ABB develops industry's first portfolio of deepwater solutions

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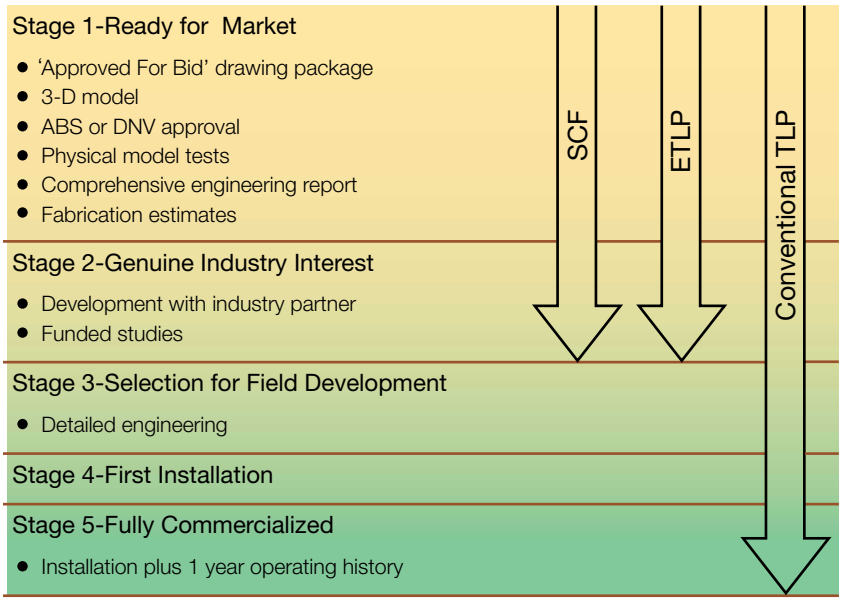
A string of new challenges is presenting itself to the offshore industry as it moves into ever-deeper waters and more remote locations. To address the problems, ABB has created a portfolio of deepwater solutions featuring two highly successful new concepts. One, the Extended Tension Leg Platform, offers a significant cost breakthrough over conventional TLPs, while the Single Column Floater is much easier to install than other, more complex types of floater. The new portfolio best matches a specific deepwater solution to a client's field development requirements.

The oil industry is moving into deeper water at an accelerated rate and the associated economic and technological challenges are formidable. Since typical deepwater developments now exceed US$1 billion, critical issues such as capital expenditure, operating expenses, time to first oil and technical risk, must be well understood and managed.

To this end, ABB Lummus Global's Deepwater Systems Division has created the industry's first deepwater solutions portfolio. The goals and expectations are three-fold:

- Develop and maintain an industry-leading portfolio of safe and viable deepwater drilling and production systems
- Provide full market coverage for strategic clients and regions
- Make available new pre-engineered technical solutions with minimum risk



1 ABB's commercialization process. Current status of ABB's deepwater hull forms

Background

History has shown that contractors tend to develop and promote specific types of deepwater concepts. ABB's new portfolio contrasts with this by providing an impartial approach to the system selection process and best matching a specific deepwater concept to a client's given field development requirements.

ABB has effectively accelerated the commercialization process of its deepwater concepts through maximum use of conventional and proven systems. This minimizes risks generally associated with less mature concepts and facilitates acceptance and implementation. The motto of ABB's deepwater concept development team is *Better – Not Different*.

To ensure that the technology needs of the deepwater industry are met, ABB depends heavily upon client interaction. Clients are routinely invited to model tests, numerous technical presentations and seminars, and jointly held workshops.

Leadership of this effort is provided by dedicated senior ABB staff with an average of over 20 years of experience.

Commercialization process

ABB's commercialization process for deepwater concepts is the most advanced in the industry. The process consists of 5 very measurable stages and is designed to minimize risks associated with new concepts. 1 illustrates the commercialization process and identifies the current status of ABB's deepwater hull forms.

Stage 1 is the most comprehensive of the five stages as it develops an 'idea' into a viable concept through technical and commercial evaluation. This stage involves extensive conceptual engineering, physical model testing, 'approval in principle' from a recognized classification agency such as ABS or DNV, construction methods, fabrication bids, and more.

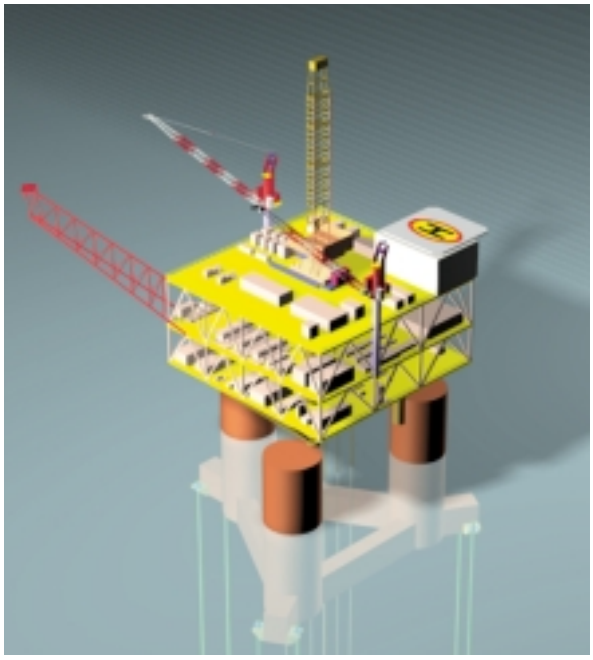
Generally, the scope of the work in Stage 1 will span one year and be completely funded by ABB. It is this commitment that allows ABB to significantly shorten the time period from concept inception to application.

ETLP

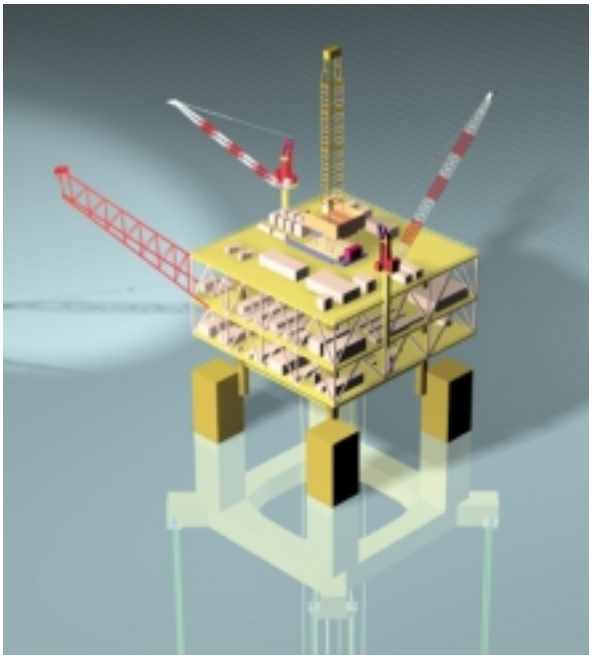
The extended base TLP (ETLP) developed by ABB is a variation of the conventional tension leg platform. It may have three or four columns 2, 3, depending upon the topsides payload, environmental design conditions and number of top tensioned risers.

The primary advantages of the ETLP are as follows:

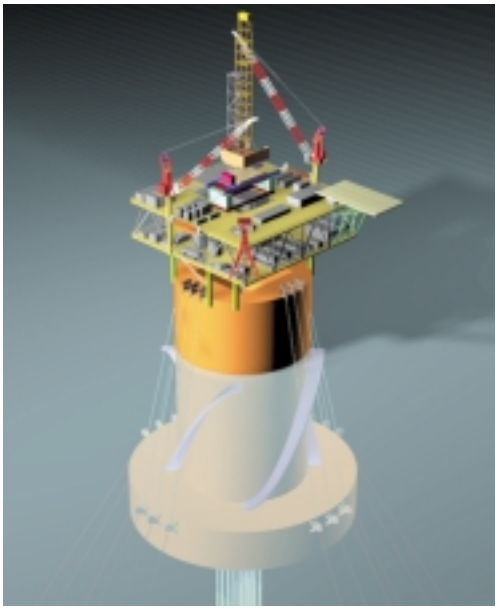
- Reduced deck structure steel weight
- Greatly improved hull weight efficiency



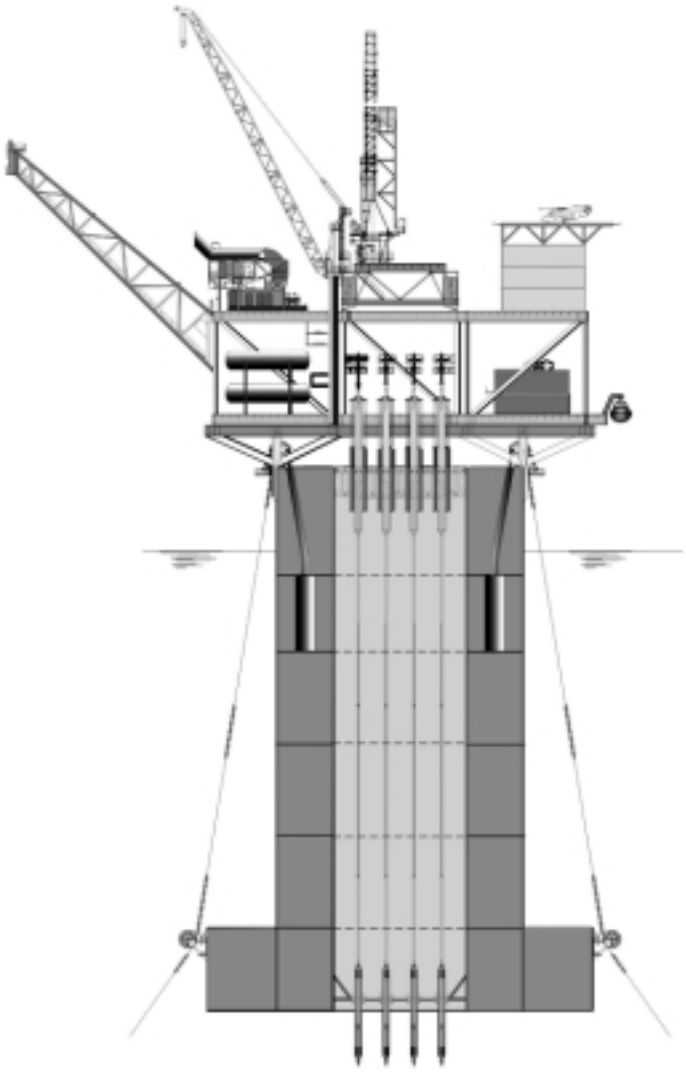
2 Extended tension leg platform with three columns. ETLPs have deck and hull weights which are 40 to 50 lighter than comparable TLPs.



3 Extended tension leg platform with four columns



4 Single column floater. Its shallower draft and extended base gives the SCF important advantages over other deepwater floater-type structures.



5 Single column floater. The SCF can be fabricated vertically as a single unit and transported directly to site. No subsequent offshore assembly is needed.

- Large moonpool, accommodating conventional top tensioned risers
- Reduced wave and current loading on the hull
- Improved tendon responses in fatigue sea states
- Enhanced flexibility through decoupling of the tendon porch horizontal separation distance from topsides deck dimensions

Significant cost savings can be realized with the ETLP. Specifically, the deck and hull steel weights of an ETLP are approximately 40 to 50 percent lighter than for a comparable conventional TLP.

SCF

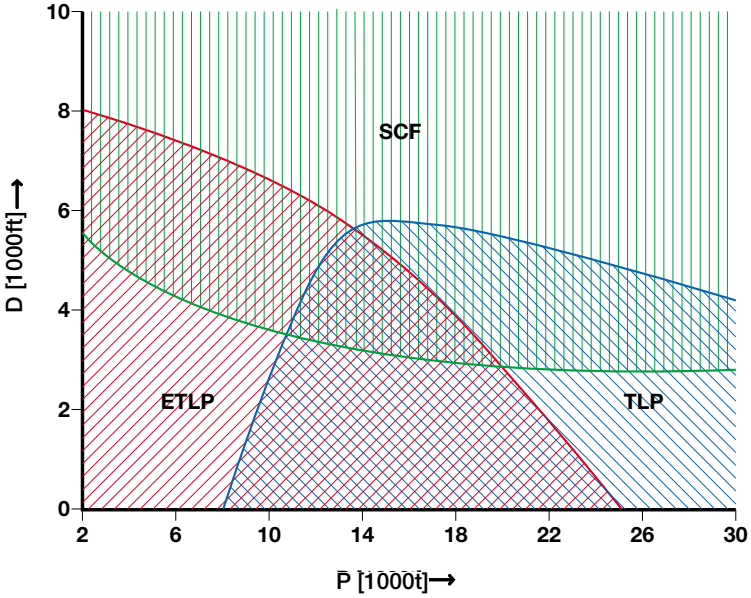
The single column floater (SCF) is a compliant, moored floater 4, 5. It differs considerably in form from other existing deepwater floater-type structures in that it has a shallower draft and extended base.

The shallow draft of the SCF is particularly significant as it reduces the total steel weight and simplifies hull construction and installation. Most notably, the SCF can be fabricated vertically as a single unit and transported directly to site. Unlike other competing concepts, it does not require any subsequent offshore assembly and does not need to be upended prior to installation. The SCF's ease of installation makes it particularly attractive for regions without an established infrastructure, such as West Africa.

A unique feature of the SCF is its ability to 'tune' the hydrodynamic motion characteristics of the platform to different topsides payloads and environmental conditions. By adjusting the relative diameters of the column and base, the SCF can easily be optimized for a particular geographic region, eg the Gulf of Mexico, and offshore West Africa and Brazil.

Deepwater platform differences

The two general forms of deepwater platforms are TLPs and floaters. When



6 ABB's deepwater application domain, here for the Gulf of Mexico

P *Payload*

D *Water depth*

TLPs and floaters are compared, it is obvious that these two types of platforms use completely different principles to suppress motion.

Tension leg platform

The mooring system of a TLP is vertically oriented and consists of tubular steel members called tendons. The tendons are highly tensioned using excess buoyancy of the platform hull. The highly tensioned tendon system limits horizontal offsets to a very small percentage of the water depth. The high tendon stiffness also reduces the system's vertical natural periods to a level well below that of the dominant wave energy. As a result, dynamic amplification of vertical motion is almost non-existent and the platform exhibits very small heave, roll and pitch motions. Essentially, the vertical motions correspond to the stretch in the tubular steel tendons. For even the largest, 75-ft (23-m) hurricane waves in the Gulf of Mexico, vertical motions of the platform are only a few inches.

Floater

Unlike the TLP, an SCF has a conventional taut-leg mooring system configuration that does not influence the wave-induced motions of the platform. The SCF has a small water plane area which limits the vertical hydrostatic restoring force, and the extended base portion of the structure contains a large amount of trapped water. The combination of the small vertical restoring force and the large effective mass keeps the vertical natural period of the SCF well above the dominant wave energy. The resulting wave-induced motions are limited to just a few feet in the design hurricane conditions.

Domain range

From an economic standpoint, the optimal 'best-for-project' selection of a deepwater hull form depends on the following parameters:

- Water depth
- Topsides payload
- Design environment

Floaters such as ABB's SCF are generally more applicable for heavier payloads in the greater water depths. Although the improved motions of a TLP-type structure are more desirable for drilling and production operations, the associated tendon mooring system costs in water depths exceeding approximately 4,500 ft become prohibitive.

Extensive analysis and evaluation has revealed the most economical application of ABB's ETLP, conventional TLP and SCF deepwater hull forms 6. This figure identifies the range of application for the Gulf of Mexico only. For other less severe design environments, such as offshore Brazil and especially West Africa, the TLP-type concepts will economically extend to deeper water and greater payloads.

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