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## Development of an ISO Standard on Marine Operations

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### Abstract

In the course of 2007 the Standard ISO 19901-6 "Marine Operations" is expected to be published as a final ISO document. This Standard is a part of the series on Standards for Petroleum and Natural Gas Industries - Specific Requirements for Offshore Structures - Part 6: Marine operations. The Standard comprises a wide field of marine operations, which due to their special nature and limited duration are not always logically and adequately covered by other standards. The Standard provides requirements and guidance for the planning, engineering and safely execution of marine operations for all types of offshore structures except for drilling rigs.

The paper explains the organization of the concerned part of ISO being ISO TC67/SC7 and indicates where the position of this Standard ISO 19901-6 is in comparison with other Standards of the series of ISO Standards Petroleum and natural gas industries - specific requirements for offshore structures (published, to be published and under preparation).

The paper will focus on the key and operational parts of the Standard 19901-6 "Marine operations". The key parts are the general considerations on the HSE plan, risk management, job safety analysis, environmental impact study, and on manning, qualifications, job and safety training. Further key parts are Organization, documentations and planning, Metocean criteria, Weight control, Stability and Ballasting operations. The operational parts give guidance and recommendations on Loadout, Transportation, Temporary mooring, Construction and outfitting afloat, Float-over topside installation, Pre-laid mooring including foundation, Offshore installation operation, Lifting operations and finally Decommissioning and removal.

The paper will show the advantage of the present Standard on the guidance and recommendations on the marine operations

for all offshore structures as will be used by the oil companies and contractors.

### Introduction

In the late 1980 proliferation of national standards were perceived as a threat. The EU tended to initiate European Standards and also initiatives from National Standards were noticed (CA, CN, ID, NO, UK). Perceived business need by the major international oil and gas companies and major oil and gas producer associations were:

- Offshore Projects as Global Business
- Global Standards for Global Projects.

The ISO came with the initiative. ISO is a worldwide federation of national standards bodies (ISO member bodies). ISO agreed on the following objectives:

- Development of global standards for Petroleum Industry
- Under the International organization for Standardization (ISO).

For this purpose the existing technical committee ISO TC67 "Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries" was reactivated. Under management of subcommittee SC7 "offshore structures" the global standards would be established. More information on the ISO TC67/SC7 for the new international standards for offshore structures is given for instance in [Ref. 1], [Ref. 2] and [Ref. 3].

These new standards for all types of offshore structures (except drilling rigs) are implemented in the ISO 19900 series. The new global standards are based on API RPs and other existing practices while the convergence should be found through harmonization with international practices as practical and possible. Each standard may consist of general normative and informative parts, while regional and national annexes can be included. Further the designs are based on the Limit State Design Practice (PSF).

National Standards Bodies and Liaison Organizations participate in the work to develop the standards either as a participating or an observing or as a liaison member.

The participating members of the ISO/TC67/SC7 are:

Argentina, Brazil, Canada, China, Denmark, Finland, France, Germany, Indonesia, Italy, Japan, Kazakhstan, Netherlands, Norway, Romania, Russian Federation, Saudi Arabia, United Kingdom and USA.

The observing members of the ISO/TC67/SC7 are:

Australia, Egypt, Republic of Korea, Poland, South Africa, Spain and Yugoslavia.

Currently 9 Working Groups (WG) under supervision of and managed by SC7 exist. Each WG is responsible for one or more documents and is supported by one or more Technical Panels (TPs). WGs and TPs are composed by internationally recognize experts. The TPs provide technical expertise. The organization scheme of the ISO/TC67/SC7 is presented in Fig.1.

In the next section the status of the present series of standards for offshore structures (including the voting) will be dealt with. Further the purpose and the developments of the standard ISO 19901-6 "Marine operations" are presented in separate sections. Finally the contents of the ISO 19901-6 will be discussed in more detail, while further the base documents used and the challenges encountered are mentioned.

### Status of the series of standards for offshore structures

**Voting procedure:** The work of preparing International Standards is normally carried out through ISO technical committees (in our case ISO/TC67). Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee (in our case SC7). International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electro technical Commission (IEC) on all matters of electro technical standardization.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

**Status:** The standards for offshore structures as prepared by the Technical Committee ISO/TC 67, Petroleum and Natural Gas Industries, Subcommittee SC 7, Offshore Structures are the series ISO 19900 to ISO 19906. The standards are tabled below and at each standard the status, if not already published, is indicated.

- ISO 19900, Petroleum and natural gas industries — General requirements for offshore structures
- ISO 19901, Petroleum and natural gas industries — Specific requirements for offshore structures, consists of the following 7 parts:
  - Part 1: Metocean design and operating considerations
  - Part 2: Seismic design procedures and criteria
  - Part 3: Topsides structure<sup>2)</sup>
  - Part 4: Geotechnical and foundation design considerations
  - Part 5: Weight control during engineering and construction
  - Part 6: Marine operations<sup>2)</sup>
  - Part 7: Stationkeeping systems for floating offshore structures and mobile offshore units.
- ISO 19902, Petroleum and natural gas industries — Fixed steel offshore structures<sup>1)</sup>

- ISO 19903, Petroleum and natural gas industries — Fixed concrete offshore structures<sup>1)</sup>
- ISO 19904-1, Petroleum and natural gas industries — Floating offshore structures — Part 1: Monohulls, semi-submersibles and spars<sup>1)</sup>
- ISO 19904-2, Petroleum and natural gas industries — Floating offshore structures — Part 2: Tension leg platforms<sup>2)</sup>
- ISO 19905-1, Petroleum and natural gas industries — Site-specific assessment of mobile offshore units – Part 1: Jack-ups<sup>2)</sup>
- ISO 19905-2, Petroleum and natural gas industries — Site-specific assessment of mobile offshore units – Part 2: Jack-ups commentary<sup>2)</sup>
- ISO 19906, Petroleum and natural gas industries — Arctic offshore structures<sup>2)</sup>

<sup>1)</sup> to be published

<sup>2)</sup> under preparation

As mentioned earlier the Standards include all types of offshore structures except for drilling rigs. It must be noted that the MODU design is covered by IMO MODU Code. The site-specific assessment of MOUs (jack-ups) is covered by ISO 19905. In ISO 19904 the mooring issues for MODUs are addressed since the analysis methodology is analogous to permanently moored units.

### Marine Operation

The series of International Standards applicable to all types of offshore structure, ISO 19900 to ISO 19906, constitutes a common basis covering those aspects that address design requirements and assessments of all offshore structures used by the petroleum, petrochemical and natural gas industries worldwide. Through their application the intention is to achieve reliable levels appropriate for manned and unmanned offshore structures, whatever the type of structure and the nature or combination of materials used.

It is important to recognize that structural integrity is an overall concept comprising models for describing actions, structural analysis, design rules, safety elements, workmanship, quality control procedures and national requirements, all of which are mutually dependent. The modification of one aspect of design in isolation can disturb the balance of reliability inherent in the overall concept or structural system. The implications involved in modifications, therefore, need to be considered in relation to the overall reliability of offshore structural systems.

The series of International Standards applicable to all types of offshore structure is intended to provide a wide latitude in the choice of structural configuration, material and techniques without hindering innovation. Sound engineering judgment is therefore necessary in the use of these International Standards.

The Marine operations part of ISO 19901 is developed to provide requirements and guidance for the planning and performance of safe marine operations. Marine operations for offshore structures are part of the construction, transportation

and installation phases when the structure is at risk from the marine environment. Marine operations can extend to decommissioning, redeployment, removal, etc.

The overall objective of ISO 19901-6 is to ensure that marine operations are performed within defined and recognized safety/confidence levels. This standard is intended to be applicable on a worldwide basis. However, where applicable additional standards, codes and guidelines should be taken into account. Special attention should be paid to national regulations governing the area that the marine operations will be performed in.

This ISO 19901-6 describes the principles of marine operations from a point of view of planning, engineering implementation and documentation for fixed and floating offshore installations. Alternative provisions, methods and requirements can fulfill the intention of this document and could be applied provided they can be documented to demonstrate at least the same level of confidence.

It is not the intent of ISO 19901-6 to govern the design of structures, systems and components used in marine operations, beyond the principles that are given. Recognized codes and standards will normally be accepted as a basis for the detailed design and fabrication requirements of such components.

#### Development of the document Marine Operation

Marine operations was initially a TP of WG 4 *Fixed concrete structures*. WG4 was established in October 1993 [Ref. 3]. The TPs working for WG4 solely working for concrete structures were:

- Structural analysis, TP 11
- Concrete works, TP 12
- Mechanical systems, TP 13
- Marine Operations, TP 14
- Inspection and condition monitoring, TP 15

Additionally WG5 are getting support and input from the following panels, working also for other WGs:

- Metocean, TP 1
- Action, TP 2
- Geotechnical, TP 4
- Seismic, TP 5
- Corrosion protection, TP 7
- Topsides, TP 9

and having the following conveners:

- TP1; Chris Shaw, Shell, The Netherlands
- TP2; Peter Tromans, Shell, The Netherlands
- TP4; Eugene Toolan, Fugro, UK
- TP5; Mike Craig, Unocal, USA
- TP7; Tomas Sydberger, DNV, Norway
- TP9; David Galbraith, Mobil, UK
- P11; Trevor Hodgson, Atkins, UK

- TP12; Steinar Leivestad, Berdall Stromme, Norway
- TP13; David C. Luther, Mobil, UK
- TP14; Johan Wichers, MARIN, Netherlands
- TP15; Anne Vegge, Petroleum Directorate, Norway.

In 2000 TP 14 completed her part of the ISO document solely directed to concrete structures. The document consisted of the following chapters as reviewed below. In the review also the names of the authors and their affiliation have been given in relation to the clause.

1. Introduction (Wichers, MARIN USA-convener TP 14)
2. Scope (Bonnemaire, Doris)
3. Definitions (Jackson and Martin, LOC UK)
4. Health, safety and environment (Roger, Bouygues Offshore)
5. Organisation and documentation (Ridehalgh, NDE)
6. Weather criteria (Reppe, Aker Marine)
7. Weight control (Tyler, ABS)
8. Stability (Hansen, DNV)
9. Ballasting operations (Tyler, ABS)
10. Temporary mooring systems (Bonnemaire, Doris)
11. Tow out from dry dock (Kakebeeke, Brown & Root)
12. Construction afloat (Ridehalgh, NDE)
13. Deck mating (Martin, LOC)
14. Transportation (Kakebeeke, Brown & Root)
15. Installation (Reppe, Aker Marine)
16. Decommissioning and removal (Roger, Buoygues Offshore).

In 2001 WG 3 *Fixed steel structures*, WG4 *Fixed concrete structures* and WG 5 *Floating structures* express the need for one ISO document on Marine Operations covering the marine operations for all offshore structures (Resolution 127 (London) and Resolution 143 (Oslo 2001)). ISO decided to give the extended task to TP 14. The Marine Operations became a part of the ISO Standard 19901 and has been indicated as ISO Standard 19901-6.

On July 2001 the TP 14 accepted the decision to extend the ISO document and became WG9. The selected authors were all experts in their areas of expertise in marine operations. The authors have written 19 clauses for the Standard 19901-6 during the period 2001-2003.

The clauses of ISO Standard 19901-6 are reviewed below. In the review also the names of the authors and their affiliation (in the time of editing) have been given in relation to the clause.

- Foreword (Johan Wichers, MARIN USA-convener WG9)
- Introduction (Johan Wichers, MARIN USA)
- 1. Scope (John Ridehalgh, NDE)
- 2. Normative references (Johan Wichers, MARIN USA)
- 3. Terms and definitions (David Ballands, LOC Americas; Johan Wichers, MARIN USA)
- 4. Symbols and abbreviations (David Ballands, LOC Americas; Johan Wichers, MARIN USA)
- 5. General considerations (Thomas Ciesielski, SAIPEM; David Ballands, LOC Americas; Einar Andeneas, Aker Kvaerner)

6. Organization, documentation and planning (John Ridehalgh, NDE; Max Kregel, Bluewater-Offshore)
7. Metocean conditions (Oyvind Lundby, NDV; John Ridehalgh, NDE; Einar Andenaes, Aker Kvaerner)
8. Weight control (John Ridehalgh, NDE)
9. Stability (Oyvind Lungby, DNV; Rolf Hilmar Hansen, DNV; Henk de Groot, Dockwise)
10. Ballasting operations (Stuart Barr, Global Maritime UK)
11. Loadout (John Ridehalgh, NDE)
12. Transportation (Henk de Groot, Dockwise; Hans Kakebeeke, Subsea 7)
13. Temporary mooring system and stationkeeping during construction (Bruno Bonnemaire, Doris Engineering)
14. Construction and outfitting afloat (Kris Digre, Shell USA)
15. Float-over topsides installation (David Ballands, LOC USA; Einar Andenaes, Aker Kvaerner)
16. Pre-laid mooring including foundation (Einar Andenaes, Aker Kvaerner, Lars Hilmersen, Aker Kvaerner)
17. Offshore installation operation (Maarten Ripping, HMC; Mick Bell, HMC USA, Einar Andenaes, Aker Kvaerner)
18. Lifting operations (John Ridehalgh, NDE; Ben Zegers, HMC)
19. Decommissioning and removal (Thomas Ciesielski, SAIPEM; Pierre Psarski, SAIPEM).

During 2003 and 2004 the ISO 19901-6 Marine Standard concept has been reviewed by the editing committee consisting of the following members:

- John Ridehalgh-NDE
- Einar Adenaes-Aker Kvaerner
- Bruno Bonnemaire-Doris
- Johan Wichers-MARIN USA. (convener WG9).

The standard was sent to ISO as ISO/CD 19901-6 N373 dated April 2004 (first edition) and March 2005 (second edition) for comments.

Comments on the ISO/CD version were received from IADC, JMSA, USA, Netherlands, France, Canada, Norway, United Kingdom, Brazil, Argentina and Denmark. The comments were studied by the editing committee. Recently the comments as appropriate were incorporated in the document and the document will be shortly released as ISO/DIS 19901-6 for final approval voting.

### Base documents and challenges

**Base documents:** The document ISO 19901-6 has been written based on experience of the authors and on the applicable parts deducted from the various documents from different organizations, as IMO, NDE, DNV, ABS, BV, API RPs and IMCA.

**Challenges:** The challenges were to edit the document to fulfill the following requirements:

- 1) The document has to be drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.
- 2) Sorting out normative and informative text and bringing the informative text into an ANNEX.
- 3) Check the consistency in terminology in the related ISO 19900, 19901, 19902 and 19903 Standards, especially the terms and definitions, symbols and abbreviated terms.

### Contents of ISO 19901-6

In the following the contents of each of the clauses are given (deleting the clauses on scope, normative references, terms and definitions and symbols and abbreviations):

- 5. General considerations

The general considerations give guidance to the HSE plan, risk management, job safety analysis, environmental impact study, manning, qualification job and safety training and accident reporting.

- 6. Organization, documentation and planning

This clause gives recommendations on the organization and communication, quality assurance and administrative and technical procedures and documentations, certification and requirements on systems and equipment.

- 7. Metocean conditions

The metocean clause provides definitions on the weather-restricted and weather-unrestricted operations. The clause gives requirements and guidance to the metocean conditions and criteria, weather windows, operational duration and metocean forecast.

- 8. Weight control

This clause gives guidance and recommendations on the weight classes, weight reserves, not-to-exceed weights, weight audits and dimensional control.

- 9. Stability

This clause sets out the general stability requirements for floating objects, with comments on the stability criteria for particular types of structure where they differ from the general requirements.

Requirements and recommendations are provided on the stability calculations, for intact and damage stability, for the stability on single- and multi-barge transport, for classed vessel, for self-floating structures and during loadout operations. Further recommendations are given on watertight integrity and temporary closures. Finally guidance for inclining tests is given.

- 10. Ballasting operations

This clause defines the design of the ballasting system and gives guidance on protection against damage and deterioration, prevention of progressive flooding in damage condition, control and indicating systems, pumps, valve arrangements, vent systems, air cushion system capacity and system testing.

- 11. Loadout

This clause refers to the loadout of structures, including but not limited to steel and concrete structures, TLPs, spar sections, FPU's, modules, components and bridges onto floating or grounded barges and ships, and also refers to the loadout and offload of floating cargoes onto submersible barges and ships.

It defines the classes of loadout and gives guidance and recommendations on the structure to be loaded, the site, quay and barge, the link beams, skidways, skidshoes and further on the mooring of floating loadout, grounded loadout, the pumping and ballasting system, the loadouts by trailers, SPMTs or hydraulic skidshoes, the propulsion system design, redundancy and back-up, the loadout onto submersible barges and vessels, the barge reinstatement and sea fastenings, the tugs, the management/organizations and the loadout manual.

- 12. Transportation

This clause deals with transportation in sheltered areas, in in-shore and off-shore conditions, using wet tow or dry transportation. Requirements, guidance and recommendations are presented on the tug bollard pull, fleet composition, tow out of dry dock, inshore and offshore tow and transport by dry tow or onboard a heavy transport vessel.

- 13. Temporary mooring system and stationkeeping during construction

This temporary mooring clause defines the environmental criteria and gives guidance and recommendations on the determination of the mooring responses, and the sizing of mooring lines, anchors, attachments and mooring line components. Further it concerns the clearances of the moored structure under extreme conditions, tensioning of mooring and other stationkeeping means.

- 14. Construction and outfitting afloat

This clause covers marine operational aspects encountered during construction and outfitting afloat. It is also intended to apply to quayside operations in sheltered water locations, such as at quaysides in an existing yard or newly constructed quay. Attention is given to structural loading and stresses, construction spread and welding.

- 15. Float-over topsides installation

This clause provides guidelines for float-over installation of topsides onto structures. The structure is either floating or fixed to the seabed. Environmental and structural considerations are presented and further recommendations on clearances and the guidance systems for topsides set-down and the operational aspects are given.

- 16. Pre-laid mooring including foundation

This clause gives requirements, guidance and recommendation on the installation of fluke, plate, suction, pile and gravity anchors, and on the pre-laid operational aspects of chain, wire and fibre ropes and TLP tendons and their mooring system connectors.

- 17. Offshore installation operation

This clause gives requirements and guidance to the

installation methods: launching, floating offload, upending, ballasting and lifting and lowering by external means. Further recommendations are given on precise positioning, skirt penetration, underbase grouting, piling, attachment to pre-laid mooring and tendon systems.

- 18. Lifting operations

The lifting clause presents guidance and recommendations on load and safety factors, lift point designs, clearances around lifted object, crane vessel and mooring lines and anchors, bumpers and guides, underwater and heave compensated lifts and lifts using DP.

- 19. Decommissioning and removal

The decommissioning and removal clause focuses on the engineering, preparation for removal, the removal itself, the transportation and disposal and finally the clearance of the site.

### Summary

1) This ISO 19910-6 will apply to all types of offshore structures on a worldwide basis.

2) The purpose of this paper is to inform the Industry of the Standard.

3) The ISO Standard 19901-6 will become the primary technical guidance replacing existing Industry practices and standards on Marine operations.

### Acknowledgement

The convener of WG9 would like to thank the mentioned experts for their contributions in the production of the Standard 19901-6. For all of us it was a very large and difficult task but it will be a lasting value to our industry.

### References

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2. Wolfram Jr., W. Robert: "Development of a Standard on Floating Structures, OTC 8420, 1997
3. Leivestad, Steinar: "ISO Standard for Fixed Concrete Structures, OTC 8422, 1997

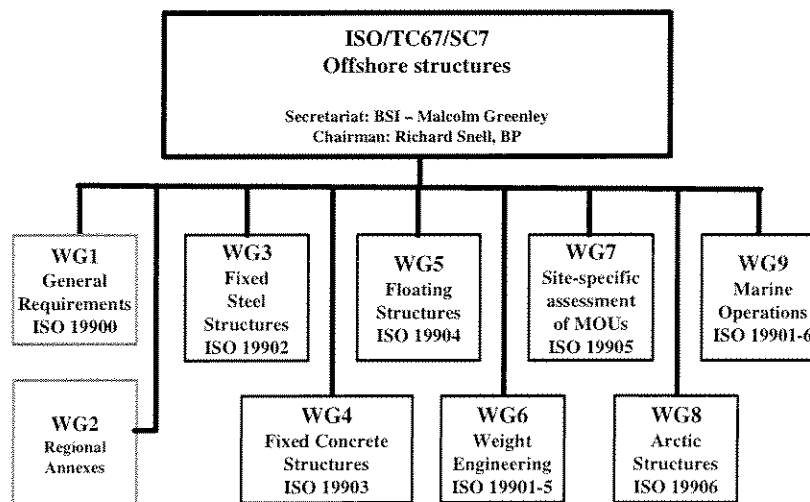


Fig. 1 Organization of ISO/TC67/SC7