AN OVERALL GUIDANCE AND PROPOSITION OF A WBS TEMPLATE FOR CONSTRUCTION PLANNING OF THE TEMPLATE (JACKET) PLATFORMS

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ABSTRACT

The template platforms have very important roles in the offshore petroleum industry. Therefore, special attention should be directed to the right planning, design, and construction of the template platforms especially for the sea water depth under 400m. Since the available templates in the literature for WBS to construct a template (Jacket) platform, are not sufficient, in this paper, a detailed Work Breakdown Structure (WBS) template is proposed for the construction of this type of offshore structures. The proposed WBS gives a good guidance for the planning design, construction load-out, transportation and installation phases of a template platform and is useful for the client, contractor and consultant parties in EPC projects. The proposed WBS template may be used for the planning phase and the conceptual, basic and detail design phases. The proposed WBS is prepared using the studies which were performed on the existing installed template platforms.

Besides a general guide for the design construction, load-out, transportation and installation of the offshore template (Jacket) structures is presented in this paper.

Keywords: Planning, design, construction, installation, Template platform, jacket, WBS

INTRODUCTION

Offshore platforms are among the most significant and the tallest structures in the world which must operate reliably in a wide range of very challenging environments. Template platforms are important infrastructures that have big impacts on the petroleum industries. Furthermore, template platforms are the platforms that are the most common type used worldwide. The goal of this paper is submitting an overall guidance and proposing a WBS template for construction of the template platforms as a general guidance for the clients, consultants, and contractors. Since in the phases of planning, conceptual and basic design, some important decisions such as the selection of location for construction of the template platform, the allocation of budget for getting the related approvals from the top management of the petroleum authorities, to submit the conceptual and basic design documents to the Planning and Budget Organization, and finally the Parliament for getting approvals and budget, as well as for the bid process and selection of contractor, having WBS for construction of a template platform is necessary. Since the available templates in the literature for WBS to construct a template platform are not sufficient, a detailed WBS template is proposed in this paper. Using the proposed WBS template, helps the client, contractor and consultant parties, particularly at the planning phase of a template platform, and gives general guidance at the design and construction phases.

The proposed WBS template may be used for planning, conceptual, basic and detail design phases. For construction design phase a more detailed WBS is required.

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Offshore platforms have many uses including oil/gas drilling and production. These offshore structures must function safely for design lifetimes of twenty-five years or more.

This paper covers mainly the planning, design, construction, and installation of the fixed template (jacket) offshore platforms. For additional information on the environmental data together with necessary formulas and the data needed for design and analysis of such structures, the instructions, data and recommendations given by (API, 2010), (Sadeghi, 1989, 2001, 2004, 2007a, 2007b, 2008 and 2013), (US Army Coastal Engineering Research Center, 1980), (US Army Corps of Engineers, 2002), (Nouban and Sadeghi, 2013 and 2014), (US Army Corps of Engineers, 2011), (Nouban, 2015) and (Nouban et al., 2016) can be used.

TEMPLATE (JACKET) PLATFORMS

Template platforms, also called jacket platforms are made of steel. Template platforms comprise basically of a jacket, decks, and piles. The main advantage of these type of platform is their stability. As they are attached to the sea floor, there is limited movement due to the effects of wind, current and wave forces. However, these platforms cannot be used in extremely deep water (i.e. in the water depths more the 400m).

TEMPLATE PLATFORMS DESIGN BASES

The principals for the design and analysis of fixed template platforms (Jacket), along with recommendations for design, analysis, construction, load-out, transportation and installation of this type of platforms, are provided in some references such as the code of practice of (API, 2010), as well as the books written by (Sadeghi, 1989, 2001) and are presented briefly below.

Construction Stages

Offshore platform construction typically includes the following phases: i) Planning, ii) Design, iii) Procurement, iv) Construction, v) Load-out, vi) Transportation, vii) Installation, and viii) Commissioning.

The fabrication of the steel structures of template platforms is performed in construction yards located a significant distance from the installation site. The Load-out, transportation, and installation of jackets require special designs and structural strength calculations. A detailed work breakdown structure (WBS) is required for the phases of planning, design, and construction of such structures. For more information, refer to (Muyiwa and Sadeghi, 2007), (Sadeghi and Babolian, 2016), (Nouban, 2016) and (Sadeghi and Nouban, 2016).

Different Analyses Needed

The main analyses required for the design of a template platform are: i) In- place analysis, ii) Earthquake analysis, iii) Fatigue analysis, iv) Impact analysis, v) Temporary analysis, vi) Load-out analysis, vii) Transportation analysis, viii) Appurtenances analysis, ix) Lift or launch analysis, x) Upending analysis, xi) Up-righting analysis, xii) Un-piled stability analysis, xiii) Pile and conductor pipe drivability analysis, xiv) Pile and conductor pile design (Tamlinson, 1987), xv) Cathodic protection analysis, xvi) Transportation analysis, and xvii) Installation analysis.

Codes of Practice

The design and analysis of template platforms can be conducted in accordance with the API-RP-2A-WSD. The API specifies minimum design criteria for a 100-year design storm.

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Loading

Loading applied to the platforms include the ship impact; dead and live loads; current, wind, earthquake; fatigue. The load combinations are considered in the design phase. For further information, refer to (Sadeghi, 1989 and 2001).

Design and Analysis of Mudmats and Piles

The soil related design of offshore structures includes the mudmat and pile design. Each project acquires a site-specific soil report showing the soil stratification and its characteristics for load bearing in tension and compression, shear resistance, and load-deflection characteristics of axially and laterally loaded piles. The soil report needs to show the calculated minimum axial capacities for piles of the same diameter as the platform design piles, SRD curves, different types of mudmat bearing capacity, pile group action curves, shear resistance values, pile tip end bearing values and lateral pile axial capacity values.

The soil characteristics are also used for a pile drivability analysis.

Software Used in the Design of Template Platforms

The following software can be used for the structural analysis of template platforms:

i. SACS, FASTRUDL, MARCS, OSCAR, StruCad or SESAM for structural analysis.

ii. Maxsurf, Hydromax, Seamoor for the hydrodynamic calculations of barges.

iii. GRLWEAP, PDA, CAPWAP for pile analyses.

Structural Analysis

A typical template platform normally has a topside containing the Main Deck, a Cellar Deck, Sub-Cellar Deck and a Helideck. The topside is connected to the top of the piles. The piles extend from the top level of the jacket through the mudline and into the soil. The jacket may serve as a template for the driving of the through-leg piles (The piles are driven through the inside of the legs of the jacket). The piles may be driven from outside of the legs of the jacket in the case of using skirt piles and using an underwater hammer.

The structural model file consists of:

i. The mudline elevation and water depth,

ii. Members sizes,

iii. Soil data including; mudmat bearing capacity, pile groups, T-Z, P-Y, Q-Z curve data,

iv. Joint coordinates,

v. Marine growth weight and locations,

vi. Inertia and mass coefficients,

vii. Distributed load surface areas,

viii. Wind areas,

ix. Anode weights and locations,

x. Appurtenances weights and locations,

xi. Conductor pipes and piles weights and their locations,

xii. Load cases include dead, live, environmental, crane loads and etc.

The structural analysis is a static linear analysis of the structure above the mudline combined with a static nonlinear analysis of the soil with the piles.

Checks are made for all tubular joint connections to analyze the strength of tubular joints against punching. The punching shear analysis is referred to as "joint can analysis".

The platforms must be capable to withstand the most severe design loads and also surviving a design lifetime of fatigue loading.

A detailed fatigue analysis is required to assess cumulative fatigue damage. The analysis required is a "spectral fatigue analysis" or simplified fatigue analysis according to API. The fatigue analysis is performed with input from a wave scatter diagram and from the natural dynamic response of the platform by applying the Palmgren-Miner formula.

The Palmgren-Miner formula, proposed in 1945, does not reflect the temporal sequence of loading cycles and is based only on the number of cycles. Dissipated energy-based fatigue formulas (not only based on cycle numbers) such as Sadeghi's fatigue formula gives more accurate results (Sadeghi et al., 1993a and 1993b), (Sadeghi, 1995, 1998a and 1998b), (Sadeghi and Nouban, 2010, 2011, 2016, 2017a and 2017b), (Sadeghi and Sadeghi, 2013).

Construction

All materials, welds, and welders should be tested carefully. For cutting, fitting, welding, and assembling, shop drawings are necessary.

Load-out and Transportation

The jackets are generally built onshore in "construction yards" for cost savings and to facilitate construction. Upon completion, they have to be loaded out and to be transported to the offshore assembly site. The design and analysis of a jacket include load-out and transportation calculation as well. All stages of the load-out should be considered and the stresses should be checked. Before transportation, the sea-fastening analysis is performed and the platform parts (jacket, decks, and appurtenances) are fastened to the barge. In the transportation analysis, the motions of roll, pitch, heave, and yaw should be considered.

To perform a transportation analysis, an environmental report showing the worst sea-state conditions during that time of the year throughout the course of the intended route need to be available for design.

Installation

All the structural members should be designed to withstand the lifting/launching, upending, up-righting, and other installation stresses.

The jackets must be designed to be self-supporting during pile driving and installation period. Mudmats are used in the bottom horizontal brace level which transfer the temporary loads to the seabed surface and soil before the completion of pile driving operation. The mudmats are made of stiffened steel plates and are generally located adjacent to the jacket leg connections near the mudline level.

The piles must be designed to withstand the stresses during pile driving operation. The piles are installed in sections. The first section must be long enough to go from a few meters above the top of the jacket leg to the mudline. The other sections (add-ons) must be welded to the first section (main piece) and the following add-ons at an elevation slightly higher than the top of the jacket legs.

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When all the piles have been driven to the required design target penetrations, they will be cut at the design "top of pile" elevation. The jacket will then be welded to the piles about 1.0 meters or less below the top of the piles around scheme plate.

GENERAL STATEMENT ABOUT WBS

The work breaks down structure (WBS) is used to define the work for a project and to develop that project's schedule. (Project Management Docs, 2014).

A WBS can show the followings at a glance:

1. What are the various elements of the project?
2. How the necessary work is distributed among the elements of the project?
3. How the larger elements of the project are subdivided into smaller ones?

In different references (Fredrick, 1997), (Project Management Docs, 2014), (Sadeghi and Aleali, 2008), (Sadeghi and Babolian, 2016), (Nouban and Sadeghi, 2013), (Nouban, 2014), general guidance and templates for different phases of various projects are submitted. In general, the available templates for WBS in literature are not enough for construction of a template platform. Therefore, by combining the literature review and the experiences from the execution of some template platforms, a WBS template to construct the template platforms is proposed.

The Proposed WBS template can be a good guidance for clients, contractors, and consultant to construct a template platform as listed below:

Work Breakdown Structure template for construction of a template platform (Jacket)

1 Initiation

- 1.1 project definition
  - 1.1.1 Project description
  - 1.1.2 Preliminary project timetable
  - 1.1.3 Preliminary project budget
  - 1.1.4 Project technical specification
- 1.2 Preliminary scope of work
- 1.3 Perform feasibility study
- 1.4 Preliminary Drawings
- 1.5 Evaluate project needs, develop major study list
  - 1.5.1 Evaluation of short-term benefits.
  - 1.5.2 Evaluation of long-term benefits.
- 1.6 Complete major studies and market recommendations
  - 1.6.1 Evaluation of the market
    - 1.6.1.1 Identifying the related marketing centers
    - 1.6.1.2 Evaluation the related marketing centers
    - 1.6.1.3 Collecting the data for the producing product
  - 1.6.2 Evaluation of long-term and short-term benefits.

1.6.2.1 Evaluation of short-term benefit

1.6.2.2 Evaluation of long-term benefit

1.6.2.3 Providing the total benefit

1.7 Providing scope of work for structural system

1.8 Develop general scope for project objectives

1.9 Develop project management plan

1.10 Submission of project charter

1.11 Submission of documents approval system

2 Planning

2.1 Creation of preliminary scope statement

2.2 Determination of project team

2.3 Project team Kick-Off Meeting

2.4 Developing the project plan

2.4.1 Preliminary topside layout

2.4.1.1 Preliminary main deck layout

2.4.1.2 Preliminary cellar and sub-cellar deck layouts

2.5 Submission of project plan

2.6 Milestones and project plan approval

3 Conceptual design

3.1 Reviewing the requirements

3.1.1 Produce accurate and complete requirements

3.1.2 Specifying, analyzing and validating early requirements

3.2 Conceptual calculations

3.2.1 In-place analysis

3.2.2 Earthquake analysis

3.2.3 Fatigue analysis

3.2.4 Impact analysis

3.2.5 Temporary analysis

3.2.6 Loadout analysis

3.2.7 Transportation analysis

3.2.8 Appurtenances analysis

3.2.9 Lift/Launch analysis

3.2.10 Upending analysis

3.2.11 Uprighting analysis

3.2.12 Unpiled stability analysis

3.2.13 Pile and conductor pipe drivability analysis

3.2.14 Cathodic protection analysis

3.3 Conceptual drawings

3.3.1 Conceptual jacket drawings

3.3.2 Conceptual piles drawings

3.3.3 Conceptual decks drawings

3.3.4 Conceptual boot landing drawings

3.3.5 Conceptual helipad drawings

3.4 Conceptual MTO and requisition

3.5 Conceptual project budget

3.6 Conceptual project performance time schedule

4 Construction site assessments

4.1 Identify the potential sites

4.2 Comparison of different sites.

4.3 Assess regulatory and environmental impacts

4.4 Identify permitting requirements

4.5 Recommend site

4.6 Apply for permits

4.6.1 Secure Environmental Organization permit

4.6.2 Secure Army Organization permit

4.6.3 Secure national petroleum organization permit

4.6.4 Secure miscellaneous permits

4.7 Select the site

5 Scope Management

5.1 Develop scope management plan

5.2 Develop scope statement

5.3 Approve scope statement

5.4 Create work breakdown structure (WBS)

6 Basic design

6.1 Endorsing conceptual design documents

6.2 Performing soil investigation

6.2.1 Cone penetration test

6.2.2 Vane shear test

6.2.3 Standard Penetration Test

6.2.4 Unconsolidated and consolidate un-drained tri-axial tests

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- 6.2.5 In-situ pile test
- 6.3 Performing calculations (design)
  - 6.3.1 In-place analysis
  - 6.3.2 Earthquake analysis
  - 6.3.3 Fatigue analysis
  - 6.3.4 Impact analysis
  - 6.3.5 Temporary analysis
  - 6.3.6 Loadout analysis
  - 6.3.7 Transportation analysis
  - 6.3.8 Appurtenances analysis
  - 6.3.9 Lift/Launch analysis
  - 6.3.10 Upending analysis
  - 6.3.11 Uprighting analysis
  - 6.3.12 Unpiled stability analysis
  - 6.3.13 Pile and conductor pipe drivability analysis
  - 6.3.14 Cathodic protection analysis
- 6.4 Preparing drawings
  - 6.4.1 Basic jacket drawings
  - 6.4.2 Basic piles drawings
  - 6.4.3 Basic decks drawings
  - 6.4.4 Basic boot landing drawings
  - 6.4.5 Basic helipad drawings
- 6.5 Preparing the specifications/procedures
- 6.6 Submitting the MTO and requisition list
- 6.7 Selection of final alternative (Selected variant)
- 6.8 Approve basic design

7 Time/Cost Management

- 7.1 Activity definition
- 7.2 Activity sequencing
- 7.3 Activity resource estimates
- 7.4 Activity duration estimates
- 7.5 Develop schedule

8 Risk Management

- 8.1 Risk management planning
- 8.2 Risk Identification

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8.3 Qualitative risk Analyses

8.4 Quantitative risk Analyses

8.5 Risk response plan

9 Bidding Process and Selection of EPC contractor

9.1 Publish the project announcement for the interested contractors

9.2 Sending the documents of project to potential contractors

9.2.1 Condition of project performing

9.2.2 Drawings

9.2.3 Calculation note

9.2.4 Technical specifications

9.3 Evaluation of the received proposal

9.3.1 Evaluation of the received technical proposal

9.3.2 Evaluation the method statement

9.3.3 Evaluation of the received commercial proposal

9.3.4 Evaluation of bonds

9.4 Selection of successful contractor

9.4.1 Preparing a comparison table for the received proposals

9.4.2 Comparison of the received technical proposals

9.4.3 Comparison of the received commercial proposals

9.4.4 Weighting the selection factors and applying the selection criteria

9.4.5 Selecting the successful contractor

9.5 Contracting process

9.5.1 Preparation of the contract documents

9.5.2 Submit bond and insurance documents

9.5.3 Receive notice to proceed and sign the contract

9.5.4 Signing and awarding the contract

10 Detail Design

10.1 Selection of and approval of the detail design sub-contractor

10.1.1 Evaluation of the documents and background of the consultant

10.1.2 Holding meetings & visiting the facilities of the consultant

10.1.3 Applying the client's procedures to consultant & approve the consultant

10.2 Introducing the client's representative for supervising the detail design performance

10.2.1 Determine the scope of work of the client's representative for supervising the detail design

10.2.2 Take progress of supervising the detail design

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10.3 Basic documents endorsements by EPC contractor

10.3.1 Endorsement of the basic design

10.3.2 Endorsement of the basic calculations

10.3.3 Endorsement of the basic drawings

10.3.4 Endorsement of the basic technical specifications

10.3.5 Endorsement of the basic fabrication procedures

10.3.6 Endorsement of the soil mechanics reports

10.3.7 Endorsement of the topography and bathymetry drawings

10.4 Performing Calculations

10.4.1 Platforms calculations

10.4.1.1 Jacket analysis

10.4.1.1.1 In-place analysis

10.4.1.1.2 Earthquake analysis

10.4.1.1.3 Fatigue analysis

10.4.1.1.4 Impact analysis

10.4.1.1.5 Temporary analysis

10.4.1.1.6 Loadout analysis

10.4.1.1.7 Transportation analysis

10.4.1.1.8 Appurtenances analysis

10.4.1.1.9 Lift/Launch analysis

10.4.1.1.10 Upending analysis

10.4.1.1.11 Uprighting analysis

10.4.1.1.12 Unpiled stability analysis

10.4.1.1.13 Pile and conductor pipe drivability analysis

10.4.1.1.14 Cathodic protection analysis

10.4.2 Topside (decks)

10.4.2.1 In-situ analysis

10.4.2.2 Earthquake analysis

10.4.2.3 Decks analysis

10.4.2.4 Temporary analysis

10.4.2.5 Loadout analysis

10.4.2.6 Transportation analysis

10.4.2.7 Appurtenances analysis

10.4.2.8 Lift analysis

10.4.3 Mechanical calculations

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10.4.3.1 Water pipelines facilities analysis

10.4.3.2 Oil/gas pipelines facilities analysis

10.4.3.3 Sanitary facilities analysis

10.4.4 Electrical calculations

10.4.4.1 Electricity supplying facilities analysis

10.4.4.2 Lightening facilities analysis

10.5 Preparing drawings

10.5.1 Jacket drawings

10.5.2 Piles drawings

10.5.3 Decks drawings

10.5.4 Boot landing drawings

10.5.5 Helipad drawings

10.5.6 Mechanical drawings

10.5.6.1 Water pipelines facilities drawings

10.5.6.2 Oil/gas pipelines facilities drawings

10.5.6.3 Sanitary facilities drawings

10.5.7 Electrical Drawings

10.5.7.1 Electricity supplying facilities drawings

10.5.7.2 Lightening facilities drawings

10.6 Preparing Material-Take-Off (MTO)

10.6.1 MTO of required amount of steel beams profiles

10.6.2 MTO of different sizes of required steel pipes

10.6.3 MTO of different sizes of required steel sheets

10.6.4 MTO of required fenders

10.6.5 MTO of required mooring chains and appurtenances

10.6.6 MTO of required mechanical equipment

10.6.7 MTO of required electrical equipment

10.6.8 List of required machinery

10.7 Preparing Technical specifications

10.7.1 Technical specifications for steel beams profiles

10.7.2 Technical specifications for steel pipes

10.7.3 Technical specifications for steel sheets

10.7.4 Technical specifications for fenders

10.7.5 Technical specifications for bumpers

10.7.6 Technical specifications for mooring chains and appurtenances

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10.7.7 Technical specifications of required mechanical equipment

10.7.8 Technical specifications of required electrical equipment

10.7.9 Technical specifications of required machinery

10.7.10 Reviewing/comment/approve the technical documents

10.7.11 Final report for technical documents

10.8 Preparing fabrication procedures

10.8.1 Fabrication procedure for platforms

10.8.1.1 Fabrication procedure for jacket construction and installation

10.8.1.2 Fabrication procedure for piles drivability

10.8.1.3 Fabrication procedure for deck construction and installation

10.8.1.4 Fabrication procedure for fenders installation

11 Procurement

11.1 Preparing procurement procedures and requisitions

11.1.1 Requisition for different sizes of steel beams profiles

11.1.2 Requisition for different sizes of required steel pipes

11.1.3 Requisition for different sizes of required steel sheets

11.1.4 Requisition for required fenders

11.1.5 Requisition for required amount of pumpers

11.1.6 Requisition for required mooring chains and appurtenances

11.1.7 Requisition for required anodes

11.1.8 Requisition for required secondary materials

11.1.9 Requisition for required mechanical equipment

11.1.10 Requisition for required electrical equipment

11.1.11 Requisition for required machinery

11.1.11.1 Requisition for pipes/plates cutting machine

11.1.11.2 Requisition for welding machine

11.2 Preparing expediting and inspection procedures

11.3 Send the technical specifications, MTO, and requisitions to suppliers

11.4 Contacting the suppliers

11.4.1 Correspond to the suppliers

11.4.2 Review of the proposals

11.5 Performa negotiation meeting with suppliers

11.5.1 Evaluation of the new ideas in the meeting

11.5.2 Make agreement with suppliers

11.6 Evaluate the received proposals

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- 11.7 Perform test on the purchased materials
  - 11.7.1 Ensuring to have the necessary equipment
  - 11.7.2 Ensuring to have the resources available
  - 11.7.3 Testing the materials & equipment
- 11.8 Shipment and delivery of materials
  - 11.8.1 Evaluate various project delivery approaches on time
  - 11.8.2 Getting good services & equipment on time
- 11.9 Inventory the materials equipment
  - 11.9.1 Inventory various materials
  - 11.9.2 Inventory various equipment
- 11.10 Storing the delivered materials at the site

12 Construction

- 12.1 Yard and Work-Force Mobilization
- 12.2 Receipt of Materials
- 12.3 Evaluation and purchasing of consumables
- 12.4 Construction design
  - 12.4.1 Preparing Safety Manual and Plan
  - 12.4.2 Preparing Shop Drawings
  - 12.4.3 Preparing QA/QC, NDT, and Dimensional Control Plan
  - 12.4.4 Design a macro task
  - 12.4.5 Modelling the structure
  - 12.4.6 Main platform construction design
    - 12.4.6.1 In-situ analysis
    - 12.4.6.2 Earthquake analysis
    - 12.4.6.3 Ship impact analysis
    - 12.4.6.4 Piles analysis
    - 12.4.6.5 Piles drivability analysis
    - 12.4.6.6 Decks analysis
    - 12.4.6.7 Fenders analysis
    - 12.4.6.8 Mooring systems analysis
    - 12.4.6.9 Cathodic protection analysis
    - 12.4.6.10 Fatigue analysis
    - 12.4.6.11 Temporary analysis
    - 12.4.6.12 Loadout analysis
    - 12.4.6.13 Transportation analysis

12.4.6.14 Appurtenances analysis

12.4.6.15 Lift/Launch analysis

12.4.6.16 Upending analysis

12.4.6.17 Uprighting analysis

12.4.6.18 Unpiled stability analysis

12.4.6.19 Pile and conductor pipe drivability analysis

12.4.6.20 Cathodic protection analysis

12.4.7 Construction design drawings

12.4.7.1 Jacket drawings

12.4.7.2 Piles drawings

12.4.7.3 Decks drawings

12.4.7.4 Boot landing drawings

12.4.7.5 Helipad drawings

12.4.8 Preparing Technical specifications

12.4.8.1 Technical specifications for steel beams profiles

12.4.8.2 Technical specifications for steel pipes

12.4.8.3 Technical specifications for steel sheets

12.4.8.4 Technical specifications for bumpers

12.4.8.5 Technical specifications for mooring chains and appurtenances

12.4.8.6 Technical specifications of required mechanical equipment

12.4.8.7 Technical specifications of required electrical equipment

12.4.8.8 Technical specifications of required machinery

12.4.8.9 Reviewing/comment/approve the technical documents

12.4.8.10 Final report for technical documents

12.4.9 Fabrication procedure for platforms

12.4.9.1 Fabrication procedure for jacket construction and installation

12.4.9.2 Fabrication procedure for piles drivability

12.4.9.3 Fabrication procedure for deck construction and installation

12.4.9.4 Fabrication procedure for fenders installation

12.5 Endorsement of Material

12.5.1 Testing the materials

12.5.2 Check the quantity of materials

12.6 Evaluation and purchasing of consumables

12.7 Provide the needed equipment/machinery

12.7.1 Pipes/plates cutters

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12.7.2 Pipes/plates filters

12.7.3 Welding machine

12.8 Testing

12.8.1 X-Ray test

12.8.2 Ultrasonic test

12.8.3 Magnetic particular test

12.8.4 Die penetration test

12.8.5 Air test of buoyancy tanks

12.8.6 Water test of buoyancy tanks

12.9 Fabrication of appurtenances

12.9.1 Barge bumpers

12.9.2 Boat landing

12.9.3 Buoyancy tanks

12.10 Construction of jacket

12.10.1 Jacket fabrication

12.10.2 Preparing piles pieces

12.10.3 Deck construction

12.10.4 Fenders installation

12.10.5 Mooring systems installation

12.10.6 Installation of anodes

12.11 Construction of mechanical facilities

12.11.1 Construction of water pipelines facilities

12.11.2 Construction of oil/gas pipelines facilities

12.11.3 Construction of sanitary facilities

12.12 Construction of electrical facilities

12.12.1 Construction of electricity supplying facilities

12.12.2 Installation of lightening facilities

12.13 Preparing As-Built drawing and certification dossier

12.14 Preparation of safety manual and plan for operation phase

12.15 Demobilization

13 Load-out

13.1 Safety manual and plan

13.2 Seafastening Drawings

13.3 Marine warranty surveyor review and approval

13.4 Positioning the barge and barge ballasting

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13.4.1 Arrangement of the ballast tanks

13.5 Fixing the cables

13.5.1 Cables as the parallel links to use winches

13.5.2 Flexible control lines & cables for the ballast systems

13.6 Testing the drums and pulling equipment

13.6.1 Control the limitations on minimum breaking load of the wire ropes

13.6.2 The skid beam top surface is cleaned & ground smooth for any projection

13.6.3 All preparations & checks are completed pulling the equipment

13.7 Pulling the jacket

13.7.1 Push/Pull system to be used to pull the heavy platform (if needed)

13.8 Seafastening the jacket

13.9 Finishing the loadout phase

13.9.1 Detaching the cables

13.9.2 Twisting of the barge in the seaway

14 Launching

14.1 Cutting the sea fastenings

14.1.1 All preparation for launch the offshore location have been completed

14.1.2 Start of lounging

14.2 Deballasting the barge tanks

14.2.1 Checking the barge bending moment & shear force during launch

14.2.2 Barge stern submergence

14.3 Pulling the jacket

14.4 Launching the jacket

14.4.1 Initiating jacket launch

14.4.2 Allowable rocker reactions & barge submergence

15 Installation

15.1 Cutting the sea fastenings

15.1.1 Upending the jacket

15.1.2 Uprighting the jacket

15.1.3 Control the stability of jacket in Unpiled condition

15.2 Detecting the buoyancy tanks

15.3 Driving the piles

15.3.1 Drive the main piece

15.3.2 Drive the add-one

15.3.3 Piles installation

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15.4 Attaching the appearances

15.4.1 Barge bumpers

15.4.2 Boat landing

15.4.3 Attaching the other appearances

15.5 Testing the welds and repairing the paints

15.6 Installation of topside

15.6.1 Lifting decks

15.6.2 Welding the deck legs to the Jacket

16 Commissioning

16.1 Commissioning of compressor

16.2 Commissioning of other equipment

16.2.1 Load testing

16.2.2 Transformer & relay testing

16.2.3 Condenser efficiency testing

17 Close-out

17.1 Issuing final dossier

17.1.1 Issue the calculation note

17.1.2 Issue As-Built drawings

17.1.3 Issue of final technical specifications

17.1.4 Issue of final fabrication procedures

17.1.5 Issue of equipment manuals

17.2 Finalizing the administration and financial issues

17.3 Issue Fire and Safety instructions and manuals

17.4 Releasing good performance guarantee

17.5 Delivery of the project

CONCLUSION

An overall guidance and a detailed WBS template are proposed for the planning, design, construction, and installation of the template platforms. Using the proposed WBS template helps the clients, contractors, and consultants, particularly in the planning and conceptual design phase of a template platform. It gives a good guidance to design and construction of template (Jacket) platforms. The proposed WBS shows close agreement with the actual procedures used in the template platforms constructed, in the case study Iranian waters.

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