Galaxie

Versatile well stimulation vessel for Nigeria
Applications
- Large-capacity treatments
- High-rate, high-pressure pumping
- Fracturing, acidizing, gravel packing

Benefits
- Stable in hostile environments
- Rapid deployment and rig-up
- Minimal environmental impact
- Reliable equipment
- Data link-up in remote locations

Features
- 8500 hhp available
- 40-bbl/min, 5000-psi treating capability
- 100% redundancy at rates up
- Continuous gel mixing capability with 2760-bbl mix-water capacity
- Continuous acid mixing capability with up to 45,000-gal raw-acid storage capacity
- 6400-ft³ sand storage capacity
- Eight precisely metered liquid-additive flow streams
- 128,000-bps satellite data transmission capability
- DP Class 1 dynamic positioning system

Advanced, versatile, well stimulation vessel
The Galaxie well stimulation vessel is the product of years of Schlumberger experience in marine, mechanical and electronic engineering. It can execute treatments efficiently, regardless of their size or complexity, with a state-of-the-art blending and pumping system.

This system can prepare fluids with almost any combination of gelling agents, crosslinkers, gel breakers, friction reducers, surfactants, demulsifiers, corrosion inhibitors and fluid-loss additives. It also precisely controls proppant addition over the full range of treatment rates.

Continuous monitoring and remote control of critical parameters during all phases ensure treatment quality. Treating lines are flexible and have quick-disconnect couplings to expedite vessel withdrawal in an emergency.

The Galaxie can stay on station even in adverse weather. Tunnel thrusters at the bow and stern, controlled by the dynamic positioning (DP) system, automatically maintain station next to a semisubmersible, jackup, platform or tension leg platform (TLP)—either alongside or stern-on.

Dynamic positioning
The Galaxie has a Class 1 DP system. Its key components are a computer, a propulsion system and a choice of two reference systems for positioning information. One is the differential global positioning system (DGPS). The other is the fanbeam system, which provides stable positioning relative to a floater or TLP and is the first choice for deepwater operations.

Fanbeam reference system
The fanbeam reference system uses a laser scanner on the Galaxie to echo signals from reflective targets on the rig or platform. Based on these signals and other data, the DP system’s computer adjusts the propulsion system to hold the Galaxie on station. The computer also captures and processes data for an environmental model, which is archived in an historical record of offshore conditions.
Propulsion system optimization
By using measurements of vessel response to optimize its propulsion system, the Galaxie can remain in a relatively fixed position, even in rough seas. Measurements come from:
- a wind direction and magnitude sensors
- gyrocompasses that provide precise headings
- a vertical reference sensor (VRS).

Reliable positioning
DP system reliability is enhanced by:
- an independent joystick and auto-heading control
- an uninterruptible power supply with battery backup
- a dedicated printer for quick alarm reference.

Equipment protection
To protect equipment from saltwater damage, the vessel has raised sidewalls and a roof over the pumps. The roof also provides storage space for liquid additives.

Extensive proppant storage
Four different types of proppant can be stored aboard the Galaxie at the same time. Tanks permanently mounted below the main deck provide 4400 ft³ of storage. A silo above deck adds another 2000 ft³. The vessel's compressor moves proppant from the permanent tanks to the silo at rates up to 10,000 lbm/min—equivalent to 40 bbl/min at 8 ppa.

Controlled proppant concentration
Process control of proppant addition to the blender automatically compensates for any change in treatment rate. This ensures correct proppant concentration is achieved under all operating conditions.

Large acid-storage capacity
Polyethylene-lined tanks above deck can store 28,400 gal of raw acid. These tanks are compatible with hydrochloric (HCl) and hydrofluoric acid and all chemical additives Schlumberger uses for acidizing.

If a job requires more acid, tanks can be substituted quickly for two high-pressure pumping skids and attached to the manifolds already in place. These tanks store an additional 16,600 gal of acid, which allows mixing and pumping as much as 107,000 gals of 15% HCl on the fly.

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The Galaxie stimulation package (top level); and bulk system (bottom level)
Fast mix-water transfer
The *Galaxie* has tank storage for 2760 bbl of mix water below the deck. This water can be transferred to the PCM* precision continuous mixer for fracturing at rates exceeding 40 bbl/min. Additional mix water can be stored in the ballast systems, increasing total capacity to 8460 bbl.

Seawater filtered on board
An on-board seawater filtration unit eliminates the need to transport and store large quantities of mix water for use in remote locations or staged treatments. All seawater used for treatments is filtered to 10 microns (nominal).

Precise liquid-additive control
Liquid additives are stored in 550-gal tanks on the upper deck. The basic tank configuration holds 7700 gal, and storage for up to 5500 gal more can be added for larger jobs.

Positive-displacement pumps connected to the tanks deliver additives at the precise rate the job design requires. The pumps, which are located in the blending center below the upper deck and controlled automatically from the PCM control rooms, are available in two classes to match rate requirements—0 to 12 gal/min and 12 to 36 gal/min.

Pumping of each additive is controlled individually to compensate for treatment-rate changes. Precise flow rates are calibrated volumetrically before treatment begins, and independent flowmeters confirm addition-rate accuracy throughout the job.

Continuous gel-mixing
The PCM mixer on the *Galaxie* maximizes treatment cost-effectiveness and minimizes environmental impact. Continuous mixing of gel treatments, using either fresh water or seawater, virtually eliminates material waste. It is faster than batch mixing and delivers seawater fracturing fluids in volumes not possible with a liquid bulk-system.

Maximum material use
Preparing gel on the fly ensures maximum use of materials. It eliminates the excess required for tank bottoms and the subsequent disposal concerns and bacteria-contamination problems.

Accurate gel loading
The PCM mixer prepares gel accurately and economically, delivering gel loadings from 5 to 80 lbm/1000 gal at rates up to 40 bbl/min. Gel-loading response to the blender is less than 5 s—nearly instantaneous.

The PCM mixer has a 10,000-gal, six-compartment, polymer-hydration reactor. Feed water enters through a control valve, and the additive system supplies the correct ratio of gelling agent to base fluid.

All systems are redundant for reliability. Additive rates can be controlled automatically or manually, and the fluid system can be adjusted in real time. A dry-add hopper and 40-bbl/min pumps are available, if needed.

In-line acid mixing
Acid systems are mixed on the fly using two 4200-gal mixing tanks at a raw acid transfer rate up to 25 bpm. The acid-blending equipment is capable of handling even the most complex acid systems—including oil-based emulsions—and can be used for both batch- and continuous-mixing operations.

All stimulation operations are controlled from the central control room.
Proppant-blending redundancy
The Galaxie has a POD® programmable optimum density blender with two diesel-powered, side-by-side, 35-bbl/min, vortex mixers. If one mixer fails, the other can be put into operation within seconds, providing 100% proppant-blending redundancy at rates up to 35 bbl/min.

The patented, double-disc, vortex mixers draw in fracturing fluid and mix proppant at the same time. They produce a uniform solid-liquid mixture without using a large averaging tub. This avoids delays when changing proppant concentrations and ensures precision and dependability—there is no auger to wear out and no seals that could leak.

The POD mixer’s specifications are

- proppant delivery—18,000 lbm/min with 100% redundancy at 9,000 lbm/min
- fluid delivery—70 bbl/min with 100% redundancy at 35 bbl/min
- proppant concentration range—0 to 22 ppa
- discharge pressure—100 psi.

On-board lab for quality control
An on-board laboratory ensures that stimulation products, base fluids and the final treating fluids meet specifications. The lab evaluates product and fluid samples from various points in critical blending areas—chemically, physically and rheologically. It also can run breaker tests.

Lab location next to the control room facilitates direct reporting of test results while treatments are being pumped. In addition, multiple samples from each treatment stage are retained for postjob analysis and evaluation.

High-pressure-pumping skids
The Galaxie has four diesel-powered, SPS-343 pump-skids designed for high-horsepower stimulation applications. They are rated at 2,000 hhp and can pump fluids at pressures up to 10,000 psi and rates up to 20 bbl/min. These skids have corrosion-resistant fittings, accessories and paint substrates and use seawater in the heat exchangers that cool the oil for their engines, transmissions and pumps.

The Galaxie also has one, twin-engine, 500-hhp pump-skid. It is used for jobs with low injection rates, such as coiled-tubing operations.

Quick-disconnect treating line
Fluids are pumped from the Galaxie to the rig or platform at treating pressure through a 300-ft 4-in.-diameter Coflexip line. The line is rated at 10,000-psi working pressure—15,000-psi test pressure—at a maximum rate of 40 bbl/min.

It is deployed from a reel and maintained at optimal length hydraulically. If an emergency occurs on the rig or platform, a quick-disconnect coupling is released remotely from the control room, allowing the Galaxie to move off location without delay.

Centralized control
Treatments are monitored and remotely controlled from a central control room that has an unobstructed view aft. A FracCAT® fracturing computer-aided treatment system monitors and records data and communicates them to the control room’s monitoring station, control console and data transfer system and the adjoining quality-control laboratory.

Continuous monitoring
Electronic, visual and mechanical monitoring of liquid and dry additive usage is continuous, and usage data are displayed and recorded. Quality-control data for fluids also are monitored continuously and reported to the control room throughout treatment execution.
Real-time adjustments
Control room personnel can make real-time adjustments to accommodate changing well conditions. They also can operate the Coflexip line’s quick disconnect, emergency shutdowns for all equipment, and the isolation valve for the pressure relief valve.

Decision-making support
Integration of the FracCAT system with FracCADE* fracturing design and evaluation software provides real-time analysis of pressure and other data to support critical decision-making during treatments. The control room also has network access through a local area network (LAN).

Remote data transfer
A stabilized satellite antenna and 128-Kbps data communication system enable the Galaxie to transmit treatment data recorded by the FracCAT system to any remote location in real-time. This allows personnel on shore to collaborate in data analysis and decision-making.

Secure Internet access
The InterACT* wellsite monitoring and control system allows secure, real-time access to these data over the Internet, using a standard Web browser. This dependable data-sharing system enhances the decision-making process, improves efficiency and substantially reduces travel and rig-time costs. Best-in-class encryption, a robust user authentication process and tight access controls ensure data privacy and confidentiality.

Numerous safety features
The Galaxie meets stringent Schlumberger and industry safety standards. The following are some of its notable safety features:
- One pressure-relief valve opens a bypass when a predetermined pressure is exceeded. The 3-in. full-opening nitrogen-charged valve is remotely controlled for immediate activation and adjustment.
- Overpressure shutdowns instantly disengage all high-pressure pump transmissions when the predetermined pressure is exceeded.
- An emergency kill-switch, engaged from the control room, immediately shuts off air and fuel to all pumps.
- Personnel are transported on and off the Galaxie from its elevated upper deck to reduce safety risks.
- The autolatch iron-rack system for loading and offloading needs no chains and binders.
- The dynamic positioning system is DPS Class 1 certified.
### Marine Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOA</td>
<td>220 ft</td>
</tr>
<tr>
<td>Breadth</td>
<td>44 ft</td>
</tr>
<tr>
<td>Draft (load line)</td>
<td>14 ft</td>
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<tr>
<td>Main propulsion engines</td>
<td>$2 \times EMD , 16-645 , E2 , diesel; , 3900 , hp , at , 1800 , rpm$</td>
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<tr>
<td>Azimuth drives</td>
<td>$2 \times 1350 , HRV , Ulstein; , 315-rpm, , 80\text{-in.} , diameter, , four\text{-blade} , FPP$</td>
</tr>
<tr>
<td>Thrusters</td>
<td></td>
</tr>
<tr>
<td>Tunnel bow thruster</td>
<td>$1 \times 700 , hp$</td>
</tr>
<tr>
<td>Tunnel stern thruster</td>
<td>$1 \times 500 , hp$</td>
</tr>
<tr>
<td>Dynamic positioning</td>
<td>DP Class 1</td>
</tr>
<tr>
<td>Communication system</td>
<td>128 Kbps , satellite transmission capability</td>
</tr>
<tr>
<td>Generator</td>
<td>$2 \times 150 , Kv$</td>
</tr>
<tr>
<td>Accommodations</td>
<td>12 for Schlumberger personnel and customers</td>
</tr>
</tbody>
</table>

### Stimulation Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-pressure pumps</td>
<td>$4 \times SPS-343 , 2000 , hhp$</td>
</tr>
<tr>
<td>Acidizing pump</td>
<td>$1 \times CPS , 361 , 500 , hhp$</td>
</tr>
<tr>
<td>Total pumping horsepower</td>
<td>8500 hhp</td>
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<tr>
<td>Cofflexip hose and reel</td>
<td>$1 \times 300 , ft \times 4 , in. , (10,0000-psi MWP) , mounted , on , reel , with , remote , disconnect , unit$</td>
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<tr>
<td>Pressure relief valve</td>
<td>$1 \times 3\text{-in.} , gas-operated$</td>
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<tr>
<td>Liquid cargo capacities</td>
<td></td>
</tr>
<tr>
<td>Fracture gel</td>
<td>2760 bbls</td>
</tr>
<tr>
<td>Fuel</td>
<td>2310 bbls</td>
</tr>
<tr>
<td>Ballast water</td>
<td>5700 bbls available for mix water</td>
</tr>
<tr>
<td>Dry bulk (proppant) cargo capacities</td>
<td></td>
</tr>
<tr>
<td>Bulk tanks (below deck)</td>
<td>$4 \times 1100 , ft^3$</td>
</tr>
<tr>
<td>Silo (above deck)</td>
<td>$1 \times 2000 , ft^3$</td>
</tr>
<tr>
<td>Total</td>
<td>6400 ft$^3$</td>
</tr>
<tr>
<td>Acid storage system</td>
<td>$4 \times 4200\text{-gal} , + , 2 \times 5800\text{-gal} , permanent , raw , acid , tanks$</td>
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<tr>
<td></td>
<td>$2 \times 8300\text{-gal} , temporary , raw , acid , tank$</td>
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<td></td>
<td>$16 , bbl/, \text{min} , raw\text{-acid} , transfer , rate$</td>
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<tr>
<td>General blender tanks</td>
<td>$2 \times 100 , bbl , capacity , tanks$</td>
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<td>PCM precision continuous mixer (fracture fluids)</td>
<td>$1 \times , PCM , unit , with , 240\text{-bbl} , capacity , and , 40 , bbl/, \text{min} , on\text{-the}\text{-fly} , mixing$</td>
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<tr>
<td>LAS* liquid additive system</td>
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</tr>
<tr>
<td>6 \times LAS channels: 15- to 50-gal/min capacity</td>
<td></td>
</tr>
<tr>
<td>8 \times 550-gal + 2 \times 250-gal liquid additive storage</td>
<td></td>
</tr>
<tr>
<td>2 \times LAS channel for liquid gel: 20 gal/min capacity</td>
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<tr>
<td>1 \times 1000-gal liquid gel storage</td>
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<tr>
<td>POD blenders</td>
<td>Process-controlled, , independent , or , parallel , operation</td>
</tr>
<tr>
<td>2 \times POD blenders (2 \times 35-bbl/min each)</td>
<td>2 \times 9000-lbm/min (0 , to , 22 , ppa)</td>
</tr>
<tr>
<td>2 \times dry-add feeders</td>
<td>1 \times PropNET* , feeder</td>
</tr>
<tr>
<td>1 \times one-compartment gravity silo (200,000 lbm)</td>
<td>1</td>
</tr>
<tr>
<td>Dynamic positioning</td>
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