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Template Design Packages for Repetitive Construction Projects

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***Abstract*—**Scope changes, scope creeps, cost and time overruns have become common in projects in the oil and gas sector. Even in repetitive projects, failure to implement lessons learnt and correct past mistakes have resulted in various setbacks. This paper describes the concept of reusing successfully implemented design packages as templates for repetitive projects, and thereby lowering the instances of project failures. Units or systems successfully installed in projects can be identified and taken up for preparing template design packages. Standardization of units and systems helps to develop templates from successful designs which can be repeatedly used with confidence. These packages can be used with minimum modifications for developing FEED packages faster, saving cost and other valuable resources. Lessons learnt from the completed project incorporated in the templates avoid repeating past mistakes during detailed design, procurement and execution. With template packages, consistent quality can be maintained for similar projects, avoiding scope creep and scope changes which will ultimately result in cost and time savings.

***Keywords*—**Engineering work package, repetitive construction, template design package, time saving in projects.

I. Introduction

THE importance of Front End Engineering Design (FEED) document cannot be overemphasized in a project, especially in the oil and gas sector where the magnitude of the project makes failures disastrous. FEED should be complete in terms of scope, accuracy and consistency across multi-disciplines to avoid discrepancies and delays during detailed engineering and execution. Organizations spent time, money and resources to ensure that a FEED is of good quality for smooth execution. The industry could reduce costs and accelerate project delivery times by more aggressively implementing advanced modularization and standardization approaches such as those already used in industries that range from autos and electronics to satellite manufacture [1].

Any organization should look for ways to standardize some of its project work by identifying common themes across its projects [2]. It should look for work packages that are similar, repetitive over time, and use the same skill and resources [2]. Due to the varying scope in different projects, a successful project can rarely be taken and repeated for success in the oil and gas industry. But different units and sub-systems within a project can be standardized and used as templates for repetitive construction as standalone projects or as a part of a bigger project.

A template design package is an engineering work package which can be used to develop a complete FEED package. It comprises of detailed scope description, technical specifications, standard drawings, bill of materials and contract documents.

Template design packages have distinct advantages apart from saving time, cost and maintaining quality and consistency. Unlike modular design packages, which fit only one size, template packages do not have the constraint of size, capacity or quantity; it can be modified and used according to the end user requirements. If used properly, the template library can really cut down planning time, significantly increase the quality of your project management experience, and decrease the risk of project failure [3].

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II. Methodology

A. Objective

The objective of using Template FEED Packages is:

1) Save FEED preparation time,
2) Save cost, man-hours and resources,
3) Maintain consistency in concept and design,
4) Ease of execution.

B. Approach

It is always better to take a successfully executed project and modify to use it as a template for future repetitive construction of similar systems. An alternative approach is to start from scratch which will involve more time and reviews to prepare a good package.

The steps involved in preparing a template package are:

1) Form a taskforce team comprising of Subject-Matter Experts (SME) from within the organization and/or third party consultant.
2) Prepare draft Template document with input from all stakeholders.
3) First review by all stakeholders.
4) Review and resolution of comments.
5) Final review by stakeholders.
6) Review and resolution of comments, if any.
7) Issue of template package for management approval.
8) Upload the document in company portal for user teams.

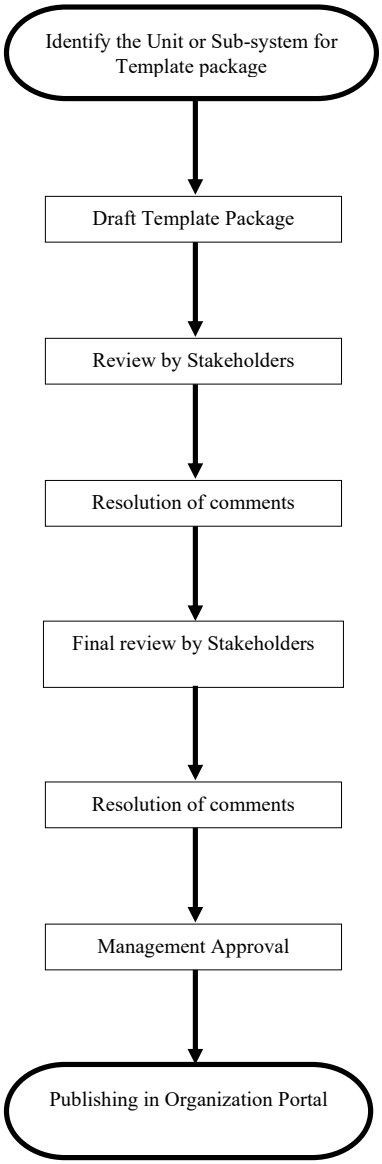

Fig. 1 Flowchart

The flowchart shown in Fig. 1 summarizes the process of preparing a template package.

Any lessons learnt and/or recommendations for change from successfully completed projects in an operation shall be incorporated in the template design package.

The ensuing section includes a case study which will briefly outline the contents of a template package.

III. Case Study

This section briefly describes the outline of the template package of "Fixed Cone Roof Tanks and Associated Works". It includes the scope of work of all disciplines like process, mechanical, electrical, instrumentation and civil.

A. Project Overview

A brief process overview is explained to show where fixed cone-roof tanks are applicable in the oil and gas industry.

Reservoir fluids are received via flow-lines at the production manifolds. They are then processed through high-pressure and low-pressure 3-phase separators for separation of oil, gas and water. The fluids from the separators enter a degassing boot and are then distributed through an inlet distributor in the wet crude tanks for uniform distribution and to increase oil/water separation efficiency. The outflow from the wet tanks is through a collector installed in the tank.

Water discharged from the wet crude storage tanks is transferred to the effluent water balance tanks where excess oil is removed and water is finally degassed.

Gas evolved from the storage tank is flowing through the tank vapor outlet line to the tank vapor compressor inlet for compression and then transmission to the gas export line.

Dry tanks store crude that has been dehydrated and desalted to the required specifications. Some water is still expected in these tanks. Gas evolved is taken out and is compressed to the gas export pressure.

TABLE I
Scope Overview of Various Disciplines

Engineering Discipline	Project Requirements
Process	Process Design Basis, Operating Philosophy, Isolation Philosophy, Shutdown Philosophy, PFD, P&ID, HAZOP, HAZID, SIL studies, QRA studies etc.
Mechanical	Equipment and Piping Design, Equipment and Piping Layout, Firefighting System, Painting and Coating, Testing & Commissioning
Instrumentation	F&G detection system, H_2S detection system, ESD system, ICSS etc.
Civil	Surveys, Tank foundations Design, Pipe supports design, Dike walls, Drain pits, Access platforms etc.
Electrical	Power Supply and Distribution, Lighting, Earthing and Lightning Protection, Cathodic Protection etc.

B. FEED Deliverables

Typical FEED deliverables shall include:

1) Detailed Scope of Work for each discipline,
2) Design Basis,
3) Technical Specifications for all systems,
4) Datasheets for equipment, valves, field devices,
5) PFD and P&IDs,
6) FEED Drawings,
7) As-Built Drawings, if any,
8) Bill of Materials,
9) Process Safety Study Reports.

All the listed documents shall be complete in all aspects except for those items that shall be unique for each tank project e.g. capacity, type of fluid, operating conditions etc. The template documents can be modified within minimum a timeframe to suit the requirements of the project and be issued for tender. Other aspects like shell thickness, pipe sizing, etc., shall be decided during the detailed engineering phase.

C. Template Package Contents

Template package preparation is a collective effort of the task force members in close coordination with the user teams and other stakeholders. The scope shall be detailed to avoid any ambiguity during detailed engineering and execution. The

typical requirements of the package are detailed discipline wise.

1. Process Engineering Works

i. The process engineering scope description includes:
ii. Process Design basis,
iii. Operating Philosophy,
iv. Isolation Philosophy,
v. Emergency Shutdown Philosophy,
vi. Thermal Relief Philosophy,
vii. Heat and Material Balance,
viii. PFDs and P&IDs,
ix. HAZID,
x. HAZOP Studies at various stages of the project,
xi. SIL studies,
xii. QRA studies,
xiii. Sizing of Relief and Vent systems,
xiv. Equipment List,
xv. Material Selection Diagrams,
xvi. Chemical type and consumption summary,
xvii. Utility summary,
xviii. Tie-in Schedule and Interfacing,
xix. Process datasheets,
xx. Process calculations, and
xxi. Firefighting Philosophy with firewater calculations.

A detailed description of all the scope requirements to be carried out by the contractor shall be given in the document. All the drawings (P&IDs) provided with the template package are for guidance only. Based on the same and scope of works, the contractor shall develop all the new P&IDs and reports during the detailed engineering phase. The P&IDs shall include process and utility systems showing all battery limits as well as demolition P&IDs (if relevant). Vendor P&IDs shall also be submitted for company review/approval. All the design and operating parameters and criteria shall be shown on the P&ID. As-Built P&IDs shall also be part of the scope.

2. Mechanical Works

The items included in the scope description for Mechanical Works are:

i. Tank datasheet,
ii. Tank design calculations (sizing, thickness etc.),
iii. Nozzle sizing and thickness calculations,
iv. Relief systems sizing calculations,
v. Vapor disengaging drums,
vi. Pipe sizing and thickness,
vii. Pipe stress analysis,
viii. Pipe support calculations,
ix. Deluge System,
x. Foam calculations,
xi. Dike area calculations,
xii. Tank GA drawings,
xiii. Tank fabrication drawings,
xiv. Piping layouts,
xv. Valves,
xvi. Painting and coating, and
xvii. Calibration and Testing.

Tank layout drawings and piping arrangement drawings can be provided with the template package as guidelines for the preparation of FEED package. Datasheet formats for mechanical equipment and valves, material selection guide etc., shall be provided along with the package. During the FEED stage when more information is available, the document can be modified to include project specific drawings.

3. Instrumentation Works

The instrumentation portion of the works consists of design, procurement, supply, installation, calibration/testing, pre-commissioning and commissioning of all instrumentation items and related materials for the new tank and its associated new deluge system, tie-ins to existing control system and shutdown system.

i. F&G detection system,
ii. Modification of DCS, ESD, F&G and H2S system,
iii. ESD with SIL certification,
iv. Controls for Deluge System, and
v. Testing and commissioning.

Scope description shall include all cabling, field transmitters, level gauges, flow meters, field devices and all sundries required for completion of the project. Any specific devices or requirements that are needed can be added during the FEED stage. All materials shall be selected based on area classification.

4. Civil Works

The civil works scope description includes:

i. Topographical survey, Geo-Technical investigation and Slit Trenching works.
ii. Site preparation, Grading, Relocation of existing underground and aboveground services and removal of contaminated soil.
iii. Construction of Reinforced Concrete Ring Beam Foundations; Cathodic protection grid below tank base, All associated Earthworks, Pipe and Valve supports, Radial Stairway, Pipe sleepers.
iv. Construction of new dike wall according to the service fluids.
v. Steel stairways.
vi. Construction of pipe and valve supports and foundations and sleepers.
vii. Construction of Access Platforms, Cross-Overs, Access ramps, Miscellaneous Steel and Concrete Structures, Valve Pits, Drain pits, Electrical Equipment Foundations, Instrument Supports and Foundations, Light Pole Foundations, Radiation shields and their foundations, etc.

5. Electrical Works

Electrical scope of work description includes:

i. Identification of power source and feeder,
ii. Tank area lighting works,
iii. Tank earthing and lightning protection,
iv. Cable installation,
v. Motor Operated Valves,
vi. Cathodic Protection, and
vii. Testing and Commissioning.

All electrical hazardous area classification drawings, and datasheet formats shall form part of the template package.

D. FEED Package Preparation

The completed template packages are reviewed by all stakeholders and approved by management for publishing in the organization portal. These packages shall be periodically reviewed and updated by SMEs based on feedback from user teams and any technological advances.

Similar technical packages were successfully prepared for pipeline projects, road construction projects, and fence and associated works projects. These template packages shall be utilized by project teams and modified to project specific FEED packages.

Once the template package is published in the organization's portal it can be accessed by all project teams. All projects are unique, so no template will cover every aspect of a new project completely [4]. Review the specific requirements to detect any that are at variance with those from previous projects [4]. The package can be downloaded and modified to suit their specific requirements and issued for tender.

There are considerable savings in time and cost for the preparation of FEED packages and even during execution when template packages are used. Reusing existing templates for repeatable process units helps de-risk the work, because many of these units are fundamentally the same from project to project [5]. Fig. 2 gives a comparison in terms of time for completion of a project with and without a template package.

FEED completion time is considerably reduced since the package is almost 75% ready. With minor modifications and additions to incorporate project specific needs, the package can be completed and be ready for tendering phase. With lessons learnt incorporated from a successfully completed previous project, the bidder's queries can be almost eliminated; thereby, saving tendering time also. Similarly, variation orders, interface issues and other issues which commonly delay project execution can successfully be reduced or eliminated, achieving considerable savings in time and cost while maintaining consistent quality.

IV. Conclusion

Successful implementation of several projects with template packages has categorically proved that using a tried and tested strategy is a better project management tool to achieve success. While maintaining high quality in execution, conflicts, scope creep and scope variation can be eliminated or reduced to a considerable extent. The project can be executed on fast track with reduced cost.

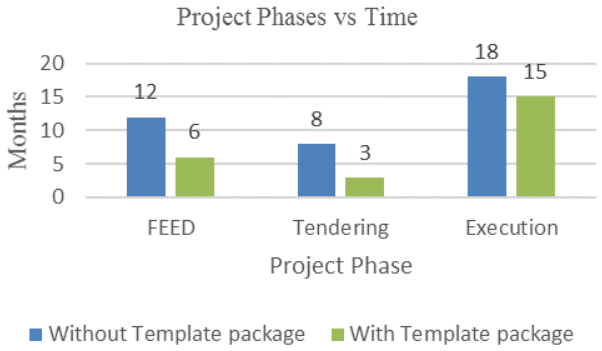

Fig. 2 Project completion time with and without Template Package

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