ICE Technologies

Thriving in Ultra HT Drilling Operations

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Product Champion

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THE HT CHALLENGE

SENSORS:
D&I, GR, APWD

ELECTRONICS

ELASTOMER

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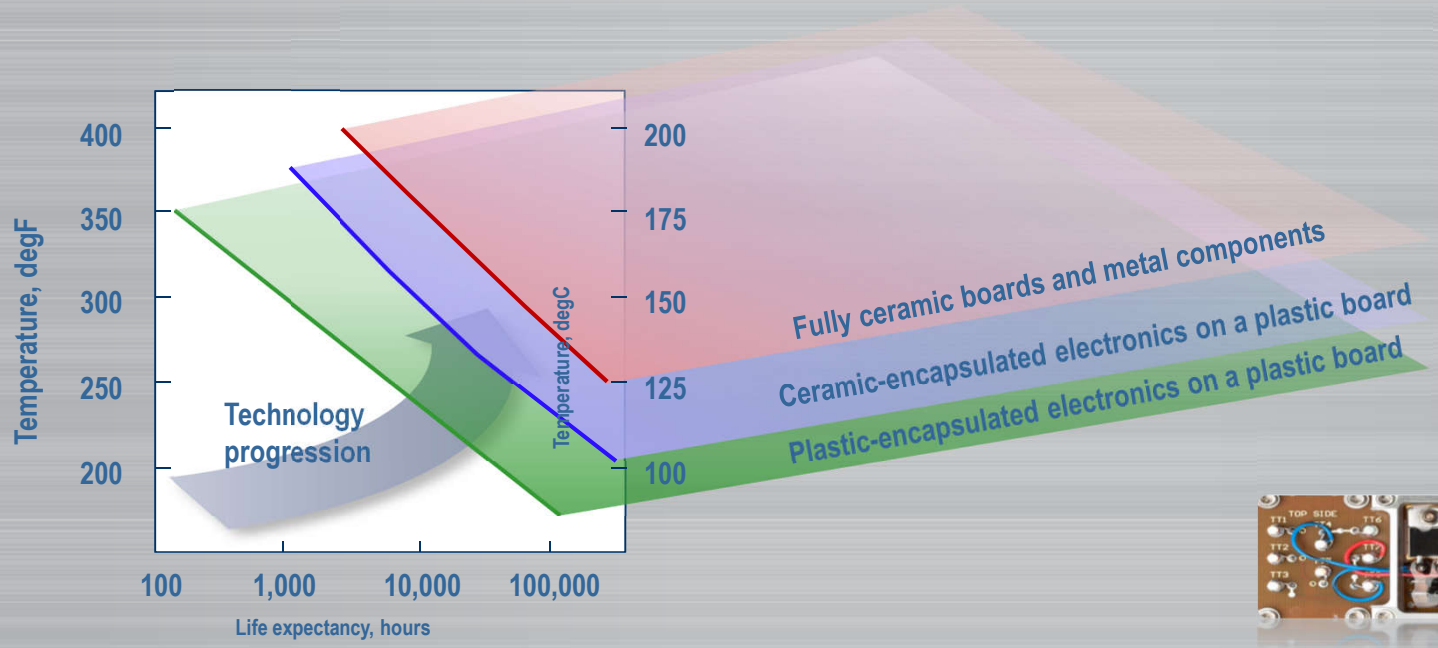
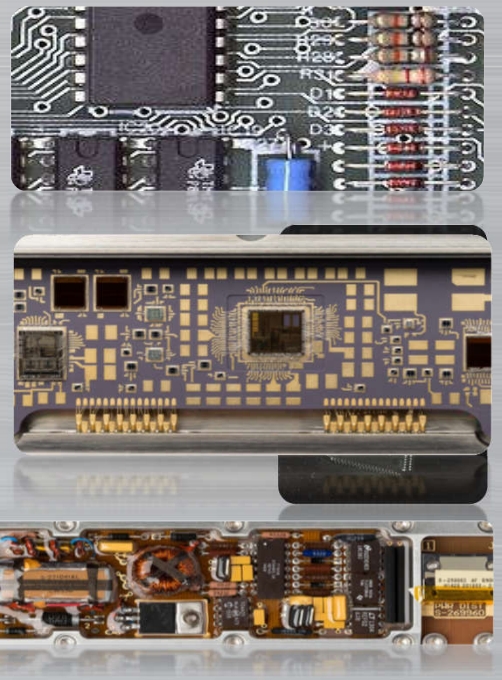
UltraHT Challenge





Proprietary and patented ceramic multichip module (MCM) technology

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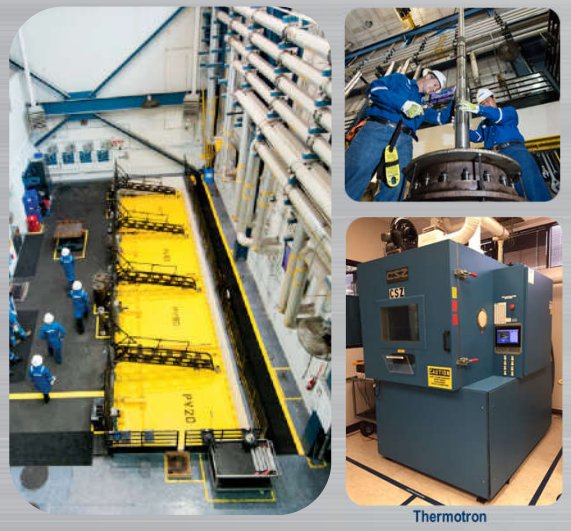
Ensuring Durability in Extreme Downhole Conditions

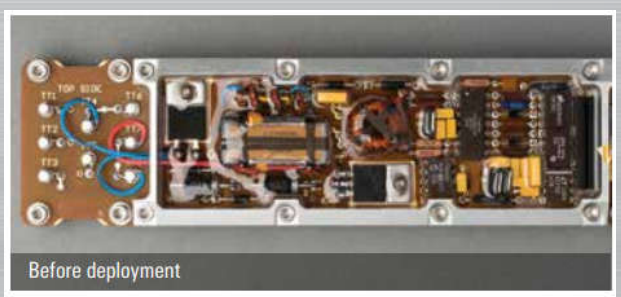
Six vessels capable of testing up to 40,000 psi and 315 degC

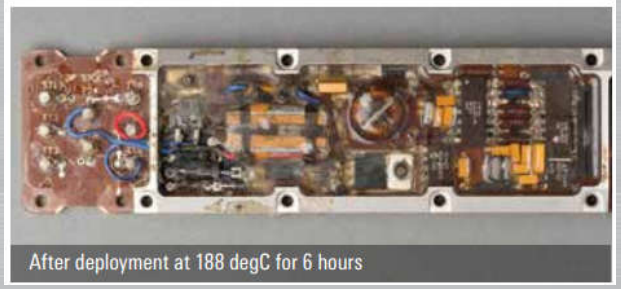


Environmental qualification and testing

- HASS / HALT / ATV testing
- Hot shock / vibration / humidity
- Thermal cycling

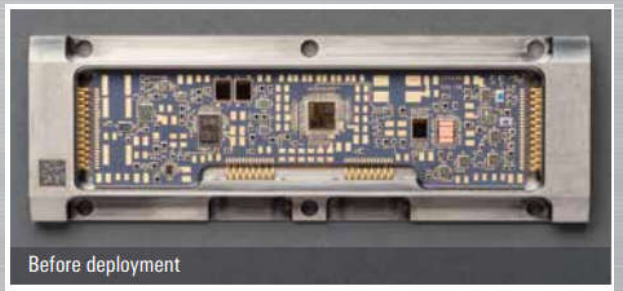
NonHT-rated Electronic Board

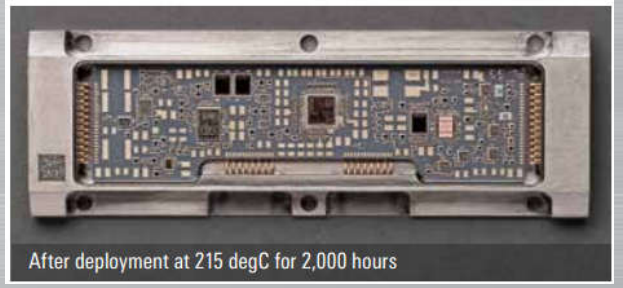




Conventional technologies

UltraHT-rated MCM





ICE services technology

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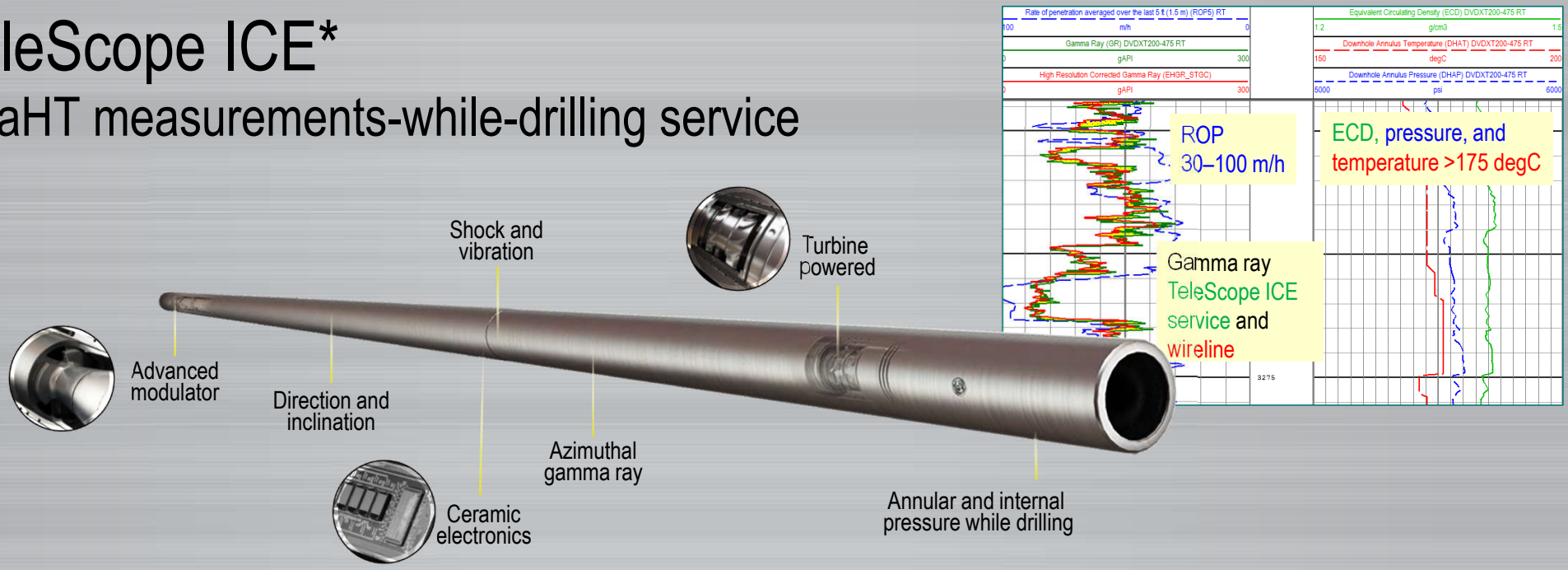
TeleScope ICE*

ultraHT measurements-while-drilling service



UltraHT BHA Platform

- Enabler for RSS and logging-while-drilling BHA
- Reliable operation independent of temperature
- Smart tool diagnostics for high reliability

Measurements

- Continuous and static surveys; toolface
- Internal and annular pressure
- Azimuthal natural gamma ray
- Shock and vibration
- Temperature

High-Speed Data Transmission

- Physical bit rates up to 6 bits/s
- Wide telemetry range
- Customizable configurations
- Fast downlink

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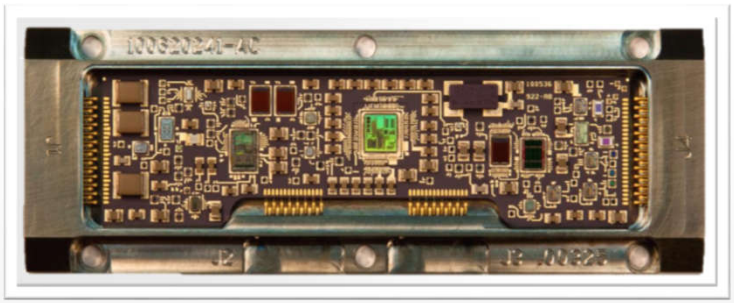
PowerDrive ICE*

ultraHT measurements-while-drilling service

The most durable RSS in HT environments up to 200 degC.

- Proprietary ultraHT electronics—substrate and MCM technology hermetically sealed in inert gas
- Innovative actuation design with metal-to-metal seals



Ruggedized fully rotating system for extreme downhole conditions

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ICE Services UltraHT BHA Features

All the benefits of the fully rotating PowerDrive* rotary steerable systems at 200 degC.

- Complex 3D trajectories
- Automated closed loops
- Reduced risk of stuck pipe
- Accurate well placement
- Enhanced hole quality

All the benefits of high-tech real-time decision making at 200 degC.

- High-speed telemetry: high-resolution formation evaluation data
- Annular pressure measurements
- Downhole drilling dynamics
- Well placement: geosteering/geostopping

The drilling BHA for HT and ultraHT reservoirs—
Maximum performance and superior reliability >175 degC

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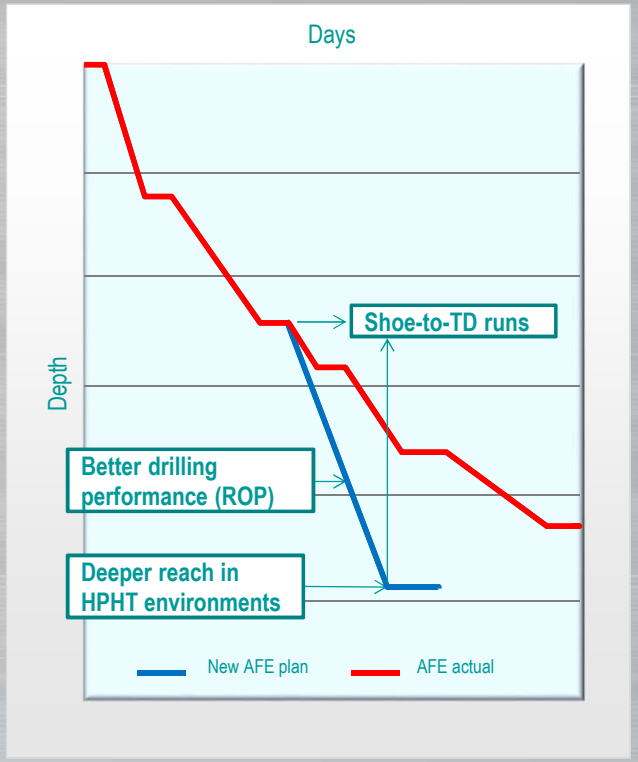
ICE UltraHT Services BHA Benefits

Fit-for-purpose ultraHT technology to **plan and drill ultraHT wells conventionally.**

- **Time saving**—eliminate planned trips due to technology limitation
- **Higher performance**—avoid special operating procedures in HT environments such as staging and additional off-bottom circulation



Reduce well construction costs in the HT and ultraHT frontier

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TeleScope ICE UltraHT MWD Service

PTTEP Saves 12 Hours of Rig Time and Enables Leaner Workflow

Challenge

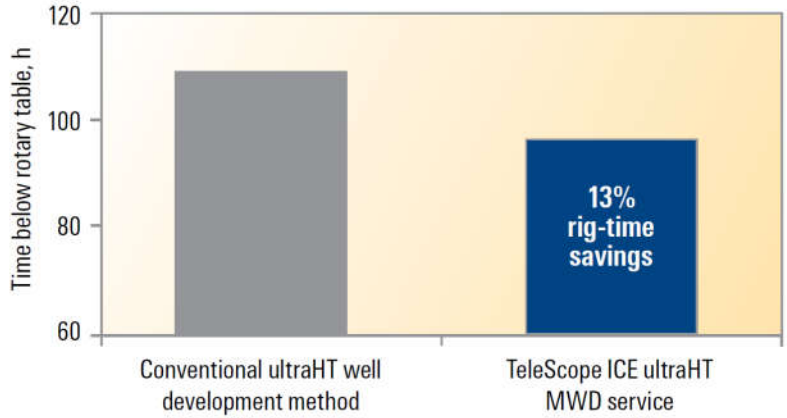
- Drill a deviated wellbore to reach a reservoir with a static temperature above 200 degC in one run using real-time survey and formation evaluation data.

Solution

- Use TeleScope ICE service to place well, minimize collision risk, and eliminate time and cost of using special operating procedures.

Results

- Optimally placed the wellbore in one run despite the static temperature reaching 204 degC.
- Eliminated additional BHA and gyro run, saving USD 300,000 in operating costs.
- Accessed new reservoirs by drilling 300 to 400 m deeper.



The TeleScope ICE service enabled PTTEP to eliminate a BHA and gyro trip in the 6⅛-in section, saving 12 hours.

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PowerDrive ICE UltraHT RSS

PEMEX Improves Trajectory and Saves 9 Days with UltraHT RSS

Challenge

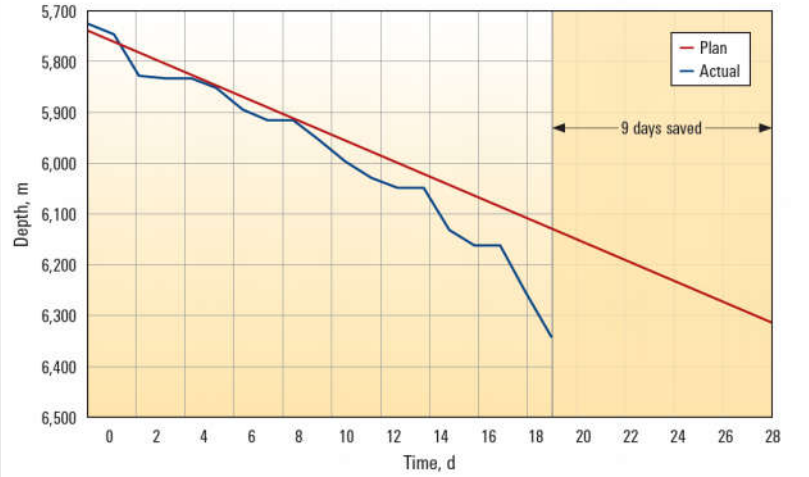
- PEMEX needed precise trajectory control of 8½-in tangent section a shallow-water Gulf of Mexico reservoir with temperatures exceeding 165 degC [329 degF] and pressures greater than 15,000 psi.

Solution

- Use the PowerDrive ICE RSS to steer the wellbore to target while withstanding the high temperatures and pressures of the field.

Results

- Successfully steered the well to target with an ROP increase of 16% compared with the previous ROP record in the field.
- Saved 9 days of rig time and USD 1.35 million.



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UltraHTHP Drilling Services

TeleScope ICE UltraHT MWD Service
PowerDrive ICE UltraHT Rotary Steerable System

- Form the first BHA specifically designed to operate at 200 degC
- Bring the benefits of fit-for-purpose solutions pursuing the best drilling performance in UltraHTHP frontier environments
- Rationalize operations with new technology-enabled workflow
- Geosteer and position wellbore precisely
- Save rig time and minimize well construction costs in ultraHT frontier environments

Thrive, not survive.

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