Processing system ready for testing

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With technical issues resolved, recently formed company's system is poised for deepwater and marginal field plunge.

Since 1969, the offshore industry has increasingly focused attention to devising the means for deepwater and marginal field development using some form of subsea processing.

Almost twenty five years after the start of field tests in the pioneering experiments conducted by BP and CFP in subsea processing using a subsea separator and booster pump in 22m of water offshore from Abu Dhabi at the Zakum field, the moment appears to be at hand for putting a complete subsea processing system to work.

The system is known as GLASS and is now owned by Bardex Subsea Corporation, which was formed this past summer for the express purpose of bringing the system and other subsea equipment designs into product fruition and on line.

GLASS is not the only subsea design package that has been developed in the industry in recent years. However, it represents a pioneering effort born out of industry cooperation in creating an economic, practical and complete system in a readily serviceable modular from that is ready for application now, using essentially off-the-shelf equipment for the development of small, remote fields - typically in 1000-3000 ft water depths, 5-50 miles from a host platform.

GLASS builds on industry experience and was created during 1990-1992 as a joint industry project supported by Chevron, Marathon, Oryx and Unocal to address Gulf of Mexico field conditions and economic (e.g., eight wells, 12,000 b/d, 450m water depth, 25 km from a host platform). Major contractors - McDermott, Rockwater and Sonat - and suppliers provided vital practical input. Although initially conceived as the solution to tackling the smaller, more difficult reservoir conditions of the Gulf of Mexico, GLASS also responds to Brazilian, North Sea and other area requirements.

The system employs a modular concept of subsea separation equipment and single phase pumping. It is guidelineless and diverless. Although these "independence" features were felt to be necessary for Gulf of Mexico conditions, it turned out that this choice led to a fairly simple arrangement that could be serviced with existing methods and vessels. It is believed to be a simpler, less expensive approach than a diver intervention system for say 700-1,300 ft water depths.

Receiving the Special Meritorious Award for Engineering Innovation at the 1993 Offshore Technology Conference are (left to right) Korosh Bassiti, commercial director for Scottish Enterprise; Peter M. Lovie, vice president engineering for Bardex Subsea Corporation; and T.V.N. (Vic) Tuft, engineering manager for Enterprise Oil Limited.

Depending on the distance from the host platform, recovery costs on a GLASS installation are estimated by Bardex Subsea to be in the region of $4 to $5 bbl, not including oil company internal charge such as overhead and insurance. (Figure 1) Total recovery is computed as 31.7m barrels compared to 25m barrels anticipated with surface completions.

The system is relatively insensitive to water depth; i.e., the subsea installation would be almost identical from 1000 to 3000 ft water depths. Deeper water depths may affect the installation methods, although the fundamental separation and pumping principles often work even better at great water depths. The system focuses on typical fractured reservoir field conditions found in the US Gulf of Mexico where production rates are relatively low and sanding and hydrates are among the difficulties encountered. Water depths encountered in the Gulf are deeper than would be in the North Sea (latter depths were the targets of such systems as GA-SP and the subsea separation experiments conducted by Hamilton Brothers using the BOET separator design).

From the outset, the design philosophy that went into the development of GLASS was market-driven and more "traditional oilpatch" with emphasis placed on avoiding the use of high tech solutions and choosing instead more proven and simple techniques.

For example, as mentioned earlier, GLASS employs single phase pumping. An examination was made of the use of multiphase pumping for the field conditions specified by the oil company participants in the Gulf of Mexico GLASS project. It was determined that available multiphase pumps might perform at gas/oil ratios of up to roughly 400 scf/bbl, but not at the 1000 or greater values typical of the Gulf of Mexico. Secondly, even if a suitable multiphase pump could be found, the power requirement would be 1-2MW; i.e., about twenty times the 50-100 KW needed for liquids-only pumping in GLASS. While 50-100 KW might often be available at existing platforms, 1-2 MW was not and would likely require a new platform! Finally, multiphase pumps with reliable subsea service were believed to be years away (they still are not available).

In contrast to alternate subsea separation developments, GLASS has avoided the use of a single complex package, opting instead for a number of easily retrievable modules. Unlike some competing designs, it does not use compression equipment subsea (which assures simplicity and reduces technology risks). GLASS also uses a system

Table 1: Summary History of Subsea Processing

Project:	ZAKUM	GA-SP	HAMILTON BROTHERS	GLASS
Location:	Abu Dhabi	UK	North Sea	USA
Scope:	Field prototype system test	Engineering dev., prototype system test in dry dock	Separator prototype test offshore	Engineering development input from operators and contractors
Engineers:	BP & CFP	Goodfellow	BOET	Bardex Subsea Corporation
When:	1969-1972	1986-1990	1986-1989	1990-1992
Water depth, ft:	72	984	248	1,500
No. of wells:	1	4	1	8
Production, bopd:	4,658	30,000	5,000	12,000
Gas oil ratio scf/bbl:	Unknown	500	400	1,000
Configuration:	Skid mounted modules on sea floor	3 levels: 14 primary modules 4 longl. modules 1 trans. module	1 skid mounted separator module	2 levels: 10 primary modules 1 secondary module
Recovery, MMBBL:	Actual 1.7 over 12 months 1 live well	Calculated 76.0 over 10 years 4 wells	Actual 3 months 1 live well	Calculated 31.7 over 12 years (8 wells)

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approach that is applicable over a wide range of distances from the host platform and in water depths.

In another example of GLASS being based on proven technology, Bardex Subsea Corporation has signed a license agreement to offer engineering and manufacture of a valved multiported connector (VMC). The VMC is a result of a UK development and prototype testing program started in 1987. The VMC is used to connect multiple lines simply so that the GLASS modules can be easily removed and replaced.

With the successful development of GLASS now a reality, the commitment for an offshore trial is being actively pursued. Given the adverse economic climate in the US offshore industry, it is more likely that the commitment will come from a European source, and perhaps in the next 6 to 24 months. ■