Baker Hughes

Center for Technology Innovation (CTI)

Advanced research and development capabilities

CTI CAPABILITIES

As you extend your operations to ultradeep waters and extreme downhole pressures and temperatures, an increased tempo of technology innovation is critical to success. No one knows this better than Baker Hughes.

For more than a century, we have aggressively invested in the research and development of new oil and gas technologies to meet your most difficult challenges. This is why Baker Hughes has remained on the leading edge of energy technologies.

Our Center for Technology Innovation (CTI) provides advanced research and development capabilities which support our commitment to delivering oilfield solutions that increase productivity, lower operational risks, and save you money.

Developing enhanced technologies through state-of-the-art research and engineering

Advancing technology through a synergistic environment

Our 209,000-square-foot research and engineering facility, located within a 14-acre campus in northwest Houston, accelerates the development of Baker Hughes completion and production technologies by providing a synergistic, collaborative environment. Approximately 150 scientists, engineers, and technicians conduct research, engineering, development, and testing at the CTI. Cross-product line collaboration at CTI results in more integrated and optimized systems for a wide range of applications.

Focusing on the toughest technical challenges

Baker Hughes advanced research and engineering at the CTI focuses on the industry's toughest challenges: extreme high-pressure/high-temperature (xHP/HT), deepwater, production optimization, and big-bore completions. The CTI features xHP/HT test cells, research labs for metallurgy, composites, elastomers, nanotechnology, fluids, electronics, visualization centers, and rapid-prototyping capabilities that allow our expert staff to take new ideas from concept to production with new levels of accuracy and efficiency.

Testing to a higher standard

The testing completed at CTI is done according to the latest industry standards such as the American Petroleum Institute (API), the International Organization for Standardization (ISO), or customer specific testing requirements.

Providing accurate downhole environments in world-class testing facilities

High-bay test cells

Four dynamic in-ground test cells rated to 40,000 psi (2758 bar) gas at 700°F (371°C), qualify tools and systems for extreme operating environments. This is the world's highest pressure and temperature capability for full-scale testing of downhole tools. The test cells consist of 75 ft (21.3 m) towers, intended for easy manipulation of 40 ft (12.2 m) joints of large OD casing into and out of the test bay.

Horizontal test cells

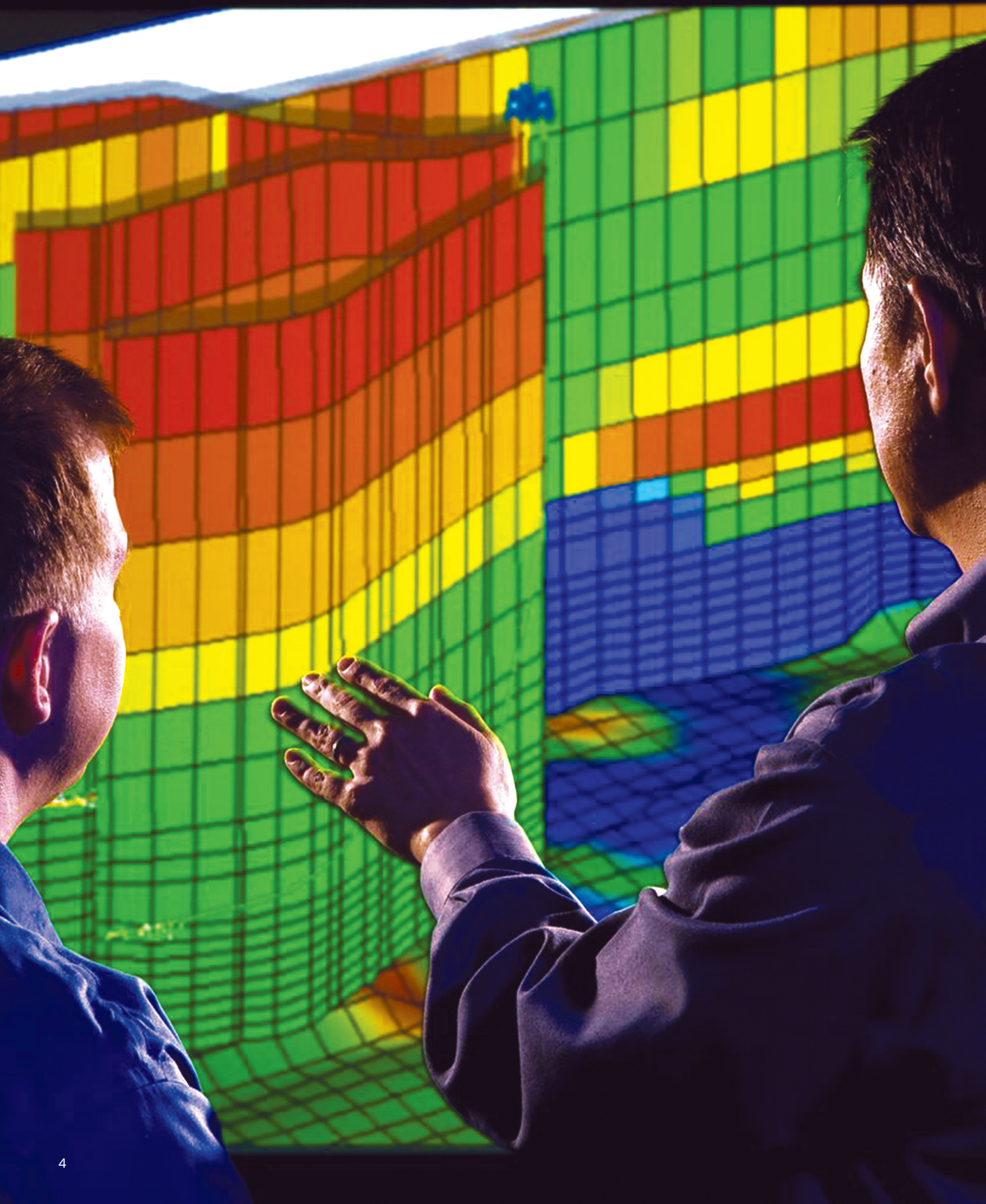
Two 40 ft (12.2 m) cells rated to 15,000 psi (1034 bar) gas at 550°F (288°C) accommodate above-ground testing. Two 20 ft (6.1 m) cells rated to 30,000 psi (2068 bar) gas at 550°F (288°C) are also above ground. These are intended for long-term HP/HT exposure and reliability testing.

HP/HT in-situ thermomechanical test cell

This cell contains three HP/HT in-situ thermomechanical systems to perform standard and custom material tests in simulated fluid and gas environments at 450°F (232°C) and 10,000 psi (670 bar) simultaneously. These systems have proven useful for HP/HT hot-wet mechanical characterizations of various high-temperature polymers, composites, and other downhole materials.

Multilateral and expandables testing

A 200 ft (61 m) horizontal cell with a hydraulic pusher is used for dynamic expansion research. This test cell is capable of applying up to 1.4 million lbf while traveling with 21 ft (6.4 m) of continuous stroke.



Focusing testing capabilities on your biggest challenges

The CTI campus contains more than 30,000 square feet of dedicated research lab space and state-of-the-art apparatus, such as inductively coupled plasma elemental analysis, X-ray fluorescence elemental analysis, X-ray diffraction compound analysis, and laser diffraction particle size analysis used in research and development of new fluids, elastomers, and materials. A scanning electron microscope with sub-3 nanometer resolution is one of the tools available to researchers for development of nanotechnology.

Metallurgy

Metallurgy, welding, and corrosion scientists investigate the limits of metals, surface treatments, welds, and more to extend the performance of next-generation tools. This group also evaluates the suitability of different metals for hostile environments.

Composites

Metallurgy, welding, and corrosion scientists investigate the limits of metals, surface treatments, welds, and more to extend the performance of next-generation tools. This group also evaluates the suitability of different metals for hostile environments.

Elastomers

Polymer scientists formulate and develop advanced material and formulation technology for current and future product offerings. They also focus on materials that are necessary for sealing in ultradeep applications.

Nanotechnology

Scientists focus on nano research and the many areas where functionalized nanocarbons can improve tool performance.

Electronics

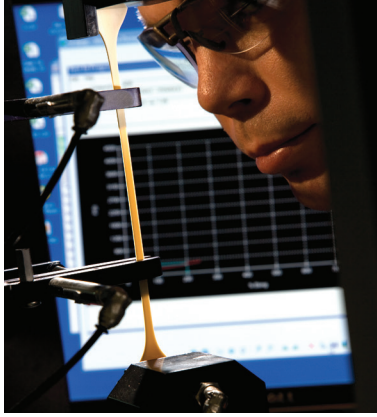
Electronics engineers conduct research and development in downhole monitoring, actuation, and remote flow control, with particular emphasis on fiber-optic and alternative sensing technologies.

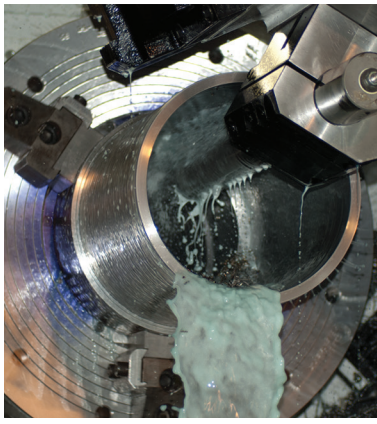
Prototype manufacturing

The CTI uses the latest machining technology and practices, including multi-axis capability and electrical discharge machining (EDM) wire-cutting technology to manufacture highly specialized prototyping components.

Additive manufacturing

CTI works closely with our Additive Manufacturing (AM) site in Houston to develop new designs specific to the AM process that offer unique benefits over traditional machining (subtractive manufacturing). These designs often create new intellectual property because AM manufacturing allows our technology team to think outside of the traditional manufacturing box; this can also offer significant time and cost savings. The end result is that our industry is seeing significantly more usage of AM manufactured parts in downhole applications and Baker Hughes is on the leading edge of this effort.





CTI Completions and Intervention Remote Operation Center

Our Remote Operations Center enables operators to seamlessly access specialized expertise across all Baker Hughes Completions and Well Intervention disciplines, regardless of well location. This model promotes stronger collaboration both internally within Baker Hughes and externally with customers. Integrated teams of Baker Hughes experts work in close partnership with operators to overcome technical challenges, enhance operational efficiency, and ensure flawless execution at the wellsite.

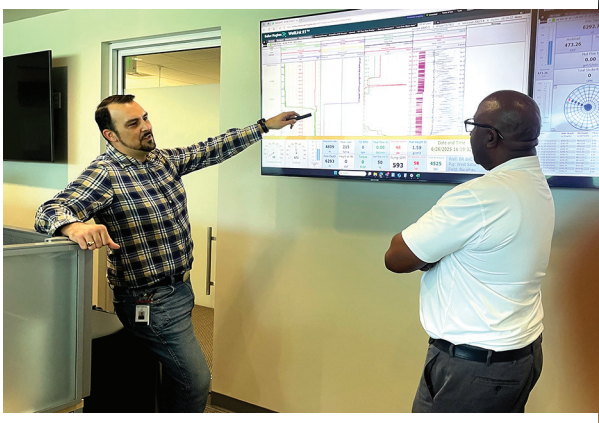
With our sister center in Dubai, we ensure true 24/7 global coverage—connecting Baker Hughes experts to the rig anytime, anywhere. Our international team brings world-class expertise with fluency in 12 languages—so support is always available and in the language needed.

Technical review capabilities

- Well simulations
- Procedure review
- Equipment selection
- Workshop instructions
- Workbook review
- Tool performance calculations

Support levels for remote monitoring

- Level 1: Monitor and support
- Level 2: Shadow
- Level 3: Active shadow
- Level 4: Demanned



Increasing customer collaboration

The CTI was designed for cross-divisional teamwork and effective collaboration with our customers. This leads to more extensive development of new problem-solving products and technologies—creating more opportunities for the success of your operation.

From projects that include a hostile-environment permanent packer, high-hydrostatic packer setting module, real-time casing imaging technology, and integration of fiber optics with sandface completions, we're delivering solutions to improve your ultimate recovery in a safe, cost-effective manner.

Baker Hughes