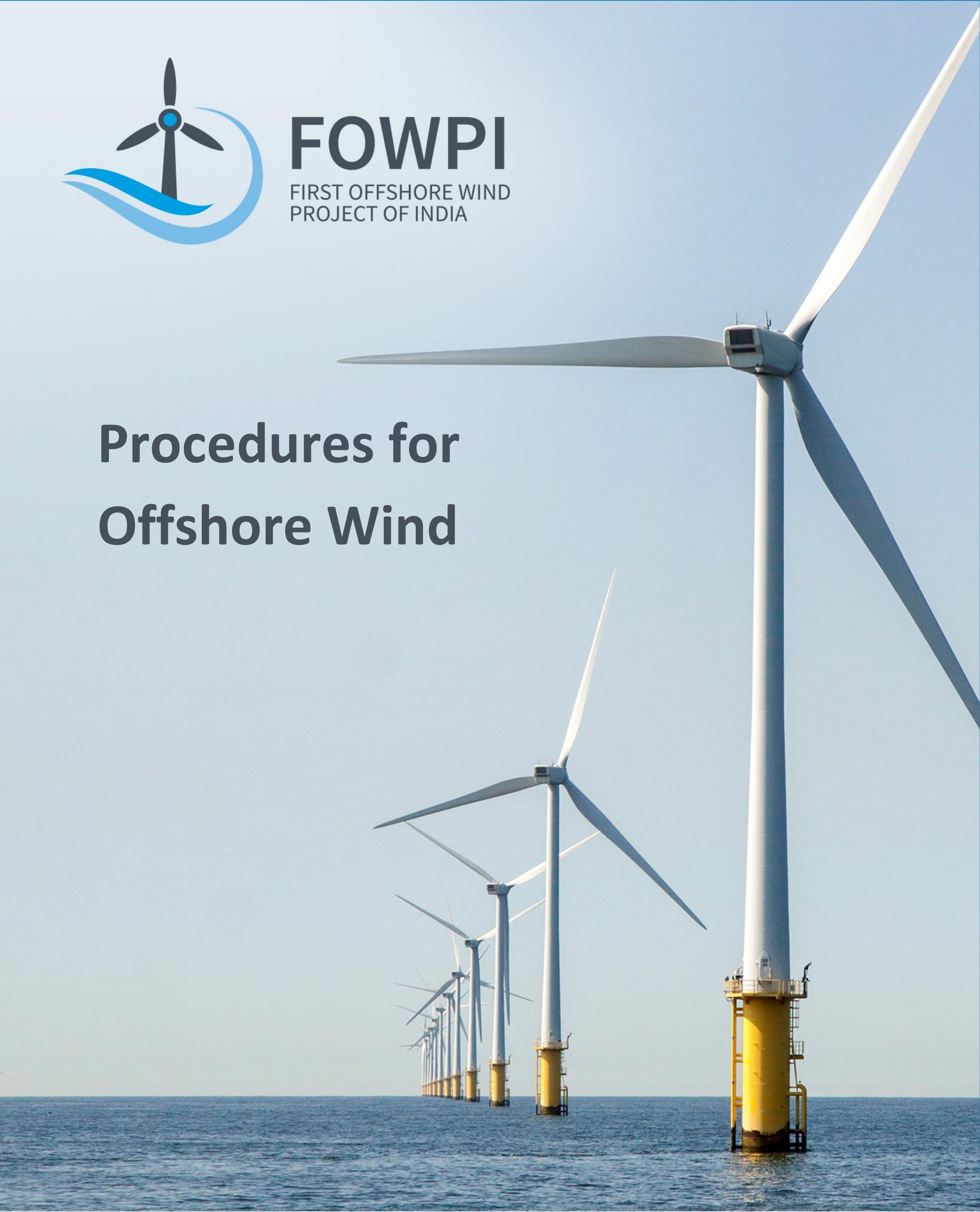
FOWPI

FIRST OFFSHORE WIND PROJECT OF INDIA

# Procedures for Offshore Wind



EUROPEAN UNION

This Project is funded by The European Union

# 1 About FOWPI

The First Offshore Wind Project of India (FOWPI) is part of the “Clean Energy Cooperation with India" (CECI) programme, funded by the European Union (EU). The programme aims at enhancing India's capacity to deploy low carbon energy production and improve energy efficiency, thereby contributing to the mitigation of global climate change. Project activities will support India's efforts to secure the energy supply security, within a well-established framework for strategic energy cooperation between the EU and India.

FOWPI is defined as a conceptual offshore wind farm near the coast of Gujarat, 25 km off Jafarabad. The project scope focus is on preliminary investigations and advisory for the wind farm including wind turbine foundation, electrical network, metocean modelling, wind resource, environmental scoping, financial modelling and others. FOWPI uses the outputs from Facilitating Offshore Wind in India (FOWIND) project (2013-2018) also supported by the European Union. FOWIND and FOWPI bring the vast experience of European countries in offshore wind, to support India with the creation of a national knowledge centre and with technical support for setting up the first offshore wind-farms in the country.

FOWPI is led by COWI A/S (Denmark) with support from COWI Pvt Ltd India and WindDForce Management Ltd. (India). The project is implemented in close collaboration with the European Union, the Ministry of New and Renewable Energy- India (MNRE) and National Institute of Wind Energy- India (NIWE).

Contract: No 2015/368469 Start 01-2016 Duration: 42 months

# 2 Disclaimer

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The 14th annual Summit between India and the European Union (EU) was held in New Delhi on 6 October 2017. Both sides adopted a Joint Statement on Clean Energy and Climate Change, reaffirmed their commitments under the 2015 Paris Agreement, and agreed to co-operate further to enhance its implementation. India and the EU noted that addressing climate change and promoting secure, affordable and sustainable supplies of energy are key shared priorities and welcomed the progress on the Clean Energy and Climate Partnership, adopted at the 2016 EU-India Summit, and reiterated their commitment to its implementation and further development. In particular the EU is committed to continue cooperation in view of the cost-effective development of offshore wind in India.

# 5 Acknowledgements

FOWPI is grateful for the support provided by European Union (EU), Ministry of New and Renewable Energy-India (MNRE), National Institute of Wind Energy- India (NIWE), and the Wind Industry.

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# Procedures for Offshore Wind

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# CONTENTS

# 1 Introduction

This document has been prepared with the purpose of providing advisory input on some of the underlining Procedures for implementing Offshore Wind Farms in India. The document consists of three independent Memo's, which cover 1) Permitting Procedures, 2) Certification Requirements and 3) H&S Guidelines. The three topics were shortlisted among a number of other relevant subjects, not included in this document, such as Quality Assurance and Control, Risk Assessment and Control, Permit Management and Contracting Strategy.

The first Memo addresses the Permitting Process, which is a central part of offshore wind project planning. A well-structured process can significantly speed up the project implementation process and reduce risks, ultimately contributing to lower costs of offshore wind energy. The Permitting Process Memo describes how four EU-countries, currently leading the offshore wind development, structure tender preparations. The Netherlands and Denmark, for instance, are shown to reach lower auction prices through higher public preparations and investments before the tender call.

The second Memo, on Certification Requirements, describes how European countries have based their permitting process in line with IEC61400-22. Thus, the Design Basis and Design Evaluation have to be certified by accredited bodies. Manufacturing, transport, installation and commissioning surveillance are quality controlled by internal and/or external bodies e.g. including the Marine Warranty Surveyor representing the insurance company.

By last, the Memo on Health and Safety guidelines is of great importance because human, environmental and material risks can be very high in the offshore environment. In Europe, Health and Safety standards to reduce this risk have been developed by the Marine Oil and Gas industry and adapted to offshore wind conditions. The Health and Safety Memo presents the guidance and numerous procedures used to manage the risk in European Offshore Wind. Links to procedures in UK, Germany, Denmark and the Netherlands are provided, which can form the basis for development of Health and Safety guidelines for Indian offshore wind.

# Permitting procedures for offshore wind - MEMO

**Confidential**

| | |
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| **Subject:** | Permitting procedures for offshore wind |
| Date: | 01 December 2017 |
| Version: | Final version |

| | |
|---|---|
| To: | Per Vølund |
| CC: | Gabriel Zeitouni |

| | | |
|---|---|---|
| From: | S. Tiedemann | |
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**Table of Contents**

## 1 Introduction

The global offshore industry is maturing and costs decrease. Auctions induce competition between market players, leading to breath-taking results: Successful project developers of the German auction in May 2017 will build offshore wind parks without receiving a subsidy by 2024/25. In December 2017, the Netherlands will invite project developers to submit bids that will not receive any public support but just the construction and production licences on commercial terms.

To benefit from decreasing cost and attract investment, countries that do not yet have experience with offshore wind development need to have reliable, well-structured, risk minimalizing permitting procedures in place. This is particularly true if a country opts for auctions as a mean to select private developers and to set the offtake price for the produced electricity.

In India, offshore wind is still at is infancy, both from a technological point of view and in terms of capacities of relevant stakeholders. This opens the unique opportunity to establish best practice procedures that are investor friendly and at the same time take political preferences into account. This memo therefore introduces the reader to lessons learnt from the European experiences with respect to permitting procedures.

The memo is structured as follows: First, the memo locates the permitting process in the general project planning. Second, it describes the permitting process in greater detail. Third, it outlines roles and responsibilities of three stakeholder groups, the government, the grid operator, and private developers. Fourth, the memo discusses the interaction between permitting and auction design.

## 2 Permitting as part of the project planning

Permitting often takes its origins in long-term national deployment **targets** for offshore wind. Policy makers translate these targets into short- to medium-term **roadmaps**. Such roadmaps increase certainty for investors and can thus trigger private project planning. To do so, they need to be reliable and in line with other policies such as electrification, decarbonisation, and local industry development. Furthermore, they should be accompanied by adequate financial incentives and a preferential regulatory framework. The more reliable and credible the roadmap, i.e. in form of a binding **national energy strategy**, the higher the likelihood of triggering interest and building a sustainable market.

From a private perspective, the project planning starts with **site development.** It is a costly and lengthy process (up to 10 years) and involves the steps of zone identification, site selection, site investigation, permitting, and construction (see figure 1). The following describes these steps in greater detail.

**Zone identification and site selection** aims to identify areas to be investigated in greater detail. To do so, enabling parameters as well as major restrictions need to be considered. Enabling parameters are the quality of the wind resource (determining the amount of production), the distance to shore and the accessibility due to weather conditions (determining the cost of construction, operation, and maintenance), the water depth (determining the construction cost). Restrictions exist with respect to usage conflicts e.g. with fishery, shipping routes, military zones, and environmental protection zones but also with respect to e.g. grid connection and ground conditions.

To come up with suitable sites, three approaches exist in Europe, an open-door, a zoning, and a site-specific approach[1]. Under an **open-door approach** the private developer chooses a specific site. Under a **zoning approach** the responsible authority designates a larger area for offshore wind development in which private developers are free to choose a site. Under a **site-specific approach** the government finds and designates a specific area.

The open-door and zoning approach leave more flexibility to the private developer yet they also bear the risk of project failure. Site-specific approaches reduce such risk for private investors but also require sufficient capabilities on the side of the responsible authority. The open-door approach becomes less and less common. A zoning approach is still prevalent in the UK and in countries with immature markets such as China. Germany, Denmark and the Netherlands moved to site-specific schemes[2]. They will be described in greater detail below.

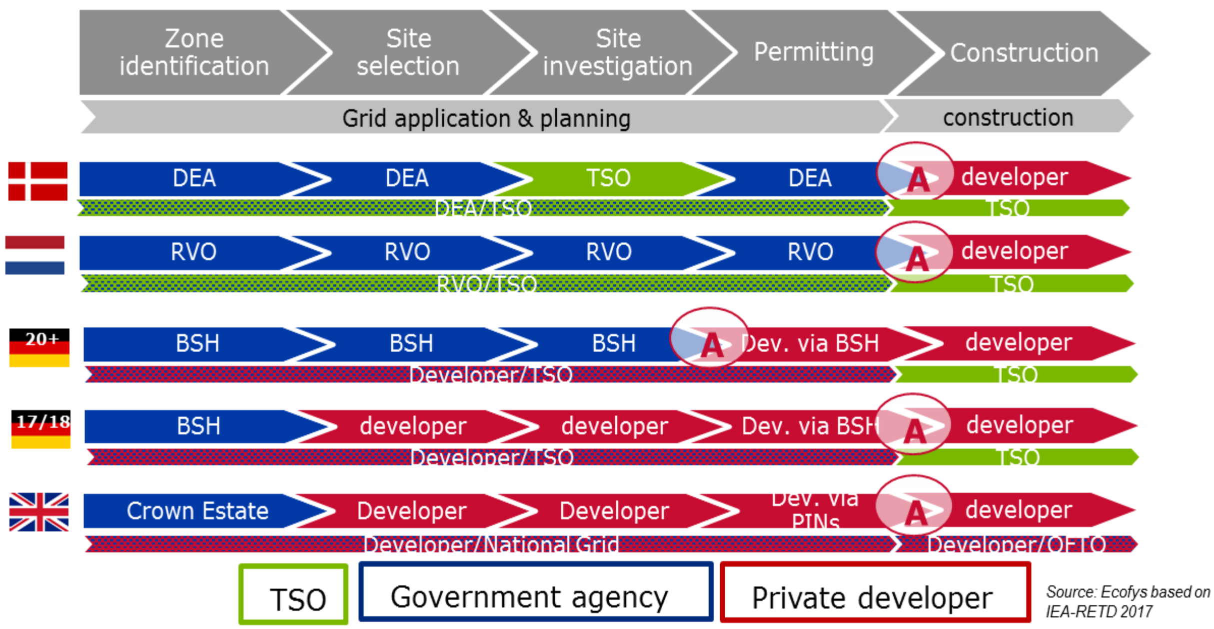


**Figure 1:** Permitting stages, responsibilities and timing of the auction; abbreviations: Danish Energy Agency (DEA), Transmission System Operator (TSO), Netherlands Enterprise Agency (RVO), Federal Maritime and Hydrographic Agency of Germany (BSH), Offshore Transmission Owner (OFTO), Planning Inspectorate (PINS)

During **site investigation**, the responsible party tries to gather as adequate information as possible. The better the information, the lower the risk and therefore the lower the capital cost. The information can also be used in the **permitting process** which only starts if a site is deemed technically and economically viable. Once the permitting process is finished, the developer can start the **construction** of the offshore

[1] IEA RETD TCP (2017), Comparative Analysis of International Offshore Wind Energy Development (REWind Offshore), IEA Renewable Energy Technology Deployment Technology Collaboration Programme (IEA RETD TCP), Utrecht, 2017, p. 22ff

[2] IEA RETD TCP (2017), Comparative Analysis of International Offshore Wind Energy Development (REWind Offshore), IEA Renewable Energy Technology Deployment Technology Collaboration Programme (IEA RETD TCP), Utrecht, 2017, p. 22ff

wind farm. During the investigation of the site conditions, **grid planning and development** starts simultaneously (see also **Figure 1**).

The following paragraphs outline the permitting process in greater detail.

## 3 Permitting process

The permitting procedure takes time, involves many actors, and is (therefore) costly. It starts with the formal opening of the procedure (i.e. by public announcement). The party seeking approval collects preliminary documents and sends the documents to the relevant authorities. It is good practice to display the documents for public consultation, conduct hearings in which potentially conflicting interests are identified, and decide on the required scope and level of depth of the main investigations, particularly of the environmental impact assessment.

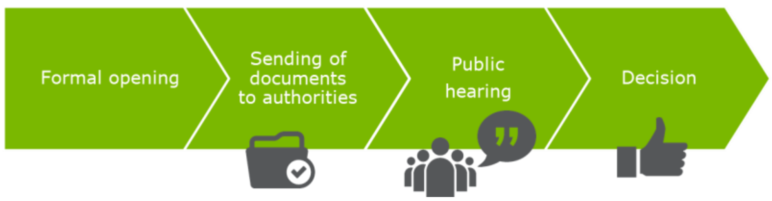


**Figure 2:** The offshore wind permitting process

The responsible party conducts those studies that are required to comply with the agreed scope. After receiving the results, an additional public hearing can be conducted to allow all involved parties including the public to raise concerns. Depending on the institutional set-up, a public authority may act as mediating partner between conflicting interests. Finally, the responsible authority issues the permit.

A permit indicates at least the design of the wind farm, specific requirements to which the project developer must comply to, a construction schedule, if necessary compensatory measures for nature conservation or compensatory payments to affected stakeholders, security measures, financial securities for decommissioning, and general standards to which the project developer must comply to. When the design changes after the permit has been awarded, the developer may be required to request approval from the responsible authority or – for major changes – may be required to repeat parts of the permitting process.

The permitting authority also follows up on the permit implementation. The authority clears the project before the construction starts. At the clearing, the authority checks if the project developer complies with the permit’s requirements. During construction, the project developer may be required to submit construction protocols on a regular basis to prove compliance with standards and requirements of the permit.

In recent years, several countries e.g. Denmark are establishing **one-stop-shops,** i.e. a single point of contact between private developers and public authorities. The one-stop-shop can either only be the central gathering point for all relevant information or be the authority actively supporting or even conducting the permitting. A one-stop-shop helps to speed up the planning process. It thereby reduces cost and overcomes problems of unclear or overlaying responsibilities between public authorities.

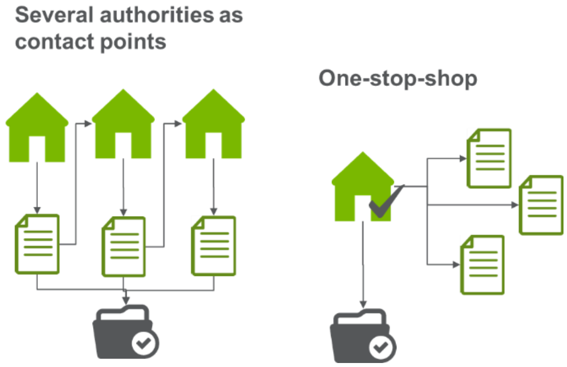


**Figure 3** A one-stop-shop for permitting procedures helps to speed up the planning process and reduce costs.

As for the permit itself, the European Union[3] outlines a framework that indicates the permit's elements yet the detailed procedural steps and standards differ between countries, increasing transaction costs and reducing synergies. In general, countries define standards on soil investigations, the construction and commissioning of turbines, eligible materials and best-practices against corrosion (including environmental standards for the use of paints), standards for safety during construction and operation, requirements for labelling, lights, radar and automatic identification systems, compatibility with shipping, noise minimisation during construction and operation.

## 4 Roles and responsibilities of stakeholders

Policy makers and governmental agencies, grid operators, and the private developers are the three principle stakeholder groups in project development. European member states divided responsibilities between the three main stakeholder groups differently. Three major approaches exist, a so-called central, decentral, and hybrid approach[4].

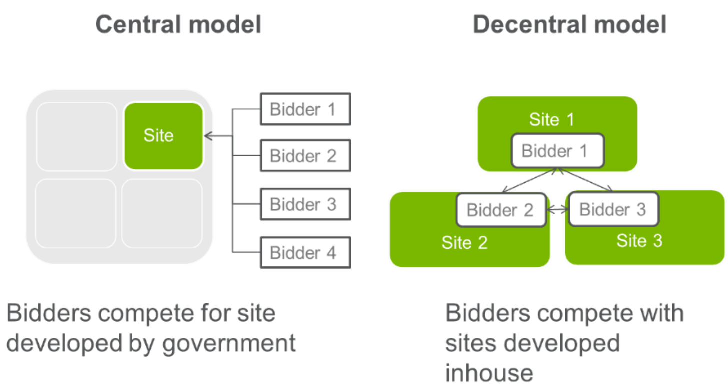


**Figure 4** Different approaches to offshore wind permitting

[3] Strategic Environmental Assessment directive 2001/42/EC, the Environmental Impact Assessment directive 2011/92/EU, Habitats Directive 92/43/EEC, Birds Directive 2009/147/EC, Marine Strategy Framework

[4] IEA RETD TCP (2017), Comparative Analysis of International Offshore Wind Energy Development (REWind Offshore), IEA Renewable Energy Technology Deployment Technology Collaboration Programme (IEA RETD TCP), Utrecht, 2017.

### 4.1 Central model

In the **central model,** the government or a governmental agency is responsible for the first stages of project planning. The government identifies suitable areas for offshore development, selects sites, and conducts preliminary site-investigations. The central authority is in control and can coordinate the initial stages, including finding solutions for conflicting interests. Cost for private offshore development can decrease as the government bears the finical risk from projects failing at an early stage. At the same time, the government needs to have or need to contract the required technical expertise. Furthermore, there is no competition for cost reduction and most promising concepts at the early stages.

In 2013, the Netherlands opted for a central development which is applied since the Borselle auction in July 2016. The government selects sites and obtains the required permits. The grid operator is responsible for grid planning and development. The private developer can acquire the permits and development rights in a competitive auction and is only responsible for the detailed technical planning and project development once all permits and the grid connection is secured.

### 4.2 Decentral model

In the **decentral model**, the private project developer takes responsibility for most of the planning stages including site selection, investigation, permitting, and – depending on the regulatory framework – sometimes even the grid development. The government is only involved as a counterparty to the private developer, i.e. to negotiate terms for the usage of public land (often the case in maritime environments) or in the permitting process. Private developers can exercise their full technical know-how and experience and thereby benefit from competitive advantages. At the same time, they must bear the risk of failing projects which can increase cost.

The UK have opted for a decentral model. The private developer is responsible for selecting and investigating sites and push the permitting process forward. The UK is also a special case as project developers play an important role in grid development. Until 2009, the offshore grid connections were constructed and owned by offshore project developers and then sold to wind farm operators after construction. Because of unbundling requirements, since 2009, offshore transmission assets are auctioned-off in tendering process and transferred to a third party (so-called Offshore Transmission owners (OFTO)). In the current setting, offshore project developers can decide whether they build the offshore grid connection by themselves or if a OFTO takes over construction. OFTOs receive a transmission tariff that is charged per megawatt hour from the wind farm operators to regain the costs of investment. Hence, in the UK model, the private developer needs to price in the cost for the grid connection. The organisational setting applied in the UK is cost effective on a case-by-case basis but does not support coordination between different projects. Larger offshore wind projects located at increasing distances from shore, may require better coordination in the development of transmission infrastructure. The British regulator Ofgem is working on measures to improve coordination between OFTOs while preserving the competitive character of the offshore transmission regime[5].

### 4.3 Hybrid model

A **hybrid model** combines the central and decentral model. The government is responsible for some of the early development phases and the grid operator often plans and constructs the grid. The private developer takes over the costly parts of the project planning stages requiring significant technical know-how. The developer also needs to conduct or contract the required detailed investigation during the permitting process. Germany and France apply hybrid schemes. Germany will move to a central model in the early 2020th. Compared to the Danish and Dutch model, developers in Germany will remain responsible for a greater part of the permitting process after being successful in the auction.

## 5 Interaction between permitting procedures and auctions

As mentioned above, auctions are a mean to select the private parties that are eligible for financial support by the government, or receive a construction and production licence as well as a price for the produced electricity in form of a power purchase agreement (PPA). Auctions and the permitting process interact in two major ways: first with respect to the “timing of the auction”, i.e. at which time during the project planning the auction takes place, and second with respect to the commissioning after the auction.

The **timing of auction** (see (A) in Figure 1) influences the risk allocation between private developer and the public: Before the auction, the project developer invests without knowing if he will be awarded or not. Furthermore, the conditions of the PPA or the level of support are unknown. An auction should therefore take place as early as possible to provide the necessary level of security to justify conducting more costly parts of the site investigation and technical planning.

At the same time, bidders will not be able to submit reasonable bids before conducting investigations in the quality of the site. Particularly, they will not be willing to submit bids if they are not sure if they can secure a permit after winning the auction. Practical experience and theoretical models show that it is in the interest of the private developer to conduct at least the most relevant studies with respect to the economics of the project before the auction. Also, they need to be sure that they can secure a permit.

Furthermore, the earlier the auction, the longer the commissioning period after the auction. If the commissioning period is long, financial close takes place far into the future (>5 years). Hence, private developers face important uncertainty about the development of capital and turbine cost as well as on the development of revenue streams (e.g. the electricity price). This increases the speculative elements of a bid and thereby the risk of a winner’s curse. The winner’s curse is defined as the risk of being awarded, i.e. being the winner, at a price at which it is not possible to realise the project without making

[5] Schittekatte, T. (2016). UK vs DE: two different songs for transporting energy to shore, published at Florence School of Regulation; Pwc (2017). Unlocking Europe’s offshore wind potential

losses. All factors taken together, almost all countries opted for auctions that happen only after significant parts of the permitting procedure took place (see Figure 1).

After the project is awarded in an auction, the project needs to be commissioned in a timely manner. If the permit is not required before the auction, the project often takes longer for being commissioned. Furthermore, the permit or the PPA as such may outline milestones which the successful bidder needs to comply with.

## 6 Conclusion

The permitting process is a central part of the project planning. If well-structured and reliable, it can significantly speed up the process, reduce risk, and thereby attract private investment at lower cost for the public.

While the required steps are similar, countries opted for different allocation of responsibilities between private developers, the government, and grid operators. Countries with less mature markets often leave technical planning and site investigations to private developers whereas the government provides a clear and reliable framework. Governments can play a central role in de-risking the process by taking over central parts of the planning process. This comes with the caveat of reducing competition for price and innovative solutions yet it can significantly reduce cost as seen in Europe. The introduction of a one-stop-shop as a central focus point for information or for the permitting process can significantly ease the permitting process.

Auctions are increasingly common to select which private developer is eligible for construction and production and under which conditions. They increase the risk of not being awarded and may create a barrier to undertake costly parts of the project planning. Auctions have two major interactions with the permitting process, regarding the timing of the auction and regarding the commissioning after being awarded. As for the timing, all countries opted to have the auction only after significant parts of the permitting are conducted. As for the commissioning, the permitting process may define milestones and deadlines for realisation after the auction.

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# APPENDIX I

# CONTENTS



## 1 Introduction

The National Institute of Wind Energy (NIWE), India's nodal agency for both on- and off-shore wind energy in the county, has in April 2018 floated an Expression of Interest[1] (EoI) for the development of the first 1 GW of offshore wind energy in the country. Under this context, and in view of recent developments, this appendix addresses the state of play in India Offshore Wind within three areas. These are:

- Zone identification and site selection
- Permitting
- Stakeholder roles & responsibilities

[1] Available at: https://mnre.gov.in/sites/default/files/tenders/EOI_for_Development_of_1000_MW_Offshore_Wind_Farm_in_Gujarat.pdf


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# 2 Developments in the Indian context

## 2.1 Zone identification and site selection

The EoI for the first 1 GW of offshore wind energy proposes a project area of 400 km² within Zone B off Gulf of Khambhat. Zone B is one of the development areas identified by FOWIND project and the proposed 400 km² project area, illustrated in Figure 1, includes and surrounds the area targeted by FOWPI studies.


*Figure 1 - Proposed 400 km² project area (brown), within Zone B (green).*

Following the EoI, two corrigendum were published addressing aspects such as eligibility criteria and possible areas of offshore wind project development. As per specification Corrigendum 2[2], the project site shall no longer be restricted to the proposed 400 km² project area and developers may select any location for project development, subject to clearance from relevant Ministries and Departments, within the exclusive economic zone (EEZ) of India.

Such development illustrates that India has simultaneously embraced all three approaches recurrent in Europe for offshore wind site selection: the open-door, the zoning, and the site-specific approach. Whereas multiple development areas have been identified (zoning approach), NIWE proposes in the EoI a specific area within Zone B (site-specific approach) but leaves the private developer free to seek for alternative locations (open-door approach).

## 2.2 Permitting

With regards to clearances and permitting, as per National Offshore Wind Energy Policy, the offshore wind projects will require "non-objection" from concerned Ministries/Departments. This has been further detailed in the EoI document extract illustrated in Figure 2. NIWE will support the clearance and permitting process by acting as a one-stop-shop. Thus centralizing and facilitating the

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[2] Available at: https://mnre.gov.in/sites/default/files/tenders/EOI%20Corrigendum%204.pdf

permitting clearance process with pertinent authorities. For the proposed 400 km² project area, within Zone B, NIWE has already initiated the request for clearances and permits.

Annexure-9

List of Clearances & NOC's required as per the policy

| S. No. | Ministry/Department | Stage-I Clearances | Stage-II Clearances (or NOCs) |
|---|---|---|---|
| 1. | Ministry of Environment & Forests | In-principle Clearance | EIA and CRZ clearance |
| 2. | Ministry of Defence | In-principle Clearance | Clearance related to defence & security aspects, related to Army, Navy, Air force, DRDO and other such institutions under MoD. |
| 3. | Ministry of External Affairs | In-principle Clearance | Clearance for development of offshore wind energy projects within the maritime zones of India. |
| 4. | Ministry of Home Affairs | In-principle Clearance | Clearance regarding deployment of foreign nationals in offshore wind energy blocks. |
| 5. | Ministry of Civil Aviation | No clearance needed at this stage. | Clearance for construction near aviation radars/aerodromes. No clearance/NOC required for all other locations. |
| 6. | Ministry of Petroleum & Natural Gas | No clearance needed at this stage. | Clearance for offshore wind power installations proposed in Oil & Gas Blocks. No Objection Certificate for construction outside the offshore Oil & Gas Blocks. |
| 7. | Ministry of Shipping | No clearance needed at this stage. | Clearance for projects near Major Ports. No Objection Certificate to operate away from shipping lanes. |
| 8. | Department of Space | In-principle Clearance | Clearance from security angle with regard to Dept. of Space installations and for minimum safety distance to be maintained from the Dept. of Space installations. |
| 9. | Department of Telecommunication | No clearance needed at this stage. | No Objection Certificate to operate outside subsea communication cable zones. |
| 10. | Ministry of Mines | No clearance needed at this stage. | No Objection Certificate to operate outside mining zones. |

*Figure 2 List of clearances and respective Ministries/Departments involved.*

## 2.3 Stakeholder role and responsibilities

NIWE is planning a number of activities within development zones in both Gujarat and Tamil Nadu. Such activities include geophysical surveys, offshore Lidar measurements and geotechnical investigations.

Figure 3 illustrates an extract of the ongoing procurement note[3] for the geotechnical investigation within Zones A and B off the coast of Gujarat. The geotechnical scope includes five boreholes and Cone Penetration Tests (CPT): three within the proposed 400 km² project area in Zone B, one outside the 400 km² project area but still within Zone B, and one in Zone A. The latter two

[3] "Offshore Geotechnical Investigation at Gulf of Khambhat, off the Coast Gujrat". Published by NIWE and available at: http://niwe.res.in/assets/Docu/tender/E-Tender_for_geotechnical_%20investigation-gulf_of_khambhat.pdf

locations, outside the proposed project area, will coincide with the upcoming Lidar locations suggested in Figure 3.

Based on consultations with NIWE, it is known that a number of additional activities are also planned for the upcoming months, these include:

- Geophysical investigations within the proposed 400 km$^2$ project area in Zone B, so to complement FOWPI geophysical survey.
- Installation of three buoys within development Zone B for metocean data collection.
- Deployment of Two Lidars in Tamil Nadu, upon obtainment of clearances by NIWE, metocean buoys, geophysical survey (covering approximately 500 km$^2$) and boreholes. All within Tuticorim area, officially known as Thoothukudi.

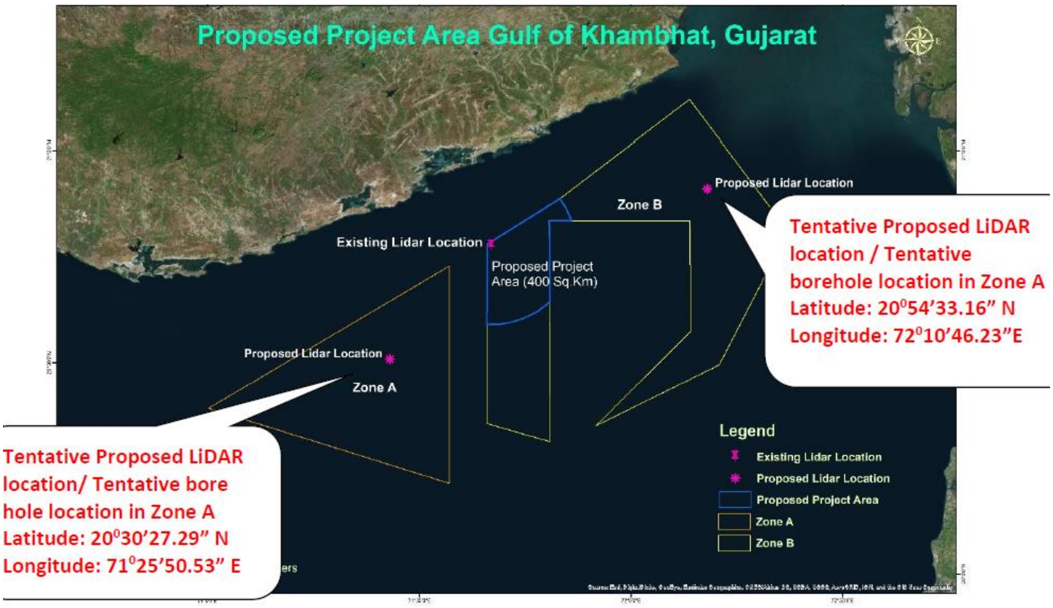


Figure 2: Map showing proposed LiDAR location for Geo-Technical Investigation

*Figure 3 - Proposed project area (blue) and proposed Lidar locations (pink) for meteorological measurements and geotechnical investigations.*

It is thus observed that the Indian offshore sector is developing towards central, hybrid and decentral models – depending of the prospected offshore wind project area in question. In the proposed project area, i.e. 400 km$^2$ within Zone B Gujarat, besides having initiated the permitting NIWE is also conducting a number of site-investigations including a geophysical survey, three boreholes and metocean measurements. Therefore a model towards the centralized applies in this area. If offshore wind developers identify and opt for alternative offshore wind project areas, a hybrid or decentral model would apply where the developer takes responsibility for most of the investigations including measurement campaigns and surveys.

With regards to the grid development and connection, it is understood that another key stakeholder Gujarat Energy Transmission Corporation (GETCO) is preparing to accommodate the offshore wind capacity expected to be tendered in off Gulf of Khambhat. FOWPI Electrical Concept Design Report[4], for instance, presents results from a GETCO Power System Analysis study and cites the preparations for a 400/220kV onshore substation close to the expected landing point of a an offshore wind farm within the proposed 400 km² project area. As per specification in the EoI, the offshore wind developer is expected to develop the infrastructure required until the onshore pooling station.

# 3 Conclusions and Recommendations

India has been making considerable progress and taking crucial steps for the deployment of offshore wind energy in its waters. Depending of the project area, offshore wind deployment may follow elements of central or decentral models, site-specific or open-door approaches, which indicates government support in de-risking and de-costing projects in specific areas while enabling project developers to pursue alternative project locations if found more optimal.

NIWE is playing a crucial role acting as a one-stop-shop for offshore wind permitting and by pursuing the first permits is certainly contributing to bringing confidence to developers and to the establishment of a permitting framework for offshore wind energy projects in India within the various relevant Ministries/Departments. In order to increase the level of transparency it is suggested that NIWE publishes already obtained permits for the proposed/expected project areas (e.g. 400 km² area in in Gujarat) and that inputs requirements from project developers are specified.

NIWE is also having an active role carrying out a number of surveys and investigations in specific sites. All of which can only contribute for the tender preparations and costing of the first projects. It can only be recommended that such investigations are continued and expanded, in order to support India's ambitious offshore wind targets of 5 GW by 2022 and 30 GW by 2030.

The offshore electrical infrastructure is foreseen to be the responsibility of project developers and this is seen as an appropriate approach for the first projects since it minimizes interface and coordination risk due to two separate entities developing essential project elements e.g. offshore wind farm and offshore substation. In order to reduce energy tariff levels for the offshore wind project the auctioning may foresee a specific and separate budget/ fee allocated to the development of potential offshore substations.

[4] Available at: http://www.fowpi.in/uploads/download_document/fowpi_electrical_concept_design_v1_36979241204.pdf

# Project certification requirements for offshore wind - MEMO

**Confidential**

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| CC: | Gabriel Zeitouni | |
| | | |
| From: | B. Prinsen | |
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## 1 Introduction

A project certification process for Renewable Energy (RE) technology is a good way to provide evidence to stakeholders (financiers, partners, utility companies, insurance companies etc.) that a set of requirements laid down in standards are met during design and construction, and maintained during operation of a RE generation plant.

Project certification becomes increasingly important when the environmental circumstances are challenging. Like offshore on the European North Sea with high wind and waves as in the Indian Gulf of Khambhat, where India's first offshore wind farm is planned, with similar metocean conditions and the additional extreme temperatures and air (e.g. dust) conditions. As in Europe, India will have to incorporate offshore wind project certification requirements into the legal framework to ensure that strict norms and standards are uphold, through independent evaluation, of the wind farm design. This memo therefore introduces the reader to lessons learnt from the European experiences with respect to project certification requirements and process.

The memo is structured as follows: First, the memo highlights the project certification requirements in the Dutch legal framework (like the Danish framework) as a case study. Second, it describes various independent accredited certification bodies and how to best interact with them. Third, it outlines the offshore wind farm design basis, certification statements and applicable norms. Lastly, this memo provides a description of the project certification process and it finishes with a conclusion and recommendation.

## 2 Legal Framework - the Dutch case

Each country will have its own specific legal framework, which may include project certification requirements. This section highlights the elements from the legal framework in the Netherlands that contain requirements for project certification.

All project certification requirements are contained in the Dutch Water Decree. Appendix I contains a broader overview of the legal framework for offshore wind farm developments in the Netherlands. For further reading on the legal framework we refer to chapter five of the Project and Site Description. Appendix II contains relevant explanatory notes to 6.16d and 6.16g of the Water Decree.

### 2.1 Requirement prior to construction (Article 6.16d)

The operator announces its intention to set up or change a wind farm at least eight weeks before the start of the construction period to the Minister and provide the following information:… a statement by an independent expert that the design of wind turbines and other wind farm components meet the requirements in article 6.16g §1 of the Water Decree.

### 2.2 Requirement prior to commissioning (Article 6.16g)

1. Wind farm components are strong enough to withstand the anticipated forces from wind, wave, current and operations.
2. The operator shall provide the Minister with a statement that the design and construction of wind turbines and other wind farm components satisfy the requirements from §1, at least four weeks prior to commissioning of the wind farm.
3. Such a statement has to be provided by an independent expert who will test the design against a set of standards which are in line with best industry practice.
4. Rules may be set by ministerial regulation on the content of such a statement.

## 3 Accredited Certification Bodies

The certification body for the certification of offshore projects shall be accredited[6] in accordance with ISO/IEC 17065 “Conformity assessment – Requirements for bodies certifying products, processes and

6 The Dutch Accreditation Council (https://www.rva.nl/en) has been evaluated and authorized by the European Accreditation organisation (EA) as the national accreditation body in the Netherlands.

services". A certification body can be accredited for specific services according to the applicable standards. For offshore wind projects, the certification body shall be accredited according to IEC 61400-22, "Wind turbines – conformity testing and certification". This IEC 61400-22 standard refers to several other standards including IEC 61400-3 "Wind turbine - Design requirements for offshore wind turbines". 61400-3 is named in 61400-22 to exist both as IEC and as EN document, where IEC is the international standard and EN the European standard.

The list of known accredited companies accredited in accordance with ISO/IEC 17065 for services in accordance with IEC 61400-22 is as follows:

- DNV-GL
- SGS
- TÜV SÛD
- ABS Consulting
- Bureau Veritas

DNV-GL has developed as Service Specification "DNVGL-SE-0073", defining how Project certification of wind farms are conducted according to IEC 61400-22. The other companies normally define the certification process in their offers and tailored to the requirements from the project developer.

### 3.1 Suggestions on how to interact with your certification body

The certification body is an independent company that needs to be objective and cannot be influenced by incentives or penalties. However, there are certain points of attention that could certainly optimise the cooperation between developer, certifier and contractor:

1. Involve the certifier in an early stage (i.e. at initial design stages);
2. Ensure that the (contractor's) design firm is experienced in offshore wind; and
3. Provide certifier design briefs for review and commenting, to avoid lengthy discussions during detailed design.

## 4 Design Basis

The design basis for the WTG and its foundation is typically structured as follows:

- Design Basis – Part A: General requirements
  - In this section, the site conditions are documented.
- Design Basis – Part B: Wind turbine specific requirements
  - In this section, the specifications related to foundation design are documented.
- Design Basis – Part C: Structure specific requirements based on part A and part B
  - In this section, the structural requirements are documented.

The certifying body defines the content which is required for each of the design bases, and it is the task of the developer (part A), WTG supplier (part B) and designer (part C) to produce the content. The certification body shall review and give final approval when accepted. There are no known restrictions to who can define and issue the 3 parts of the design basis. In practise, it might be quite difficult for other companies than the wind turbine manufacturer to define Design Basis Part B. It could also create some difficulties with the certification body if Design Basis Part C is not defined and issued by a company which is highly involved in the detailed design of the foundations.

## 5 Certificates and Conformity Statements

The project developer and certification body agree on a list of documents which the certification body reviews and comments on, which is formalised in a certificate or conformity statement issued by the certification body.

## 6 Applicable Norm

International Standard IEC 61400-22, which has been prepared by IEC technical committee 88: Wind turbines. It defines rules and procedures for a certification system for wind turbines (WT) that comprises both type certification[7] and certification of wind turbine projects installed on land or off-shore. This system specifies rules for procedures and management for carrying out conformity evaluation of wind turbines and wind farms, with respect to specific standards and other technical requirements, relating to safety, reliability, performance, testing and interaction with electrical power networks. Full access can be purchased in the online IEC store.

## 7 Project Certification Process

Project certification includes the following steps:

1. Design basis
2. Design evaluation
3. Manufacturing surveillance
4. Transport and Installation surveillance
5. Commissioning surveillance
6. Final evaluation

The first two project certification steps are always conducted by one of the accredited certification bodies.

For step 3 most projects use either internal or external resources for welding and coating inspection during manufacturing as an alternative to a certification body. In case the certification body is asked to conduct manufacturing surveillance they mainly focus on certificates, and documentation and only by short visits for spot checks. To ensure quality at all steps of the manufacturing the project owners normally have full time inspectors at most factories to capture and report on any problems.

For step 4 and 5 the project owner will normally contract a Marine Warranty Surveyor representing the insurance company.

[7] On national level type certifications are not always a strict requirement from the legal framework. However, as part of best practice, DNVGL-SE-0073 (page 27) states the requirement of a type certificate of the WTG during project certification.

## 8 Conclusion and Recommendation

Based on our knowledge of the Dutch best practice and the interpretation of the legal requirements from the Dutch Water Decree, we conclude that at a minimum the i) Design basis and ii) the Design will have to be certified by an accredited body. However, it remains possible that the manufacturing surveillance (certification step 3) would also have to be evaluated by an accredited body, depending on the local legal framework and interpretation by the competent authority. Therefore, it will always be important to establish a good working relationship and alignment on process, milestones and compliancy requirements between developer and competent authority.

To our knowledge offshore wind projects have so far only been evaluated by an accredited body up to and including the third certification step. The first two steps have been a prerequisite to receive subsidy and a building permit, whereas the third certification step was solely executed to satisfy lenders' and insurers' requirements.

**Appendix A: The Dutch legal framework in more detail**

| Laws and Regulations | Main authorities |
|---|---|
| The Offshore Wind Energy Act | Ministry of Economic Affairs (EA) |
| National Water Plan & Water Decree | Ministry of Infrastructure and Environment (I&E) in accordance with the Ministry of EA |
| Wind Farm Site Decision | Ministry of EA in accordance with the Ministry of I&E |
| Ministerial Order for Offshore Wind Energy 2015 | Ministry of EA in accordance with the Ministry of Finance |

**The Offshore Wind Energy Act (Wet Windenergie op Zee)**
The Offshore Wind Energy Act was established in order to provide a solid legal framework for the development of offshore wind energy and is structure as follows:

- The National Water Plan (Nationaal Waterplan) designates areas for offshore wind energy, the Water Decree regulates certain aspects from the national water plan;
- Wind Farm Site Decisions (Kavelbesluiten) designate where the wind farms will be built and under what conditions they can be constructed and operated; and
- The Ministerial Order for Offshore Wind Energy 2015 sets out the SDE+ tender scheme to provide subsidy and a permit to develop an offshore wind farm.

*Nb. The Offshore Wind Energy Act is currently under review to facilitate the changes in future offshore wind tenders.*

**Water Decree**
The Water Decree Art. 6.5 states that no Water Permit is needed for an offshore wind farm where the Offshore Wind Energy Act applies. Instead, the Water Decree has a special section for the operation of wind farms including environmental and safety provisions (art. 6.16a-6.16l Water Decree). Furthermore, Article 6.16g prescribes the details of the project certification requirements.

**Wind Farm Site Decision (Kavelbesluit)**
The Offshore Wind Energy Act creates the possibility to include exemptions for different environmental laws (Nature Conservation Act and Flora and Fauna Act) in the Wind Farm Site Decision. This means that traditional environmental permits are no longer required, as long as the developer proves that it complies with the Wind Farm Site Decision. The Decisions are very similar and contain among others:

- Location of the wind farms and the offshore grid connection platforms;
- Conditions for the operation of the wind farm; and
- Exemption for the Nature Conservation Act and Flora and Fauna Act.

**Ministerial Order for Offshore Wind Energy 2015 (Regeling windenergie op zee 2015)**
The SDE+ subsidy tender is mainly regulated by the Ministerial Order for Offshore Wind Energy 2015, which establishes the conditions for handing a subsidy application. Within the subsidy procedure, additional documents containing information about the project site, can be found on a dedicated website provided by the Dutch Enterprise Agency: http://offshorewind.rvo.nl/

*Nb. The tender for Sites I and II of the Hollandse Kust (Zuid) Wind Farm Zone is scheduled to open in Q4 2017, initially with a procedure without subsidies.*

## Appendix B: Explanatory notes to 6.16d and 6.16g of the Dutch Water Decree

**Article 6.16d**
Pursuant to the first section, paragraph c, the operator will provide a declaration of an independent expert on the design of the wind turbines. This concerns for example a certificate for the design of the wind turbine and transformer station, including mast construction and foundation. The certificate must show that the design of the turbines and the substation meets the requirements laid down in Article 6.16g , first paragraph, on the technical integrity of the wind turbines and other installations.
…

**Article 6.16g**
A wind turbine must be designed and constructed in such a way that the anticipated forces and tensions during operation are incorporated in the construction design without any objections, in accordance with the locally occurring forces of nature elements.

The technical integrity of the wind farm must be assessed by an independent expert. The operator shall submit a declaration from the expert to the Minister. The statement of the expert will be based on research during the design phase. In the design, the safety-critical elements are determined as the length of the piles as well as the thickness and the quality of the steel used, the location-specific detailed design of the turbine towers. The declaration of the independent expert indicates whether the wind turbines and other installations are built to the previously determined design criteria. The independent expert will base his assessment on prevailing international standards, such as EN 61400-3, and other, normally internally set, quality criteria.

It should be noted that the declaration of the independent expert for the Minister is not binding. The Minister will assess the submitted documents; while the conclusion of the Minister may differ from the opinion of the expert. This can happen on substantive grounds but also in case there are doubts of the actual level of independence and expertise of the person who issued the statement. The operator is responsible to make its own judgement on the independence of the expert. It goes without saying that the expert in question should not be in a dependent relationship with respect to the operator, in order to avoid any doubt on bias or favouritism.

In addition, the independent expert should be able to demonstrate that he has a set of proven industry practice standards, which are incorporated in its quality system. The independent expert will be an international classification body. Several classification bodies have already drawn up their own quality criteria for assessing the technical integrity of wind turbines.

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# APPENDIX II

## CONTENTS



## 1 Purpose of project certification

As a global manufacturing hub with a huge population and decades of solid economic growth [1], India has a tremendous need for civil infrastructure, including power. However, India has experienced some high-profile failures [2, 3] in the past that have led to the loss of life and property. As India seeks to develop its offshore wind infrastructure, it is important to consider how to protect this investment and insure the stability of this new industry and the reliability of the provided power to the Indian people. As the design and construction of offshore wind farms are complex and interdisciplinary, project certification aims to help de-risk the process by ensure compliance with approved codes, standards and procedures at all phases of the project.

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Building of offshore wind farms is complex due to a number of factors, such challenging marine conditions, but engineers may design a structure that is safe and reliable, only to have components manufactured out of tolerance and with improper materials. If a design is not followed in manufacturing, or manufactured components are installed in deviance from specifications, structures can fail prematurely, which can have a devastating effect.

Project certification for offshore wind farms is a process defined in IEC 61400-22 whose aim is to ensure that offshore wind farms are designed and constructed in a manner that is appropriate for the site environmental conditions. The certification process is integrated into the project development, with a third party (certification body) verifying that the design, manufacture, and installation conform to specific criteria, that appropriate methodologies are used, and that rigorous documentation is produced. The certification body must be independent in order to be effective, and should not be otherwise involved in the design or execution of the project. This independence helps project certification de-risk the project by ensuring compliance with the IEC 61400-22 standard. The certification body conducts document review, independent calculations, auditing, and inspection surveillance at various phases of the project in support of this goal.

## 2 Project certification phases

While multiple schemes exist for Project Certification of offshore wind farms, international practice follows the IEC 61440-22 standard for conformity testing. This standard covers wind turbine type-certification as well as project certification. Generally, project certification assumes that a project is employing a wind turbine that has been fully reviewed and approved and carries an approved type certificate. For full details on each phase, reference is made to IEC 61400-22.

### 2.1 Site conditions evaluation

The site conditions evaluation phase examines a number of properties at the site with a strong focus on determining whether analysis of wind and marine conditions conforms to the requirements outlined in the IEC 61400-3 and IEC 61400-1 standards. The certification body should be expected to review any reports that detail metocean conditions, measurement campaigns or hindcasting, geotechnical investigations for conformity and to ensure that suitable information exists within them to calculate applicable site-specific parameters necessary for design.

In India, special attention should be paid to documenting earthquake conditions and ground accelerations necessary to evaluate their effect on structural response of the wind turbines and foundations. IEC guidance on this subject is well developed. In addition, the certification body must carefully evaluate the reports and calculations to estimate cyclone conditions for Indian sites. Currently, IEC standards do not address the assessment or modelling of cyclone/typhoon conditions for offshore windfarm design, so draft guidance or other suitable standards must be identified and accepted by the certification body.

This phase should conclude with a statement of conformity indicating that the documentation reviewed by the certification body is compliant with the IEC 61400-22 standard.

## 2.2 Design basis evaluation

The design basis evaluation is a critical part of project certification as a quality design basis sets the path forward for design execution. and focuses on determining whether documentation exists in sufficient quantity and quality for a safe design and execution of the project. In this phase, the focus is on how the results from the site assessment will be applied to the design, as well as establishing the principles, philosophies, codes and standards and owners requirements that will be followed in the detailed design of the RNA (Rotor Nacelle Assembly), tower and foundation. A major focus is on laying out a detailed process for computation of design loads that the structure will experience, given the site-specific conditions.

This phase should conclude with a statement of conformity indicating that the documentation and reports reviewed by the certification body is compliant with the IEC 61400-22 standard. The SoC must identify the documentation reviewed.

## 2.3 Design Evaluation

The design evaluation has many different elements, but the aim of each is to assess whether the design principles, requirements, codes, and standards outlined in the design basis are adhered to. Evaluating the documentation at each step of the design for conformity with the design basis is the major point of each phase. This helps ensure transparency in the design process as well as a safe design of the project for a particular site done in accordance with approved engineering standards.

- Integrated load analysis

  The certification body evaluates the methods used to calculate the loads and responses on the integrated wind turbine structure (RNA, tower, foundation, soil). Focus is placed on how the driving load cases are determined for the site, which partial safety factors are applied, and identifying any difference in load level ratings from the wind turbine type certificate.

  This phase concludes with a statement of conformity indicating that the documentation reviewed by the certification body is compliant with the IEC 61400-22 standard and the design basis.

- Site-specific wind turbine/RNA design evaluation

  Special emphasis is placed on assessing whether the site-specific conditions (including structural loads) are within the limitations or conditions specified on the wind turbine type certificate. The certification body is required to evaluate the structural, mechanical and electrical component suitability and the corrosion protection system with respect to the site conditions in the design basis. If any components of the RNA are not covered by the type certificate, or must be redesigned to be suitable for the site, the certification body will evaluate the design documentation for these elements.

- Support structure design evaluation

  The support structure includes the tower, sub-structure and foundation. A major focus of this phase is to evaluate the design of the support structure with respect to the integrated loads analysis and the design basis. Documentation reviewed includes geotechnical, design drawings, part lists, manufacturing specifications, and design calculations.

  This phase concludes with a statement of conformity indicating that the documentation reviewed by the certification body is compliant with the IEC 61400-22 standard and the design basis.

- Other installations design evaluation (optional)

  Other installations can include substations and cables, corrosion protection, etc. If a scope of work is agreed upon for this phase, it concludes with a statement of conformity indicating that the documentation reviewed by the certification body is compliant with the IEC 61400-22 standard and the design basis.

## 2.4 Surveillance

Throughout the manufacturing phase of the project, the certification body conducts audits and inspections in order to verify that the manufacturing of wind turbines, support structures, and other installations are undertaken with a quality system in place (ISO 9001) and according to design specifications and drawings. This helps ensure a uniform level of quality for components made and sourced in a complex global supply chain.

IEC 61400-22 allows for a customized scope for surveillance, to be agreed upon between the certification body and the project owner. The scope can be reduced or expanded depending on the experience level of manufacturing contractors, past turbine performance, and component criticality, among other considerations.

Surveillance is also carried out to verify that the structures and systems are transported, installed and commissioned by authorized and qualified personnel in accordance with design documentation and manuals. For further details see IEC 61400-1.

A statement of conformity is issued individually for wind turbine/ RNA manufacturing, support structure manufacturing, other installations manufacturing, transportation and installation, and commissioning.

## 2.5 Final evaluation and project certificate

The final evaluation is a report delivered by the certification body that lists all documentation reviewed for the project certificate and lists all conformity certificates issued for the individual phases. A project certificate is issued based on the final evaluation report, and references the final evaluation as well as all the codes and standards that form the basis of the project.

## 2.6 Operation and maintenance surveillance.

To maintain the project certificate, the certification body undertakes periodic review and audit of operation and maintenance records and reports. A focus is placed on any repaired, replaced or modified components. If repairs are not completed in accordance with the project certificate, the certification body may require additional work to ensure compliance. After each evaluation, the certification body issues a statement of conformity.

# 3 Recommendations for offshore project certification in India

Project certification is a process that helps to de-risk offshore wind development. As India seeks to nurture its offshore wind industry, whether in partnership with global offshore-wind leaders, or local Indian developers, it is important to consider and manage the associated risks. Established global companies bring a wealth of knowledge and successful records of accomplishment, but may not be too familiar with how to develop a project facing local Indian hazards which combine cyclones and earthquakes. Local Indian developers may also find the translating their experience in other areas is difficult because offshore wind presents some unique engineering challenges. In either case, project certification helps to improve transparency and ensures that the design, construction and operation of wind farms offshore proceeds according to a logical and approved plan.

At the heart of project certification is the concept of independence. Because the certification body has otherwise no stake in the success of the project, it helps to ensure that quality and conformity in development is balanced between expediency and price. As India seeks to develop a national process to handle offshore wind development, project certification can help to ensure the quality and reliability of the projects, but only if the process is inclusive of the unique local hazards and the independence of the certification body is preserved. Balancing quality with developer needs is difficult to do within the context of a governmental agency because bureaucracy can become inefficient, and developers who self-certify their work can sometimes make poor trade-offs.

Going forward India should develop rules and qualifications for entities wishing to offer services in project certification, using the IEC 61400-22 guidelines as a template. Criteria for accreditation of certification bodies should be developed, and a framework for how or whether these agencies interface with governmental agencies explored. Maintaining the independence of the certification body should be a priority, but clear requirements should be developed for certification bodies to ensure that they balance the needs of both project stakeholders and the Indian public.

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# Health and Safety guidelines for offshore wind - MEMO

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**Table of Contents**

## 1 Introduction

Since the start of offshore wind in Europe, the industry sector had to deal with various health and safety challenges. The supply chain of the offshore wind industry: manufacturing, siting, transport, construction and maintenance is different from those of other industries in each step. Challenges in manufacturing and transport arise from the enormous weight and size of the different components. During siting, transport and construction, the remote location of the sites at open sea with extreme and rapidly changing weather conditions is the main difference to other industries. The enormity of the plants and the unique environmental conditions on the one hand and the recent formation of the offshore wind industry on the other hand are among the reasons for the ongoing development of specific health and safety guidelines for the offshore wind sector.

Offshore wind farm construction and operations pose significant health and safety risks for (contractor) personnel and should always be handled with great care to create a safe working environment. This memo therefore introduces the reader to lessons learnt from the European experiences with respect to offshore wind health and safety risks, national and international guidelines to mitigate such risks and key best practice procedures for a typical offshore wind farm project. The information in this document is intended to provide first guidance. The First Offshore Wind Project of India (FOWPI) initiative should include an experienced health and safety manager/coordinator at an early stage in the tender process to ensure the right level of health and safety requirements for tenderers.

The memo is based on a literature study and practical experience with offshore wind and safety guidelines and structured as follows: First, the memo highlights the most important offshore wind health and safety risks. Second, it describes various (inter)national guidelines. Third, it describes how health and safety guidelines are translated in concrete procedures for risk mitigation in offshore wind projects. Fourth, this memo finishes with a conclusion and recommendation for FOWPI.

## 2 Health and Safety Risks

To allow for a systematic assessment and handling, dangerous tasks are associated with the potential hazards that might occur during the project work. A hazard is a situation or an activity with the potential to harm people, environment or property. With regard to offshore wind projects, the most relevant hazards are listed in Table 1.

**Table 1: Hazards and dangerous activities in offshore wind projects**

| Hazards | Activities & Operations |
|---|---|
| Access and egress | Aviation |
| Confined spaces | Cable laying and entry |
| Electricity | Lifting |

| | |
|---|---|
| Ergonomics | Marine co-ordination |
| Fire | Navigation |
| Geological unknowns | Piling and grouting |
| Hazardous substances | Ports and mobilisation |
| Weather and sea-conditions | Remote working |
| Noise | Subsea operations |
| Unexploded ordnance | Vessel operations |
| Vibration | Waste and spillage management |
| Height | |

Risk is the measure for the likelihood of a hazard - an event that might led to harm and loss of people, plant, the environment or the project itself. Risks are typically assessed in two dimensions: first, the probability of occurrence and second the severity of the associated hazard. The severity is a measure for the harm that could be caused by an incident. The probability quantifies the likelihood of an incident of the associated hazard. Risk assessment requires the awareness of all possible events and the detailed knowledge of each step of a task. The result of the risk assessment are usually three risk categories: low, medium and high. A low risk, on the one hand, does not require immediate action. A high risk, on the other hand, should not be accepted by the employer but result in the implementation of an alternative method. As a result, risk assessment is an instrument that helps to identify hazards and indicates how to deal with those. An exemplary Task Risk Assessment Template is attached in Appendix A.

## 3 Health and Safety Guidelines

Health and safety guidelines help employers to mitigate risks. Those guidelines are usually formulated by national or international institutions or by industry associations and affiliated companies. Some countries provide highly detailed health and safety guidelines, whilst others establish basic standards in legislation leaving the responsibility for their formulation to the industry sector or to single companies. Disregarding differences in national practices, 'no incidents and injuries' has become the rule that overlays each particular guideline in the offshore wind energy sector.

### 3.1 International guidance

The following table provides an overview of International organisations that provide Health and Safety guidelines for the offshore wind sector. It includes links to the most relevant online resources.

**Table 2 Overview of international guidance on Health and Safety in offshore wind**

| Organisation | Description | Online resources |
|---|---|---|
| The Energy Institute | The Energy Institute does not work on health and safety guidelines itself but provides an extensive database of all kinds of resources in the field of health and safety in offshore wind projects. The institute is based in the UK and collaborates with The Crown Estate. | The offshore wind collection provides more than 100 guidance documents. |

| Organisation | Description | Online resources |
| --- | --- | --- |
| European Agency for Safety and Health at Work (EU-OSHA) | EU-OSHA is the European Union information agency for occupational safety and health. Our work contributes to the European Commission's Strategic Framework for Safety and Health at work 2014-2020 and other relevant EU strategies and programmes, such as Europe 2020 . | EU-OSHA has published a number of reports including guidelines for the wind sector, including:<br>• E-fact 79: Occupational safety and health in the wind energy sector<br>• Occupational safety and health in the wind energy sector<br>• E-Fact 80: Hazard Identification Checklist: Occupational Safety and Health (OSH) risks in the wind energy sector |
| Global Offshore Wind Health and Safety Organisation (G+) | (G+) is an international association based in the United Kingdom (UK) with the aim of creating and delivering world class health and safety guidelines for the offshore wind industry. The association has 11 members which are all European utilities. So far, G+ has published two good health and safety guidelines, one for working at height and a second one for the safe management of small service vessels. | The G+ has developed two good practice guidelines, and has published these through the Energy Institute in November 2014. These guidelines provide recommendations for working at height in the offshore wind industry, and the management of small service vessels. |
| International Finance Corporation (IFC) – part of the World Bank Group | IFC, a member of the World Bank Group, is the largest global development institution focused exclusively on the private sector in developing countries. | The General EHS Guidelines contain information on cross-cutting environmental, health, and safety issues potentially applicable to all industry sectors. This document should be used together with the relevant Wind Industry Sector Guidelines |
| International Marine Contractors Association (IMCA) | An influential trade association with more than 900 members from the offshore marine construction industry worldwide. The organisation provides one of the most extensive collections of health and safety guidelines for offshore projects in general, including offshore wind but also offshore oil and gas projects. | HSSE Guidance and Technical Reports can be obtained from the IMCA website. |
| WindEurope | Formerly known as the European Wind Energy Association), which actively promotes wind power in Europe and worldwide. It has over 450 members, active in over 40 countries. | WindEurope has a Health and Safety Working Group which aims to promote and share H&S activities, best practices and lessons learned. They occasionally publish guidelines e.g. on emergency arrangements including first aid |

## 3.2 National guidance

International harmonisation of guidelines is a relatively recent development. Many developers still consider national guidance to be leading. The following sections provide an overview of guidance from national institutions.

### 3.2.1 United Kingdom

The most common collection of health and safety guidelines in the UK is conducted by RenewableUK. The renewable energy trade organisation develops health and safety guidelines for the offshore wind energy sector and has currently about 430 members from associated industries, which are onshore wind, offshore wind as well as wave & tidal energy. The objective of RenewableUK's Health & Safety Working Group is a renewables sector free of fatalities, injuries and work-related ill-health. The Health & Safety Strategy 2016-2018 supports an overall improvement in the health and safety performance of the sector and addresses complex or contentious issues that are unique or have a particular sector specific dimension. Guidelines for offshore wind projects provided include: risk management, emergency response & preparedness, work at height, lifting operations, etc.

### 3.2.2 Germany

In Germany, most of the responsibility for establishing and implementing specific health and safety guidelines is left to companies. The applicable regulatory framework is the Safety and Health at Work Act (Arbeitsschutzgesetz - ArbSchG) which defines basic rules and standards without being particular on offshore wind. The act obliges the employer to organise and implement a functioning safety concept and only provides few and generic health and safety guidelines. The established safety concept must be internally documented, monitored and should lead to an improvement of the health and safety situation. To achieve this, the creation of an occupational safety committee within the company and the provision of personnel and equipment is required. To assure companies' compliance with the legislative requirements, federal state agencies and accident insurer are commissioned for both, external monitoring and advisory services.

Furthermore, the Occupational Physicians, Safety Engineers and Other Occupational Safety Specialists (Arbeitssicherheitsgesetz - ASiG) act, requires the employer to appoint company doctors and occupational safety specialists. These support occupational health, safety and accident prevention and cooperate with health and safety authorities. To improve the internal coordination of occupational health and safety, professional companies with more than 20 employees must form a safety committee, which should meet at least once every three months.

### 3.2.3 Denmark

In Denmark, an approach similar to the German one is pursued. The Offshore Safety Act provides basic standards and obliges offshore operating companies to implement an own safety concept as well as organizational measures for occupational safety. Other than in Germany, the act is focused on occupational health and safety for offshore operations in specific. This approach allows to be more specific on basic standards and on the requirements to the safety concept. For example, the Danish Offshore Safety Act provides guidelines for risk assessment and mitigation, health and safety activities, emergency response, etc. The elaboration of detailed health and safety guidelines however is left to the companies.

For the internal organization of occupation safety, the Offshore Safety Act obliges companies to form an Accident Investigation Commission, an Emergency Preparedness Committee as well as an Offshore Safety Council, which consist of representatives of the social partners and various authorities. Members of safety committees maintain and improve the health and safety conditions on the installations and need to be trained by the employer.

Compliance with health and safety requirements is monitored by Danish Working Environment Authority (WEA), a government organization under the Danish Ministry of Employment in the field of occupational health. Inspections focus on the companies' own control of the risks through their management systems for health and safety and on the involvement of employees. The WEA participates in the International Regulators Forum (IRF) with regard to occupational health and safety.

#### 3.2.4 The Netherlands

In the Netherlands, a lot of space is left to employers and employees in terms of occupational Health and Safety. Basic standards are described in law as in the German and Danish case. How these standards are compiled into a concrete safety concept is then left to the companies. Measures are typically recorded in a catalogue of labour.

The Netherlands Wind Energy Association (NWEA) provides an internet page for the Wind Energy Companies Health and Safety Catalogue, denoted Arbocatalogus. Therein, arrangements on health and safety guidelines between employees and employers are collected. The NWEA is an organisation for the onshore and offshore wind sector and supports policy change to optimise wind energy deployment. The association has about 300 members representing the entire supply chain of the wind sector.

### 3.3 Commonly used guidelines

Appendix B contains a list of each countries' health and safety guidelines with links to online resources with detailed information. Here we provide a brief description of the most common health and safety guideline categories:

- **Guidance on the investigation and reporting of incidents,** defines the procedures and formal requirements in a case of an incident. It includes recommendations on interviewing the personnel, inspecting the site and filing and managing the collected information. It also gives examples for an incident classification scheme and insurance reporting.
- **Marine roles for small workboats,** aims to provide guidance for the staff of the offshore wind industry operating on small workboats less than 200 gross tonnes. The guidance considers the special requirements and areas of competence of the operation of those small sized vessels. It needs to be understood as a framework which should be applied with regards to local requirements.

- **Risk assessment,** provides recommendations for the continuous mitigation and controlling of risks in the offshore work environment. It highlights the importance of communicating information about hazards to reduce injuries of workers or damages of the equipment. The assessment can be conducted via a written document or with the help of a toolbox meeting and covers a wide variety of areas within the offshore operation.
- **Safe lifting,** sets the guidelines for lifting jobs in the marine environment. As they are a crucial part of offshore operations the document lays out rules for equipment, maintenance and safe operation. Besides the theoretical background a safe proceeding also requires experience and practice.
- **Toolbox talks,** is a guideline that gives recommendations for the phase right before the actual job at the offshore wind park. A group talking with focus on the tasks of each team member maximizes the effectiveness and reduces the risk of accidents or delays during the operation. They can take place on a regular basis or at shift change at should follow the four basic requirements of timing, attendance, observation and knowledge.
- **Working at height,** is a guideline initially developed for the offshore oil and gas industry to reduce the number of work at height accidents. Besides the discussion of hazards and recommendations for works on a ladder, stinger or near an open hold, the specific aspects of working in the offshore wind industry were added in the guideline of the G+.

## 4 Health and Safety Procedures

An offshore wind farm developer, owner and/or operator should always implement a Health and Safety policy (or management system), including concrete working procedures to mitigate high risk activities in the field. Health and safety procedures are often the compilation of generic health and safety guidelines into concrete procedures on project level. Those procedures involve training and certification of employees and the establishment of standard operating procedures for the mitigation of identified risks. Factors of success in the evolution and implementation of health and safety procedures are transparency, communication, the involvement of workers and continuous efforts towards improvement.

A Health and Safety policy (or management system) can consist of several components such as requirements, instructions and procedures:

> **Requirements** can apply to certain training requirements of personal, personal protective equipment (PPE), vessels and helicopters. There are three different offshore training standards originating from the shipping, oil and gas and offshore wind industries. Please refer to the outcomes of a Gap Analysis Offshore Training Standards (Ecofys by order of TenneT), which shows that the Global Wind Organisation (GWO) training is the most extensive in terms of duration, cost and validity. GWO training objectives are specified to the wind turbine environment, so not always applicable to / necessary for work on an offshore platform, where STCW (merchant navy) or OPITO (oil and gas industry) training might also be sufficient.

> **Instructions** can apply to working in certain areas such as the quayside, offshore (wind turbines and substations) or onshore (control buildings, contractor sites).

- **Procedures** help formalise a safety policy (or management system) to manage the significant risks (see Table 7) associated with an offshore wind farm environment. The most important and commonly used procedures for offshore wind farm projects are highlighted in this section.

**Table 3: Typical high-risk activities in offshore wind projects that require clear working procedures**

| High risk activities |
|---|
| Working at height and rope access |
| Working in confined spaces |
| Working with electricity (low voltage and high voltage) |
| Hot work (welding, flame cutting, grinding etc.) |
| Heavy lifting (>500 KG) and odd size lifting onshore and offshore |
| People transfer at sea (vessel-to-vessel and vessel-to-structure) |
| Helicopter transfers and personnel winching operations |
| Jack up / DP (dynamic position) operations |
| Diving activities |
| Working during adverse weather conditions |
| Last minute changes in working methods |

***Please Note:*** *The generalised procedures in the following sections of this document are for information purposes only. Each wind farm owner should appoint a professional Health and Safety manager or coordinator to set-up a project specific Health and Safety policy or management system, including project specific procedures.*

### 4.1 Work plan

For every work activity in offshore wind farms a work plan, including a Work Method Statement and Task Risk Assessment, is typically required. The person (often a contractor) conducting the work is responsible to setup this document, which could be based on a template provided by the wind farm owner. After review and approval by the wind farm owner (or representative of the owner) a permit to work can be issued. Figure 1 provides an indication of the work planning process.

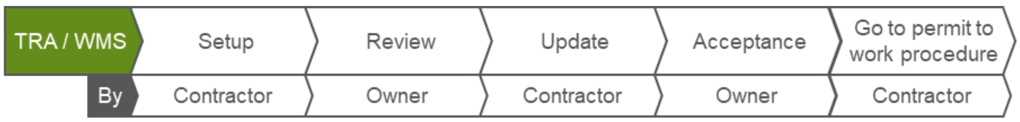


**Figure 5: Flowchart of task risk assessment and work method statements**

A work plan typically includes a description of the scope, organisation, planning, detailed description of activities and risk mitigation measures, specifically:

- Circumstances;
- Hazards;
- Risk descriptions;
- Pre-control risk assessment (probability, severity & risk);
- Method to mitigate, eliminate or reduce the risk;
- Post control risk assessment and residual risk (probability, severity & risk)

### 4.2 Permit to Work

A permit to work (and access the wind farm) is issued by the owner of the wind farm to control i) the type of work conducted when and where ii) who enters the wind farm (assets) iii) to inform others (other contractors, authorities etc.). A general procedure is provided in figure 2.

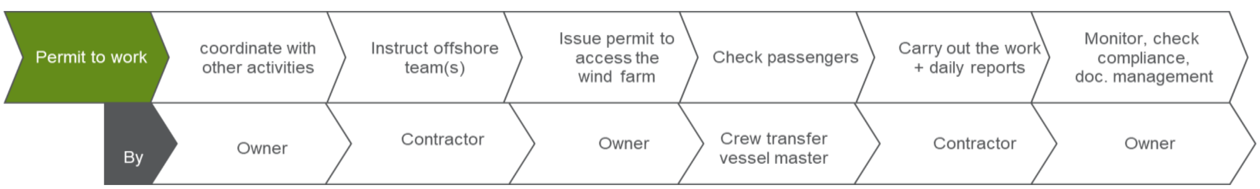


**Figure 6: Flowchart of permit to work procedure**

### 4.3 Management of Change

A management of chance (MoC) procedure can help to ensure that associated hazards and risks are properly identified and managed. The procedure should capture appropriate review, approval, implementation and tracking within the offshore wind farm project organisation.

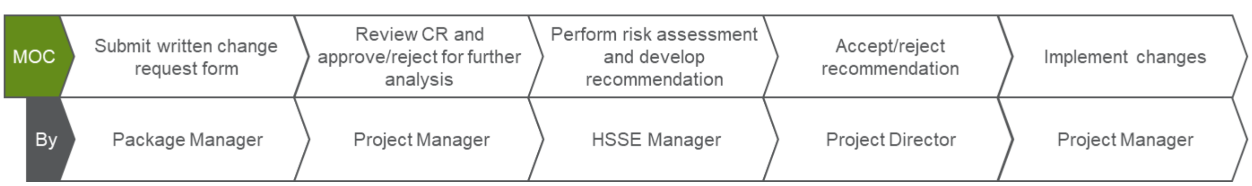


**Figure 7: Flowchart of management of change procedure**

### 4.4 Health and Safety reporting and performance improvement

If implemented properly Health and Safety reporting procedures will significantly improve the safety in the work environment. Often it is also a legal requirement, so good record keeping is important to remain compliant with local legislation. A Health and Safety report allows owners and authorities to identify where and how risks arise and whether they need to be investigated. It also allows HSE and local authorities to target their work and provide advice on how to avoid work-related incident and accidents. Information from such reports can be used as an aid to risk assessment, helping to develop solutions to potential risks. Records also help to prevent injuries and ill health, and control costs from accidental loss (www.hse.gov.uk).

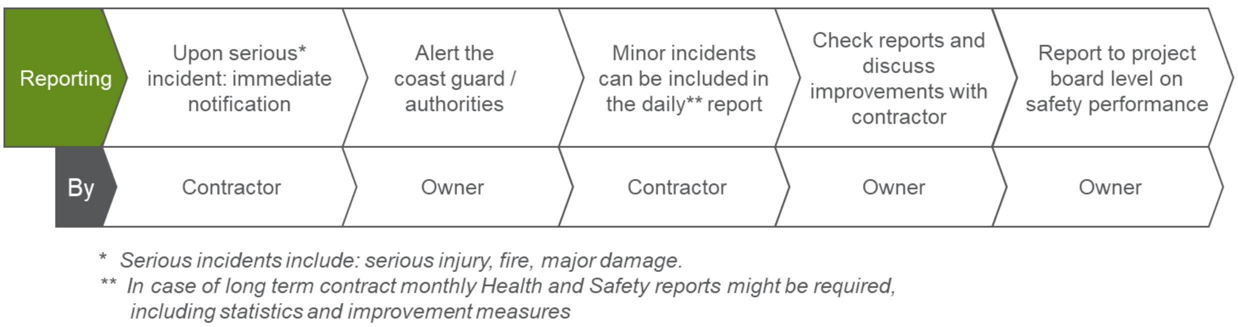


**Figure 8 Flowchart of a generalised reporting procedure**

### 4.5 Emergency response

The party conducting work activities, often contractors, should have in place their own emergency response procedure (ERP) to reflect the requirements of their scope of work and in line with their own organisation. However, they should always make sure to align this procedure with the relevant project specific emergency procedures. A general emergency response procedure is depicted in the flowchart in figure 5.

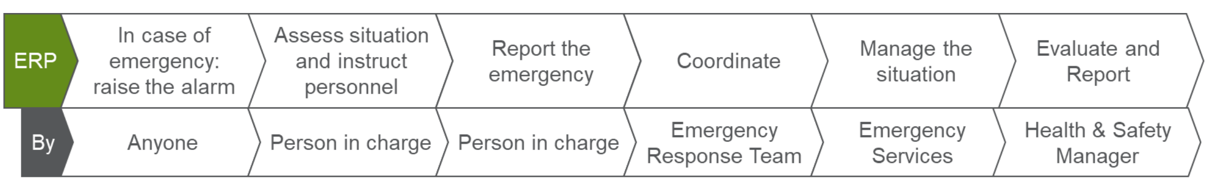


**Figure 9 Flowchart of a generalised emergency response procedure**

## 5 Conclusion and Recommendation

Europe is the world leader in offshore wind power, with the first offshore wind farm being installed in Denmark as early as 1991. In the early days, many standards and procedures were adopted from the Oil and Gas industry. For FOWPI this might also be a logical process, considering the highly mature oil and gas industry in the region. However, over the past 25 years the guidelines and procedures for offshore wind in Europe have become more tailor made to the wind industry, incorporating a quarter of a century of experience and lessons learned. It is recommended that these lessons are as much as possible incorporated in the first offshore wind project in India.

The first offshore wind project in India should have a clear Health and Safety policy statement in place. This statement should be drafted by local health and safety experts, with guidance and support from experienced European health and safety expert(s). It is important to incorporate clear health and safety requirements for contractors in the tender documents. Therefore, it is imperative that the right level of health and safety expertise is attracted to the project at an early stage in the tender process.

**Appendix A: Example Task Risk Assessment**

| | PROBABILITY OF OCCURRENCE | | | | | |
|---|---|---|---|---|---|---|
| | | A | B | C | D | E |
| S E V E R I T Y | 1 | LOW | LOW | LOW | LOW | MED |
| | 2 | LOW | LOW | LOW | MED | HIGH |
| | 3 | LOW | LOW | MED | HIGH | HIGH |
| | 4 | LOW | MED | HIGH | HIGH | HIGH |
| | 5 | MED | HIGH | HIGH | HIGH | HIGH |

| PROBABILITY OF OCCURRENCE | SEVERITY | RISK |
|---|---|---|
| **A** May never occur | **1** Negligible | Low = No immediate action required, proceed with care |
| **B** May occur | **2** Moderate | |
| **C** Might occur | **3** Serious | Medium = Review & implement preventative measures |
| **D** May occur infrequently | **4** Major | |
| **E** Will probably occur | **5** Catastrophic | High = Unacceptable. Find alternative method |

| SEVERITY | HUMAN | ENVIRONMENT | MATERIALS / EQUIPMENT |
|---|---|---|---|
| NEGLIGIBLE | No or minor injury. | No or insignificant clean up naturally dispersed | No or insignificant damage to equipment or materials |
| MODERATE | One lost time accident, with no loss of part of the body, or prolonged disability | Clean up requires less than 1day | Damage to equipment or materials with lost time of 1 day production |
| SERIOUS | Multiple lost time accidents. One injury with loss of part of body, or with permanent disability | Clean up requires approx. 1 week | Significant damage to local area or essential equipment |
| MAJOR | One fatal injury. Several victims with loss of part of the body, or with permanent disability | Clean up requires approx. 1 month | Significant damage to local area or essential equipment which stops the work until a later date |
| CATASTROPHIC | Several fatal injuries | Clean up requires more than 1 month | Extensive damage to local area or essential equipment which stops the work totally |

**Task Risk Assessment Table**

| ACTIVITY | HAZARD | CONSEQUENCE | INITIAL RISK | RISK CONTROL MEASURE | RESIDUAL RISK |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |

### Appendix B: Overview of National Health and Safety Guidelines

| Country | Organisation | Health and Safety Guidelines |
| --- | --- | --- |
| UK | RenewableUK | The RenewableUK Health & Safety Vision - Mission and Strategy 2016 - 2018<br>The RenewableUK online guidelines catalogue, including:<br>• Offshore Wind and Marine Energy Health and Safety Guidelines<br>• Good practice guidelines for Integrated Offshore Emergency Response<br>• Wind Turbine Safety Rules<br>• Vessel Safety Guide<br>• Overview of principles and practices in managing confined spaces |
| DE | German Federal Government | Guidance provided by the German federal government includes:<br>• Safety and Health at Work Act of 7 August 1996 (Federal Law Gazette I p. 1246), as last amended by Article 8 of the Act of 19 October 2013, from the Federal Ministry of Labour and Social Affairs<br>• A German Offshore Wind Energy Security Framework (in German), from the Federal Ministry of Transport and Digital Infrastructure<br>• Minimum requirements for the construction of offshore structures (in German), from the Federal Maritime and Hydrographic Agency of Germany |
| DK | Danish Working Environment Authority (WEA) | The Danish Offshore Safety Act (2015). Consolidated act no. 831 of 1 July 2015 regarding safety, etc. for offshore installations for exploration, production and transportation of hydrocarbons (The Offshore Safety Act) including:<br>• Risk assessment and risk mitigation (sections 33-37)<br>• Design, construction, layout and equipment (Sections 38-44)<br>• Emergency Response (Sections 45)<br>• Health and safety activities (Sections 46-49)<br>• Training and competence (Section 50)<br>• Working hours, rest and off-duty periods (Section 51)<br>• Registration and notification etc. (Section 52)<br>• Performance of work and medical examinations, etc. (Sections 53-57) |
| NL | Netherlands Wind Energy Association (NWEA) | The Dutch 'Arbocatalogus' including guidelines on:<br>• Communication in offshore wind (for employee / for organization)<br>• Diving activities (for organization)<br>• Offshore transfer from a vessel from and to a short fixed ladder (for employee / for organization)<br>• Offshore transfer from a vessel / jack-up from and to the platform (for employee / for organization)<br>• Offshore transfer from a vessel from and to a vertically moving platform (for employee / for organization)<br>• Offshore transfer between vessels (for employee / for organization)<br>• Sudden cardiac failure (for employee / for organization)<br>• Organisation in case of impact hazards (for employee / for organization)<br>• Physical (over)burdening due to pushing and pulling (for employee / for organization)<br>• Climbing wind turbine and access to gondola/mast (for employee / for organization)<br>• Exposure to direct sunlight (UV radiation) (for employee / for organization)<br>• Working in enclosed spaces (for employee / for organization) |

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# APPENDIX III

## CONTENTS



## 1 Executive summary

India has a large offshore oil and gas (O&G) industry with fields in both the Arabian Sea and the Bay of Bengal. The list of Oil Industry Safety Directorate (OISD) standards and guidelines is comprehensive, but tailored to offshore O&G activities.

As the name implies, the FOWPI project supports the preparations for the first offshore wind project in India and there are currently no standards or guidelines that specifically cover offshore wind.

This document is an attempt to identify:

- Which OISD standards and guidelines are directly applicable to the offshore wind industry
- Which OISD standards and guidelines could be made to apply to the offshore wind industry after editing and revision


| VERSION | DATE OF ISSUE | PREPARED | CHECKED | APPROVED |
|---|---|---|---|---|
| V1 | 06.07.2018 | RS/MOIS/AMKE | LNKR | GAZE |

- Which additional standards and guidelines are needed to fully cover Health & Safety (HSE) in the emerging Indian offshore wind industry

The document also addresses EU legislation, relevant European national legislation and industry guidelines as source of inspiration for the development of future Indian legislation to support health and safety management in this new industry.

It is our opinion that with proper support, and along with the offshore wind industry and the Indian government, relevant H&S procedures in India can learn upon, and do even better than, current practice in the EU.

## 2 HSE responsibilities

According to EU legislation the developer/owner of the offshore wind farm is responsible for HSE throughout the lifecycle of the wind farm.

Prior to construction, various vendors will be manufacturing components at their own premises. If the developer/owner commits to delivering a project involving no loss of life or injury whatsoever, then contracts should be written that oblige vendors and their sub-vendors to meet safety standards. The duty holder would retain the right to inspect and audit vendors and sub-vendors premises against the standards. Imposing financial penalties on vendors if a fatality or injury occurs whilst executing the contract should be considered.

During the construction phase, there will be large numbers of employees and contractors working offshore 24 hours a day, possibly accommodated on ships or temporary accommodation rigs.

During the operational phase, the wind farm will be unmanned but it will occasionally be necessary to send a few personnel offshore in the event of an upset or to carry out planned maintenance tasks. Direct supervision of the work may be difficult unless supervisors are included as members of the offshore team.

## 3 Relevant offshore H&S standards/guidelines currently available in India

The Factory Act (1948) was amongst the first legislation enacted with the prime objective of protecting workmen employed in factory against industrial occupational hazards in India. Since then various industry specific legislations have been enacted (such as Mine Act 1952, Petroleum Rules 1976 etc.) that governs the health and safety aspects for respective industries.

Considering that these acts / regulations are primarily focused on onshore industrial activities, Petroleum and Natural Gas (Safety in Offshore operations) Rules, 2008 were notified under Oil field (regulations and development) Act, 1948 by Ministry of Petroleum and Natural Gas, Government of India. Under these rules the Government has designated Oil Industry Safety Directorate (OISD) as a competent authority for the implementation of these rules and regulations covering the health and safety aspects of the offshore oil and gas industry.

OISD has developed various standards for typical work processes involved in offshore oil and gas production. OISD standards and guidelines are located at oisd.gov.in.

The key health and safety aspects that are relevant to the offshore wind power and relevant OISD guidelines are listed in the table below.

*Table 1 Health and Safety topics covered or partially covered by existing OISD standard and guidelines.*

| Offshore wind – health and safety aspects / topics | OISD standard /guidelines |
|---|---|
| Safety Management System | OISD-GDN-206 Guidelines on Safety Management System in Petroleum Industry. |
| Permit to Work | OISD-STD-105 : Work Permit System |
| Hazardous chemicals | OISD-STD-114: Hazardous chemicals and their handling. |
| Personal Protective Equipment (PPE) | OISD-STD-155: PPE |
| Excess and Egress | OISD-GDN-192 : Safety Practices during construction |
| Working at heights | |
| Confined spaces | |
| Handling and Lift equipment | |
| Helicopter transportation | |
| Work above water | |
| Job Safety Analysis (JSA) | OISD –GDN-207: Contactor's Safety |
| Site planning and layout | |
| Incident Reporting and Investigation System | |
| Safety equipment and PPEs | See also OISD-STD-155 |
| Static Electricity / electrical systems | OISD-RP-110: Recommended practice on static electricity<br>OISD-RP-149: Design aspects for safety in electrical systems |
| Risk assessment, Hazards and Control system | OISD-GDN-232: Identification of hazards and control measures in E&P (exploration and production) industry. |
| Drilling and workover Rigs | OISD-GDN-218: Guidelines for safe rig-up and rig –down of drilling and work-over rigs. |
| Emergency Response and preparedness | OISD-GDN-227: Emergency Response and Preparedness in E&P industry. |

## 3.1 Identified gaps in OISD guidelines

Based on a screening and assessment of OISD guidelines found online, shortcomings relevant for offshore wind are listed below:

- Safety Management System
  - Consider amending GND-206 to include wind power relevant guidelines (source of inspiration could be RenewableUK)
- Permit to Work system
  - Consider amending OISD-STD-105 to include work and rescue at height
  - Paper based permit system may not be best solution (a cloud based system could be a better alternative)
- Access and egress
  - Consider amending OISD-GDN-192 to include vertical ladders and escape routes
- Working at Height
  - Consider amending OISD-GDN-192 to cover rescuing persons from height (source of inspiration could be RenewableUK)
- Confined spaces
  - OISD-GDN-192 §6.6 seems to cover topic
- Handling and Lift Equipment
  - OISD-GDN-192 §6.9 seems to cover topic
- Helicopter transportation
  - Consider amending OISD-GDN-192 §6.12.7 to allow for hoisting of persons between an aircraft and the top of a WTG nacelle (source of inspiration could be RenewableUK)
- Work above water
  - OISD-GDN-192 §6.16 seems to cover this topic
- Job Safety Analysis
  - Partly cowered in OISD-GDN-207 §5.1, amendment needed to cover work at an OWF
- Site planning and layout
  - Partly covered in OISD-GDN-207 §5.4, amendment needed to cover work at an OWF.
- Incident and Near Miss Reporting and Investigation System
  - To be implemented as per clause no. 4.12 of OISD-GDN-206 on 'Safety Management System'
- Safety Equipment and PPEs
  - OISD-GDN-207 needs elaboration regarding type of equipment used and required on WTGs
- Static Electricity / electrical systems
  - Seems to be covered in OISD-RP-110 and OISD-RP-149 (and National Electrical Code SP30-2011 by BIS)
- Risk assessment, hazard and control system
  - Another approach is recommended for offshore wind (source of inspiration could be appendix B of DNV-OS-J201 and RenewableUK)
- Drilling and workover Rigs
  - Covered to some extent in OISD-GDN-218 but amendment needed to cover vessels used in wind power industry
- Emergency Response and preparedness
  - Consider amending OISD-GDN-227 to cover the needs of offshore wind power (source of inspiration could be RenewableUK and Wind Europe (formerly known as EWEA))

Design, quality assurance and marine issues are not included specifically in OISD standards. Shortcomings in these subjects are listed below:

- Design (not included in OISD)
  - Adaption of, or inspiration from UK CDM regulation supporting health and safety management
  - Make use of relevant EN/ISO standards regarding wind turbines and safety of machinery during design
  - Make use of DNV-GL standards
- Quality Assurance / Quality Management
  - Make use of internationally recognised quality standard ISO 9000
- Marine Issues
  - Expected to be covered in existing Indian legislation

The gaps identified are explained below in further detail:

**Safety Management System**

"Guidelines on Safety Management System in Petroleum Industry OISD-GDN-206" This can form the basis for the FOWPI Safety Management System. Many aspects are not relevant for the wind industry and there may be new and unfamiliar tasks involved.

Training of personnel is covered in this guideline and the tracing of employees and the courses that they have completed.

Further wind energy specific guidelines are available in RenewableUK "Offshore Wind and Marine Energy Health and Safety Guidelines" and these can provide additional input to the FOWPI Safety Management System.

**Permit to Work system**

The principles described in OISD-STD-105: "Work Permit System" lend themselves to use in the offshore wind industry. Confined space entry is relevant and flammable gases may occur in small quantities below the airtight platform in the WTG foundation transition piece so "Hot work" would be relevant.

Working at height is far more common in the offshore wind industry and equipment may be unfamiliar, also provisions for rescue at height need to be addressed. The Permit to work system for FOWPI can be based on OISD-STD-105 with modifications.

A simple paper based Permit system may not be suitable where supervisors (permit issuers) may be based onshore whilst technicians have to complete their tasks at remote offshore locations. A cloud based system could be considered.

**Hazardous chemicals**

Hazardous gases can occur (below the airtight platform) in the WTG foundation transition pieces depending on the design. This can be due to current from the cathodic protection system causing electrolysis of seawater. The main concerns are hydrogen and chlorine. These are covered in OISD-STD-114 and Material Safety Data Sheets (MSDS) are provided.

**Personal protective equipment (PPE)**

OISD-STD-155 covers many types of PPE used in the oil and gas industry both onshore and offshore.

The safety belts and harnesses described in the standard would not be likely to meet the requirements for working in the offshore wind industry. The descriptions are of waist belts with shoulder straps. Work on a WTG requires a full body harness with waist belt, leg straps and shoulder straps.

**Access and egress**

OISD-GDN-192 makes provision for the use of ladders, safety harnesses, lifelines and fall arrest devices. It may not always be possible to provide two escape routes on a WTG.

Ladders on a WTG are permanently fixed vertical ladders and the use of fall arrest devices and safety harnesses is mandatory.

The use of inflatable life rafts is not envisaged on WTG towers. They are however commonly used on OSS substation platforms.

**Working at Height**

OISD-GDN-192 covers working at height and the guidelines can be applied directly to working at height on a WTG. The guidelines do not cover rescuing persons from height and additional guidance will be needed when writing FOWPI procedures. RenewableUK "Working at Height and Rescue Training Standard" provides additional guidance. Training centres for working at height will need to be set up or existing training centres expanded to cater for offshore wind personnel. Expanded certification procedures may needed for the training centres.

**Confined spaces**

OISD-GDN-192 §6.6 seems to cover working in confined spaces adequately. A FOWPI procedure would be required to identify the spaces on a WTG or an OSS substation platform that qualify as confined spaces. RenewableUK "Confined Spaces Circular 2015" provides guidance.

**Handling and Lift Equipment**

OISD-GDN-192 §6.9 seems to cover this topic adequately.

**Helicopter transportation**

OISD-GDN-192 §6.12.7 covers helicopter transport to and from a solid helicopter deck. It does not cover hoisting of single persons between an aircraft and the top of a WTG nacelle (which is possible in some WTG designs). Further wind energy specific guidelines are available in RenewableUK "Aviation Guidance".

Crew transfer by boat is common in the wind industry but OISD guidelines covering this could not be found. Boats equipped with the Ampelmann system are also used as they allow crew to walk directly onto the service platform. Guidance on access systems can be found in ECN "Offshore wind access".

**Work above water**

Work on the outside of a WTG constitutes work above water except on the service platform where the transition piece meets the WTG. OISD-GDN-192 §6.16 covers the topic.

**Job Safety Analysis**
This is covered in OISD-GDN-207 §5.1. At conventional work sites onshore or on an offshore oil installation, the safety officer and the supervisor will likely be on-site. This may not be the case at an OWF, Procedures would have to be developed to overcome this challenge.

**Site planning and layout**
This is covered in OISD-GDN-207 §5.4. The general requirements will be similar for an OWF but details may be somewhat different since the many worksites (individual WTGs) are not readily accessible from the workshops and central facilities which may be onshore or on temporary rigs or ships close to the OWF.

**Incident Reporting and Investigation System**
The incident investigation should be done as per provision of clause no. 4.12 of OISD-GDN-206 on 'Safety Management System'. Reporting is a statutory requirement for the oil and gas industry. Since the offshore wind industry is just starting up, there are currently no statutory requirements to report incidents and near misses or investigate root causes. FOWPI procedures should be written to cover this topic and to make the data widely available for sharing experience.

**Static Electricity / electrical systems**
We assume India's "National Electrical Code SP30-2011" published by BIS (Bureau of Indian Standards) would apply.
OISD-RP-110: Recommended practice on static electricity
OISD-RP-149: Design aspects for safety in electrical systems
May also be relevant.

**Risk assessment, hazard and control system**
Hazard identification is required before any form of mitigation can be applied. Hazards in the oil and gas industry are significantly different and more serious than those in the offshore wind industry.

Appendix B of DNV-OS-J201 provides a comprehensive list of potential hazards for Offshore Substation (OSS) platforms and a method for Formal Safety Assessment. Further wind energy specific guidelines are available in "RenewableUK "Offshore Wind and Marine Energy Health and Safety Guidelines".

**Drilling and workover Rigs**
There is no drilling or workover here but jack-up ships with heavy lift cranes may be used to transport WTG towers and transition pieces to site and lift them to the sea bed.

Procedures for surveying the sea bed and preparing for jacking down a rig are described in "OISD-GDN-218: Guidelines for safe rig-up and rig–down of drilling and work-over rigs". Since the FOWPI will have many WTG towers, there will be intense marine activity for a period of time, until all the WTG towers are installed and commissioned.

**Emergency Response and preparedness.**

OISD-GDN-227 (Emergency Response and Preparedness in E&P Industry) sets out principles and guidelines for emergency response plans. The conditions requiring evacuation of WTG tower would not be comparable to conditions requiring evacuation of and oil platform. There are not likely to be lifeboats or inflatable rafts on a WTG tower and the number of personnel needing to evacuate may be small.

Whilst a WTG tower or an OSS platform is manned, a standby vessel or crew boat would normally be stationed in the vicinity to transport personnel back to shore. Some OSS platforms are equipped with helicopter decks and a fast rescue craft (FRC). The FRC is primarily to rescue people who have fallen overboard, but it could also be sent to assist evacuation of a WTG tower.

Evacuation of all installations in the field may be required because of impending dangerous weather conditions. Early warning would be needed to coordinate such an action. Permission to travel out to the field would also take account of weather forecasts.

All personnel should be trained in advanced first aid and communication with onshore medics should be available at all times.
RenewableUK "Working at Height and Rescue Training Standard 2014" has guidelines specifically for the wind industry. Inspiration can also be found in Wind Europe (formerly known as EWEA) "working the wind safely, guidelines on emergency arrangements including first aid".

**Design**
We were unable to identify Indian regulation describing roles, responsibilities and processes regarding health and safety in construction projects.
The Construction (Design and Management) Regulations 2015 (CDM) including guidelines from the UK Health and Safety Executive (HSE) may be used as inspiration to ensure a systematic approach for more detailed health and safety management (the approach used in the CDM is comparable to regulation in other European countries). The CDM or the intention behind it is a well-proven way of supporting a Health and Safety Management System.

The EU recognises wind turbines as machines as defined by EU Machinery Directive. The Machinery Directive requires that all Machines that are CE Certified must be commissioned operated maintained and decommissioned without putting workers lives in danger. We do not know if India has a similar approach.

During design, ISO/EN standards for wind turbines and safety of machinery can be applied to comply with some of the health and safety requirements for example (list not exhaustive):

- EN50208 Wind turbines – Protective measures – Requirements for design, operation and maintenance
- EN ISO 14122 – Safety of machinery – Permanent means of access to machinery

Since this is the first offshore wind farm in India there are no design standards available, adoption of the DNV-GL standards should be considered.

Det Norske Veritas (DNV-GL) publishes standards that may also be used in the design of offshore WTG towers, OSS (substation) platforms and other structures.

Examples of relevant DNV standards (list not exhaustive):
- DNV-OS-J100: Offshore Wind Turbines
- DNV-OS-J101: Offshore Wind Turbine Structures
- DNV-OS-J102: Wind Turbine Blades, Nov. 2004
- DNV-OS-J103: Offshore Wind Turbine Electrical Systems, 2005
- DNV-OS-J104: Offshore Wind Turbine Gear Boxes, 2005
- DNV-OS-J201 "Offshore Substations for Wind Farms"

**Quality Assurance / Quality Management**
We were unable to find applicable Indian standards but ISO 9000 standards are universally applicable. This will ensure that all work and all products used in the project meet predefined standards of quality.

**Marine Issues.**
As major shipping nation India has comprehensive legislation governing the shipping industry. Shipping, including heavy lift vessels and mobile rigs associated with FOWPI would be covered by existing legislation.

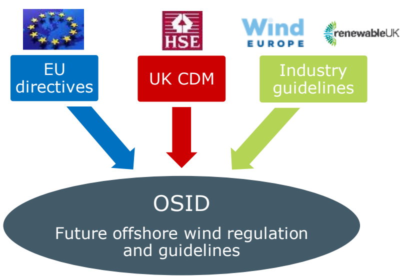
# 4 European HSE References

As FOWPI is planned to be the first offshore wind energy project in India. There is very little local experience in this field among the Authorities, operators, workforce or contractors) and no offshore wind specific Indian standards.

Some OISD standards are directly transferable to the offshore wind industry, others could be used if amendments are applied. Some tasks in the offshore wind sector are not covered by existing Indian legislation and presumably new standards would need to be prepared. European legislation may act as a source of inspiration as wind power is considered a mature industry in Europe.

The European Union (EU) legislature, selected national European legislation (the UK for example) and industrial bodies, trade associations and non-profit organizations representing offshore wind power industry are a recommended first step in forming future Indian offshore wind regulation and guidelines.

*Figure 1 Forming offshore wind regulation*




**The EU directives**
All EU legislation comes in directives based on the legal foundation established in Article 153 of the Treaty on the Functioning of the European Union. EU legislature has established a system of basic principles of health and safety management, which must be implemented into national law by the Member States. The European Framework Directive (1989/391/EEC) is most important act and together with the Directive for temporary or mobile construction sites (92/57/EEC), they establishes general principles for managing health and safety, such as responsibility of the employer, rights/duties of workers, using risk

assessments to continuously improve company processes, and workplace health and safety representation. The risk assessment is a core element in the Framework Directive and with the introduction of the risk assessment, the chances for improving health and safety in the workplace have grown, but also the employer's responsibility. EU legislation makes the employer responsible for prevention in the company. Single duties can be delegated to specialists, but the overall responsibility cannot. With this EU framework and the fact that directives are implemented in the member states, wind developers/owners are responsible for HSE in the OWF lifecycle and need amongst other to assess health and safety risk. More information about the EU Directives is accessible at oshwiki.eu. A very comprehensive guideline to 92/57/EEC has been compiled and is accessible at osha.europa.eu/da/legislation/guidelines.

The EU directive of 2013/30/EU covers safety of offshore oil and gas operations. It was initiated in response to the Macondo / Deepwater Horizon disaster in the Gulf of Mexico in April 2010. It may provide some additional inspiration as it is somewhat newer than many of the OISD standards.

**UK CDM - Guidance from national health and safety legislation**

The Health and Safety Executive (HSE) is the body responsible for the encouragement, regulation and enforcement of workplace health, safety and welfare in the UK. Legislation from the HSE and its guidelines are based on EU directives mentioned above, similar to other European countries (member states). The UK health and safety legislation and guidelines are of a high quality and written such as to be readily understood by most educated people.

Virtually everyone involved in a construction project in the UK has legal duties under the Construction (Design and Management) Regulation (CDM). These "duty holders" include the Client, Designer, Principal designer, Principal contractor, Contractor and Worker. The main duty of the client is to ensure that his project is suitably managed, ensuring the health and safety of all who might be affected by the work. The "duty holders" are further defined in the CDM regulation.

The "duty holders" need good understanding and effective implementation to manage the CDM requirements in UK offshore wind projects. The CDM legislation has most often been applied to land-based projects, which do not always readily integrate with marine activities and maritime legislation. The party responsible for co-ordinating health and safety activities during design phase (the Principal designer) and fabrication/installation phase (Principal contractor) must interpret and apply the Regulations as the UK does not have legislation specifically for offshore wind. The HSE legislation and guidelines are however recommended as source of inspiration. More information is accessible at hse.gov.uk and hse.gov.uk/construction/cdm/2015.

**Industry guidelines**

Europe is the world leader in offshore wind power, with the first offshore wind farm (Vindeby) being installed in Denmark in 1991. The decades of experiences has been consolidated in a row of industrial bodies, trade associations and non-profit organizations supporting the industry today. A number of these establishments are making tremendous efforts to share their experience in comprehensive guidelines including health and safety. Among these establishments are Wind Europe (formerly known as EWEA, with more than 30 years of experience) and RenewableUK (with more than 40 years of experience). Below is a list of selected guidelines from the two associations:

Wind Europe (formerly known as EWEA)
- Working the wind safely, guidelines on emergency arrangements including first aid – 2013

RenewableUK
- Onshore wind health and safety guidelines – 2015
- Offshore wind and marine energy health and safety guidelines – 2014
- Confined Spaces Circular – 2015
- Vessel Safety Guide – 2015
- Wind Turbine Switchgear Safety – 2015
- Integrated offshore emergency response – renewables (IOER-R) – 2016
- Offshore renewables aviation guidance (ORAG) – 2016
- Working at Height and Rescue Training Standard – 2014

Other relevant guidelines are also relevant:

EU-OSHA
- Occupational safety and health in the wind energy – 2013

World Bank Group
- Environmental, health, and safety guidelines for wind energy – 2015

ECN (energy research centre of the Netherlands, changing name to TNO)
- Offshore wind access – 2018

# 5 Conclusions and Recommendations

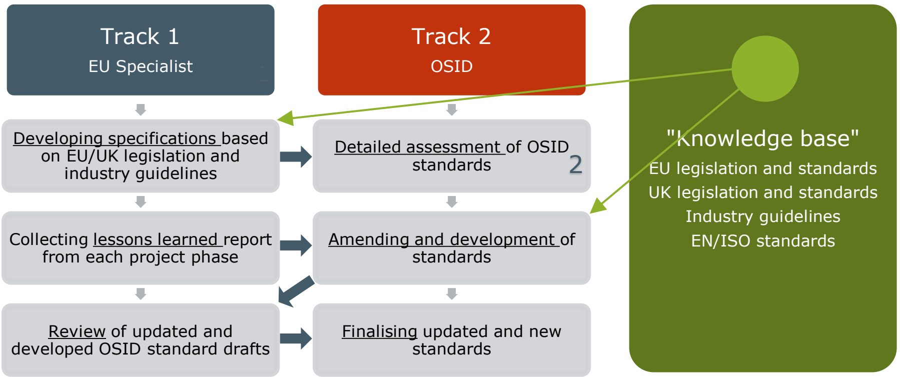
The offshore wind technology in Europe is progressing fast. In the industry's own opinion it could be driven faster by a policy framework as positive as that which promoted the offshore oil and gas sector from the 1960s onwards. This also includes health and safety regulation. India can benefit from the European experience and do even better by developing an offshore wind power specific policy framework from the very beginning, to support this new industry including management of health and safety. The following steps are recommended in order to achieve this:

- Establishment of a network of specialists to enable adoption of European best health and safety practice
- Development of “extended” health and safety specifications for the first tenders (supporting the legislative work)
- Establishing a “fast track” to develop new and amend existing legislation and standards
- Use of experienced vendors, contractors and designers to support a transfer of knowledge to India.

Overall this document recommends the amendment of existing Indian legislation and guidelines to better match current stage or to perform even better than European offshore wind power (OSID shortcomings included above). The natural step, as indicated above, would be to expand OSID giving it a mandate to regulate the new offshore wind industry in India.

Amending national legislation and standards is however often a long-term process presumably reaching further than the FOWPI. It is our opinion that two parallel tracks are needed in a process of effectively developing supportive legislation and standards. The tracks are illustrated below:

*Figure 2 Maturing OSID to regulate offshore wind power*




An EU specialist, e.g. FOWPI, should be responsible for Track 1 (pilot project track), using selected European health and safety legislation, standards and guidelines as basis in the health and safety specifications for the wind farm.

OSID should be responsible for Track 2 (the government track), conducting a prioritized amendment of existing legislation and standards with both input from European health and safety legislation, standards and guidelines and continuous input and feedback from FOWPI.

The priority in this development process should be:

1. Developing health and safety specification for first projects based on industry best practice
2. Amendment of existing OSID standards and guidelines and development of new ones to support future offshore wind power projects

FOWPI

FIRST OFFSHORE WIND PROJECT OF INDIA