Multiphase Boosting & Wetgas Compression
Green Oil & Gas production by using Bornemann Multiphase Technology

Bornemann designs and manufactures tailormade Twin Screw Multiphase Systems that help the oil industry eliminate methane flaring when processing Multiphase mixtures of liquids and gases. This benefits customers by improving production efficiency, reducing emissions and helping them comply with government regulations.
Land-based projects: The same straightforward installation and cost savings apply. Whatever the situation – permafrost, desert, jungle – multiphase is the solution.

Economical and Sustainability Approach:

- Zero flaring - Zero CO₂ - Zero environmental pollution
- Commercial usage of the gas as energy resource
- Footprint reduced to a minimum
- Clean Production
- Less equipment - Less Total Cost of Ownership
- Prolonged lifecycle of the oil well by Multiphase wellhead pressure control

More than 600 proven references of installed Bornemann Multiphase Boosting Systems.

www.bornemann.com
No Separation, Zero Flaring

Conventional Technology

Multiphase Technology and Customer Benefits

Unpredictable Flow
The focus is on unpredictable flows, previously considered as unprofitable. Twin Screw Multiphase Pumps handle these with ease and at a fraction of the conventional costs.

Untreated Stream
Twin Screw Multiphase Pumps offer a reliable solution to suit a whole range of potential flows. Untreated products ranging from wet-gas to heavy crude are reliably pumped in any situation, off-shore, thermal or conventional. In addition flaring can be avoided making this byproduct available for profitable use.

Prolonged Production
Exploiting oilfields in harsh or inaccessible environments and extending the lifecycle of oil wells is the perfect opportunity to generate a sizeable profit. A comparatively low investment and impressively reduced Total Cost of Ownership are the commercial benefits.
### Process Flexibility
Untreated stream and unpredictable flow can be handled by using Twin Screw Multiphase Pumps to guarantee highest process flexibility. Multiphase fluids with Gas Volume Fraction up to 100% can be handled. Using Twin Screw Multiphase Pumps, there is no risk of plugging caused by Wax or Paraffin.

### Less Complexity
No separation in the oil field during the pumping process makes wellhead separators and associated equipment obsolete. A simplified system layout results in less footprint.

### Fast Payback
Using Twin Screw Multiphase technology leads to a reduced back pressure, resulting in an increased flow and a shorter return on investment. End-users can expect longer production cycles from existing fields. A simplified layout and less installed equipment reduce capital and operation costs.
Multiphase Pump Series

MPC HC / MPC HC-S

- High capacity applications
- ≤ 100 % GVF (MPC HC) / ≤ 99 % GVF (MPC HC-S)
- Differential Pressure up to 50 bar (725 psi)
- Flow from 50 m³/h (7,457 BPD) up to 8000 m³/h (1,207,547 BPD)
- 300# rating

MPC HD / MPC HD-S

- High differential pressure applications
- ≤ 100 % GVF (MPC HD) / ≤ 99 % GVF (MPC HD-S)
- Differential Pressure up to 120 bar (1,740 psi)
- Flow from 50 m³/h (7,547 BPD) up to 5000 m³/h (754,717 BPD)
- 300#, 600# and 900# rating

MPC HC / MPC HC-S

- High capacity applications
- ≤ 100 % GVF (MPC HC) / ≤ 99 % GVF (MPC HC-S)
- Differential Pressure up to 50 bar (725 psi)
- Flow from 50 m³/h (7,457 BPD) up to 8000 m³/h (1,207,547 BPD)
- 300#, 600# and 900# rating

MSL

- Single well applications
- ≤ 99 % GVF
- Differential Pressure up to 22 bar (319 psi)
- Flow from 5 m³/h (755 BPD) up to 250 m³/h (37,736 BPD)
- 300# rating

MW

- Standard applications
- ≤ 97 % GVF
- Differential Pressure up to 50 bar (725 psi)
- Flow from 50 m³/h (7,457 BPD) up to 5500 m³/h (830,189 BPD)
- 300# rating
The unique rotor design enables Bornemann to maintain a short bearing span and a compact pump design. The best suitable material selection for the feed screws and shafts in respect to bending and corrosion resistance.

Screws with a decreasing pitch. Reliable manufacturing process for screws with decreasing pitch. Proven increase in efficiency for Multiphase service. Substantial decrease in Total Cost of Ownership by smaller drive train and lower power consumption.
Unique Design Features

The heart of each Multiphase System is the Bornemann Multiphase Pump.

More than 80 years’ experience in Twin Screw Pump Technology and above 30 years’ experience in Multiphase Boosting Technology with more than 600 references of installed Multiphase Boosting Systems demonstrate Bornemann’s worldwide leadership.

Systematic research and development are leading to innovative solutions for the future.
**Designed as a Multiphase Pump with internal liquid recirculation**
- less system complexity
- higher reliability
- enlarged separating casing for liquid hold-up
- up to 100% dry run capability

**Engineered Rotor Set**
- superior material selected to purpose
- higher mechanical core strength
- reduced spare part cost

**Customized Screw Profile**
- long service life
- high efficiency
- customized to process

**Compact Design**
- short bearing span
- minimized shaft deflection
- high efficiency

**Low Pulsation**
- less vibration
- long service life

**Constant Conditions on Mechanical Seal**
- extended service life
- mechanical seals rated for fully designed system pressure
- designed for Multiphase conditions
Tailormade Multiphase System Solutions

Complete Multiphase Boosting Systems
With an extensive experience in research & development, engineering, production and commissioning all over the world Bornemann is able to supply complete system solutions – for a wide range of performance conditions and harsh ambient environmental conditions.
The skid-mounted Multiphase Pump is equipped with all necessary instrumentation and safety devices. Bornemann supplies complete Multiphase Systems including electrical drive system with motor, variable frequency converter and all required electrical / mechanical auxiliaries. Prior to shipment, the complete Multiphase System will undergo a complete system factory acceptance test.

**Safety first**
The Bornemann system guarantees full safety and automatic operation under all circumstances.

- Fail and fire safe ball valves isolate the Multiphase Pump System inlet and outlet
- Automatic shut down in case of out of range measuring value
- Hard wired emergency chains
- Constantly monitored Multiphase process

**Plug and Pump**
The skid-mounted Multiphase Pump is equipped with all necessary instrumentation and safety devices. Bornemann supplies complete Multiphase Systems including electrical drive system with motor, variable frequency converter and all required electrical / mechanical auxiliaries. Prior to shipment, the complete Multiphase System will undergo a complete system factory acceptance test.
Conventional Multiphase Boosting

In the future, one of the most important sources of oil will be reserves that have already been discovered but have not yet been recovered.

Even though the performance of individual fields varies widely, and advancing technology is improving recovery, still more than half of the world’s oil found to date remains in declining and abandoned fields. Bornemann Multiphase Boosting recovers more of this oil and extends field life by reducing wellhead pressure.

The rate at which oil flows from a reservoir to the production tubing depends heavily on the pressure loss across perforations, a screen, a gravel pack and other elements of the completion. Inflow also depends on pressure losses in the tubing and in surface production equipment.

Application Challenges
Reducing wellhead pressure is an important way to boost production throughout the life of a field. Minimizing wellhead pressure is especially critical as reservoir energy declines, in economically marginal fields, and where an enhanced recovery method is being used.

Flow restriction caused by surface back pressure on the reservoir can be eliminated by installing a Bornemann Multiphase Boosting System at the wellhead or at a manifold that combines production from several wells. Multiphase Boosting can also eliminate the need for field separators, and provide other advantages in remote or restricted areas where more traditional approaches to field development are not possible.

In a wide range of oil and gas production applications, Bornemann Multiphase Boosting is capable of:

- Inlet pressure as low as 0.1 barg (1.5 psig)
- Differential pressure as high as 120 bar (1,740 psi) with a single pump
- Operation in combination with a down hole pump or gas lift system
- Operation either in parallel (for high volume or redundancy) or in series (for high differential pressure)
- Unmanned, remote-controlled operation

The Solution
The core of the Bornemann Multiphase Boosting System is a Twin Screw positive displacement pump. Patented features allow it to handle all fluid mixtures, even pure gas at the pump inlet. Among other advantages, the ability to handle a range of fluid mixtures helps to prevent the formation of emulsions. Inlet pressure – wellhead pressure – is kept constant by adjusting the rotational speed. As an integrated part of each Bornemann Multiphase Boosting System, the control system is able to operate the system on a constant inlet pressure by speed adjustment.

A Bornemann Multiphase Boosting System consists of a Twin Screw pump and a driver (usually an electric motor) which are installed on a common base plate to minimize the unit’s footprint. Remotely operated, fail-safe ball valves on both inlet and discharge isolate the pump in case of unexpected operating conditions.
An inlet strainer and a discharge check valve, along with the necessary instrumentation complete the system. This gives the Multiphase Boosting System the versatility to safely operate in a variety of applications and conditions including offshore platforms, remote locations and environmentally sensitive locations, just to name a few.

Advantages
A Bornemann Multiphase Boosting System helps to reduce back pressure, which results in increased flow and a shorter return on investment.

The system also offers:

- Reduced capital and operating cost as a result of simplified field layouts and streamlined maintenance
- Elimination of field separation and flaring, reducing environmental impact
- Safe and continuous operation, even when remotely operated
- Single vendor sourcing with complete engineering and operating responsibility

References
In early 2000, a Bornemann Multiphase Boosting System was installed in the Midway Sunset Oil Field in California, USA. The Multiphase Boosting System reduced the back pressure on rod pumps, well stuffing boxes, and flow lines resulting in a significant boost in production from diatomite wells.

The client recognized the environmental benefits of operating a Multiphase Boosting System instead of conventional facilities realizing the following benefits:

- Improved project cycle time by reduced regulatory permitting requirements.
- Reduced spill potential by eliminating tanks, fin fans, and lowering pressure on the flow lines and stuffing boxes.
- Smaller footprint which disturbs the natural habitat less and lowers location construction costs.

By using Bornemann Multiphase Boosting Systems, the pump suction pressure fell from about 200 psi to as low as 20 psi and production rates increased threefold from about 1,000 BPD to 3,000 BPD.

Design Features
Bornemann Multiphase Pumps feature:

- A patented enlarged pump casing that provides an internal liquid hold-up chamber and a recirculation valve, to allow for a “dry running” condition (100 % GVF)
- Field-replaceable pump internals
- High strength rotor designed for harsh operating conditions and changing flow requirements

- Short bearing span with reduced mechanical seal diameter for improved reliability and a more compact unit
- Simple, reliable oil bath lubrication also in Multiphase System arrangements where external Lube Oil Systems are required
- Designs tailored to each application that complies with major international quality and safety standards
Global reserves of heavy crude are significant. To date, the contribution of heavy oil to world supply has been modest, but as lighter crudes become harder to find, the demand for heavy oil will significantly increase. Bornemann Multiphase Boosting is capable of handling the special challenges faced by heavy oil producers. Heavy oil reserves exist in several areas of the world and often involve severe operating environments.

Bornemann has extensive experience in Heavy Crude Oil Multiphase Boosting environments.

For example, in Venezuela’s Orinoco Belt, where oil viscosity is 8°-12° API, Bornemann has a proven track record in the application of Heavy Crude Oil Multiphase Boosting.

**Application Challenges**

In addition to high viscosity, the use of Multiphase Pumps in boosting heavy oil, faces other unique challenges such as:

- The crude may be diluted with light crude or naphtha
- Gas Volume Fraction is typically low during early production, then increases
- Very heavy liquid slugs can enter the pump, requiring the pump system to adjust the speed to changed process requirements
- Water cut may gradually increase at any moment during production
- Production may be intermittent and artificial lift systems may be overloaded
- Very high sand content may apply, which has to be boosted together with the production

**The Solution**

Bornemann’s heavy crude oil Multiphase Boosting Pumps are equipped with a special internal recirculation valve that reduces pressure peaks to minimize vibrations caused by slugging because well stream fluid phases can change quickly.

The very high viscosity of the fluid also requires that the operating speed be reduced. Pumps selected for heavy crude applications run at moderate speeds and the pump screws have a larger-than-normal pitch. The lower speed and larger pitch ensure that the chambers of the pump are filled to minimize noise and vibration.

Many Multiphase Boosting applications in heavy crude oil service are in newly developed fields. In Venezuela’s oil fields, Multiphase Boosting Systems are supplied as a complete package, specially designed for Heavy Crude Oil Multiphase Boosting.

**Advantages**

Bornemann’s robust Twin Screw Multiphase Pump for heavy crude oil service helps increase production and reduce capital and operating expenses. A Twin Screw Multiphase Pump operates on the positive displacement principle which offers the following key advantages:

- Not sensitive to phase changes
- Able to handle any combination of oil, water and gas.
- Easily adapt to changing capacity requirements by speed control
- Can handle hard particles
- Special coating developed for heavy sand loaded fields
In Venezuela’s Orinoco Belt, heavy oil fields are typically located about 20 km from the gathering station. Production must be diluted with light crude or naphtha before entering the pipeline.

The many installations in the Orinoco Belt have made it possible to standardize multiphase boosting systems for the fields in this heavy oil region. Operating experience in Orinoco has also provided much of the information needed to further advance the multiphase boosting technology.

In the Petrozuata oil fields, desanders were taken out from the process before central processing to keep the installation simple and centralized.

Bornemann Multiphase Boosting Systems are designed with specially engineered and coated pump internals that have been demonstrated to handle the high sand loaded well stream without any significant increase in wear.

The first Bornemann Multiphase Systems, in Venezuela, were installed more than 20 years ago and are still in continuous operation within their designed range. Over this period of time, the Multiphase Boosting Systems were able to successfully adapt to the varying field operating conditions, including the usage of the different artificial lifting methods.

The installed Bornemann Multiphase Boosting Systems are all remotely operated.

**Design Features**

Bornemann Multiphase Pumps for heavy oil service feature a patented large pump casing with an internal separation chamber for liquid hold-up.

Rotor materials and pitch are specially engineered for each application.

For high sand loaded well streams, which are typical in heavy crude oil applications, Bornemann has developed special coatings for the Multiphase Pump internals which have been successfully tested and approved in several applications.

Multiphase boosting systems can be relocated, and if capacity requirements at the new location are different, screws can be changed and the Multiphase System can easily adapt to new process conditions.

High gas content may cause the pump temperature to exceed specified limits. To avoid a shutdown, the inlet side of the boosting can be connected to a diluent supply system that can inject diluent for cooling. In heavy crude oil services, diluent is available in the oil fields via a separate pipeline infrastructure.

Check valves and automatic shutdown valves also protect the boosting from “back spin.”

**References**

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Multiphase Boosting In Thermal Operations

Canada’s heavy oil reserves, estimated at 1.7 to 2.5 trillion bbl of oil, are an increasingly important source of supply, in part due to technology advances that have significantly reduced production costs and increased recovery. Bornemann Multiphase Boosting Systems have been used successfully to help meet these goals by collecting gas from the wellbore annulus to reduce back pressure and provide additional revenue.

Steam injection processes are used as both primary and secondary recovery methods for heavy oil deposits around the world. The most common methods are Steam Assisted Gravity Drainage (SAGD) and Cyclic Steam Stimulation (CSS). Both processes subject equipment to high temperatures, acid gases and steam.

<table>
<thead>
<tr>
<th>Application Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAGD wells are drilled in pairs and use continuous steam injection to mobilize bitumen. As steam is injected into the upper well, it mobilizes the oil above it which then drains down to the lower production well due to gravity. The producer well typically has an electrical submersible pump (ESP) installed and requires control of the liquid column to maintain efficient pumping. This is achieved by controlling the annulus gas pressure in the well bore.</td>
</tr>
<tr>
<td>Cyclic Steam wells are usually horizontal wells drilled into tight heavy or extra heavy oil formations. In the initial phase, high pressure steam is injected into the well for a period followed by a “soak” time to allow the oil to mobilize and flow to the downhole pump inlet.</td>
</tr>
</tbody>
</table>

During the production phase Bornemann Multiphase Systems are used to reduce pressure of the hot annulus gas and effectively control positive suction pressure on the rod pumps. The Bornemann Multiphase Boosting Systems have a unique ability to handle the high temperature wet gas at high compression ratios.

<table>
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<tr>
<th>The Solution</th>
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<tbody>
<tr>
<td>Bornemann Multiphase Boosting Systems are perfectly suited to handle the high temperature wet gas mixtures that are found in the annulus while providing the highest operational availability. Using a Bornemann Multiphase Pump in these applications will greatly lower capital cost associated with traditional compression and pumping systems and completely eliminate the need for well pad flares and inlet scrubbers. Bornemann Multiphase Boosting Systems have been providing greater than 97% reliability in these very demanding applications for more than twenty years.</td>
</tr>
</tbody>
</table>

In both processes, the typical well stream includes saturated steam and condensate water, small amounts of bitumen, and gas including methane, CO₂ and H₂S.

When Multiphase Pumps are used in SAGD and CSS applications:

- Gas composition can shift from an 80/20 CO₂ methane ratio to a ratio of 20/80
- Inlet temperature is near that of saturated steam, about 130°C
- 20-30 wells are drilled from a single pad, and total gas production from the pad may reach 30,000 sm³/d (1 MMscf/d)
- A Multiphase Boosting System can also be used to transfer total production from the pad

The design of a Bornemann Multiphase Boosting System for a well stream with an average gas volume fraction of more than 98 % and few liquid slugs - essentially a “wet gas compressor” - is similar to the design of conventional Bornemann Multiphase Boosting Systems. However, in Thermal Operations, Bornemann Multiphase Systems are designed with an additional external liquid recirculation and cooling system to guarantee a stable process while handling very high temperature wet gas.
Advantages
Bornemann Multiphase Boosting Systems offer these advantages in annulus vapor recovery service:

• Simple, compact installation reduces footprint and environmental impact
• Control of annulus gas pressure and the height of the liquid column in the casing optimizes production
• Gas that would have been wasted could be used to generate process steam, lowering the production costs
• Greater than 99 % up time ensures constant peak production
• Low maintenance costs improve operating margins
• Elimination of flares meets obligations under the Kyoto protocol and local air quality standards

Also, the ability to handle thermal expansion and quick temperature changes is especially important for wet gas compression service. A Twin Screw Multiphase Pump has two pairs of intermeshing screws that rotate within a housing, forming cavities between them and between the screws and the housing. Fluid is conveyed from inlet to discharge along both sides of the housing, ensuring that axial forces are always fully balanced.

Since there is no metal-to-metal contact, the pump clearances are sealed by liquid. When handling a gas stream that contains a small amount of liquid, sealing and cooling liquid is stored in the pump housing and flows through a separate cooling circuit. In Thermal Operations, liquid storage is often combined with external separation.

References
Bornemann, with the ability to provide complete turnkey systems, has the world’s largest installed base of Multiphase Boosting applications in Thermal Operations, including:

• Systems installed at Imperial Oil Canada’s Cold lake facility
• Systems installed in Canadian Natural Resources Ltd.’s Primrose field
• Installations for Deer Creek Energy, Husky, Statoil and other major producers operating in Canada

Design Features
These features of Bornemann multiphase boosting systems make them well suited for annulus vapor recovery:

• Seals in MW based Multiphase Systems operate at suction pressure
• A thermo-siphon as an integrated part of the MW Multiphase Pump circulates atmospheric buffer fluid for seal protection at high gas volume fractions
• Seals in MPC based Multiphase Systems often used in high pressure SAGD applications run at discharge pressure to avoid instable conditions at the mechanical seal
• Alloy overlay in O-ring areas mitigates CO₂ corrosion
• Speed of the variable frequency drive is controlled by suction pressure
Wet Gas Compression

As exploitation of global natural gas resources has become more important, major gas producers have expressed growing interest in utilizing Multiphase Boosting as wet gas compressors to enhance production. In response to this trend, Bornemann has developed reliable and cost effective Multiphase Boosting packages for this service.

When a well stream has a high gas volume fraction and only contains small amounts of liquid, Multiphase Pumps operate as “wet gas compressors.” These well streams are often found in marginally economic fields where optimizing production and minimizing cost are critical goals.

**Application Challenges**

The same guidelines are used to design a Multiphase Boosting system for wet gas compression service. However special attention must be given to ensure that the wet gas compression unit is capable of handling thermal expansion and quick temperature changes.

Applications of Multiphase Boosting Systems operating as wet gas compressors typically involve:

- Gas volume fractions greater than 98 %
- Low amounts of low viscosity fluids
- Heat generated by compression
- Installation either onshore or offshore

**The Solution**

Wet gas compression generates heat that is removed from the pump either by re-circulating liquid from the well stream or by injecting liquid from a reservoir. In a liquid cooling configuration, temperature in the casing is reduced by a cooler connected directly to the liquid reservoir of the multiphase pump.

A large internal chamber stores water inside the pump housing. Water can be used to cool and lubricate the mechanical seals and pump internals, and to seal the clearances between the screws where metal-to-metal contact is not allowed.

In case thermodynamic calculations require a larger external separator to collect water from the well stream, Bornemann uses an external recirculation system to ensure enough liquid is available for cooling and sealing purposes. A high pressure cooler integrated in the liquid recycle allows for an unlimited run time.

The flushing effect when recirculating hydrocarbons is calculated by the use of process simulation software.
Advantages
In most cases, however, the key benefit is an increase in gas production, whether installed onshore or on an offshore platform. The low maintenance expense and lower capital cost of Bornemann Multiphase Boosting Systems have a significant positive impact on project economics.

Design Features
In a typical application, a Bornemann Multiphase Pump together with its components is mounted on a common base plate to minimize the footprint of the skid.

A typical wet gas compression system includes:

- Multiphase pump
- Electric motor with variable frequency drive
- Piping and valves
- Instrumentation for safety and control
- Emergency shut down valves

References
At an existing gas facility in the Netherlands with one gas well six km away, the pressure was too low to meet system requirements and production often had to be shut down. To boost the pressure, Bornemann designed a wet gas compression system for the following conditions:

- Capacity: 125,000 sm³/d
- Gas vol. fraction: 99.9 %
- Inlet pressure: 5 to 25 barg
- Outlet pressure: 25 to 30 barg
- Pressure ratio: 2 to 6
- Inlet temperature: 10 to 60°C
- Outlet temperature: 80°C

Since initial startup in October 2002, the wet gas compression system has operated continuously with an uptime of 99.8 %. Gas production has been accelerated and an increase in ultimate recovery from 90 to 95 % was achieved.
Offshore Multiphase Boosting

Space and weight are limited on remote offshore platforms with high costs of construction, maintenance, and lost production.
As distances between satellite platforms and central facilities increase, and deep water tiebacks become longer, boosting pressure and avoiding the cost of multiple submarine pipelines are also critical. Efficient and reliable Bornemann Multiphase Boosting Systems are a perfect solution to meet these special challenges.

Key offshore oil and gas production facilities include Central Processing Platforms (CPP) and satellite Wellhead Platforms (WHP), which are usually unmanned and located up to 100 km from the CPP.
In deep water, smaller discoveries may be developed with subsea completions and gathering stations that are tied back to a central platform. As distances increase, back pressure in the submarine pipeline to the CPP can be high compared to topside Multiphase Boosting applications.
Processing equipment on the platform adds more back pressure at the wellhead and lowers production.
Bornemann Multiphase Boosting Systems helps eliminate back pressure and increase production by efficiently transporting all three phases of a typical well stream – liquid, gas and solid – without separation.

Multiphase Boosting provides an efficient and reliable way to maintain the performance of declining fields by:
- Upgrading low pressure streams to system pressure
- Reducing well head pressure to increase production
- Boosting untreated well streams without the need for separation equipment, as space on offshore platforms is limited

Offshore Multiphase Boosting
• Upgrading low pressure streams to system pressure
• Reducing well head pressure to increase production
• Boosting untreated well streams without the need for separation equipment, as space on offshore platforms is limited

Application Challenges
A well stream will flow naturally to a platform as long as the wellhead pressure is higher than the pipeline pressure. As the wells age, reservoir and wellhead pressures will decline respectively. In gas fields, liquid production will increase over the lifetime of a well and gas production will decrease. In oil wells, the opposite may occur, resulting in a well stream with an increasing gas volume fraction.

The Solution
A Bornemann Multiphase Boosting System is an economical solution to transport untreated production to a Central Processing Platform (CPP) or an export pipeline.

Multiphase Boosting Systems are able to deal with changing flow conditions throughout the lifetime of a well, as well as short term transient conditions such as gas and liquid slugs. The positive displacement screw pump, with patented Bornemann features, can handle 100 % gas flow for limited periods and continuous 100 % liquid flow.

This feature eliminates the need for separation which will substantially save the cost of an additional submarine pipeline.
Bornemann Multiphase Boosting systems installed on offshore platforms offer:

- A several-fold increase in production
- Rapid return of investment
- Reduced capital and operating cost
- No shut downs due to changing fluid conditions
- Elimination of flares
- Advanced technology
- Enhanced production control

References

With more than 20 installations in Offshore Multiphase Boosting System environments, Bornemann demonstrates a long history of invaluable experience and know how in handling these challenging applications, through individually tailored solutions to meet the end-user specifications and requirements.

In 2017 Bornemann developed a unique Multiphase Boosting System for an offshore platform in the North Sea.

The system was designed as a wet gas compressor built to boost gas stream with a continuous 100 % GVF. By considering a volume of up to 5,500m³/hr, Bornemann built the world's largest Twin Screw Multiphase Pump based on the MPC 11 Multiphase Pump.

To achieve liquid sealing of the clearances inside the pump, an external separation with backflow to the Multiphase Pump suction was considered along with other system components such as electrical Motor, Variable Frequency Drive, Bornemann Seal Oil System, Lube Oil System, Air Cooler and Control System.

Design Features

Each Bornemann system is configured for a specific installation. Customized pump casings can be pressure rated to ANSI 900 PSI, a differential pressure rating up to 120 bar is possible. Parallel and serial Multiphase Boosting System configurations can be tailored in accordance to customer needs.

Replaceable liners simplify pump maintenance and engineered rotors are designed to minimize shaft deflection. Flooded rotating elements allow "dry running" for a limited period of time and special trims are available for severe service conditions.
### Arctic Environment

<table>
<thead>
<tr>
<th>Country</th>
<th>Russia</th>
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<tbody>
<tr>
<td>Pump Type</td>
<td>3 x MPC 208</td>
</tr>
<tr>
<td>Medium</td>
<td>Multiphase Mixture Crude Oil</td>
</tr>
<tr>
<td>Capacity</td>
<td>500 m³/hr</td>
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<tr>
<td>Pressure</td>
<td>21 bar / 305 psi</td>
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<tr>
<td>Speed</td>
<td>2,000 rpm</td>
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<tr>
<td>Shaft Power</td>
<td>276 kW / 375 hp</td>
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<tr>
<td>Gas Content</td>
<td>96 % Slug Flow</td>
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</tbody>
</table>

### Sensitive Environment

<table>
<thead>
<tr>
<th>Country</th>
<th>Ecuador</th>
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<tbody>
<tr>
<td>Pump Type</td>
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<tr>
<td>Medium</td>
<td>Multiphase Mixture Crude Oil</td>
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<tr>
<td>Capacity</td>
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<tr>
<td>Pressure</td>
<td>69 bar / 1,001 psi</td>
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<tr>
<td>Speed</td>
<td>1,800 rpm</td>
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<tr>
<td>Shaft Power</td>
<td>1,220 kW / 1,659 hp</td>
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<tr>
<td>Gas Content</td>
<td>32 % Slug Flow</td>
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</table>

### Desert Environment

<table>
<thead>
<tr>
<th>Country</th>
<th>Algeria</th>
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<tbody>
<tr>
<td>Pump Type</td>
<td>2 x MPC 10 MD</td>
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<tr>
<td>Medium</td>
<td>Multiphase Mixture Crude Oil</td>
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<tr>
<td>Capacity</td>
<td>5,022 m³/hr</td>
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<tr>
<td>Pressure</td>
<td>25 bar / 363 psi</td>
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<tr>
<td>Speed</td>
<td>2,000 rpm</td>
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<tr>
<td>Shaft Power</td>
<td>1,949 kW / 2,651 hp</td>
</tr>
<tr>
<td>Gas Content</td>
<td>98 % Slug Flow</td>
</tr>
</tbody>
</table>

### Onshore

<table>
<thead>
<tr>
<th>Country</th>
<th>India</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump Type</td>
<td>3 x MW 10C</td>
</tr>
<tr>
<td>Medium</td>
<td>Multiphase Mixture Crude Oil</td>
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<tr>
<td>Capacity</td>
<td>4,828 m³/hr</td>
</tr>
<tr>
<td>Pressure</td>
<td>12.4 bar / 180 psi</td>
</tr>
<tr>
<td>Speed</td>
<td>1,500 rpm</td>
</tr>
<tr>
<td>Shaft Power</td>
<td>1,140 kW / 1,550 hp</td>
</tr>
<tr>
<td>Gas Content</td>
<td>90 % Slug Flow</td>
</tr>
</tbody>
</table>

### Offshore

<table>
<thead>
<tr>
<th>Country</th>
<th>The Netherlands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump Type</td>
<td>1 x MPC 268 / Dieselengine</td>
</tr>
<tr>
<td>Medium</td>
<td>Multiphase Mixture Wetgas</td>
</tr>
<tr>
<td>Capacity</td>
<td>610 m³/hr</td>
</tr>
<tr>
<td>Pressure</td>
<td>25 bar / 362.6 psi</td>
</tr>
<tr>
<td>Speed</td>
<td>1,765 rpm</td>
</tr>
<tr>
<td>Shaft Power</td>
<td>450 kW / 612 hp</td>
</tr>
<tr>
<td>Gas Content</td>
<td>99 %</td>
</tr>
</tbody>
</table>

### Self Sufficient

<table>
<thead>
<tr>
<th>Country</th>
<th>Thailand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump Type</td>
<td>2 x MPC 268 / Gasengine</td>
</tr>
<tr>
<td>Medium</td>
<td>Multiphase Mixture Wetgas</td>
</tr>
<tr>
<td>Capacity</td>
<td>498 m³/hr</td>
</tr>
<tr>
<td>Pressure</td>
<td>43.5 bar / 631 psi</td>
</tr>
<tr>
<td>Speed</td>
<td>1,800 rpm</td>
</tr>
<tr>
<td>Shaft Power</td>
<td>600 kW / 816 hp</td>
</tr>
<tr>
<td>Gas Content</td>
<td>50 % - 99.8 %</td>
</tr>
</tbody>
</table>
Selected Applications

Mobile Application

Country          | Saudi Arabia
Pump Type        | 1 x MPC 208 - Super Duplex
Medium           | Multiphase Mixture
                | Crude Oil
Capacity         | 343 m³/hr
                | 51,774 bpd
Pressure         | 10.3 bar / 149 psi
Speed            | 2,000 rpm
Shaft Power      | 119 kW / 162 hp
Gas Content      | 50 % - 99 %
Slug Flow        |

High Differential Pressure

Country          | UAE
Pump Type        | 2 x MPC 400
Medium           | Multiphase Mixture
                | Crude Oil
Capacity         | 1,406 m³/hr
                | 212,226 bpd
Pressure         | 83 bar / 1,204 psi
Speed            | 1,600 rpm
Shaft Power      | 2,260 kW / 3,074 hp
Gas Content      | 22 % - 100 %
Slug Flow        |

Thermal Operations (SAGD)

Country          | Canada
Pump Type        | 2 x MPC 208
Medium           | Multiphase Mixture
                | Wetgas (SAGD)
Capacity         | 143 m³/hr
                | 21,585 bdp
Pressure         | 28 bar / 406 psi
Speed            | 1,691 rpm
Shaft Power      | 111 kW / 151 hp
Gas Content      | 97 %
Slug Flow        |

Thermal Operations (VRU)

Country          | Canada
Pump Type        | 2 x MW 8.5
Medium           | Multiphase Mixture
                | Wetgas (Vapor
                | Recovery Unit)
Capacity         | 440 m³/hr
                | 66,415 bpd
Pressure         | 4 bar / 58 psi
Speed            | 898 rpm
Shaft Power      | 69 kW / 94 hp
Gas Content      | 95.40 %
Slug Flow        |

Heavy Crude Oil

Country          | Venezuela
Pump Type        | 5 x MW 9.3
Medium           | Multiphase Mixture
                | Heavy Crude Oil
Capacity         | 4,545 m³/hr
                | 686,038 bpd
Pressure         | 18.6 bar / 270 psi
Speed            | 1,760 rpm
Shaft Power      | 1,118 KW / 1,520 hp
Gas Content      | 90 %
Slug Flow        |

Shale Oil

Country          | USA
Pump Type        | 1 x MPC 7T HC
Medium           | Multiphase Mixture
                | Crude Oil
Capacity         | 218 m³/hr
                | 32,906 bpd
Pressure         | 11.45 bar / 166 psi
Speed            | 2,064 rpm
Shaft Power      | 86 kW / 117 hp
Gas Content      | 40 % - 82 %
Slug Flow        |