

Service Reference Sheet Comprehensive Pre-Construction (Installation Preparation) Solutions

1.0 Related Services

Installation Engineering, Project & QHSE Management, Tendering, Procurement & Financial Support, Offshore Construction Support, Client Representation, Operations & Maintenance and Innovation Development.

2.0 Introduction

Primo Marine has extensive expertise, in-depth knowledge and experience to provide independent engineering solutions tailored for the requirements of the offshore Dredging, Oil and Gas, Renewable Energy and Power sectors. Solutions designed to ensure the best starting conditions for all projects are achieved, through offering an extensive capability including a plenitude of analysis and risk based studies for the complete pre-construction (installation preparation) phase. Incorporated within the Pre-Construction Engineering Capabilities is:

- Route Analysis, Route Optimisation & Protection.
- Risk Based Studies, Design and Analysis.
- Verification Studies, Design and Analysis.

3.0 Scopes

Primo Marine has provided independent engineering expertise into many of Europe's largest installation projects, from interconnectors i.e. BritNed, NordLink, NorNed, to export cables i.e. DolWin, HelWin to Offshore Wind Farms i.e. Amrumbank, Butendiek and Thornton Bank.

Primo Marine adopts the role of "Owner's Engineer" and considers this as a core differentiator in regard to the engineering scopes being offered. Providing complete independent in-depth technical knowledge to ensure adherence to all corporate, project, financial and legislative specifications for the benefit of the project and all the respective stakeholders.

4.0 Comprehensive Packages

Primo Marine offers Engineering expertise, either as part of an overall "comprehensive service package", in combination with Project & QHSE Management, Offshore Construction Support, Operations & Maintenance, Tendering and Innovation Design or as bespoke packages related to the pre-construction (installation preparation) and installation phases.

5.0 Engineering Pre-Construction (installation preparation) Phase

Primo Marine provides Engineering solutions, incorporating experience of all lessons learned during the pre-construction (installation preparation) phase, from its extensive track record, amongst others NorNed, BritNed, NordBalt, IFA2 and NordLink. The solutions have been designed to focus firmly on providing a more realistic CAPEX/OPEX balance for projects, in terms of ensuring successful route engineering and burial compared to the costs of dealing with obstacles and obstructions during the installation phase, as well as the potential cost of damage, failure and maintenance over the lifetime of the cable. Primo Marine provides combined engineering and technical solutions based on three core principles:

- A solid theoretical background, (in-depth technical knowledge and expertise).
- Application and flexible deployment of resources.
- Practical experience of all the lessons learned from all projects completed, (incorporating real offshore installation experience into the engineered and technical solutions).

Primo Marine provides the following Pre-Construction (installation preparation) phase services:

6.0 Route Analysis, Route Optimisation & Protection

Primo Marine offers an extensive capability for route engineering in terms of analysis, optimisation and protection focusing completely on reducing (1) **installation risk** (2) **installation cost** (3) **cost of seabed preparation** (4) **claims (by differing parties/stakeholders)**. Incorporated within the Route Analysis, Route Optimisation & Protection Engineering Capabilities is:

- Route Engineering, Design and Preparation – optimising routes in the provided corridor to reduce the risk of installation and cost.
- Risk Based Burial Design – studies incorporating qualitative and quantitative assessments of external threats to the cable within problematic areas.
- Seabed Mobility assessments and Advanced Morphodynamic Modelling – assessments on seabed mobility from route surveys in regard to relevance of initial burial depth and the maintenance of cables during their lifetime, by incorporating such assessments into route engineering and designs such as dredging profiles.
- Advanced Morphodynamic Seabed Modelling – assessments designed to provide estimated depth of burial maintenance required over the cables lifetime, relative to various initial burial depths.
- Profiling including 3D Analysis – adjusting profiles i.e. sand waves.
- Field data reviews covering (geophysical, geotechnical survey, GIS, AIS and metocean).
- Geotechnical (bore-holes, CPT) and Geophysical (bathymetric, SSS and SBP) analysis.
- In terms of tendering support (see Tendering, Procurement & Financial Support):
 - Designing survey campaigns to support the pre-construction phase by acquiring crucial data for route engineering.
 - Defining requirements for Geophysical and Geotechnical survey campaigns.

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7.0 Risk Based Studies, Design & Analysis

Primo Marine offers an extensive capability of Risk Based Studies, Design & Analysis, focusing completely on (1) **installation risk** (2) **installation cost** (3) **cost of seabed preparation** (4) **claims (by differing parties/stakeholders)**.

Incorporated within the Risk Based Studies, Design & Analysis Capabilities is:

- Burial Assessment Studies – assessment of acceptable probability of cable failure, external threats, the protection provided by burial into soil types encountered.
- Burial Assessment Studies – incorporating trencher expertise for assessment and selection of suitable types of cable trenchers.
- Third Party Damage – risk assessments.
- HDD Feasibility Studies at Landfalls – including the rerouting at the landfall to facilitate easier landing operations and thus reduce the risks passes.
- Crossing & Landfall Designs – the design including obtaining of crossing agreements, defining the type of crossing i.e. separation requirements and safe trench distances.
- 3D Engineering:
 - Including engineering of the route in provided corridor to avoid steep slopes, boulders and potential UXO's.
 - Design of dredging profiles, rock berms and pre-sweep profile.
- Cable Burial Risk Analysis – full spectrum of assessment and advice on all protection methods, amongst which are trenchers.
- Cable & Pipeline (Protection Study & Stability Analysis) – including bottom roughness.
- Risk Analysis – including seabed preparation studies, incorporating potential immediate mitigation e.g. guard vessels and buoys.
- Workability Studies – amongst others:
 - MetOcean (Meteorological and Oceanographical e.g. wind, waves, currents, ice) Data, for installation planning and design phase of marine assets such as platforms, pipelines and cables as well as coastal infrastructure such as harbours and sea defences.
 - Time-series Data to derive the workable windows for offshore operations.

8.0 Verification Studies, Design & Analysis

Primo Marine offers an extensive capability of Verification Studies, Design & Analysis, focusing completely on (1) **installation risk** (2) **installation cost** (3) **cost of seabed preparation** (4) **claims (by differing parties/stakeholders)**.

Incorporated within the Verification Studies, Design & Analysis is:

- Review of installation, trenching, dredging, construction support methodologies and procedures including providing confidence in the documentation.
- Review of methods and procedures for diverse activities such as crossings, permits, HDD entry and exit points.
- Installation Equipment Specification – including all reviews, reports and recommendations of procedures in order to provide overall confidence of selected equipment and approach.
- Liaising – recognised independent status, expertise and experience is instrumental in regard to successful liaising (interfacing) with:
 - Key stakeholders and authorities in regard to permitting and approvals.
 - Marine Warranty Surveyors throughout the complete installation phase.
- Permitting and Crossing Agreements – interfacing with all key stakeholders and authorities related to crossing design, permitting and agreements.

9.0 Peer Reviews & Subject Matter Expertise

Primo Marine offers extensive experience and expertise throughout the complete lifecycle of the project, from pre-installation to installation and from installation to operations and maintenance. Incorporated within the service offering are the following summary activities:

- Peer Reviews (including subject matter expertise) – the conducting of complete peer reviews, including establishing and management of project risk registers. Reviews designed to incorporate all practical lessons learned from an extensive track record, as well as offshore cable industry.
- The management of multiple subsea activities including provision sum operations.
- The provision of subject matter expertise including pro-active problem solving of event, challenges and issues (including the arranging and management of third parties).
- The interfacing with all significant parties to provide technical solutions.
- The advising with project documents and the management of.
- The providing of licence management and supporting of licences, agreements and approvals.
- The translation of technical issues into contractual and permit requirements.