Certification Scheme for Marine Renewable Energy Technologies

November 2016

Guidance Note
NI 631 DT R00 E

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BUREAU VERITAS

MARINE & OFFSHORE DIVISION

GENERAL CONDITIONS

ARTICLE 1

1.1. - BUREAU VERITAS is a Society the purpose of whose Marine & Offshore Division (the "Society") is the classification (" Classification ") of any ship or vessel or offshore unit or structure of any type or part of it or system therein collectively hereinafter referred to as a "Unit" whether linked to shore, river bed or sea bed or not, whether operated or located at sea or in inland waters or partly on land, including submarines, hovercrafts, drilling rigs, offshore installations of any type and of any purpose, their related and ancillary equipment, subsea or not, such as well head and pipelines, mooring legs and mooring points or otherwise as decided by the Society.

The Society:

- "prepares and publishes Rules for classification, Guidance Notes and other documents (" Rules ");
- "issues Certificates, Attestations and Reports following its interventions (" Certificates ");
- "publishes Registers.

1.2. - The Society also participates in the application of National and International Regulations or Standards, in particular by delegation from different Governments. Those activities are hereafter collectively referred to as " Certification ".

1.3. - The Society can also provide services related to Classification and Certification such as ship and company safety management certification; ship and port security certification, training activities; all activities and duties incidental thereto such as documentation on any supporting means, software, instrumentation, measurements, tests and trials on board.

1.4. - The interventions mentioned in 1.1., 1.2. and 1.3. are referred to as " Services ". The party and/or its representative requesting the services is hereinafter referred to as the " Client ". **The Services are prepared and carried out on the assumption that the Clients are aware of the International Maritime and/or Offshore Industry (the "Industry") practices.**

1.5. - The Society is neither and may not be considered as an Underwriter, Broker in ship's sale or chartering, Expert in Unit's valuation, Consulting Engineer, Controller, Naval Architect, Manufacturer, Shipbuilder, Repair yard, Charterer or Shipowner who are not relieved of any of their expressed or implied obligations by the interventions of the Society.

ARTICLE 2

2.1. - Classification is the appraisement given by the Society for its Client, at a certain date, following surveys by its Surveyors along the lines specified in Articles 3 and 4 hereafter on the level of compliance of a Unit to its Rules or part of them. This appraisement is represented by a class entered on the Certificates and periodically transcribed in the Society's Register.

2.2. - Certification is carried out by the Society along the same lines as set out in Articles 3 and 4 hereafter and with reference to the applicable National and International Regulations or Standards.

2.3. - **It is incumbent upon the Client to maintain the condition of the Unit after surveys, to present the Unit for surveys and to inform the Society without delay of circumstances which may affect the given appraisement or cause to modify its scope.**

2.4. - The Client is to give to the Society all access and information necessary for the safe and efficient performance of the requested Services. The Client is the sole responsible for the conditions of presentation of the Unit for tests, trials and surveys and the conditions under which tests and trials are carried out.

ARTICLE 3

3.1. - **The Rules, procedures and instructions of the Society take into account at the date of their preparation the state of currently available and proven technical knowledge of the Industry. They are a collection of minimum requirements but not a standard or a code of construction neither a guide for maintenance, a safety handbook or a guide of professional practices, all of which are assumed to be known in detail and carefully followed at all times by the Client.**

Committees consisting of personalities from the Industry contribute to the development of those documents.

3.2. - **The Society only is qualified to apply its Rules and to interpret them. Any reference to them has no effect unless it involves the Society's intervention.**

3.3. - The Services of the Society are carried out by professional Surveyors according to the applicable Rules and to the Code of Ethics of the Society. Surveyors have authority to decide locally on matters related to classification and certification of the Units, unless the Rules provide otherwise.

3.4. - **The operations of the Society in providing its Services are exclusively conducted by way of random inspections and do not in any circumstances involve monitoring or exhaustive verification.**

ARTICLE 4

4.1. - The Society, acting by reference to its Rules:

- "reviews the construction arrangements of the Units as shown on the documents presented by the Client;
- "conducts surveys at the place of their construction;
- "classes Units and enters their class in its Register;
- "surveys periodically the Units in service to note that the requirements for the maintenance of class are met.

The Client is to inform the Society without delay of circumstances which may cause the date or the extent of the surveys to be changed.

ARTICLE 5

5.1. - **The Society acts as a provider of services. This cannot be construed as an obligation bearing on the Society to obtain a result or as a warranty.**

5.2. - **The certificates issued by the Society pursuant to 5.1. here above are a statement on the level of compliance of the Unit to its Rules or to the documents of reference for the Services provided for.**

In particular, the Society does not engage in any work relating to the design, building, production or repair checks, neither in the operation of the Units or in their trade, neither in any advisory services, and cannot be held liable on those accounts. Its certificates cannot be construed as an implied or express warranty of safety, fitness for the purpose, seaworthiness of the Unit or of its value for sale, insurance or chartering.

5.3. - **The Society does not declare the acceptance or commissioning of a Unit, nor of its construction in conformity with its design, that being the exclusive responsibility of its owner or builder.**

5.4. - The Services of the Society cannot create any obligation bearing on the Society or constitute any warranty of proper operation, beyond any representation set forth in the Rules, of any Unit, equipment or machinery, computer software of any sort or other comparable concepts that has been subject to any survey by the Society.

ARTICLE 6

6.1. - The Society accepts no responsibility for the use of information related to its Services which was not provided for the purpose by the Society or with its assistance.

6.2. - **If the Services of the Society or their omission cause to the Client a damage which is proved to be the direct and reasonably foreseeable consequence of an error or omission of the Society, its liability towards the Client is limited to ten times the amount of fee paid for the Service having caused the damage, provided however that this limit shall be subject to a minimum of eight thousand (8,000) Euro, and to a maximum which is the greater of eight hundred thousand (800,000) Euro and one and a half times the above mentioned fee. These limits apply regardless of fault including breach of contract, breach of warranty, tort, strict liability, breach of statute, etc.**

The Society bears no liability for indirect or consequential loss whether arising naturally or not as a consequence of the Services or their omission such as loss of revenue, loss of profit, loss of production, loss relative to other contracts and indemnities for termination of other agreements.

6.3. - All claims are to be presented to the Society in writing within three months of the date when the Services were supplied or (if later) the date when the events which are relied on of were first known to the Client, and any claim which is not so presented shall be deemed waived and absolutely barred. Time is to be interrupted thereafter with the same periodicity.

ARTICLE 7

7.1. - Requests for Services are to be in writing.

7.2. - **Either the Client or the Society can terminate as of right the requested Services after giving the other party thirty days' written notice, for convenience, and without prejudice to the provisions in Article 8 hereunder.**

7.3. - The class granted to the concerned Units and the previously issued certificates remain valid until the date of effect of the notice issued according to 7.2. here above subject to compliance with 2.3. here above and Article 8 hereunder.

7.4. - The contract for classification and/or certification of a Unit cannot be transferred neither assigned.

ARTICLE 8

8.1. - The Services of the Society, whether completed or not, involve, for the part carried out, the payment of fee upon receipt of the invoice and the reimbursement of the expenses incurred.

8.2. - **Overdue amounts are increased as of right by interest in accordance with the applicable legislation.**

8.3. - **The class of a Unit may be suspended in the event of non-payment of fee after a first unfruitful notification to pay.**

ARTICLE 9

9.1. - The documents and data provided to or prepared by the Society for its Services, and the information available to the Society, are treated as confidential. However:

- "Clients have access to the data they have provided to the Society and, during the period of classification of the Unit for them, to the **classification file** consisting of survey reports and certificates which have been prepared at any time by the Society for the classification of the Unit ;
- "copy of the documents made available for the classification of the Unit and of available survey reports can be handed over to another Classification Society, where appropriate, in case of the Unit's transfer of class;
- "the data relative to the evolution of the Register, to the class suspension and to the survey status of the Units, as well as general technical information related to hull and equipment damages, may be passed on to IACS (International Association of Classification Societies) according to the association working rules;
- "the certificates, documents and information relative to the Units classed with the Society may be reviewed during certificating bodies audits and are disclosed upon order of the concerned governmental or inter-governmental authorities or of a Court having jurisdiction.

The documents and data are subject to a file management plan.

ARTICLE 10

10.1. - Any delay or shortcoming in the performance of its Services by the Society arising from an event not reasonably foreseeable by or beyond the control of the Society shall be deemed not to be a breach of contract.

ARTICLE 11

11.1. - In case of diverging opinions during surveys between the Client and the Society's surveyor, the Society may designate another of its surveyors at the request of the Client.

11.2. - Disagreements of a technical nature between the Client and the Society can be submitted by the Society to the advice of its Marine Advisory Committee.

ARTICLE 12

12.1. - Disputes over the Services carried out by delegation of Governments are assessed within the framework of the applicable agreements with the States, international Conventions and national rules.

12.2. - Disputes arising out of the payment of the Society's invoices by the Client are submitted to the Court of Nanterre, France, or to another Court as deemed fit by the Society.

12.3. - **Other disputes over the present General Conditions or over the Services of the Society are exclusively submitted to arbitration, by three arbitrators, in London according to the Arbitration Act 1996 or any statutory modification or re-enactment thereof. The contract between the Society and the Client shall be governed by English law.**

ARTICLE 13

13.1. - **These General Conditions constitute the sole contractual obligations binding together the Society and the Client, to the exclusion of all other representation, statements, terms, conditions whether express or implied. They may be varied in writing by mutual agreement. They are not varied by any purchase order or other document of the Client serving similar purpose.**

13.2. - The invalidity of one or more stipulations of the present General Conditions does not affect the validity of the remaining provisions.

13.3. - The definitions herein take precedence over any definitions serving the same purpose which may appear in other documents issued by the Society.

BV Mod. Ad. ME 545 L - 7 January 2013

GUIDANCE NOTE NI 631

Certification Scheme for Marine Renewable Energy Technologies

Novembre 2016

Section 1 General

Section 2 Approval in Principle

Section 3 Prototype Certificate

Section 4 Component and Type Certificates

Section 5 Project Certificate

SECTION 1 GENERAL

1 Introduction

1.1 Purpose of the document

1.1.1 The purpose of this Guidance Note is to provide an overview of the certification scheme applicable to Marine Renewable Energy (MRE) technologies. Description of the certification scheme is intended to help the different stakeholders to identify the necessary certificates to conduct their MRE projects.

This Note covers different types of technology for energy conversion from wind, wave, tidal or temperature gradients at sea, such as:

- Floating Offshore Wind Turbine (FOWT)
- Current and Tidal Turbine (CTT), including sea and river turbine
- Ocean Thermal Energy Converter (OTEC)
- Wave Energy Converter (WEC).

Specific requirements for design are not included in this Note, they may be found in the relevant Rules and Guidance Notes of the Society.

1.2 Certificates

1.2.1 To meet a broad range of needs within the MRE industry, different certificates are introduced, see Tab 1:

- Approval in Principal (AIP)
- Prototype Certificate
- Component and Type Certificate
- Project Certificate.

Note 1: For wind turbine, the Society's evaluation system can be based on the public, internationally recognized IEC 61400 series, including in particular the IEC 61400-22 describing the general certification scheme, the IEC 61400-1 related to general design and load cases, and the IEC 61400-3 for offshore wind turbines.

1.3 General definitions

1.3.1 Administration

Administration means the Government of the State responsible for or managing the area in which the MRE unit is operating.

1.3.2 Approval

Approval means the review by the Society of documents, procedures or other items related to certification, verifying solely their compliance with the relevant Rules requirements, or other referential where requested.

1.3.3 Certification

Certification is a procedure by which a third party gives written assurance that a product, process or service conforms to specified requirement; also known as conformity assessment.

1.3.4 Provisional Certificate

A Provisional Certificate may serve as a Certificate in some cases. It may be issued on request and when the Society deems it necessary. All outstanding issues are listed. As outstanding issues become closed, updated deliverables can be issued.

1.3.5 Evaluation of conformity

Systematic examination of the extent to which a product, process or service fulfils specified requirements.

1.3.6 Survey

Survey means an intervention by the Surveyor for assignment or maintenance of certificate or interventions by the Surveyor within the limits of the tasks delegated by the Administration.

Table 1 : Certificates overview

Life cycle phase	Certification phase	Deliverables	AIP	Prototype certificate	Component certificate	Type certificate	Project certificate
			Sec 2	Sec 3	Sec 4	Sec 4	Sec 5
Development	Risk assessment	Evaluation report conformity statement	Qualitative studies Sec 2	(Optional) Sec 3, [3]	-	(Optional) Sec 4, [3]	(Optional) Sec 5, [3]
	Design basis			Basic design evaluation Sec 3, [4]	Sec 4, [4]	Sec 4, [4]	Sec 5, [5]
	Integrated loads				-	-	Sec 5, [6]
	Design evaluation				Sec 4, [5]	Sec 4, [5]	Sec 5, [7]
Construction	Manufacturing	Evaluation report conformity statement	-	(Optional) Sec 3, [5]	Sec 4, [6]	Sec 4, [6]	Sec 5, [8]
	Transport and installation surveillance		-	-	-	-	Sec 5, [9]
Operation and maintenance	Testing	Evaluation report conformity statement	-	Sec 3, [6]	Sec 4, [7]	Sec 4, [7]	-
	Commissioning surveillance		-	(Optional) Sec 3, [7]	-	-	Sec 5, [10]
	Characteristics measurements		-	-	-	(Optional) Sec 4, [8]	(Optional) Sec 5, [11]
Final		Final evaluation report & Certificate	X **(1)**	X	X	X	X
In service		Report	-	Sea trials (optional) Sec 3, [8]	-	-	Sec 5, [12]

(1) For AIP, a lettter of Approval is delivered in lieu of certificate

1.3.7 Surveillance

Surveillance is a continued monitoring and verification of the status of procedures, products and services, and analysis of records in relation to referenced documents to ensure specified requirements are met.

1.3.8 Verification

The method used to ensure the quality of purchased materials, items or components or of in-process products at appropriate point of the process.

1.3.9 Conformity statement

The conformity statement is a document issued upon successful completion of evaluation of a certification module.

1.4 Technical definitions

1.4.1 Energy converter

The energy converter is the device for production of (electrical) energy from renewable energy (wind, current, thermal energy...) and its own structure.

1.4.2 Foundation

Foundations are installations at the seabed or in the seabed, serving as anchoring of station-keeping system and providing the transfer of loads to soil.

1.4.3 Sub-structure

The sub-structure is the part of the support structure which connect the station keeping system, if any, or foundation to the energy converter or to the tower if any.

1.4.4 Support structure

The support structure consists of the foundation, station keeping system, sub-structure and the tower, when relevant.

1.4.5 Tower

The tower is the part of a support structure which connects the sub-structure to the energy converter.

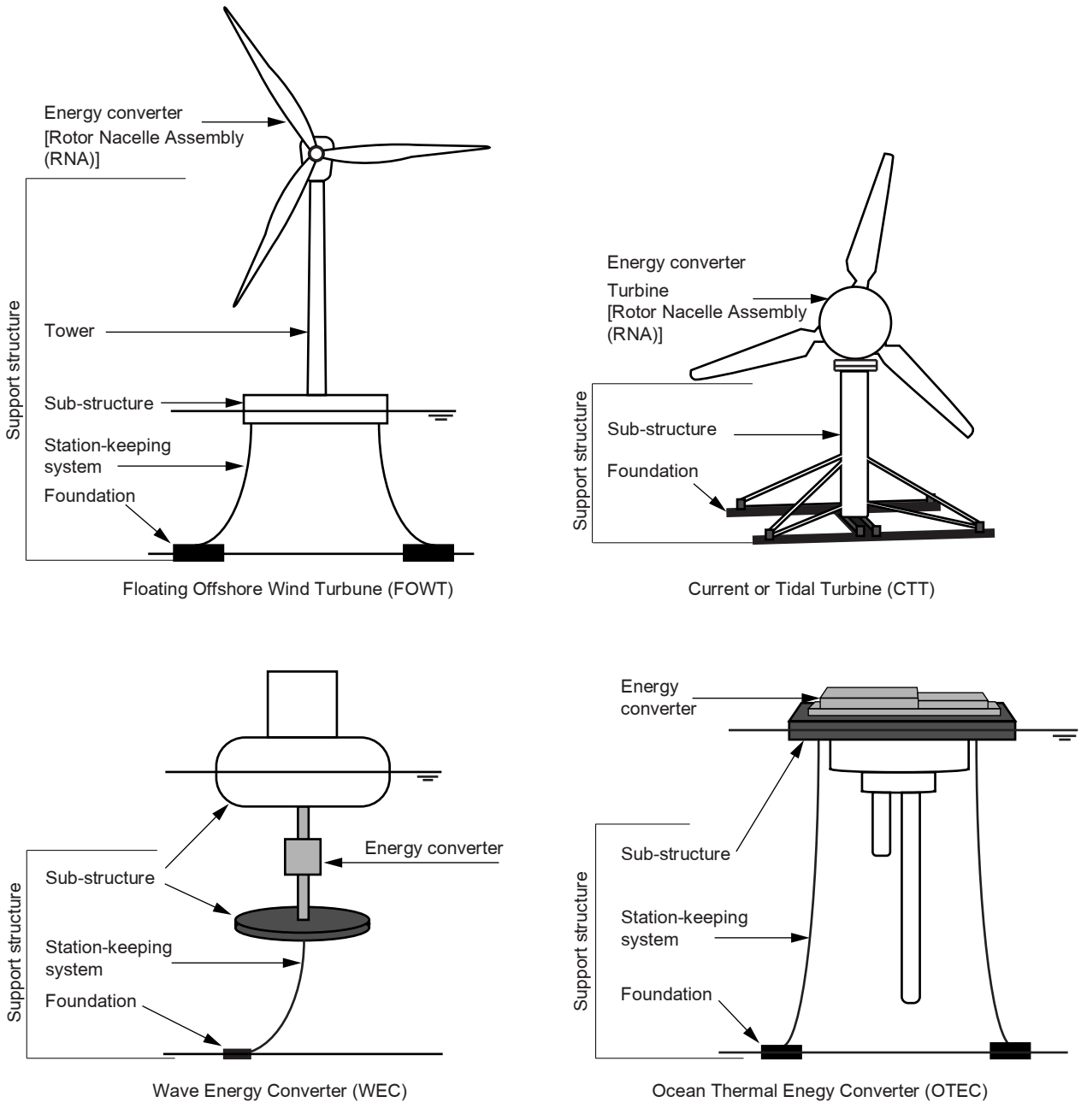
Note 1: Tower is generally to be considered for a FOWT.

1.4.6 Station-keeping system

The station-keeping system is a system capable to maintain the unit in position within specified limits.

Note 1: Station-keeping system may consists in mooring lines, tension legs, dynamic positioning system...

Figure 1 : Types of marine renewable energy



1.5 Acronyms

1.5.1

IEC : International Electrotechnical Commission
ISO : International Organization for Standardization
MRE : Marine Renewable Energy
FOWT : Floating Offshore Wind Turbine
CTT : Current and Tidal Turbine
OTEC : Ocean Thermal Energy Converter
RNA : Rotor Nacelle Assembly
WEC : Wave Energy Converter
O&M : Operation & Maintenance
P&ID : Piping and Instrumentation Diagram.

1.6 Guides, codes or standards

1.6.1 The documents presented here are only the governing documents. Specific documents to be used on each relevant design aspect are defined as part of the Design Basis of each element.

1.6.2 General

The following Society documents may be considered:

- NR183 Rules for the towage at sea of vessels or floating units
- NR320 Certification scheme of materials and equipment for the classification of marine units
- NR426 Construction survey of steel structures of offshore units and installations
- NR445 Rules for the classification of offshore units
- NR462 Recognition of test laboratories
- NR476 Approval testing of welders
- NR480 Approval of the manufacturing process of metallic materials
- NR493 Classification of mooring systems for permanent offshore units
- NI 525 Risk based qualification of new technology - Methodological guidelines.

For Floating Offshore Wind Turbine, the following standards may be considered:

- NI 572 Classification and certification of Floating Offshore Wind Turbines
- BV-WFPC-100: Bureau Veritas guide on offshore wind farm project certification
- IEC 61400: Wind turbines
  (IEC 61400-22: Wind turbines - Part 22: Conformity testing and certification).

For Current and Tidal Turbine, the following standards may be considered:

- NI 603 Guidance Note on Current and Tidal Turbines
- IEC TS 62600: Marine energy - Wave, tidal and other water current converters.

The following documents may be considered:

- Norsok Standard NS 3473: Concrete structures - Design and detailing rules
- Eurocodes EN 1990 to 1998, with national annexes
- ISO 19900 to 19906: Requirements for offshore structures
- ISO/IEC 17065: Conformity assessment - Requirements for bodies certifying products, processes and services
- IEC 61892: Mobile and fixed offshore units - Electrical installations
- IEC 60146: Semiconductor converters - General requirements and line commutated converters.
- ISO/IEC 17021: Conformity assessment - Requirements for bodies providing audit and certification of management systems
- ISO/IEC 17025: General requirements for the competence of testing and calibration laboratories

2 Certification approach

2.1 Overview

2.1.1 The certification scheme is based on the conformity of a serie of modules. Delivery of the certificate is subject to the completion of all mandatory modules. Optional modules are also proposed and may be added to the mandatory modules. The completion of a module may be based on a documentation review and/or independant calculations and/or audits and/or inspections.

2.2 Deliverable

2.2.1 Each module of the certification procedure, once validated, is concluded by an evaluation report and a conformity statement. At the end of each certification procedure, a certificate, attesting to the conformity and correctness of all mandatory and, if applicable, optional modules, is issued along with the final evaluation report.

2.3 Third parties' certificates

2.3.1 Different certification bodies may be involved in the certification process. The Client may therefore submit to the Society, Test Report, Conformity Statements or Certificates (e.g. Type Certificate) from other certification bodies.

The Society does not take responsibility for other Certification Bodies' work.

Note 1: About wind industry (FOWT), the Society follows the procedure prescribed by the IECRE Conformity Assessment System and described in IECRE clarification sheet n° 6A Project Certification Recognition Arrangement (available on the IECRE web page (http://www.iecre.org/)).

2.4 Methodology

2.4.1 The evaluation process consists of document review as well as independent analyses or inspections, depending on the module under consideration.

2.4.2 Evaluation plan

At the beginning of the process, a detailed Evaluation Plan is submitted to the client. This evaluation plan describes the evaluation process into details, together with the working methods and the primary planning.

2.4.3 Document review

A large part of the evaluation consists in reviewing calculation notes, specifications, drawings, data sheets, reports, certificates, etc. The evaluators verify the completeness of the provided documentation and its conformity to the reference set of standards for the verification.

A typical document verification loop consists of two successive reviews. Upon completing the first review, the Society issue a list of comments to be considered by the client. A second review is then performed to confirm that all these remarks have been correctly implemented in the updated document. No significant changes to the content or to the calculation methods other than the necessary corrections are allowed for in one review cycle.

2.4.4 Collaborative platform VPM

Bureau Veritas has developed a web-based collaborative platform, Veristar Project Management (VPM) as illustrated in Fig 2. It is a specific software tool for document review, ensuring smart management of the complete documentation and effective communication between the Society and the client. Each document submitted is recorded in this tool which centralizes all the comments made by the reviewer and answers from the Client. This reviewing process ensures transparency and efficiency.

2.4.5 Independent analyses

The Society may performs independent calculations based on its own assumptions and methods. The goal of these independent calculations is to verify some key characteristics of the project. They do not prevent the client from performing its own sensitivity analyses.

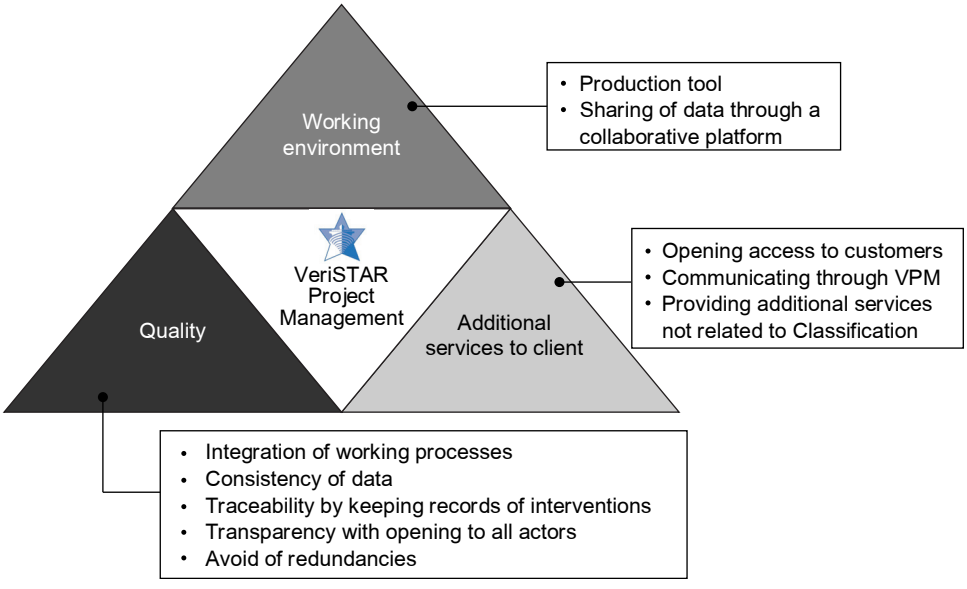
Independent analyses are usually performed for the most critical cases only and not as a standard basis. They are based on inputs provided by the client.

2.4.6 Tests

Tests are to be carried out by an accredited testing laboratory. If it is not the case, the party conducting the testing is to comply with at least the criteria of ISO/IEC 17025 or ISO/IEC17020, as applicable.

Note 1: Guidance may be found in NR462 Recognition of test laboratories.

Figure 2 : Veristar Project Management



2.4.7 Inspections and surveillance

The surveillance of a specific process (manufacturing, transportation, installation, etc.) consists of verifying that the procedures in force meet specified requirements. This verification usually involves several methods:

- Evaluation of the quality system
- Verification of the compliance of the procedures with the specified requirements
- Verification of the effective application of the procedures.

The quality system evaluation is normally limited to the verification that the quality systems of the different manufacturers or operators involved are certified according to ISO 9001. This quality system certification is to be carried out by an accredited certification body operating according to ISO/IEC 17021. If the quality system is not properly certified, the Society have to evaluate that it meets sufficient quality management requirements.

The evaluation of the compliance of the procedures usually consists of reviewing the different documents related to the process under scrutiny (manuals, checklists, reports, etc.) and verifying their compliance to the specified requirements.

Finally, the verification of the correct application of the procedures involves review of records and reports related to the process under scrutiny and several on-site inspections of the process. The exact scope and extent of the inspections depend on the component to be inspected and the manufacturing process itself.

3 Reference set of certification requirements

3.1 General

3.1.1 During the evaluation, the conformity of the component/unit/farm is assessed according to a hierarchy of requirements which need to be defined jointly at the start of the process. This set of requirements forms the reference basis for Prototype, Component, Type or Project Certification.

3.1.2 Different steps can be followed to determine the set of requirements:

a) Breakdown into components

Depending on the technology considered and associated available standards, the level of details of the breakdown may vary.

A functional analysis can be helpful to ensure exhaustive identification of each component constituting the unit such as blades, generator, cables, connectors, etc.

b) Technology assessment

The maturity and similarity or difference in the operating conditions for each component identified is to be established by a Technology Assessment, conducted following Tab 2 (A methodology is described in NI 525).

c) Identification of codes and standards

For each component identified and assessed, existing standards and their application for the specific MRE unit conditions are identified. For each component identified in a) and assessed in b), existing standards are identified and their applicability for the specific MRE conditions is to be investigated.

Note 1: Components for which the technology assessment is equal to 0 (proven technology in similar application conditions) are likely to be already covered by existing codes or standards applicable in the specific MRE unit conditions.

Table 2 : Technology assessment scale

Technology maturity	Application conditions	
	Similar	Different
Proven	0	1
Limited field history	1	2
New	2	3

3.1.3 It is recognized that existing record of in-service information may not be sufficient to provide a comprehensive set of dedicated MRE standards. In that purpose, use of existing codes and standards from MRE and related sectors may be combined with a risk-based approach for the most innovative and unknown part. The resulting reference set of certification requirements may contains:

- existing codes and standards
- existing codes and standards with appropriate modifications when necessary, to adapt them to the specific MRE unit context
- additional requirements for MRE unit components which are not covered by any existing code or standard.

3.2 Risk based methodology

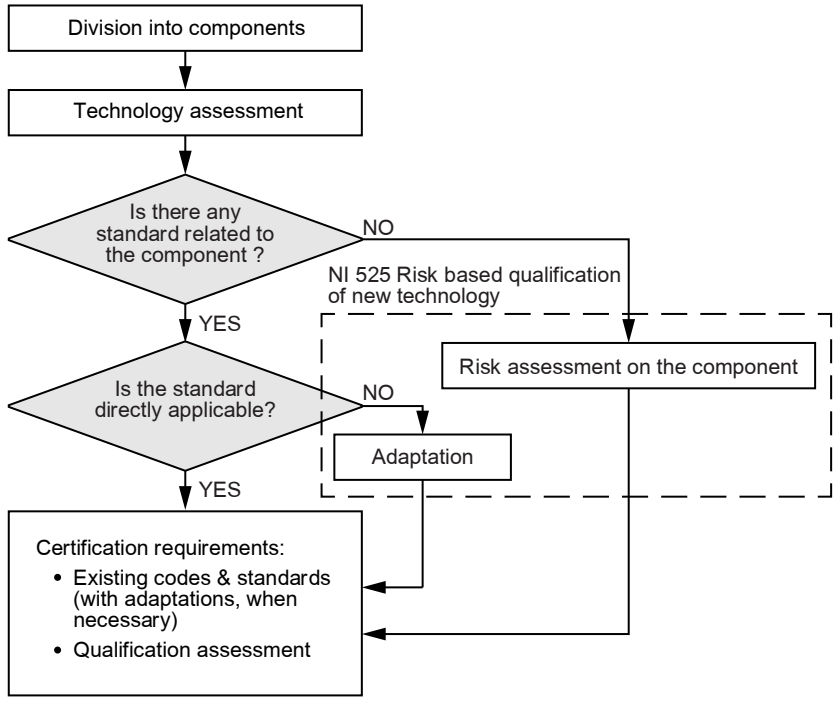
3.2.1 The purpose of the risk-based methodology is to assess the availability and relevance of existing codes and standards for each MRE unit component and to provide adaptations or appropriate requirements when necessary.

Risk assessments are considered at different levels:

- when there is no existing codes and standards
- when there are codes and standards from related sectors, but they need to be adapted to the specific MRE unit conditions.

The risk-based methodology for the definition of the reference set of certification requirements is illustrated in Fig 3.

Figure 3 : Risk-based methodology of the reference set requirements



3.2.2 No existing code and standard

If there are no guidelines nor standards for a specific component, neither in the MRE sector, nor in related sectors; then the qualification steps described in NI 525 may be implemented.

Potential high risks induced by the component are to be identified and assessed in terms of frequency and severity of the consequences. Associated mitigation measures and qualification activities (calculations or physical tests) are to be implemented to ensure safety and reliability of the component.

3.2.3 Codes and standards from related sectors

If there are standards from related sectors (such as shipping or offshore oil & gas), appropriate modifications or interpretation may be necessary to adapt their requirements to the specific MRE unit conditions. The specific MRE unit context deviations from their conditions of application are to be assessed.

Potential gaps or over-constraining requirements regarding MRE projects are to be investigated. Appropriate modifications or interpretation may be considered to adapt the requirements, subject to the agreement of the Society.

As a guidance, the qualification procedure described in NI 525 is recommended to identify specific failure modes induced by the MRE unit conditions. Associated mitigation measures and qualification activities (calculations or physical tests) are to be deployed and conducted to ensure safety and reliability of the component.

SECTION 2 APPROVAL IN PRINCIPLE

1 General

1.1 Application

1.1.1 Approval In Principle (AIP) is applicable for a concept of MRE unit. It is issued as soon as pilot studies are completed and confirms that the outline project does not present any contradiction either with the state of art or with the applicable rules. It also determines which rules can be taken into account when no rules are strictly applicable.

The AIP refers to qualitative studies and is based on general options chosen by the Client.

1.1.2 Purpose

The AIP may have the following objectives:

- To establish the design code to comply with
- To verify that the design is feasible, achievable, and contains no technological showstoppers that may prevent the design from being matured
- To verify that the design is deemed to be suitable for use in the metocean conditions that the unit facility will be located in
- To verify that the design is deemed to be suitable for use in all phases of operation including design, manufacturing, transportation, installation, commissioning, operation and maintenance
- Provide recommendations to fulfill through the following phases of the project.

1.1.3 AIP is a flexible process, adapted to early certification stages. Discussions need to be held between the Society and the Client as a first step to define the scope and extent of the AIP:

- rules and regulations to be considered for the review
- scope of the AIP (list of submitted documentation).

1.1.4 Scope of the AIP

The scope of the AIP may covers design reviews of different documents relating to:

- General arrangement drawings
- Metocean/hydrodynamics
- Stability, when relevant
- Hull structure
- Corrosion
- Mooring design, when relevant
- Riser design (for OTEC)
- List of systems and equipment onboard
- P&ID of the systems
- Ballast system, when relevant
- Electrical design (single line diagram and load balance)
- ...

Note 1: AIP may focus on the design basis, the submitted documentation may consist of methodological reports and design philosophies.

Note 2: The document review is not supported by calculation.

2 Approval

2.1 Delivrables

2.1.1 Letter of approval

Approval In Principle may be granted by a letter with a final report in which the documents reviewed, the Society's remarks and comments, and the rules for which fitness was checked are listed.

2.2 Validity

2.2.1 Any major modification likely to invalidate the principles as evaluated on the documents may reconsider the validity of the Certificate.

SECTION 3 PROTOTYPE CERTIFICATE

1 General

1.1 Application

1.1.1 Prototype Certification is applicable for the first unit of a new generation. The general plausibility and safety of the unit design is assessed, with focus on previously identified risk areas.

2 Prototype Certification

2.1 Prototype Certification scheme

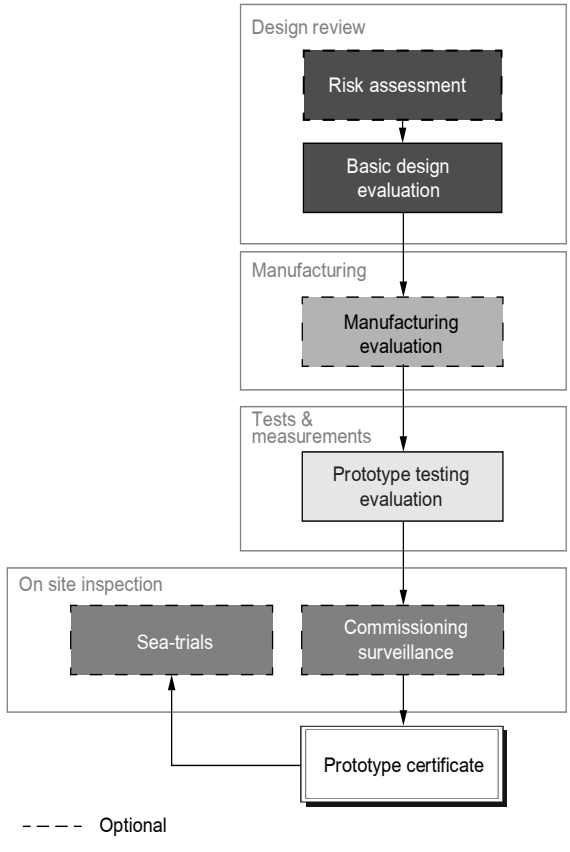
2.1.1 The Prototype Certification scheme consists of the completion of the modules, as given in Fig 1:

- Risk assessment (optional)
- Basic design evaluation
- Manufacturing surveillance (optional)
- Prototype testing evaluation
- Commissioning surveillance (optional)
- Sea trials (optional).

2.1.2 Validity

The validity period of the Prototype Certificate is maximum 3 years.

Figure 1 : Prototype Certificate scheme



3 Risk assessment (optional)

3.1 General

3.1.1 The risk assessment aims at identifying systematically:

- Hazardous situations, such as collision or climatic extremes and their possible causes and effects induced on asset integrity, personal safety and environment.

Note 1: HAZID (Hazard Identification method) is recommended.

- Component failures: failure modes and their possible causes and effects induced on asset integrity, personal safety and environment.

Note 2: FMECA (Failure Mode, Effects and Criticality Analysis) is recommended.

3.1.2 Evaluation of the risk assessment module consists of a review of the risk assessment documents to ensure that no hazard remain unaddressed.

3.1.3 The Society reserves the right to consider the risk assessment as mandatory.

4 Basic design evaluation

4.1 General

4.1.1 The basic design evaluation focus on loads and major structural components. Particular attention is paid on risk areas identified through the risk assessment. It consists of a design basis evaluation and evaluation of detailed design.

Note 1: A previous AIP as described in Sec 2 can facilitate the review of this module.

4.2 Design basis evaluation

4.2.1 The design basis aims at identifying all requirements, assumptions and methodologies which are essential for the design and the design documentation, including:

- codes and standards

  and eventually additional requirements or deviations from these codes and standards when required and additional requirements for components which are not covered by existing codes and standards (see Sec 1, [3.2])

- design parameters, assumptions, methodologies and principles
- other requirements, e.g. for manufacture and commissioning as well as for operation and maintenance.

4.3 Design evaluation

4.3.1 The purpose of the design evaluation module is to examine whether the prototype is designed and documented in conformity with the design assumptions, specific standards and other technical requirements. It can be limited to loads, major structural components, control and protection systems and personnel safety issues.

Design evaluation consists in a review of detailed design documentation (calculation notes, drawings, specifications). Independent analytical and/or numerical calculations may be performed by the Society for verification purpose, typically for major structural components.

5 Manufacturing evaluation (optional)

5.1 General

5.1.1 The manufacturing evaluation ensures that the intended quality requirements are met for the prototype and the component under consideration.

As part of the manufacturing evaluation, welding procedures specifications and existing qualification are reviewed and inspections are to be planned covering the critical phases of the fabrication process.

6 Prototype testing evaluation

6.1 General

6.1.1 The prototype testing evaluation aims to verify that the prototype under test displays the behaviour predicted in the design. It may be limited to the safety and function tests and consists of:

- prototype test plan evaluation
- prototype testing.

Note 1 : Power performance measurements may be considered.

6.2 Prototype test plan

6.2.1 The prototype test plan aims to provide data needed to verify aspects that are vital to safety and need additional experimental verification. Main components to be tested during the test period and loads to be documented during the tests are to be specified.

Evaluation is based on a review of the prototype test plan.

6.3 Prototype testing

6.3.1 The prototype testing may be limited to the safety and function tests. It aims to verify that the prototype under test displays the behavior predicted in the design.

Evaluation is based on:

- demonstration that the control and protection system functions correspond to the approved test plan
- verification of the dynamic behaviour.

7 Commissioning surveillance (optional)

7.1 General

7.1.1 The commissioning surveillance is an optional module of the Prototype Certification procedure. On a case by case basis, the commissioning of the prototype unit may be surveyed by the Society at the request of the Client.

8 Sea trials (optional)

8.1 General

8.1.1 The review of prototype unit testing at sea is an optional module of the Prototype Certification procedure. On a case by case basis, compliance of sea trials reports with the specifications of the prototype testing may be assessed by the Society and included in the Prototype Certificate at the request of the Client.

SECTION 4 COMPONENT AND TYPE CERTIFICATES

1 General

1.1 Application

1.1.1 Type and Component Certification are applicable for the "generic part" of a standard commercial unit, considering a series of units of common design and manufacture. Type certification considers the same certification modules as Component Certification, but applied to the complete unit. As such, components that are already certified are easily integrated into the Type Certification procedure.

1.1.2 Component Certification

Component Certification is applicable for unit components that are likely to be used in multiple projects. In such cases, a specific Component Certification can avoid the repetition of design evaluations for each project, as long as the external conditions are not more severe than those specified in the Component Certificate.

The purpose of Component Certification is to confirm that a major component of a specific type is designed, documented and manufactured in conformity with design assumptions, specific standards and other technical requirements.

1.1.3 Type Certification

The purpose of Type Certification is to confirm that the unit type is designed, documented and manufactured in conformity with design assumptions, specific standards and other technical requirements. Demonstration provided by the Client that it is possible to install, operate and maintain the unit in accordance with the design documentation is required.

Conformity of the unit is checked according to specified environmental conditions, corresponding to a specific load envelope.

Type Certification can avoid the repetition of the certification procedure for each project, as long as the environmental conditions are not more severe than those specified in the Type Certificate.

2 Type and Component Certification

2.1 Component Certification scheme

2.1.1 Component certification consists of the modules:

- Design basis evaluation
- Design evaluation
- Manufacturing evaluation
- Type testing
- Final evaluation.

Component certificate modules and their application for Type Certificate are illustrated in Fig 1.

2.2 Type Certification scheme

2.2.1 Main modules of the Type Certification scheme are:

- Risk assessment (optional)
- Design basis evaluation
- Design evaluation
- Manufacturing evaluation
- Type testing
- Type characteristics measurements (optional)
- Final evaluation.

Type certificate modules and their application for Project Certificate are illustrated in Fig 2.

Any modification of the design, procedures or specifications by the Client is to be reported without delay to the Society with all documentation affected by the modification. Potential extension of the Type Certificate is to be decided by the Society on a case by case basis.

Figure 1 : Component certificate scheme and application with Type Certificate

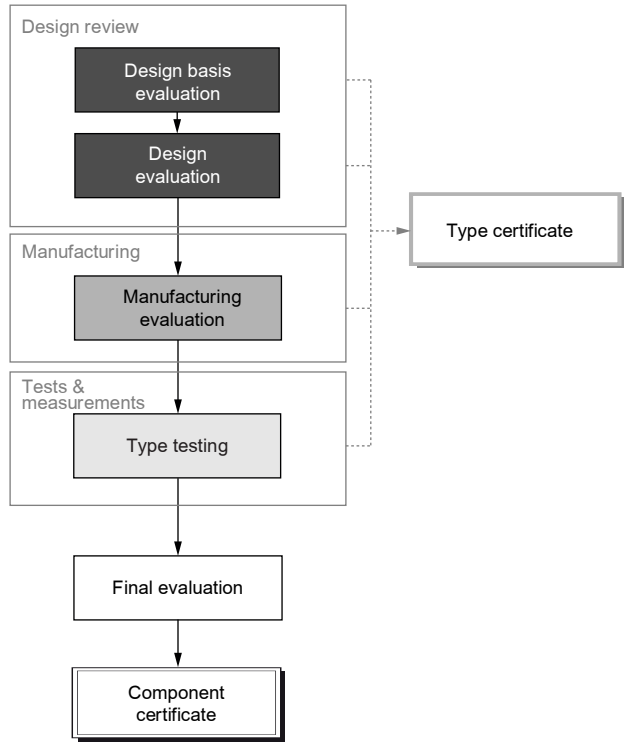
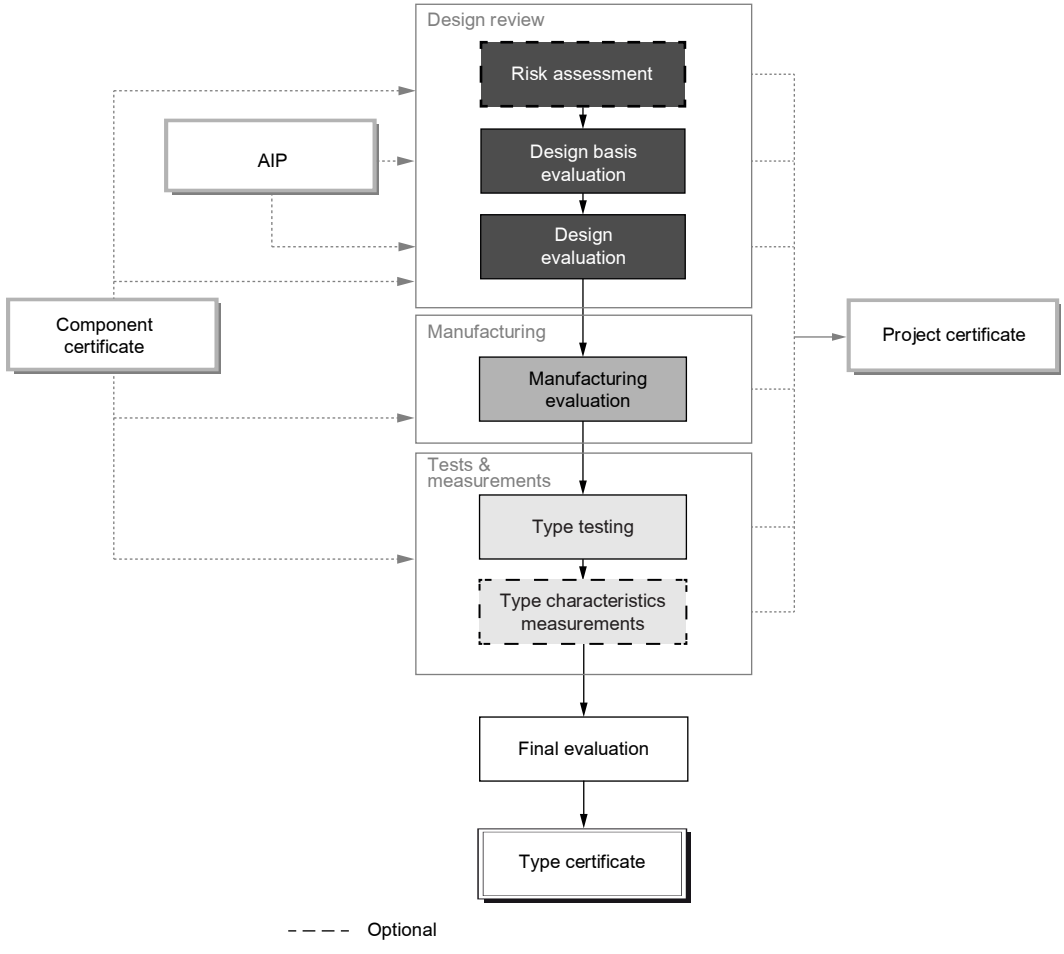


Figure 2 : Type certificate scheme and application with AIP, component and project certificate



2.3 Deliverables

2.3.1 Evaluation reports

Evaluation report is delivered for each evaluated module. This report summarizes the evaluations and independent analyses performed by the Society for the evaluation of the said module, the different findings that were pinpointed, and the final results of the investigations. It asserts the Society's conclusion on the conformity of the module under scrutiny.

The following reports are issued after evaluation of the corresponding module:

- Evaluation report for Risk Assessment, when requested
- Evaluation report for Design Basis
- Evaluation report for Design Assessment
- Evaluation report for Manufacturing
- Evaluation report for Type testing
- Evaluation report for Type characteristics measurements, when requested
- Final evaluation report.

2.3.2 Conformity Statements

If the modules are deemed to be compliant with the relevant requirements, the corresponding Conformity Statements are issued:

- Conformity Statement for Risk Assessment, when requested
- Conformity Statement for Design Basis
- Conformity Statement for Design Assessment
- Conformity Statement for Manufacturing
- Conformity Statement for Type testing
- Conformity Statement for Type characteristics measurements, when requested.

2.3.3 Type/Component Certificate

A Type/Component Certificate is issued at the end of the certification procedure when all mandatory modules have been successfully completed. A Type/component Certificate attests to the conformity and correctness of all mandatory modules and, if applicable, of the optional modules.

2.4 Validity and maintenance of certificate

2.4.1 Validity

The validity period of the Type/Component Certificate is 5 years.

The period validity of a provisional certificate or conformity statement is not to exceed 12 months from the date of issuance.

2.4.2 Maintenance

The Certificate validity is subject to the periodic surveillance and the annual review of report including information on installed units and abnormal operating experience or failures known to the certificate holder and any minor modifications

Any outstanding issue as well as the actions undertaken to resolve it are to be reported without delay to the Society for evaluation. Resulting unit inspections may be required at the convenience of the Society.

Any modification of the unit design, procedures or specifications by the Client is to be reported without delay to the Society with all documentation affected by the modification. Potential extension of the Type/Component Certificate is to be decided by the Society on a case by case basis.

2.4.3 Periodic surveillance is performed to check that the unit/component produced correspond to the type-certified unit/component. The period is not to exceed 2,5 years.

When no quality system according to ISO 9001is in place, surveillance period does not exceed 1 year.

3 Risk assessment (optional)

3.1 General

3.1.1 The risk assessment aims at identifying systematically:

- Hazardous situations, such as collision or climatic extremes and their possible causes and effects induced on asset integrity, personal safety and environment.

Note 1: HAZID (Hazard Identification method) is recommended.

- Component failures: failure modes and their possible causes and effects induced on asset integrity, personal safety and environment.

Note 2: FMECA (Failure Mode, Effects and Criticality Analysis) is recommended.

3.1.2 The Society reserves the right to consider the risk assessment as mandatory.

4 Design basis evaluation

4.1 General

4.1.1 The design basis aims at identifying all requirements, assumptions and methodologies provided by the Client, which are essential for the design and the design documentation, including:

- codes and standards

  and eventually additional requirements or deviations from these codes and standards when required and additional requirements for components which are not covered by existing codes and standards (see Sec 1, [3.2])
- design parameters, assumptions, methodologies and principles
- other requirements, e.g. for manufacture and commissioning as well as for operation and maintenance.

Verification of this module consists in examination that the design basis is well documented by the Client and sufficient for a safe design of the unit.

4.1.2 In particular, the following information is to be stated in the design basis:

- design loads cases
- external design parameters
- load factors and load reduction factors, if relevant
- safety factors
- duration of simulations and their number
- extreme and fatigue design analysis methodology
- environment conditions (including for installation)
- target lifetime
- inspection scope and frequency
- requirements for conditions monitoring systems.

5 Design evaluation

5.1 General

5.1.1 The purpose of the design evaluation module is to examine whether the unit is designed and documented in conformity with the design assumptions, specific standards and other technical requirements.

Design evaluation consists in a review of design documentation (calculation notes, drawings, specifications). Independent analytical and/or numerical calculations may be performed by the Society for verification purpose, typically for major structural components.

5.1.2 The design evaluation module is declined into sub-modules covering different topics. The main sub-modules are the followings:

- Control and protection system
- Loads and load cases

  load envelope check through the review of behaviour and load calculations submitted to the Society, including independent analysis by the Society where deemed necessary

- Structural component
  design review of structural components based on the validated load envelope
- Mechanical component
  design review of mechanical components based on the validated load envelope
- Electrical component
  design review of electrical components based on the validated load envelope
- Blades, when relevant
- Process evaluation (manufacturing, transportation, installation and maintenance)
- Personnel safety
- Component tests.

6 Manufacturing evaluation

6.1 General

6.1.1 The manufacturing evaluation aims at assessing whether the manufacturer is able to build the unit type in conformity with the documentation design verified during the design evaluation.

This evaluation includes the following elements:

- review of the manufacturing plan and procedures
- quality system evaluation: conformity with ISO 9001 or ad-hoc evaluation of the quality system in place
- manufacturing inspection: the manufacture of one representative specimen is attended by the Society to check that all requirements regarding critical components and manufacturing processes are correctly implemented in production and assembly. Inspections by the Society are to be planned for each component and for the global integration within the final unit.

6.1.2 The manufacturing evaluation presupposes the Client and the manufacturer(s) operate a quality system. It requires manufacturing of at least one representative specimen of the type under certification.

7 Type testing

7.1 General

7.1.1 The purpose of the testing module is to prove that the MRE unit respects the behavior expected by the design. Testing reports are to be submitted to the Society for approval. At the convenience of the Society, attendance of tests may be required.

7.1.2 The purpose of the type testing is to provide data needed to verify power performance, aspects that are vital to safety and any other aspects that can not be reliably evaluated by analysis.

The type testing evaluation verifies the test report to ensure that the tests have been carried out in accordance to the approved test program and it properly documents the aspects required for certification.

In addition, inspections are performed to verify that critical personnel safety features are satisfactorily implemented.

7.1.3 The type testing consider the following aspects:

- Safety and function tests: check that the unit under test displays the behavior predicted in the design.
- Power performance measurements: to document a measured power curve for the unit type under specified conditions
- Load measurements: to validate design calculations and to determine the magnitude of loads under specific conditions.

Note 1: For FOWT and CTT, the type testing may consider blade tests to check blade structural design and to assess the suitability of manufacturing processes.

7.2 Documentation to be submitted

7.2.1 The following documents are to be submitted:

- Inspection records (completed preferably prior to tests), to demonstrate the conformity of the unit/component with the design documentation
- Test plan
- Test report (documented by testing and test results).

8 Type characteristics measurements (optional)

8.1 General

8.1.1 The type characteristics measurements are optional. They aim to establish the performance-related characteristics of the unit type other than power performance. Characteristics measurements may include:

- Power quality tests: to document the characteristic quality of the power generated by the unit type
- Low-voltage-ride-through measurements: to document the low-voltage-ride-through capabilities of the unit type.
- Acoustic noise measurements: to document the acoustic emission characteristics of the unit type.

8.1.2 The evaluation of the type characteristics measurements is based on verification that measurements have been carried out on a unit representative of the type to be certified and have been carried out in accordance with an approved detailed program. The test report submitted by the Client is evaluated by the Society.

8.1.3 In addition, inspections are performed to verify that critical personnel safety features are satisfactorily implemented.

8.2 Documentation to be submitted

8.2.1 The following documents are to be submitted:

- Inspection records (completed preferably prior to measurements), to demonstrate the conformity of the unit with the design documentation
- detailed measurement program
- test report (documented by measurements and test results)

9 Final evaluation

9.1 General

9.1.1 The purpose of the final evaluation is to provide documentation of the findings of all operating bodies involved in the evaluation of the elements of the type/component certificate. The verification activities and results are documented in the Final Evaluation Report.

9.2 Final evaluation report

9.2.1 The final evaluation report issued by the Society consists of:

- reference list of all documentation relevant to the Type/Component certificate
- report of all conformity statements issued by the Society for the certification modules for outstanding issues

9.2.2 A final assessment is carried out on this basis and the decision whether or not to issue a Type/Component Certificate is made. In all cases, the final evaluation report is delivered to the Client.

SECTION 5 PROJECT CERTIFICATE

1 General

1.1 Application

1.1.1 The purpose of Project Certification is to evaluate whether a specific farm, including type-certified units and other auxiliary installations, is designed and built taking into account the external conditions at the intended location and in conformity with National Authorities requirements, applicable standards, construction and electrical codes and other relevant site-specific requirements

The process covers the whole lifecycle of the project, including design, manufacturing, transportation, installation, commissioning, operation and maintenance, with the exception of decommissioning.

Note 1: Requirements for decommissioning are usually specified by local regulations.

2 Project Certification

2.1 Project Certification scheme

2.1.1 The general Project Certification scheme contains both mandatory and optional modules. It is divided into several modules that are evaluated individually, though not always independently from each other as some use the results from previous modules as inputs.

Each module, once validated, is concluded by an Evaluation Report and a Conformity Statement. The Project Certificate with the Final Evaluation Report, is issued at the end of the certification procedure when all mandatory modules have been successfully completed. A Project Certificate attests to the conformity and correctness of all mandatory modules and, if applicable, of the optional modules.

2.1.2 Main modules of the Project Certification scheme are illustrated in Fig 1:

- Site conditions assessment
- Risk assessment (optional)
- Design basis evaluation
- Integrated load analysis
- Design assessment
- Manufacturing surveillance
- Transportation and installation surveillance
- Commissiong surveillance
- Project characteristics measurements (optional)
- Final evaluation
- Operation and maintenance surveillance (optional).

2.2 Delivrables

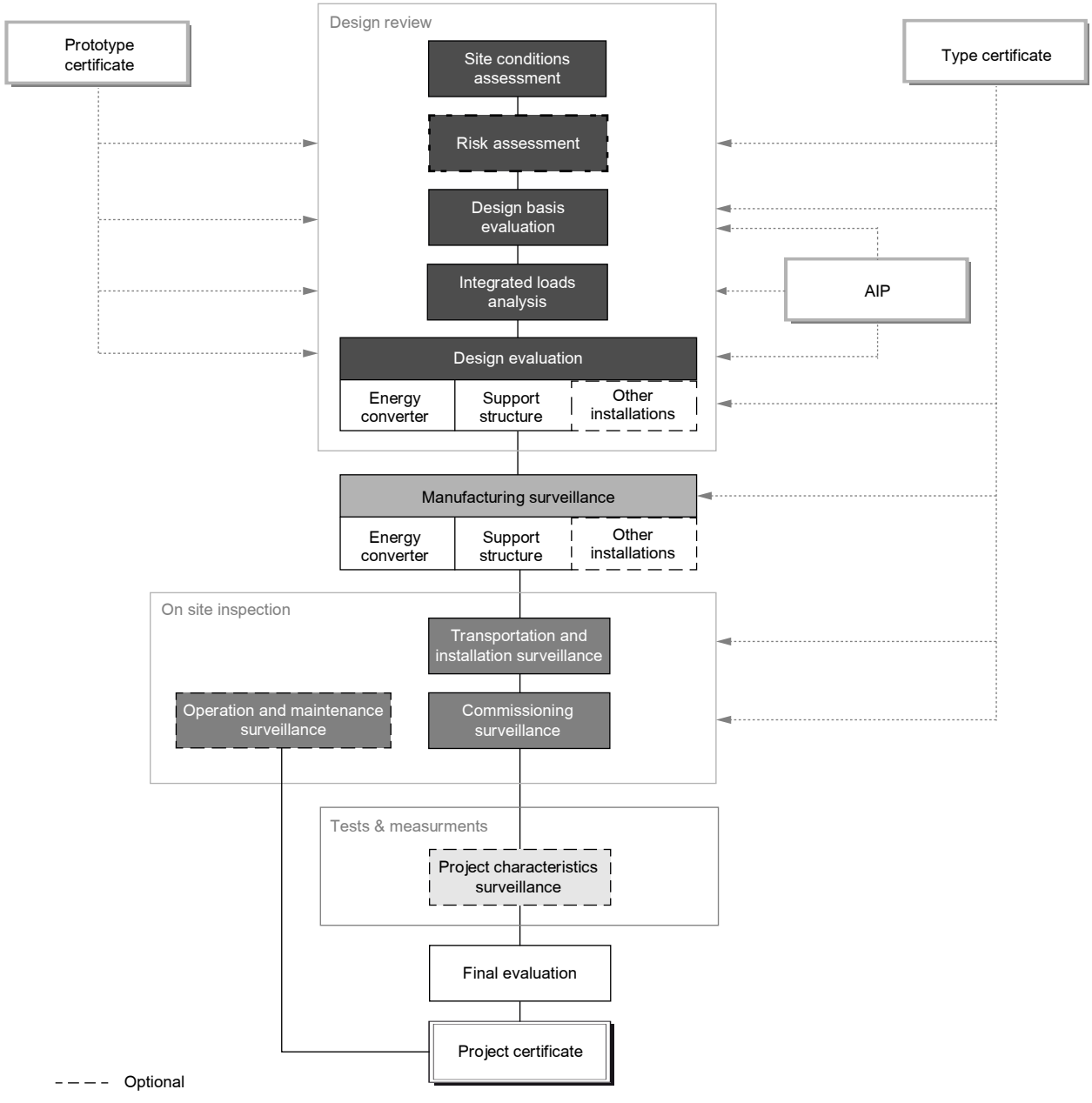
2.2.1 Evaluation reports

An Evaluation report is delivered for each evaluated module. This report summarizes the evaluations and independent analyses performed by the Society for the evaluation of the considered module, the different findings that were pinpointed, and the final results of the investigations. It asserts the Society's conclusion on the conformity of the module under scrutiny.

The following reports are issued after evaluation of the corresponding module:

- Evaluation report for Risk Assessment, when requested
- Evaluation report for Site conditions assessment
- Evaluation report for Design Basis
- Evaluation report for Integrated load analysis
- Evaluation report for Design Assessment
- Evaluation report for Manufacturing surveillance
- Evaluation report for Transportation and Installation surveillance
- Evaluation report for Commissioning surveillance
- Evaluation report for Project Characteristics surveillance, when requested.

Figure 1 : Project certificate scheme and application with AIP, Prototype and Type Certificate



2.2.2 Conformity statements

If the modules are deemed to be compliant with the relevant requirements, the following Conformity statements are issued:

- Conformity statement for Risk Assessment, when requested
- Conformity statement for Site conditions assessment
- Conformity statement for Design Basis
- Conformity statement for Integrated Load Analysis
- Conformity statement for Design Assessment
- Conformity statement for Manufacturing surveillance
- Conformity statement for Transport and Installation surveillance
- Conformity statement for Commissioning surveillance
- Conformity statement for Project Characteristics surveillance, when requested.

2.2.3 Final evaluation report

Once all mandatory modules have been successfully evaluated and the corresponding conformity statements issued, a final evaluation is performed and a final evaluation report is issued, summarizing the conclusions from all evaluation reports. This Final Evaluation Report also references all the documents relevant to the Project Certificate.

A final assessment is carried out on this basis and the decision whether or not to issue a Project Certificate is made. In all cases, the Final Evaluation Report is delivered to the Client.

2.2.4 Project Certificate

The Project Certificate, along with the Final Evaluation Report, is issued at the end of the certification procedure given that Conformity Statements are issued for all mandatory modules. The Project Certificate refers to the Conformity Statements for the completed modules.

Note 1: When a module is not reviewed by the Society (as requested by the Client), a valid Conformity statement and Evaluation report for this module are to be provided to the Society in order to deliver the Project Certificate.

2.3 Special cases

2.3.1 If there is no Type Certificate for the unit under consideration, the mandatory modules Type Certificate within Project Certification are to be fulfilled by the Client, and hence the mandatory modules of Type Certification covered by the Project Certification are evaluated by the Society with respect to the specific project and site-specific conditions.

2.4 Validity and maintenance of certificate

2.4.1 Validity

The validity period of the Project Certificate is to be agreed by the Society on a case by case basis, aiming at covering the lifetime of the farm.

The period of validity for the Provisional Certificate or conformity statement, is not to exceed 12 months from the date of issuance.

2.4.2 Maintenance

The Project Certificate validity is subject to the periodic inspections outcomes and the annual review of monitoring, operation, maintenance and repair reports provided by the Client, see [13].

Any outstanding issue as well as the actions undertaken to resolve it are to be reported without delay to the Society for evaluation. Resulting unit inspections may be required at the convenience of the Society.

Any modification of the unit design, procedures or specifications by the Client is to be reported without delay to the Society with all documentation affected by the modification. Potential extension of the Project Certificate is to be decided by the Society on a case by case basis.

3 Site condition assessment

3.1 General

3.1.1 The purpose of the site conditions assessment module is to examine whether the environmental (current, waves, etc.), electrical and soil (geotechnical and earthquake) properties at a site are conform to the parameter values defined in the design documentation.

3.1.2 Evaluation of the site conditions assessment is to consist of:

- review of site surveys specifications
- deviations of design parameters (e.g. geotechnical interpretation)
- review of final deliverables.

3.1.3 Site surveys specifications

The extent, quality and relevance of the metocean and soil surveys is reviewed. The completeness and correctness of the associated reports with regards to the selected design standards is verified.

The models used to complement the on-site measurements (e.g. hindcast model for marine data) is evaluated, in particular in terms of correlation with existing measurements, and it is verified that their outputs are suitable for the structural design.

3.1.4 Derivation of design parameters

The methodology and assumptions used for the deviation of the site-specific design parameters on the basis of the measured and modelled data, in particular regarding the extrapolation of extreme values is reviewed.

3.1.5 Documentation to be submitted

Document to be submitted are to include:

- Metocean report
- Geotechnical report
- Geotechnical interpretation.

All references listed in the documents are to be provided upon request.

4 Risk assessment (optional)

4.1 General

4.1.1 The risk assessment aims at identifying systematically:

- Hazardous situations, such as collision or climatic extremes and their possible causes and effects induced on asset integrity, personal safety and environment.

Note 1: HAZID (Hazard Identification method) is recommended.

- Component failures: failure modes and their possible causes and effects induced on asset integrity, personal safety and environment.

Note 2: FMECA (Failure Mode, Effects and Criticality Analysis) is recommended.

4.1.2 Evaluation of the risk assessment module consists of a review of the risk assessment documents to ensure that no hazard remain unaddressed.

4.1.3 The Society reserves the right to consider the risk assessment as mandatory.

5 Design basis assessment

5.1 General

5.1.1 The purpose of the design basis evaluation is to verify that the design basis is sufficient for a safe design and execution of the project, i.e. that it is coherent, exhaustive, sufficiently documented and that it meets all requirements related to the certification references. The Design Basis is typically split into three parts:

- The Design Basis Part A (Site Conditions and Employer Requirements)
- The Design Basis Part B (Energy Converter)
- The Design Basis Part C (Support Structure).

The coherence between the three parts of the Design Basis is evaluated, as well as the completeness of the combined Design Basis. The coherence of the design methodologies, assumptions and requirements is evaluated.

The evaluation consider the conformity of the Design Load Cases (DLC) to the selected design standards, and the validity of the methodology and assumptions for the load simulation.

5.2 Design Basis Part A (Site Conditions and Employer requirements)

5.2.1 The Design Basis Part A evaluation typically includes:

- review of the meteorological, marine and geotechnical conditions at the site relevant for the design

Note 1: Meteorological conditions refer to wind, temperature, humidity, pressure, air density, solar radiation, precipitation and salinity.

Note 2: Marine conditions refer to waves, currents, water levels, sea ice (if relevant) and marine growth

- review of the extent, quality and relevance of the metocean and soil surveys
- verification of the completeness and correctness of the associated reports with regards to the selected design standards
- evaluation of the models used to complement the on-site measurements (e.g. hindcast model for marine data), in particular in terms of correlation with existing measurements. It is verified that outputs are suitable for the structural design. This evaluation is based on the conclusions from the previous Site Condition Assessment module
- review of the methodology and assumptions used for the deviation of the site-specific design parameters on the basis of the measured and modelled data, in particular regarding the extrapolation of extreme values.

5.3 Design basis Part B (Energy Converter)

5.3.1 The Design Basis Part B is generally the responsibility of the energy converter Supplier, and typically includes:

- interpretation of wind/wave/tide/sea and environmental input (turbulence, shear, etc.)
- definition of design load cases
- design parameters
- partial safety factors for the load simulations
- Energy converter (turbine) Type Certificate, if any and possible deviations from the certificate.

Note 1: For wind farm or current and tidal farm, the determination of the turbulence intensity including the wake effect from neighbouring turbines is verified.

5.4 Design basis Part C (Support Structure)

5.4.1 The Design Basis Part C is generally the responsibility of the Support Structure Supplier, and describes the general design requirements, methodology and assumptions for the design of the support structure.

The Society checks that the codes defined as references are appropriate and adapted to the specificities of the project and that the selected codes are compatible. The coherence of the design methodologies and assumptions is evaluated.

The following issues are addressed (if applicable):

- Geotechnical interpretation and geotechnical design parameters
- Material characteristics data (concrete, reinforcing steel, prestressing bars ...)
- Load cases considered (permanent loads, operating loads, accidental loads...)
- Load cases combinations for the different operating phases (construction, launch, towing, operating, ...)
- Design methodologies and principles regarding:
  - Natural frequencies
  - Extreme Events (ULS)
  - Fatigue Analysis (FLS)
  - Serviceability (SLS)
  - Accidental Events(ALS)
  - Connections (bolted, flanged, etc.)
- Scour protection
- Corrosion protection
- Requirements regarding Transportation, Installation, Operation, Maintenance and Decommissioning.

5.5 Documentation to be submitted

5.5.1 The Society reviews the following documentation as a minimum:

- Metocean report
- Geotechnical report
- Geotechnical interpretation
- Design Briefs
- Design Basis Part A, B and C.

All references listed in the documents are to be submitted upon request.

6 Integrated load analysis

6.1 General

6.1.1 The integrated loads analysis aims at verifying the site-specific loads and load effects on the complete unit. The evaluation includes:

- Review of the calculation methodology
- Independent calculations (in general based on an integrated model).

6.1.2 This module includes:

- site-specific load calculations review, based on measured environmental conditions
- assessment of any difference between the site-specific loads and the design load envelope assumed for the Type Certification, if any
- further load analyses performed by the Client, when relevant.

6.2 Review of calculations

6.2.1 Review of calculation consist in reviewing the load reports, focussing in particular on the comparison of the applied calculation methodology with the agreed Design Basis and the reference standards (wind, wave or current models used, simulation characteristics, statistical extrapolation of extreme loads, etc.).

6.3 Independent calculations

6.3.1 In addition to the documentation review, a large part of the verification is based on independant calculations. These calculations may include:

- hydrodynamics analyses
- integrated model analyses to consider:
  - substructure model and hydrodynamic loads
  - RNA model and aerodynamic loads (for wind turbine)
  - interface
  - final combined loads.

7 Design evaluation

7.1 General

7.1.1 The design evaluation aims at reviewing the unit design with regard to the integrated loads as defined in the previous module. The design evaluation is typically split into sub-modules:

- design evaluation of the energy converter
- design evaluation of the support structure
- design evaluation of auxiliaries installations, such as cables array, sub-station,...(optional).

7.2 Design evaluation of the energy converter

7.2.1 The energy converter is to be Type Certified. If there is no Type Certification, see [2.3].

No detailed investigations are needed if the energy converter is type-certified and if the following conditions are satisfied:

- the design of the component to be installed is the same as the design that has been certified
- the calculated site-specific loads on the component are not higher than the design loads considered in the Type Certificate.

In case of site-specific modifications or reinforcements that are not covered by the Type Certificate, a specific assessment will need to be made on a case by case basis to evaluate the level of additional verification to be performed.

7.2.2 Design evaluation of the energy converter is based on the followings:

- comparison of the site-specific loads with the design loads specified in the Type Certificate

  If the loading on the machine implied by the actual site conditions is higher than the design loads, it is to be demonstrated that the increased loads do not endanger the structural integrity of the energy converter. The additional calculations and analysis are to take into account the results from the module Site Conditions Evaluation. Similarly, any change in vibration modes or natural frequencies are to be stated and carefully evaluated.
- verification that the system accelerations and inclinations remain within the design limits as specified in the Type Certificate.

Note 1: For FOWT, attention is paid on the interface between the nacelle and the tower specifically designed for the site.

7.3 Design evaluation of the support structure

7.3.1 The design evaluation of the support structure includes a detailed examination of the documentation.

Note 1: The support structure is composed by the sub-structure and the foundation (including the mooring system). For the FOWT, the tower is part of the support structure.

7.3.2 The design evaluation aims to verify the compliance of calculations notes with the Design Basis. It includes (if relevant):

- Sub-structure design evaluation
- Tower design evaluation (for FOWT)
- Station keeping system design evaluation, if any
- Foundation design evaluation.

7.3.3 The design evaluation aims to verify the compliance of calculations notes with the Design Basis. It includes (if relevant):

- Design calculations
  - structural review

Note 1: Independent analyses may be performed for the most significant structural elements.

  - compliance of drawing with calculations and specifications
  - corrosion protection system investigation, including the calculation of corrosion allowances and sacrificial anodes
  - review of the seabed stability, scour assessment and scour protection system
- Specification of materials
- Manufacturing specification
- Weight reports
- Installation documentation:
  - intended installation procedures,
  - installation tolerances,
  - planned measurements and inspections.
  - driveability study
- O&M plan review to verify the suitability of the intended requirements and to ensure consistency with the assumptions for the design.

7.3.4 Sub-structure design evaluation

The sub-structure design evaluation is to consider the followings aspects:

- structural design, including connections
- substructure stability
- mechanical and electrical equipment
- fire & safety systems.

a) Structural review

The structural review is based on:

- Consideration of the design assumptions of the sub-structure
- Review of the design calculations for dimensioning the sub-structure
- Review of the procedures for implementation of the sub-structure
- Independent review of design analysis of the sub-structure

An independent analysis may be performed to verify the structural design of the sub-structure.

Calculation reports are to be based on set of reference defined in the Design Basis and are to provide justification of resistance, stability and sustainability sections in the main combinations of load cases, as well as a fatigue verification.

As the installation process is specific, special care is devoted to the review of the transportation and installation documentation, including the intended installation procedures, the installation tolerances, the planned measurements and inspections. The calculations of the loads sustained by the substructure during transportation and installation are carefully reviewed.

Note 1: When concrete structure are used, particular care is taken for the review of the concrete / steel interface, especially at the connections with the mooring equipment. The sustainability of the sub-structure is to be ensured in all these phases and must be justified. The following parameters impact the sustainability: formulation of concrete, type of reinforcing steel, coating, cathodic protection, protective coating…

b) Stability analysis

Stability analysis in intact conditions and, if relevant in damaged conditions, is performed with loading cases, covering all operating drafts. This analysis includes:

- review of the documentation and information on conformity to international standards applicable on stability matters
- verification of a complete stability model of the sub-structure according to criteria defined and agreed at basic design stage.

c) Machinery and electrical equipment

Machinery and electrical equipment evaluation is based on a review of documentation related to the machinery and electrical devices installed in the sub-structure (bilge, piping mechanical integrity and the electrical safety of the sub-structure's systems).

d) Safety - detection, firefighting and escape

Safety evaluation is based on a review of documentation describing and explaining the systems of detection, firefighting and route escape in the floater compartments, if relevant.

Note 2: For FOWT, the design evaluation includes tower design evaluation to confirm that the design of the tower correspond to the design assumptions specified in the Design Basis. This include the review of:

- Material properties
- Tower structure:
  - Ultimate strength, Buckling, Fatigue
  - Door opening reinforced with frame
  - Bolted connections
- Natural frequency
- Manufacturing procedures
- Transportation procedures
- Installation procedures
- Maintenance procedures

In addition, independent calculation may be performed and may cover the following aspects depending on the dimensioning criteria (strength, fatigue, stiffness):

- Data base set up
- Ultimate strength, fatigue, buckling, bolted connections
- Natural frequency.

7.3.5 Station keeping design evaluation (if relevant)

The station keeping design evaluation consists of:

- independent analyses
- review of documentation

  Documentation is to include (if relevant):
  - Diffraction radiation analysis
  - Global loads analysis
  - Hydrodynamic model calibration report
  - Mooring system ultimate strength verification and fatigue verification
  - Anchors holding capacity verification
  - Mooring connectors verification
  - Anchors structural strength verification.

7.4 Design evaluation of auxiliaries installations: Inter-array cables design (optional)

7.4.1 When requested, the inter-array cables design evaluation is based on:

a) Structural design evaluation:
   - review of documentation:
     - detailed technical specifications developed towards the umbilicals / power cables suppliers
     - specification for the cable end-fitting and general cable termination drawings
     - specification of ancillary items (bend stiffener, bottom connection...)
     - global dynamic analyses documentation
   - independent analysis: global dynamic analysis of the dynamic cable.

b) Electrical design evaluation: verification of the compliance with the standards and other specifications in the approved design basis as well as project specific parameters including electrical loads and site conditions:
   - Evaluation of the design documentation including layout drawings, cable schedules and electrical schematics
   - Evaluation of the design with respect to cable loading simulation and associated cable sizing calculations
   - Evaluation of the design with respect to the site specific conditions.

8 Manufacturing surveillance

8.1 General

8.1.1 Manufacturing surveillance ensures that the intended quality requirements are met for the specific project. As part of the manufacturing surveillance, the quality system of the manufacturer is to be evaluated and manufacturing inspections are to be planned.

8.2 Quality system evaluation

8.2.1 The quality system evaluation is normally limited to verification that the quality system is certified according to ISO 9001. This quality system certification is to have been carried out by an accredited certification body that operates according to ISO/IEC 17021.

8.3 Manufacturing inspection and surveillance

8.3.1 The manufacturing inspection and surveillance includes:

- An initial audit to evaluate the ability of the supplier to produce the component under consideration according to the approved design specifications and with the intended quality level.
- Periodical on-site inspections covering all critical phases of the fabrication process, including the non-destructive testing (NDT) when applicable, including:
  - Verification that design specifications are properly documented in workshop drawings, workshop instructions, purchase specifications, fabrication methods and procedures, including in particular special processes, and welding and NDT procedures when applicable

- Review of manufacturing records
- Visual inspection of ongoing manufacturing processes for compliance with the approved manufacturing procedures.

The sampling rate for inspections is determined individually for each component and each manufacturer. If necessary, several inspections are performed in order to witness all phases of the manufacturing process.

8.3.2 Manufacturing Evaluation Plan

The surveillance activities are detailed in a Manufacturing Evaluation Plan. This specific plan is prepared once detailed information about the manufacturing activities are available, and before the start of the manufacturing surveillance activities.

8.3.3 Review of fabrication documents

The following fabrication documents are review:

- Quality control plans
- Construction drawings
- Welding procedures specifications and existing qualifications, if applicable
- Existing qualifications of welding operators, if applicable
- Existing qualifications of Non Destructive Test operators
- Fabrication procedures
- Testing procedures
- Contractor Quality Assurance/Quality Control (QA/QC) manual
- Coordination procedure and planning
- List of sub-contractor and vendors.

8.3.4 Survey of fabrication

The survey of fabrication includes the following activities:

- Materials traceability
- Visual random checks
- Identification of Non Destructive Test operators
- For welded structures:
  - Cuttings and welding preparations
  - Main fit-ups
  - Identification of welders
  - Preheating
  - Welding consumables
  - Welding parameters
  - Heat treatment
  - Witnessing of dimensional inspection
- For concrete structures:
  - Radial and tangential reinforcement
  - Embedment
  - Concrete casting
  - Curing conditions
  - Construction joints, grouting
  - Measuring and testing equipment
  - Material tests
- Witnessing of non-destructive testing
- Final visual inspection
- Contractor's site queries
- Contractor's non conformity reports.

8.4 Type certified units

8.4.1 Suppliers may have been evaluated as part of the Type Certification process. However, the manufacturing inspection during Type Certification is based on one specimen only. For project Certification, additional surveillance activities are included in order to verify that the manufacturing of units for the specific project is carried out according to the approved design and with the intended quality, in particular with regards to modified components.

Lower-level subcontractors are normally not subjected to the manufacturing surveillance. However, the Society reserves the right to extend the scope of inspection in case of critical components, unusual materials or special processes.

Note 1: For unit with type certified RNA, the hub and nacelle assembly is subjected to inspections based on random sampling. These inspections cover both the assembly process and the final assembled hub and nacelle. Focus is given in particular on the welded and bolted connections and the electrical installations. These inspections take place at the Hub and Nacelle assembly plant. During these inspections, the incoming good inspections for the other components of the hub and nacelle assembly is verified.

9 Transportation and installation surveillance

9.1 General

9.1.1 The objective of the transport and installation surveillance is to make sure that no excessive loading is sustained by the units during the transportation and the installation, and to prevent any damage on the components.

A full inspection of the first transport and installation is performed, after which the T&I surveillance will not be systematic but based on random sampling. The exact sampling rate will be determined based on the project specificities and on the findings from the first inspections.

Note 1: As part of this transport and installation surveillance plan, synergies with the Marine Warranty Surveyor (MWS) activities are be investigated in order to minimize the amount of inspections needed for the certification. An interface matrix between certification and MWS may be developed jointly with the MWS contractor.

9.1.2 Attendance of a Surveyor during transportation and installation is decided at the convenience of the Society, in order to ensure that the hull and systems are in apparent good condition after transportation or installation stages, without visible damage.

9.1.3 Transportation & Installation Evaluation Plan

The surveillance activities are detailed in a Transportation & Installation Evaluation Plan, as part of the global evaluation. This specific plan is prepared once detailed information about the transportation and installation activities are available, in particular the corresponding Integrated Transportation Plans, and before the start of the surveillance activities.

9.2 Transportation surveillance

9.2.1 The transportation surveillance aims to verify that the proposed transportation procedures and test plans are documented in sufficient detail and that they comply with the design basis and the requirements of the reference standards. The description of the transportation process is to include:

- Technical specifications for the transportation
- Limiting environmental conditions
- Safety instructions
- Transportation arrangement including required fixtures, tooling and equipment
- Transportation loads and load conditions.

In addition, an onshore survey is performed at the harbour with the aim to verify compliance with the design requirements and approved procedures for transportation. The surveillance covers in particular the following aspects:

- Lifting operations during preparation
- Monitoring of the fastening of the different components
- Follow-up procedure on transportation damages and non-conformities.
- Compliance with the requirements for acceptable weather conditions.

9.3 Installation surveillance

9.3.1 The installation surveillance covers the offshore operations during installation and includes:

- documentation review,

  to verify that the proposed installation process is documented in sufficient detail in the installation documentation and that it complies with the design basis and the requirements of the reference standards.

- witness of offshore installation,

  to verify the compliance with the design requirements and approved procedures for installation. The surveillance covers in particular the following aspects:
  - Compliance with the requirements for acceptable weather conditions during sea transportation and installation
  - Surveillance of seabed preparation
  - Verification for damage to the structure prior to installation
  - Surveillance of lifting operations
  - Surveillance of welding, bolting, non-destructive testing, etc.
  - Surveillance of scour protection installation
  - Final visual inspection after installation
  - Follow-up procedure on installation damage and non-conformities
- installation records review (pile driving records, grouting and grout tests reports, etc.)

Any deviation from the intended procedures is to be justified, and may involve subsequent inspections.

10 Commissioning surveillance

10.1 General

10.1.1 The commissioning of the project is to be surveyed by the Society, on the basis of an agreed program, to ensure that the procedures described in the commissioning manual are correctly and fully implemented. It is verified that the proposed procedures and test plans are documented in sufficient details and comply with the design basis.

10.1.2 The commissioning surveillance consists of:

- Inspections to verify that the commissioning is performed according to the procedures, focus on:
  - Conformity of the main components with the certified design documents
  - General appearance of the unit
  - Witnessing of the safety and function tests
  - Visual inspection of the corrosion protection
  - Check for potential damage.
- Review of the commissioning records and the final commissioning reports on a spot check basis.

  Any deviation from the intended procedures is be justified, and may involve subsequent inspections.

Note 1: For wind turbine, IEC 61400-22 specifies that at least the commissioning of the first turbine has to be witnessed, plus one additional turbine for every fifty turbines in the project. The minimum number of commissioning inspections is therefore one. The Society reserves the right to request additional inspection if deemed necessary.

Note 2: For CTT, the first series of CTT is to be witnessed by the Society to ensure that the structure and system are in apparent good condition after transportation or installations stages, whithout visual damages.

11 Project characteristics measurements (optional)

11.1 General

11.1.1 The Project characteristics measurements are optional. They aim to determine performance related characteristics of the project at the specified site. These measurements may include:

- grid connection compatibility
- power performance assessment
- acoustic noise emission assessment.

11.1.2 Grid connection compatibility

Grid connection compatibility measurements are to verify the grid codes specified for the site. The evaluation is based on:

- comparison between site measurements and grid codes conditions
- verification of measurement procedures
- review of test report describing measurement conditions, instrumentation, equipment and calibrations.

11.1.3 Power performance assessment

The Power performance assessment concerns one or more units at the project site. The evaluation is based on:

- comparison of site measurements and test with reference data of the individual units
- verification of measurement procedures
- test report.

11.1.4 Acoustic noise emission assessment

The acoustic noise emission assessment aims to verify the compliance with the local requirements and/or the client criteria. The evaluation is based on verification of measurement procedures.

12 Final evaluation

12.1 General

12.1.1 The Final Evaluation is the final step of the Project Certification scheme. The objective is to ensure the completeness of all evaluations performed and to document all relevant findings and observations. It is verified that all findings have been closed out properly. The verification activities and results are documented in the Final Evaluation Report.

12.1.2 Particular attention is devoted to the interface between the different modules and especially between modules performed by different certification bodies.

The evaluation activities performed on modules not evaluated by the Society and the corresponding certification documentation are reviewed to an extent sufficient for the acceptance of the conformity statements and, their integration in the final Project Certificate.

12.2 Final evaluation report

12.2.1 The final evaluation report issued by the Society consists of:

- reference list of all documentation relevant to the Project Certificate
- report of all conformity statements issued by the Society for the Project Certification modules for outstanding issues.

12.2.2 A final assessment is carried out on this basis and the decision whether or not to issue a Project Certificate is made. In all cases, the final evaluation report is delivered to the Client.

13 Operation and maintenance surveillance

13.1 General

13.1.1 The operation and maintenance surveillance aims to check that operation and maintenance activities are performed according to the requirements described in the respective manuals included in the design documentation. This surveillance includes documentation review and inspections of installations covered by the Project Certificate.

13.2 Reports and records review

13.2.1 Monitoring, maintenance and repair reports are to be presented to the Society annually. At the convenience of the Society, additional tests and inspections may be required.

13.2.2 Operation and maintenance review is to verify that:

- maintenance is performed by authorized and qualified personnel
- maintenance is performed according to maintenance manual
- control parameters are in accordance to the limit specified in design documentation
- repair, modification and replacement are carry out in accordance to the certificate.

13.3 Inspections

13.3.1 Inspections are to be planned at regular intervals, the interval being agreed on a case by case basis by the Society.

13.3.2 The general condition of the installations covered by the Project Certificate are inspected.

The inspection may be performed by random sampling. The exact sampling rate will be determined on a case by case basis depending on the evaluation of the operation and maintenance procedures, monitoring, inspection and test plan and on the results from previous inspections.

Units that are under performing or that have been subject to anomalies will be investigated as a priority.