A major challenge in lengthy horizontal or highly deviated wellbores is running the casing string to depth. Drag between the casing string and the formation can often exceed the load capacity of the casing hook, preventing tools from reaching optimal setting depth. This challenge is compounded in shallow horizontal wells. Finding a way to minimize the drag is the key to extending the reach of highly deviated and horizontal wellbores.

A technique developed to “float” the casing into the wellbore using buoyancy-assisted casing equipment (BACE) allows operators to run casing to the bottom of these particularly challenging wellbores. Paired with floating equipment, the application of BACE traps lightweight fluid or air in the lower section of the casing string, thereby reducing the weight of the casing. The lighter weight reduces drag by lifting the casing string away from the formation wall and minimizes the surface area contact of friction.

This technique enables increased running depth and decreased potential for casing buckling or sticking. To simplify its application, BACE is fully integrated with the casing string, and it helps reduce risk because it has no outer shear pins posing potential leak points. Additionally, the tool doesn’t require debris barriers that can obstruct free flow in the casing. As opposed to other methods or alternatives, BACE does not leave behind any trace of rupture disc within the casing wall, which can impair fracture plug deployment during plug-and-perf operations.

Three recent jobs in unconventional shale plays involving lengthy lateral casing strings illustrate the effectiveness of the BACE technology to overcome challenges.

**Using buoyancy-assisted casing equipment to extend lateral reach**

**Tool allows casing string to run to total depth.**

**Kevin Ardoin, Halliburton**

**Reaching out in the Western Hemisphere**

In the first case study an operator planned an extended lateral well of about 3,962 m (13,000 ft), anticipating challenges getting the casing to planned depth. The operator also was concerned about the compatibility of equipment throughout the casing string for cementing and future operations.

Halliburton performed analysis on the wellbore and determined that the best way to set the casing would be to use BACE along with a fullbore pressure-operated fracturing sleeve. Additional torque and drag analysis identified the need to create a buoyant chamber at the heel of the wellbore.

While the service company was executing the job, BACE ruptured at the planned applied casing pressure. After successfully removing the buoyant air chamber, technicians launched the bottom plug from the surface, landed it down on the BACE plug and released it to initiate displacement. During the cement job the plugs were successfully pumped through the RapidStart Initiator Casing Test without incident, proving compatibility and allaying concerns the operator had in the planning stage.

**Challenges in the Eastern Hemisphere**

In the second case study an operator planned to run about 3,200 m (10,500 ft) of casing in a lateral wellbore and achieve both planned total depth (TD) and top-of-cement for zonal isolation. Because the job would be the operator’s longest lateral, it was extremely concerned about successfully executing to plan.

Halliburton performed torque and drag analysis using the wellbore parameters and determined BACE would be the best course of action placed at the heel of the wellbore. Additionally, cement design modeling suggested the use of an external sleeve inflatable packer collar (ESIPC) for second-stage cementing. Executing the job, the extended-reach casing was floated to planned TD using BACE, and the success of the run eliminated the contingency of running a smaller liner to achieve TD. All displacement measurements for the cement plugs and the BACE were in accord with the job design, and the ESIPC functioned properly, enabling the displacement of the second-stage cementing to achieve planned top of cement.
**Specialty casing application with fiber optics**

In the third case study an operator sought to set casing in a well with a true vertical depth of 3,246 m (10,650 ft), a measured depth of 6,390 m (20,967 ft) and a bottomhole temperature of 137.7°C (280°F). The operator also wanted to run fiber optics as it considered the well something of a “science project” to monitor in situ conditions and provide data for future well development in the area.

The Halliburton team proposed using BACE and, after conducting torque and drag analysis with wellbore conditions, it determined the technology would work best near the heel of the wellbore. The subsequent four months of planning and preparation for the job entailed mobilizing the necessary downhole tools, surface equipment and field personnel to the site and conducting a critical well review to ensure all elements of the operation were coordinated.

The execution phase began with the team positioning the BACE about 2,438 m (8,000 ft) from the end of the string and then successfully floating the casing and fiber optics to TD. Next, pressure inside the casing was increased to 1,250 psi and ruptured the disc as planned, which separated the 10 parts per gallon well fluid from the air-filled chamber. Finally, the team circulated about 1,000 bbl of fluid to ensure that all of the air in the buoyancy chamber was depleted, after which the cement job was performed.

With critical data being fed back to the operator, the BACE provided a successful outcome, according to the operator. During the planning phase the operator estimated the job of running fiber optics with the casing would take three to five days at a pace of running about four joints of casing per hour. By using BACE the operator was able to run about 14 joints of casing per hour and cut three days from the operation, reducing time and costs.

As lengthy horizontal and highly deviated wellbores become increasingly common, the application of this type of technology could become a more widely used technique in more places around the world.