PROGETTO PER LA REALIZZAZIONE DI UN IMPIANTO PER LA PRODUZIONE DI ENERGIA MEDIANTE LO SFRUTTAMENTO DEL VENTO NEL MARE ADRIATICO MERIDIONALE - BARIUM BAY
74 WTG – 1.110 MW

PROGETTO DEFINITIVO - SIA

Progettazione e SIA

Indagini ambientali e studi specialistici

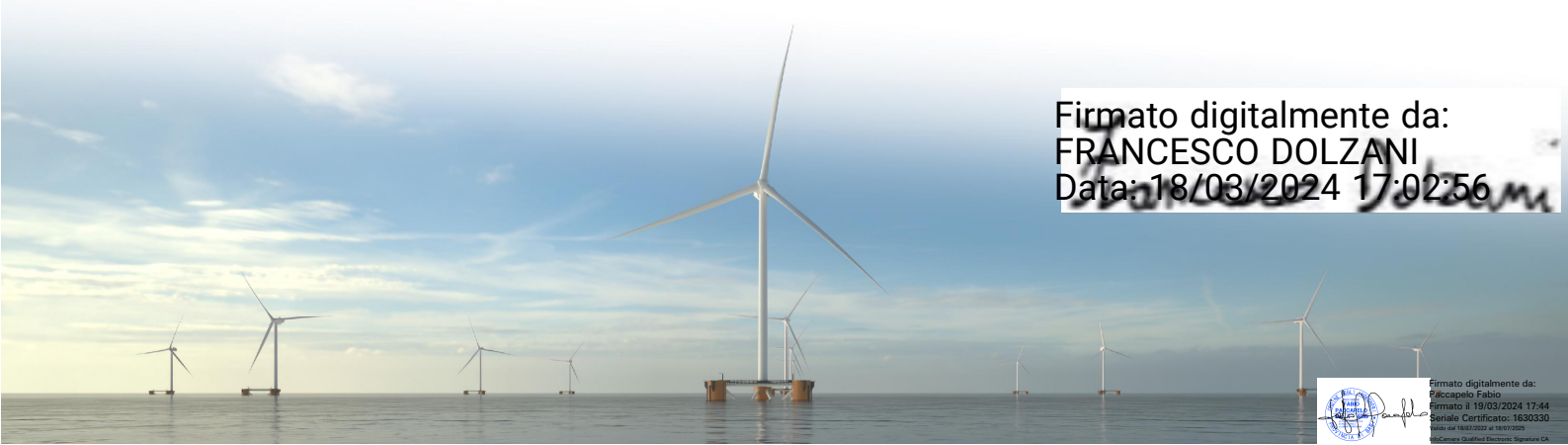
Studio misure di mitigazione e compensazione

supervisione scientifica

7. CANTIERIZZAZIONE, MANUTENZIONE E DISMISSIONE

R.7.3 Indicazioni gestionali sulle attività O&M

REV.	DATA	DESCRIZIONE
00	03/24	integrazioni MASE



INDICE

1. PREMESSA

Scopo del presente documento è fornire le linee guida, l'identificazione delle principali attività di gestione e manutenzione per il parco eolico Barium Bay, costituito da 74 aerogeneratori di potenza unitaria di 15 MW, per una potenza complessiva d'impianto pari a 1110 MW, sito al largo del tratto di costa tra Bari e Barletta.

In particolare, nel presente documento si è proceduto a indicare maggiori dettagli rispetto alle macro attività riportate nell'elaborato già allegato al progetto denominato R.7.1.

Ad ogni modo, si tenga conto che le tecnologie previste per questo impianto sono di recente introduzione e ad oggi sono in esercizio pochissimi, tutti tranne il recentissimo Tampen, costituiti da massimo 5 turbine: ciò comporta che non vi è ad oggi una esperienza significativa per poter comporre uno storico previsionale di attività di manutenzione programmata.

Project	Commissioning date	#	MW single	MW tot	System	Status	Consent	Water depth	Country	Classification	Configuration
Zefyros (fmr Hywind I)	2009	1	2.3	2.3	Hywind I	Online	Permit approved	150	NORWAY	Ballast stabilised	Spar
Goto Sakiyama 2016	2016	1	2.1	2.1	Toda Spar	Online	Permit approved	96	JAPAN	Ballast stabilised	Spar
Hywind Scotland	2017	5	6	30	Hywind II	Online	Permit approved	105	UK	Ballast stabilised	Spar
Floatgen	2018	1	2	2	Damping Pool	Online	Permit approved	33	FRANCE	Waterplane stabilised	Barge w/ damping pool
Hibiki	2018	1	3	3	Damping Pool	Online	Permit approved	55	JAPAN	Waterplane stabilised	Barge w/ damping pool
WindFloat Atlantic	2019	3	8.4	25.2	WindFloat	Online	Permit approved	93	PORTUGAL	Waterplane stabilised	Semisub
Kincardine Tranche 2	2021	5	9.5	47.5	WindFloat	Online	Permit approved	60	UK	Waterplane stabilised	Semisub
TetraSpar Demo	2021	1	3.6	3.6	TetraSpar	Online	Permit approved	200	NORWAY	Ballast stabilised	Pendulum
Yangxi West Shapa Demo	2021	1	5.5	5.5	TH Floater	Online	Permit approved	27	CHINA	Waterplane stabilised	Semisub
Hywind Tampen	2022	11	8.6	94.6	Hywind III	Online	Permit approved	260	NORWAY	Ballast stabilised	Spar

2. INQUADRAMENTO DELLE ATTIVITÀ DI GESTIONE E MANUTENZIONE

Come per tutte le tipologie di opere, le attività di manutenzione possono essere suddivise in:

- Manutenzione preventiva
- Ispezione
- Manutenzione correttiva

In generale tutte le opere previste sono progettate e realizzate con standard qualitativi tali da richiedere un intervento minimo di manutenzione in circostanze normali. I sistemi di controllo, in particolare, sono dotati di caratteristiche di sicurezza che consentono di massimizzare la protezione dell'integrità del sistema in condizioni ambientali estreme durante le operazioni: se si verificano condizioni meteorologiche estreme durante le normali operazioni, i sensori di bordo del floater e dell'aerogeneratore attiveranno l'arresto del funzionamento.

Il personale addetto all'ispezione e alla manutenzione monitorerà le prestazioni delle varie componenti interpretando i problemi di avviso delle varie apparecchiature e componenti del sistema. Le telecamere di bordo e una gamma completa di altri sensori possono essere utilizzati per consentire la sorveglianza e l'interazione remota con il sistema. La gamma di sensori installabili ha tre obiettivi principali: monitoraggio, diagnosi, abilitazione e supporto agli interventi da remoto.

2.1 MANUTENZIONE PREVENTIVA

Le attività di manutenzione preventiva devono essere intraprese secondo i manuali dei produttori, su base periodica, per monitorare le condizioni del sistema, prevenire il degrado dei componenti e intervenire (riparare/sostituire) prima che l'apparecchiatura si guasti, evitando tempi di fermo imprevisti.

L'evoluzione delle condizioni delle attrezzature e delle strutture nel corso della vita guiderà il continuo aggiornamento del piano di manutenzione. Le specifiche tecniche di manutenzione dipendono dalle apparecchiature da mantenere, che devono essere definite durante le fasi di ingegneria. La maggior parte delle opere è composta da componenti standard del settore che richiedono poca manutenzione.

2.2 ISPEZIONE

Lo scopo delle ispezioni strutturali periodiche è quello di monitorare l'integrità delle strutture, sia al di sopra che al di sotto del livello medio dell'acqua, compresi i cavi inter-array e i sistemi di ormeggio. L'ambito e la periodicità delle ispezioni strutturali periodiche sono determinati dall'ente di classificazione incaricato, ove applicabile.

Per i vani meno accessibili senza scale, sono richiesti anche tecnici con competenze specifiche. Per ridurre al minimo l'impiego di questa categoria di tecnici, le ispezioni possono essere effettuate anche da velivoli senza pilota pronti per il mercato o, per i compartimenti sommersi, da ROV portatili.

Le grandi ispezioni subacquee devono essere eseguite da un ROV dispiegato da qualsiasi imbarcazione con capacità DP2 di posizione dinamica e gru idonea per il dispiegamento di ROV.

2.3 MANUTENZIONE CORRETTIVA

La manutenzione correttiva verrà eseguita quando una parte delle apparecchiature incorre in guasti o se le condizioni di deterioramento aumentano il rischio di guasto, richiedendo un'azione correttiva per prevenire guasti successivi. La piattaforma galleggiante è progettata per consentire la sostituzione dei componenti offshore. L'accento sarà posto sui mezzi di movimentazione dei materiali per consentire la rimozione rapida e sicura e la reinstallazione delle parti. I componenti di grandi dimensioni possono essere riparati a terra, quando possibile.

2.4 SOSTITUZIONE DEI COMPONENTI PRINCIPALI E MANUTENZIONE STRAORDINARIA

In caso di sostituzione di un componente importante del sistema floater-aerogeneratore, si dovrà prevedere il ritorno al porto. Si tratta di rimorchiare la piattaforma in porto in modo che il componente interessato possa essere sostituito utilizzando strutture a terra in un ambiente protetto.

La piattaforma è progettata con connettori di ormeggio della piattaforma plug-and-play e un I-Tube scollegabile, che può essere facilmente collegato nel processo inverso rispetto all'installazione, entrambe operazioni da eseguire in meno di 24 ore. La soluzione I-Tube flottante impedisce una perdita di produzione di energia a livello di array derivata da una potenziale manutenzione correttiva di grandi dimensioni, garantendo così una produzione ininterrotta dalle unità rimanenti mentre l'unità interessata è in transito e in riparazione.

L'operazione di rimorchio a porto viene eseguita secondo le seguenti fasi:

- Allestimento logistica in porto
- Allestimento piattaforma
- Dispiegamento I-tube
- Scollegamento sistema di ormeggio
- Traino offshore e relative attività di zavorramento
- Ormeggio piattaforma lato banchina
- Intervento di manutenzione straordinaria
- Traino offshore e ricollegamento I-tube e sistema di ormeggio

Altre strategie di intervento, attualmente in fase di sviluppo per questa tipologia di opere, possono includere navi con gru galleggianti per carichi pesanti.

2.5 PARTI DI RICAMBIO E REQUISITI DI STOCCAGGIO

Data l'importanza dell'opera, dovrà essere previsto un inventario di parti di ricambio critiche e non critiche. suddivisibile in 6 categorie:

- Sistema di zavorra: include pompe di zavorra, pompe di sentina portatili, pannelli VFD, ventole di ventilazione e ricambi associati come guarnizioni, giunti, tenute, cuscinetti, ecc.
- Tubazioni e valvole: tubazioni di zavorramento, valvole e raccordi.
- Sistemi di alimentazione: cavi di alimentazione, prese di alimentazione, modulo di alimentazione UPS, interruttori di alimentazione
- Attrezzatura di supporto sul campo: pompe dell'acqua di mare, pezzi di ricambio per gru (grasso, bulloni, ecc.) e ormeggio ricambi verricello
- Struttura secondaria: bulloneria e staffe per grigliato e corrimano, anodi • Strumentazione: ausili alla navigazione, inclinometri, trasmettitori di pressione, trasmettitori di livello, rilevatori di perdite, tra l'altro
- Per quanto riguarda i sistemi di cavi di ormeggio e inter-array, le raccomandazioni sui pezzi di ricambio sono guidate dagli articoli con il tempo di consegna più lungo, che sono tipicamente la cima di ormeggio e il cavo inter-array.

3. STRUTTURE GALLEGGIANTI E SOMMERSE

Premesso che le strutture in acciaio navale, unitamente al sistema di protezione alla corrosione, sono progettate per rimanere integre per tutta la vita di servizio di progetto, assicurando un certo grado di ridondanza e un margine di sicurezza che varia a seconda dell'importanza del componente, o connessione, e alla sua accessibilità per ispezioni e riparazioni. Quindi, ad esempio, in fase di design alle strutture che sono fondamentali per l'integrità strutturale globale della piattaforma, sono soggette all'accumulo dei danni a fatica delle onde e possono essere inaccessibili alle ispezioni, sono applicati dei coefficienti di sicurezza "alti" (fino a 10).

Tuttavia, danni accidentali, ambiente marino (corrosività, erosione del fondale, depositi e incrostazioni) e usura dovuti al normale utilizzo dei sistemi della piattaforma richiedono una corretta routine di manutenzione di tutte le parti strutturali per ridurre i costi di esercizio e prolungare la vita di servizio.

Un buon programma di manutenzione comporta un'analisi regolare e approfondita di tutti gli elementi vitali e ispezionabili. Queste ispezioni consentono di diagnosticare potenziali problemi prima che si traducano in riparazioni importanti. Con queste informazioni è possibile programmare in anticipo le riparazioni e la manutenzione preventiva, controllando così i costi operativi e i tempi di inattività. Inoltre, le ispezioni possono essere importanti per stimare e aggiornare la vita dei componenti strutturali, tenendo una cronologia temporale dei carichi applicati che consideri anche eventi non attesi.

I principi, le linee guida e i requisiti per i programmi di ispezione e manutenzione per le opere offshore sono forniti nello standard DNV-ST-0145 per le sottostazioni offshore e DNVGL-RU-OU-0512, emessa nel 2020 specificatamente per le strutture dei parchi eolici galleggianti e che qui si allegano, con specifico riferimento al capitolo

Lo standard richiede la preparazione di un programma basato sulla valutazione del rischio, che deve essere sviluppato già in fase di progetto e deve considerare la vita di progetto dei componenti della piattaforma.

Generalmente, l'intervallo delle ispezioni degli impianti a mare non eccede l'anno. Si inizia già nelle prime fasi della vita operativa con una prima ispezione, che fornisce una valutazione delle condizioni iniziali dei sistemi. Le ispezioni si susseguono poi periodicamente in accordo al programma di ispezione e manutenzione, il quale può essere rivisto e adeguato sulla base dei risultati delle ispezioni precedenti. Il personale conivolto deve possedere competenza specifica nel design della sottostazione, nei sistemi di bordo e nelle tecniche di manutenzione previste.

Le strutture emerse che necessitano di ispezione, sia per le strutture galleggianti che per quelle della sottostazione sono:

- strutture di piano e di elevazione (gambe, diagonali, pareti);
- passerelle e scale;
- j-tube;
- strutture di approdo e parabordi;
- dispositivi di sollevamento;
- piano di appontaggio (helideck);
- scialuppe.

Per questi elementi le ispezioni saranno focalizzate principalmente su:

- eventuali ammaccature e deformazioni;
- danni a fatica;
- serraggio delle bullonature;

- corrosione.

Il piano di appontaggio (helideck) dovrà essere sempre tenuto pulito e libero da acqua o altri agenti che potrebbero rovinare la superficie e compromettere la visibilità della segnaletica (marking). Nello specifico, l'ispezione strutturale interesserà:

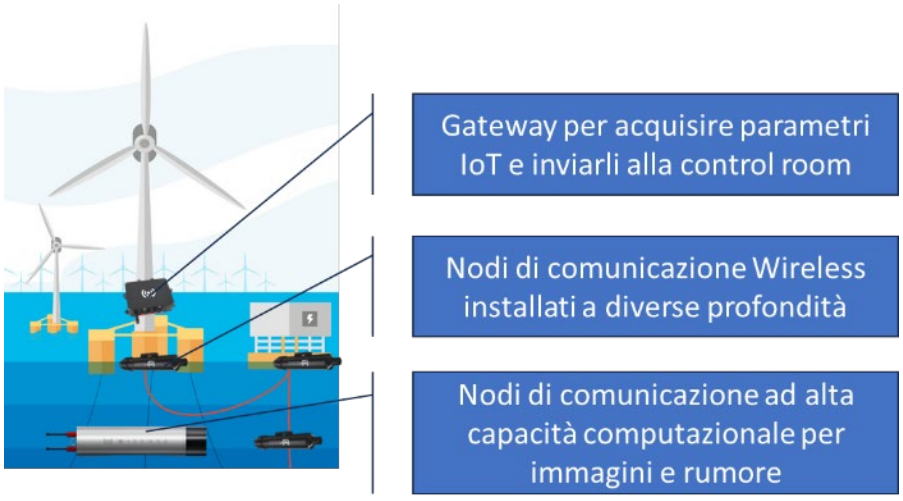
- struttura di connessione al topsides;
- landing net;
- safety net perimetrale;
- punti di tie-down;
- indicatori di vento.

L'ispezione delle strutture nella splash zone e immerse riguarderà inoltre l'integrità dei sistemi anticorrosivi (controllo degli spessori dei tubi, degli anodi, del coating), gli spessori dell'accrescimento marino sulle strutture e fenomeni erosivi del fondale attorno ai pali e ai cavi.

3.1 MONITORAGGIO MEDIANTE TECNICHE WIRELESS

Come riportato anche in relazione ai sistemi che si intende utilizzare per la gestione dell'Operation Technology, in vista di possibili scenari futuri in cui il supporto della tecnologia e dell'intelligenza artificiale sarà essenziale nel semplificare le attività di gestione e manutenzione, oltre che nel migliorarne sensibilmente efficacia e affidabilità, già in questa fase è stata avviata la messa a punto, in collaborazione con **WSense** (https://wsense.it), un sistema di monitoraggio infrastrutturale in grado di assicurare un riscontro continuativo sullo stato delle infrastrutture.

Su ogni struttura immersa delle pale eoliche verranno inseriti sensori wireless a diverse profondità collegati con il gateway incorporato alla pala eolica sia sulla struttura galleggiante che sui tiranti che sulle giunture. Il monitoraggio verrà effettuato sia sul pali di sostegno che sulle fondazioni che sulle mooring lines.



Lo stesso monitoraggio wireless verrà effettuato sulla sottostazione di storage fissa e su ogni fondazione.

I parametri strutturali rilevanti per evidenziare cedimenti strutturali:

- corrosione strutture metalliche,
- inclinometri,
- estensimetri,
- tensioni,
- vibrazioni,
- accelerometri 3D,
- analisi del seabed,

- rumore,
- immagini.

Lo scopo è stimare il MTBF (mean time between failures) al fine di abbattere i costi di manutenzione ed i fermi operativi delle macchine. Tali tecnologie verranno tutte implementate al fine di essere integrabili con i sistemi SCADA tradizionali utilizzati nella gestione della produzione dell'energia delle pale eoliche.

4. APARECCHIATURE ELETTRICHE ED ELETTROMECCANICHE

In impianti con installazione offshore, anche per ottimizzare gli interventi di manutenzione richiesti, tutte le apparecchiature elettriche sono permanentemente monitorate dal sistema di supervisione di sottostazione che segnala istantaneamente al sistema di controllo remoto l'insorgere di anomalie per un tempestivo intervento.

In aggiunta, si prega di considerare il set di attività manutentive e loro periodicità di seguito elencato come indicativo, ad ogni modo definito e concordato con il fornitore prescelto delle diverse macchine.

TRASFORMATORI e REATTORI SHUNT

Verifica	Frequenza
Letture dispositivi misurazione	registrazione continua e invio a sistema di controllo remoto
Registrazione operazioni OLTC	
Livelli olio conservatore	
Livello olio tasche alloggiamento	ogni 6 mesi
Pulizia isolatori	
Funzionamento e calibrazione dispositivi	ogni anno
Misura isolamento avvolgimenti (con Megger)	
Misura rigidità dielettrica olio	
Analisi olio trasformatore	
Pulizia radiatori	
Condizione essiccatore	ad ogni visita della squadra manutentiva in piattaforma
Funzionamento ventilatori	
Stato collegamenti messa a terra	
Assenza perdite olio	
Misura capacità e tanδ isolatori	ogni 2 anni

GIS

Verifica	*Frequenza*
Letture dispositivi misurazione	*registrazione continua e invio a sistema di controllo remoto*
Controllo della superficie delle guarnizioni per eventuali danni meccanici, danni da corrosione o anomalie e per contaminazione.	*dopo 2 anni*
Controllare le condizioni esterne annotando il contatore dei cicli di commutazione	*dopo 12 anni o numero di interruzioni definite dal fornitore*
Controllare visivamente che il disco di rottura con la piastra di protezione non sia danneggiato	
Controllare il funzionamento dei riscaldatori anticondensa	
Controllare connessioni (cavi e pressacavi) e serrare i terminali se necessario	
Controllare la pressione di riempimento del gas con un manometro di precisione	
Controllare il funzionamento dei monitor di densità	
Verificare il funzionamento dei circuiti di sgancio (interruttori automatici)	
Verificare il funzionamento degli interblocchi (interruttori)	
Verificare il funzionamento degli interblocchi SF6 (interruttori automatici)	
Verificare il funzionamento della funzione antipompaggio (interruttori)	
Controllare circuito controllo (interruttori automatici)	
Controllare le condizioni esterne annotando il contatore dei cicli di commutazione	*dopo 25 anni o numero di interruzioni definite dal fornitore*
Controllare visivamente che il disco di rottura con la piastra di protezione non sia danneggiato	
Controllare il funzionamento dei riscaldatori anticondensa	
Controllare connessioni (cavi e pressacavi) e serrare i terminali se necessario	
Controllare la pressione di riempimento del gas con un manometro di precisione	
Sostituire i filtri	
Controllare il contenuto di umidità del gas SF6	
Misurare il contenuto di aria del gas SF6	
Eseguire la prova di tenuta sull'impianto	
Controllare il funzionamento dei monitor di densità	
Controllare l'attuatore (interruttori automatici)	
Verifica attuatore (modulo sezionatore e sezionatore di terra, messa a terra in corso e sezionatore di terra rapido)	

Verifica	***Frequenza***
Verificare il funzionamento dei circuiti di sgancio (interruttori automatici)	
Verificare il funzionamento degli interblocchi (interruttori)	
Verificare il funzionamento degli interblocchi SF6 (interruttori automatici)	
Verificare il funzionamento della funzione antipompaggio (interruttori)	
Controllare circuito controllo (interruttori automatici)	
Controllare i collegamenti elettrici, serrare i terminali se necessario	
Verificare la regolazione del giunto di dilatazione di rimozione	
Controllare i collegamenti elettrici nella morsettiera o nel quadro elettrico, serrare i terminali se necessario	

DNV·GL

RULES FOR CLASSIFICATION

Offshore units

DNVGL-RU-OU-0512 Edition October 2020

Floating offshore wind turbine installations

DNV GL AS

FOREWORD

DNV GL rules for classification contain procedural and technical requirements related to obtaining and retaining a class certificate. The rules represent all requirements adopted by the Society as basis for classification.

Any comments may be sent by e-mail to *rules@dnvgl.com*

CHANGES – CURRENT

This is a new document.

The rules enter into force 1 January 2021.

CONTENTS

CHAPTER 1 PRINCIPLES AND PROCEDURES FOR CLASSIFICATION

SECTION 1 INTRODUCTION

1 Introduction

1.1 General

This publication presents *DNV GL rules for classification of floating offshore wind turbine installations*, the terms and procedures for assigning and maintaining classification, including listing of the applicable technical references to be applied for classification.

It supplements DNVGL-SE-0422 *Certification of floating wind turbines* by providing classification services that may be used as part of the design, construction and operation of a floating offshore wind turbine project.

Guidance note:

Class is a service established to ensure impartiality and standardised rules and processes for shipping and offshore assets. A similar service is suitable for floating offshore wind turbine installations, by adopting the knowledge gained from the ship and offshore industries.

Requirements from owners, regulators and other stakeholders vary around the world. This rule set and DNVGL-SE-0422 complement each other by supporting different schemes and preferences for individual projects.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

1.2 Scope

This document covers classification of unmanned floating offshore wind turbine installations of the following design types:

— ship-shaped installations
— barge/pontoon installations
— column-stabilised installations
— cylindrical installations
— deep draught floating installations
— tension leg installations
— floating installations other than above.

1.3 Organisation

This document is divided into four main chapters as follows:

— this chapter is providing general information about classification principles and procedures
— Ch.2 providing general regulations and principles
— Ch.3 providing design and construction requirements
— Ch.4 providing requirements for maintenance of class in the operational phase.

2 Definitions and abbreviations

2.1 Verbal forms

The verbal forms used in this document are defined in Table 1.

Table 1 Verbal forms

Term	*Definition*
shall	verbal form used to indicate requirements strictly to be followed in order to conform to the document
should	verbal form used to indicate that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others
may	verbal form used to indicate a course of action permissible within the limits of the document

2.2 Definitions

The terms defined in Table 2 are used in this document.

Table 2 Definitions

Term	*Definition*
accredited	used by DNV GL in this context as being recognised or authorised by one or more national or international authority or organisation
alteration	change that does not affect the basic character or structure of the installation it is applied to
assessment	act of assessing, appraising or evaluating a condition of a product, process or system
builder	party contracted to build an installation in compliance with the Society's rules
certificate	compliance document referring to a standard that is ratified or accepted by a government, and issued by a third party organisation, see DNVGL-CG-0550 Sec.3
certification	service that comprises assessment of compliance with applicable requirements and issuance of a certificate if compliance is confirmed
class	class is assigned to and will be retained for units or installations, which the Society has found to be in compliance with applicable requirements of the Society's rules
class certificate	certificate targeting an asset and referring to the Society's rules for classification, see DNVGL-CG-0550 Sec.3
class entry	assignment of class to an existing installation
class notation	abbreviation or keyword expressing a specific feature relating to an installation or its machinery, systems and equipment, or service area while referring to specific requirements in the rules
classification	service which comprises the development and maintenance of independent technical standards for units or installations, class rules and standards, and to verify compliance with the rules and standards throughout the unit's or installation's life The extent of and methods for verifying compliance will be decided by the Society to establish reasonable assurance that the relevant rules are complied with.
close-up examination	examination where the details of structural components are within the close visual inspection range of the surveyor, i.e. preferably within reach of hand

Term	*Definition*
coating conditions	— GOOD: condition with only minor spot rusting — FAIR: condition with local breakdown at edges of stiffeners and weld connections and/or light rusting over 20% or more of areas under consideration, but less than as defined for POOR condition — POOR: condition with general breakdown of coating over 20% or more of areas or hard scale at 10% or more of areas under consideration
commissioning	process of assuring that components, equipment and the systems are functioning in accordance with the functional requirements
compliance document	document stating that the issuing organisation has established reasonable assurance that the target complies with all or selected requirements of the standard editions referred to, see DNVGL-CG-0550 Sec.3
concurrent surveys	surveys required to be concurrently completed shall have the same date of completion A survey required to be carried out in conjunction with or carried out as part of another survey shall be completed on or before the completion of the other survey, however, within the time window for that survey.
condition of class	requirement that specific measures, repairs or surveys shall be carried out within a specific time limit in order to retain class
condition on behalf of the flag administration	requirement that specific measures, repairs or surveys shall be carried out within a specific time limit in order to retain the statutory certificate A condition on behalf of the flag administration will be issued only when the Society has been authorised by the flag administration.
condition	general term that includes both condition of class and condition on behalf of the flag administration
contract for construction	contract between the prospective owner and the builder to build an installation
conversion	change that substantially alters the dimensions, carrying capacity or the type of the installation
critical structural areas	areas that have been identified from calculations to require monitoring or from the service history of the subject installation or from similar or sister installations to be sensitive to cracking, buckling or corrosion which would impair the structural integrity of the installation
customer	any person and/or company which has requested the Society's service and/or has entered into a contract for services directly with the Society
declaration	compliance document issued by a first party organisation, see DNVGL-CG-0550 Sec.3
deficiency	failing or shortcoming with respect to applicable requirements
designer	party who created or developed documentation which is submitted to the Society for approval or information
documentation	drawings, descriptions, calculations, reports, procedures and similar information describing the design, construction, installation, testing, operation, maintenance or status of a target, see DNVGL-CG-0550 Sec.3
exceptional circumstances	unavailability of dry-docking facilities, unavailability of repair facilities, unavailability of essential materials, equipment or spare parts, or delays incurred by action taken to avoid severe weather conditions

Term	*Definition*
emergency towing	towing related to an emergency situation normally caused by failure of the installations own propulsion (compare with normal towing)
flag administration	government of the state whose flag the installation is entitled to fly
floating offshore wind turbine installation	floating installation composed of wind turbine(s) (rotor-nacelle assembly), floating support structure of type described by these rules and a station keeping system
floating substation installation	floating installation composed of transformer stations or converter stations, floating support structure of type described by these rules and a station keeping system
guidance notes	additional information containing advice which is not required for the assignment or retention of class, but with which the Society, based on experience, advises compliance
independent tank	self-supporting tank which does not form part of the installation's hull and does not contribute to the hull strength
independent gravity tank	tank with design vapour pressure not exceeding 0.7 bar
interpretation	norms for fulfilling the associated principal requirements as defined by other regulatory bodies on matters which are left to the satisfaction of the flag administration or are vaguely worded These do not preclude the use of other alternative solutions, but these shall be documented and approved for compliance to the principal requirement equivalent to the original interpretation.
lay-up	term used for installations that are out of commission In this state the offshore installations may be at anchorage or permanently moored in a safe harbour.
main character of class	characters showing compliance with a defined set of classification rules for hull and/or machinery
main functions	in the context of these rules for classification: — structural strength — stability, watertight integrity and weathertightness — drainage and bilge pumping — ballasting — power generation (limited to items covered by class) — position keeping.
manufacturer	organisation that manufactures the material or product, or carries out part production that determines the quality of the material or product, or does the final assembly of the product
mechanical completion	verification that the components, equipment and the systems are constructed, installed and tested in accordance with applicable drawings and specifications and are ready for testing and commissioning in a safe manner
memorandum to owner	information related to the installation, its machinery, systems and equipment or applicable requirements A memorandum to owner will be issued in relation to information that does not require any corrective action or survey.
newbuilding	new installation under construction at a builder
non-convention ship	ship or a barge not covered by the international conventions (in these rules the term ship is used for similar units or installations)

Term	*Definition*
non-permanently manned installation	installation which is unattended, but which may be visited regularly, and where its operations are aligned with requirements from the national authority and owner's classification of pre-determined risk severity Such installations are provided with accommodation that is suitable for the intended visits to the installation.
offshore installation	buoyant or non-buoyant construction engaged in offshore operations, and which is designed and intended for use at one particular location for an extended period
overall examination	examination intended to report on the overall condition of the structure
owner	registered owner and/or manager of the installation and/or any other organisation and/or person who has assumed the responsibility for operation of the installation and who on assuming such responsibility has agreed to take over all the duties and responsibilities related to the installation
patrolling	independent and unscheduled check that the applicable processes, activities and associated documentation of the building functions continue to comply with the rules and statutory requirements
plan approval	systematic and independent examination of drawings, design documents or records by the Society in order to verify compliance with the rules or statutory requirements where authorised by the flag administration The extent and method of plan approval will be decided at the discretion of the Society.
plan approval staff	personnel authorized to carry out plan approval and to conclude whether or not compliance with the rules or statutory instruments has been met
port state authority	maritime authority in the country of the installations port of call
position mooring	anchoring system for position keeping at the installations working location
pressure vessel	tank with design gas or vapour pressure exceeding 0.7 bar
procedural requirements	requirements for the process of assessing compliance with technical requirements Procedural requirements cover: — basis for design assessment, i.e. information or documentation requirements — requirements for certification of products — requirements for surveys to assign, maintain and retain class.
prompt and thorough repair	permanent repair completed at the time of survey to the satisfaction of the surveyor, therein removing the need for the imposition of any associated condition of class
quality audit	systematic and independent examination to determine whether established work processes and quality systems are adhered to
quality system	quality management system and established procedures for production and control
quality survey plan	plan that systematically identifies activities related to the classification project (e.g. construction, installation, testing, mechanical completion, pre-commissioning, testing and commissioning) and the extent of involvement each party (i.e. yard's QC, yard's QA, DNV GL and owners (if desired)) will undertake such a plan needs to be submitted to the Society for approval prior to commencement of classification projects
reliability	ability of a component or a system to perform its required function under given conditions for a given time interval

Term	*Definition*
representative tanks	those tanks which are expected to reflect the condition of other tanks of similar type and service and with similar corrosion protection systems When selecting representative tanks account shall be taken of the service and repair history on board and identifiable critical and/or suspect areas.
retroactive requirement	requirement in the rules or a statutory requirement that will enter into force for certain installations in operation and under construction at a given date or at an upcoming survey The retroactive requirement will specify the required actions to be taken in order to retain class or statutory certification. Retroactive requirements related to statutory certification will be issued only if the Society has been authorised to carry out statutory certification on behalf of the flag administration.
rules	independent standard that consist of all requirements, technical and procedural, adopted by the Society as the basis for classification and published in DNV GL's rules for classification and referred documents
sighting survey	survey to confirm that the relevant construction or the equipment is in a satisfactory condition and, as far as can be judged, will remain so until the postponed survey has been carried out
Society	DNV GL AS and its affiliates carrying out classification and statutory certification
safety systems	systems, including required utilities, which are provided to prevent, detect/warn of an accidental event/abnormal conditions and/or mitigate its effects
sister installations	installations that are constructed in a series under one classification contract and of one design
spaces	separate compartments including holds and tanks
statement of compliance	compliance document that is issued by a third party organisation, and is not a certificate, see DNVGL-CG-0550 Sec.3
statutory certification	service with the intention of confirming compliance with regulatory codes and regulations, in agreement with relevant flag administrations
substantial corrosion	extent of corrosion such that assessment of corrosion pattern indicates wastage in excess of 75% of allowable margins, but within acceptable limits
survey	systematic and independent examination and/or testing of an object
surveyor	personnel authorised to carry out surveys and to conclude whether or not compliance has been met
suspect areas	areas showing substantial corrosion and/or are considered by the surveyor to be prone to rapid wastage
technical requirements	requirements for design and construction of a installation, system or component, and the minimum requirements they shall meet during the operational lifetime
temporary conditions	design conditions not covered by operating conditions, e.g. conditions during fabrication, mating and installation phases, and dry transit phases
temporary equipment	equipment intended for use on board for a period not exceeding 30 months and which is covered by class, requires hook-up to systems covered by class and/or is a significant deck load and/or may pose a risk for fire, explosion and escape routes

Term	*Definition*
temporary mooring	anchoring in sheltered waters or harbours exposed to moderate environmental loads
tentative rules and standards	provisional rules or standards to which DNV GL reserves the right to make immediate and/or retroactive adjustments in order to obtain the purpose intended
(normal) towing	drawing or pulling the installation by a chain or line using a tug boat Normally towing is performed for installations without any propulsion for (re-)location (compare with emergency towing).
transit conditions	all wet installation movements from one geographical location to another
unmanned installation	installation which is unattended, but which may be visited for shorter period, and where its operations are aligned with requirements from the national authority and owner's classification of pre-determined risk severity Such installations are not provided with accommodation.
verification	service that confirms through the provision of objective evidence (analysis, observation, measurement, test, records or other evidence) that specified requirements have been met
weathervaning	installation moored with yoke or turret and able to weathervane
witnessing	attendance of tests or measurements with the intention of verifying compliance with agreed test or measurement procedures

2.3 Abbreviations

Table 3 Abbreviations

Abbreviations	*Description*
BS	British Standard (issued by British Standard Institution)
CG	DNV GL class guideline
CMC	certification of materials and components
CC	condition of class
CA	condition on behalf of the flag administration
CVI	close visual inspection
DAF	dynamic amplification factor
DFF	design fatigue factors
DP	design pressure
FMECA	failure mode effect and consequence analysis
FUI	fatigue utilisation factor
GVI	general visual inspection
IACS	International Association of Classification Societies Unified rules, interpretations, guidelines and recommendations may be found on www.iacs.org.uk.

Abbreviations	*Description*
IC	inspection category
IIP	in-service inspection programme
IMO	International Maritime Organization
ISO	International Organisation for Standardization
HP	high pressure
LRFD	load and resistance factor design
NS	Norwegian standard
MC	machinery continuous
MCBM	machinery condition based maintenance
MIC	microbiologically influenced corrosion
MO	memorandum to owner
MPI	magnetic particle inspection
MPMS	machinery planned maintenance system
MR	machinery renewal
NDT	non-destructive testing
OBP	out of plane bending
OEM	original equipment manufacturer
OS	DNV GL offshore standard
OTG	DNV GL offshore technical guideline
QSP	quality survey plan
RBI	risk based inspection
RCM	reliability cantered maintenance
RNA	rotor-nacelle assembly
RP	DNV GL recommended practice
RR	retroactive requirement
SC	structural continuous
SCF	stress concentration factor
SI	International system of units
SSI	shared structural inspection
SWL	safe working load
UT	ultrasonic testing
WSD	working stress design

3 Normative references

3.1 General

This document includes references to other DNV GL documents and recognised codes and standards which shall be used in conjunction with the requirements given in this document for assignment of class.

3.2 DNV GL reference documents

Applicable DNV GL reference documents are listed in Table 4. See Ch.2 Sec.1 [2.3] for applicable editions.

Table 4 DNV GL reference documents

Document code	*Title*
DNVGL-CG-0550	Maritime services
DNVGL-OS-A101	Safety principles and arrangement
DNVGL-OS-B101	Metallic materials
DNVGL-OS-C101	Design of offshore steel structures, general - LRFD method
DNVGL-OS-C102	Structural design of offshore ships
DNVGL-OS-C103	Structural design of column-stabilised units - LRFD method
DNVGL-OS-C104	Structural design of self-elevating units - LRFD method
DNVGL-OS-C105	Structural design of TLPs - LRFD method (when applicable)
DNVGL-OS-C106	Structural design of deep draught floating units - LRFD method
DNVGL-OS-C201	Structural design of offshore units - WSD method
DNVGL-OS-C301	Stability and watertight integrity
DNVGL-OS-C401	Fabrication and testing of offshore structures
DNVGL-OS-D101	Marine and machinery systems and equipment
DNVGL-OS-D201	Electrical installations
DNVGL-OS-D202	Control and monitoring systems
DNVGL-OS-D301	Fire safety
DNVGL-OS-E301	Position mooring
DNVGL-OS-E302	Offshore mooring chain
DNVGL-OS-E303	Offshore fibre ropes
DNVGL-OS-E304	Offshore mooring steel wire ropes
DNVGL-OS-E401	Helicopter decks
DNVGL-RU-OU-0101	Offshore drilling and support units
DNVGL-RU-OU-0300	Fleet in service
DNVGL-RP-0286	Coupled analysis of floating wind turbines

Document code	Title
DNVGL-SE-0190	Project certification of wind power plants
DNVGL-SE-0422	Certification of floating wind turbines
DNVGL-ST-0119	Floating wind turbine structures
DNVGL-ST-0126	Support structures for wind turbines
DNVGL-ST-0378	Standard for offshore and platform lifting appliances
DNVGL-ST-0437	Load and site conditions for wind turbines
DNVGL-ST-C502	Offshore concrete structures

3.3 Other references

Other normative references are given in Table 5. See Ch.2 Sec.1 [2.3] for applicable editions.

Table 5 Non-DNV GL normative references

Document code	Title
IACS Recommendation No.47	Shipbuilding and Repair Quality Standard, see www.iacs.org.uk

4 Informative references

4.1 DNV GL informative references

The publications listed in Table 6 are referenced in the text of this document, and may be used as a source of supplementary services and information. See Ch.2 Sec.1 [2.3] for applicable editions.

Table 6 DNV GL informative references

Document code	Title
DNVGL-CP-0338	Type approval
DNVGL-CP-0484	Approval of service supplier scheme
DNVGL-RU-SHIP	DNV GL rules for classification: Ships

4.2 Other references

Other references are given in Table 7. See Ch.2 Sec.1 [2.3] for applicable editions.

Table 7 Other references

Document code	Title
ISO 3166	Codes for the representation of names of countries and their subdivisions
ISO 4309	Cranes - Wire rope - Care and maintenance, inspection and discard
ISO 9001	Quality management systems - Requirements

Document code	*Title*
ISO 17359	Condition monitoring and diagnostics of machines - General guidelines
ISO/IEC 17020	Conformity assessment- Requirements for the operation of various types of bodies performing inspection

CHAPTER 2 GENERAL REGULATIONS AND PRINCIPLES

SECTION 1 CLASSIFICATION PRINCIPLES

1 Introduction

Classification provides assurance that a set of requirements laid down in rules established by DNV GL are met during design and construction, and maintained during operation of a floating offshore wind turbine installation.

Classification has gained worldwide recognition as representing an adequate level of safety and quality.

Classification implies an activity, in which an installation is surveyed during construction on the basis of design approval, tested before being taken into service, and surveyed regularly during its whole operational life. The aim is to verify that the required safety standard is built in, observed and maintained.

Having assigned class, DNV GL will issue a classification certificate and enter the main particulars and details of class in the register of vessels classed with DNV GL.

The general regulations and procedures described in DNVGL-RU-OU-0101 Ch.1 *Offshore drilling and support units* shall apply.

2 Applicable rules

2.1 General

These rules lay down technical and procedural requirements related to obtaining and retaining a class certificate for a floating offshore wind turbine installation.

2.2 Equivalent standards

For other types of floating offshore wind turbine installations with design alternatives not explicitly covered by these rules, alternative solutions may be accepted provided adequately documented in order to provide an overall safety standard equivalent with the rules.

National rules and standards may replace the standards referenced in this document on a case by case basis.

2.3 Rule formalities

2.3.1 Unless stated otherwise, the coming into force date for these rules and the DNV GL documents references by these rules as technical basis for classification shall be six (6) months after the date of publication.

2.3.2 In exceptional cases, where unacceptable service experience and/or theoretical findings clearly show that the safety hazards may arise in connection with items covered by the existing rules, DNV GL may lay down supplementary requirements to maintain the overall safety standard reflected by the rules.

2.3.3 DNV GL will consider alternatives found to represent an overall safety standard equivalent to that of the explicit rule requirements provided such alternatives have been worked out according to the principles of the rules. The alternative solution shall be adequately documented and will be reviewed for acceptance on basis of relevant references set forth by DNV GL.

2.3.4 In cases where detailed requirements are not given in the rules, specific solutions or decisions approved by DNV GL and its surveyors shall be based on the principles of the rules. Any deviation from the requirements shall be documented and agreed between all contracting parties.

2.4 Interpretations

2.4.1 These rules and the technical standard as being referred to are based on internationally accepted principal requirements. In cases where these:

a) contain only functional requirements
b) allow alternative solutions to prescriptive requirements or
c) are generally or vaguely worded,

a DNV GL interpretation has been added.

2.4.2 The interpretations are not aiming at introducing additional requirements, but at achieving uniform application of the principal requirements. The interpretations may be regarded as norms for fulfilling the principle requirements.

2.4.3 The interpretations do not preclude the use of other alternative solutions. Such solutions shall be documented and approved for compliance to the principal requirement equivalent to the original interpretation.

2.5 Conversions and alterations

2.5.1 Conversions or alterations of installations shall in general comply with the rules at the time of class assignment. If current rules are less stringent than those originally in force, then the current rules may be applied.

2.5.2 When conversions or alterations involves modifications which:

— substantially alters the dimensions or carrying capacity of the installation (e.g. > 5% change in the installation's displacement), or
— changes the type of installation, or
— changes the main class of the installation,

DNV GL will decide on the rules to be applied.

2.5.3 If the structure, machinery, systems and equipment shall be converted or altered, the changes shall be documented and be approved in the same manner as for new installations.

Guidance note:

Alterations to the structure, machinery, systems and equipment made possible by amendments of the applicable rules may be undertaken provided the general safety and reliability level required for retention of class will be maintained.

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2.5.4 Conversions or alterations shall take place under the supervision of a surveyor.

3 Statutory certification

3.1 General

3.1.1 The Society undertakes statutory certification on behalf of flag administrations when and to the extent the Society has been authorised to do so by the individual flag administration.

Statutory certification includes inter alia approval, survey and the issuance of statutory certificates.

When the Society acts on behalf of a flag administration, the Society follows international statutory instruments, IACS Unified Interpretations and DNV GL statutory interpretations, and generally follows guidance issued by IMO in Circulars etc. unless the flag administration has instructed the Society otherwise.

3.1.2 It is assumed by the Society that required statutory surveys for units classed by the Society will be carried out by the Society or by officers of the flag administration itself and that statutory certificates will be issued by the Society or by the flag administration. The Society assumes the right to withdraw class if statutory certificates are not issued as described in this paragraph.

3.1.3 For a dually Ccassed unit, where the Society has not been authorised by the flag administration to issue statutory certificates, the Society may accept that such certificates are issued by the other class society as authorised by the flag administration.

3.2 Service suppliers

Where surveyors use the services of service suppliers in making decisions affecting statutory requirements, the suppliers shall be approved by either:

— the relevant flag administration
— a duly authorised organisation acting on behalf of the flag administration
— an equipment supplier when explicitly described by IMO conventions, resolutions or circulars, or
— the Society.

4 Interaction with national authorities

4.1 General

These rules are intended for floating offshore wind turbine installations operating under a maritime regime, where the classification concept is used as part of the certification or license regimes for obtaining compliance with applicable national requirements (e.g. regulations of the shelf state and/or flag state administration, as required).

DNV GL will not verify compliance with statutory requirements unless authorised by the national authority or flag state administration.

Guidance note:

Maritime regime usually means that the installation is carrying a flag from a flag state administration. In the context of this document, installations following the principles and referenced standards will be considered to follow a maritime regime even if the installation is not carrying a flag.

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4.2 Installations not following a maritime regime

For installations that are not following a maritime regime, herein referred to as non-convention installations, the classification scope may be subject to modified and/or additional requirements as specified by national authorities in the location of installation.

Guidance note:

In some cases it may be a matter of judgment if the installation can be categorised to follow maritime regime and to which conventions, regulations and requirements the installation shall be designed and operated.

It is recommended that relevant national authorities are contacted for such principal clarification.

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4.3 Use of national standards

Where national authorities require use of national or specific standards, they may be used in lieu of standards referenced in this document provided it can be demonstrated that the overall safety level is equivalent or better than the rules.

Guidance note:

The use of specific national standards may be used as a replacement or in combination with the standards referenced in this document.

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4.4 Dual or double class

Where national authorities require that a specific class society shall be used DNV GL may enter into a dual or double class agreement.

Guidance note:

Dual class means that scope of work is distributed between class societies on a case by case basis. Double class means that both class societies perform the full class scope.

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5 Class scope and notations

5.1 Scope

5.1.1 General

Classification follows the technical scope as described in Ch.3 Sec.1 and covers the design, construction, commissioning and operational phases of floating offshore wind turbine installations.

5.1.2 Associated topics normally not covered by the rules

The items listed below are not covered by these rules, unless agreed otherwise:

— rotor-nacelle assembly (RNA)
— tower for RNA including slewing ring/yaw bearing
— power transmission system for RNA
— inter-array and power export cables

Guidance note:

The items not covered by these rules may be certified according to DNVGL-SE-0190 and parts may be covered by the optional class notation **Wind**.

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5.2 Notations

5.2.1 General

Classed floating offshore wind turbine installations will be given a class designation consisting of:

— construction symbol
— main character of class
— structural design notation
— service notation
— special equipment and systems notations (as applicable)
— special feature notations (as applicable).

5.2.2 Construction symbols

The symbol ✠ will be given to installations built under the supervision of DNV GL.

The symbol ✠ will be given to installations built under the supervision of a recognised classification society and later assigned class with DNV GL.

5.3 Main character of class

5.3.1 The notation ✠**OI Floating offshore wind turbine installation** will be given to installations intended for long term service at one site specific location for a prolonged period with hull, utility and safety systems found to be in compliance with the basic requirements of applicable DNV GL offshore standards referred to in the rules. Temporary conditions are not included unless specifically specified. When moored on location, the additional class notation **POSMOOR** is mandatory. Other types of position keeping systems are subject to special consideration.

5.3.2 There may be cases where the customer wishes to limit the scope of classification to selected areas and items only. Such special class arrangements may be acceptable provided it can be demonstrated that areas and items not covered by classification have, or will be, designed, constructed and maintained to an appropriate recognised standard. The involvement by DNV GL will be specified in the class agreement and reflected in the class notations for the installation.

5.4 Structural design notations

Class notations related to structural design are described in Table 1.

Table 1 Class notations related to structural design

Class notation	*Description*	*Design requirements*	*Survey requirements*
Ship-shaped	Monohull ship structure having displacement hulls.	Ch.3 Sec.1 and Ch.3 Sec.2	Ch.4
Barge	Monohull barge structure having displacement hulls.	Ch.3 Sec.1 and Ch.3 Sec.2	Ch.4
Column-stabilised	A structure dependent on the buoyancy of widely spaced columns for floatation and stability in all modes of operation.	Ch.3 Sec.1 and Ch.3 Sec.2	Ch.4
Cylindrical	A cylindrical shaped displacement hull with or without machinery.	Ch.3 Sec.1 and Ch.3 Sec.2	Ch.4
Deep draught	Spar, deep draught semi or other deep draught floating installation. Spar can consist of multi-vertical columns, single column with or without moonpool (e.g. classic, truss and cell spar). May consist of multi-vertical columns with ring pontoon with or without a heave damping structure.	Ch.3 Sec.1 and Ch.3 Sec.2	Ch.4
Tension leg	A buoyant structure connected to a fixed foundation by pre-tensioned tendons.	Ch.3 Sec.1 and Ch.3 Sec.2	Ch.4

5.5 Additional class notations related to special equipment and systems

Table 2 lists most relevant additional class notations for floating offshore wind turbine installations. A complete list of additional class notations can be found in DNV GL rules for classification: Offshore drilling and support units, DNVGL-RU-OU-0101 Ch.2 Sec.7.

Table 2 Additional class notations

Class notation	*Description*	*Qualifier*	*Rule reference*
Crane	Offshore, shipboard and platform cranes	-	Ch.3 Sec.2 [4]
Cyber secure	Requirements to cyber security for an installation	*	Ch.3 Sec.2 [11]
DDV	Data driven verification	*	Ch.3 Sec.2 [16]
D-INF	Data collection infrastructure	*	Ch.3 Sec.2 [15]
FAB	Additional hull fabrication follow up	*	Ch.3 Sec.2 [8]
FMS	Additional fatigue methodology specification	*	Ch.3 Sec.2 [7]
HELDK	Helicopter deck	*	Ch.3 Sec.2 [3]
HMON	Hull monitoring system	*	Ch.3 Sec.2 [6]
ISDS	Integrated software dependent systems	*	Ch.3 Sec.2 [10]
POSMOOR	Position mooring	*	Ch.3 Sec.2 [2]
Recyclable	Inventory of hazardous materials part 1	-	Ch.3 Sec.2 [9]
Smart	Class services that utilize digital and technical solutions to improve the operational efficiency	*	Ch.3 Sec.2 [14]
Walk2Work	Offshore gangways	-	Ch.3 Sec.2 [5]
Wind	Wind power system including RNA, tower, power generation and transmission system on board the installation (i.e. excluding export power cables)	-	Ch.3 Sec.2 [13]
Winterized	Prepared for operation in cold climate conditions	*	Ch.3 Sec.2 [12]
* These notations contain several optional qualifiers. These are described in the specified rule reference.			

CHAPTER 3 DESIGN AND CONSTRUCTION PROVISIONS

SECTION 1 DESIGN AND CONSTRUCTION REQUIREMENTS FOR OI FLOATING OFFSHORE WIND TURBINE INSTALLATIONS

1 General

1.1 Introduction

1.1.1 This section identifies design and construction requirements common to all types of floating offshore wind turbine installations. Installations complying with these requirements will be assigned ✠**OI Floating offshore wind turbine installation.**

1.1.2 The following discipline areas are covered:

— safety principles and arrangement
— materials
— hull design and fabrication
— stability, watertight and weathertight integrity.

The following systems are covered limited to the hull and its systems, unless the voluntary class notation **Wind** is selected:

— marine and machinery systems and equipment
— electrical systems and equipment
— instrumentation and telecommunication systems
— fire protection.

Guidance note:

RNA, tower and the power generation and transmission system with their associated systems may be covered by voluntary class notation **Wind**.

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1.1.3 Systems and structures will be certified or classified based on the following main activities:

— design approval
— certification of materials and components (CMC)
— survey during construction and installation
— survey during commissioning.

Further description of activity procedures are given in DNVGL-RU-OU-0101 Ch.1 Sec.4.

1.1.4 The requirements of this section are given as:

— references to standards, codes and rules containing technical requirements which shall be complied with for assignment of main class
— supplementary requirements which shall be applied in conjunction with the technical reference documents for assignment of class
— requirements for CMC.

1.2 Technical reference documents

1.2.1 Technical requirements are given by reference to selected:

— DNV GL offshore standards (OS)
— DNV GL class guidelines (CG)
— DNV GL recommended practices (RP)
— DNV GL service specifications (SE)
— DNV GL standards (ST)
— other DNV GL rules and standards
— internationally recognised codes and standards.

1.3 General assumptions

1.3.1 DNV GL may accept alternative solutions found to represent an overall safety level equivalent to that stated in the requirements of this document or the referred standards.

1.3.2 Any deviations, exceptions and modifications to the design codes and standards given as reference documents shall be documented and approved by DNV GL.

1.3.3 Where referred codes and standards specify that the extent of inspections and tests shall be agreed between contractor, manufacturer and customer, the resulting extent shall be agreed with DNV GL.

1.4 Adjustment of scope for unmanned installations

1.4.1 This document is intended for unmanned installations. Where requirements in referenced standards are based on permanently manned installations, the scope for classification may be adjusted to reflect the reduced risk to personnel. Changes in scope shall be approved by DNV GL as specified in [1.3.2].

1.5 Documentation requirements for items not covered by classification

1.5.1 When the RNA, tower and the power generation and transmission systems are not covered by the Society's classification, those systems shall be delivered with certificates issued by an accredited body for the wind farm.

1.5.2 For the items mentioned in [1.5.1] the documentation shall include information that enables the Society to verify a coupled analysis as required in [4.2.2].

2 Safety principles and arrangement

2.1 General

2.1.1 Safety principles and arrangement include the following discipline areas:

— design principles, including generic accidental loads
— arrangement
— communication
— escape

and should comply with the generic safety principles given in DNVGL-ST-0119 Sec.2 and supplemented in DNVGL-OS-A101 Ch.2 Sec.1, DNVGL-OS-A101 Ch.2 Sec.2, DNVGL-OS-A101 Ch.2 Sec.5 and DNVGL-OS-A101 Ch.3, as relevant for the type of installation considered.

2.1.2 Safety requirements for wind turbine installations of specific design shall be worked out to ensure a level of safety equivalent to that required by relevant chapters of the International Convention for the Safety

of Life at Sea, 1974 (SOLAS), as amended or alternatively the Code for the Construction and Equipment of Mobile Offshore Drilling Units, 2009 (IMO MODU Code), and which are covered by the following DNV GL offshore standards:

— DNV GL Offshore standards for structures, see Table 1
— DNVGL-OS-C301 *Stability and watertight integrity*
— DNVGL-OS-D101 *Marine and machinery systems and equipment*
— DNVGL-OS-D201 *Electrical installations*
— DNVGL-OS-D202 *Automation, safety and telecommunication systems*.

2.1.3 Safety requirements for unmanned wind turbine installations may not entirely be suited to follow a maritime regime. The arrangement shall provide a level of safety which is adequate for the installation during its intended operation and shall be clearly described in a project design brief for acceptance by the Society.

Guidance note:

Risk assessment methods may be used to demonstrate acceptable levels of safety.

If the proposed arrangement affects requirements of national regulatory authorities, or where requirements are not concluded, it is recommended that relevant authorities are contacted for principal clarifications/acceptance of the proposed arrangement.

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2.2 Project design brief

The customer shall create a project design brief which describes the design and operational philosophies and limitations. The design brief shall be submitted to the Society for acceptance prior to commencement of the approval process. . Any use of alternative design standards and/or risk mitigations shall be described and justified in order to ascertain that the design will be carried out within an overall safety standard equivalent with the intention of the rules. The design assumptions and approved conditions will be included in the appendix to the classification certificate.

3 Materials

3.1 Technical requirements

Materials for:

— rolled steel for structural applications
— steel tubes, pipes and fittings
— steel forgings
— steel castings
— aluminium alloys

shall comply with the requirements given by DNVGL-OS-B101 Ch.2. Barge type installations shall comply with the material requirements given in DNVGL-OS-C102 Ch.2 Sec.1.

Concrete structures shall comply with DNVGL-ST-C502 *Offshore concrete structures*.

3.2 Supplementary classification requirements

3.2.1 Certification requirements for materials are in general given in DNVGL-OS-B101 Ch.3. For barge type installations the certification requirements to materials are given in DNVGL-RU-SHIP Pt.2 Ch.2 Sec.1 [3.1].

3.2.2 Rolled, forged or cast elements of steel and aluminium for structural application shall be supplied with DNV GL's material certificates.

4 Structural design

4.1 Scope

4.1.1 Class scope shall be defined by the installation type and class notations. It will typically cover the following:

- hull including superstructures as relevant
- structural interfaces between hull and components
- influence from the RNA and tower on hull global motions
- foundations for:
  - towing and mooring equipment
  - launching and recovery appliances for life-saving appliances (as applicable)
  - lifting appliances with safe working load > 30 kN or resulting static overturning moment at deck greater than 100 kNm
  - winches with safe working load > 50 kN
  - equipment with operational weight > 10 tonnes.

Guidance note:

Governmental regulations may cover structures not covered by class scope, e.g. access platforms, handrails, stairs, ladders and other outfitting structures.

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4.1.2 Excluded from the scope are:

- environmental events defined by an annual probability lower than $2x10^{-2}$
- ice loads unless specified
- earthquakes and other exceptional environmental events
- soil conditions, except for anchors as described by DNVGL-OS-E301 Ch.2 Sec.3.

Guidance note:

The annual probability for environmental events is harmonised with the requirements specified in DNVGL-ST-0119.

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4.1.3 Transit conditions are not included in the structural design scope of work, unless otherwise agreed.

4.2 Technical requirements

4.2.1 Structural design standard for different installation types is provided in DNVGL-ST-0119 Sec.7 and supplemented with requirements in Table 1.

Table 1 Overview of structural design requirements and methods

Structure type	*Document code*
Ship-shaped type	DNVGL-OS-C102
Barge/pontoon type	DNVGL-RU-SHIP Pt.5 Ch.11
Column-stabilised type	DNVGL-OS-C103
Cylindrical type	DNVGL-OS-C101

Structure type	*Document code*
Deep draught type	DNVGL-OS-C106
Tension leg type	DNVGL-OS-C105
Concrete structures	DNVGL-ST-C502

4.2.2 The Society shall receive for approval a coupled analysis for the total system of the turbine and foundation including mooring system.

Guidance note:

DNVGL-RP-0286 may be used as a guidance for performing coupled analysis.

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5 Fabrication and testing of structures

5.1 Technical requirements

5.1.1 Requirements for:

— welding procedures and qualification of welders
— fabrication and tolerances
— testing
— corrosion protection systems

shall be in accordance with DNVGL-OS-C401 Ch.2.

For barge/pontoon type installations the requirements are given in DNVGL-RU-SHIP Pt.5 Ch.11

5.1.2 Concrete structures for offshore wind turbine installations shall comply with DNVGL-ST-C502.

5.2 Supplementary classification and certification requirements

5.2.1 Classification procedures specifically related to fabrication and testing of offshore structures are given in DNVGL-OS-C401 Ch.3. For barge type installations, see DNVGL-RU-SHIP Pt.2.

5.2.2 Basic principles for the involvement of class during newbuilding are given in DNVGL-RU-OU-0101 Ch.1 Sec.4 [1.5] to DNVGL-RU-OU-0101 Ch.1 Sec.4 [1.7].

6 Stability and watertight/weathertight integrity

6.1 Technical requirements

6.1.1 Requirements for:

— intact and damaged stability
— watertight integrity
— freeboard
— weathertight closing appliances

shall be in accordance with DNVGL-ST-0119 Sec.10 and supplemented by DNVGL-OS-C301.

6.1.2 The flooding assumptions in a damaged condition, as described by DNVGL-OS-C301, may not be directly transferable to some offshore wind turbine installations and shall be clearly described in the project design brief for acceptance by the Society.

Guidance note:

The project will define the acceptable consequences of flooding in damaged condition, and design accordingly. For example: If it is acceptable that a turbine capsizes and/or sinks as a result of flooding in damaged condition, there will not be a requirement for buoyancy in damaged condition.

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7 Marine and machinery systems and equipment

7.1 Technical requirements

7.1.1 Requirements for marine and machinery systems and equipment include:

— general piping design, fabrication and testing
— pumps, valves and pipe connections
— ballast, bilge and drainage systems
— air, overflow and sounding pipes
— cooling, feed water and condensation systems
— lubricating oil, fuel oil and thermal oil systems
— hydraulic, steam and pneumatic systems
— heating, ventilation and air conditioning systems
— pressure vessels
— anchoring and mooring equipment

and shall be designed, manufactured, tested and installed in accordance with DNVGL-ST-0119 Sec.12 and supplemented by DNVGL-OS-D101.

7.2 Supplementary classification and certification requirements

7.2.1 Classification procedures specifically related to marine and machinery systems and equipment are given in DNVGL-OS-D101 Ch.3.

7.2.2 Certification requirements for equipment are given in DNVGL-OS-D101 Ch.3.

8 Electrical systems and equipment

Electrical systems covered by these rules are limited to the hull and its systems, i.e. not for the RNA, tower and the power generation and transmission system and its associated systems, unless they are covered by voluntary class notation **Wind**.

Electrical systems and equipment include:

— system design
— switchgear and control gear assemblies
— rotating machinery
— static converters
— cables
— miscellaneous equipment
— installation and testing
— A.C. supply systems

and shall be designed, manufactured, tested and installed in accordance with DNVGL-ST-0119 Sec.12 and supplemented by DNVGL-OS-D201.

9 Control and monitoring systems

9.1 Technical requirements

Control and monitoring systems covered by these rules are limited to the hull and its systems, i.e. not for the RNA, tower and the power generation and transmission system and its associated systems, unless they are covered by voluntary class notation **Wind**. Control and monitoring systems and equipment include:

— design principles and system design
— computer based systems
— component design and installation
— environmental conditions
— user interface

and shall be designed, manufactured, tested and installed in accordance with DNVGL-ST-0119 Sec.11 and supplemented by DNVGL-OS-D202.

9.2 Supplementary requirements

Telemetry systems may be designed in compliance with DNVGL-OS-D202.

10 Fire protection

10.1 Technical requirements

Fire protection includes:

— passive fire protection
— active fire protection
— fire fighting systems

and shall be designed, manufactured, tested and installed in accordance with DNVGL-OS-D301 unless there are specific fire safety requirements from a national regulatory authority. The requirements of DNVGL-OS-D301 shall be adapted to the actual risk of an unmanned floating wind turbine installation.

Guidance note:

For an unmanned floating wind turbine installation without combustion machinery installed, the amount of active and passive fire protection will be limited or omitted, except for non-combustible materials used.

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11 Preparation for surveys and inspections on location

11.1 General

11.1.1 It is advised that operational survey and inspection aspects are taken into consideration at the design and construction stages.

Guidance note:

Special consideration should be made for fatigue and corrosion allowances to enable risk based inspection methods to prolong the inspection intervals.

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11.1.2 The following matters will be taken into consideration for acceptance of surveys to be carried out on location:

- arrangement for underwater inspection of hull and openings affecting seaworthiness
- marking of the hull
- means for blanking off all openings
- accessibility of all tanks and spaces for inspection
- corrosion protection of hull or structure
- testing facilities of all important machinery.

Guidance note:

The underwater body should be marked in such a way that the surveyor can identify the location of any damages found. The necessary preparation of the hull should be based on a risk based Inspection plan for frequency and need for access to areas on the installation.

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SECTION 2 ADDITIONAL CLASS NOTATIONS

1 Introduction

1.1 General

1.1.1 This section identifies design and construction requirements for assignment of additional class notations relating to system, equipment and special facility installations.

1.1.2 Floating offshore wind turbine installations fitted with systems and/or special features complying with relevant requirements of this section may be assigned class notations as described.

1.2 Technical reference documents

1.2.1 Technical requirements are given by reference to selected:

— DNV GL offshore standards
— DNV GL classification guidelines
— DNV GL recommended practices
— other DNV GL rules and standards
— internationally recognised codes and standards.

1.2.2 The technical reference documents which shall be applied are given in the following subsections.

1.3 General assumptions

1.3.1 DNV GL may accept alternative solutions found to represent an overall safety level equivalent to that stated in the requirements of this document or referred standards.

1.3.2 The requirements stated in this section for additional class notations shall be regarded as supplementary to those given for assignment of main class and relevant service notations.

2 Position mooring system

2.1 General

2.1.1 **POSMOOR** notation is mandatory for permanently moored floating offshore wind turbine installations, see Ch.2 Sec.1 [5.3.1] and Ch.2 Sec.1 [5.3.2].

2.1.2 Objective

The notation aims to cover the reliability of the mooring system and equipment, for the purpose of ensuring safe position mooring.

2.1.3 Scope

The notation covers the following aspects:

— environmental conditions and loads
— mooring system analysis
— mooring equipment
— tests.

2.2 Application

2.2.1 The notation is complemented with the qualifiers as described in Table 1.

Table 1 POSMOOR class notations

Class notation	*Description*	*Qualifier*	*Description*
POSMOOR	Position mooring system	<none>	Passive position mooring system according the technical requirements of DNVGL-OS-E301 Ch.2
		A	Mooring system designed according to API 2SK
		V	Mooring system designed for positioning in vicinity of other structures

2.3 Technical requirements

2.3.1 The technical requirements of DNVGL-OS-E301 Ch.3 Sec.1 shall be complied with for assignment of the **POSMOOR** notations. For floating offshore wind turbine installations, the environmental events defined by an annual probability lower than $2x10^{-2}$ may be used for the mooring system.

2.3.2 The technical requirements of API 2SK shall be complied for the qualifier **A**.

2.4 Certification of materials and components

Certification of equipment shall be in accordance with DNVGL-OS-E301 Ch.3.

3 Helicopter decks

3.1 General

3.1.1 Floating offshore wind turbine installations fitted with landing platforms for helicopters may be given the class notation **HELDK** together with qualifiers as defined in Table 2.

3.1.2 Objective

The objective of the **HELDK** notation is to ensure the safety and reliability of the helicopter deck structure and safety of the installation in relation with helicopter operations and hangar facilities.

3.1.3 Scope

The scope of the notations is dependent on the qualifiers as listed in Table 2.

Table 2 HELDK class notation

Class notation	*Description*	*Qualifier*	*Description*
HELDK	Helicopter deck	<none>	Structure
		S	Additional requirements to the safety of the installation
		H	Additional requirements to helicopter safety
		F	Additional requirements to helicopter facilities

3.1.4 Application

The qualifiers listed in Table 2 may be individually selected or combined.

3.2 Technical requirements

Technical requirements for **HELDK** shall comply with DNVGL-OS-E401 Ch.2 and DNVGL-RU-SHIP Pt.6 Ch.5 as listed below:

— DNVGL-OS-E401 Ch.2 Sec.1 to DNVGL-OS-E401 Ch.2 Sec.4 for notation **HELDK**
— DNVGL-RU-SHIP Pt.6 Ch.5 Sec.5 [5] for additional requirements for qualifier **S**
— DNVGL-RU-SHIP Pt.6 Ch.5 Sec.5 [6] for additional requirements for qualifier **H**
— DNVGL-RU-SHIP Pt.6 Ch.5 Sec.5 [7] for additional requirements for qualifier **F**.

3.3 Certification of materials and components

The certification requirements are described in DNVGL-OS-E401 and DNVGL-RU-SHIP Pt.6 Ch.5.

4 Crane installations

4.1 General

4.1.1 Objective

The additional optional class notation **Crane** sets requirements for a design standard for on-board permanently installed cranes.

4.1.2 Scope

The scope for additional class notation **Crane** provides requirements for cranes with respect to:

— safety and functionality
— devices for locking the crane in a parked position
— devices for supporting the crane structure.

Two terms are used in this section to describe the intended use of the crane, these are offshore crane for cargo handling outside the installation while at sea and platform crane for cargo handling on the installation.

4.1.3 Application

The additional class notation **Crane** applies to the selected cranes installed on floating offshore wind turbine installations.

See applicable structural standard, i.e. DNVGL-OS-C101 to DNVGL-OS-C201 concerning supporting structure (e.g. pedestal), and DNVGL-OS-C301 concerning stability.

An installation found to be in compliance with the requirements in this section may be assigned the additional class notation **Crane**.

4.1.4 Definitions

Terms defined in Table 3 are used in this chapter.

Table 3 Definitions and abbreviation

Term	*Definition or abbreviation*
offshore crane	a lifting appliance on board an installation intended for handling of loads outside the installation while at sea
platform crane	a lifting appliance on board an installation intended for handling loads within and outside the installation while in dock/harbour and within the installation while at sea

4.2 Technical requirements

4.2.1 Design loads

In addition to the specific design loads given in DNVGL-ST-0378 *Standard for certification of offshore and platform lifting appliances*, loads due to installation motions shall be considered. Design values of linear and angular accelerations are given in DNVGL-OS-C101.

4.2.2 Parking and overturning

Devices shall be provided for all cranes in parked position (at sea) to be anchored to the hull structure. The anchoring devices shall be designed to withstand inertia forces due to motions and loads due to 'out of service' winds. The strength calculations shall be based on accepted principles of statics and strength of materials, applying the safety factors as stipulated for load case III in DNVGL-ST-0378.

4.2.3 Sliding

In parked position, (for an installation at sea), sliding should be prevented by means of anchoring devices, see [4.2.2]. If sliding is intended to be prevented by friction between rail and wheels only, the coefficient of friction shall not be taken greater than 0.15.

4.2.4 For a crane in operation, sliding shall not take place unless the forces parallel to rails exceed 1.3 times the values for load case II in DNVGL-ST-0378. When this is not satisfied, sliding shall be prevented by a device locking the crane in position. The strength of this device shall be based on the safety factors for load case II/load combination II, as referred above.

4.3 Certification

For cranes that class notation **Crane** shall be applied to, the builder shall request the manufacturers to order certification as described in Table 4.

Table 4 Certification requirements

Object	*Certificate type*	*Issued by*	*Certification standard*	*Additional description*
offshore crane	PC	Society	DNVGL-ST-0378	Product certificate after installation and testing on board
platform crane	PC	Society	DNVGL-ST-0378	Product certificate after installation and testing on board
PC - product certificate				

4.4 Testing

After completed installation on board, functional testing and load testing of the crane shall be carried out as specified in DNVGL-ST-0378.

5 Offshore gangways

5.1 General

5.1.1 In case a floating offshore wind turbine installation is equipped with an onboard gangway, this may be assigned class notation **Walk2work**.

5.1.2 Objective

The **Walk2work** clarifies that the gangway has been certified against DNVGL-ST-0358 and that the installation is fit for walk-to-work operations using the gangway.

5.1.3 Scope

The scope of the notation covers the gangway's safety and functionality, devices for locking the gangway in a parked position (at sea) and for supporting the gangway structure and testing of the gangway. In addition, the notation implies that the gangway is approved for operations within the defined most unfavourable envelopes of the installations stability and station keeping capabilities.

5.2 Technical requirements

The technical requirements of DNVGL-RU-SHIP Pt.6 Ch.5 Sec.16 apply, taking into account main class stability requirements as defined in DNVGL-OS-C301.

5.3 Certification of materials and components

The offshore gangway shall have a product certificate issues by the Society against DNVGL-ST-0358.

6 Hull monitoring system

6.1 General

6.1.1 Floating offshore wind turbine installations equipped with instrumentation system for monitoring hull behaviour in accordance with the requirements of this section may be assigned class notation **HMON** as given in DNVGL-RU-SHIP Pt.6 Ch.9 Sec.3.

6.1.2 Objective

The system will give warning when stress levels and the frequency and magnitude of accelerations approach levels which require corrective action and may also be used as input to the class notation **FMS(SENS)**, see [7].

6.1.3 Scope

The owner shall decide how the hull monitoring system should be configured, i.e. which features to be included and how the measured and processed data shall be used.

6.1.4 Application

See DNVGL-RU-SHIP Pt.6 Ch.9 Sec.3 for qualifier definitions.

6.2 Technical requirements

Assignment of **HMON** class notations is based on compliance with DNVGL-RU-SHIP Pt.6 Ch.9 Sec.3.

7 Fatigue methodology specification

7.1 General

7.1.1 Floating offshore wind turbine installations may be assigned an optional fatigue class notation **FMS**. The qualifiers are listed in Table 5.

7.1.2 Objective

The objective of the **FMS** notation is to reduce the probability for fatigue cracks in the hull structure in-service by enhancing fatigue scope in the design and construction phase.

7.1.3 Scope

The **FMS** notation provides enhanced fatigue design scope by requiring:

— spectral fatigue calculations
— additional details to be controlled
— stricter design fatigue factors (DFF).

This ensures that details are adequately designed to meet the required design fatigue life for the specified operation location(s). The result from the fatigue calculations shall be used to develop the required newbuilding inspection plan as detailed in [7.2] and may upon the request from the owner form the basis for an in-service inspection programme, that may be risk based (RBI), specifically made for the installation.

Table 5 Class notations related to fatigue methodology specification

Class notation	*Description*	*Qualifier*	*Description*
FMS	Fatigue methodology specification	**Y**	Calculated design life in years
		NUM	Scope of notation covers fatigue assessment by numerical twin, see DNVGL-RU-OU-0300 Ch.3 Sec.4 [35]
		SENS	Scope of notation covers fatigue assessment by numerical twin and hybrid twin, see DNVGL-RU-OU-0300 Ch.3 Sec.4 [35]

7.2 Technical requirements

Detail requirements for **FMS(Y)** for ship shaped installations are given in DNVGL-OS-C102 Ch.3 Sec.1 [2.1]. For other hull shapes the requirements will be agreed on a project specific basis.

8 Hull fabrication

8.1 General

8.1.1 Floating offshore wind turbine installations with ship-shaped or circular hulls may be assigned the class notation **FAB** as given in Table 6.

Guidance note:

For other hull shapes similar requirements are mandatory and are specified in DNVGL-OS-C401.

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8.1.2 Objective

The objective of **FAB** is to reduce the risk of disruption in the installations lifetime due to repair of possible welding defects from fabrication by increasing the non-destructive testing (NDT) scope during fabrication of hull structure.

8.1.3 Scope

The **FAB** notations cover increased NDT requirements and fabrication tolerances as detailed in Table 6.

Table 6 Class notations related to hull fabrication

Class notation	*Description*	*Qualifier*	*Description*
FAB	Additional NDT scope		Increased scope of NDT
		+	Further increased scope of NDT and tolerance levels aligned with DNVGL-OS-C401

8.2 Technical requirements

Technical requirements are given in DNVGL-OS-C102 Ch.3 Sec.1 [2.4].

9 Recyclable

9.1 General

Floating offshore wind turbine installations may be assigned the class notation **Recyclable** as given in Table 7.

Table 7 Class notations related to environment

Class notation	*Description*	*Qualifier*	*Description*
Recyclable	Safe and environmentally sound recycling of installations		Covering the development of inventory of hazardous materials part 1

9.2 Objective

The objective of **Recylable** is to document compliance with the requirements for inventory of hazardous materials (IHM) set forth by the *IMO Hong Kong Convention for the Safe and Environmentally Sound Recycling of Ships*.

9.3 Technical requirements

The requirements given in the DNVGL-RU-SHIP Pt.6 Ch.7 Sec.4 shall be complied with for assignment of the class notation **Recyclable**.

10 Integrated software dependent systems

10.1 General

10.1.1 Floating offshore wind turbine installations built and tested in compliance with the requirements of DNVGL-OS-D203 may be assigned one of the optional class notations for integrated software-dependent systems shown in Table 8.

Table 8 ISDS class notations

Class notation	*Description*
ISDS [system1,...,system n]	Installations having undergone enhanced software-dependent system integration for the system(s) according to DNVGL-OS-D203

10.1.2 Objective

The objective of **ISDS** is to reduce the risk for delays in new-build projects and modification projects, as well as for downtime and accidents caused by software in the operation phase.

10.1.3 Scope

The systems covered by the notation shall be specified and are as shown by the given qualifiers. The selection of systems is listed in DNVGL-OS-D203 Ch.3 Sec.1 Table 1.

The scope of DNV GL's involvement depends on the confidence level specified.

10.1.4 Application

Any combination of selected systems may be made.

10.1.5 **ISDS** may only be applied for systems as covered by classification through main class and other additional class notations.

10.1.6 Unless otherwise agreed the confidence levels of DNVGL-OS-D203 Ch.3 Sec.1 Table 1 apply.

10.2 Technical requirements

There are no additional technical product requirements.

11 Cyber security

11.1 General

11.1.1 Floating offshore wind turbine installations constructed and tested in accordance with the requirements in DNVGL-RU-SHIP Pt.6 Ch.5 Sec.21 may be assigned the class notation **Cyber secure**, with qualifiers, as outlined in Table 9.

Table 9 Class notation for cyber security

Class notation	*Qualifier*	*Purpose*	*Application*
Cyber secure	<None>	Establish barriers to prevent, mitigate and respond to cyber-attacks	Initial level of cyber security is based on IMO resolution MSC.428(98) and MSC-FAL.1/ Circ.3.
	Essential		Essential level of cyber security for the installations essential systems, see DNVGL-RU-SHIP Pt.6 Ch.5 Sec.21 [1.4.3].
	Advanced		Advanced level of cyber security for the installations essential systems, see DNVGL-RU-SHIP Pt.6 Ch.5 Sec.21 [1.4.4].
	+		Selected level of cyber security for specified system(s), see DNVGL-RU-SHIP Pt.6 Ch.5 Sec.21 [1.4.5].

11.1.2 Objective

The objective of **Cyber secure** is to ensure that sufficient and correctly performed cyber security barriers are established to prevent, mitigate and respond to cyber-attacks.

11.1.3 Scope

The notation covers critical systems, which individually or collectively make up functions subject for cyber security assessment, see DNVGL-RU-SHIP Pt.6 Ch.5 Sec.21 [2].

Guidance note:

For **Cyber secure(+)**, DNVGL-RP-0496 and DNVGL-RP-G108 may be used as guidance for conducting a risk assessment.

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11.1.4 Application

These rules may be applied to any installation where one or more functions are controlled by cyber physical systems. The implementation process for class notation **Cyber secure** constitutes activities by several roles in the relevant phases, see DNVGL-CG-0325 for guidance.

11.2 Technical requirements

System design shall follow the requirements in DNVGL-RU-SHIP Pt.6 Ch.5 Sec.21 [3] and DNVGL-RU-SHIP Pt.6 Ch.5 Sec.21 [4].

11.3 Documentation requirements

For documentation requirements, see DNVGL-RU-SHIP Pt.6 Ch.5 Sec.21 [1.8].

12 Winterized

12.1 General

Floating offshore wind turbine installations designed or prepared for operation within particular geographical or environmental areas may be assigned the voluntary class notation **Winterized**.

12.2 Objective

The objective of the notation **Winterized** is to ensure operational availability of systems in cold climate conditions.

12.3 Scope

The notation **Winterized** includes additional requirements for systems as further detailed in DNVGL-RU-OU-0101 Ch.2 Sec.7 [20.3].

The table below lists the different qualifiers for the **Winterized** notation.

Table 10 Class notation Winterized

Class notation	*Description*	*Qualifier*	*Description*
Winterized	Operation in cold climate	**Basic**	Operation occasionally in cold climate for short periods
		Cold	Operation in cold climate regularly or for an extended period of time, though not necessarily in ice-infested waters
		Polar	Operation in extreme cold climate of the polar regions year-round, typically in ice-infested waters
		t_w	Extreme low ambient air temperature in °C

12.4 Application

For **Winterized**, relevant reinforcement of the installation is mandatory if intended to be installed in ice-infested waters. Additional details are given in DNVGL-OS-A201 Ch.3.

12.5 Technical requirements

The technical requirements are given in DNVGL-OS-A201 Ch.2.

12.6 Certification requirements

The certification requirements are given in DNVGL-OS-A201 Ch.3 Sec.2.

13 Wind turbine and associated systems

13.1 General

Floating wind turbine installations where the RNA, tower and other associated systems are certified by DNV GL may be issued with the voluntary class notation **Wind**.

13.2 Objective

The objective of the **Wind** notation is to ensure that the RNA, tower and other associated systems are certified and suitable for the intended area of operation.

13.3 Scope

The scope of the **Wind** notation includes the following main elements:

— control and protection systems

— loads and structural strength.
— rotor blades
— machinery and housings (nacelle cover and spinner)
— tower and foundation design
— electrical installations
— manuals.

13.4 Application

The class notation **Wind** may be applied to all types of floating wind turbine installations.

13.5 Technical requirements

In order to obtain the **Wind** class notation the wind turbine and associated systems shall be delivered with a project certificate in accordance with DNVGL-SE-0190. The turbine design shall be suitable for installation on a floating offshore wind turbine installation.

14 Smart

14.1 Introduction

The digital technology development with widespread use of digital solutions and increased connectivity available for the wind energy industry, is enabling use of data and information to further optimize installations operations. Enhancements may be achieved by a standalone solution on an installation, but taking out the full potential requires a life cycle perspective for an installation or a fleet of installations. Efficient scale-up requires reliable data collection infrastructures and data management, and a certain level of standardization. The digitalization also introduces new risks towards cyber- and data-security which shall be managed.

DNV GL has a range of notations and services contributing to more effective operations and to ensure that data driven solutions are safe and suitable for the given application.

14.2 Objective

The objective for the **Smart** notation is to promote and visualize a shift towards more efficient and green operations that are based on digital or environmental friendly solutions, enhancing the performance and operation of an installation.

14.3 Scope

The additional class notation **Smart** provides a framework for profiling a variety of class services that utilize digital and technical solutions to improve the operational efficiency or environmental footprint of the installation. The scope of the notation is split in three (2) different qualifiers, each referring to a range of available services or by assessment of novel technology, denoted as enhancements, see [15.5].

These rules do not give guidance on the suitability of the different enhancements or combinations. See DNVGL-CG-0508 for more details and guidance.

14.4 Application

The additional class notation **Smart** may be applied to any installation in operation and to a newbuilding.

14.5 Class notations

Installations built in compliance with the requirements of this subsection and relevant referenced rules and standards, may be assigned the additional notation **Smart** with qualifiers shown in Table 11.

Table 11 Class notations

Class notation	*Qualifier*	*Enhancement category*	*Additional description*
Smart	**OPM**	operations and maintenance - machinery, equipment and systems	operations and maintenance enhancements related to maintenance management of machinery and equipment, condition monitoring, systems and installation performance
	OPH	operations and maintenance - hull and structure	operations and maintenance enhancements related to structural integrity management and performance of hull and structure

14.6 Technical requirements

System design shall follow the requirements in DNVGL-RU-SHIP Pt.6 Ch.5 Sec.24 adopted to be suitable for a floating offshore wind turbine installation.

15 Data collection infrastructure

15.1 Introduction

Optimization of the operations through digitalization requires access to relevant and reliable data collected from sources like sensors, control systems and other types of data acquisition or interfaces where data is made available.

The use of data extends from single parameters to larger data sets providing important information about performance or condition of machinery, equipment or systems, supervisory control, quality assurance to complex models and applications offering predictive analytics like machine learning that can learn from vast quantities of historical data.

With an increasing amount of collected data the need for systems that offer a systematic data collection and storage becomes essential and the use of data collection infrastructures to ensure this function will be necessary.

15.2 Objective

The additional class notation **D-INF** addresses standardisation of data and metadata to support a cost effective, scalable, reliable and secure data collection, storage and exchange of data.

15.3 Scope

The rules for **D-INF** provide requirements for a data collection infrastructure established to facilitate installation-to-shore data exchange with the following main elements:

— data collection infrastructure, network and connectivity
— data quality and security management.

D-INF does not introduce requirements for applicable source systems and solutions.

15.4 Application

D-INF may be applied to any installation in operation and to a newbuilding.

The data collection infrastructure includes those components necessary to collect, manage and relay data from an installation to the data consumer.

A data collection infrastructure includes:

— installation server

— data relay component
— remote data server.

The rules describing installation server, data relay component, network and connectively, may be applied by the yard as part of the newbuilding as applicable. Rules describing requirements for remote data server, data quality and security management, may be applied by the owner.

The rules describing requirements for data quality and security management, see DNVGL-RU-SHIP Pt.6 Ch.11 Sec.1 [4], may be applied to describe applicable requirements for other additional notations and/or survey arrangements covered by the rules.

15.5 Class notations

Installations built in compliance with the requirements in this document may be assigned the additional notation **D-INF** with qualifiers shown in Table 12.

Table 12 Class notations

Class notation	*Qualifier*	*Purpose*	*Application*
D-INF	**P**	A proprietary data collection infrastructure to facilitate the collection and exchange of data.	Based on customized requirements defined by a specific data collection use case.
	S	A standardized data collection infrastructure to facilitate the collection and exchange of data.	Based on standardized requirements defined by a specific standard.

15.6 Technical requirements

System design shall follow the requirements in DNVGL-RU-SHIP Pt.6 Ch.11 Sec.1 adopted to be suitable for a floating offshore wind turbine installation.

16 Data-driven verification

16.1 Introduction

Digital technology and increased possibilities for connectivity open for the use of data-driven verification (DDV) systems and methods. Utilising the opportunities of DDV may increase effectiveness of verification and test functionality and open for more efficient and accurate assurance processes.

Guidance note:

As per this rule release a major part of existing maritime and offshore target systems may not be prepared for implementation of DDV methods, nor may such methods be developed.

It is recommended to include the Society in the development of DDV methods intended to be used for retention of class certificates.

For more information on the objectives and philosophies behind the DNV GL data-driven and D-Class initiative , see DNVGL-CG-0557 Sec.1 and DNVGL-CG-0557 App.A.

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16.2 Objective

These rules are developed in order to support industry development of data-driven verification systems and methods, and to help in implementing such to provide genuine and trustworthy verification evidence when replacing more traditional methods.

The Rules build upon the principles of:

— ensuring that systems are designed to be verified
— incorporating verify on-demand capabilities

The objective also aims at reducing exposure to non-productive time associated with taking installations out of service for trials, reducing costs associated with surveyors from various organisations attending the installation, reducing redundant verification activities, and reducing the cognitive burden imposed upon crew carrying out testing.

16.3 Scope

This document sets requirements to DDV systems and arrangements onboard installations, and to verification methods.

16.4 Application

The additional class notation **DDV** applies to any installation provided with arrangements enabling verification of specified on board target systems by use of data driven verification methods.

16.5 Class notations

16.5.1 Installations built and tested in compliance with the requirements in this section may be assigned the additional class notation **DDV** with a minimum one qualifier describing the actual target system (TS) and verification method (VM) accordingly. Relevant qualifiers are given in Table 13. For floating offshore wind turbine installations the relevant target system(s) will be agreed between the Society and owner.

The resulting syntax will then be: **DDV(TS1[VM1], … TSn[VMn])**

Table 13 Verification methods (VM) signifying the method of verification

Qualifier for verification method (VMn)	*Description*
AVA	Algorithm-based verification agent and advanced data analytics: this qualifier designates data driven verification functions based on an automatic algorithm with a dedicated role, purpose, function, and responsibility (i.e. agent) in conducting verification (i.e. generating evidence) by interacting with the target system through an API or other digital interface using documented methods and data structures. The AVA shall also support delivery of a tamper-free data-based body of evidence which can be used for classification purposes, to the Society. The AVA acts as a 'tester' and generates evidence and possibly also makes decisions and conclusions (e.g. go/no-go).
BITE	Verification based on built in test functionality: this qualifier designates data driven verification functions (hardware and software) which are built into, or connected to, the target system with the purpose of generating verification data, automatically or upon operator request, and to deliver a tamper-free data-based body of evidence which can be used for classification purposes, to the Society. It is accepted that the target system may need to be taken out of operation and put into test mode for the verification activity to be performed. The target system/BITE shall have the capability to transfer the generated BITE verification data over an API or other digital interface using documented methods and data structures.

Qualifier for verification method (VMn)	*Description*
DSA	Verification based on digital survey applications: this qualifier designates data driven verification functions utilizing digital test tools where the complete, or specified parts of the verification scope is incorporated and managed by the crew or other dedicated test personnel. The tool incorporates test procedures to be performed for generation and gathering of onboard system(s) generated data and supports delivery of a tamper-free data-based body of evidence which can be used for classification purposes, to the Society. The target system may need to be taken out of operation and put in to test mode for the verification activity to be performed. The interaction between DSA and the target system, and the generated target system/DSA verification data shall be carried over an API or other digital interface using documented methods and data structures.
DT	Verification based on digital twins: verification of a target system is based on testing or simulations performed by application of a digital twin.
SVS	Verification based on self-verifying systems: this qualifier designates data driven verification functions where the verification function is an integral part of the target system functionality (hardware and software). I.e. the system shall continuously or at specified intervals, during normal operation, automatically provide tamper-free data which can be used as body of evidence for classification purposes, to the Society. The delivered data shall in general provide/indicate conclusions on the acceptance criteria. The target system/ SVS shall have the capability to transfer the generated SVS verification data over an API or other digital interface using documented methods and data structures.

16.6 Technical requirements

System design shall follow the requirements in DNVGL-RU-SHIP Pt.6 Ch.11 Sec.2 adopted to be suitable for a floating offshore wind turbine installation.

CHAPTER 4 CLASSIFICATION IN OPERATION

SECTION 1 GENERAL PROVISIONS

1 Introduction

1.1 General

1.1.1 The objective of the technical and procedural requirements of this chapter is to establish reasonable assurance that the installations hull, machinery, equipment and systems are in satisfactory condition and in compliance with applicable standards to allow continued operation.

For floating wind turbine installations DNV GL encourages the use of inspection arrangements and methodologies with focus on enabling ways of working that can be utilised in cooperation with the Society to minimise out of service time and obtain an optimal utilisation of the installation. This may be done by:

— integrating activities from owner and Society
— performing classification activities on a continuous basis
— using alternative systematics (survey arrangements)
— performing survey according to condition and utilisation
— applying condition based maintenance (CBM)
— use of data analytics based on collection of sensor data
— accepting owners inspection and testing as part of class scope.

The remainder of this chapter states the basic principles and requirements for retention of class to installations covered by the provisions of these rules, where no project-specific inspection arrangement has been agreed and adopted. Requirements are applicable to main class, service notations and additional class notations unless otherwise stated.

1.1.2 The extent of periodical survey is presented in Sec.3 for main class, Sec.4 for additional systems and facility notations and Sec.5 for alternative survey arrangements.

1.1.3 DNV GL will develop and maintain an in-service inspection program (IIP) which will contain the structural items to be surveyed to satisfy the requirements of main class, excluding any additional class notations. The IIP constitutes the formal basis for surveying structural items under main class and shall be completed to the satisfaction of attending surveyor before renewal survey can be credited. Further information about different IIP levels are given in Sec.3.

1.1.4 Concrete structures shall be subject to in-service inspection according to the principles given by DNVGL-ST-C502 Sec.8 and aligned with the survey scheme adopted by this chapter.

1.2 Preferred survey programme

1.2.1 The preferred class approach is to utilise the integrity management system of the owner, allowing classification activities to be carried out on a continuous basis and performing survey according to condition and utilisation. The approach assumes access to data analytics based on collection of sensor data from the installations, approved as part of a risk based inspection (RBI) programme. The survey plan is developed using alternative survey arrangements as specified in Sec.5.

1.2.2 With sister installations a survey plan covering the field may be developed. This will enable an optimised survey scheme by survey of a representative number of installations. The methodology will assume that each wind turbine installation experience similar utilisation and degradation.

1.2.3 If the owner does not want to apply survey schemes given in [1.2.1] and [1.2.2] a survey scheme following Sec.3 shall be followed.

1.3 Survey pre-planning and record keeping

1.3.1 A specific survey programme for the installation(s) shall be worked out by the owner in cooperation with the classification Society in advance of surveys.

1.4 Surveys performed by approved companies

Parts of the periodical surveys may be carried out by companies approved by DNV GL. More details are given in Sec.6.

2 Periodical surveys

2.1 General

2.1.1 All installations shall be subjected to periodical surveys in accordance with requirements of this chapter confirming that the hull, machinery, equipment and systems remain in satisfactory condition and in compliance with approval according to accepted standards.

2.1.2 Periodical surveys will belong to one of the following categories for the various level of survey requirements:

— annual survey
— intermediate survey
— complete survey.

The survey required in conjunction with issuance of a new class certificate is denoted:

— renewal survey.

The following specific surveys may be scheduled for one or more of the above categories:

— bottom survey
— survey of mandatory additional class notations (e.g. **POSMOOR**)
— survey of optional class notations (voluntary class notations).

2.1.3 Periodical surveys shall be carried out at prescribed intervals and within applicable time windows.

A survey may be split in different parts, commenced and progressed within the time window provided all the requirements of the survey are completed by the end of the time window.

The main class intermediate survey cannot serve as commencement of the next renewal survey.

For concurrent surveys, see Table 1, the time window may be limited by that of the other survey.

2.1.4 The due date of a periodical survey will be established depending upon the survey interval, measured from one of the following events, whichever is relevant:

— date of class assignment
— date of commissioning
— due date of the previous corresponding survey
— date of completion of the previous corresponding survey
— date of completion of a major conversion.

A survey may be commenced prior to the defined time window at owners request. In such a case the due date for subsequent surveys will be adjusted accordingly.

2.1.5 The scope of survey may be extended when compliance with applicable rules cannot be satisfactorily confirmed based on extent of surveys as given, or when the surveyor suspects that the installation is not maintained or handled in accordance with the basis for retention of class.

2.2 Postponement of periodical surveys

2.2.1 Except for annual and intermediate surveys for main class, the Society may accept to postpone periodical surveys upon special consideration in each separate case. Postponement of main class renewal survey may be considered only in exceptional circumstances.

2.2.2 Postponement of main class renewal survey shall not exceed three (3) months. Postponement of periodical surveys will not affect the surveys next due date.

2.2.3 Postponement of the renewal survey may be granted only upon the owners written request. Such a request shall be received by the Society well in advance of the expiry date of the classification certificate. A postponement of the renewal survey shall be based on satisfactory result from a sighting survey.

2.3 Survey Schedules

2.3.1 Annual survey schedule is as follows:

- The due date in general corresponds to the anniversary date of the class assignment or the expiry of the previous classification certificate if different.
- The survey shall be carried out within a time window of three (3) months on either side of the due date.
- In case a main class annual survey is commenced prior to the defined time window, the survey shall be completed not more than six (6) months after the date of the survey commencement. In such cases the anniversary dates for the subsequent annual surveys shall be advanced, corresponding to a date not later than three (3) months after the completion date of the commencement survey just carried out.
- An additional main class annual survey may be required when the anniversary date has been advanced.

Annual surveys shall be performed each year, also those years where an intermediate, complete or renewal survey is performed. Survey requirements applicable for annual surveys are therefore not repeated for corresponding intermediate, complete or renewal surveys.

2.3.2 Intermediate survey schedule is as follows:

- The due date shall correspond to the date 2.5 years after the expiry date of the previous class certificate.
- The survey shall be carried out within a time window of nine (9) months on either side of the due date.
- The main class intermediate survey shall be completed concurrently with the second or third main class annual survey in each period of the classification certificate.
- The same surveys and thickness measurements of tanks or spaces shall not be credited towards both intermediate and renewal survey.

2.3.3 Renewal survey schedule is as follows:

- The due date is set at five (5) year interval and corresponds to the expiry date of the classification certificate.
- The survey shall be completed within a time window of three (3) months before the due date.
- The survey may be commenced at the fourth annual survey or between the fourth and fifth annual surveys.

— In case the survey is commenced more than 15 months before the expiry date of the classification certificate, the due date of the survey shall be advanced to a date not later than 15 months after the completion date of the commencement survey.
— The renewal survey shall be completed concurrently with the last main class annual survey in each period of the classification certificate.
— The same surveys and thickness measurements of tanks/compartments shall not be credited towards both intermediate and renewal survey.
— Installations that are re-commissioned after being laid-up shall be specially considered.

2.3.4 Statutory surveys

If the installation is to be registered in a national register, statutory requirements from the register shall apply.

Guidance note:

A national register may be a flag state. Typical requirements may then be IMO SOLAS convention or IMO MODU code unless the register has its own requirements.

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2.4 Class notations

2.4.1 Optional class notations where specific surveys have been defined are listed in Table 1.

Table 1 Surveys for optional class notations

Class notation	*Description*	*Survey type*	*Conjunction with main class survey*	*Survey requirements*
Crane	Comprises offshore - and/or onboard cranes	Annual	N/A	Sec.4 [4]
		Complete (5 years)	N/A	
		Intermediate	Intermediate	
		Complete (5 years)	Renewal	
Cyber secure	Cyber security	Annual	N/A	Sec.4 [9]
		Renewal	N/A	
FMS	Additional fatigue methodology specification. Only relevant for qualifiers **NUM** and **SENS**	Annual	N/A	Sec.4 [7]
HELDK	Helicopter deck	Complete (5 years)	Renewal	Sec.4 [3]
HMON	Hull monitoring system	Annual	Renewal	Sec.4 [6]
ISDS	Integrated software dependent systems	Annual	Annual	Sec.4 [10]
		Complete	Renewal	
POSMOOR	Position mooring system	Annual	N/A	Sec.4 [2]
		Complete (5 years)	N/A	

Class notation	*Description*	*Survey type*	*Conjunction with main class survey*	*Survey requirements*
Recyclable	Inventory of hazardous materials Part 1	Complete (5 years)	Renewal	Sec.4 [8]
Walk2work	Offshore gangways	Annual	N/A	Sec.4 [5]
		Complete (5 years)	Renewal	
Wind	Wind turbine and associated systems	Annual	N/A	Sec.4 [12]
		Complete (5 years)	N/A	
Winterized	Operation in cold climate areas	Annual	N/A	Sec.4 [11]
		Complete (5 years)	Renewal	

SECTION 2 PRINCIPLES FOR PLANNING AND EXECUTION OF SURVEYS

1 General

1.1 Preparation for survey

1.1.1 The owner shall provide the necessary facilities for safe execution of surveys.

1.1.2 For overall and close-up examination, means shall be provided to enable the surveyor to examine the structure in a safe and practical way, see [2.1].

2 Structure and equipment

2.1 Conditions for survey and access to structures

2.1.1 In preparation for survey and to allow for a thorough examination, all spaces shall be cleaned including removal from surfaces of all loose accumulated corrosion scale.

Guidance note:

Spaces should be sufficiently clean and free from water, scale, dirt, etc. to reveal corrosion, deformation, fractures, damage, or other structural deterioration. However, those areas of structure whose renewal has already been decided are only required to be cleaned and descaled to the extent necessary to determine the limits of the renewed areas.

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2.1.2 All spaces shall be made safe for access, i.e. gas freed, ventilated and illuminated, and prepared for the surveyor to examine the structure in a safe and practical way. One or more of the following means for access, acceptable to the surveyor, shall be provided:

— permanent staging and passages through structures
— temporary staging and passages through structures
— lifts and moveable platforms
— hydraulic arm vehicles such as conventional cherry pickers
— boats or rafts
— portable ladder
— other equivalent means.

2.1.3 A survey planning meeting shall be held prior to the commencement of any renewal and intermediate surveys between the attending surveyor(s), the owners representative in attendance and the responsible person for any approved service supplier (thickness measurement/NDT company representative), where involved.

2.2 Survey extent

2.2.1 The survey consists of examination, measurements and testing as required for different survey categories with the aim to ensure that the hull structure, hull equipment and piping are in satisfactory condition with respect to corrosion, deformation, fractures, damage or other structural deterioration.

2.2.2 When examination or overall examination is required the structure or object is visually examined from a distance (not close-up). In such cases the general maintenance, the condition of protective coating, rust

deposits, leakages and structural detachments and damage may be observed and the surveyor may extend the survey as considered necessary.

2.2.3 When close-up examination is specified by the rules or required by the surveyor the structure or object is visually examined from a distance normally within reach of hand. The surveyor may extend the close-up examination as deemed necessary taking into account the maintenance of the spaces under survey, the condition of the corrosion protection system and where spaces have structural arrangements or details which have suffered defects in similar spaces or on similar installations according to available information.

2.2.4 The surveyor may require thickness measurements in any portion of the structure where signs of wastage are evident or in areas where wastage is normally found. The surveyor may extend the scope of the thickness measurements if considered necessary.

2.2.5 When thickness measurements are specified by the rules or required by the surveyor the measurements shall be carried out to an extent sufficient to determine both general and local corrosion levels.

Thickness measurements shall be carried out by a qualified company approved by the Society, see also Sec.6 *Services performed by approved companies*.

The surveyor shall review the final thickness measurement report.

2.2.6 Where substantial corrosion, as defined in Ch.1 Sec.1 Table 2, is found additional thickness measurements shall be taken to confirm the extent of substantial corrosion.

Areas found with substantial corrosion, which are not repaired, shall be recorded for thickness measurements at subsequent annual surveys.

2.2.7 The examination may be extended also in cases when:

- information is available of defects suffered on similar structure or details in similar tanks/compartments on similar installations
- the structure under survey has been approved with reduced scantlings due to an approved corrosion control system
- suspect areas identified shall be recorded for examination at subsequent annual surveys.

2.2.8 The owner shall keep a complete record of all the thickness measurements and prepare a thickness measurement report including:

- locations of the measurements
- thickness measured and corresponding original thickness
- the date when the measurements were carried out
- type of measuring equipment
- personnel performing the measuring and their qualifications
- the report shall be signed by the operator.

These additional thickness measurements shall be carried out before the survey is considered as completed.

2.2.9 In the design of column-stabilised, deep draught and cylindrical structures, corrosion allowance is normally not included as the structure is considered adequately protected against corrosion, e.g. by sacrificial anodes, impressed current and coating.

For ship-shaped or barge/pontoon type installations, corrosion addition is included as part of the DNV GL rules for ships, but in addition combined with a corrosion protection system similar for mobile offshore units.

The corrosion diminution criteria as given in DNVGL-CG-0172 shall be applied. Alternative methods may be accepted in agreement with the Society.

2.2.10 Where provided, the condition of protective coating of voids and tanks shall be examined. The condition will be rated GOOD, FAIR or POOR as defined in Table 1 below.

Table 1 Conditions of protective coating

Coating system and coating condition	*Definition*
Corrosion prevention system	A full hard coating, usually to be epoxy coating or equivalent. Other coating systems, which are neither soft nor semi-hard coatings, may be accepted provided they are applied and maintained in compliance with the manufacturer's specification. See IACS UR Z87/MSC.1/Circ 1330.
Coating condition GOOD	Condition with only minor spot rusting.
Coating condition FAIR	Condition with local breakdown at edges of stiffeners and weld connections and/or light rusting over 20% or more of areas under consideration, but less than as defined for POOR condition.
Coating condition POOR	Condition with general breakdown of coating over 20% or more of areas or hard scale at 10% or more of areas under consideration.

2.2.11 For structures where original protective coatings are in GOOD condition, the extent of close-up examination and thickness measurements may be specially considered.

Special consideration as used in this context is taken to mean, as a minimum, that sufficient close-up examination and thickness measurements are carried out to confirm the actual average condition of the structure under the protective coating.

For areas with general breakdown of the protective coating, close-up examination and thickness measurements shall be carried out to an extent sufficient to determine both average and local corrosion levels.

2.3 Repair of structural damage or deterioration

2.3.1 A prompt and thorough repair is a permanent repair completed at the time of survey to the satisfaction of the surveyor, therein removing the need for the imposition of any associated condition of class.

2.3.2 There are situations where composite repairs may be accepted on a case by case basis. The procedure to be followed it is specified in DNVGL-RP-C301. The Society shall be involved before the application of the repair procedure on the installation.

2.3.3 Any damage in association with wastage over the allowable limits (including buckling, grooving, detachment or fracture), or extensive areas of wastage over the allowable limits, which affects or, in the opinion of the surveyor, will affect the installations structural, watertight or weathertight integrity, shall be promptly and thoroughly repaired.

3 Machinery and systems

3.1 Maintenance and preparation for survey

3.1.1 Every installation shall have implemented a maintenance system including machinery system and equipment subject to class. The maintenance system may cover an individual installation or groups of installations of similar design and location.

The maintenance system shall ensure that:

— inspections and maintenance are carried out at defined intervals
— any non-conformity is reported with its possible cause, if known
— appropriate corrective action is taken
— records of these activities are maintained.

The maintenance system may be based on collection of sensor data and use of data analytics.

The machinery and systems subject to class shall be maintained in accordance with the maintenance system implemented.

3.1.2 In preparation for survey and to allow for a thorough examination, any machinery components installed and related spaces shall be cleaned, including removal from surfaces of loose accumulated corrosion scale and mud. The spaces and components of attention shall have proper access including dismantling as necessary.

SECTION 3 PERIODICAL SURVEY EXTENT FOR MAIN CLASS

1 General

1.1 Introduction

1.1.1 This section and Sec.4 present the standard extent of surveys for retention of main class (**OI**) for all service notations when the owner has decided not to follow the preferred survey programme specified in Sec.1 [1.2].

The descriptions for the different surveys first cover requirements relevant for all installation types followed by installation type specific descriptions.

1.1.2 The extent of the periodical survey on the installations structure is further detailed by the in-service inspection programme (IIP) as described in below.

1.1.3 The requirements in this section will only be applicable to the extent the specified equipment or systems are installed onboard the installation.

1.2 In-service inspection programme

1.2.1 The in-service inspection programme (IIP) is developed on the basis of a general, experience-based scope in combination with design and fabrication particulars for the actual installation as well as experience from in-service surveys of installations of similar type. The Society will develop and maintain the IIP.

1.2.2 An in-service inspection programme shall be developed for offshore floating wind turbine installations based on DNVGL-RU-OU-0300 Ch.3 Sec.1 Table 1 and DNVGL-RU-OU-0300 Ch.3 Sec.1 Table 2.

Guidance note:

The proposed inspection plans as given in DNVGL-RU-OU-0300 Ch.3 Sec.1 Table 1 and DNVGL-RU-OU-0300 Ch.3 Sec.1 Table 2 are generic plans developed based on gained experience for offshore installations. Offshore floating wind turbine installations have in general different layouts than other types of offshore installations and the generic plans might be inappropriate. Therefore, it is suggested that individual survey plans are prepared based on the design documentation.

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If the design documents the structural fatigue utilisation with considerable margins or if the installation has **FMS** notation, see Ch.3 Sec.2 [7], the basic requirements for NDT inspection may be modified and/or reduced compared to the basic scope.

When the installation is operating in other environmental conditions than considered in the design, the inspection scope may be modified, accounting for the actual application of the installation.

The owner/operator has the responsibility to provide the necessary documentation for class approval, when modification of the basic in-service inspection programme is requested.

The in-service inspection programmes may be prepared using different methodology, standard generic or more probabilistic methods. Three (3) levels are defined as follows:

— Level 1:

The standard and default in-service inspection programme (IIP), denoted first level, is prepared based on a simple risk based inspection (RBI) approach. The plan is established based on general knowledge and experience from years of installation (and offshore and ship) surveys. If not otherwise agreed, this type of in-service inspection programme shall be developed by default.

— Level 2:

The second level, qualitative RBI, is based on the above basic RBI with the addition of design and fabrication particulars for the specific installation. This may be detailed fatigue results, ultimate strength

utilisation, coating system applied, etc. which will be combined as basis for preparing the in-service inspection programme. This approach is applied, if requested by the owner, for installations where adequate information is available from design and construction phase.

— Level 3:

The third level is to prepare the in-service inspection programme using a quantitative, refined probabilistic approach where uncertainties with respect to different parameters affecting degradation, i.e. related to fatigue, coating, corrosion, wear and tear are analysed for determination of inspection intervals which secure the necessary safety level to be maintained. The quantitative approach is performed as an advisory service as requested by owner/operator and the modified inspection plan shall be approved by class before being applied as the class in-service inspection plan.

Guidance note:

For more details on how to perform the qualitative and/or quantitative risk based assessment, see DNVGL-OTG-17 *Inspection planning of MOUs in-service by use of RBI methodology*, DNVGL-RP-C210 *Probabilistic methods for planning of inspection for fatigue cracks in offshore structures* and DNVGL-RP-C302 *Risk based corrosion management*.

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1.2.3 The extent of examination specified in the referred tables may be modified based on design documentation evaluation, inspection results/crack history and experience with similar installations/details (defined as level 2 for the IIP).

1.2.4 The extent of examination specified in the referred tables may be refined by use of RBI methodologies, (defined as level 3 for the IIP), see [1.2.2].

Guidance note:

At the first annual or intermediate survey after construction, column-stabilised installations and other non-standard structures may be subject to examination of major structural components including non-destructive testing, as deemed necessary by the Society. If the Society deems such survey to be necessary, the extent should be agreed to by the Society and the owner or customer prior to commencement of the survey.

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1.2.5 Detailed locations for thickness gauging will be prepared based on the condition of the installation and following the applicable tables in [4]. Measurements shall be recorded and stored in DNV GL's structure integrity management (SIM) tool.

2 Annual survey

2.1 Survey extent

2.1.1 Annual survey is a general survey of the hull and equipment, machinery and systems to confirm that the installation complies with the relevant rule requirements and is in satisfactorily maintained condition.

The survey covers systems and parts for:

— structure and equipment
— any equipment, machinery and safety systems
— temporary equipment as defined in DNVGL-RU-OU-0101 Ch.1 Sec.1 [2.2].

The survey for the temporary equipment shall only confirm class involvement as specified in DNVGL-RU-OU-0101 Ch.1 Sec.5.

Guidance note:

The structural survey extent should follow the installation specific IIP as described in [1].

Survey requirements on position mooring equipment and systems are covered by the **POSMOOR** notation as described in Sec.4 [2].

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Guidance note:

Since floating offshore wind turbine installations will be of a wide variety of structural types and equipment installed , the requirements in this and subsequent sections are only relevant as long as the structures or equipment exists onboard.

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2.1.2 The survey will usually be performed on location provided that the structure, including submerged parts, can be thoroughly inspected as specified in the in-service inspection programme. If required, underwater inspection shall be in accordance with an approved procedure, and using approved personnel and equipment.

2.2 Structure and equipment, general

2.2.1 The following requirements are applicable for all types of structural design. Specific type requirements, e.g. self-elevating, ship-shaped, column stabilized, deep draught and cylindrical installations are given in [2.3].

2.2.2 Any material alterations to the installation (its structural arrangements, subdivision, superstructure, fittings, and closing appliances upon which the stability calculations or the load line assignment is based) shall be surveyed and the relevant documentation shall be reviewed.

2.2.3 Approved loading and stability information shall be available upon request. This information shall be the same as required when the installation was assigned class with the Society or at a later conversion of the installation, in accordance with the rule requirements applicable in each case.

2.2.4 The system for recording changes to the lightweight of the installation shall be examined.

Guidance note:

For more information and guidance with regards to lightweight control see DNVGL-OTG-12 *Lightweight* monitoring and control during the operational life-cycle.

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2.2.5 Items which are important for the reserve buoyancy in connection with stability of the installation shall be surveyed. The survey shall include inspection of any external and internal closing appliances, ventilators and air pipes.

2.2.6 External and internal weather and watertight doors, hatches and dampers shall be examined and function tested.

2.2.7 Remote control system for valves in sea water inlets and outlets shall be surveyed and tested.

2.2.8 It shall be checked as far as practically possible that draught marks are legible. Functionality and proper working of draught measurement gauges shall be confirmed.

2.2.9 Manual and automatic fire doors and dampers shall be examined and function tested.

2.2.10 Ventilation ducts and operation of ventilation including emergency stop for any machinery rooms shall be examined.

2.2.11 Means of protection of the crew, such as guard rails, bulwarks, walkways and lifelines shall be examined.

Guidance note:

For installations subjected to annual load line survey by DNV GL, the requirements in [2.2.7] and [2.2.10] are covered by this survey.

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2.2.12 Where the installation has an impressed current cathodic protection system, the annual overview readings from the system shall be examined.

2.2.13 Condition of protective coating shall be reported according to Sec.2 [2.2.10]. For areas with general breakdown of the protective coating, close-up examination and thickness measurements shall be carried out to an extent sufficient to determine both general and local corrosion levels.

2.2.14 Suspect areas (substantial corrosion previously defined) or areas where substantial corrosion is found at the survey being carried out, shall have thickness measurements extended following Table 1 as guidance.

Table 1 Thickness measurements, extent and pattern in way of areas with substantial corrosion

Area/structural member	*Extent of measurement*	*Pattern of measurement*
Plating	Suspect area and adjacent plates	5 points over 1 m^2
Stiffeners	Suspect area	3 points in line across web 3 points in line across flange
See IACS UR Z7 Table 2		

Guidance note:

See Sec.2 [2.2] for the extend of thickness measurements.

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2.2.15 Means of escape

Escape routes shall be examined to be free from obstacles.

2.3 Structure and equipment, hull type specific

2.3.1 Additional requirements for ship-shaped installations

There are no additional requirements.

2.3.2 Additional requirements for column-stabilised installations

Installations with submerged primary structural members allowing internal access for inspection may be omitted from external survey, subject to satisfactory results from the internal survey.

2.3.3 Primary structural members which are flooded shall be subject to external survey unless otherwise agreed. The extent of survey is given in the in-service inspection programme, and will comprise visual inspection of vital parts and may include non-destructive testing of highly stressed areas.

2.3.4 The means for leakage detection of dry bracings shall be function tested. Records of owner's routine testing and inspection of the area shall be reviewed. If owners routines are not duly followed up, external NDT of the column to brace connections may be required to be carried out.

2.3.5 Additional requirements for installations of other hull shapes

The requirements shall be defined on a case by case basis.

2.4 Machinery and safety systems

2.4.1 All installations

The survey shall include examination of spaces for machinery and equipment located therein, with particular attention to general cleanliness and maintenance with special attention to fire hazards.

Guidance note:

Most installations will have limited or no machinery and safety systems installed. Any requirements in this chapter will only apply as relevant for installed machinery and safety systems.

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2.4.2 The surveyor decides the extent of running tests and/or opening of machinery, tests of safety devices and equipment.

2.4.3 The bilge and ballasting system and related subsystems, such as remote operation of pumps, valves and tank level indication shall be visually surveyed and tested.

2.4.4 For fire extinguishing systems the survey shall include as relevant:

- testing of the water fire fighting system i.e. fire pumps, fire mains, hydrants and hoses as deemed necessary
- verification of the non-portable and portable fire extinguishers and portable foam applicators
- examination of the fixed fire extinguishing systems.

2.4.5 The following systems shall be surveyed and tested for correct functioning as relevant:

- fire detection and alarm system
- fixed gas detection and alarm system, both flammable and toxic
- general alarm system and communication between control stations.

2.4.6 For electrical installations the survey shall include:

- examination of main source of electrical power with respect to general condition, fire hazard and personnel safety, i.e. generators if installed, main switchboards, distribution boards, control gear, consumers, chargers and battery/UPS systems.

Guidance note:

Applicable test records may replace the required testing:

- inspection of insulation monitoring devices for all distribution systems. If in doubt of correct reading (ex. the reading is infinity), the device shall be tested
- examination of cable installations with respect to general condition, support and physical protection
- examination of emergency source of electrical power with respect to general condition, fire hazard, personnel safety and function, i.e. generator, emergency switchboard, emergency distribution boards, control gear, chargers, emergency consumers and battery/ UPS systems
- check if any modifications are done in the electrical system
- test of emergency power system, i.e. manual and automatic connection of generator/batteries to emergency switchboards, alternative start methods
- verify that the document schedule of batteries is kept up to date.

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3 Intermediate survey

3.1 General

3.1.1 There are no additional requirements for the intermediate survey outside the requirements given in the annual survey scope, including the IIP.

4 Renewal survey, structure and equipment

4.1 General

4.1.1 Renewal survey is a major survey including visual examinations, measurements and testing of the hull and equipment, machinery and systems, in order to confirm that the installation complies with the relevant rule requirements and is in satisfactorily maintained condition.

The required examinations, measurements and tests shall be carried out before the renewal survey is regarded as completed.

Guidance note:

Survey requirements on position mooring equipment and systems are covered by the additional notation **POSMOOR** as described in Sec.4 [2].

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4.1.2 Possible deficiencies shall normally be rectified before the renewal survey is regarded as completed.

The Society may accept that minor deficiencies, recorded as condition of class, are rectified within a specified time limit, normally not exceeding three (3) months after the survey completion date.

4.2 All installations

4.2.1 An annual survey, see [2], shall be carried out as part of the renewal survey.

The extent of the survey on the structure is given in the IIP as described in [1.2], and will additionally include the requirements given in the remaining of this section.

4.2.2 Thickness measurements shall as a minimum be carried as specified in [4.3] and [4.4] for respectively ship-shaped and column stabilized installations.

Additional thickness measurements may be required where wastage is evident or suspect as evaluated during surveys.

4.2.3 Air pipe heads on exposed deck structure shall be externally and internally examined following the Table 2. According to the results of the examination, the surveyor may require examination of other air pipe heads.

Table 2 Survey of air pipe heads on exposed deck

Installation type	*First renewal survey*	*Second renewal survey*	*Third renewal survey*
All installations	Four randomly chosen (max 25%), preferably serving ballast tanks	25% of all the air pipes randomly chosen	All air pipe heads. Exemption may be considered for air pipe heads where there is substantiated evidence of replacement within the previous five years.

4.2.4 All tanks and compartments and free-flooding spaces throughout the installation shall be examined externally and internally for excess wastage or damage.

The survey shall include all structures, piping systems outside machinery area , i.e. plating and framing, valves, coupling, anodes, equipment for level indication, bilges and drain wells, sounding, venting, pumping and drainage arrangements.

Suspect and/or critical structural areas should be examined and may be required to be tested for tightness, non-destructive tested or thickness gauged.

4.2.5 The watertight integrity of internal tanks, bulkheads, decks and other compartments shall be verified by visual inspection.

Special arrangements related to stability such as watertight closing appliances for openings in internal bulkheads and decks, cross-flooding, counter-flooding etc., shall be examined and tested if necessary.

Guidance note:

Documented maintenance may be considered as a base for extent of dismantling.

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4.2.6 Pressure vessels, compartments and/or critical structural areas may be required pressure tested for tightness if found necessary due to actual suspect status condition as evaluated at survey.

Independent tanks in machinery spaces shall be tested as deemed necessary.

4.2.7 Remote level indicating systems for ballast tanks shall be surveyed and function tested.

4.2.8 Underwater parts and items

External surfaces of the hull, shall be selectively cleaned to the satisfaction of the attending surveyor and examined together with appendages, (as applicable).

Sea chests, sea strainers, other sea inlets, and discharges (above and below the waterline) with nozzles, valves, shall be selectively cleaned to the satisfaction of the attending surveyor and examined.

Alternative survey methods may be accepted upon special consideration provided equivalency to opening up is achieved.

4.2.9 Signboards

The presence of required signboards shall be verified.

4.2.10 Corrosion protection

The cathodic protection system of the submerged zone shall be surveyed by visual inspection. The efficiency of the system for the forthcoming five year period shall be confirmed. Corrosion in welds of vital parts which may be subject to fatigue shall be particularly considered.

Potential measurements shall be performed if deemed necessary.

4.2.11 Major appurtenances

Fixation of major appurtenances to the main structure shall be surveyed. These may typically include crane pedestals, helicopter decks and heavy deck modules or skids.

4.3 Specific requirements for ship-shaped, barge/pontoon and cylindrical installations

4.3.1 Thickness measurements shall as a minimum be carried out as shown in Table 3.

Table 3 Minimum requirements for thickness measurements for ship-shaped, barge/pontoon and cylindrical installations at renewal survey

Renewal survey no.1 Age 0-5 years	*Renewal survey no.2 Age 5-10 years*	*Renewal survey no.3 Age 10-15 years*	*Renewal survey no.4 and subsequent Age >15 years*
1) Suspect areas throughout the installation.	1) Suspect areas throughout the installation. 2) One transverse section of deck plating within the amidships 0.6 L, together with internals in way as deemed necessary. Where the installation is configured with side ballast tanks, the plating and internals of the tanks are also to be gauged in way of the section chosen. 3) Wind turbine foundation boundary bulkhead plating.	1) Suspect areas throughout the installation. 2) Two transverse sections (girth belts) of deck, bottom and side plating within the amidships 0.6 L together with internals in way as deemed necessary. Where installation is configured with side ballast tanks, the plating and internals of the tanks to be gauged in way of the required belts, Remaining internals in ballast tanks to be gauged as deemed necessary. 3) Wind turbine foundation boundary bulkhead plating. 4) Internal in forepeak tank as deemed necessary. 5) Selected air pipes and ventilator coamings on exposed main deck.	1) Suspect areas throughout the installation. 2) A minimum of three transverse sections (girth belts) of deck, bottom, side, and longitudinal-bulkhead plating within the amidships 0.6 L, together with internals in way (including in perimeter ballast tanks, where fitted in way of belts). 3) Wind turbine foundation boundary bulkhead plating. 4) Internals in forepeak and after peak tanks as deemed necessary. 5) Lowest strake of all transverse bulkheads in hold spaces. Remaining bulkhead plating to be gauged as deemed necessary. 6) All plates in two wind and water strakes, port and starboard, full length. 7) All exposed main deck plating full length and all exposed first-tier super-structure deck plating (poop, bridge and forecastle decks). 8) All keel plates full length plus additional bottom plating as deemed necessary by the surveyor, particularly in way of cofferdams . 9) Duct keel or pipe tunnel plating or pipe tunnel plating and internals as deemed necessary. 10) All air pipes and ventilator coamings on exposed main deck.
Notes: 1) if considered necessary by the attending surveyor. 2) to 10) mandatory thickness measurements, number and extent of thickness measurement requirements may be modified by the surveyor considering the corrosion protection condition and arrangements.			

4.3.2 Inspection area categorisation

Application categories for structural components to be inspected referred in Table 3, are defined in Table 1.

Special areas for inspection:

— Connections of bulkheads, stiffeners, flats or decks.
— Mooring, connections within structure at support.

— External brackets, portions of bulkheads, and frames which are designed to receive concentrated loads at intersections of major structural members.
— Support connections for helideck etc.
— Highly utilised areas supporting anchor line fairleads and winches, crane pedestals etc.
— Other support areas.

Primary areas for inspection:

— Structural members of bulkheads, stiffeners, flats or decks and girders in deck structure.
— Deck plating, heavy flanges, and bulkheads within the upper hull or platform which form box or I type supporting structure.
— Bulkheads, decks, stiffeners and girders which provide local reinforcement or continuity of structure in way of intersections, except areas where the structure is considered for special application.
— Main support structure of heavy sub-structures and equipment, e.g. anchor line fairleads, cranes and helicopter deck.

Other areas for inspection:

— upper platform decks, or decks of upper hulls except areas where the structure is considered primary or special areas for inspection
— other structures not categorised as special or primary.

4.4 Specific requirements for column-stabilised installations

4.4.1 Thickness measurements shall be carried out as shown in Table 4.

Table 4 Minimum requirements for thickness measurements for column-stabilised installations

Id.	*Area*	*Renewal survey no.1 Age 0-5 years*	*Renewal survey no.2 Age 5-10 years*	*Renewal survey no.3 Age 10-15 years*	*Renewal survey no.4 and subsequent Age >15 years*
1	All	Suspect areas	Suspect areas	Suspect areas	Suspect areas
2	Structural components of special and primary areas for inspection	Areas with indication of wastage.	Areas with indication of wastage.	Areas with indication of wastage.	Areas with indication of wastage.
3	Bracings		Representative plates in splash zone. Internals as deemed necessary.	Representative plates and internals in splash zone. Representative plates and stiffeners at the connection to column/ pontoon and bracings (k-nodes).	Representative plates and internals in splash zone. Representative plates and stiffeners at the connection to column/pontoon and bracings (k-nodes).
4	Columns		Representative plates in splash zone. Internals as deemed necessary.	Representative plates and internals in splash zone. Selective plates and stiffeners of selective seawater tanks.	Representative plates and internals in splash zone. Selective plates and stiffeners of selective seawater tanks.

Id.	*Area*	*Renewal survey no.1 Age 0-5 years*	*Renewal survey no.2 Age 5-10 years*	*Renewal survey no.3 Age 10-15 years*	*Renewal survey no.4 and subsequent Age >15 years*
5	Pontoons			One girth belt of each pontoon. Selective tank top plates of selective seawater tanks.	Two girth belts of each pontoon. Selective tank top plates of all seawater tanks.
6	Column and/or Pontoon seawater tanks used for trimming the installation			Representative plates and stiffeners.	Representative plates and stiffeners.
7	Chain lockers			Representative plates and stiffeners.	Representative plates and stiffeners.
8	Exposed upper hull where box or I beams receive major concentrated loads			Representative plates and stiffeners.	Representative plates and stiffeners.
9	Main supporting structure of heavy substructures and equipment. e.g. wind turbine, crane pedestal, and helicopter deck			Representative plates and stiffeners.	Representative plates and stiffeners.
10	Structural components of special category other than under 3-9 above. (These areas are normally identified in the IIP)			Representative plates and stiffeners.	Representative plates and stiffeners.
11	Air pipes and ventilators			Selected air pipes and ventilator coamings on exposed main deck.	All air pipes and ventilator coamings on exposed main deck.
Notes: 1) and 2) if considered necessary by the attending surveyor. 3) to 11) mandatory thickness measurements, number and extent of thickness measurement requirements may be modified by the surveyor considering the corrosion protection condition and arrangements.					

Guidance note:

Sample of structures prone to rapid wastage:

— Areas of columns and bracings without an efficient/intact hard epoxy coating system in way of the splash zone.
— Column and pontoon seawater tanks without an efficient/intact hard epoxy coating system.
— Chain lockers.

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4.4.2 Inspection area categorisation

Application categories for structural components to be inspected referred in Table 4, are defined in Table 3.

Special areas for inspection:

— Connections of bulkheads, stiffeners, flats or decks and girders in vertical columns, decks, lower hulls diagonals.
— Portions of deck plating, heavy flanges, and bulkheads within the upper hull or platform which form 'box' or 'I' type supporting structure which receive major concentrated loads.
— External shell structure in way of intersections of vertical columns, decks and lower hulls.
— Major intersections of bracing members.
— Highly stressed areas at connections of vertical columns, upper platform decks and upper or lower hulls which are designed to provide proper alignment and adequate load transfer.
— External brackets, portions of bulkheads, and frames which are designed to receive concentrated loads at intersections of major structural members.
— Highly utilised areas supporting anchor line fairleads and winches, crane pedestals, etc.

Primary areas for inspection:

— Bulkheads, stiffeners, flats or decks and girders in vertical columns, decks, lower hulls diagonals.
— Deck plating, heavy flanges, and bulkheads within the upper hull or platform which form 'box' or 'I' type supporting structure which do not receive major concentrated loads.
— External shell structure of vertical columns, lower and upper hulls, and diagonal and horizontal braces.
— Bulkheads, decks, stiffeners and girders which provide local reinforcement or continuity of structure in way of intersections, except areas where the structure is considered for special application.
— Main support structure of heavy substructures and equipment, e.g. anchor line fairleads, cranes, life boat platform, thruster foundation and helicopter deck.

Other areas for inspection:

— Upper platform decks, or decks of upper hulls except areas where the structure is considered as primary or special areas for inspection.
— Bulkheads, stiffeners, flats or decks and girders in vertical columns, decks, lower hulls, diagonal and horizontal bracing, which are not considered as primary or special application.
— Other structures not categorised as special or primary.

4.4.3 Lightweight survey

A lightweight survey shall be conducted at the first renewal survey. If a lightweight survey indicates a change from the calculated light ship displacement in excess of 1% of the operating displacement, an inclining test shall be conducted, or the difference in weight shall be placed in an indisputably conservative vertical centre of gravity and approved.

4.4.4 If the survey or test at the first renewal survey demonstrated that the installation is maintaining an effective weight control programme, and is confirmed by the records under [2.2.4], light ship displacement may be verified in operation by comparison of the calculated and observed draught. Where the difference between the expected displacement and the actual displacement based upon draught readings exceed 1% of the operating displacement, a lightweight survey shall be completed in accordance with [4.4.3].

4.5 Specific requirements for installations of other shape

The requirements for ship-shaped installations shall be applied as far as practical.

5 Renewal survey, machinery and systems

5.1 General

Machinery systems and equipment are covered by the renewal survey as described in [5.2.1].

The renewal survey may be replaced by alternative survey arrangements as described in Sec.5.

5.2 Machinery

5.2.1 Machinery systems shall be examined and tested according to Sec.5 [2].

5.3 Electrical installations

5.3.1 The survey shall comprise examination of the electrical installations with regard to fire and explosion hazards and injury from accidental touching. The survey shall include testing of correct functioning of equipment covered by class requirements.

Guidance note:

Electrical installations relating to wind turbine power production is not covered by main class. These may be included by selecting the voluntary class notation **Wind**.

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5.3.2 As far as practicable, the following equipment shall be examined for satisfactory condition:

— main and emergency switchboards
— generators
— distribution boards
— motor starters
— electrical motors
— converters (e.g. transformers, rectifiers, chargers)
— cable installations
— enclosures for electrical equipment
— lighting equipment
— heating equipment
— battery installations.

5.3.3 The following tests shall be carried out to the extent deemed necessary by the surveyor to ascertain the proper functioning of the equipment if equipment is installed:

— insulation resistance indicating device
— emergency generator including switchboards
— battery chargers
— mechanical ventilation of battery rooms and lockers
— marking lights
— electrical motors for essential and important use
— emergency generator, auto start following loss of main supply.
— emergency generator, remote operation.

Protection relays in generator and bus tie circuit breakers shall be tested with secondary current injection, or with suitable apparatus made for testing of the installed protection units.

5.3.4 Records of insulation test shall be shown to the surveyor. This requirement may be waived if:

— testing of all individual motors is included and logged in the planned maintenance system, and
— the insulation monitoring alarms required by DNVGL-OS-D202 Ch.2 Sec.2 are integrated in the machinery alarm.

5.4 Safety and control systems

5.4.1 Correct functioning of the various parts of the following systems shall, as far as applicable, be verified:

— alarm and safety system
— manual control of any equipment and machinery.

5.4.2 When cancelling of automatic load reduction and/or automatic stop of engine are provided, these functions shall be demonstrated to the satisfaction of the surveyor.

5.4.3 Emergency switch(es) for all electrical equipment including emergency generators, except alarm and communication systems and lighting in vital areas such as escape routes and landing platforms, shall be proved satisfactory (by a combination of testing and review of maintenance records).

SECTION 4 ADDITIONAL CLASS NOTATION SURVEYS

1 Introduction

1.1 General

1.1.1 This section presents the standard extent of surveys for retention of optional class notations.

1.1.2 Unless otherwise noted, the interval of the complete surveys as listed in this section is five (5) years.

2 Position mooring system

2.1 General

2.1.1 The requirements in this subsection apply to installations with class notation **POSMOOR**. Survey scope for groups of wind farm installations of similar design and location will be specially considered.

When several installations are grouped together in a field the survey scope should be adjusted to ensure that a representative selection of units and corresponding mooring system components are included in the class inspection scope. In order to utilise a field approach to the **POSMOOR** surveys an approved mooring integrity management (MIM) programme shall be in place, see [2.8].

The MIM programme will, when approved, override the listed calendar based annual and complete survey requirements listed in this section.

For wind farm installations where a MIM programme is not in place the survey requirements listed in the below subsections will apply to each unit, but may be reduced on a case by case basis when more than one unit is grouped together.

2.2 Types of surveys

2.2.1 Annual survey

Annual surveys may be carried out with the installation at operational draft and the mooring system in use. No special inspection aids are required and no disruption to the installations operation is intended.

2.2.2 Complete survey

Complete survey requires appropriate cleaning with good access and adequate lighting.

The complete mooring system for position keeping on location is subject to comprehensive survey, including opening up and NDT of selected parts of the mooring equipment installed.

Critical parts of all mooring lines and accessories shall be thoroughly visually examined and subjected to extensive NDT when required. The extent and type of survey is dependent on the design such as corrosion allowance, corrosion protection and fatigue.,see Table 1 below.

For installations with mooring line arrangements where line adjustments in operation are not part of original design basis, particular attention should be paid to the hang off arrangement.

A complete survey requires an inspection plan to be submitted by owner. This plan shall be based on the inspection criteria as set forward in this subsection in addition to findings and observations from past surveys.

2.2.3 Continuous survey

The owner may opt for a continuous survey scheme instead of the default calendar based one. This will require an approved mooring integrity management programme (MIM) to be in place. Installations equipped

with an approved mooring integrity management (MIM) programme shall follow the requirements set forward in that programme.

2.2.4 Owners shall ensure that the mooring system can be adequately surveyed. An inspection and survey plan for how the class survey scope will be met, shall be submitted to the Society for approval at the commencement of the in-service phase.

The inspection and survey plan shall be based on information from the post-installation inspection carried out as part of the completed installation of the mooring system, see DNVGL-OS-E301 Ch.3 Sec.2 [12].

This post installation inspection report shall comprise inspection data for all lines, from the anchor or foundation to the end connection towards hull structure and contain all recorded abnormalities and/or observations, which shall be noted with picture, description and location on the line.

Final tension recorded at installation shall be stated for all lines, and remaining twist, incl. acceptance criteria at time of installation, shall be stated. These data shall be included along with similar recordings from the surveys.

The inspection plan shall as a minimum cover the requirements set forward in Table 1.

2.3 Survey schemes for long term position mooring

2.3.1 The survey schemes are listed in Table 1.

If an approved mooring integrity management programme is in place, this shall be followed instead of Table 1. See [2.8] for requirements to approval of mooring integrity management programmes.

Table 1 Applicable survey schemes with reference to survey requirements

	Survey requirements [3), 4)]			
	General requirements		*Additional requirements*	
	Annual [2)]	*Complete*	*Complete*	
Systems designed with a fatigue life factor of 5 or greater [1)]	[2.4]	[2.6]	[2.7]	
Systems with an approved mooring integrity management programme (MIM)	[2.8]			

1) All lines inspected in-water on location.
2) For first annual after installation, the additional requirements of [2.5] apply.
3) Recordings from installation survey and the expanded first annual survey may require inspections below the waterline between the 5 yearly surveys. This additional inspection scope can also be triggered by special design solutions requiring a more frequent survey interval.
4) Incidents where damages, or suspected damages occur shall be reported to the Society, see DNVGL-RU-OU-0300 Ch.1 Sec.3 [1.2]. These incidents may require additional inspections.

2.4 Annual survey - general requirements

2.4.1 General

Annual survey consist of documentation review and general visual examination of the visible parts on the mooring system, unless otherwise specified in an approved mooring integrity management programme or previously recorded damages or flaws require more frequent survey activities, e.g. installation damages, for which MO(s) are issued.

2.4.2 Documentation review shall include:

- review to ensure that all installation survey documentation are available, complete with certificates for all installed components
- verify that documentation records from the expanded first annual survey are available for reivew
- the mooring analysis as required in DNVGL-OS-E301 Ch.3 Sec.1 [3.2] shall be verified
- it shall be verified that the installation operates within the limits stated in the mooring analysis
- review of mooring line records (as per applicable survey scheme)
- review of maintenance records for relevant components
- the calibration certificates for the load cells shall be verified, see DNVGL-OS-E301 Ch.2 Sec.4 [14].
- review of reports from all observed or suspected damages, incidents and repairs/replacements/ modifications carried out since last survey
- re-tensioning shall be verified carried out on installations where re-tensioning of the mooring lines in the first year(s) of operation is part of the design requirements.

2.4.3 Accessible and visible parts of the installation's mooring system for position keeping on location shall be visually surveyed.

2.5 Annual survey - additional requirements - first annual after installation

2.5.1 The first annual survey after installation shall be expanded to contain the below requirements:

- In-water survey shall be performed from the anchor or pile to the hull connection for all lines.
- In this survey the 'as is' condition of the system shall be mapped and all recorded abnormalities/ observations shall be noted with picture, description and location on line.
- The mooring system components shall be compared with the recordings and observations from the installation survey.
- The alignment of chain links in fairleads, if applicable, shall be inspected.
- Twist shall be recorded. Chain twist in excess of 3 degree interlink twist is in general not accepted. Twist in wire beyond stated limit in certificate is not accepted.
- Tension shall be verified for installations not having continuous monitoring of their tension. Line tension shall be verified to be within the tolerances set in the original design. Tension adjustments shall be done if outside design limit, unless otherwise proven to be acceptable by an updated mooring analysis.
- Trenches in proximity to piles or anchors shall be recorded.
- A complete report shall be submitted to class for review.

The expanded first annual survey is only applicable for the first five year survey cycle.

The data from the expanded first annual survey shall be used as baseline for future surveys.

Guidance note:

The additional requirement to the first annual survey is based on the fact that within a year in operation the mooring system has settled, lines have settled in seabed, trenching, if this is an issue, will now clearly appear. This phase is referred to as the bed-in phase.

Other deficiencies like misalignments in shackles, H-links and pad eyes will be visible.

Twist in chain and wires could have redistributed and can cause unwanted bending moments in single components, affecting the fatigue life of these.

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2.5.2 The first annual **POSMOOR** survey may be carried out earlier than the survey window for annual **POSMOOR** survey, but not earlier than after the season considered the worst with respect to weather and sea movements.

The survey should be completed before closing of window for first annual **POSMOOR** survey.

2.5.3 After the expanded first annual survey, no in-water surveys are required prior to first complete survey, unless damages or suspected damages occur in operation, or otherwise deemed necessary by attending surveyor/mooring specialist.

2.5.4 The consecutive annuals shall follow the scope as in [2.4].

2.6 Complete survey - general requirements

2.6.1 General

The requirements given for annual survey apply with the additions given in this subsection.

2.6.2 The scope of the complete periodical survey is complemented as specified in [2.7].

2.6.3 Function testing of the mooring system equipment shall be performed, unless only permanent stoppers/connectors are used:

— line tension systems are to be verified calibrated (where fitted)
— inclinometers are to be verified calibrated (where fitted)
— broken line warning systems are to be verified in order (where fitted).

2.6.4 Hull connection

The hull connection structure and termination components shall be subject to close visual inspection in-water, as far as possible.

2.6.5 Particular attention shall be paid to:

1) Rate of wear and signs of rotational movements beyond what is expected or assumed in design.
2) If abnormal or accelerated wear is observed, NDT and/or detailed engineering assessment shall be carried out.
3) NDT shall be done if suspected out of plane bending (OBP): due to larger movements than taken into account at design basis.
4) Verify free movement of components where the ability to rotate freely is depending on a bearing solution.

2.6.6 Special attention shall be given to the holding ability of the line termination/stopper.

2.6.7 If chain jacks, adjustable chain stoppers, or ratchets are installed, the owner shall ensure that the required rotation cycle of the chain link resting in pocket is followed.

2.6.8 If the design comprises trumpets at the connection point/stopper for mooring line, provisions for survey of the section inside the trumpet shall be arranged.

2.6.9 The effect of installed cathodic protection systems, (if applicable), shall be mapped and documented.

2.6.10 Extent and type of marine growth shall be recorded for all lines.

2.6.11 Alterations to above scope shall be agreed in advance with a specialist surveyor or engineer from the Society, and the proposed actions shall at least ensure the same integrity level is achieved and documented.

A more extensive scope may be required if findings are observed.

2.6.12 Upon completion of survey the owner, or owner representative, shall submit a complete inspection report to the Society.

- A comprehensive inspection report shall be recorded with pictures giving an overview of the condition of the mooring system.
- All abnormalities (both findings and minor observations) shall be recorded with position (line no. and depth/location on line) and be documented with pictures for follow-up and future reference.
- The report shall contain an assessment and action plan for future follow-up and reference of all recorded findings and observations.

Guidance note:

The scope of the complete survey as described in this subsection may be adjusted after the first complete survey based on the result from the first five-year cycle.

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2.6.13 Requirements for inspections below the waterline between the five yearly surveys after the expanded first annual survey may be exempted unless recordings from installation survey and the expanded first annual survey have triggered requirements for a more frequent inspection in excess of initial class scope, or there are special arrangements in the design solution which mean a more frequent survey interval is required and agreed.

The exemption being incidents where damages, or suspected damages occur. In these cases the Society shall be contacted.

2.6.14 Connection elements such as Kenter shackles, pear links, C-links and D-shackles with locking pin through bow and bolt, and swivels are not accepted in long term mooring systems. If such equipment is installed, it shall either be dismantled and subjected to non-destructive testing of all machined surfaces, or be replaced with new elements at least every five (5) years.

2.7 Complete survey – fatigue design life factor 5 or greater

2.7.1 The requirements in [2.7] are valid for mooring system design according to:

- API RP2SK Third Edition, October 2005 (design life factor 10)
- DNVGL-OS-E301 *Position mooring*, (design life factors 5 and greater).

2.7.2 For assumptions and conditions for acceptance of approach, see Table 1.

2.7.3 All mooring lines shall be inspected in-water, during a five (5) years period as follows:

- General visual inspection of all mooring lines.
- The mooring lines shall be compared with the reports from previous surveys and any new observations shall be recorded for evaluation.

— Close visual inspection (incl. cleaning) of one line from each mooring line cluster. Where lines are not clustered but evenly distributed, at least three mooring lines shall be selected. The selected lines shall be evenly spread and both normally windward and leeward side shall be included.

Guidance note:

Divers may be required to utilise for the upper parts of the line, where a ROV may be difficult to operate, typically just below the waterline.

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— Close visual inspection shall include cleaning of all discontinuities on the line, like shackles, sockets, rope connectors, etc.
— Cleaning of at least one link between each discontinuity, or as otherwise agreed with attending surveyor in order to map the condition. Both 'intergrip' measurements and diameter measurements shall be taken at this location.
— Cleaning of a sufficiently number of links and 'intergrip' measurements as well as diameter measurements to determine the wear and abrasion in the touch down-area/trash zone.
— Close visual inspection of selected links towards the pile until the chain is buried.
— Trenches in proximity to pile or anchors shall be recorded.
— Where MIC (microbiologically influenced corrosion), and consequently pitting, is observed on the chain links, the MIC affected areas shall be mapped and the extent and size of the pitting shall be recorded for evaluation together with the mapped corrosion rate.
— Chain measurements shall be done in the 'splash zone' or in case of submerged systems; downwards from the hull connector/stopper until the readings clearly start to show a reduction in corrosion and/or wear, but never less than at least 5 m below the waterline when the installation is at its lightest draft:
  — These measurements shall include at least one line from each cluster, or min. two representative lines in case of even distribution of lines.
  — Both intergrip measurements and diameter measurements shall be taken.
  — Should the intergrip measurements and/or diameter measurements show reducing levels below the normal defined splash zone, the measuring shall continue until the data trend-line demonstrates that the lowest values are captured.
  — For measurements in the touch-down/trash zone, sufficient reading shall be taken to ensure that the interlink wear and corrosion rate is mapped.

Guidance note:

In order to complete the chain readings and close visual inspection a combination of rope access personnel, divers and ROV may be required. The owner's survey plan should take this into consideration.

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2.7.4 Both the chain link diameter measurements and the two (2) neck measurements (intergrip) shall be tabulated and data presented to the Society in such a way that the reading's trend-line can be established for each selected line. This trend-line shall demonstrate that the areas with lowest readings are captured.

Guidance note:

When recording the lowest intergrip readings one should take into account that the fabrication process of the chain link, as well as in-service wear, will give the load bearing cross sectional area of the link crown an oval shape. To more correctly estimate the remaining cross sectional area, one should measure the crown diameter 90^{o} off the interconnecting link crowns.

Measurement tools should be used which facilitate this measurement in-water.

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2.7.5 The statistically weakest link shall be evaluated with regards to the overall trend and individual variation between links.

Raw data shall be submitted to the Society for evaluation along with a description of the chosen method utilised to calculate the weakest link.

Deep or large pittings shall be recorded separately with picture and dimensions. Deep pittings on bend and crown shall be evaluated separately.

The uncertainty in data shall take into account the expected trend-line readings due to variations in corrosion. Data and experience from similar designs and operational areas with respect to potential effect of MIC/pitting should be taken into account.

Guidance note:

For installations operating in environments where access in the splash zone carry a too high risk for involved personnel and equipment, and for which measurements for only part of the required length of line can be carried out, alternative solutions may be accepted on a case by case basis. In these cases a more conservative approach with respect to corrosion rate may be required adopted.

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2.7.6 Survey and chain measurements based on scanning, photogrammetric 3D modelling, and other similar methods, are accepted used under the condition that the service provider, method and equipment is approved. Case by case approval may be given.

New or novel methods shall be subject to a formal approval by the Society prior to being taken into use. Case by case approvals with new technology or applications may also be given, given attendance of a surveyor or mooring specialist form the Society.

Guidance note:

The Society have no restrictions on the implementation of technologies aiming at improving and increasing the accuracy of the survey methods applied, but new methods shall be subject to formal approval in advance.

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2.7.7 Wire segments shall be subject to GVI (general visual inspection), and all tears in the sheathing shall be recorded. Damages and/or tears in sheathing shall be subjected to CVI (close visual inspection). Cleaning shall be done as required to satisfactorily observe the extent of damages.

2.7.8 Fibre ropes shall be subject to GVI of all lines, but all visible damages and tears in the sheathing and/or jacket shall be recorded. Damages and tears in sheathing and/or jacket shall be subjected to CVI.

2.7.9 All recorded damages to wire and fibre ropes shall be subject to assessment by competent personnel provided by owner, as well as the Society.

2.7.10 Special attention shall be paid to connection elements such as:

- LTM (long term mooring) shackles and their bolts and locking devices
- wear and tear of connection elements
- corrosion with attention to severe pitting and signs of MIC
- steel wire rope sockets and their cathodic protection system
- chain stoppers
- wear and tear of chain links in chain stoppers and fairleads
- the links in a position to be subject to out of plane bending
- links either inside or in danger of coming into contact with trumpets
- damage to the protection (sheathing) of steel wire rope.

2.7.11 Where accessible, NDT shall be taken of the links closest to the chain stopper to check for cracks caused by out of plane bending (OPB). A plan for NDT shall be included in the owner's inspection programme.

For submerged connections, and where the effect of OPB was not part of the original design basis, an assessment shall be done with respect to OPB.

Guidance note:

OPB was not required to be taken into account in the mooring system design prior to the DNV-OS-E301, October 2013, Edition.

For these installations, new OPB calculations based on the actual measured dimensions of the link, combined with actual installation movements/link movements in operation, may be required on a case by case basis.

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2.7.12 A comprehensive survey report shall be recorded with pictures giving an overview of the condition of the mooring system.

All abnormalities shall be recorded with position and documented with pictures and an assessment and action plan for future follow-up and reference.

2.7.13 More detailed inspection including NDT may be required if the in-water inspection reveals defects that are considered as critical, i.e. cracks, severe pitting and wear and tear. An engineering assessment may be carried out and submitted to class as input and decision support for deciding expanded inspection scope or other required actions.

2.7.14 Additional requirements – tropical waters only

For installations located in tropical waters, or waters with a history with high risk of MIC, more extensive chain measurements than described in [2.7.3] to [2.7.5], shall be taken the first time measurements are included in scope.

Guidance note:

For areas considered tropical waters the ILLC 1966 definition apply. For installations located in the outer edges of the chart zones, or for which other presented and comparable field data clearly indicate a more normal corrosion/MIC rate, the additional requirements may be waived on a case by case basis. For installations inside the tropical zone for which the measurement results from first complete survey show a corrosion/MIC rate and extent considered to be in line with project estimates, the additional scope may be waived for further complete surveys.

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The measurements shall be carried out for at least twice the number of lines normally selected for measurements, and comprise:

— 2-neck measurements (intergrip)
— Diameter measurements of the chain link (average over two diameters.. taken at 90º angle).

All scaling and growth shall be removed at the location of the measurement points.

Guidance note:

When cleaning the links for measurement the area where the tool/calliper is placed, shall be cleaned to the level where shining metal is observed when using a steelbrush, or equivalent, (grinding not allowed). When cleaning the chain links for inspection one need to be aware that the removal of the hard scaling and corrosion products built up on the surface, will result in the corrosion speeding up for some time after the removal. The corrosion products reduce the mass transfer of oxygen and other agents to the metal surface resulting in the reduction of the kinetic of the cathodic reactions. Hence when removing this layer for inspection, the corrosion rate will increase. It is recommended to paint the cleaned areas (using e.g. standard zinc enriched marine paint) after the measurements are taken, to the extent possible.

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2.8 Mooring integrity management

2.8.1 In case a mooring integrity management (MIM) programme is developed for the installation and this have been subject to class review and approval, this programme shall be followed instead of the listed requirements to annual and complete surveys as described in subsection [2.4] to [2.7].

2.8.2 A MIM programme shall as a minimum address and document the following:

— Risk based assessment of mooring integrity risks imposed throughout the mooring lifecycle for all individual components and the mooring system as a whole.
— Identification of key risks for each component.
— A developed in-service integrity management strategy to mitigate risks for each component (e.g. inspection, monitoring, replacement), based on the risk assessment.
— A strategy for mitigating mooring integrity risks introduced during the design, manufacturing and installation phases.
— For installations currently in-service, the risks introduced during the past design, manufacturing and installation phases should be assessed retrospectively.
— For installations currently in-service, a new baseline shall be established at the introduction of the MIM programme.

Guidance note:

The below documents may be used as reference:

— DNVGL-RP-E308 Mooring integrity management
— Oil & Gas UK, Mooring integrity guidelines, Issue 3, November 2014.

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2.8.3 The MIM programme shall be surveyed and audited at each annual survey.

3 Helicopter deck

3.1 Application

The requirements in this subsection apply to installations with class notation **HELDK**.

3.2 Complete survey

See DNVGL-RU-SHIP Pt.7 Ch.1 Sec.6 [8].

4 Crane

4.1 Application

4.1.1 The requirements in this subsection apply for installations with additional class notation **Crane**.

4.1.2 **Crane** applies to any type of crane intended for cargo handling outside or on the installation. For an installation with more than one crane installed, class notation **Crane** may be applied to selected cranes only. The selected cranes will be identified in the appendix to the classification certificate.

4.1.3 Scope

The systems covered are in accordance with Ch.3 Sec.2 [4] and include following:

— structure
— machinery
— control and monitoring systems
— safety systems.

4.2 Annual survey

4.2.1 Objective

The intent of the annual survey is to verify satisfactory condition of the equipment without any intrusive interventions, given that the installation is in operation.

4.2.2 Scope

The extent of the annual survey is given in DNVGL-RU-OU-0300 Ch.3 Sec.4 [10.3].

4.3 Complete survey (five-yearly, renewal)

4.3.1 Objective

The intent of the complete survey is to confirm that the equipment and systems are fit for operation for another five (5) years.

4.3.2 Scope

The extent of the complete survey is given in DNVGL-RU-OU-0300 Ch.3 Sec.4 [10.4].

4.4 Crane - condition assessment

Crane or **Crane-offshore** applies to any type of offshore crane intended for cargo handling outside the installation while at sea and to any type of platform crane intended for cargo handling on the installation.

As an alternative to the survey scope described in the **Crane** rules, a condition assessment of the crane may be performed. The condition assessment shall be based on design working period calculations. Based on the condition assessment a repair, replacement and inspection plan shall be established and implemented.

As part of the condition monitoring the following steps shall be completed:

— identification of design and installation data
— recording necessary in operation data
— calculating the design working period
— performing special assessment
— reporting all necessary information, calculations and assessment
— establishing a repair, replacement and inspection programme.

The above steps shall be performed according to ISO 12482.

See DNVGL-RU-OU-0300 Ch.3 Sec.4 [10.5] for fleet in service requirements for crane - condition assessment.

5 Offshore gangways

5.1 General

The requirements in this subsection apply to installations with class notation **Walk2work**.

5.2 Surveys

Annual and complete surveys at an interval of five (5) years shall be in accordance with DNVGL-RU-SHIP Pt.7 Ch.1 Sec.6 [37].

5.3 Repairs and modifications

Repairs and modification of the gangway shall follow DNVGL-RU-OU-0300 Ch.3 Sec.4 [11].

6 Hull monitoring system

6.1 General

The requirements in this sub-section apply to installations with class notation **HMON**.

6.2 Objective

The purpose of the survey is to ensure the maintenance of the hull monitoring system as specified for the class notation.

Annual survey shall be carried out according to DNVGL-RU-SHIP Pt.7 Ch.1 Sec.6 [14].

7 Fatigue methodology specification

7.1 Application

The requirement in this subsection applies to installations with class notation **FMS(NUM)** and **FMS(SENS)**.

7.2 Annual survey

It shall be checked that the approved in-service test programme for all sensors has been followed.

Annual survey scope consists of verifying that data transfer and data quality is acceptable, and survey of sensor system as described for **HMON**.

In addition, it shall be evaluated that the data from the installation is of suitable quality to be used as input to potential RBI regimes.

The retention of **FMS(NUM)** and **FMS(SENS)** for installations in operation is dependent on the quality and availability of data. If the data from the installation is not of suitable quality to be used as input to potential RBI regimes, the notation may be withdrawn, see DNVGL-RU-OU-0300 Ch.3 Sec.4 [35.8].

8 Recycling

8.1 Application

The requirements in this subsection apply to installations with class notation **Recyclable**.

8.2 Surveys

Initial, complete, additional and final surveys shall be carried out according to DNVGL-RU-SHIP Pt.7 Ch.1 Sec.6 [33].

9 Cyber secure

9.1 Application

The requirements in this subsection apply to installations with class notation **Cyber Secure**.

9.2 Surveys

For initial, annual and complete surveys, see DNVGL-RU-SHIP Pt.7 Ch.1 Sec.6 [41].

10 Integrated software dependent systems

10.1 General

10.1.1 Application

The requirements in this subsection apply to installations with the class notation **ISDS**.

10.1.2 Objective

The purpose of the survey is to ensure the confidence that has been built into the installation is actually maintained.

10.1.3 Modifications

The owner shall inform the Society whenever a system with the **ISDS** notation is modified. For major upgrades or conversions of the installation in operation the full set of requirements in DNVGL-OS-D203 may apply.

11 Winterization

11.1 General

These requirements apply to installations with the following class notation **Winterized**.

11.2 Surveys

Annual and complete surveys shall be carried out according to DNVGL-RU-OU-0300 Ch.3 Sec.4 [18].

12 Wind turbine and associated systems

12.1 General

These requirements apply to installations with the following class notation **Wind**.

Requirements for operational surveys shall be according to DNVGL-SE-0190 [4.3.2]. It is also required to have a valid operational statement of compliance from DNVGL on the tower, rotor and nacelle assembly.

13 Smart

13.1 General

These requirements apply to installations with the following class notation **Smart**.

13.2 Surveys

The scope for annual and complete surveys shall be decided on a case by case basis.

14 Data collection infrastructure

14.1 General

These requirements apply to installations with the following class notation **D-INF**.

14.2 Surveys

The scope for annual and complete surveys shall be decided on a case by case basis.

15 Data driven verification

15.1 General

These requirements apply to installations with the following class notation **DDV**.

15.2 Surveys

The scope for annual and complete surveys shall be decided on a case by case basis.

SECTION 5 ALTERNATIVE SURVEY ARRANGEMENTS

1 Introduction

It is recommended that the Society in collaboration with the owner create a survey scheme that is based on the specific field and its installations. This survey scheme will take into consideration the fact that there are identical installations in the field

A survey scheme using methods specified in this chapter will be the default schemes for floating offshore wind turbine installations.

A survey arrangement applies to a specific area (discipline) or type of equipment on an installation. When implemented it will define all roles and responsibilities applicable for that specific area or equipment and how this shall be followed up on the installation during the operations phase. Survey arrangements are applicable to periodical surveys for main class and selected optional class notations.

Survey arrangements are defined and available for the following areas:

— machinery equipment, see [2]
— structure, see [3].

2 Machinery survey arrangements

2.1 General

2.1.1 Introduction

The different machinery survey arrangements are based on the Society's machinery list in accordance with DNVGL-RU-OU-0300 Ch.2 and as specified for the installation. The difference between them is the conditions for obtaining and maintaining the survey arrangement. If a survey arrangement is not specified, the periodical survey requirements as detailed in Sec.3 [5] shall be followed.

2.1.2 Machinery survey arrangements

The following survey arrangements are available for class related machinery items:

— machinery renewal (MR)
— machinery continuous (MC)
— machinery planned maintenance system (MPMS)
— machinery planned maintenance system – reliability centred (MPMS RCM)
— machinery condition based maintenance (MCBM)
— electrical systems integrity management (ESIM).

For more details about the different survey arrangements, see DNVGL-RU-OU-0300 Ch.2 Sec.2.

3 Structural survey arrangements

3.1 General

The structural integrity of an installation is maintained by different survey arrangements. The structural survey arrangements are based on the IIP, see Sec.3 [1.2] in accordance with type of installation.
The difference between the arrangements is the conditions for obtaining and maintaining the survey arrangement. If a survey arrangement is not specified, the periodical survey requirements as detailed in Sec.3 shall be followed.

The following survey arrangements are available:

— renewal
— structural continuous (SC)

— shared structural inspection (SSI)

For more details about the different survey arrangements, see DNVGL-RU-OU-0300 Ch.2 Sec.4.

For more details about the different structural survey arrangements, see DNVGL-RU-OU-0300 Ch.2 Sec.4.

4 Data and applications

Sensor data (parameters), other data and information collected from a specific installation, several installations in a field or from other available sources may be applied to determine optimal solutions and enable more real time and well documented decisions. Sensor data may be used for performance monitoring (local/remote), maintenance optimisations, utilisation calculations and remote surveys.

The Society promotes the use of sensor data as an integrated part of classification systematics and follow up during in-service. Any type of application shall be approved and any sensor data used shall be quality assured according to the rules and applicable standards. Sensor data shall be collected and transferred safely, ensuring a sufficient level of security to prevent and mitigate any potential threat or attack. Data collection infrastructure used for data consumption and sharing shall ensure a sufficient level of interoperability to facilitate composite hardware, software, network resources and services required for a sufficient data management.

For more details about data and applications, see DNVGL-RU-OU-0300 Ch.2 Sec.5.

Guidance note:

The term sensors can include more than only real sensors. It can also include indicator sensors (function based) and numerical sensors (design model based) where design assumptions are replaced with more accurate assumptions on asset specific encountered environmental data. Real sensors may also be combined with design models to utilise the accuracy of the real sensors and the extent of the design models to predict responses at other locations, i.e. hybrid sensors. All these represent variations of digital twins.

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SECTION 6 SURVEYS PERFORMED BY APPROVED COMPANIES

1 Surveys by approved companies

1.1 General

Parts of the periodical surveys may be carried out by companies approved by DNV GL. The following survey parts may be performed by such companies:

— thickness measurements
— bottom survey afloat
— general NDT
— mooring line survey
— condition monitoring (CM).

1.2 Thickness measurements

1.2.1 Thickness measurements as part of the periodical surveys shall be carried out by a qualified company approved by the Society.

1.2.2 Thickness measurements shall normally be carried out by means of ultrasonic test equipment. The accuracy of the equipment shall be proven to the surveyor as required.

1.2.3 A thickness measurement report shall be prepared. The report shall give the location of the measurements, the thickness measured and the corresponding original thickness. Furthermore, the report shall give the date when the measurements were carried out, type of measuring equipment, names of personnel and their qualifications. The report shall be signed by the operator.

Guidance note:

For more information, see DNVGL-CP-0484 App.A [1] *Firms engaged in ultrasonic thickness measurements of ship's structure*.

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1.3 Bottom survey afloat

An approved company shall be used. The survey shall be witnessed by a surveyor of the Society. The diver shall use pictorial equipment of such quality that the surveyor is fully satisfied with the information relayed.

Guidance note:

For more information, see DNVGL-CP-0484 App.A [3] *Service suppliers carrying out in-water survey of ships, high speed and light craft and mobile offshore units* and DNVGL-OTG-08 *Guidance on bottom survey*.

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1.4 Non-destructive testing

Non-destructive testing as part of the periodical surveys shall be carried out by a qualified company approved by the Society.

Guidance note:

For more information, see DNVGL-CP-0484 App.B [4] *Firms engaged in non-destructive testing (NDT) on offshore projects and offshore units/components*.

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1.5 Mooring chain inspections

Dry inspection of mooring lines as part of the periodical surveys shall be carried out by a qualified company approved by the Society.

Guidance note:

For more information, see DNVGL-CP-0484 App.B [12] *Renewal survey examination of mooring chain intended for mobile offshore units*.

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1.6 Condition monitoring

Condition monitoring as part of DNV GL's periodical surveys of machinery components and equipment, can be carried out by a company approved by the Society.

Guidance note:

For more information, see DNVGL-CP-0484 App.B [5] *Service suppliers engaged in condition monitoring of machinery onboard ships and mobile offshore units*.

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CHANGES – HISTORIC

There are currently no historical changes for this document.

About DNV GL

DNV GL is a global quality assurance and risk management company. Driven by our purpose of safeguarding life, property and the environment, we enable our customers to advance the safety and sustainability of their business. We provide classification, technical assurance, software and independent expert advisory services to the maritime, oil & gas, power and renewables industries. We also provide certification, supply chain and data management services to customers across a wide range of industries. Operating in more than 100 countries, our experts are dedicated to helping customers make the world safer, smarter and greener.

SAFER, SMARTER, GREENER