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## **Regulatory expectations on moorings for floating wind and marine devices**

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# Regulatory expectations on moorings for floating wind and marine devices

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Foundations for renewable energy structures continues to evolve, including the introduction of turbines tethered to the sea bed by cable and mooring systems often known as “floating turbines”. Although this has similarities for oil and gas installations, there are significant differences, especially in terms of the potential to cause harm to the environment or people. It is therefore essential that the navigational and health and safety regulatory expectations for the mooring systems are set in proportion to the potential risks with a view to develop a safe and sustainable industry for the long term.

Established good practice in related sectors such as the offshore oil and gas industry should be referred to as a starting point in developing guidance specific to this industry. With this view, the ***Offshore Information Sheet (OIS) No. 4/ 2013 on Offshore Installation Moorings – Rev 2 Nov 2016*** may be used to draw up design specifications for new mooring systems. While complete compliance is not the intention, the principles implied are considered essential as outlined below.

## Overall Aim

The duty holder shall ensure that an offshore renewable energy installation (OREI) and its moorings possesses such integrity, throughout its lifecycle, as is reasonably practicable to ensure the health and safety of persons at work and/or those affected by the operation of the said device.

The design of the OREI and its mooring should ensure that:

- it can withstand such forces acting on it as are reasonably foreseeable;
- its construction, commissioning, operation, modification, maintenance and repair of the installation may proceed without prejudicing its integrity;
- it may be decommissioned and dismantled safely;
- in the event of reasonably foreseeable damage to the installation or its moorings, it will retain sufficient integrity to enable action to be taken to safeguard the health and safety of persons on or near it.

Reasonable foreseeable considerations include:

- Environmental conditions, e.g. winds, waves, water depth, tidal and current conditions;
- Loads during operational conditions including normal operation, contact loads from access boats and temporary loads maintenance operations.
- Moving the OREI including tow out to site;
- The weight of the installation and anything on it, buoyancy, drag and inertia forces from movement of the OREI;
- Unplanned incidents including vessel impact; and
- Mooring failure (thereby becoming a navigational hazard to third parties).

## Safety Management System

The safety management system for the design, fabrication/manufacturing, installation, operation, maintenance and decommissioning of an OREI and its mooring system should as a minimum demonstrate compliance with the legislation listed in Annex 1.

## Design

Although there is no specific standard for all types of OREIs mooring designs, various classification societies have their own standards which include but not limited to:

- DNV-OS-J103 - Design of Floating Wind Turbine Structures
- ClassNK - Guidelines for Offshore Floating Wind Turbine Structures
- ABS code "Guide for Building and Classing Floating Offshore Wind Turbine Installations

Furthermore ISO 19901-7:2013 provides standards for station keeping systems for floating offshore structures and mobile offshore units in the oil and gas sector, principles and guidance within can be used in the renewable sector to the duty holder's advantage. The various standards sometimes also refer to other standards for more specific subjects such as materials technology or mooring systems. The duty holder should demonstrate that they have designed, manufactured or installed the mooring system in accordance with, where appropriate, internationally recognised standards or guidelines, proportional to the reasonably foreseeable considerations anticipated. Records of the key decisions made should be kept in a suitable form such as a design report or decision log.

## **Hardware**

All permanent mooring components must be of an appropriate standard, quality and certified by an independent competent body such as a class society, or similar, for its material composition.

## **Installation**

The installation of a mooring system as part of an OREI development will be subject to the Construction (Design and Maintenance) Regulations 2015 (CDM). A key element of CDM is that the duty holder should manage risks by the application of the principles of prevention. Where possible risk should be eliminated. Risks that cannot be eliminated should be reduced as far as is reasonable practicable. Residual risk should be managed with collective measures being provided before personal protective equipment.

The designer of the mooring system must take into account these principles and any pre-construction information provided (as defined within CDM) to eliminate, so far as is reasonably practicable, foreseeable risks to the health or safety of any person:

- carrying out or liable to be affected by construction work;
- maintaining the mooring system or OREI; or
- using the OREI as a workplace.

For example, the designer should consider installation techniques which, if reasonably practicable, remove diving operations.

The designer should provide sufficient information to enable the installation contractor to plan, manage and monitor work to install the mooring system so that any residual risk is, in accordance with the principles of prevention, reduced so far as is reasonably practicable.

Suitable and sufficient risk assessments shall be carried out by a competent person to determine a safe system of work for installation.

Suitable tests should be carried out to ensure that it has been correctly installed for safe operation.

## **Operation**

Integrity management is a vital part of long term operations. The design risk assessment, or similar, for the mooring system should prior to installation determine frequency and location of inspection, and control measures required to maintain suitability actions to be taken in the event of mooring system impairment. Mooring Integrity Guidelines, API RP 21 and API RP 2SM “In-service Inspection of Mooring Hardware for Floating Structures” although primarily for the oil and gas, could assist in determining the nature and frequency of the inspection required for OREIs.

### **Monitoring**

There must be a provision for the continuous monitoring of the floating wind or marine device by way of position monitoring using GPS or other suitable means that could alert a remote monitoring centre in case of mooring failure.

### **Verification**

Third party verification (TPV) by an independent competent person / body is considered necessary to ensure quality in design, fabrication and operation. This should bring in technical expertise and independent oversight. TPV is a continuous activity that requires specifying performance standards for each safety and environmentally critical system (SECE). These (items designated as SECEs and their performance standards) are agreed between the duty holder and the verifier, who then verifies against the agreed performance standard. If there is a modification to the mooring system or new information comes to light on its reliability then it should be subject to further TPV.

## **Annex 1: Applicable Legal Requirements**

The primary legislation is the Health and Safety at Work Etc Act 1974 s2 and s3 to ensure the health and safety of persons either at work or affected by work activities.

Management of Health and Safety at Work Regulations (MHSWR) 1999 requirements include but not limited to:

- Reg 3 requires a suitable and significant assessment of the risks to the health and safety of his employees and others who may be affected, for the purpose of identifying the measures to comply with the requirements and prohibitions imposed by the relevant statutory duties. The significant findings should be recorded;
- Reg 5 requires an employer to make and give effect to such arrangements as are appropriate, having regard to the nature of his activities and the size of his undertaking, for the effective planning, organisation, control, monitoring and review of the preventive and protective measures; and
- Reg 7 requires the employer to appoint suitable competent persons to assist him in undertaking the measures he needs to take to comply with the requirements and prohibitions imposed upon him by or under the relevant statutory provisions.

Provision and Use of Work Equipment Regulations (PUWER) 1998 requirements include but not limited to:

- Reg 4 requires employers to ensure that work equipment is so constructed or adapted as to be suitable for the purpose for which it is used or provided. In addition, when selecting work equipment, every employer shall have regard to the working conditions and to the risks to the health and safety of persons which exist in the premises or undertaking in which that work equipment is to be used and any additional risk posed by the use of that work equipment;

Reg 6 requires Every employer shall ensure that, where the safety of work equipment depends on the installation conditions, it is inspected –

- (a) after installation and before being put into service for the first time; or
- (b) after assembly at a new site or in a new location,

Supply of Machinery Regulations – ESHR include (1.3.1 and 1.3.2):

- Machinery and its components and fittings must be stable enough to avoid overturning, falling or uncontrolled movements during transportation, assembly, dismantling and any other action involving the machinery. If the shape of the machinery itself or its intended installation does not offer sufficient stability, appropriate means of anchorage must be incorporated and indicated in the instructions.
- The various parts of machinery and their linkages must be able to withstand the stresses to which they are subject when used. The durability of the materials used must be adequate for the nature of the working environment foreseen by the responsible person, in particular as regards the phenomena of fatigue, ageing, corrosion and abrasion.
- The instructions must indicate the type and frequency of inspections and maintenance required for safety reasons. They must, where appropriate, indicate the parts subject to wear and the criteria for replacement.

## Annex 2: References

### Legislation

1. Health and Safety at Work Etc Act 1974
2. Construction (Design and Maintenance) Regulations 2015 (CDM)
3. Management of Health and Safety at Work Regulations (MHSWR) 1999
4. Supply of Machinery Regulations 2008
5. Provision and Use of Work Equipment Regulations (PUWER) 1998

### Guidance

6. Offshore Information Sheet (OIS) No. 4/ 2013 on Offshore Installation Moorings – Rev 2 Nov 2016 – HSE
7. DNV-OS-J103 - Design of Floating Wind Turbine Structures
8. Class NK - Guidelines for Offshore Floating Wind Turbine Structures
9. ABS code "Guide for Building and Classing Floating Offshore Wind Turbine Installations
10. ISO 19901-7:2013 - Petroleum and natural gas industries. Specific requirements for offshore structures. Station keeping systems for floating offshore structures and mobile offshore units
11. API Recommended Practice 2I - In-service Inspection of Mooring Hardware for Floating Structures, Third Edition
12. API Recommended Practise - 2SM -Design, Manufacture, Installation, and Maintenance of Synthetic Fiber Ropes for Offshore Mooring – 2<sup>nd</sup> Edition