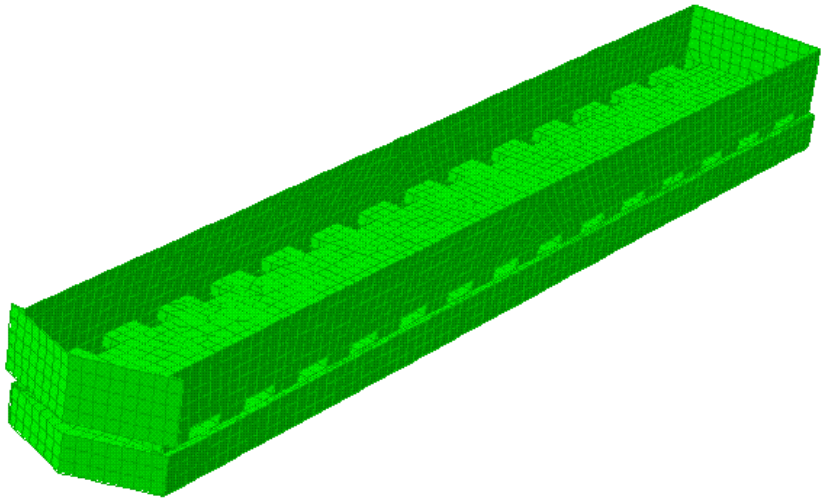
FLOATING GAS TO LIQUIDS: UNLOCKING POTENTIAL

For a number of years BPP-TECH and Worley Engineers Inc. have been working on economic solutions for stranded gas produced offshore. Now a new generation of floating production storage & offloading vessels (FPSOs) promises, at last, to make its production commercially viable.

Significant volumes of oil associated gas have, in the past, been produced offshore without a viable market or effective use nearby. Additionally, significant volumes of offshore condensate associated gas and dry gas also exist but again without a viable market. These circumstances have usually resulted in the costly re-injection of the nil-value gas, flaring (recent legislation, now prohibits most flaring) and/or a delay in the development of the entire resource.

However, the advancement of FPSO vessels offers the opportunity for using stranded gas for offshore production. In particular this relates to high value methanol and synthetic hydrocarbon products such as diesel, petrol, syn-crude and naphtha.

Using their combined production, processing and FPSO experience, Worley and BPP-TECH have focused on optimisation of both vessel and processing to develop a complete and confident solution for prime economic utilisation of offshore stranded gas.



Design drivers

The design of the WGT hull is optimised using the following key design drivers:

Storage capacity: the primary driver for the hull size and configuration is the need to store the appropriate required volumes of both methanol and oil. The unique hull form allows a large increase in storage capacity.

Stability: sizing and configuration of the hull are also driven by the need for adequate provision for ballast to maintain appropriate stability and draft through a range of loading conditions.

Motion reduction: equipment used in gas-to-liquid conversion processes can be particularly susceptible to the motions of the floating vessel in waves. In order to minimise the potential for process plant shutdown it is necessary to ensure that the motions of the vessel are kept to a minimum in the expected sea conditions.

Regulations & standards: the vessels have been designed to meet the MARPOL guidelines for FPSOs and other relevant standards for specific areas of application.

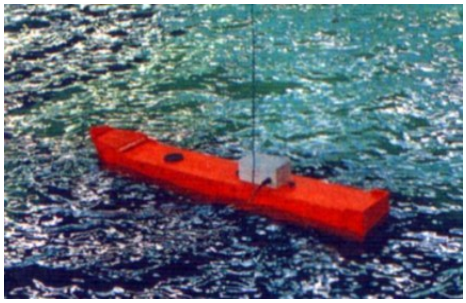
Design details

Process plant: processing plant equipment types and features are carefully selected to minimise space requirements, avoid unnecessary open flames and allow for easy operation and maintenance, including replacement of catalysts. The estimated weight and centre of gravity of the various pieces of equipment were used to establish accurate weight distribution.

Configuration: in order to provide a large deck area and minimise motions, a novel and proprietary hull design was utilised. The design consists of one hull suspended below the other using a series of connectors. The upper hull also

features motion control tanks along the beams of the platform.

Maximum dimensions: maximum conventional hull dimensions are maintained for each of the two hulls. They are designed for fabrication in dry dock or on slipways and, when desired, can be mated in protected water at sea, using conventional methods.



Design optimisation

Geometry: in order to allow for the effect of changes to the geometry to be investigated quickly and efficiently, BPP-TECH developed software tools to calculate the small angle hydrostatics of the platform throughout a range of loading conditions and also to simulate typical loading/offloading cycles. Estimates of steel weight per unit volume were used to calculate overall steel weight. This allowed the geometry to be altered in order to produce feasible designs with low steel weight, and optimised build cost.

Other outputs from the design tools include: calculations of draft; metacentric height; wind loading; structural loads and resonant periods for roll, pitch and heave. These values are calculated for all possible loading conditions.

The principal geometry is refined to produce a family of floating platforms that are capable of storing the required capacity of oil and converted liquid (methanol or other high value products).

Large angle hydrostatic analysis: the most feasible designs are then analysed further to check that each design meets the stability guidelines for the full range of loading conditions.

Hydrodynamic analysis: finally, the designs are modelled using the SESAM software suite provided by DNV. Each design is analysed to verify that it would not experience undue motions as a result of the waves in the design sea conditions at the proposed location.

Conclusions

The concept has been shown to be technically feasible and economically viable. Without a systematic method for evaluation and optimisation, it is often a complex and time consuming process to change the many variables necessary for efficient optimisation.

By using the BPP-TECH design tools it is possible to simply alter one variable and quickly confirm the effect on all aspects of the conceptual design. The design tool also allows changes to the process plant equipment to be refined and incorporated throughout the design process, allowing the latest weight and centre of gravity data to be incorporated during the later stages of design.