



In the event that conventional MUX control of a BOP (Blow-Out Preventer) is lost during a subsea emergency, Sonardyne's acoustic BOP control system is an off-the-shelf system that allows a well to be remotely shut-in by means of a high security, through-water wireless acoustic communications link.

During an emergency, system components installed on the BOP are remotely activated from a control room on the rig or using a portable command system deployed from a lifeboat, support vessel or ROV.

### System Overview

The subsea components of the system are comprised of a Subsea Electronic Module (SEM) connected to multiple Deep Acoustic Remote Transceivers (DARTs) programmed to receive, decode and validate acoustic commands from the surface. The surface command unit generates acoustic commands in response to operator input and transmits them via a hull-mounted or simple over-the-side transceiver to the DARTs. Once decoded and validated, the SEM activates the selected functions within the BOP; a pre-defined sequence of BOP functions can be stored in the SEM and initiated by a single acoustic command. This considerably speeds up the BOP shut-in and disconnect operations in an emergency. Alternatively, BOP functions can be operated individually, providing maximum flexibility to deal with any emergency situation.

SEMs and DARTs are depth rated to 4,000 metres (12,000 feet) and the SEM can operate with up to four DARTs depending on the level of system redundancy required. The acoustic link operates at a data throughput rate of 600 baud using Sonardyne's Wideband digital signal architecture to ensure reliable performance in hostile acoustic operating conditions. All subsea units are constructed from super duplex stainless steel to ensure long term corrosion-free operation, without the need for cathodic protection.

### Features at a glance

- Fully API compliant
- Provides control and monitoring if primary BOP control is lost
- Highly secure 2-way wireless acoustic link
- Acoustic signal technology field proven in a well control emergency
- Multiple layers of subsea equipment redundancy
- Flexible subsea interface to client's electro-hydraulic package
- Powered by long-life internal lithium battery packs or local 24v DC supply
- Depth rated to over 4,000 metres

# ACOUSTIC BOP CONTROL SYSTEM

## HIGH SECURITY EMERGENCY BACKUP BOP CONTROL

### Subsea System Configuration

The subsea system is fully dual redundant, using two DARTS connected to a dual redundant SEM. The use of two subsea acoustic transceivers avoids the risk of acoustic signals being masked by the riser and can be expanded to four if required. The SEM provides the interface to the client BOP, driving up to 12 pilot valve solenoids to operate the hydraulic functions. 12 pressure operated switches and 4 analogue sensors indicate the BOP's internal status and the SEM can interface to BOPs from all major manufacturers.

DARTS are installed on arms typically 2-3 metres long that swing-out from the BOP stack on deployment. This ensures that they have an unobstructed 'line-of-sight' signal path up to the rig for reliable communications. The subsea cables that connect the DARTs to the SEM installed on the BOP itself are PBOF (Pressure Balanced Oil Filled) and all seals and connectors use double O-rings with a pressure test port to ensure full compliance with API requirements.

### Surface System Configuration

The surface control system is available in both fixed and portable configurations.

The fixed system is installed on the rig and communicates with the SEM via a hull-mounted acoustic transceiver. The unit can be installed on a hydraulic through-hull or through-tube deployment pole that extends 3-5 metres below the vessel to clear the main source of surface noise, DP thrusters. If the rig is fitted with a Sonardyne acoustic position reference system, the emergency BOP system can utilise the installed transceivers, otherwise a dedicated one is supplied.

The bridge control unit is a 19" rack-mounting panel configured with large, push-buttons to initiate an emergency disconnect sequence. A multi-line LCD display provides operating instructions and status information. Operating individual BOP functions or initiating an emergency disconnect sequence is a two-handed operation, requiring both push-buttons to be operated simultaneously to prevent accidental operation.

The Portable Command System is a rugged, self-contained unit that can be used as an alternative to the fixed unit. It can be operated from a standby vessel, lifeboat or helicopter using the dunking transceiver and cable supplied.

In the event of a major subsea blowout, the presence of a large oil and gas plume in the water column may interfere with acoustic communications. In order to overcome this, the portable dunking transceiver is depth rated to 3,000 metres so can be fitted to an ROV and manoeuvred close to the wellhead and below the plume for unobstructed signal transmission and reception.

A relay transponder can also be deployed on the seabed at the beginning of a drilling operation, a suitable distance away from the wellhead, where it can communicate horizontally with the BOP. This enables acoustic signals from the surface to avoid the need to pass through any oil and gas plume below the rig.

### Test Functions and System Availability

The system's readiness for activation is checked by a periodic 'heartbeat' signal sent automatically from the surface to the subsea system; the reply indicates the health of the system. There are also built-in functions to routinely test all pilot valve solenoids in the client's BOP. All operations and communications are logged.

### Wideband Signalling Technology

Sonardyne Wideband, the proprietary digital acoustic signalling technology built into

### SEM and DARTS

The subsea system uses two acoustic transceivers called DARTS connected to a dual redundant Subsea Electronic Module (SEM). The SEM can interface to BOPs from all major manufacturers.



### Hull Transceiver and Control Panel

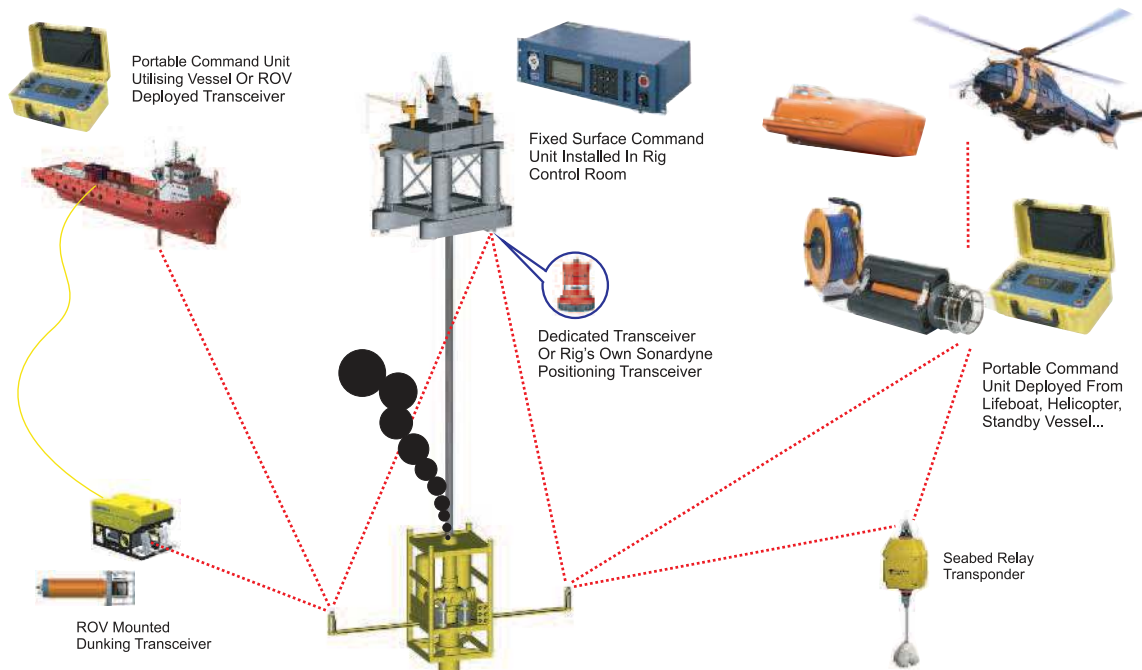
The fixed control system communicates with the BOP via a hull-mounted transceiver. The control panel contains large push-buttons to initiate an emergency disconnect sequence.



### BOP Acoustic Transceivers

DARTS are installed on arms that swing-out from the BOP stack on deployment.





the system, provides a two-way communication link that is highly robust and resistant to noise, multi-path effects and interference from other acoustic sources. Each SEM has a unique address and will only respond to commands that include this code. This allows several rigs to operate systems within acoustic range of one another without any interference. The probability of a false trigger event has been shown to be extremely remote, whilst the probability of operation on demand has been similarly shown to be very high.

### Noise from a Wild Well

The extreme level of noise emanating from a wild well creates a very challenging operating environment for acoustic systems to overcome. Sonardyne Wideband acoustic systems were employed extensively during the Macondo incident and the operational experience gained has served to demonstrate that reliable two-way acoustic communication can be consistently achieved, even within a few feet of the blowout.

### Environmental Performance

Variations in temperature and salinity between water layers can cause refraction of acoustic signals when horizontal communication ranges exceed water depth. However, the vertical or near-vertical communication path between a drilling rig and its BOP stack means that the performance of the Sonardyne system is unaffected by deepwater thermoclines.

### Track Record and Support

As a major supplier of acoustic systems to the offshore oil and gas industry with over four decades of experience, Sonardyne has in-depth knowledge of the subsea acoustic environment and can provide the only acoustic systems that are fully API compliant and have been field-proven in the immediate proximity of a major subsea blowout. The company has achieved an excellent track record of reliability, backed up by the availability of worldwide support, 24 hours a day, 365 days a year.

### Portable Command System

The Portable Command System is a self-contained unit that can be operated from a small vessel, a life raft or a helicopter, using the dunking transceiver and cable supplied.





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## Acoustic BOP Control System Performance Summary

Depth Rating	4,000 metres / 12,000 feet
Battery Life (SEM and DARTs)	12 months (Minimum quiescent consumption)
Frequency Band	Sonardyne Wideband MF (18–36kHz) or LMF(14-19 kHz)
Acoustic Communications	<ul style="list-style-type: none"> <li>– Robust 2 way communications</li> <li>– Each installation has unique system address</li> <li>– Multiple redundant architecture; up to 4 DARTs and 2 surface transceivers per system, operating in a multiple redundant configuration</li> </ul>
Down Communication Link (Commands + Status Requests)	<ul style="list-style-type: none"> <li>– All command data contains redundant security information</li> <li>– Down commands are received by all DARTs in the system</li> <li>– Individual DARTs can be addressed for diagnostics</li> <li>– Subsequent 'status request' commands are used to confirm actuation of the commanded functions</li> </ul>
Up Communication Link (Valve + Sensor Status. Diagnostics on request)	<ul style="list-style-type: none"> <li>– Acknowledgement of all commands</li> <li>– Status replies of all pressure switches and 4-20mA sensors</li> <li>– Battery consumption (SEM + all DARTs)</li> <li>– Comms check each DART to SEM</li> <li>– Low current test of each solenoid</li> </ul>

## Acoustic BOP Drilling System Equipment List

Key: ● = Required ○ = Optional



● Type 8135  
Surface  
Command Unit



○ Type 8138  
Hull  
Transceiver



○ Type 8142  
HPT Positioning  
Transceiver



○ Type 8021/23  
GDT Positioning  
Transceiver



● Type 8157  
Portable  
Command Unit



● Type 8140  
Portable Dunking  
Transceiver



● Type 8136  
Wideband  
BOP SEM



● Type 8137  
Wideband  
BOP DART

## Other Drilling Systems from Sonardyne

- Marksman LUSBL
- DP-INS
- Marine Riser Angle Monitoring System
- Riser Profiling System

## Key Technologies



### Wideband 2<sup>®</sup>

Sonardyne Wideband is an ultra-wide bandwidth signal architecture that delivers reliable acoustic navigation and telemetry of subsea data in all operating environments. The technology is proven to offer a host of benefits; fast and robust transmission of data, precise ranging, wide area coverage, mitigation from multipath signals and greater immunity to noise from vessels and other acoustic systems.



### Redundancy

Sonardyne's acoustic BOP systems are configured for dual redundancy where subsea hardware is cross linked so that in the event of equipment failure, emergency control availability can be maintained.



### Portability

In a rig evacuation scenario, the system can be operated from almost any size boat including life rafts. The dunking transceiver designed for use with the system can even be fitted to an ROV for near-well activation of the BOP.



### Battery Life

Sonardyne's latest generation of wireless acoustic BOP controllers use low power electronics and high performance long-life lithium cells so that drilling crews can keep acoustic equipment deployed for longer. External battery packs can further extend operational capability.



### Support

Need to get in touch? Sonardyne's customer support team is available around the clock to get you the answers you need. From advice on which product to use to operational support, it's all part of the service.