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Benguela-Belize Compliant Piled Tower: Topsides Engineering

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Abstract

This paper is a review of the Topsides Drilling and Production Facility for the Benguela-Belize Platform. The review covers design critical aspects including planning, construction support, vendor data control, weight management, and design interfaces.

The 33,300 s.t. Benguela-Belize topsides is three times larger than the Baldpate CPT topsides and four times larger than the Petronius CPT topsides. The detail design was completed in 12 months, with the first handovers to the fabrication contractor occurring 8 months after contract award. Daewoo Shipbuilding and Marine Engineering (DSME) and Kellog Brown & Root LLC (KBR) used KBR's Stage Methodology to successfully execute the handover of the engineering design to DSME for inclusion of vendor certified data and fabrication support engineering.

Each of the three major lifts presented challenges for Heerema's Thialf Heavy Lift Crane Vessel (HLCV), the largest marine construction vessel in the world. Together with DSME and Heerema, KBR developed control and mitigation strategies to ensure the lifts remained within the capacity of the lift vessel without compromising the installation strategy.

Weight and center of gravity control were key factors in maintaining schedule and controlling costs. The relatively small cross section of the CPT tower tends to make the tower weight and the foundation design more sensitive to weight increases and COG shifts than conventional jacket structures. The weight and COG monthly review caused numerous relocations of the equipment and subassemblies. The project design team was able to improve the COG position significantly and control the design weight so that the platform could be fabricated and installed on schedule.

Introduction

The Benguela Belize Topsides dry weight of 33,300 s.t. makes it one of the largest topside facilities in the world. It is significantly larger than any previous topside facility installed on a compliant tower substructure (Petronius – 7,500 s.t., Baldpate – 9,800 s.t.). Key factors in successfully developing the Topsides facility were supporting the aggressive construction schedule and controlling the weight and center of gravity.

Abbreviations & Acronyms

3D CAD	3 Dimensional Computer Aided Design
AFC	Approved For Construction
BB	Benguela Belize
BOPD	Barrels of Oil Per Day
BOPWD	Barrels of Produced Water Per Day
BWD	Barrels of Water per Day
COG	Center of Gravity
CPT	Compliant Piled Tower
CVX	ChevronTexaco (now Chevron)
DSME	Daewoo Shipbuilding and Marine Engineering
DPP	Drilling and Production Platform
EPCI	Engineer, Procure, Construct, Install
FEED	Front End Engineering Design
FPSO	Floating Production, Storage, and Offloading facility
HAZOP	HAZard & OPerations safety review
HLCV	Heavy Lift Crane Vessel
ISO	ISometric
KBR	Kellog Brown & Root LLC
MSCFD	Million Standard Cubic Feet per Day
MSF	Module Support Frame
MTO	Material Take Off
NPS	Nominal Pipe Size
P&ID	Process & Instrumentation Diagram
s.t.	short ton (2,000 pounds)
SDRL	Supplier Data Requirements List
SID	Safety In Design requirements