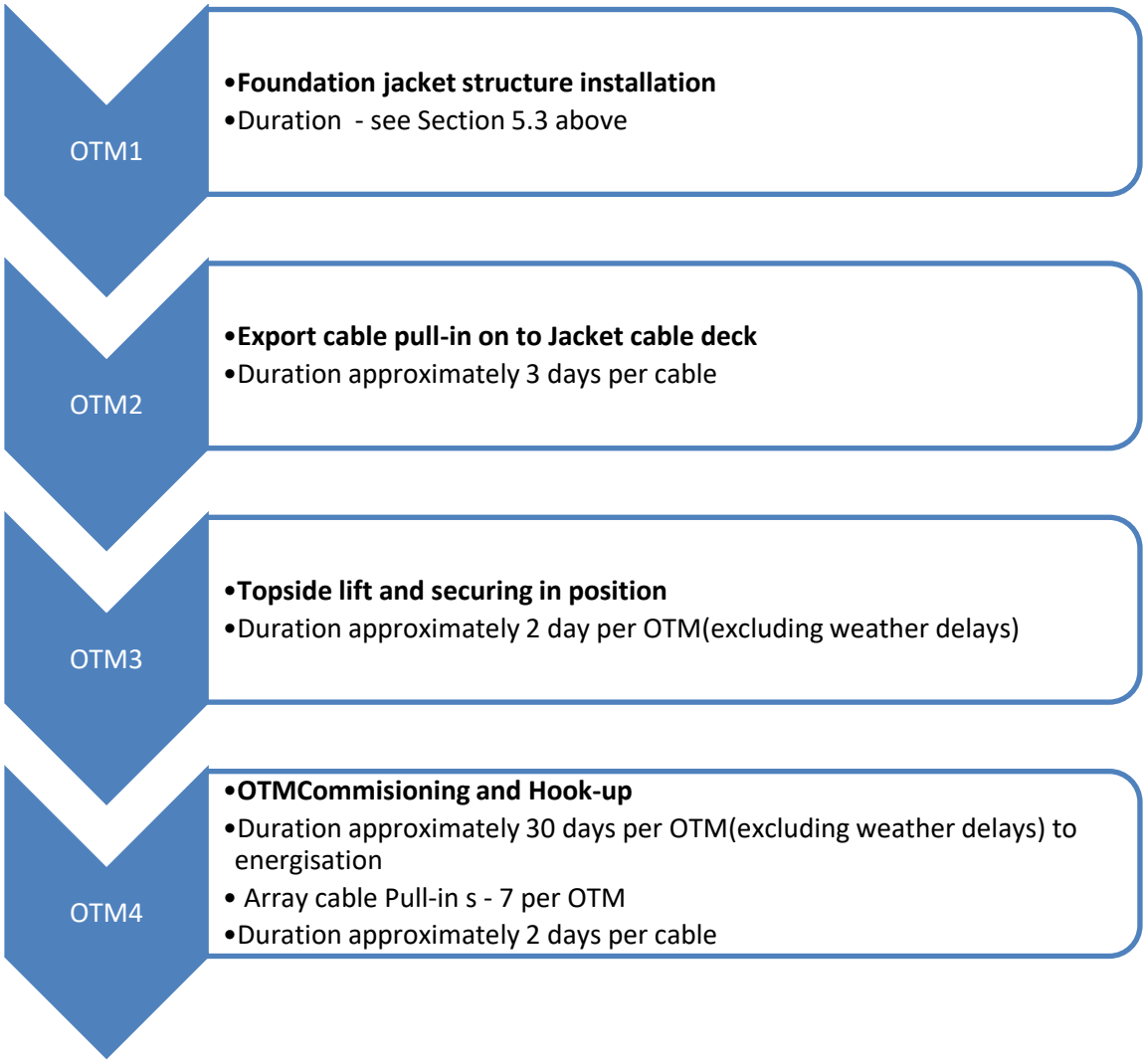
Delivery to the Construction Site

5.7.4 The OTMs will be delivered directly to the offshore Wind Farm site from the fabrication site for installation.

Method and Process of Installation

5.7.5 An indicative OTM installation sequence is presented in Figure 5.26 below, including current indicative, approximate durations for the completion of each operation. Greater detail on each of the stages in the installation process (OTM1 – OTM3) is then provided in the subsequent sections.

Figure 5.26 OTM Installation Sequence following Seabed Preparation



OTM Installation Stage OTM1 – Jacket foundation installation

5.7.6 Installation of the jacket substructures for the OTMs will be as described under Section 5.4 above.

OTM Installation Stage OTM2 – Export Cable Installation

5.7.7 Installation of the export cable onto the OTMs will be as described in the OfTW CMS for Export Cable installation.

OTM Installation Stage OTM3 – Top Side Installation

5.7.8 The topside platform which includes the transformer module and associated switchgear will be assembled as a single unit prior to lifting onto a barge and being transported to the Wind Farm site. This will ensure that once offshore, the lift of the module onto the jacket transition piece will take minimal time. Where possible, all rigging for lifting operations will be in place prior to shipping the module offshore.

5.7.9 Once a sufficient weather window is available to undertake the lift is available, the lift will commence using a heavy lift vessel and the topside is lowered onto the jacket substructure. It is anticipated that the topside module will be secured into position by use of a grouted connection (similar to the jacket-pile grouting operation described in Section 5.4) and a stab-in. Alternatively a bolted or welded connection may be used.

OTM Installation Stage OTM4 – Commissioning and Hook Up

5.7.10 Once the OTM topside module is secured to the jacket, the export cables will be connected following a process similar to that described for inter-array cable installation under Section 5.5 above. This will allow back energisation of the OTM from the National Grid connection at Blackhillock via the export cable.

5.7.11 Pre energisation commissioning activities take place within the module such as setting up communication systems with the shore, lighting, fire-fighting system commissioning etc. (see also Section 5.8 below). Once all systems are enabled, the OTM HV electrical systems are commissioned using back energisation. When complete the OTM is operational and able to provide energisation for the wind turbines as required.

5.7.12 Other commissioning activities will then take place within the module such as setting up communication systems with the shore, lighting, fire-fighting system commissioning etc. (see also Section 5.8 below).

Figure 5.27 - Example of an OTM top-side layout installed on a jacket structure and arrangements of topsides and cable deck

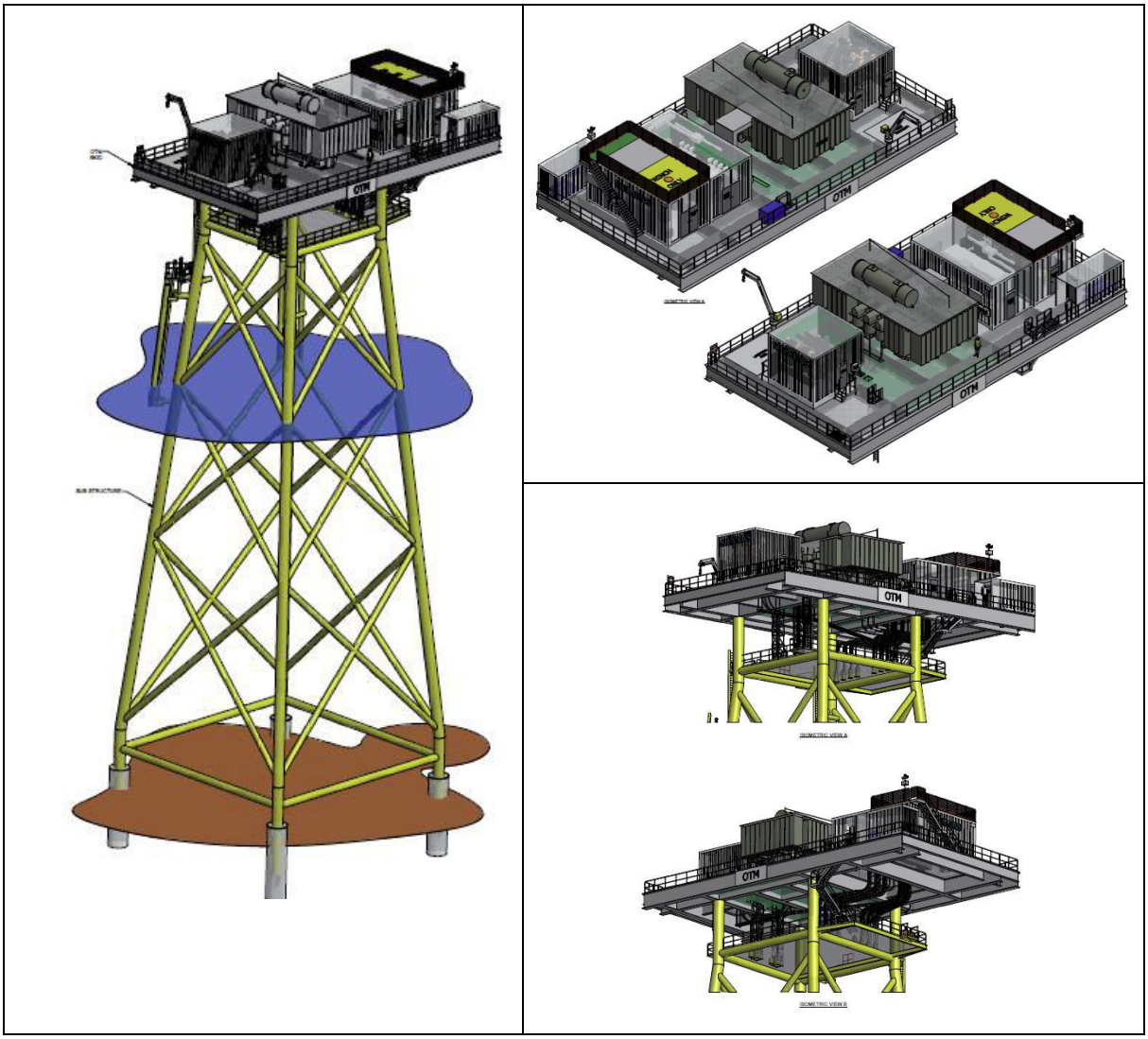


Figure 5.28 – SHL vessel performing heavy lift of a conventional offshore substation platform topside

5.8 Wind Farm Electrical Connection and Commissioning

5.8.1 Once the export cables and OTM's have been energised from the National Grid connection at Blackhillock substation, the process of offshore commissioning commences. Commissioning of the wind turbines, will be carried out on an individual basis, but require initial energisation for the commissioning process, prior to generation. Note that further information on the commissioning of the OfTW works will be provided in the OfTW CMS.

5.8.2 Personnel will be transferred from the local commissioning port using small crew transfer vessels and landed on the wind turbine.

5.8.3 The required works that will be completed during commissioning of the Wind Farm in preparation for generation include the following:

- Provide power for the commissioning work;
- Testing of switchgear in the tower bottom;
- Installation and commissioning of the internal personnel hoist/ internal ladders in the WTG tower;
- Test and commissioning of internal personnel hoist;
- Final alignments of turbine drive train and associated ancillary equipment;
- Installation and testing of all fibre optic cables from the splitter box in the turbine transition piece to the location of the Supervisory Control and Data

Acquisition (SCADA) server;

- Internal cleaning of the WTG nacelles and towers and removal of all loose waste;
- Test control cables (fibre optic cable) from nacelle to base of tower electrical equipment;
- Test control cables (fibre optic cable) from base of tower electrical equipment to transition piece communications panel;
- Installation and commissioning of wind turbine SCADA system at the turbine;
- Installation and commissioning of SCADA system at substation;
- Installation and commissioning of SCADA across whole Development;
- Demonstrate full functionality of the Development's communication systems, locally and remotely;
- Installation and commissioning of SCADA servers and related equipment for SCADA at offshore and onshore substations;
- Handover of commissioned and operating turbines.

5.8.4 The SCADA system is vital to the operation of the Wind Farm. The SCADA system connects the individual turbines and OTMs to a central computer. This computer and the associated communication systems will allow remote supervision of the behaviour of all the wind turbines and also the Wind Farm as a whole. It will keep a record of all the activity on and allows determination of any corrective action needed. It also records output, availability and error signals. Communication will be via optic fibres which are embedded in the subsea cables.

6 Good Working Practices

6.1 Introduction

6.1.1 The Section 36 consent relating to this CMS (see Table 1.1 above) includes the following requirement:

> *The CMS must set out the construction procedures and **good working practices** for installing the [Wind Farm].*

6.1.2 Good working practice is not defined by the consent; for the purposes of complying with this requirement BOWL have taken the requirement to imply the following:

> *The reasonable application of methods of working that have been shown to achieve the best outcomes or that reach or exceed relevant legislative standards.*

6.1.3 In the context of the construction of the Development this has been taken to apply to those standards, guidance or examples of good practice working that will act to:

- Manage the construction process so as to avoid harm to construction personnel or third parties; and
- Ensure effects on the environment and other users of the marine environment are minimised as far as reasonably practicable (and in line with the commitments made by BOWL or the requirements of the project consents).

6.1.4 The following sections set out the areas of good working practices that will be applied during the construction process described by this CMS. They address the following specific areas:

- Offshore renewable industry good practice guidance;
- Health and safety procedures;
- Construction management procedures;
- Environmental management procedures; and
- Specific good working in relation to aspects of the construction process (as set out in Section 5 of this CMS) (that, for example, act to avoid or reduce environmental impacts or impacts on other users).

6.1.5 Cross reference is made to other relevant consent plans (as described under Section 1.4 of this CMS) and to the BOWL Statements of Compliance set out in Section 2.

6.2 Offshore renewable industry good working guidance

6.2.1 There are a number of good practice guidance documents that have been produced for or in relation to the offshore renewables industry in recent years. Where relevant, BOWL will require that such good practice is reflected in the detailed method statements produced by the key contractors and sub-contractors.

6.2.2 Industry guidance documents are listed in Table 6.1.

Table 6.1 –Offshore Wind Construction Good Working (or Best Practice) Guidance

Produced by	Title	Scope
The G9[1], published through the Energy Institute	Working at height in the offshore wind industry (published December 2014)	Covering design, construction, commissioning, and operation; designed to reduce the need for work at height; topic guidance sheets, covering common hazards, personal protective equipment, training and competence, fitness requirements, and the responsibilities of those procuring, supervising and undertaking work; with supporting information, such as regulatory requirements in selected EU countries and technical standards.
	The safe management of small service vessels used in the offshore wind industry (published December 2014)	Cover working with vessels that have a gross tonnage of less than 500, such as crew transfer vessels, guard vessels, survey vessels and construction support vessels. The guidelines cover audit and inspection regimes for Wind Farm service vessels, operating procedures for routine marine operations, training and competence of crew and passengers, and safety equipment.
The Crown Estate	Sharing lessons learned and good practice in offshore transmission (published June 2014)	Presents the findings from a study commissioned to understand experience and lessons learned in the development, construction and operation of offshore transmission infrastructure.
	Construction vessel guideline for the offshore renewables industry (Published September 2014)	This guideline is designed to follow on from Vessel safety guide 'Guidance for offshore renewable energy developers (Vessel safety guide)' published by RenewableUK in January 2012 and is intended to assist by providing guidance to developers and the supply chain for the construction of an UK offshore Wind Farm project
Renewables	Offshore Wind and	H&S guidelines for the offshore wind sector

[1] Formed in 2010, the G9 comprises nine of the world's largest offshore wind developers and focuses on creating and delivering world class health and safety performance across all of its activities in the offshore wind industry. Membership comprises Centrica, Statoil, Eon, RWE, DONG Energy, Scottish Power Renewables, SSE, Statkraft and Vattenfall.

Produced by	Title	Scope
UK	Marine Energy H&S Guidelines (published March 2014)	covering all phases of development and identifying risks and significant safety hazards and activities.
	Safety and Emergency Response in Offshore Wind (Published November 2011)	Guidance on managing Search and Rescue resources within the UK Search and Rescue Region in relation to the development of offshore renewable development.
	Safety Circular: Notices to Mariners. Guidance for Offshore Wind & Marine Projects (Published 2013)	This Circular provides a short summary of the accepted scope and format for issuing NtoM.
	Incident Response: Offshore Wind and Marine Projects (Published October 2012)	This circular sets out a reminder and simplified protocol for managing the immediate stages following an actual or potential major incident where 3rd party assistance may be required.
	FLOWW Best Practice Guidance for Offshore Renewables Developments: Recommendations for Fisheries Liaison(Published January 2014)	Sets out best practice guidance on liaison between the offshore wind industry and the fishing industry.
	Guidelines for Selection and Operation of Jack-ups in Marine Renewable Energy Industry (Published November 2013)	Industry guidance aimed at jack-up owners, operators, developers and contractors engaged in site-investigation, construction, operation and maintenance of offshore wind and marine energy installations.
	H&S First Aid Needs Assessment (Published December 2013)	Provide basic information on how duty holders can assess the provision of adequate and appropriate equipment, facilities and personnel to ensure employees receive proper attention if they are injured or taken ill at work.
	Vessel Safety Guide Guidance for Offshore Renewable Energy Developers (Published April 2012)	Provides guidance and insight on the selection of vessels through all phases of Wind Farm development.

6.3 Health and safety procedures

6.3.1 The BOWL commitments related to SHE and incorporating the adequacy of equipment used and the training and competence of all construction personnel as well as matters relating to construction vessels are set out in Section 2.3 – 2.7 above.

6.3.2 It is noted in Section 2.3 that the Development will be a notifiable project for the purposes of The Construction (Design and Management) Regulations 2015 (CDM regulations).

6.3.3 BOWL will ensure compliance with the CDM regulations in the design of the project and through the completion of the construction process. BOWL will appoint a Principal Designer and a Principal Contractor for the project, ensure sufficient time and resources are allocated to the project, provide relevant information and require that the Principal Designer and a Principal Contractor carry out their duties.

6.3.4 Combined, these commitments will act to reduce the risk of SHE incidents occurring during the construction of the Development.

6.4 Construction management procedures

6.4.1 BOWL will ensure a range of project management procedures are in place during the construction process that will, alongside the relevant approved consent plans, act to ensure the safe, compliant installation of the major project components as described in this CMS, including but not limited to:

- A dedicated marine coordination centre to coordinate all activities on site including all vessel and personnel movements, electrical switching and site surveillance.
- Contracts with key contractors to a recognised standard (e.g. FIDIC, LOGIC or similar);
- Detailed construction method statements and risk assessments prepared by each of the key contractors and sub-contractors;
- Appropriate interface management procedures;
- A detailed integrated construction programme maintained regularly with input from the three EPC contractors;
- Clear roles and responsibilities allocated to all parties (see also Section 4.8 above);
- Appropriate and regular communications between all contracted parties and with relevant third parties;
- Marine warranty survey at all key construction activities

- Appropriate third party certification of the Wind Farm design; and
- A clear process of reporting, recording and auditing of the construction process, contractor performance and methods for managing shortfalls in performance.

6.5 Environmental management measures

6.5.1 The environmental management measures that will be applied by BOWL and the key contractors and sub-contractors incorporate a variety of good working practice and legislative standards in relation to the control of waste, dropped objects, pollution prevention, chemical usage, control of invasive non-native species, etc. Environmental management measures are set out in the Environmental Management Plan (the EMP) which, once approved, will be applied in undertaking the proposed construction works set out in this CMS.

6.5.2 In addition to the EMP, a number of other consent plans or requirements also incorporate matters related to environmental management (and incorporate elements of good working practice) including:

- The piling strategy (PS) – management of foundation piling operations to mitigate effects on marine mammal populations;
- The vessel management plan (VMP) – management of vessel operations to mitigate effects on marine mammal populations;
- The navigational safety plan (NSP) – setting out matters related to the management of construction vessels to ensure navigational safety;
- The lighting and marking plan (LMP) and the navigational safety plan (NSP) – lighting and marking to mitigate against impacts on other sea users;
- The marine pollution control plan (MPCP) – response to pollution incidents;
- The cable plan (CaP) – cable installation procedures.
- The commercial fisheries liaison officer (FLO) – liaison with the local fishing industry and notification of planned works, vessel movements etc; and
- The archaeological WSI and PAD.

6.5.3 In addition, any matters set out in the environmental statement in relation to the mitigation and management of construction will be incorporated into the CMS (see Section 7 below and Appendix A).

6.6 Project-specific good working practices

6.6.1 There are a number of specific good working practices that will be applied to certain aspects of the construction process as set out in this CMS and that will seek to minimise the environmental effects arising from the construction. The following sections set out the good working practices related to:

- Drill arising and soil plug disposal;
- Grouting operations;
- Seabed preparation and jack-up usage;
- Cable and scour protection;
- Piling operations;
- Drilling muds;
- Cable installation; and
- Minimising effects on other sea users.

6.6.2 A number of these are also set out in relation to environmental management in the EMP.

Drill arisings and soil plug disposal

6.6.3 Where necessary drill arisings and soil plug material generated during pile installation will be deposited on the seabed adjacent to the foundation location. Volumes generated per pile will be small (estimated maximum of circa 230m^3 for drill arisings and circa 24m^3 for soil plugs per pile; a combined disposal of up to circa 254m^3 per pile). Drilling is not likely to be required for every pile location and in some cases soil plug volumes will also be less.

6.6.4 In the case of soil plug, spoil will be deposited at the seabed in the vicinity of the piles by means of rigid piping or flexible hose and it is possible to control and monitor to some extent the number and location of spoil heaps to manage the impacts at the seabed.

6.6.5 Drill arisings are managed through a reverse circulation drilling system using seawater and deposited to the seabed.

6.6.6 Spoil heaps, if required, can be measured during disposal using Remote Operated vehicle (ROV) sensors or other appropriate methods. The height of the spoil mounds will not exceed 4 m above mean sea bed level (MSBL) at each pile location.

6.6.7 Grout will not be used to control drill spoil as was suggested as an option in the Environmental Statement, the material being left on the seabed for dispersion by the prevailing hydrodynamic forces.

Grouting

6.6.8 Grout will be used to cement the joints between the piles and jacket structures. The volumes of grout required will be minimised as far as possible through design whilst meetings the other design requirements.

6.6.9 Grout loss will be minimised by the monitoring and control of grout volumes being injected into each joint and by the subsea monitoring of grouting operations by use of an ROV.

6.6.10 The high pressure grouting equipment will be pressure tested onshore prior to being loaded onto the installation vessel to ensure there are no leaks. Once grouting is complete the grouting equipment will be cleaned on the vessel with water in a controlled manner to prevent grout from washing overboard.

Seabed preparation and anchor/jack-up movements

6.6.11 No seabed preparations are anticipated prior to foundation installation (with the possible exception of boulder or debris removal) thereby reducing seabed disturbance and the generation of spoil material and spoil disposal requirements. Potential boulders at Jacket footprint locations are avoided in the design stage or removed prior to arrival of HLV in the field.

6.6.12 Jack up movements and leg re-positioning will be minimised through the design of installation process so as to avoid unnecessary disturbance to seabed habitats. Similarly, anchor movements will be minimised.

Cable and scour protection

6.6.13 The current support structure design means that no scour protection will be required around the foundation structures, thereby reducing impacts on seabed habitats as a result of the placement of scour protection material. There remains a possibility that there may need to be scour protection around the OTMs due to the number of cables terminating into these jackets.

6.6.14 The need for cable protection material is not currently anticipated, other than localised and close fitting cable protection at the cables ends between the J or I-tubes and the buried sections.

Soft start piling

6.6.15 Soft start piling procedures will be applied at the start of piling operations as part of the marine mammal mitigation protocol. Full details of the piling approach and wider marine mammal mitigation is set out in the Piling Strategy.

Drilling muds

6.6.16 Where relief drilling is required during pile installation (see Foundation Installation Stage F5 under Section 5.3), drilling operations will not require the use of oil based lubricants, but instead will use seawater based drilling systems with no added chemicals.

Cable Installation

6.6.17 Inter-array cable installation (see Section 5.4) is expected to be completed principally by the use of a water jetting trenching tool. These tools use a high pressure water jet to fluidise the seabed soils allowing the cable to sink under its own weight to the target burial depth. They rely on the disturbed sediment settling back into the cable trench to create cover/backfill on top of the cable as the trenching tool passes.

6.6.18 To maximise post-trenching cable cover and to minimise the disturbance of sediment away from the trench, site specific trencher settings will be derived based on the soil conditions to ensure disturbed sediment is monitored and managed efficiently throughout operations.

6.6.19 Further details on the cable laying process will be provided for approval in the CaP.

Minimising effects on other sea users

6.6.20 BOWL recognise that the Development represents a major infrastructure construction project in the waters of the Moray Firth that are also used by a variety of other marine users including other commercial shipping, the commercial fishing industry and recreational sailors.

6.6.21 In order to ensure that effects on these other marine users are minimised, standard good working practices will be employed to ensure effective communication to minimise interactions and communicate risks arising from construction works to others in the vicinity of the construction site. A number of these are specific requirements of the consents but also represent good working practice, including:

- The regular issuing of Notice to Mariners (NtoMs);
- Establishment of safety zones during construction;
- Use of radio navigation warnings;
- Appointment of a suitably qualified Fisheries Liaison Officer;
- Charting of the project by provision of information to the UKHO
- Notification of commencement and completion of the works to local mariners, fishermen's organisations and HM Coastguard and Buckie Harbour Master by use of NtoMs;

- Notification of details of the works through the Kingfisher Fortnightly Bulletin and provision of information to the SeaFish industry on vessel routes, timings and location of the works and relevant operations; and
- Provision of details on the location of the Development for inclusion in the Clyde Cruising Club Sailing Directions and Anchorages.

6.6.22 In addition, the project consents contain a number of other conditions which will essentially set out good working practice requirements in relation to reducing effects on other marine users, including:

- Burial or otherwise protecting seabed cables;
- Provision and agreement of necessary marking and lighting and buoyage for the Development;
- Employment of measures (through use of the Transportation Audit Sheet) to control debris on the seabed and a process, where necessary, for the reporting of dropped objects and subsequent investigation/recovery;
- Agreed measures for emergency response (through the agreement of an Emergency Response and Co-ordination Plan (ERCoP)).

6.6.23 Further details on these consent requirements will be provided for approval in a number of the other necessary consent plans including the VMP, the NSP (which include ERCoP), the LMP, the CaP and the EMP. BOWL, in addition to the good working practices embodied in the consent conditions, is also proposing to engage guard vessels during the period of active construction in order to ensure that third parties do not approach too close to the Development area and the location of construction activities (see also Section 4.6 above).

6.6.24 BOWL will also apply for construction safety zones under the provision of the Energy Act 2004 which will act to provide a clear ‘area to be avoided’ for other marine users; the location of the active safety zones will be provided as part of the NtoMs issued.

7 Compliance with the Environmental Statement

7.1 Introduction

7.1.1 The relevant conditions of the S36 Consent and the OfTW Marine Licence require that the CMS be in accordance with the construction methods assessed in the ES, SEIS and Application, and that it includes details of how the construction related mitigation steps proposed in the ES, SEIS and Application are to be delivered. Sections 7.1 and 7.2 set out information from the ES/SEIS and original application with regard to:

- Compliance with the construction methods assessed; and
- Construction related mitigation and management from the ES/SEIS.

7.2 Compliance with Construction Methods Assessed in the ES/SEIS

7.2.1 The ES and SEIS described the range of methods that could be applied during the construction of the Development (this was in the form of a broad 'Rochdale Envelope' incorporating a variety of options in relation to the Development design and the approach to installation).

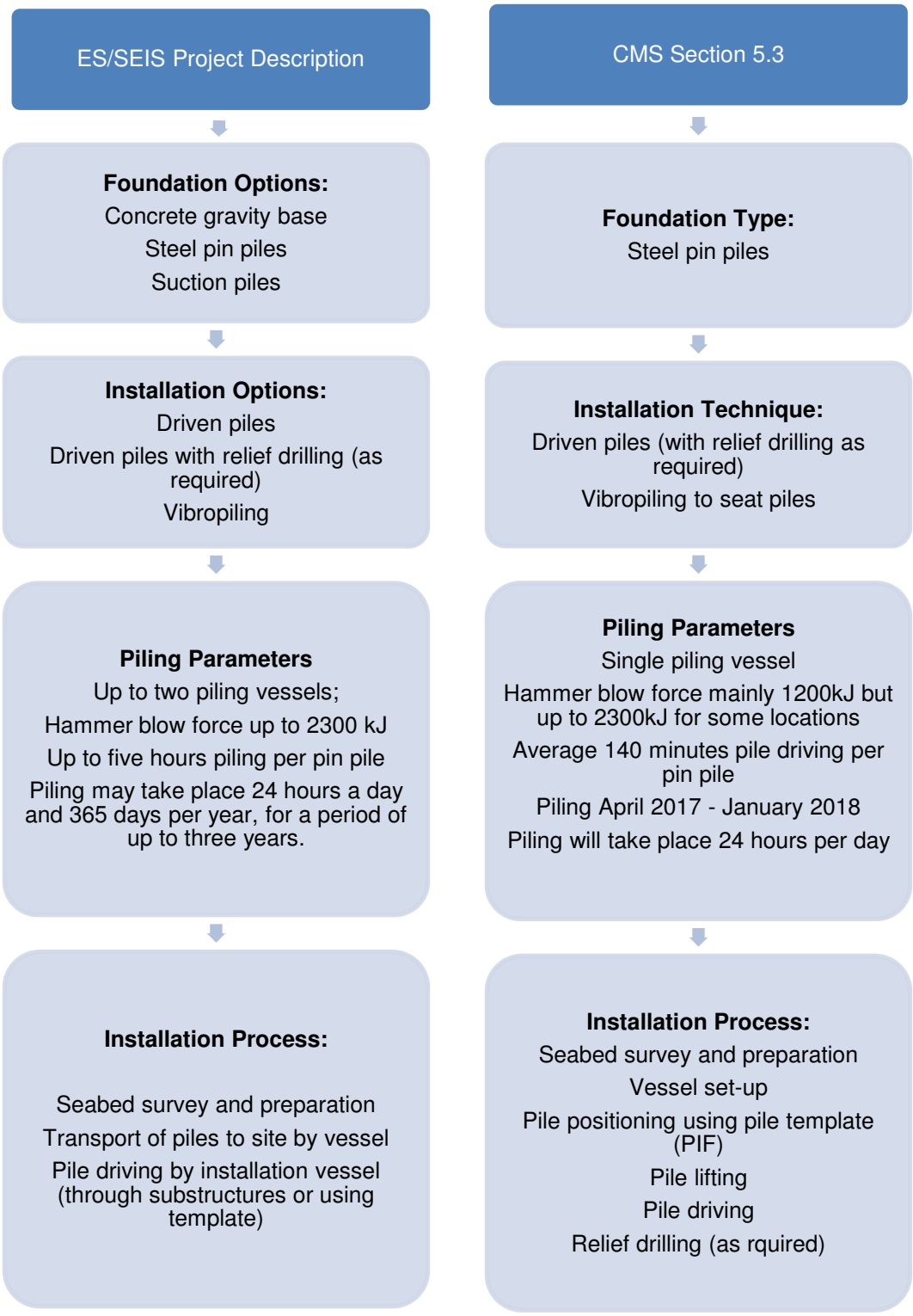
7.2.2 Since the Development consents were awarded, the design of the Development and the approach to installation has been substantially refined to that described in this CMS (and in other relevant consent plans). In order to demonstrate compliance of this refined design, construction methods described in ES and SEIS are summarised in the following sections below and compared to the construction methods detailed within this CMS (see Figures 7.1 to 7.5).

7.2.3 Appendix B provides a tabulated comparison of project construction parameters and methodologies as presented in the ES/SEIS and this CMS.

WTG and OTM Foundation Installation

7.2.4 Figure 7.1 below summarises the foundation options and assumed installation methods presented within the ES/SEIS. It also summarises the selected options and confirmed installation methods described in this CMS. The BOWL Piling Strategy (and the summary presented in Section 5.3 of this CMS) provides confirmation that the piling operations now proposed will not exceed the Rochdale Envelope assumptions listed above as originally set out in the ES/SEIS.

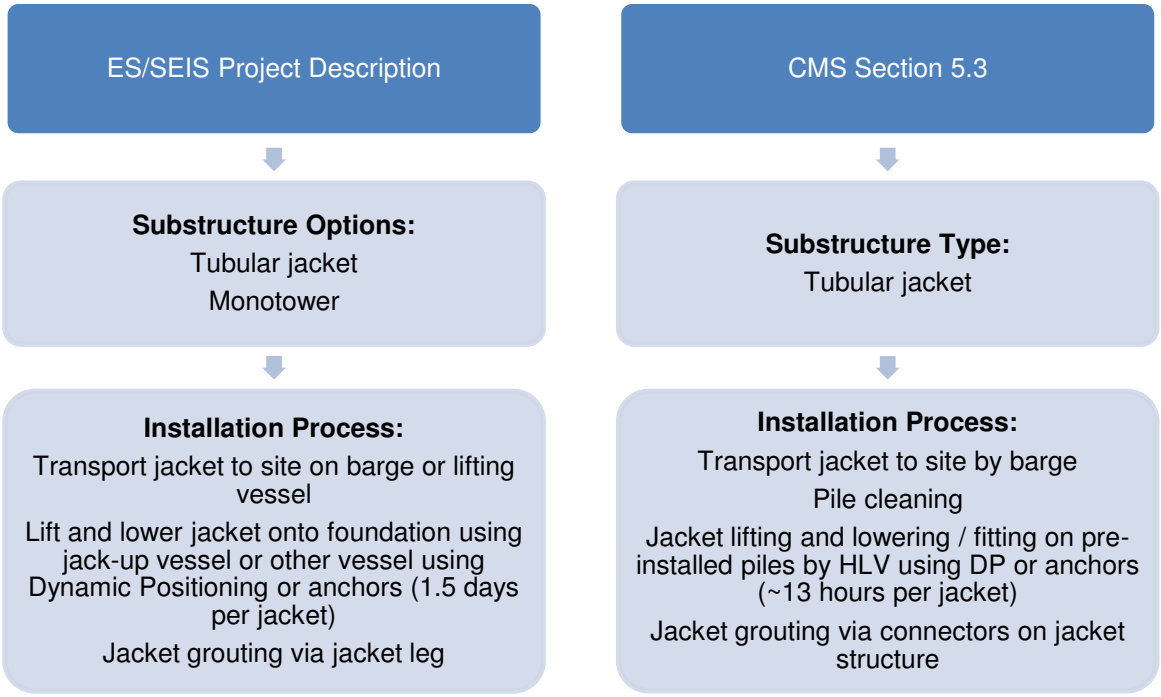
Figure 7.1 – Comparison of support structures (foundation) installation methods described in the ES/SEIS and CMS



WTG and OTM Jacket Substructure Installation

7.2.5 Figure 7.2 below summarises the substructure options and assumed installation methods presented within the ES/SEIS. It also summarises the selected options and confirmed installation methods described in this CMS.

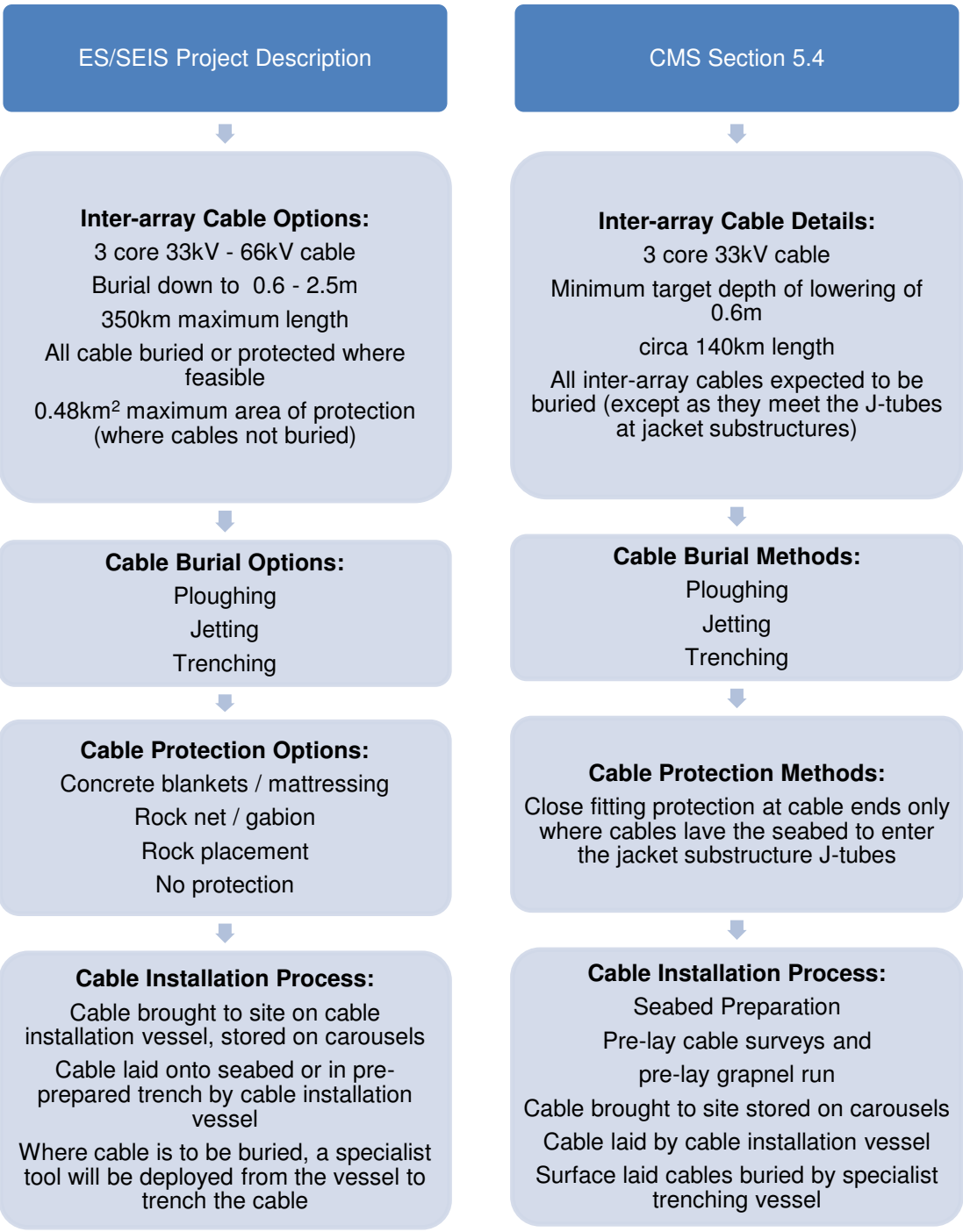
Figure 7.2 – Comparison of substructure installation methods described in the ES/SEIS and CMS



Inter-Array Cable Installation

7.2.6 Figure 7.3 below summarises the inter-array cable options and assumed installation methods presented within the ES/SEIS. It also summarises the selected options and confirmed installation methods described in this CMS.

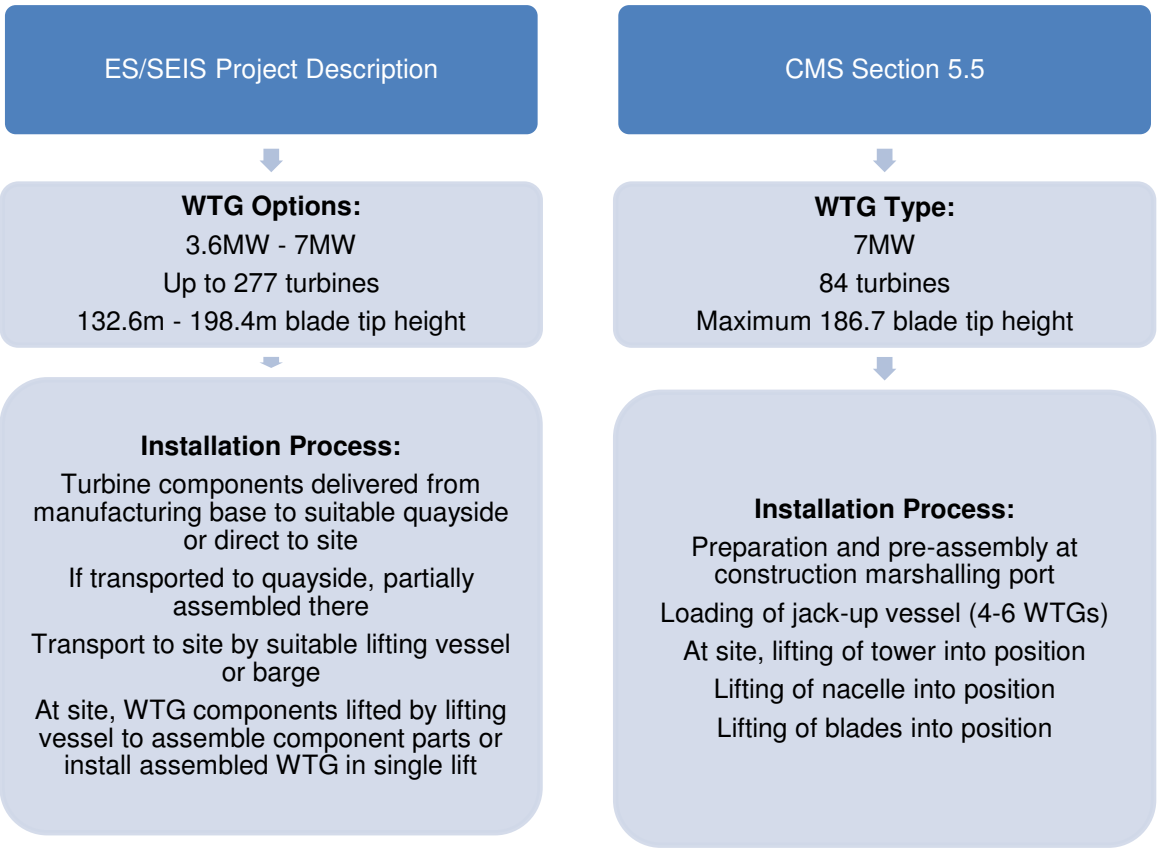
Figure 7.3 – Comparison of inter-array cable installation methods described in the ES/SEIS and CMS



Wind Turbine Generator Installation

7.2.7 Figure 7.4 below summarises the WTG options and assumed installation methods presented within the ES/SEIS. It also summarises the selected options and confirmed installation methods described in this CMS.

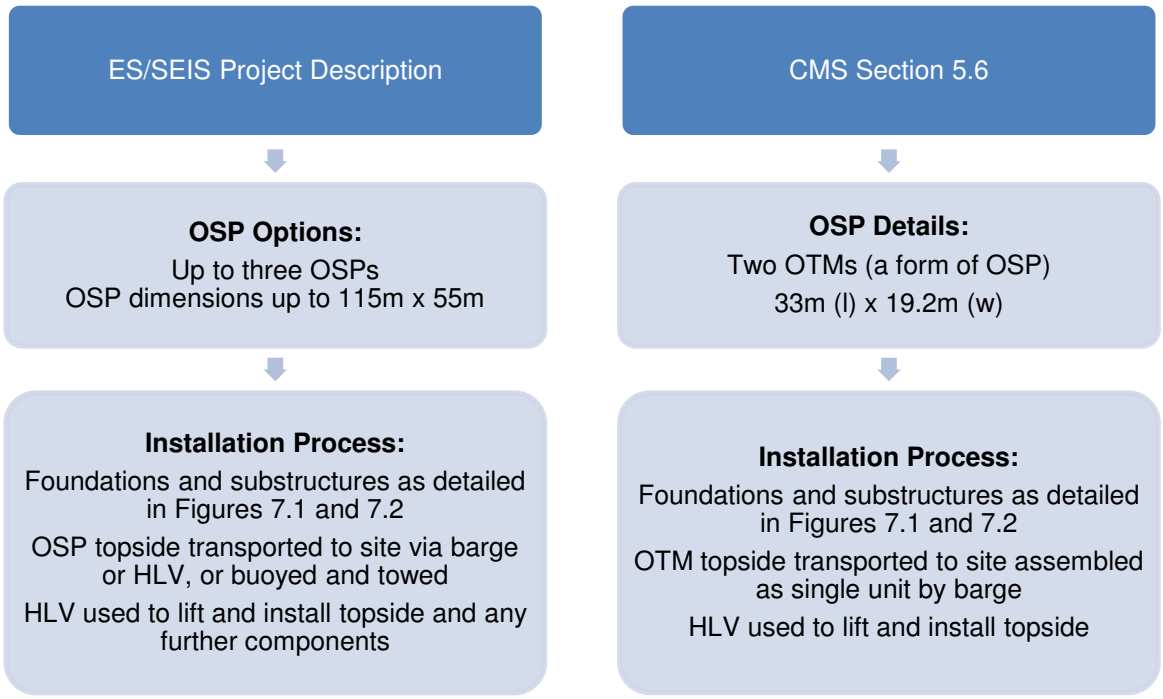
Figure 7.4 – Comparison of WTG installation methods described in the ES/SEIS and CMS



Offshore Transformer Module Substation Installation

7.2.8 Figure 7.5 below summarises the offshore substation platform options and assumed installation methods presented within the ES/SEIS. It also summarises the selected options and confirmed installation methods described in this CMS.

Figure 7.5 – Comparison of offshore substation installation methods described in the ES/SEIS and CMS



7.3 Delivery of Construction-related Mitigation Proposed in the ES/SEIS

7.3.1 The ES and SEIS detailed a number of mitigation commitments specific to installation activities. The construction-related mitigation measures are primarily associated with the process of installing piles and jacket foundations. Measures are summarised in Table 7.1 below and presented in full in Appendix A, which identifies where each commitment has been addressed within the CMS or within other BOWL Consent Plans where appropriate.

Table 7.1 - Summary of construction-related mitigation within the ES/SEIS

Construction Process	Mitigation Measures	Implementation
Jacket foundation installation:		
Piling operations	• Application of soft-start procedures • Adherence to a marine mammal mitigation protocol • Development of a piling strategy	Mitigation to be applied during piling operations is detailed in the BOWL Piling Strategy (PS)
Drilling operations	• Use of non-toxic, biodegradable drilling fluids • Control of drilling fluids • Control of sediment releases	CMS Sections 5.3 and 6.6 describe the relief drilling process, the nature of drilling muds that would be used, the nature of the drill arisings and how they would be controlled.
Inter-array installation:		
Cable installation	• Cables to be buried or protected	CMS Section 5.4 identified that cable protection is not currently anticipated for the main inter-array installation (with only some cable protection possibly required where cables come to the surface to enter jacket J-tubes). Further detail is included in the CaP
Other:		
Safety during construction	• Application of safety zones • Communications and notifications	CMS Sections 4.6 and 6.6 outline BOWL's proposals to use safety zones. CMS Section 6.6 sets out good practice to minimise interference

Construction Process	Mitigation Measures	Implementation
	• Lighting and marking	with other sea users. Communication and notification requirements during construction are detailed in the BOWL Environmental Management Plan and in more detail in the NSP. CMS Section 6.5 makes reference to the BOWL Lighting and Marking Plan, which will set out more detail on lighting and marking requirements during construction.
Site management	• Development of environmental site management procedures	On site environmental management measures are detailed in the BOWL Environmental Management Plan

7.3.2 Beyond these measures that are specific to construction methods, other mitigation measures relevant to the construction phase of the Development are implemented by a number of BOWL Consent Plans.

Appendix A ES and SEIS Commitments

Table A1 presents the commitments made by BOWL in the ES and SEIS to mitigation measures relative to construction methods and processes set out in this CMS. The table provides details of the commitments and a cross-reference to where each commitment is implemented.

A complete register of the mitigation, management and monitoring commitments made in the ES/SEIS and required by consent conditions is set out in the commitments registers included as part of the EMP.

Table A1 - ES and SEIS Construction-related Mitigation relevant to the CMS

Source	Reference (ES or SEIS chapter)	Details of Commitment	Implementation
ES	Project Description	If drilling of pin piles is undertaken, drilling fluids will be biodegradable and non-toxic	CMS Sections 5.3 and 6.6
ES	Project Description	All waste will either be contained and recovered and disposed of onshore or collected in a macerator or treatment facility to be incorporated into the design to allow discharge of black water (i.e. water containing untreated effluent)	EMP
ES	Project Description	Appropriate site management procedures, method statements and tool box talks will also be utilised throughout the construction phase	EMP
ES	Other Issues	Measures will be taken to control and minimise levels of suspended sediment generated during construction and associated deposition rates	CMS Sections 5.3 and 6.6
ES	Project Description	Temporary safety zones will be marked with a navigation buoy at each corner of the zone. The zone will be subject to a Notice to Mariners as a temporary construction site and off limits to third parties. The zones will be advertised using the proper channels and liaison will take place prior to implementation with the relevant local sea users and bodies, including the port authorities	CMS Sections 4.6 and 6.6 NSP
ES	Project Description	A 500 m (the maximum permissible under international law) safety zone will be in place around each turbine during construction, major maintenance, possible extension and decommissioning	CMS Sections 4.6 and 6.6 NSP
ES	Project Description	A Control Centre, part of the necessary operation and maintenance facilities, will have an Automatic Identification System	CMS Section 4.7 NSP

Source	Reference (ES or SEIS chapter)	Details of Commitment	Implementation
		(AIS), Radar coverage, and CCTV coverage, which will identify vessels with AIS facilities entering into the safety zone during construction and commissioning activities. This will be in addition to visual observations by personnel on Wind Farm vessels or guard vessels working within and around the Wind Farm site and OfTW corridor. Any vessel identified or observed to stray in to the safety zone will be contacted by a designated member of the crew of the Wind Farm or guard vessels. A Control Centre will monitor AIS and non-AIS vessels by CCTV and record the movements of ships around the Wind Farm as well as company vessels working at the site	
ES	Project Description	Marine navigational marking, including lights and marks on significant and intermediate peripheral structures will be provided in accordance with NLB requirements	CMS Section 6.6 LMP
ES	Project Description	The nacelle of the turbine will be fitted with a heli-hoist platform (typically a minimum of 4 m x 4 m) with associated markings and lighting. The turbine will be supplied with a turbine control system which can stall the turbine blades allowing helicopters to access	LMP
ES	Project Description	Appropriate site management procedures, method statements and tool box talks will also be utilised throughout the construction phase	EMP
ES	Marine Mammals	Soft-start procedures for pile driving will be incorporated and will be for a period of no less than 20 minutes	PS
ES	Marine Mammals	BOWL will adopt piling protocol according to the JNCC guidelines (JNCC, 2010). This involves employment of dedicated MMOs and Passive Acoustic Monitoring (PAM) operatives with the aim of detecting marine mammals within an agreed 'mitigation zone' (no less than 500 m measured	PS

Source	Reference (ES or SEIS chapter)	Details of Commitment	Implementation
		from the pile location) and potentially recommending a delay in the commencement of piling activity if any marine mammals are detected. The pre-piling search will be carried out for a minimum of 30 minutes prior to the commencement of piling. Reports detailing the piling activity and marine mammal mitigation will subsequently be sent to JNCC/SNH after the end of all the piling activity	
ES	Marine Mammals	BOWL will look to investigate further the application to the Project of a number of different mitigation tools to reduce underwater noise as trialed by ESRa in summer 2011 if these tools prove to be viable commercially and achieve sufficient sound reduction such that effects on marine mammals would be significantly reduced	PS
ES	Marine Mammals	BOWL will continue to work with Marine Scotland and key stakeholders to undertake work to fill gaps in the understanding of the effects of underwater noise on marine mammals behaviourally and at a population level. BOWL will work collaboratively with the wider Offshore Wind Industry in Scotland and the UK as well as with key experts in the field of underwater noise and marine mammals to undertake this work	PS
ES	Marine Archaeology and Cultural Heritage	Should it not be possible to avoid sites of cultural heritage interest during construction, a full programme of archaeological investigation which may include diver survey or Remote Operated Vehicle (ROV) investigation will be undertaken to identify the nature and extent of these sites. Subject to these investigations an appropriate mitigation strategy will be agreed upon with Historic Scotland	WSI and PAD
ES	Commercial Fisheries	The developer will apply for safety zones during the construction phase.	CMS Sections 4.6 and 6.6 NSP
ES	Commercial	Cables will be buried to a target depth of	CMS Section 5.4

Source	Reference (ES or SEIS chapter)	Details of Commitment	Implementation
	Fisheries	one metre, where it is reasonably practicable to do so. In instances where alternative protection is required, then the developer will seek where feasible to install appropriate and reasonable protection	CaP
ES	Shipping and Navigation	Safety Zones will be applied for in line with DECC guidance	CMS Sections 4.6 and 6.6 NSP
ES	Commercial Fisheries OfTW	Consultation will be ongoing with fisheries interests to minimise, where possible, the effect of construction activities that will result in the temporary loss of fishing grounds	EMP
ES	Other Issues	During construction and operation of the Development there will be ongoing liaison with the operators of all infrastructure in the Moray Firth. In particular further consultation is required with Oil Operators in relation to exclusion zones around platforms	NSP VMP
ES	Other Issues	Measures will be taken to ensure that the risk of accidental damage to oil infrastructure from vessel movements associated with construction is reduced.	NSP VMP
ES	Other Issues	During construction of the Development, safety zones will be in operation	CMS Sections 4.6 and 6.6 NSP
SEIS	Fish and Shellfish Ecology	The duration of the soft start piling would be not less than 20 minutes per pile in accordance with JNCC guidelines.	PS
SEIS	Fish and Shellfish Ecology	When piling commences a ‘soft-start’ procedure will be employed and the force of piling will gradually be increased to alert species in the vicinity to the commencement of the operations	PS
SEIS	Marine Mammals	Piling will not commence if a marine mammal is sighted within the 500 m mitigation zone.	PS
SEIS	Marine Mammals	BOWL and the wider offshore wind industry are investigating the feasibility of a number of mitigation measures to reduce the effects of construction noise on marine mammals	PS
SEIS	Marine Mammals	During all piling operations trained	PS

Source	Reference (ES or SEIS chapter)	Details of Commitment	Implementation
		Marine Mammal Observers (MMOs) will use visual and where required, acoustic detection, to ensure that marine mammals are not within the direct injury zone	
SEIS	Marine Mammals	Passive Acoustic Monitoring (PAM) will be particularly important for periods of poor visibility or night time conditions. PAM buoys will surround the piling location and detections will be sent back to the PAM operator on a dedicated vessel	PS
SEIS	Marine Mammals	Acoustic Deterrent Devices (ADDs) are a particularly useful tool for mitigating effects upon seals as a result of the difficulties associated with identifying and observing these species, particularly at night and during periods of poor visibility	PS
SEIS	Marine Mammals	When piling commences, a 'soft-start' procedure will be employed and the force of piling will gradually be increased. BOWL will take account of the most up to date soft start guidance at the time	PS
SEIS	Marine Mammals	If concurrent piling operations are undertaken, vessels will operate at no more than 5 km from each other.	PS
SEIS	Marine Mammals	Upon receiving detailed geotechnical information, BOWL will develop a piling strategy with the aim of reducing effects on agreed species throughout the construction period. Where possible the piling programme will determine what hammer energies are most likely to be used at specific locations in advance of any piling commencing, which will allow the development of a piling programme that has measures embedded within it to reduce the effects on marine mammals when compared to the worst case scenario presented in the ES and the SEIS. BOWL will continue discussions with Marine Scotland and relevant consultees in order to devise a piling strategy with	PS

Source	Reference (ES or SEIS chapter)	Details of Commitment	Implementation
		the aim of mitigating certain impacts where possible.	
SEIS	Residual Effects	Embedded industry standard mitigation including the following: • Consideration of a requirement for 500 m safety zones around construction activities and a 50 m safety zone during the operational phase; • Marine navigational marking will be provided; • Burial or protection of inter-array cables where feasible; • Liaison to ensure information circulated to mariners; • The Wind Farm and associated inter-array cables will be charted by the UK Hydrographic Office in Admiralty Charts; and • An Emergency Response Co-operation Plan (ERCoP) for the Wind Farm will be put in place pre-construction.	CMS & CaP NSP (inc. ERCoP) EMP LMP
SEIS	Summary - Physical Processes and Geomorphology	Construction best practice to minimise sediment release to the marine environment.	CMS Section 6.6 & CaP

Appendix B Compliance with ES/SEIS Rochdale Envelope Parameters

Table B1 presents a comparison of consented project parameters relevant to the installation and construction process, against the details set out in this CMS. Vessel types and useage are set out separately in Table B2 below.

Table B1 – Comparison of ES/SEIS Rochdale Envelope and CMS construction and installation parameters

Construction related parameter	**ES/SEIS**	**CMS**
Overall Wind Farm		
Number of wind turbine structures	Up to 277 (3.6MW capacity turbines)	84 (7MW capacity turbines)
Maximum site generating capacity	997.2MW	588MW
WTG and OSP foundations (piling)		
Foundation type	Pin piles (up to four per foundation) Suction piles Gravity base	Pin piles (four per foundation)
Maximum number of pin piles	1108 (WTG) + 12 (OSPs)	344 (84 x WTG + 2 x OTMs)
Pin pile diameter	2.4m (turbines) 3.0m (OSPs)	2.2m (WTG and OTMs)
Pin pile lengths	20 – 80m	Variable: ~35m - 60m
Maximum footprints per turbine	Pin pile (2.4m diameter) x 4: 18.1m^2	Pin pile (2.2m diameter) x 4: 15.2m^2
Piling time (per pile)	Up to 5 hours	Average ~145 minutes
Installation method (piles)	Pin piles: Pile driving (2300kJ maximum blow force); Relief drilling; Vibropiling	Pile driving (mainly 1200kJ but up to 2300kJ maximum blow force at some locations) Relief drilling (where required) Vibropiling (to seat piles prior to percussive piling)
Depth of drill arisings deposited on seabed	No greater than 5 m above MSBL	No greater than 4 m above MSBL
Drill Mud details (type,	Biodegradable, non-toxic,	Seawater based system with

Construction related parameter	**ES/SEIS**	**CMS**
composition, quantity)	probably water based muds	no added chemicals
Maximum volume of sediment arisings per foundation	424 m^3	254m^3 (drill arisings and soil plugs)
WTG and OSP substructures		
Substructure type	Tubular jacket Monotower	Tubular jacket
Design	Tubular steel lattice structure with up to 4 'legs'	Tubular steel lattice structure with 4 'legs'
Dimensions	Unknown – dependent on water depth and foundation type	Base dimensions (pile to pile): 24m x 24m
Connection between foundation pin piles and substructure jacket	Grouted connection (cement based)	Grouted connection (cement based)
Installation method	Lifting from the cargo barge or sinking of barge and controlled descent to the seabed	Lifting before lowering of the jacket from the transport barge onto the pre-installed piles by HLV.
Installation time of jacket (per jacket)	16 – 40 hours	21 Hours (including jacket lift and grouting)
Wind Turbines		
WTG Tip height range	132.6m – 198.4m	186.7m
WTG Hub height range	79m – 115.9m	110m
WTG Nacelle dimensions	Up to 26m x 16m x 12m	20.6m(l) x 9m(h) x 9.1m(w) including hub
Blade clearance above Lowest Astronomical Tide	25.4m – 33.4m	32.7m
WTG Maximum rotor diameter	165m	154m
Blade swept area	Up to 21,382.5m^2	18,626.5m^2
Minimum spacing	642m	1100m (excluding any micro-siting)
Installation method	Sequential lifting of individual	Sequential lifting by jacket up

Construction related parameter	**ES/SEIS**	**CMS**
	turbine components or lifting and installation of part or whole turbine assemblies.	vessel and installation of the turbine towers, nacelle and blades.
Wind turbine installation time (per turbine)	30 – 90 hours	WTG installation (tower, nacelle and blade lifting and installation) approx. 31.5 hours (total time for jack up load – transit – installation and repositioning to next location – approx. 83 hours)
Inter-array cabling		
Voltage range	33kV – 66kV AC	33kV
Maximum length	350km	~140km
Length buried	Buried where possible	Buried where possible (except at the J-tubes)
Burial depth range	0m – 2.5m	Depth of Lowering of 0.6 to 0.8m, where possible
Maximum extent of cable protection	0.48 km^2	Possible requirement for protection for sections where DOL is not achieved; anticipated to be significantly lower than 0.48km^2.
Installation method	Ploughing Trenching Jetting	Trenching Jetting
Protection method	Concrete blanket / mattressing Rock net / gabion Rock placement No protection	Close fitting protection at cable ends only where cables leave the seabed to enter the jacket substructure J-tubes; potential use of additional protection (most likely rock armour or concrete mattress) where DOL is not achieved
Offshore Substations		
Type	AC or DC OSP	AC OTM (a form of OSP)
Maximum number	2 AC & 1 DC	2
Maximum dimensions	115m x 55m	33m (l) x 17.2m (w)

Construction related parameter	**ES/SEIS**	**CMS**
Maximum height above LAT	20m	20m
Available Foundation Types	Pin Piles (excluding pre-driven piles) (3 m pin piles) Suction Piles	Pin Piles
Available Substructure Type	Tubular Jacket	Tubular Jackets
Met masts		
Maximum number	3	0
Maximum Height above LAT	115 m	-
Design	Lattice tower structure with equipment on booms at various heights including the top.	-
Available Substructure Types	Tubular Jacket Monotower	-
Available Foundation Types	Pin piles Suction piles Gravity Base Monopile	-

Table B2 – Comparison of main Construction Vessel and Helicopter Use from ES/SEIS Rochdale Envelope and CMS

Vessel	**ES/SEIS**	**CMS**
Foundation installation (piling)		
Installation vessel	HLV (e.g. Stanislav Yudin)	HLV (e.g. Stanislav Yudin or Oleg Strashnov)
Vessel for pile delivery	Heavy Cargo Vessel (Jumbo Javelin)	Cargo vessel or barge
Vessel positioning type	DP or anchored	DP or anchored
Substructure installation		
Jacket installation	Jack-up (e.g. Sea Installer / Sea Challenger)/HLV(e.g. Oleg Strashnov)	HLV (e.g. Stanislav Yudin or Oleg Strashnov)
Vessel for jacket delivery	Barge	Cargo vessel or barge
Vessel for jacket delivery	Tug	Transport barge tug

Vessel	**ES/SEIS**	**CMS**
WTG installation		
Installation Vessel	Jack-up (e.g. Seafox 5)	Jack-up (Pacific Orca)
Number of Legs	6	6
Commissioning		
Turbine / OSP commissioning	1 Hotel vessel	None
Vessels for crew transfer	3 crew vessels	Crew transfer vessels
Inter-array cable installation		
Inter-array cable laying	Cable laying vessel	Cable laying vessel
Inter-array cable trenching	Trenching vessel	Trenching vessel
Inter-array cable transport	-	Cable transport vessel
Cable protection	Rock placement vessel	Need not currently anticipated
Others		
Guard vessels	2 guard vessels (likely to be local fishing boats)	Guard vessels
Helicopter Operations	Secondary access to installations to be provided by helicopter transfer	Helicopter operations may be used for crew transfer to the contruction area; up to 6 return journeys per week.

Appendix C Wind Farm Boundary Coordinates

Table C1 presents the boundary coordinates for the Wind Farm.

Table C1 – Beatrice Offshore Wind Farm boundary co-ordinates

Latitude	Longitude	Latitude	Longitude
58° 09.894' N	002° 56.984' W	58° 10.022' N	002° 57.168' W
58° 10.023' N	002° 57.169' W	58° 10.061' N	002° 57.225' W
58° 10.382' N	002° 57.687' W	58° 10.382' N	002° 57.689' W
58° 10.913' N	002° 58.456' W	58° 11.104' N	002° 58.411' W
58° 11.221' N	002° 58.588' W	58° 11.287' N	002° 58.846' W
58° 11.251' N	002° 59.176' W	58° 11.840' N	003° 00.723' W
58° 12.290' N	003° 00.236' W	58° 12.705' N	003° 00.013' W
58° 13.742' N	002° 59.124' W	58° 14.567' N	002° 58.286' W
58° 15.390' N	002° 57.485' W	58° 16.238' N	002° 56.281' W
58° 17.216' N	002° 55.175' W	58° 18.376' N	002° 54.952' W
58° 19.023' N	002° 53.555' W	58° 19.324' N	002° 52.844' W
58° 19.590' N	002° 52.027' W	58° 19.730' N	002° 50.983' W
58° 19.637' N	002° 50.254' W	58° 19.176' N	002° 48.588' W
58° 18.787' N	002° 47.061' W	58° 18.762' N	002° 46.961' W
58° 18.724' N	002° 46.814' W	58° 18.056' N	002° 45.252' W
58° 18.056' N	002° 45.252' W	58° 18.004' N	002° 45.131' W
58° 18.004' N	002° 45.130' W	58° 17.960' N	002° 45.162' W
58° 17.766' N	002° 45.310' W	58° 17.574' N	002° 45.463' W
58° 17.382' N	002° 45.623' W	58° 17.193' N	002° 45.790' W
58° 17.091' N	002° 45.882' W	58° 16.981' N	002° 45.984' W
58° 16.794' N	002° 46.163' W	58° 16.609' N	002° 46.348' W
58° 16.426' N	002° 46.539' W	58° 16.245' N	002° 46.736' W
58° 16.065' N	002° 46.938' W	58° 15.887' N	002° 47.147' W
58° 15.712' N	002° 47.362' W	58° 15.538' N	002° 47.583' W
58° 15.367' N	002° 47.808' W	58° 15.197' N	002° 48.040' W
58° 15.029' N	002° 48.277' W	58° 14.864' N	002° 48.520' W
58° 14.781' N	002° 48.647' W	58° 14.701' N	002° 48.769' W
58° 14.541' N	002° 49.022' W	58° 14.382' N	002° 49.280' W
58° 14.333' N	002° 49.363' W	58° 14.301' N	002° 49.409' W
58° 14.136' N	002° 49.652' W	58° 13.973' N	002° 49.899' W
58° 13.812' N	002° 50.152' W	58° 13.654' N	002° 50.411' W
58° 13.524' N	002° 50.630' W	58° 13.487' N	002° 50.693' W
58° 13.334' N	002° 50.962' W	58° 13.183' N	002° 51.235' W
58° 13.035' N	002° 51.515' W	58° 12.889' N	002° 51.798' W
58° 12.745' N	002° 52.086' W	58° 12.605' N	002° 52.379' W
58° 12.467' N	002° 52.676' W	58° 12.332' N	002° 52.978' W
58° 12.242' N	002° 53.185' W	58° 12.234' N	002° 53.195' W
58° 12.067' N	002° 53.432' W	58° 11.902' N	002° 53.675' W
58° 11.856' N	002° 53.743' W	58° 11.843' N	002° 53.760' W
58° 11.828' N	002° 53.780' W	58° 11.813' N	002° 53.799' W
58° 11.641' N	002° 54.025' W	58° 11.472' N	002° 54.256' W
58° 11.304' N	002° 54.492' W	58° 11.139' N	002° 54.735' W
58° 10.976' N	002° 54.983' W	58° 10.815' N	002° 55.235' W
58° 10.657' N	002° 55.494' W	58° 10.501' N	002° 55.757' W
58° 10.347' N	002° 56.025' W	58° 10.197' N	002° 56.299' W

Latitude	Longitude	Latitude	Longitude
58° 10.062' N	002° 56.552' W	58° 10.061' N	002° 56.552' W
58° 10.048' N	002° 56.577' W	58° 09.903' N	002° 56.860' W
58° 09.872' N	002° 56.922' W	58° 09.872' N	002° 56.922' W
58° 09.865' N	0 02° 56.936' W	58° 09.894' N	002° 56.983' W.