



DEEP WATER



MATURE FIELDS



UNCONVENTIONALS

# Halliburton Baroid: SEPARATION SOLUTIONS

**ENGINEERED SOLUTIONS TO MAXIMIZE  
FLUID PERFORMANCE**



## Increasing Performance, Reducing Costs

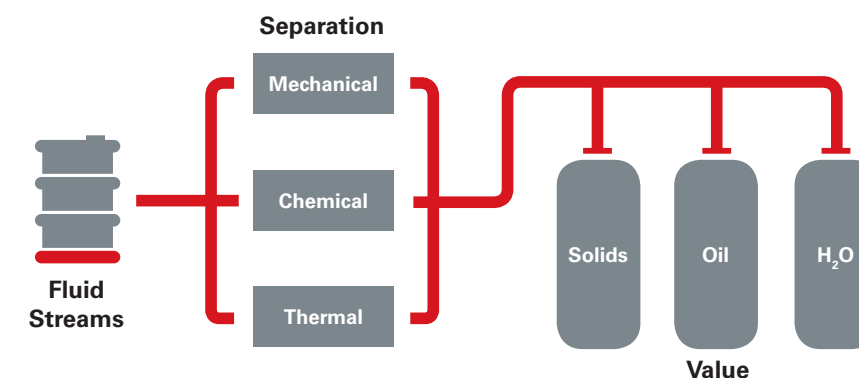
Separation solutions from Halliburton Baroid provide operators with a wide range of high-value services designed to maximize fluid performance and minimize environmental impact while providing measurable reductions in operational expenses. Thanks to process-driven execution, tailored design, market-leading technologies, and extensive experience, Baroid fluid separation systems help operators reliably achieve higher profit margins.

### Our separation capabilities include:

- » Engineering services
- » Solids control
- » Cuttings dryers
- » Thermal treatment
- » Cuttings reinjection
- » Swarf separation and recovery
- » Slop water treatment
- » Handling and transport
- » Filtration

## Achieving Next-Level Fluid Performance

Maintaining fluid properties helps increase drilling efficiency and overall performance. Predictable fluid densities and rheologies are critical in order to keep wellbore integrity intact, and effective solids removal is a key component to ensure fluid consistency. Baroid has a range of separation technologies and services to help you clear unwanted solids from your circulating system to extend the life of your fluids and maximize rates of penetration (ROPs).



## Maximizing Recovery

Efficiently separating disposable solids and waste from usable fluids can have a dramatic impact on project and fluid performance. By leveraging our mechanical, chemical, and thermal expertise and our technology portfolio, we can help drastically reduce disposal volumes and recover or reuse fluids, resulting in significant cost savings for our customers.



# Design-to-Delivery Separation Solutions

Designing and executing proper separation systems require skilled upfront planning and installation. Every system has unique requirements, and identifying the proper equipment and personnel is the foundation for successfully executing and maximizing overall project performance.

Our BaraSolve® engineering services provide you with access to a world-class, multidisciplinary engineering team with more than 100 years of combined experience to manage your solids control, separation, and handling projects from design to installation. The result is an optimal operational solution, along with comprehensive project management, to ensure that your business objectives are met.

Effective separation solutions must address multiple factors in today's challenging operations, including strict environmental regulations, waste treatment logistics and expenses, drilling efficiency and performance, and remote locations with infrastructure limitations. Our experienced engineering team carefully considers your requirements and constraints in order to deliver proactive and customized separation systems. The ultimate goal of these services is to maximize fluid performance and minimize environmental impact while providing measurable reductions in operational expenses.

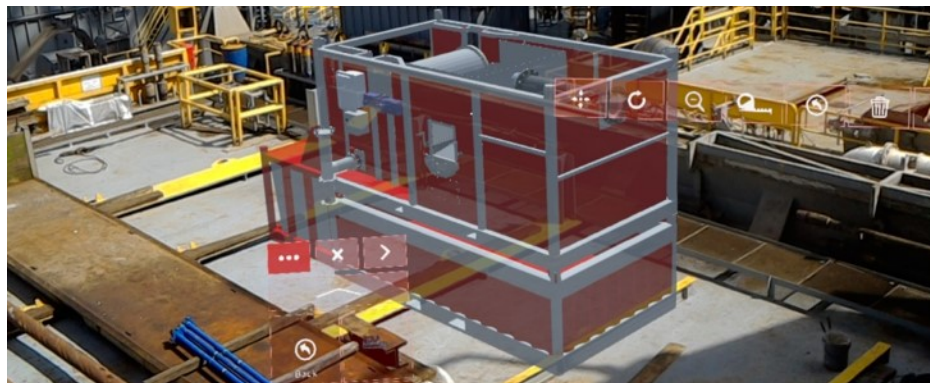
## Our engineering services for separation solutions include:

- » Project management
- » Engineering design
- » Site surveys
- » Technical drafting
- » Rig audits
- » Equipment installation
- » Feasibility studies

## Imersiv™ Augmented Reality and Virtual Reality:

Halliburton Baroid are transforming the traditional rig survey by using unique digital technologies that can save you multiple days of rig time, eliminate uncertainties, and improve accuracy of rig surveys.

The unique combination of Imersiv AR/VR technologies empowers rig personnel to scan the rig site, capture precise and detailed measurements, and generate 3D holographic scale models of the equipment. We then collaborate with you in real-time to overlay the equipment onto the physical rig space, enabling you to make decisions quicker and gaining confidence that your solids control and fluids management equipment is installed as planned.

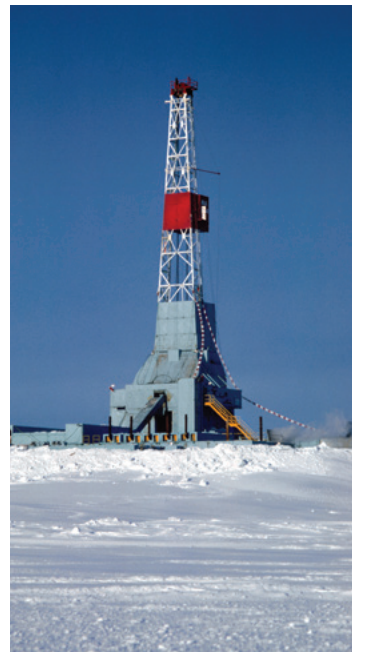


# Process-Driven Execution

The cornerstone to our solutions is process execution. Our technical and operational processes are designed to identify and address the value drivers for your operation. We collaborate with you to define what drives value in your operation, and we employ process engineering to tailor our separation solutions to meet or exceed each project's regulatory, operational, and economic objectives. This approach is used to deliver consistent results across all operating environments – from routine to extremely complex operations.

# Domain Expertise

Basin-specific knowledge and expertise, global experience, and extensive upstream lifecycle understanding enable Baroid to replicate lessons learned in specific basins or upstream disciplines and transfer them to other areas and emerging markets.







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# Solids Control

## OPTIMIZE FLUID PERFORMANCE

Baroid has a range of technologies and services to ensure that you extend the life of your fluids and that you also maximize rates of penetration (ROPs). Effectively and efficiently removing unwanted solids helps to lower fluid dilution rates, decrease the volume of required additives, achieve higher flow rates, and reduce fluid degradation. This helps minimize the cost of maintaining fluid properties and can decrease the volume of solid and liquid waste that must be transported for disposal. We provide solutions that deliver maximum solids removal to help you increase performance and reduce your operational expenses.



### Field Results:

ON AVERAGE, SCREEN  
LIFE HAS BEEN **18%**  
IMPROVED BY

RESULTING IN UPTO  
**41%** SCREEN COST  
SAVINGS PER RIG

### Shale Shakers

Shakers function as the first separation method to remove large solids from drilling fluids. From cost-effective, manually adjustable three-panel shakers to advanced, hydraulically actuated dual-pool designs with scalping decks, we can help engineer, install, and operate the optimum shaker setup to maximize the efficiency of your solids control system.

### Shale Shaker Screens

Total screen life and flow rates can help dramatically impact profitability, and we have constructed a unique portfolio of shaker screens to meet your needs. We will collaborate with you to find the right balance of cost and performance, regardless of shaker manufacturer, screen size, or cut point targets.

### BaraMesh® Shale Shaker Screens

Efficient solids removal can have a significant effect upon all aspects of drilling operations ranging from lower fluid maintenance costs to reduced nonproductive time (NPT). Poor screen selection can result in significant additional expenditures and can have a direct impact on the efficiency of drilling operations.

BaraMesh® screen cloth combines the high conductivity of a conventional, high-aspect-ratio rectangular mesh, the solids-removal capabilities of a square mesh with the ability to outlast other screens. The foundation of our design is based on using a rectangular screen shape comprising a heavier wire diameter.



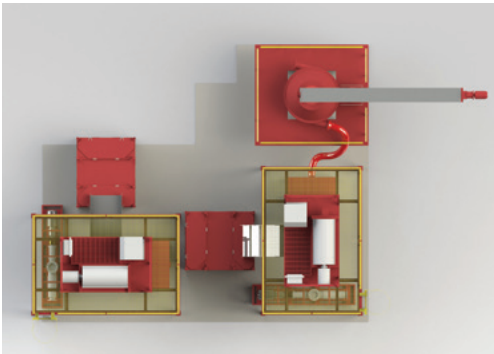
Centrifuges

Centrifuges can be added to any solids control system to further enhance solids separation and to recover both weighting agents and fluids. We can help identify the optimum centrifuge for your operation to deliver fluid performance that meets or exceeds your expectations, along with weighting agents and base oil recovery to protect your bottom line.

Mixing and Shearing

The On-The-Fly (OTF) Mixer is a highly portable system specially designed to provide a continuous, high-volume, high-flow-rate blend of seawater, riserless drilling fluid, and, when necessary, brine.

The Hydraulic Shearing Unit is used to ensure that desired fluid properties are achieved before they are used in the active system. This unit conditions the fluid to simulate rigsite drilling conditions through a drill bit. Fluids sheared with the unit show significant improvements in stability, yield point, and low-shear rheology.



CASE STUDY

While operating in the Colorado Rockies, an operator was attempting to maintain mud weights at or below 8.6 ppg, but found that, by using a single HH 5500 centrifuge, the mud weights would slowly creep up to approximately 9–9.1 ppg.

Baroid implemented a customized dewatering unit, enabling the customer to maintain the rig's active system at the ppg levels requested, while removing more solids content by enhancing the centrifuge capabilities and improving the mud properties throughout all sections of the well. These changes allowed the operator to save approximately eight hours of dewatering time on each well, and to also maintain and improve drilling ROPs as a result of cleaner fluid and lower solids content.

SAVED  
**8HRS**  
OF DEWATERING  
TIME WHILE  
MAINTAINING &  
IMPROVING ROP

Dewatering

Water clarification or dewatering is the chemical process by which water-based fluids and slurries are treated to separate water from the suspended solids. We offer dewatering services to treat water to be recycled at the rigsite as drill water or wash water. Recycling can reduce the volume of waste to be disposed of and helps minimize the total environmental impact of a drilling operation. Depending on local regulations and the drilling additives used, our dewatering systems may produce water that can be safely discharged to the environment.





# Separation and Handling

## REDUCE COSTS AND MINIMIZE ENVIRONMENTAL IMPACT

Reducing overall disposal volumes can help minimize or eliminate transportation costs and liability, while also reducing reliance on landfill options for final waste disposal. We offer a range of separation capabilities that provide mechanical, chemical, and thermal means to enable significant volume reductions, fluids reuse, and advanced cuttings treatment to minimize transportation and environmental risk.

For the remaining solids and liquids that do require handling and transport, we provide custom solutions according to local conditions to maximize drilling efficiency and to meet or exceed safety and environmental regulations.

### CASE STUDY

On a previous well, an operator in a U.S. land operation disposed of all cuttings and liquid mud coming off the shakers, resulting in excessive waste of oil-based mud (OBM) and extremely high disposal costs. Baroid implemented a trailer-mounted VCD designed to provide efficient throughput, even while drilling at a high ROP. The application of this technology enabled the operator to recover 2,398 bbl of oil off the cuttings, reducing the oil OOC level to 3.83 percent. This led to savings of USD 301,900 due to a 40 percent reduction in trucking and disposal costs.

RECOVERED  
**2,398 BBL**  
OF OIL OFF THE CUTTINGS

USD 301,900  
SAVINGS  
DUE TO A **40%** REDUCTION  
IN TRUCKING

### VERTICAL CUTTINGS DRYERS

- » BaraG-Force™ V-71 – Small footprint installations and low power consumption with 25–45 tons/hour processing capacity
- » BaraG-Force V-133 – High-capacity, high-ROP operations with 40–60 tons/hour processing capacity
- » BaraG-Force mobile VCD – Fully mobilized for remote locations and multi-rig projects with 25–45 tons/hour processing capacity
- » BaraG-Force VacVCD system – Combines a pneumatic transfer and VCD system in a modular package featuring 25–45 tons/hour processing capacity

### Cuttings Dryers

When cuttings from oil-based fluid projects exit the shakers, oil content can be in excess of 15 percent. We have established two vertical cuttings dryer (VCD) systems to help reclaim valuable base fluids and reduce the oil on cuttings (OOC) levels to below 5 percent. This helps reduce dilution rates and additive use for improved fluid consistency, and the lower OOC level allows overboard discharge in approved areas. Our BaraG-Force™ cuttings dryer portfolio can help you reduce disposal volumes while meeting environmental regulations and reducing overall project costs.

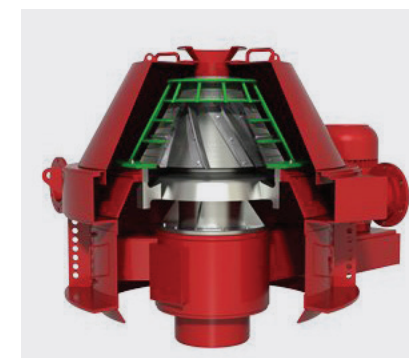
Every project has unique requirements. We can help identify the right technology and configuration for your rig to deliver maximum efficiencies.

### BaraG-Force™ Mobile VCD Systems

The BaraG-Force mobile VCD includes a centrifuge unit that features a high-capacity, decanting centrifuge designed for continuous feed. This centrifuge has the efficient throughput necessary for real-time oil-based drilling operations. The mobile unit can easily move on and off location and reduces costs and logistics associated with rig-up and rig-down operations.

### BaraG-Force VacVCD Systems

The BaraG-Force VacVCD system combines a proven pneumatic transfer system and an efficient VCD design in a single, modular package. The integrated system reduces rig space and enables the transport of cuttings from the shakers to the integrated VCD without the use of augers or lifts.







**Thermal Treatment Solutions**

Efficiently separating solids and waste from usable fluids can have dramatic impacts on project and fluid performance. Thermal treatment technologies can be the most efficient and effective way to reduce overall waste volumes and recover valuable base fluid for reuse in the active mud system. Our BaraPhase™ line of thermal treatment options includes proven legacy indirect drum systems and the latest friction-based onshore and offshore thermomechanical cuttings cleaners to help you recover maximum base oil and deliver less OOC.

Equipment is only one piece of a thermal processing solution. We can help define both the equipment and fluids to maximize base oil recovery, minimize waste volumes, and lower the cost of your operations.

**Onshore and Offshore Thermomechanical Cuttings Cleaners**

Baroid has developed a range of thermomechanical cuttings cleaner (TCC) options to provide thermal treatments of cuttings in both onshore and offshore applications. The TCC design can be adjusted based on rig constraints and operational requirements. The friction-based cuttings treatment utilizes rotating hammers to create heat, thus eliminating the risk of other thermal treatment options that utilize open flames. This helps TCCs achieve Zone 2 ratings, so they can be installed next to the shaker house.

TCCs can be configured to process three or six tons per hour on land, or six tons per hour offshore. Land-based installations are able to process waste and cuttings from multiple rigs or wells simultaneously, while offshore installations are stackable to help reduce deck space requirements and free up space for other assets.

This advanced thermal processing can reduce OOC to below 1 percent. During processing, oil recovered from the cuttings can be used into the active mud system to help reduce overall material consumption and to lower fluid costs. Additionally, the ability to recover and reuse oil helps maintain fluid properties and contributes to overall fluid performance throughout the drilling project.

**CASE STUDY**

A project in Kazakhstan required that the operator comply with disposal regulations stating that final treated cuttings oil content have an OOC level of less than 1 percent. Baroid personnel customized a separation strategy, using the TCC system. Over the course of four years, the operator has treated more than 36,000 m³ of cuttings by using this system, with zero NPT or spill incidents recorded. The operator also saved an estimated USD 5.6 million by recovering, rather than incinerating, 4,500 m3 of base oil.

**RECOVERED**  
**4,500 m³**  
**OF BASE OIL**

**SAVED**  
**USD 5.6 M**

**Thermal Desorption Solutions**

The goal of any thermal desorption technology is to produce oil-free or ultra-low total petroleum hydrocarbon (TPH) solids for disposal by distilling the oil from cuttings and recovering it to be reused as drilling fluid. Baroid can select the most suitable technology for your operations and optimize it based on the available footprint and capacity requirements.







CASE STUDY

For an offshore operator, Baroid implemented a BaraCRI™ system to improve efficiency and help meet environmental regulations. To date, more than 1.3 million bbl of cuttings, waste mud, and seawater have been injected. This eliminated the transport of more than 10,000 skips, helping the operator save more than USD 4 million.

OVER **10,000** SKIPS

SAVED **USD 4M**

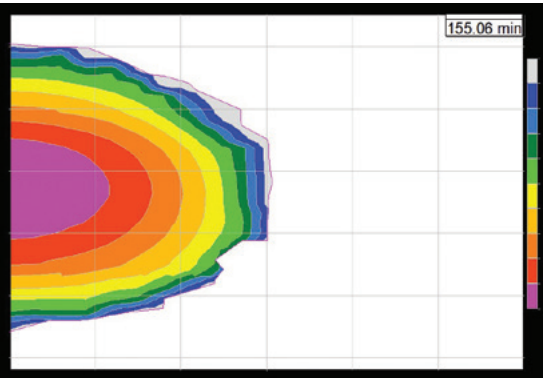
Cuttings Reinjection Solutions

As transportation costs rise, disposal regulations become increasingly restrictive, and more cuttings are classified as hazardous waste, cuttings reinjection (CRI) can be an optimal solution for the disposal of drilling waste in many applications.

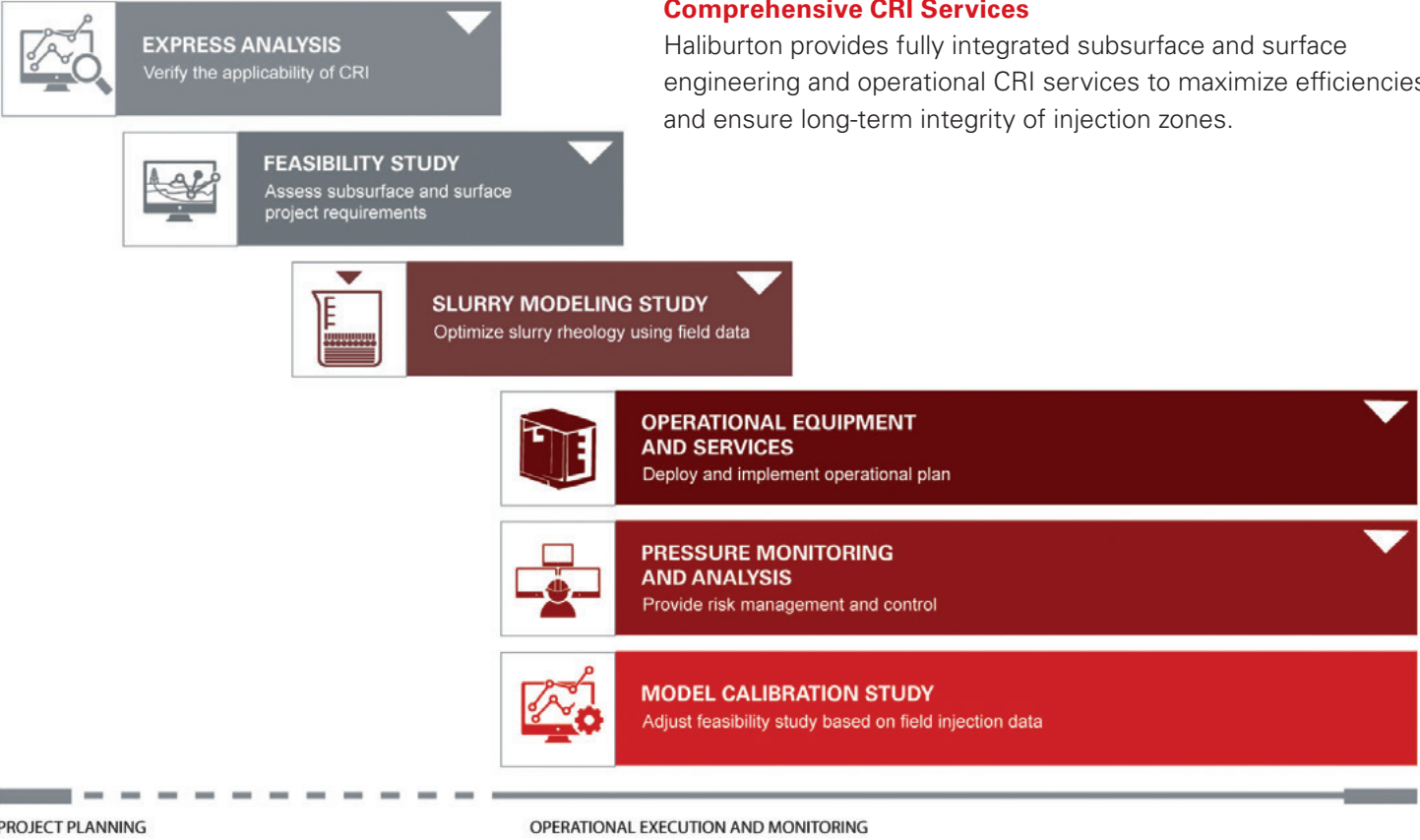
CRI provides a permanent and contained zero-discharge solution for drill cuttings and other operational waste. The waste streams are normally injected as slurries or fluid batches into induced fractures created by the injection process in the selected injection zone. This disposal technique helps mitigate the environmental risks and liabilities associated with the transfer, transportation, treatment, and disposal of drilling waste at the surface.

BENEFITS

- » Reduce the negative environmental impact of drilling waste surface disposal (such as for drilled cuttings, rig wash, dewatering water, and contaminated rainwater in cuttings pits)
- » Decrease the need for surface storage and cuttings pits
- » Eliminate cuttings and drilling waste transportation risks
- » Allow the disposal of different waste streams via one method



Our BaraCRI™ cuttings reinjection (CRI) services provide a comprehensive approach that is tailored to the specific needs of each project. We combine upfront geomechanical analysis and slurry modeling with best-in-class technology to engineer CRI systems that meet your operational and environmental requirements. Through pressure monitoring and analysis, we provide risk management and control services to make certain operations run smoothly. Our calibration study includes geomechanical modeling to align initial feasibility data with operational injection data to inform any potential adjustments to the operational plan.



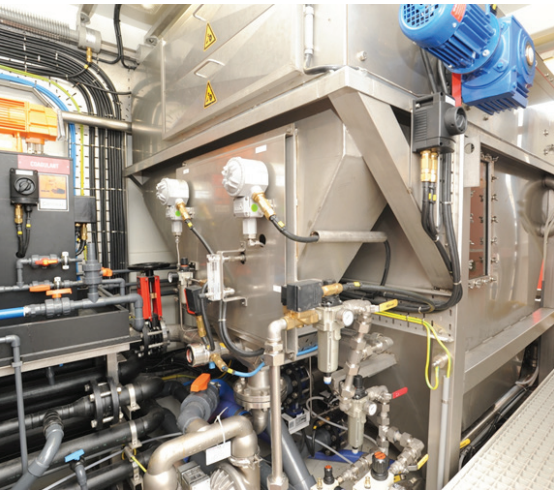
Comprehensive CRI Services

Haliburton provides fully integrated subsurface and surface engineering and operational CRI services to maximize efficiencies and ensure long-term integrity of injection zones.



SWARF SEPARATION AND RECOVERY APPLICATIONS:

- » Plug and abandonment
- » Platform decommissioning
- » Sidetracks
- » Offshore platforms, semis, jackups, and drillships
- » Onshore drilling and workover rigs



Swarf Separation and Recovery

Significant quantities of swarf (metallic shavings, filings, and particulates) can be generated during slot recovery and decommissioning operations that may require the removal of sections of the original casing strings. Where cut and pull of the casing are not options, extensive milling may be required. Additionally, section and window milling to sidetrack wells often generate large quantities of swarf. Removal of swarf from a milling fluid requires a reliable and efficient means of separation at surface to ensure successful operations. Failure to remove this harsh metallic material leads to issues including excessive wear and tear on rig surface equipment; contamination of drilling fluids; and health, safety, and environmental (HSE) risks to personnel.

The BaraMag™ swarf separation and recovery unit is designed to separate the swarf from the drilling fluid by mechanical and magnetic means. Return flow from the well passes through the unit, with the first stage capturing the majority of the swarf and discarding the material into a collection skip. The swarf is then transported to an onshore facility where the metal is recovered for recycling. A final separation and polishing stage removes fine to ultra-fine magnetic particles that may still be entrained in the fluid.

Slop Water Treatment Solutions

Conventional management of offshore drilling slop is costly. Regardless of the composition, all slop is typically shipped to shore for treatment and disposal. In addition to the high transportation cost, the process of shipping to shore for treatment exposes operators to the hazards and risks associated with the logistics of transport.

The BaraH<sub>2</sub>O™ slop treatment unit is modular and highly efficient, and can treat a range of oily water slop produced on a rig – at the source. Clean water from the unit can be discharged directly to the environment or reused in pit washing operations. The unit will significantly reduce slop sent onshore for treatment by up to 95 percent.

The processing principles are based on a combination of chemical treatment and dissolved air flotation (DAF). The chemicals flocculate and bind together particles, making them easier to separate. This then allows flotation by dissolved air to separate both particles and oil from the slop water, leaving the effluent in an acceptable condition to be discharged to the environment or reused on the rig.

CASE STUDY

An operator used a BaraClear™ Hi-Flow Filtration unit to improve fluid and operational efficiency. By reducing the NPT associated with cleaning conventional filtration units, the operator saved eight hours of rig time, valued at approximately USD 330,000.

SAVED  
8 HRS  
WORTH  
USD 330,000

BARACLEAR™ FILTRATION SOLUTIONS:

- » Dual pod filter units
- » Filter presses
- » Hi-flow filtration
- » Oil and grease monitoring

CLEANWELL® SOLUTIONS:

Our integrated wellbore cleanout solutions effectively clean your well, preparing it for completion while minimizing rig time and waste fluids. These solutions include:

- » Engineering expertise and software
- » Single-trip tool systems
- » Engineered suite of customized BaraKlean® cleanup pills
- » Equipment with flow rates of 30–37 bpm
- » Integrated design and operations that help provide increased efficiency
- » Customized solutions for well and installation requirements

Filtration Solutions

Clean fluids are critical to enable successful completions and workovers. Solids or oil and grease particles can plug the formation and prevent the proper flow of hydrocarbons; therefore, effective solids or oil and grease removal can provide measurable benefits in reservoir performance. Removing these particles often requires a combination of filtration methods.

BaraClear™ filtration services can help identify and apply targeted solutions to clean the wellbore of contaminants and prevent particles from blocking pores in the formation. We have developed a range of solutions, including dual pod filtration units and traditional filter presses to go along with advanced solutions for technically challenging wells and low-permeability formations to help ensure maximum filtration, minimum formation plugging, and environmental compliance.

BaraClear™ Hi-Flow Filtration Units

Our BaraClear Hi-Flow Filtration units nearly double the flow rates of standard filter presses and incorporate unique safety features. Pneumatic, direct diatomaceous earth (DE) delivery helps reduce dust exposure, while a fiberglass work deck placed above piping and a single-point hose collection area help improve worker safety. We can customize installations for any rig to help you to achieve consistent and optimized filtration rates, decrease circulating time, and reduce HSE risk.





CASE STUDY

An operator asked Baroid to review and optimize its cuttings transportation system in the Mediterranean Sea. The existing method leveraged a screw conveyor as the primary, and only, means of transporting cuttings from the shakers to a zero-discharge cuttings handling system.

Using our BaraSolve™ engineering services, we provided a tailored solution that included the installation of two BaraStream™ SV400 cuttings collection and pumping units and four HCB™ tanks on the drillship as backup cuttings transport and storage solutions.

This solution enabled the operator to avoid 22 hours of NPT, equating to rig time savings of approximately USD 744,000. Furthermore, Halliburton mitigated the wider risks associated with stopped circulation, stuck pipe, and time lost to trips out of the hole.

OPERATOR SAVES  
**USD 744,000**  
IN RIG TIME,  
AVOIDING  
**22 HOURS**  
OF DIRECT NPT

Handling and Transport

Bulk Handling Solutions

In zero-discharge or limited-discharge areas, drill cuttings and waste will often need to be transported to an offsite treatment and disposal facility. Vessel constraints and weather conditions play a significant role in the efficiency of transportation solutions, and HSE risks associated with augers, crane lifts, and potential spills can further increase transportation liability. Our BaraStream™ bulk handling solutions help operators reduce these risks through pneumatic conveyance and storage and transport capabilities.

Our BaraStream solutions are modular; they include patented technologies, and can be integrated as a transport and collection method into various cuttings treatment solutions, such as thermomechanical cuttings cleaner and cuttings reinjection methods. We collaborate with operators to understand the unique requirements of your projects to deliver a custom solution designed for maximum reliability.

A typical system includes the pneumatic BaraStream™ SV400 pumping system to collect and transport cuttings to skips, honey comb base (HCB™) tanks on the rig or vessel, or cuttings transport tanks (CTT) on the vessel.



HCB™ TANKS

- » Handling capacity of 11 m³ per tank
- » Designed for standard 8 ft x 8 ft x 20 ft ISO frame
- » Easily scalable modular design
- » Patented honeycomb pattern tank bottom
- » Six sequential discharge points at bottom of tank
- » Can be lifted horizontally or vertically during mobilization and demobilization



CTT UNITS

- » Holding capacity of 15 m³ per CTT
- » Common vessel configurations include up to 16 CTT units, or the equivalent of 60–90 skips
- » Standard 20-foot ISO container
- » ISO lock frame
- » Modular and scalable design
- » No manual handling required
- » Pneumatic fill capabilities
- » Hydraulic discharge functions

Pneumatic Systems

Our line of fully pneumatic BaraStream vacuum and blower systems helps reduce HSE risk and NPT, as well as improve cuttings handling efficiency in onshore and offshore applications.

- » BaraStream SV400 system – High-capacity, compact, and versatile air-operated vacuum/blower unit
- » BaraStream SV60 system – Highly portable solution for small-scale fluid transfer

Traditional Solutions

Auger Systems

We can help design the most efficient auger system for your rig, with added safety and maintenance features, such as immediate-stop brakes and quick-release couplings to help reduce HSE risks and improve cleaning or repair times.

Skip and Ship or Skip and Truck Options

We provide variable-capacity skip options with modular and stackable containers for onshore and offshore cuttings transport.







# HALLIBURTON

## BaraEco™ Centu

### Facilities

#### Separation Facility

Located north of Aberdeen, Scotland, in Peterhead, our BaraEco™ Separation Centre is purpose-built to provide comprehensive liquid and solids treatment to ensure that operators meet or exceed all regulatory requirements. With the ability to process over 55,000 tons (50,000 metric tons) of drill cuttings and 33,000 tons (30,000 MT) of slops annually, it is one of the largest drilling waste storage and treatment facilities in the industry. This facility also features a fully equipped onsite laboratory with dedicated research and development (R&D) space, and serves as the Eastern Hemisphere separation solutions training hub.

#### Mobile LMP

The BaraSwift® mobile liquid mud plant (LMP) is easily and quickly deployed, and reduces logistical constraints of typical LMP solutions. While the standard configuration includes onsite storage for 1,030 m<sup>3</sup> (6,480 bbl), the modular BaraSwift LMP design enables its storage capacity to be tailored according to the operator's needs.

## Why Halliburton

### Engineered Separation Technology

Combining our mechanical technologies and manufacturing capabilities with our robust chemical portfolio and know-how, Baroid engineers and customizes solutions that deliver fluid performance.

In addition to our current technologies, Baroid continues to develop new and innovative solutions to solve the challenges that operators will face in the future.



Sales of Halliburton products and services will be in accord solely with the terms and conditions contained in the contract between Halliburton and the customer that is applicable to the sale.

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