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## 2012 Meritorious Awards For Engineering Innovation

Cody Ozcan, Assistant Editor, and Scott Weeden, Senior Editor

May 10, 2012

### Judges choose top 17 industry projects

The E&P editors and staff proudly present the winners of the prestigious 2012 Special Meritorious



Awards for Engineering Innovation. The pages that follow spotlight the 17 awards the independent team of judges picked as best of the 2012 crop of entries. The winners reached across a broad range of disciplines and addressed a number of problems that posed roadblocks to efficient operations. These technologies opened new and better avenues to the complicated process of finding and producing hydrocarbons around the world.

This year, some of the brightest minds in the industry from service and operating companies submitted entries representing better technology and new techniques for judges to consider.

The award program honors engineering excellence and achievement in every segment of the upstream petroleum industry. It recognizes new products and technologies that offer innovation in concept, design, and application.

Winning entries represent techniques and technologies that are most likely to solve costly problems and improve exploration, drilling, production, facilities, and IT efficiency and profitability. The people and companies that submitted the entries realize the oil- and gas-producing industry depends on new, better, and constantly changing technological innovation to continue producing low-cost oil and gas from smaller and deeper reservoirs to feed an increasingly energy-thirsty world.

Contest judges chose the winners, but there were no losers in this contest. The products chosen represented the best of a long list of winners.

The expert panel of judges included engineers and engineering managers from operating and consulting companies worldwide. They applied their expertise in areas in which they specialize. Judges were excluded from categories in which they or their companies had a business interest.

E&P would like to thank these distinguished judges for their efforts in selecting the winners in this year's competition.

As in past years, E&P will present the 2012 awards at the [Offshore](#) Technology Conference in Houston, Texas, on April 30, 2012.

An entry form for the 2013 Special Meritorious Awards for Engineering Innovation contest is available at [EPmag.com](#). The deadline for entries for 2013 is Dec. 31, 2012.

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**ARCTIC/DEEPWATER INNOVATION WINNER**

ION GEOPHYSICAL | UNDER-ICE SEISMIC DATA ACQUISITION

**Technology allows seismic data acquisition in 100% ice cover**

While it holds an abundance of the world's undiscovered hydrocarbons, the Arctic poses extreme challenges to all E&P activities, including seismic data acquisition and processing. Harsh conditions limit the weather window for safe and efficient seismic operations and can damage in-water acquisition equipment and introduce unwanted noise into acquired seismic datasets. Combined, these factors have historically limited both the quantity and the quality of available seismic information in the Arctic.

To address these challenges, ION Geophysical developed new technologies that enable acquisition of seismic data under ice. From an operations standpoint, ION employed an icebreaker to open a hole in the ice ahead of seismic vessels and created specialized handling equipment to allow the safe deployment, towing, and recovery of specially modified in-water seismic equipment. The inclination angle of the earth's magnetic field in the Arctic required the company to reengineer standard seismic compass technology to accurately record course headings in the Arctic's cold and weak magnetic environment. To help manage ice threats, ice field navigation, and cable defense, ION modified its command-and-control system. And ION's data processing group developed new algorithms and processing routines to handle the unique noise events created by operating seismic equipment in 100% ice cover.

These technologies have enabled E&P companies operating in the Arctic to acquire essential seismic data in areas where no modern seismic data exists, dramatically extending the time window for data acquisition while reducing exploration and production risk and informing drilling decisions.



New Arctic acquisition technologies extend the weather window for seismic surveys.

**DRILL BITS WINNER**

TESCO CORP. | XCD3 CASING DRILL BIT

**New casing drill bit improves casing while drilling**

Running the casing to the desired depth can be problematic in troublesome drilling operations. Combining the processes of casing running and drilling can drastically cut the time and cost of extensive projects.

Casing while drilling (CwD) is a process that transforms the casing string into a drillstring, allowing the wellbore to be drilled and cased simultaneously. To allow the next interval to be drilled, the CwD must contain a sturdy bit that is also drillable via a rollercone or PDC. Tesco Corp.'s new XCD3 Casing Drill Bit accomplishes both of these goals.



The XCD3 is drillable via rollercone or PDC.

To compare performance of casing and drilling methods, several La Yuca wells in Ca?o Limon used XCD3 Casing Drill Bit technology in fields that have previously been drilled and cased using conventional methods. The fields that were cased and drilled conventionally had an average ROP of 40 m/hr (134 ft/hr) for a 220-m (722-ft) well.

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According to the company, the 9 5/8 -in. conventional drilling, tripping out, and casing running process took an average of seven hours. In the fields that used the XCD3, the La Yuca wells were able to be cased and drilled in 3.5 hours at an average depth of 217 m to 224 m (713 ft to 735 ft).

### COMPLETIONS WINNER

HALLIBURTON | EQUIFLOW – AUTONOMOUS INFLOW CONTROL DEVICE

#### Next-generation inflow control device increases oil production

Current ICD technology is designed to delay the onset of water and gas breakthrough in a horizontal wellbore. However, production is prevented while the delay is in place. Additionally, the functionality of the ICD ends once the inevitable breakthrough occurs. The next generation of inflow control device (ICD) takes current ICD methodology one step further by designing the tool to function autonomously for the life of the well.

The autonomous inflow control device (AICD) restricts unwanted production of water and gas while continuing to allow the unimpeded flow of valuable hydrocarbons. The AICD utilizes an innovative and highly engineered flow path to manipulate fluid flow based on dynamic flowing properties. There are three individual dynamic fluid components: the viscosity selector that determines what fluid is flowing through the device, the flow switch that directs the selected fluid down one of two paths, and the flow restrictor that constricts the flow of undesirable [fluids](#). The AICD determines fluid properties such as density and viscosity. The main flow path of the flow switch, called a "fluid crossroad," vectors the fluid into one of two directions through the main flow path through the AICD. If the fluid contains water or gas, it follows the viscosity-dependent path, which then forces the fluid to spin within the device. The centrifugal force associated with spinning translates directly into pressure loss that prevents flow of fluid through the AICD.

Efficiency improves by limiting unwanted fluid production at the surface, thereby greatly reducing its associated separation and disposal costs, and by stimulating oil flow in adjacent compartments, thereby increasing oil production. Halliburton's EquiFlow AICD thus improves completion reliability and efficiency by smoothing production throughout the interval, delaying water and gas breakthrough, greatly reducing water and gas production after breakthrough, and increasing ultimate recovery from the well.



The autonomous inflow control device can work for the life of the well.

### DRILLING FLUIDS WINNER

M-I SWACO, A SCHLUMBERGER COMPANY | ENVIROTERM NT

#### Water-based drilling fluid can be used in high-temperature settings

Improvements in drilling technology have allowed operators to drill deeper, more challenging wells for longer periods of time. Drilling fluids are essential to this process, providing buoyancy, suspending cuttings, controlling pressure, and cooling the wellbore to avoid wear on the drillbit.

M-I SWACO has developed the Envirotherm NT water-based drilling fluid. This technology is an [HP/HT](#) fluid that is able to be used in severe conditions, at temperatures in excess of 232°C (450°F). The system results in low and stable rheological properties and low



[HP/HT](#) fluid loss. The chemistry is water-based and chrome-free, making it environmentally acceptable worldwide. According to the company, this is achieved by decreasing the bentonite and drill solids content as fluid density and wellbore temperatures increase. In place of the bentonite, high temperature-resistant polymeric materials are used that stabilize the viscosity and gel strength, reducing issues caused by flocculation of reactive clay solids at high temperatures and viscosity increase resulting from chemical contamination. The fluid also is stable in the presence of contamination from soluble calcium, salts, and acid gases.

The Envirotherm NT enables operators to optimize drilling and minimize environmental impact in high-temperature applications.

Envirotherm was used when drilling an exploration well targeting a HP/HT [tight gas](#) reservoir. Challenges included contamination worries and environmental limitations. Envirotherm was able to lower the rheology, which helped minimize the equivalent circulating density. The same strategy was used during both 8 3/8 -in and 5 7/8 -in sections, [HPHT](#) product concentrations being gradually increased towards well TD.

## DRILLING TOOLS WINNER

WEATHERFORD INTERNATIONAL | MOTARYSTEERABLE

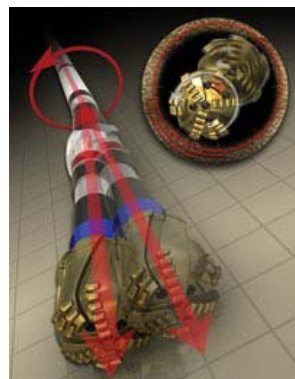
### Directional drilling optimized by combining a mud motor system with the RSS

Mud motors can cause a significant reduction in drilling efficiency in sinuous wellpaths because of sliding. RSSs, their steerable system counterpart, accomplish the same desired effect of steering wells with the added technology of 3-D directional control but are typically more expensive.

The MotarySteerable by Weatherford combines the traits of these two techniques, optimizing directional drilling. The system consists of a mud motor equipped with a bent sub and MWD components that maneuver via targeted bit speed, eliminating the need for sliding. The tool also includes full 3-D directional control and continuous rotation of the drillstring.

A well in South Texas used the MotarySteerable system to drill an interval from 1,125 m to 2,469 m (3,691 ft to 8,100 ft) in a single run. It had an average ROP of 45 m/hr (149 ft/hr). The system ultimately saved the client an estimated cost of more than US \$200,000.

According to the company, the tool is designed for wells ranging in size from 6 in. to 12? in., with low build rates of 0° to 3° per 30 m (100 ft).



Weatherford's MotarySteerable system bridges the gap between mud motors and RSSs.

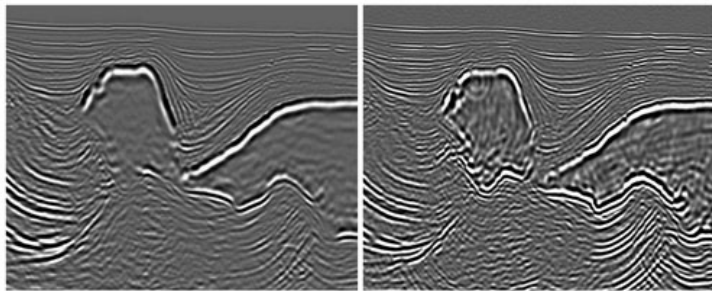
## EXPLORATION TECHNOLOGY WINNER

WESTERNGECO | DUAL-COIL SHOOTING MULTIVESSEL FULL-AZIMUTH ACQUISITION

### New method of seismic data acquisition calls for vessels to sail in overlapping circles

Traditional marine seismic data acquisition introduces imaging challenges and an inevitable loss of productive time. Conventional data acquisition techniques call for a vessel to sail in parallel lines across the surface of the water. This method takes time, as the vessel must turn around between the end of one straight line and the start of the

next. Also, in areas of complex geology, ray bending can leave portions of the subsurface untouched. A new technique developed by WesternGeco can provide a higher range of azimuths and decreases the amount of nonproductive time (NPT) by avoiding the need to steer the vessel into parallel lines.



The coil shooting technique improves seismic resolution.

The new technique steers the vessel into a series of overlapping circles, recording seismic data continuously. This relieves the operators of unnecessary NPT while still providing full-azimuth (FAZ) coverage. According to the company, the design of the survey is such that additional coils are easily added on an ad hoc basis to increase the survey area. A dual-coil multivessel survey uses two recording vessels with their own sources and two separate source vessels that sail in wide-diameter interlinked circles.

In areas of the western [Gulf of Mexico](#), four vessels sailed in interlinked circles with a 12.5 km (7.8 mile) diameter. The dual-coil design delivered a trace density 2.5 times that of contemporary WAZ surveys, while also improving the signal-to-noise ratio. WesternGeco's first dual-coil long-offset FAZ survey covered more than 4,000 sq km (1,544 sq miles) in a five-month period with 400 coils.

## FACILITIES WINNER

[OFFSHORE](#) SOLUTION BV | OAS

### New gateway improves efficiency of offshore access systems

Safely transporting personnel to an offshore structure can prove difficult in areas where the seas have a significant wave height. Installation time also is an issue, causing a decrease in productivity and an increase in maintenance costs. Standard offshore access systems (OASs) require an extreme amount of attention and care to ensure that marine personnel are transferred safely.

Offshore Solution BV produced an OAS with a telescopic, hydraulically operated gateway. A hydraulically operated gripper head connects the gangway to the offshore structure. The heave compensation is disengaged upon connection, allowing the gangway to "float" between the vessel and the installation. Once connected, the walkway automatically compensates for the six movement planes of the vessel motion and enhances safety by using a semi-automatic traffic light system. If there should be a need for an emergency disconnection, the gripper head's mechanism has the ability to automatically release from the landing station's connection pole.



The Offshore Solution OAS is the only one of its kind to automatically compensate for the six movement planes of the vessel motion.

Installation of the OAS is reduced to fewer than 24 hours by using a free-standing



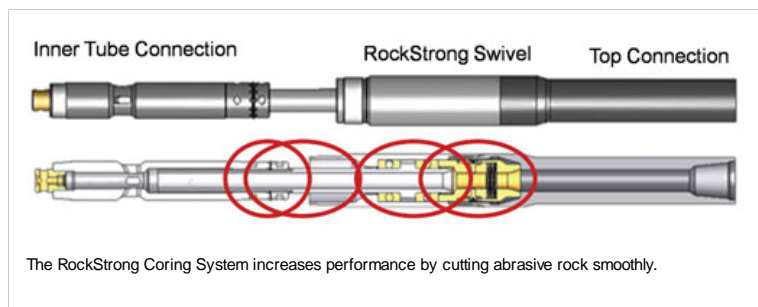
skid-mounted unit installed on the system. The OAS can service several installations through the use of one vessel, increasing available man-hours up to 70% and resulting in a 100% increase in productivity and 50% reduction in maintenance costs. The Bourbon Gulf Star, deployed at Qatar Shell GTL Ltd.'s Pearl gas-to-liquids project, has been connected via the OAS for more than 2,500 hours with 100% availability for the past year, providing personnel access at all hours of the day. More than 32,000 personnel transfers have occurred without incident. FORMATION

## EVALUATION WINNER

HALLIBURTON | ROCKSTRONG CORING SYSTEM

### Coring system isolates swivel from barrel, mitigates vibration

Coring in extreme HP/HT wellbore environments can be difficult and can require special attention with the use of specialized tools. In order to prevent jamming, the core should be cut very smoothly and should not be exposed to an excess amount of vibration. If there is vibration of the core, pieces can be damaged or fractured, causing rock and rubble that will jam during the operation. In the case of a jamming incident, the core barrel must be tripped to surface in an attempt to recover the partial core. In areas such as [deepwater](#) wells and deep gas wells, this process can be extremely costly.



The RockStrong Coring System by Halliburton can increase performance in HP/HT or hard rock conditions by cutting the abrasive rock smoothly and making the shaft independent of the outer barrel, isolating it from vibrations. Contemporary swivels undergo the same amount of vibrations as the outer barrel. By isolating the swivel from the barrel, vibration is mitigated. Because the Rock-Strong Coring System cuts the rock in a much smoother fashion compared to other systems, there is less damage to the core and therefore a decreased risk of jamming. The system also cuts larger sized cores, works with an ultra-stable double-bearing system, and excludes rubber seals, which tend to diminish temperature tolerance.

In the UK North Sea, the coring system cut a total of 153 m (501 ft) of core in four runs with 98% recovery. In Algeria, the RockStrong cut abrasive quartzitic sandstone 314 m (1,030 ft) in nine runs at 175°C (347°F). In Norway, there was a 100% recovery when cutting 241 m (792 ft) in two runs, at a well angle of 25°.

## HSE WINNER

HALLIBURTON | CLEANSTREAM SERVICE

### Ultraviolet light used to disinfect [fracing](#) fluid

Biocides are necessary in [fracing](#) fluids because they control bacteria that potentially destroy their effectiveness, leading to the corrosion of iron or steel that can cause the well to produce hydrogen sulfide. Biocides, however, are extremely controversial when it comes to environmental concerns. They must be handled carefully and also must be registered with federal and local environmental protection agencies. Ultraviolet (UV) light has been used as a disinfectant in other industries for years but never in a field environment because of the engineering challenges associated with applying the

technology in fracing operations.



The CleanStream service unit enables effectively using ultraviolet light to control bacteria in fracturing fluids.

Halliburton developed the CleanStream service to control the bacteria found in fracing fluids with UV light. The CleanStream service meets the demands of the field environment, significantly reducing and, at times, totally eliminating the need for biocide used to treat the fracing fluids for bacteria. According to the company, this was achieved by accurately controlling the UV bulbs, determining the amount of light required based on the turbidity of water being treated and determining the extent of effectiveness of the disinfection.

A nine-stage [Haynesville](#) horizontal well in Nacogdoches, Texas, used the CleanStream process, treating a total of 3,735,469 gallons of water at 80 bbl/min. The bacteria concentration was measured from both the intake and discharge side of the CleanStream trailer using the serial dilution method, showing better than a 99% reduction in both the sulfate reducing and aerobic bacteria levels.

## INTELLIGENT SYSTEMS & COMPONENTS WINNER

BAKER HUGHES | VISION WEB-BASED MONITORING SYSTEM

### New system method to analyze performance of ESP systems, improves ESP runlife

Standard electrical submersible [pumping](#) (ESP) analysis tools monitor ESP systems to optimize engineering resources. Most ESP analysis tools require a system expert to diagnoses an upset condition, and the expert must review data trends over extended periods of time.

Baker Hughes has developed a Vision Web-based monitoring system that analyzes the data streams and diagnoses pump conditions using an advanced mathematical technique called the fuzzy logic diagnostics engine. Discrepancies between live ESP data and a model of the well can be viewed for any inaccuracies. The system monitors more than 2,900 ESPs around the globe, providing exception-based reporting, which improves ESP runlife and increases production and fast payout. The Vision model attempts to alert the production engineer to production improvement opportunities and any potential consequences in equipment runlife as a result of those suggestions.



Vision Web-based monitoring service provides the ability to view and track real-time data when dealing with dynamic wells.

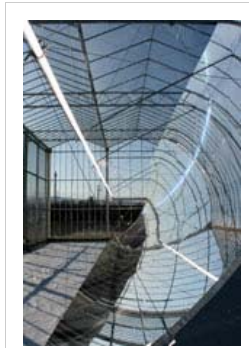
An operator in West Texas was provided trending, alarming, and exception-based reporting on pilot wells through the Vision Web-based monitoring system. Full-time ESP experts from Baker Hughes analyzed the performance of the operator's wells, providing recommendations regarding optimization of production performance. According to Baker Hughes, its client reduced rolling average failure frequency by 55%; prevented 25 immediate failures; achieved a full field-monitoring program with 1,800 active ESP systems; and increased uptime, production, and system efficiency.

## IOR/EOR WINNER

## GLASSPOINT | SINGLE TRANSIT TROUGH

**Solar energy cuts cost of generating steam for heavy oil production**

Up to 60% of the operating costs for steamflooding heavy oil come from buying natural gas to produce the steam. GlassPoint developed a solar-thermal technology that produces steam for thermal EOR, using solar power to produce steam. GlassPoint's Single Transit Trough (STT) design houses solar collectors inside an agricultural greenhouse to protect the system from high winds, dust, sand, and humidity.



The curved surface of the solar energy device preheats water to 88°C, thus cutting down the use of natural gas.

In February 2011, GlassPoint unveiled its first commercial, solar-enhanced EOR project at Berry Petroleum's 21Z lease in Kern County, Calif. The 21Z Berry project used curved-front surface reflectors suspended from a glasshouse structure. Automated software positions the mirrors to track the sun throughout the day, focusing the light on stationary receiver tubes to preheat water to 88°C (190°F) with the sun's radiant heat that produces about 1 MMBtu/hr of solar heat. This preheated water is then introduced to the natural gas-fired steam generator, reducing fuel use and operating costs.

The commercial-grade greenhouse is comprised of galvanized steel and aluminum construction, with tempered 4-mm glass roof and walls covering approximately 650 sq m (7,000 sq ft). The mirrors are made of an anodized aluminum reflective material, used widely in commercial lighting fixtures. By enclosing the system inside a

protected glasshouse, the company can deploy inexpensive, lightweight components that are already in high-volume production worldwide.

The 21Z Berry project's high-performance, front-surface reflectors eliminate multiple light transits through dirty glass. As a result, the system delivers higher real-world optical efficiency than traditional solar systems by creating a more direct pathway from the mirror to the receiver tube where steam is generated. An automated washing system and control center ensures the solar EOR system can achieve performance specifications remotely with minimal operator intervention.

**PRODUCTION TECHNOLOGY WINNER**

## BAKER HUGHES | ULTRA-TEMPERATURE SAG-D ESP SYSTEM

**Technology improves performance in SAG-D applications**

Steam-assisted gravity drainage (SAG-D) wells that are extreme enough to require an electric submersible [pumping](#) (ESP) system often can exceed the capabilities of multiple components in the system. Conventional ESP systems usually work at temperatures to 149°C (300°F), but operators striving for increased production rates and extended reliability have pushed the limits of their ESP systems to almost 200°C (392°F).

The Centrilift Ultra-Temperature ESP system, the world's first ultra-temperature ESP system for SAG-D wells, can be operated at significantly higher temperatures than conventional ESP systems and is capable of operating at well fluid temperatures to 250°C (482°F). The technology features an electrical insulation system, developed from the testing of unconventional insulation materials. The Ultra-Temperature ESP system also leads to a mitigation of material degradation, resulting in less production interruption and operational expenditures.

Thirty-two SAG-D wells in Canada have had the ultra-temperature ESP system installed. The technology has accumulated more than 10,000 run days in operator wells with fluid temperatures ranging between 210°C and 230°C (410°F and 446°F). These higher

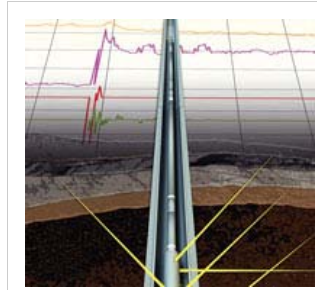


temperatures lower the viscosity of the produced oil and allow for a larger steam chamber, which extends the system runlife. Operators have seen a greater return on investment from the increased oil recovery and production rates this innovative ESP system has provided.

## REMEDIATION WINNER

SCHLUMBERGER | LIVE DIGITAL SLICKLINE SERVICES

### Slickline service measures, transmits information in real time



LIVE digital slickline services are applicable to any slickline operation, incorporating toolstring components that enhance the process depending on the requirements of the operation.

Though standard slickline service equipment has remained beneficial in simplicity, cost-effectiveness, and suitability, depth accuracy and toolstring control at times are insufficient, leading to operational inefficiencies and limitations. LIVE digital slickline services by Schlumberger uses standard slickline surface equipment and cable, insulated with a polymer coating, allowing two-way digital data telemetry. Downhole tool data and commands flow real-time between a surface acquisition and control system and a new line of downhole tools and accessories.

The LIVE technology measures and transmits wellbore, tool, and reservoir information, increasing data visibility and tool control. Toolstring shock, deviation, tool movement and head tension, natural gamma ray activity, and casing collar location information, as well as wellbore pressure and temperature measurements, can be transmitted in real time to the operator during slickline operations. This technology also can reduce the amount of people and equipment necessary to complete certain well intervention programs through its inherently light footprint and the crew and equipment rationalization achieved by covering a scope of work done previously by a combined electric line and slickline operation. Schlumberger also has developed associated accessories such as a surface-controlled interactive jar and release device for fishing and jarring operations, electro-hydraulic setting tools, a surface-activated trigger, and a tool suite for logging measurements, expanding and enhancing slick-line operations.

More than 500 field operations across the globe have implemented the LIVE technology. Benefits of using digital slickline include elimination of multiple rig up/rig downs, faster run in/pull out hole times, explosive free device setting, safe on-demand slickline perforating, and a significant decrease in equipment transportation and logistics. The wells serviced ranged widely in types, fluids, and deviations and included borehole temperatures to 140°C (290°F) and well depths to 4,900 m (16,000 ft).

## STIMULATION WINNER

GASFRAC | WATERLESS LPG GEL

### New waterless LPG gel uses propane, increases production

In the past, conventional fracing fluids gave rise to concern because of contamination worries, the use of biocides and carcinogens, and an increasing amount of truck traffic that caused an excess of CO2 emissions. GasFrac's new [stimulation](#) technology has replaced these fracing fluids with a waterless LPG gel made up primarily of propane.



The Ultra-temperature ESP for SAG-D wells works at higher temperatures and improves performance.

Recovery of the LPG is near 100%, phase trapping is practically eliminated, and LPG properties allow for extended shut-in times without detriment. This results in increased production rates of the stimulated well as compared to conventional water fracturing systems. Because the propane is recyclable and reusable, there also is a reduced risk of flaring. Multiple storage tanks are used to store and feed the LPG to specialized sand blenders, each with its own pressurized nitrogen blanket present for precautionary reasons. The sand blender is a pressurized enclosed system in which the proppant is preloaded, purged, and pressurized with nitrogen. A controller then meters the proppant into the gelled LPG before high-pressure pumping units inject the gelled slurry into the well bore.

In the McCully gas field in New Brunswick, Canada, the GasFrac waterless LPG gel yielded an effective average fracture half-length that was double that of a water [frac](#). Operators found that 100% of the propane was recovered during a two-week flow period. In addition, propane fracs in the field's low-permeability sands yielded an initial uplift factor of two over a water [frac](#). It has been estimated that the propane uplift for the McCully field is expected to be sustained up to 10 years.

#### **COMPLETIONS HONORABLE MENTION**

##### **HALLIBURTON | LINER-CONVEYED GRAVEL PACK**

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In an effort to improve drilling and completion efficiency and reduce overall well cost, Halliburton developed and deployed its liner-conveyed gravel pack (LCGP) system. Rather than making multiple trips, an operator can use the LCGP system to run liner and perform the gravel-pack installation in a single trip.

The system optimizes production and minimizes erosion. In some applications, use of the LCGP may enable the reduction of a casing size in the well design. Other advantages include maximizing the system ID for unrestricted flow, eliminating a liner run along with liner cleanout trip and liner testing, saving drilling fluid, and allowing installation of an open-hole gravel pack or a standalone screen installation.

Halliburton adapted its LCGP system for gravel packing a multilateral completion for a major operator working offshore Latin America. The operator was able to achieve the time and cost savings associated with the LCGP system, which has been reported to be up to four days out of a 10-day conventional completion.

#### **DRILLING FLUIDS HONORABLE MENTION**

##### **HALLIBURTON | TUNED SPACER V SPACER FLUID**

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Excessive bottomhole temperatures require optimized drilling fluid technology to keep operations flowing smoothly. With temperatures exceeding 200°C (392°F), drilling fluid must be thermally stable enough to perform efficiently without causing operational challenges.

Tuned Spacer V spacer fluid by Halliburton remains stable in ultra high-temperature environments. It allows modification of both rheological properties and density at service temperature for project-specific well conditions and specific applications through use of its extreme-temperature synthetic polymer. The spacer fluid is pumped ahead of the cement, displacing drilling fluid and preventing contamination. The fluid is displaced efficiently, eroding the filter cake from the formation. According to the company, the rheological properties promote turbulence even at low pumping rates for better mud removal and to help prepare the well bore to receive cement, allowing the slurry behind it to bond to the outer casing for effective zonal isolation.

The fluid can be mixed in any equipment found in the oil field. The spacer fluid is being used at temperatures up to 323°C (450°F). In the South Texas [Eagle Ford shale](#), the application of the Tuned Spacer V spacer fluid has minimized testing time within the

laboratory and on the rig by providing accurate and reproducible results from the laboratory to the field.

#### **HSE HONORABLE MENTION**

##### **HALLIBURTON | OFFSHORE SLOP UNIT**

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Slop, a mix of wash water, rain water, remnants of drilling and completion fluids, and other similar fluids considered as waste, must be transported from an offshore rig to the shore, where it can be carefully discarded. During this operation, there is an increased risk of emissions from transport; risk of spill to the environment during transfer/offloading from rig to boat; risk of exposure to hydrogen sulfide (HS); and risk of the slop settling in storage tanks, leading to costly tank cleaning operations.

Halliburton has developed an offshore slop unit that uses chemical flocculation and dissolved air flotation to address the challenges associated with treating slop in an offshore environment. A 6-m(20-ft) mobile container provides a high treatment capacity combined with a very high tolerance for particles and oil. The company uses an online, continuous fluorescence analyzer to monitor the discharge water, ensuring that the discharge waste is environmentally compliant. By completing the slop treatment offshore, there is a reduced risk of emissions, HS exposure, and spill to the environment.

A North Sea operator, with an excess of 1,000 cu. m. of slop generated per month, previously required slop to be transported to shore for processing. According to the company, in the first 16 months after installing the offshore slop unit, more than 10,600 cu. m. was processed, discharging greater than 80% of the processed slop and eliminating the need to transport waste to shore. It also eliminated associated costs and HSE risk. Estimated cost savings for this operation was US \$2.7 million.

#### **REMEDiation HONORABLE MENTION**

##### **HALLIBURTON | RIGLESS E-LINE RECOMPLETION SYSTEM**

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Keeping a rig stationed on a well during several steps of the production process is a very expensive decision to make. Rental rates for each rig can escalate costs for operators, and inconvenient scheduling times lengthen the project's completion timeline. Rigless operations can be cost-efficient and can speed production.

Halliburton developed a rigless e-line recompletion system that eliminates the need for a rig when operating an electric line. Only a wireline logging unit, a crane or portable mast, and the required pressure control equipment are necessary, giving operators the opportunity to relieve the field of the rig earlier. The recompletion solution comprises a DPU-I-LS (long-stroke) electro-mechanical setting tool, a through-tubing high-expansion elastomeric bridge plug, and a non explosively operated positive displacement dump bailer. The DPU-I-LS can be used in any borehole fluid and provides a slow and controlled plug setting force that is independent of the hydrostatic pressure.

In the West Cameron area of the [Gulf of Mexico](#), the rigless e-line recompletion solution saved the client more than US \$700,000 after effectively completing the through-tubing plug-back operation without the use of a rig.

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