Interval-Control Valve Meets Deepwater, HP/HT Needs

As operators push into new, more demanding environments in the search for hydrocarbons, technology providers have stepped up efforts to design downhole equipment to meet the challenges. Nowhere is this scenario more evident than in deepwater settings at depths beyond 7,500 ft, where pressures and temperatures can be extremely high and often render completion equipment ineffective.

A durable interval-control valve (ICV), designed especially for deepwater and high-pressure/high-temperature (HP/HT) conditions, has been developed recently by WellDynamics (a Halliburton company) as a key addition to the company's suite of intelligent-completion technologies. A core component of an intelligent-completion system, an ICV enables the control of well inflow or injection downhole, at the reservoir, without physical intervention. Operators, by this means, are able to optimize production and improve recovery **(Fig. 1).**

The inaugural installation of the valve, called the HS-ICV, was recently in progress at the StatoilHydro Snorre B complex and slated for completion while *JPT* was at the press. Additional installations are planned at the operator's Gøya and Tyrihans assets. StatoilHydro has been closely involved in the design and qualification of the new ICV.

A 15,000-psi version of this ICV, designed specifically to meet HP/HT needs in the Gulf of Mexico, is now being developed for a major operator. Currently, valve development is in the prototype stage, with qualification testing slated to conclude by mid-2009.

ICV Design and Operation

The ICV technology was developed with three goals in mind.

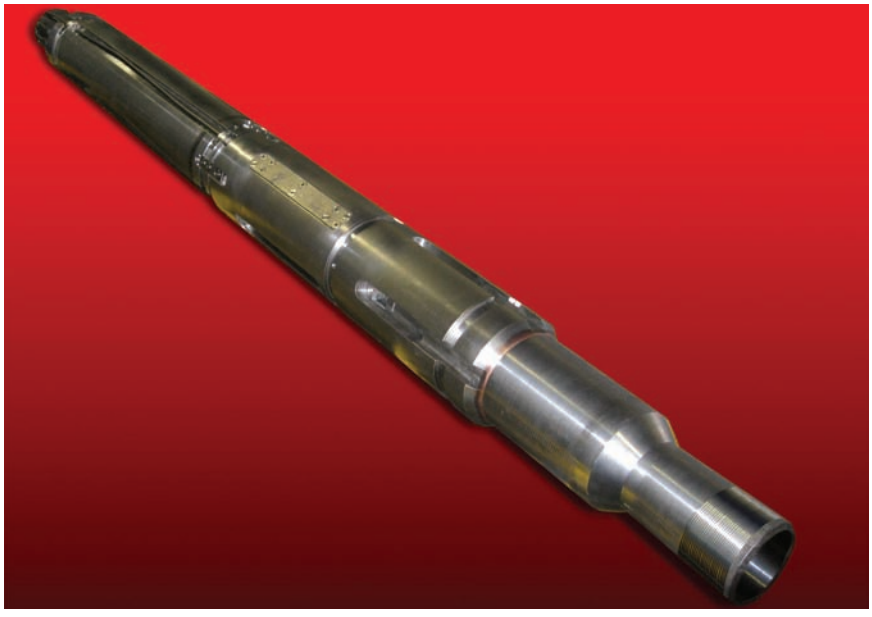

Fig. 1—A newly developed ICV, designed for deepwater and HP/HT conditions, enables advanced reservoir management by means of the tool's discrete-positioning choke trim and optional position sensors.

- Reliable performance in HP/HT conditions, encompassing temperatures up to 330°F and pressures up to 15,000 psi
- Compatibility with existing downhole-control and incremental-positioning systems
- Enablement of closed-loop reservoir optimization

The ICV is actuated hydraulically and operated remotely from the surface by means of downhole-control-system technology. The valve design incorporates optional position sensors that, in conjunction with permanent monitoring systems, provide real-time feedback on the valve position.

The ICV also has been designed optimally to allow bypass of multiple hydraulic- or electric-control lines, without compromising the valve rating, and thus enables smooth, reliable ICV installation in complex, multizone applications where there are multiple control lines.

Metal-to-Metal Sealing

A key design feature of the ICV is a proprietary, debris-tolerant, metal-to-metal seal, which enables the valve to unload at differential pressures of up to 5,000 psi. The sealing system enables life-of-well performance in the most demanding environments and features a secondary thermoplastic wiper/seal, which eliminates the potential for seal damage caused by downhole debris. The sealing arrangement has been rigorously tested and qualified at low and high (15,000-psi) static pressure differentials, providing the basis for developing future, high-pressure versions of the valve.

The ICV features a pressure-balanced valve mandrel that eliminates the need for a closing-latch mechanism and thereby enables significant tool-length reduction, compared with previous designs. The valve mandrel design also incorporates a shift profile that enables the sleeve to be

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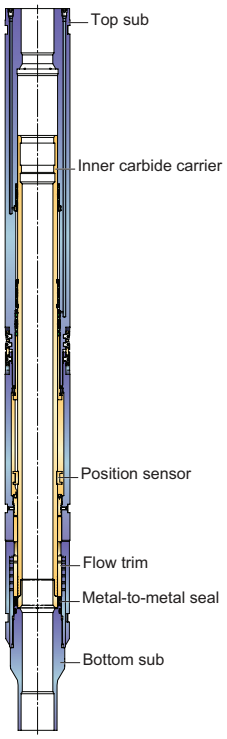


Fig. 2—A cross-section view of the new ICV is shown.

shifted mechanically, should the flow of hydraulic power be compromised.

The hydraulic chamber of the ICV houses premium, thermoplastic seals, designed to operate under high actuation pressures and over a wide temperature range (40–330°F). These seals have superior chemical compatibility and high-temperature performance capability. The seal design provides seal redundancy and sealing integrity, thereby minimizing the possibility of catastrophic failure.

Shrouded Configuration

A shrouded configuration of the ICV is available, primarily for dual-zone, stacked gravel-pack applications. The shroud can be equipped with a shrink-fit carbide insert that prevents erosion damage in injection applications. In nonshrouded injections, the valve can be fitted with a carbide-lined deflector to divert fluid flow from the walls of the casing. In both applications, the ICV assembly is designed so that the flow area around the valve is maximized and equal to or greater than the tubing flow area.

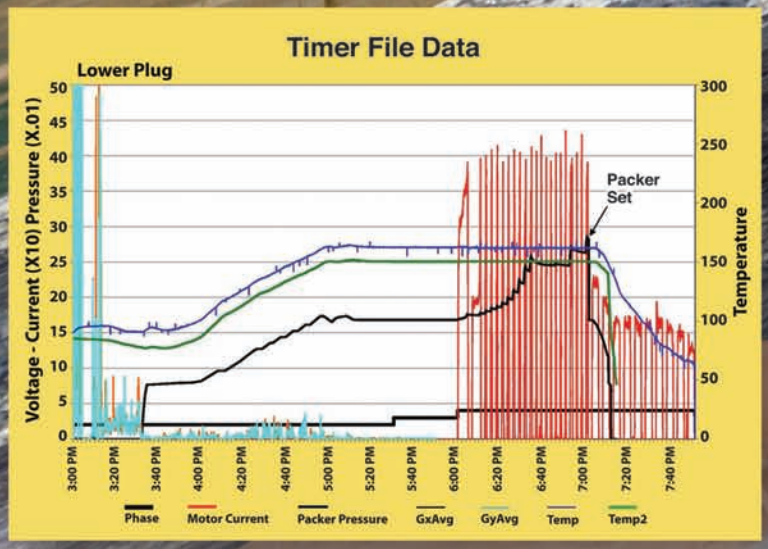
Choking Applications

The ICV is suitable for both on/off intervention avoidance and more versatile choking applications. For the choking application, the ICV is fitted with a multiposition flow trim that can be customized to ensure that the degree of control matches reservoir-management requirements.

Optional dual onboard position sensors track the movement of the flow trim. These position sensors provide real-time feedback to confirm the fulfillment of remotely actuated valve commands. In combination with a surface-positioning downhole-control system, the ICV choke trim can be positioned quickly and accurately without the need for complex downhole hardware **(Fig. 2).**

The combination of the ICV with permanent downhole-gauge technology enables operators to measure downhole conditions, adjust well inflow or injection, and optimize reservoir performance through a closed-loop system in highly demanding oilfield environments. **JPT**

Information provided by WellDynamics.



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