SBM OFFSHORE

EXPERIENCE MATTERS

2016 ANNUAL REPORT

entrepreneurial and productive environment will ensure that these goals are met and SBM Offshore continues to deliver the desired results to its clients.

2.9 TECHNOLOGY

MANAGEMENT APPROACH

SBM Offshore develops its technology strategy by engaging externally with its clients and internally with the Company's Product Line divisions, to identify, understand and analyze the key technical and business trends in the offshore industry. Armed with this market-based information, it strives to predict future technology gaps and to find innovative, safe, reliable and cost-effective solutions to meet these challenges. SBM Offshore's Technology Team actively works towards this goal to ensure that the Company is well positioned for future projects in the market as clients' needs evolve.

The Company's success is driven by its reputation in the industry for being at the forefront of advanced technology, providing market-driven solutions for almost 60 years. There are many field-proven examples and world records to illustrate this, the latest – FPSO *Turritella* – is a showcase of the client's confidence in SBM Offshore's technological expertise contributing towards the exploration of new frontiers. Turritella illustrates the effectiveness of teamwork between client and subcontractor.

The Company continues to focus primarily on FPSO and mooring technology to further strengthen its position as a world leader in these areas, but is increasingly diversifying its efforts into emerging technologies associated with Floating LNG and Renewable Energies.

KPIs and Targets

The success of SBM Offshore's Technology division is measured by the quantity and quality of new designs and proprietary components delivered to TRL[18] four, which represents the fully qualified, project-ready stage. The Company sets a target on the number of new systems and components to be delivered during the year. The quality is measured by the percentage of turnover enabled by new technology.

Given the market's urgent need to reduce capital costs and SBM Offshore's strategy for affordability and improved competitiveness, the majority of the development work in 2016 focused on using technology to reduce field development costs and to increase functionality. This primary objective to reduce the cost of its core products is already giving tangible benefits and has also matured a range of new components and products through prototype testing to be market ready.

Two examples of where this has been successful in 2016 are:

- SBM Offshore's semi-submersible hull and mooring system design was selected as the client's preferred floater option to support potential future field development. SBM Offshore will continue with FEED engineering on the semi-submersible during 2017, while Anadarko continues appraisal drilling to further delineate the opportunity for future FID
- The Fast4Ward FPSO standardization project, where SBM Offshore anticipated the market needs over two years ago and now the matured concept is being marketed as offering significant cost reduction

Technology development continues to be guided by three key principles:

1. To be driven by market demand – development projects will reflect the current and future challenges faced by customers

[18] Technology Readiness Level (TRL) is an internal SBM Offshore process to ensure that the development of the Company's technologies is assessed in a controlled and consistent manner. By going through several stages – each with stringent tests and controls in place – this gateway system effectively ensures that every new technology has met the highest standards before reaching the final level (four) when it is fully qualified and mature enough to be considered for commercialization.

2. To strive to improve safety through inherently safe design and increase the Company's overall rate of return on investment through reduced costs, increased efficiency and/or improved performance
3. To retain its technology leadership position in the offshore market and continue to develop sustainable solutions

Beyond the technical challenges, there is an overall business challenge to make projects more cost effective and affordable for clients.

Key technical challenges seen in the industry today are:

- Optimization of floating production to reduce costs, by standardization of FPSO hulls and topsides processing facilities as much as possible
- Simplification of facilities to strip out unnecessary complexity to reduce costs
- Building a portfolio of cost effective gas solutions, both for floating production of LNG for import of LNG products
- Finding cost effective solutions for a clean energy future

Competitive Advantage through Technology

SBM Offshore strives to deliver high performance solutions that exceed client's expectations and go beyond what is available in the market. During 2016, revenues were generated from three main projects where technology played an important part in SBM Offshore being selected for the contract award:

- FPSO *Turritella* – where the turret mooring system is one of the most challenging ever designed and built in the industry
- *Prelude* FLNG turret – where the design mooring loads are a world record – enabled by the Company's proprietary technology
- Ichthys FPSO turret – where the high mooring loads and massive swivel stack are enabled by the Company's proprietary technology

The technology development process ensures that continued investment in each new technology is justified against business cases. In addition, since new technology can become a source of risk if not correctly managed, SBM Offshore matures its new technology through a structured stage-gate system to ensure that it is fully mature before being offered for sale or introduced into its projects. This Technology Readiness Level (TRL) process includes full scale prototype testing of new proprietary components and full FEED level definition of new systems. The TRL process was introduced in 2012 and is now well established in the Company's development program.

2016 PERFORMANCE

- Fast4Ward™ and the Renewables Wind Floater were officially launched onto the market
- Qualification was completed for a semi-submersible hull design including condensate storage within the column legs, for remote gas fields as an alternative to pipeline export of condensate
- Continued development for floating gas solutions with its innovative TwinHull™ FLNG concept, targeted at mid-scale capacities. The concept has progressed in maturity and is now being offered to clients as a very cost-effective yet robust solution for FLNG mid-scale
- The Company continues to build expertise in the Lazy Wave Steel Riser (LWSR) design as a cost effective solution for ultra deepwater and/or HPHT field and to ensure that the Company's FPU and FPSO products can be fully optimized when accommodating them. This includes on-going collaboration with the industry-led DeepStar JIP
- Continued prototype testing of a mechanical connector for steel risers, as a lower cost alternative for deploying steel risers offshore, in conjunction with SBM Offshore's partner GMC

- Completion of the SBM Offshore designed FPSO *Turritella* disconnectable turret for the Stones development
- Design of a range of new swivels for enhanced performance – construction of a prototype has started, along with fabrication of a dedicated test rig
- Development of low cost turret mooring systems for less complex projects

The key technologies that were commercialized in 2016:

FPSO Standardization

- Completion of the conceptual and basic design phases of the Company's Fast4Ward™ standardization project, which includes a range of pre-engineered standard building blocks for large and complex FPSOs. The project has now progressed to the project execution stage

A new execution model for the next generation of FPSOs by SBM Offshore.

Building on the Company's solid track record for FPSO delivery portfolio and leveraging almost 300 years of cumulative operational experience, SBM Offshore launched its Generation 4 standardized FPSO design this year.

- Establishing standard designs, leading to more framework agreements with equipment suppliers – adding to the catalogue of standard equipment
- Continuation of the evaluation and qualification of new compact technologies – included full scale prototype testing where needed – for topsides processing for FPSOs, where enhanced performance or significant cost reduction can be achieved

Offshore Renewable Energies

Whilst Oil and Gas will remain an important part of the global energy demand for many years, Renewable Energies continue to show strong and accelerating growth in the market. SBM Offshore is therefore leveraging its experience in offshore technology to seek innovative solutions for offshore renewable energies, which can be cost competitive against current alternatives. The Company has consistently been investing in marine renewable energy technology development since 2006, recognizing the need for clean energy. It continues its technology development program in this area, with two innovative projects:

- A mini Tension Leg Platform (TLP) for Floating Offshore Wind energy. This draws on our expertise in optimizing marine structures to design a high performance and low cost floating support structure for the wind turbines. The resulting mini-TLP concept was successfully model-tested in 2015 and is now being matured in collaboration with our partners. In 2016 the concept was chosen as the preferred solution by EDF Energies Nouvelles for its Provence Grand Large project, offshore France
- A revolutionary Wave Energy Converter (the S3 WEC) based on the use of Electro Active Polymer materials and associated power electronics. The Company is now ready to move into the small scale prototype at sea stage

At present the Company's main focus is on solutions for floating wind and wave energy conversion, whilst also exploring opportunities in other areas of Renewable Energy.

'Industry Firsts' of latest projects

1. FPSO *Turritella* represents :
   - The deepest oil and gas production in a world record water depth of 2,900m (9,500ft)
   - The first use of Steel Risers on a disconnectable turret
2. The Articulated Rod Connecting Arm (ARCA) technology successfully completed all development testing in 2016 and is project-ready. This is the industry's first diver-less connection and disconnection device for mooring lines in deep water. It achieved an Offshore Technology Conference award in 2015
3. The Company's Very High Pressure (VHP) swivel, which was successfully qualified at 830 barg in 2015 was re-qualified at 1000 barg this year and is now fully project ready for HPHT field development
4. The *Prelude* FLNG turret was successfully integrated into the *Prelude* FLNG in Korea. This turret will be a world record in terms of mooring loads once the FLNG is operational

Inhouse R&D testing center

During 2016 the Company moved its R&D testing center to larger premises in France. This laboratory will enable a wider range of tests to be performed and will focus both on expanding the range of proprietary mooring technology, as well as development of new products for Renewable Energies and LNG.

Technical Standards

A key driver for the costs of new projects is the set of technical standards to be applied. Typically, these can fall into three categories – client standards, contractor standards or a hybrid set of customized standards. In the current climate of severe cost pressure there is a logical push in the industry towards more acceptance of contractor standards. By leveraging its expertise SBM Offshore can minimize project customization and efficiently deliver more standard products with potentially significant cost and schedule savings.

The Company achieves this through its Group Technical Standards (GTS) – established in 2003 – by integrating key elements of its accumulated project and fleet operational experience. Whereas client standards tend to be generic, covering a range of offshore facilities, SBM Offshore's GTS are FPSO specific and optimized around that product. To date the Company has executed over 20 projects using its GTS as the basis, including the units delivered in 2016 the FPSO *Cidade de Maricá*, FPSO *Cidade de Saquarema* and FPSO *Turritella* – in these vessels GTS was supplemented by client functional specifications and additional requirements as appropriate.

The Company aims to continue to refine and develop the GTS for the benefit of future projects.

Intellectual Property

The Company maintains a significant Intellectual Property (IP) portfolio including patents, trademarks, and copyrights. Around 180 patent families cover a wide range of items including FPSO mooring and turret systems, semi-submersible and tension leg FPUs, hydrocarbon transfer and processing systems including LNG and gas processing, drilling and riser technologies and offshore installation.

During 2016, the Company divested non-core patents, made 18 new patent applications in different countries and progressed with action against several parties for infringement of SBM Offshore patents.