Operators and contractors are experiencing new challenges in developing deepwater fields. The challenges that must be addressed to ensure the success of the development involve areas of safety, environment, concept design, cost, flow assurance and equipment reliability. Today's deepwater completions must maximize ultimate recovery for projects to be economically viable. Newly discovered deepwater reservoirs are capable of high flow rates, and the wells must be designed accordingly. The cost and inaccessibility of deepwater wells also require the industry to rely heavily on new technology to optimize the capital expenses on projects.

Completion design and equipment reliability are critical to the success of a development. While new technology is essential, there are risks in using technology that has not been rigorously tested for reliability. Reliability problems during the life of a well show up in the form of reentry and workovers, which must be minimized to achieve project economics. Problems may result in formation damage, lost reserves, safety and environmental exposure.

Typically, deepwater completions are characterized as either dry tree or wet tree (subsea well). Dry-tree concepts include completions from tension leg platforms (TLPs), compliant towers and spars. These completions are similar to conventional platform completions and allow wireline access during the producing life of the well to be incorporated into the design philosophy. Deepwater dry-tree completions are designed for higher rate producibility.

Wet-tree concepts, or subsea completions, are typically more complex than conventional platform completions and normally include provisions for hydrate inhibition, pressure and temperature monitoring and possibly even new "intelligent" hardware for flow control in a multizone completion. Wireline access during the producing life of the well is typically not included in the design.

For wells in which wireline logging will not be feasible, such as subsea completions, installing permanent downhole pressure, temperature and flow-monitoring equipment allows producers to anticipate or avert problems. The intelligent completions can provide economic benefits along with the ability to remotely control different producing horizons, but at present offer an unknown risk in equipment reliability. Timely interventions or adjustments of completion equipment, such as flow-control devices will improve reservoir drainage and ultimate recovery. Reliability of permanent monitoring equipment has improved steadily during the past decade, making the technology more attractive for deepwater and subsea applications, where reliability is paramount.

Maintaining a clean environment challenges the industry to control air emission and pollution during well cleanup operations. Subsea completions normally require a period of flowback on the rig through portable test equipment in order to ensure producibility. This flow test will assist the engineer in validating the completion. Emission control during flow testing is a concern for our industry; the burning of liquids and flaring or venting of gas is controlled by the regulatory bodies of most oil-producing countries. Operators and contractors are working together to provide new technology and procedures to overcome these concerns.

The abandonment of a deepwater field challenges a company's ability to control expenses and liability. More conventional techniques are used for abandoning dry-tree type completions, but tubing retrieval and abandonment of subsea completions require the same specialized equipment used for initial installation at a very high cost. Advances in new technology and techniques should provide the industry with cost- and risk-reduction opportunities for deepwater field abandonments.

The technology, concept design and the complexity of deepwater operations have changed dramatically in the last five years. To sustain the growth of deepwater operations, the industry will be continually challenged to make new advances. It is in the interests of both operator and service industry to provide solutions to the technical challenges we will face.

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