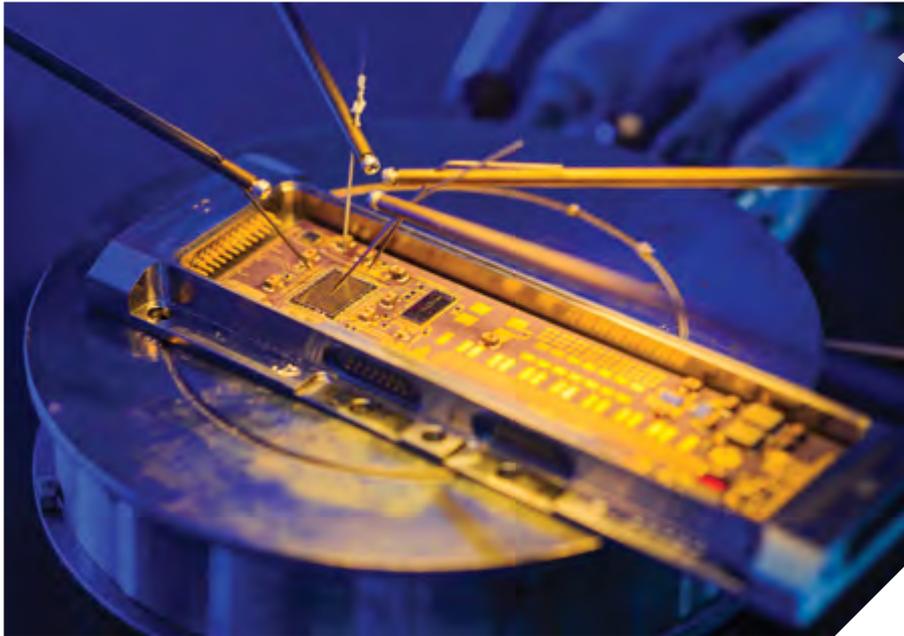


# High-temperature target

Jerry Lee examines how Schlumberger's PowerDrive ICE ultraHT RSS enabled Pemex to drill a high temperature well in Mexico's shallow Sureste Basin.



The proprietary electronics in the PowerDrive ICE and TeleScope ICE services have been verified to 200°C (392°F) and 2 million shocks for 35,000 hours. Images from Schlumberger.

complex J-shaped profile with a curve that inclined to 25° in the 8.5in hole section.

To achieve this profile, Pemex required a rotary steerable system (RSS) with precise inclination control to drill the curve. Challenging the well plan further, this system also needed the ability to operate in heavy weight mud and in a high-temperature (HT) environment – 338°F above the 8.5in section and expected to exceed 356°F, which is above the 350°F rating of most HT-rated RSSs.

To drill this HT exploration well, Pemex required a RSS-rated above 350°F in order to reliably control the direction of the drillbit while operating

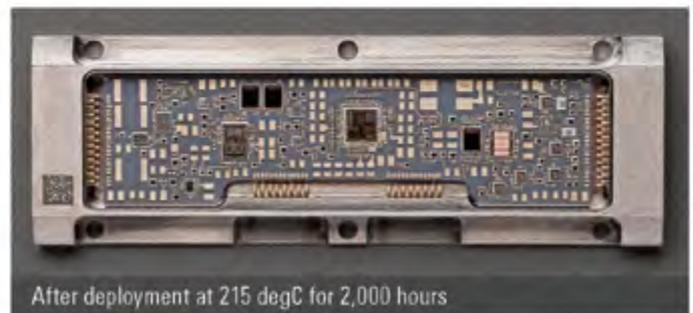
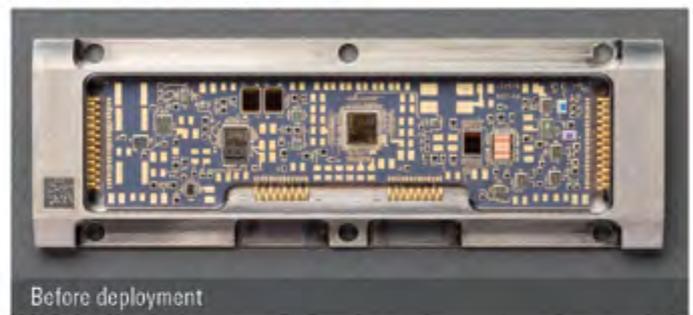
Exploring for hydrocarbons offshore Mexico, Pemex planned to drill an exploratory well targeting a high-pressure, high-temperature

(HPHT) reservoir in the shallow waters of the Sureste Basin. To reach their reservoir objective, Pemex engineers developed a well plan that required a

## Non-HT-rated electronic board



## UltraHT-rated multichip module



Left: The non-HT-rated electronic board failed after being exposed to 188°C (370°F) for approximately 6 hours. Right: The ultraHT-rated multichip module, however, has full functionality after being tested to 215°C (419°F) for 2000 hours.

in a HT environment. If a RSS rated below 350°F were selected instead, the risk of an electrical component failing under HT conditions increases and would result in the loss of directional control. With Pemex's well plan demanding a sharp inclination to reach the objective, this could be problematic.

Pemex found their solution in Schlumberger's PowerDrive ICE ultraHT RSS, which is a fully rotating system with ruggedized electronics that expands the RSS's operating window to 392°F and 30,000psi. As a result, Pemex had the ability to reliably maintain control of the direction of the drillbit while operating in the HPHT environment. Furthermore, the PowerDrive ICE ultraHT RSS used metal-to-metal seals, enabling the system to function in heavy weight mud, which was called for in the well plan.

In addition to having the ability to control the direction of the drill bit, the driller needs to know where the well is being drilled and in what direction. Traditionally, this is done by running a wireline with logging tools to survey the well, which would determine where the well has been drilled and orientation of the well. Each survey then would require pipe to be tripped multiple times and for sections of the well to be drilled in order for the survey to see if the well is on target or if corrections need to be made, all while rig time accumulates.

However, with the precise inclination control needed to follow the complex well profile, real-time directional data delivery was required. As a result, Pemex equipped the bottomhole assembly (BHA) with Schlumberger's arcVISION array resistivity compensated service and TeleScope service. The arcVISION service provided the driller with gamma ray, inclination and annular pressure-while-drilling data, and TeleScope provided high-speed telemetry-while-drilling. With these two services, the real-time directional data, needed for the driller to follow the complex will profile, was provided.

Using this BHA, which included a SHARC bit from Schlumberger's

Smith Bits, Pemex drilled the 8.5in hole section of the well, building the inclination of the curve from 17.5° to 26.3°. A tangent to the curve was then drilled and maintained till the end of the run, resulting in a dogleg severity of 2.94°/30m. For 304 hours, the PowerDrive ICE ultraHT RSS operated reliably in temperatures ranging from 338°F to 358°F and in mud weights up to 17ppg.

The combination of the arcVISION and TeleScope services with the PowerDrive ICE ultraHT RSS enabled the precise inclination control the driller needed to drill the curve in a HT environment, make corrections on-the-fly, and outperform the directional plan.

Due to the success the system achieved, Pemex would see the PowerDrive ICE ultraHT RSS used as the standard for the exploration wells that followed and targeted the HT reservoir. **OE**