

Innovative Subsea Development Solution For Deepwater Egyptian Field

Scarab/Saffron Project

Working in support of the BG-operated Scarab/Saffron Subsea Development project in the West Delta Deep concession off the Mediterranean coast of Egypt, INTEC Engineering of Houston is pushing the envelope of technology to ensure the reliable operation of a long-distance tie-back of well fluids from a deepwater subsea production system to onshore processing facilities.

The concession is operated by Burullus Gas Company, a joint venture that includes Egypt's national oil company, Egyptian General Petroleum Corporation (EGPC); BG Egypt; and Edison Gas.

At 56 miles, the Scarab/Saffron subsea tie-back represents the second-longest tie-back in the world, with Shell's Mensa tie-back in the Gulf of Mexico currently holding the record at 68 miles. First gas from Scarab/Saffron is targeted for first quarter 2003.

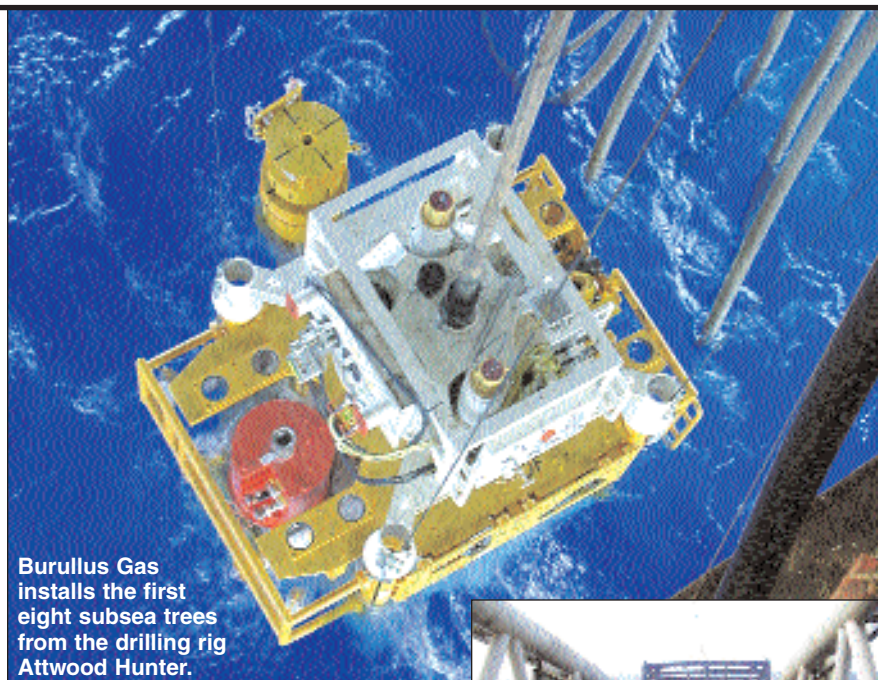
Importantly, INTEC has designed the West Delta Deep subsea pipeline and production system to accommodate the future subsea tie-in of BG's newly announced deepwater discoveries in the Simian, Sienna and Sapphire Fields, all nearby the Scarab/Saffron development.

With the tie-in of Simian/Sienna scheduled for 2005, BG and its partners will announce an industry first with a long-distance tie-back of 70 miles via a controls platform, reports Richard Scarr, BG project general manager for the Simian/Sienna development. The Sapphire Field is planned for tie-in to the West Delta Deep system in 2006.

Proven Technology

"Using proven technology and well-supported by INTEC, we're building on our experience with the Scarab/Saffron development. We plan to utilize this technology and its commercial success to expand the development scheme, with the tie-in of the Simian/Sienna Fields as our next challenge," said Scarr. The Simian/Sienna Fields will provide feedstock for Egypt's first liquefied natural gas (LNG) export facility, with a capacity of approximately 600 MMscf/d.

The vision for this endeavor, said INTEC President Willem Timmermans, rests with BG and its partners. "BG and its partners are demonstrating the value that comes from challenging conventional strategies while using proven technologies for a region with very little infrastructure or history for deepwater offshore field development," he said.



Burullus Gas installs the first eight subsea trees from the drilling rig Attwood Hunter.



A 20-inch joint of the export line is visible in the stinger of the derrick lay barge.

Risk Management

Peter Roberts, INTEC's vice president of European operations, echoed this point, explaining that from the outset, BG and its partners recognized the importance of a systems approach and have valued flow assurance as a tool in managing operational risk.

"BG and its partners are demonstrating their reliance in the ability of facility system planners to predict parameters for safe, efficient operations—under a wide range of operating conditions—based on system simulation," Roberts said.

Timmermans said the collaborative effort for the Scarab/Saffron project and the entire West Delta Deep development prospect is delivering a deepwater subsea system in frontier territory within budget and on schedule.

Industry Experience

"We've brought together a team with the demonstrated capability to understand the complexities of the West Delta Deep Subsea Development," Timmermans explained. INTEC, he added, has pioneered subsea solutions for such world-class projects as TotalFinaElf's Canyon Express, Shell's Mensa, Mariner Pluto and Chevron/Texaco's Gemini, all in the Gulf of Mexico.

Deepwater Managing Contractor

For the Scarab/Saffron project, Burullus Gas has contracted INTEC in a consortium

with Bechtel to act as the Deepwater Managing Contractor (DMC) for the complete implementation of the Scarab/Saffron development, which includes onshore and offshore activities.

INTEC's responsibility within the DMC is for the offshore portion of the project while Bechtel is responsible for overall project management and engineering of the onshore gas processing facilities. Plant construction for the onshore plant is under way near Alexandria.

Large Diameter Pipelines

The approximately \$700 million development calls for the installation of two large-diameter subsea pipelines, one 24-inch and one 36-inch, from the Scarab/Saffron development wells north of Egypt's Nile Delta, to the newly built shore facilities.

The pipeline export system, currently under construction, will have a design capacity of approximately 1,800 million standard cubic feet per day gas. For the first four years of Scarab/Saffron produc-

tion, Burullus will use only the 24-inch pipeline, bringing the 36-inch line into operation as reservoir pressures decline.

Simian/Sienna Development

Oversized for the initial Scarab/Saffron development, the pipeline system will accommodate the planned expansion of the West Delta Deep Development initially with a tie-in of the Simian/Sienna Fields. While a relatively new occurrence in subsea construction—in particular for these long distances, subsea tie-backs are expected to become more prevalent as the industry continues deepwater development.

Scarr envisions an initial six wells for development of the Simian/Sienna Fields, eventually increasing to 18 wells in water depths up to 3,600 feet. The Simian/Sienna wells will be monitored via a shallow-water controls platform, with hydrocarbons evacuated to shore via the Scarab/Saffron export pipelines.

Contracting Strategy

“We’re using deepwater subsea innovations, such as those applied in the Gulf of Mexico, and new contracting strategies to bring gas reserves to the marketplace and to increase shareholder value,” said Scarr.

For the Simian/Sienna and Sapphire developments, he said BG and its partners plan to use an EPIC—engineer, procure install and commission—strategy for the total offshore scope. For development of the onshore terminal expansion, an EPC strategy is planned. The LNG plant will be built by others.

“One of our biggest challenges for frontier projects such as these is getting a successful contracting strategy in place to manage the many companies, cultures and special talents needed to achieve the project goals. By using an integrated management team on the Simian/Sienna project, we believe we can build on the lessons learned on Scarab/Saffron,” said Scarr.

Scarr said Burullus is presently pre-qualifying companies for the Simian/Sienna EPIC contract, with invitations to bid expected to be issued this quarter.

INTEC’s Scope Of Work

Meanwhile, INTEC is completing its work on the offshore elements of the Scarab/Saffron development. As DMC, INTEC’s responsibilities have included:

- Front-end engineering design (FEED)
- Preparation of ITB documents (ITBs)
- Contract award of all service and supply subcontracts
- Management of all suppliers and contractors
- Overall project execution through commissioning and first gas

Following the development of a detailed front-end design concept and plan, INTEC recommended larger bid packages to minimize mobilization and interfaces while ensuring the best possible combination of equipment suppliers. This plan resulted in the formation of various consortiums of subcontractors to deliver equipment packages that would meet the project needs in terms of design flexibility, schedule and

cost, said Uri Nootboom, INTEC’s vice president of Offshore Projects.

“The pieces have to ‘fit together’ to ensure effective interface of subsea hardware and controls. We tried to create bid packages with sufficient design flexibility so that the best possible combination of suppliers would be able to match their equipment,” he said.

For example, this bidding strategy resulted in a successful bid from EDDC, an alliance of Cameron, the project’s supplier of subsea hardware trees, and Kvaerner, which is providing the subsea control system. In another case, INTEC separated pipe supply from the installation contract to facilitate the timely and economic purchase of large-diameter pipe under the correct market conditions. The DMC also incorporated as much local content as pos-



A pipeline barge at the port in Damietta, Egypt, loads out 10-inch pipe for the Scarab/Saffron development.

sible in developing the bid packages.

Development Scheme

The Scarab/Saffron development scheme calls for the tie-in of an initial eight subsea wells in waters up to 2,040 feet deep. With the addition of a third manifold and associated piping and umbilicals, the initial installation will handle up to 12 wells, with a maximum of 20 wells contemplated over the life of the field. Provisions for more subsea power may be required for this expansion, in addition to requisite manifolds, piping and umbilicals.

The initial wells are tied back with 10-inch in-field flowlines to the two manifolds—four wells each—in 1,360 feet of water. Two 20-inch export lines link the manifolds to a pipeline end manifold (PLEM)—where Burullus Gas will tie in the future fields—in somewhat shallower water and nearer shore. The dual large-diameter pipelines connect the PLEM to the shore facilities. Jumper spools connect the flowline and pipeline flow paths. Onshore, production is received in a limited-capacity, 5,000-barrel slug catcher before fluids are sent to the gas plant for processing.

BG and its partners anticipate a normal minimum production rate of 300 MMscf/d of gas for Scarab/Saffron, with a maximum

rate of 600 MMscf/d of gas possible to accommodate consumer demand. In addition, the system may be required to operate at an “abnormal” minimum production rate as low as 150 Mmcf/d.

Flow Assurance

This variation in production rate—together with the need to design for total system capacity and future tie-ins that are expected to triple the maximum Scarab/Saffron production rate—presented the DMC with a number of flow assurance issues for the optimum operation of a large-diameter, long-distance tie-back system emanating from a low-pressure reservoir, advised Tom Choate, INTEC’s project systems manager for Scarab/Saffron.

“Flow assurance and operability under these changing conditions are critical. We’ve met the challenge, designing a tightly integrated system that is versatile and robust, using fit-for-purpose equipment to ensure reliability and simplicity of operation,” said Choate. The flow assurance and operability design is integrated with the design and operation of the wells, the reservoir, the subsea equipment, the control system, the pipeline system and the onshore facilities.

“Our common design basis,” said Choate, “covers every aspect of the project, with effective interface between the offshore and onshore equipment, including the design, supply and installation of all equipment and pipelines.”

He explained that the range of production rates from the system—varying between 8 and 100 percent of the total system capacity—has demanded a lot of front-end planning and innovation to avoid unacceptably high transient liquid flow rates within the pipeline system.

Elements of the flow assurance strategy include effective use of hydrate inhibitors, including glycol, which the operator will inject continuously into each subsea well, and the installation of state-of-the-art production monitoring systems to accommodate the varying production rates and gas plant requirements.

Operating Strategy

“In large part, the operating strategy focuses on prevention, detection and remediation of hydrates and the control of liquid surges to avoid unnecessary gas plant disruption or downtime,” Choate said. Given the operational requirements for the Scarab/Saffron pipeline system, INTEC conducted detailed studies, including transient multiphase hydraulic models to determine the boundaries and limitations of the system’s operating envelope for the life of the field.

The boundaries, noted Steven Cochran, INTEC’s flow assurance manager on the project, include minimum operating rates, maximum ramp-up and start-up rates and maximum water content.

“Liquids management has been our biggest challenge with a lot of concern for the accumulation of liquids in the pipelines at low production rates, as dictated by consumer demand,” he said.

To address this issue, INTEC has developed ramp-up procedures to ensure that the capacity of the onshore slug catcher and liquid handling system is not exceeded. Additional procedures include the management of system shutdowns, hydrate control and complete system optimization, within the parameters of the production profile and varying gas rates.

Project Status

Manufacture of the subsea equipment and umbilicals for Scarab/Saffron is well-advanced and pipeline construction has begun, with INTEC managing detailed planning and installation of the subsea equipment and pipelines. INTEC's project management has included the supervision of approximately 20 international and in-country subcontractors and suppliers, including Stolt Offshore and Petrojet Marine Services (PMS), Egypt's national offshore installation contractor.

Stolt Offshore is subcontracted to complete the subsea installation. Stolt's derrick/lay barge "LB 200" is installing the large-diameter export lines, with Stolt's pipelay barge "Seaway Falcon" installing the in-field flowlines. Stolt's dynamically positioned (DP2) construction vessels "Seaway Explorer" and "Seaway Legend" are installing the subsea manifold and will complete pipeline burial, survey and hydrotest work.

PMS is providing support for the shallow-water portion of the project using pipelay barges "Petrojet 11" and "Petrojet 12" for the

Stolt Offshore S.A., charged with the task

Prep Work For Export Pipelines On Scarab/Saffron Development

Constructing the pipelines for the Scarab/Saffron offshore development is no easy task. Under the direction of Stolt Offshore S.A., a particularly challenging segment was recently completed where the two export lines come ashore and connect to a new gas treatment terminal being built at Idku.

Prior to the work beginning, a cofferdam was constructed that reached just over 1,300 feet out into the Mediterranean. As noted by BP Egypt, it was critical to the success of the project that two export pipelines be successfully winched onto the beach at Idku last year so that crews could complete the pipeline system this year in time to meet the planned first gas date in early 2003.

Working under a subcontract to Stolt Offshore S.A., Egyptian offshore contractor Petroleum Marine Services was charged with handling the shore approach work.

shore approach and to lay the large-diameter pipe. PMS also is installing a 300-ton manifold and has completed concrete coating of the gas export pipelines.

The Big Picture

The Scarab/Saffron project, concluded

A pipelay barge, operated by Petroleum Marine Services was anchored about a half mile offshore and a steel cable was passed along the axis of the cofferdam to the winch. Offshore, the cable was connected to a pulling head. As crews aboard the barge welded up the 40-foot joints of 24-inch concrete-coated pipe, the winch was used to pull the pipe joints off the barge and toward the beach.

The process continued until the pullhead emerged out of the cofferdam and was pulled on to the beach. The entire operation, which began in September 2001, took about eight weeks. Although the beach pull only involved only a short section of the pipe, it was a critical operation that was completed successfully. Later this year, Stolt Offshore will return with a large lay barge and pick the pipes up off the seabed and link them to the subsea production system. **P&GJ**

Timmermans, has required a lot of forward thinking: the ability to "see the big picture" in terms of the complete system—its components and interfaces—to ensure the safe, reliable operation of a gas pipeline system under varied and changing economies. **P&GJ**