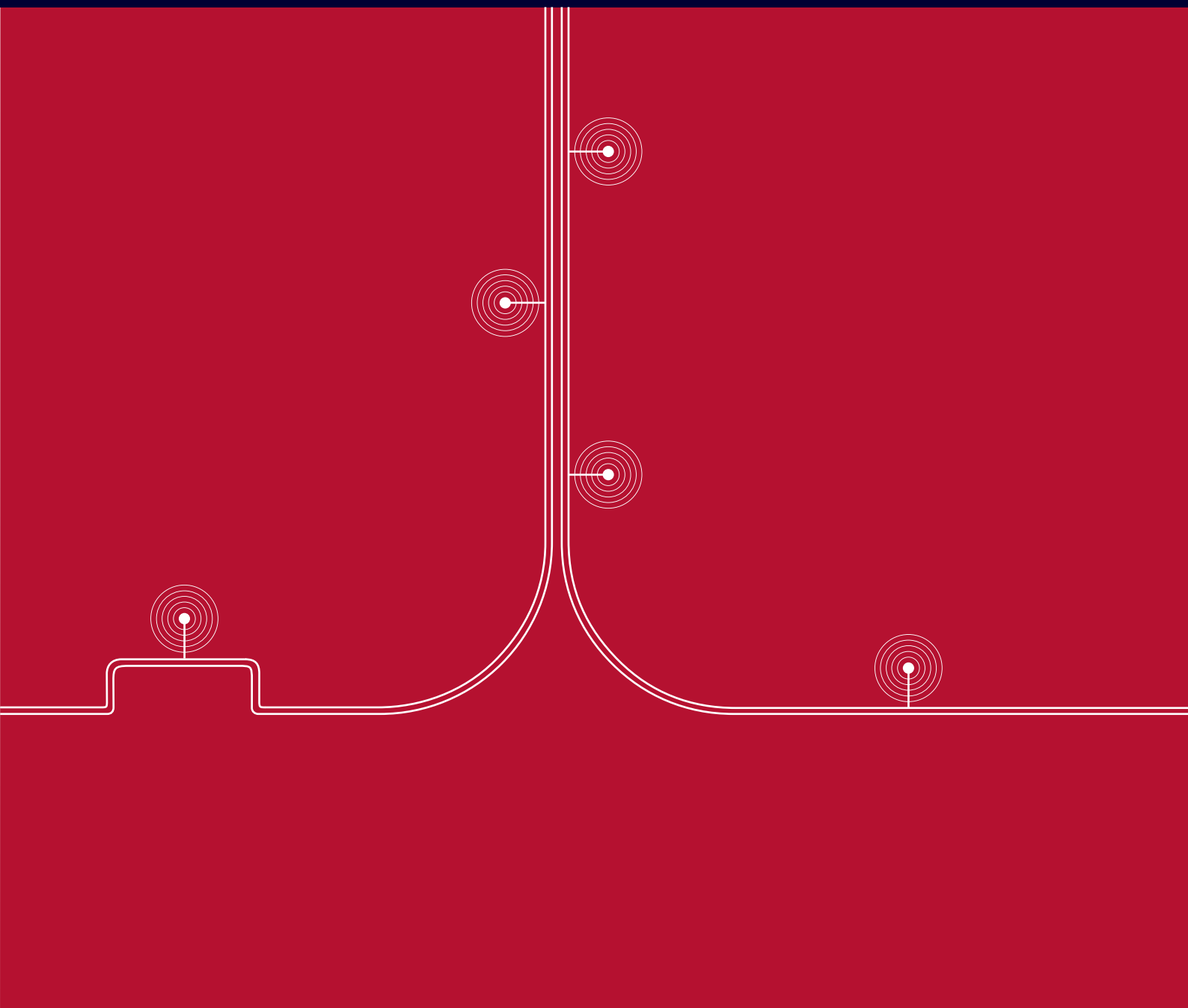


Subsea Asset Monitoring

manage detect analyse report



OUR COMPANY

WE MONITOR WE DETECT WE ANALYSE WE REPORT

YOUR WELLS, PIPELINES, RISERS, DRILLSHIPS AND FLOATING PRODUCTION FACILITIES REQUIRE CONTINUOUS STRUCTURAL MONITORING TO UNDERSTAND THEIR CONDITION, TO PREVENT FAILURE AND TO MAXIMISE THEIR OPERATIONAL LIFE. THE ENGINEERING CHALLENGES INVOLVED ARE CONSIDERABLE; FROM DEPTH, TEMPERATURE AND MOTION TO POWER, DATA AND COMMUNICATION. BUT THEY ARE CHALLENGES WE HELP CLIENTS SOLVE DAILY, WITH OUR LOW-RISK AND TRUSTED SOLUTIONS. ALL OF WHICH COME WITH THE BACKING OF OUR GLOBAL SUPPORT NETWORK.

LOW RISK. HIGH RELIABILITY. FIT FOR PURPOSE

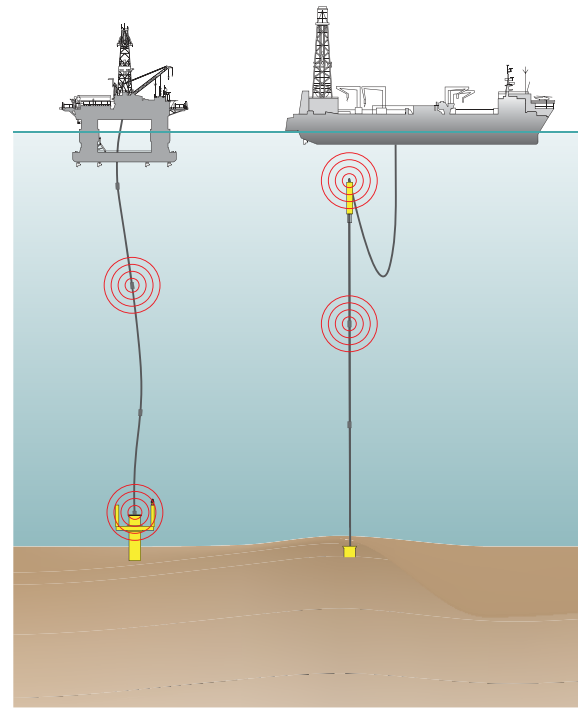
The aim of monitoring is to ensure the safe operation of subsea assets. This is based on developing an understanding of how subsea structures and assets are responding to loads and enabling faults to be detected at an early stage. In-situ, real-time data measured by monitoring systems allow structures to be analysed so you can determine whether their integrity is being jeopardised. This in-turn helps to guide intervention activity. Asset monitoring can also allow optimisation of production efficiency, savings on periodic inspections and to facilitate proactive maintenance regimes, while extending service life, safely.

Our expertise range from autonomous networks of seabed sensors monitoring structural vibration and safety critical control systems mounted on blowout preventers (BOPs), to the detection, classification and localisation of hydrocarbon leaks, mooring line monitoring and riser angle monitoring.

Our subsea hardware is engineered to withstand the enormous pressures of the deepest oil field. Our digital wideband communication signals can penetrate the hostile acoustic environment surrounding well heads to transfer your data quickly and reliably to the surface and our battery-powered, low-power sensors can remain continuously deployed for more than a decade.

CUSTOM ENGINEERING

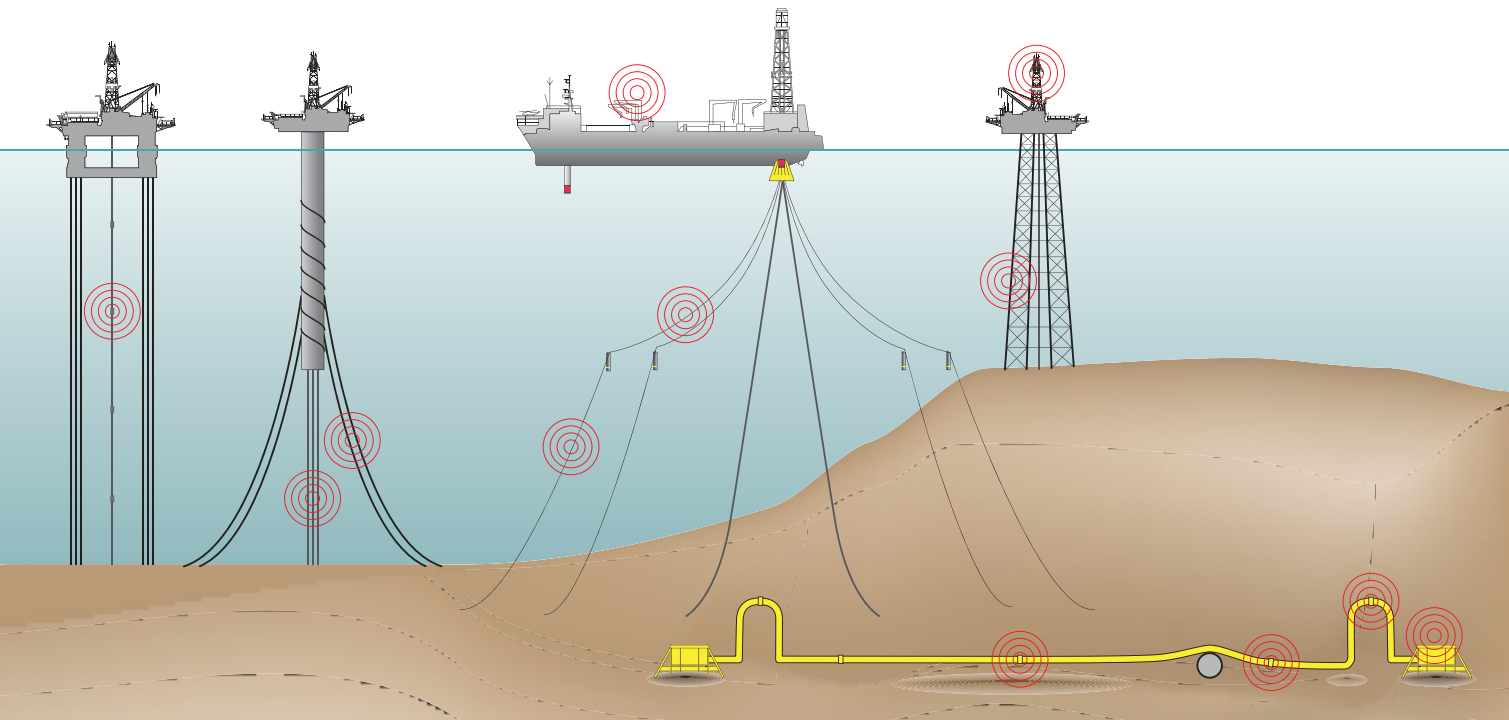
In many cases, production systems, subsea infrastructure, vessels, mooring systems and operating environments are unique. That's why we'll work with you even before you procure equipment so we can fully understand your needs. And where standard off-the-shelf products cannot meet your specific space, weight, depth and functionality demands, we have the know-how and in-house resources to design, test and manufacture customised solutions on time and on budget.



WHY INVEST IN SONARDYNE

- We work with the world's leading asset owners, operators and service companies to provide them with innovative asset monitoring solutions
- We deliver off-the-shelf or custom-engineered projects on time and budget
- We offer global support to your asset management teams, subsea engineers and vessel crew
- We are committed to maintaining a safe, zero harm and sustainable working environment





**SMART, AMT, DUNKER 6
AND BLUECOMM**

PIPELINE AND SPOOL PIECE CONDITION MONITORING

SUCCESSFUL OPERATION OF SUBSEA PIPELINE INFRASTRUCTURE REQUIRES ACCURATE, TIMELY AND MEANINGFUL DATA ABOUT SYSTEM CONDITION AND STATUS TO MAINTAIN INTEGRITY AND RELIABILITY. OUR FAMILY OF INTEGRATED CONDITION MONITORING AND SENSING TECHNOLOGIES HELP MINIMISE UNPLANNED DOWNTIME BY GATHERING, ANALYSING AND COMMUNICATING DATA YOU NEED TO PREVENT DAMAGE, PLAN MAINTENANCE REGIMES, IDENTIFY INTEGRITY BREACHES AND DEVELOP EARLY INTERVENTIONS.

PIPELINE AND SPOOL PIECE MOTION MONITORING

Processing raw subsea sensor data and wirelessly supplying only the critical information to the surface is at the heart of our SMART systems. SMART (Subsea Monitoring, Analysis and Reporting Technology) integrates a number of technologies to provide long-endurance monitoring of subsea infrastructure, including pipelines and spool pieces.

SMARTs can record a wide range of acceleration and angular rates in all axes. Processing this information subsea and comparing it with customer-defined thresholds, ensures that only the most important subset of information is relayed to the surface. Each unit can also accommodate many other sensors, such as pressure, temperature and strain gauges, to provide a one-stop remote monitoring solution.

BUCKLING, WALKING OR CREEPING

Buckling, walking or creeping of subsea infrastructure such as pipelines and termination assemblies is caused by variations in the temperature and pressure of their multiphase contents. The impact of this behaviour can be continually monitored using our Autonomous Monitoring Transponders (AMTs); low-power, long-endurance systems that contains high-quality pressure sensors and inclinometers. When mounted on structures subject to movement, they can range to a static reference array on the seabed and calculate any movement to subcentimetre-level accuracy.

With our 6G modem capability you can get your data back using your platform of choice, whether that is a manned vessel, unmanned surface vessel (ASV), autonomous underwater vehicle (AUV) or unmanned underwater vehicle (UUV).

HIGH BANDWIDTH OPTICAL COMMUNICATIONS

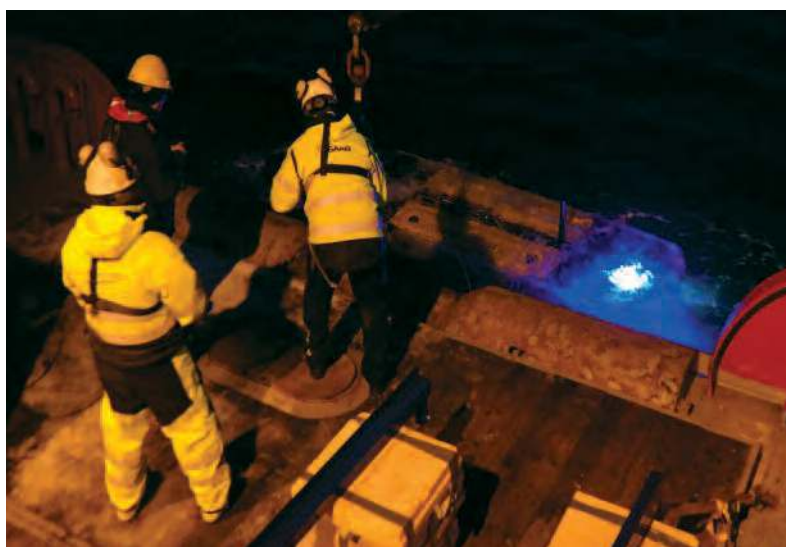
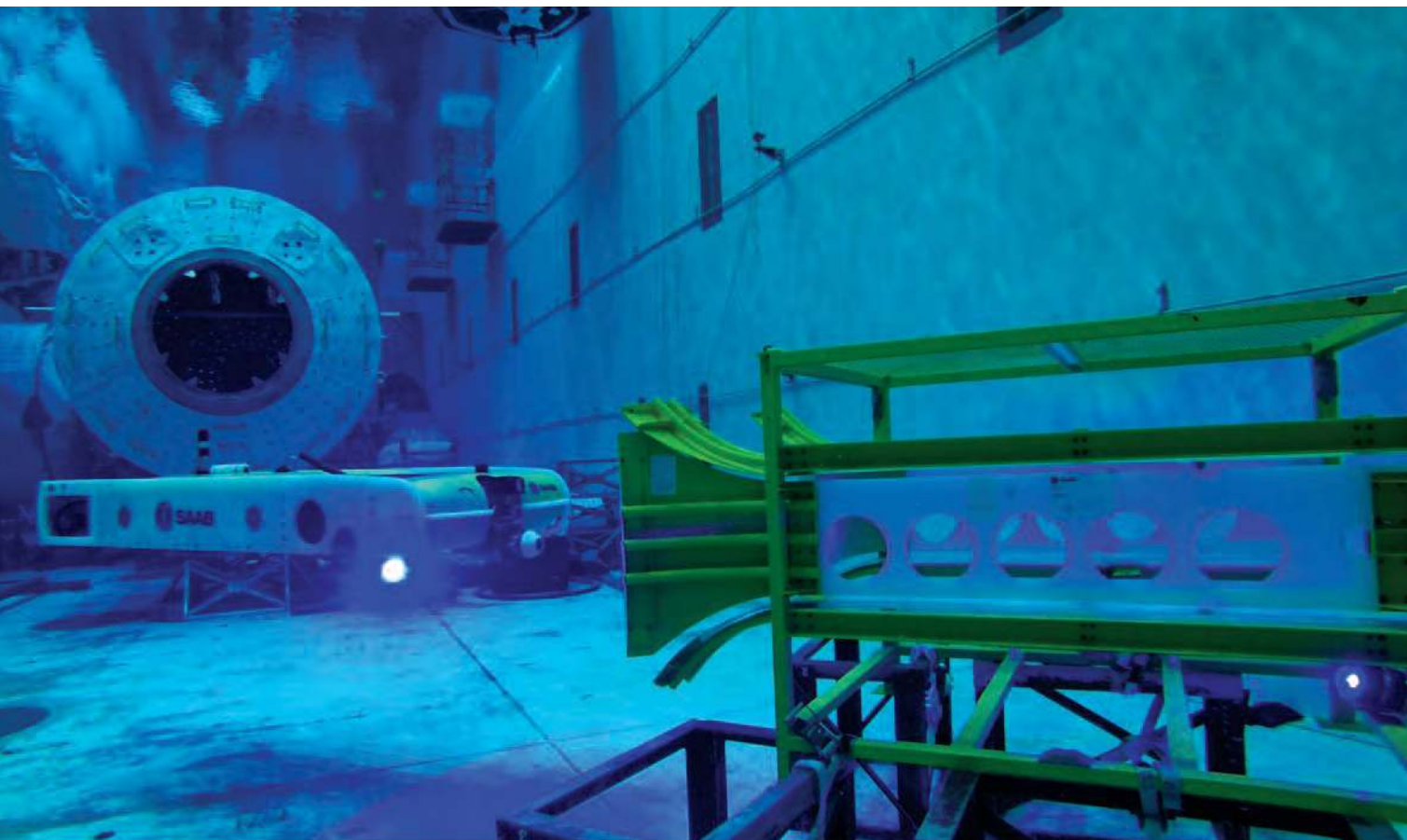
SMART systems can be supplied with integrated BlueComm free space optical modems for those monitoring applications where large volumes of data need to be wirelessly transmitted. BlueComm can transmit data at rates in excess of 10 Mbps, making it possible to transfer data faster, using much less power, compared to acoustic through-water telemetry.



WHY CHOOSE SMART, AMT AND BLUECOMM

- Based on our low-risk 6G hardware platform and Wideband 2 digital signal technology
- Wide variety of sensor options and designs to suit any applications
- Long deployment periods
- Up to 10 Mbps data rate with BlueComm





**MRAMS, SMART, DPTI 6
AND DUNKER 6**

PRODUCTION AND DRILLING RISER MONITORING

UNDERSTANDING SUBSEA DRILLING RISER POSITION AND MOVEMENT IS KEY TO ENSURE DRILLING RIGS OR SHIPS KEEP WITHIN A POSITION TOLERANCE TO THE LOWER MARINE RISER PACKAGE. FOR PROLONGED PRODUCTION RISER MONITORING, LONGER TERM DATA COLLECTION IS REQUIRED TO SUPPORT THE FATIGUE ANALYSIS ESSENTIAL TO MAINTAIN ASSET INTEGRITY. WIRELESS AND DEEPWATER-RATED, OUR RISER MONITORING TECHNOLOGIES USE SECURE THROUGH-WATER ACOUSTIC TELEMETRY TO RELIABLY TRANSMIT REAL-TIME RISER STATUS TO THE SURFACE CONTROL ROOM AND BEYOND.

DRILLING RISER MONITORING

MRAMS (Marine Riser Angle Monitoring System) is a high-accuracy solution for monitoring the differential angle between a drilling riser and blowout preventer (BOP) in order to reduce excessive wear on wellheads. Designed for use from both dynamically positioned (DP) and moored drilling rigs, MRAMS uses our low-risk, field-proven 6G hardware and Wideband 2 acoustic technology to maintain an uninterrupted wireless data link between a rig and BOP, even in the high-noise environments typically associated with drilling operations.

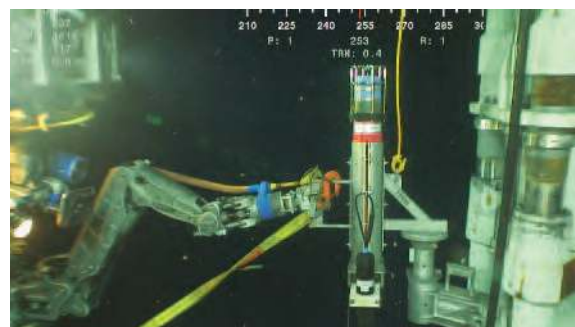
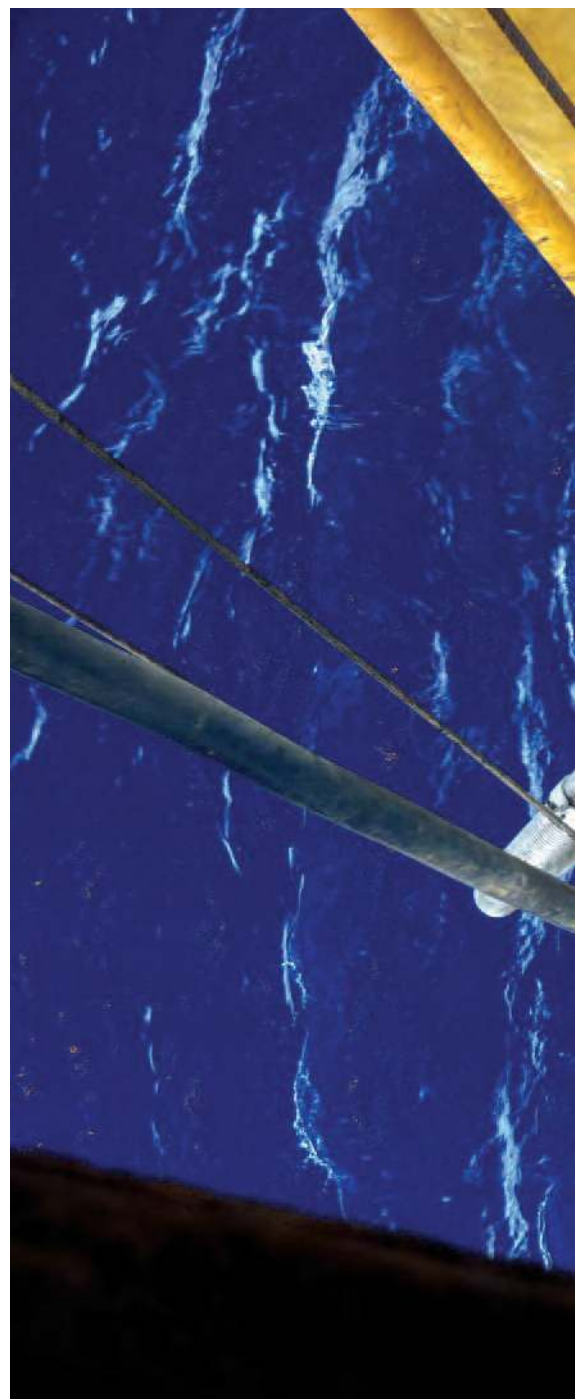
PRODUCTION RISER MONITORING

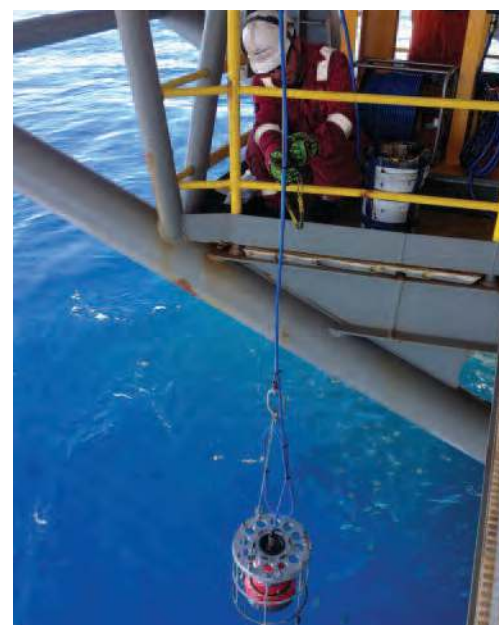
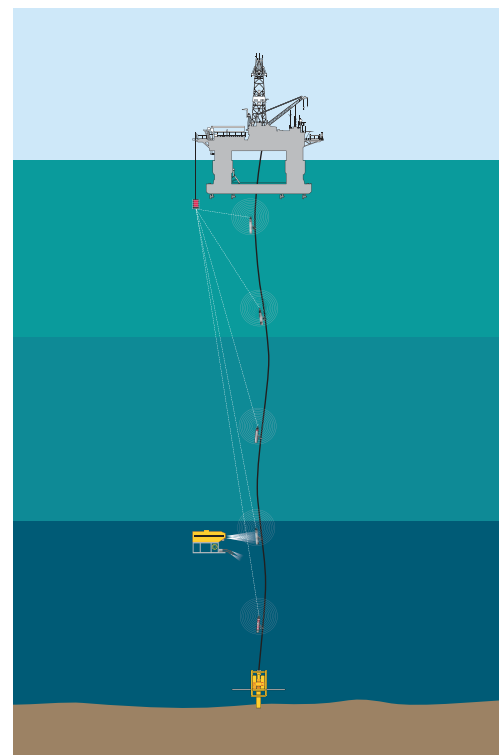
Our riser profiling system provides a wireless, real-time vertical profile of water current speed and direction and the temperature and inclination of risers deployed from drilling or production vessels. The system can be used standalone, integrated within a Marksman acoustic position reference system or with a third-party integrated monitoring system.

Using SMART or DPTi 6 transponders wirelessly mounted along the length of the riser, current profiling, high-accuracy pressure and temperature data and control inputs for local strain gauge sensors can be provided. Topside software makes changing monitoring regimes easy. When SMARTs are being used, on-board processed data can be efficiently and wirelessly transmitted to a surface transceiver.

SURFACE COMMUNICATIONS

The flexibility and choice offered by our family of subsea asset monitoring instruments is matched by an equally impressive range of topside instruments that are available to suit any operational scenario. We regularly supply command and control surface equipment for use on vessels of opportunity, where it might be installed and removed in a relatively short space of time, permanently on rigs and production platforms, and on unmanned surface vessels, ROVs or even resident AUVs.





WHY INVEST IN SONARDYNE TO MONITOR YOUR RISERS

- Low-risk and proven; track record exceeding 20 years
- A cable-free system for monitoring riser and BOP differential angles to prevent excessive wear
- Provides clear and unambiguous data on a riser's angle and profile
- Compatible with our DP reference systems
- Wide range of topside options for permanent or temporary installation



SMART, DUNKER 6 AND HPT

MOORING INTEGRITY MONITORING

MOORING LINE AND ANCHOR LEG INTEGRITY IS AN AREA OF CONCERN WITH FAILURES STILL ALL TOO COMMON. OUR SUBSEA SYSTEMS CAN MONITOR MOORING LINES CONTINUOUSLY, DETECTING AND REPORTING FAILURES PROMPTLY TO ASSET MANAGERS, ALLOWING SAFE MANAGEMENT OF RIGS AND FLOATING PRODUCTION FACILITIES. SUCH SYSTEMS CAN ALSO PRESENT MOORING LINE INCLINATION AND LINE TENSION REAL-TIME IN THE MARINE CONTROL ROOM.

MOORING LINE MONITORING SYSTEM

Maintaining mooring line integrity for offshore production and storage facilities is a key element for safe operations. By using SMART sensors, mooring line or anchor legs can be constantly monitored to ensure no line breaks have occurred. Using integrated internal high-accuracy pressure sensors and six degrees of freedom inertial motion units (IMUs), anchor breaks, both above or below the SMART, can be quickly identified and reported to the topside control room.

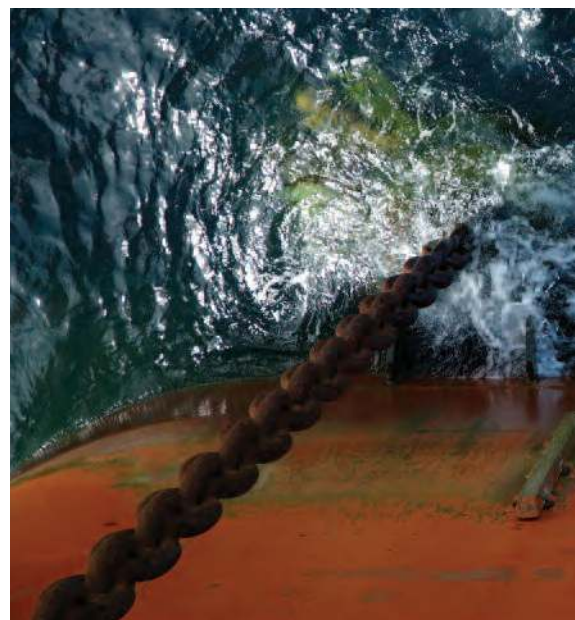
By using efficient wireless acoustic telemetry each mooring line-located SMART can transmit statistical information to the surface transceiver giving its position, depth and movement. As a cable-free arrangement, SMART is cost-effective to install and operate.

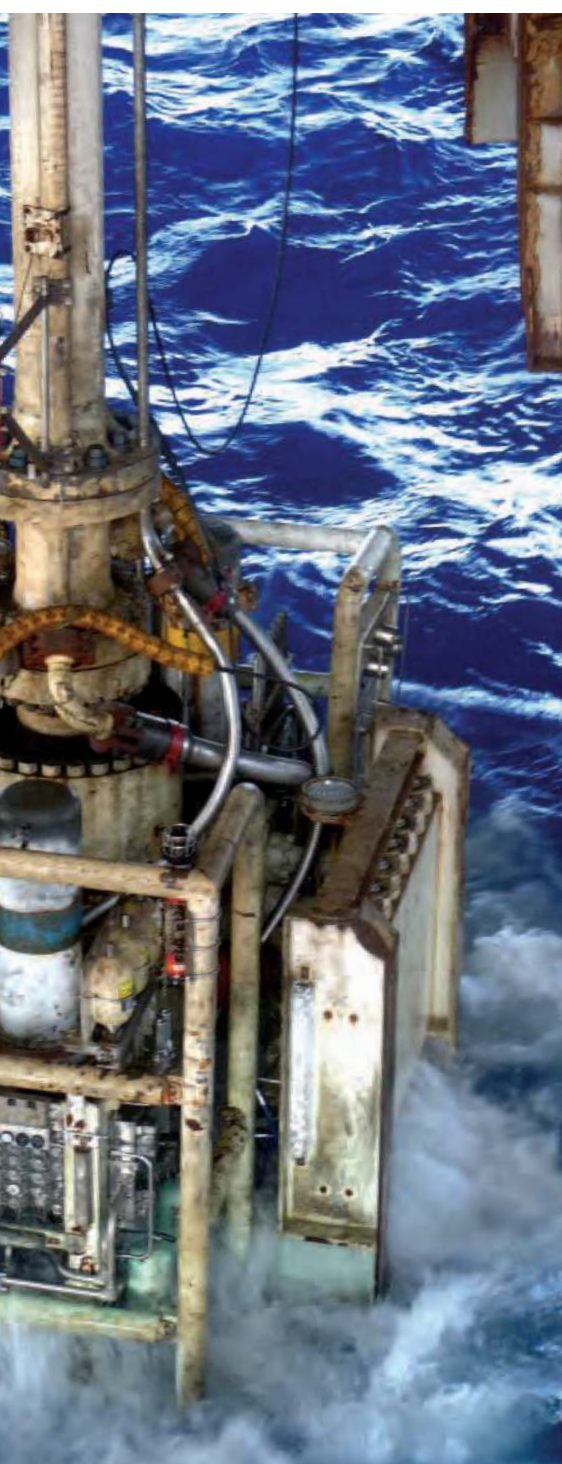
Surface located transceivers, such as our Dunker 6 or HPT – which may already form part of your existing vessel or rig acoustic equipment installation – can be used to harvest data from the SMARTs at any user-defined interval or on-demand. A range of deployment systems can be supplied, including over-the-side and permanently mounted on a through-hull arrangement with a gate valve.

BOP FATIGUE AND BOP ANCHOR MONITORING

As BOPs have increased in size, we have developed complimentary technologies and sensors to address two important challenges. SMART systems can accurately monitor BOP accelerations and rotations to help operators ensure that wellhead fatigue is within safe working limits.

SMARTs can also be configured to act as a recording, processing and telemetry system for BOP tension monitoring systems. Using SMARTs in this configuration provides a way to monitor the securing line tension, record static and dynamic load and transmit already processed, user-ready data to a drilling or surface vessel on demand. Ordinarily data is read from load pins at the rigging point on the BOP or at the rigging point on the seabed pile.





WHY CHOOSE SMART TO MONITOR YOUR MOORING INTEGRITY

- Provides subsea data processing and analysis for identifying critical data
- Digital and analogue interfaces to internal and external sensors and instruments
- Highly configurable for all environmental conditions and operating water depths
- Robust and secure data telemetry protocols; recovery on-demand or scheduled



SENTRY AND SOLSTICE

LEAK DETECTION

UNDETECTED LOSS OF HYDROCARBON CONTAINMENT OR BREACH OF ASSET INTEGRITY SUBSEA CAN CAUSE ENVIRONMENTAL DAMAGE. AN EARLY WARNING SYSTEM THAT CAN CONFIDENTLY ALERT THE OPERATOR OF A LEAK CAN AVOID UNWANTED POLLUTION AND PENALTIES. OUR ACTIVE HYDROCARBON DETECTION AND CLASSIFICATION TECHNOLOGY DETECTS GAS AND OIL IN THE WATER TO VERY ACCURATE LEVELS FROM BOTH FIXED LOCATIONS AND MOBILE ASSETS.

DETECT, LOCALISE, CLASSIFY

Covering a 360° field of view, with a detection coverage radius up to 1,200 m, the deepwater rated Sentry Integrity Monitoring System (IMS) can detect leaks of monophasic gas down to 0.1 litre per minute (equivalent to around 1 barrel of oil per day) or monophasic oil to 1 litre per minute (equivalent to 10 barrels of oil per day). Once installed, Sentry is capable of monitoring over one billion cubic feet of seawater.

Two configurations of Sentry are available. Mounted on a lander, Sentry-W connects into your asset's existing power and communication seafloor infrastructure. It will run autonomously providing alerts only when its on-board processing has ascertained a positive detection and classification of a leak. Remote access onshore is configurable for multiple users.

Where no infrastructure is available, Sentry-B – a standalone battery operated system – can be lander-deployed, complete with subsea data processing. At preset intervals, or where a leak event is detected, summary data is transmitted using a 6G acoustic modem to a surface transceiver for onward transmission to shore via radio or satellite. Surface transceivers and satellite communications systems can be mounted on a moored buoy, integrated into an unmanned surface vehicle (USV), or positioned over the side of a vessel, rig or floating production system.

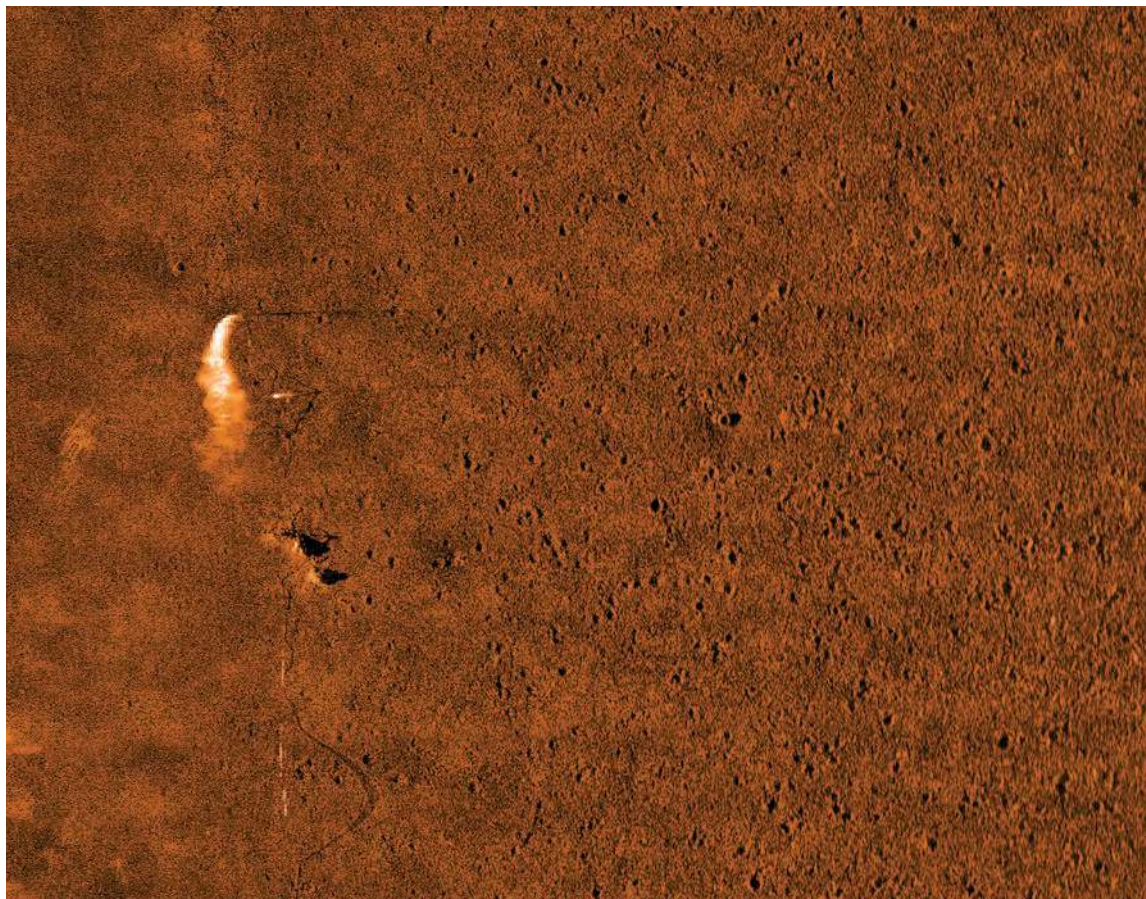
MOBILE LEAK DETECTION

For inspecting greater lengths of subsea assets, such as trunk pipelines, our compact yet high-performance Solstice side scan-sonar containing powerful automatic target recognition (ATR) algorithms can be integrated into an AUV to provide detection and location of any containment losses of oil or gas.

CCS SITE MONITORING

Containment failure at an offshore carbon capture and storage (CCS) site, while viewed as highly unlikely, is of significant concern to regulatory bodies, operators and environmental groups. We have developed the capability to detect and monitor any leakage at high risk locations using a combined sonar and chemical sensing lander to deliver sensitive and reliable automated leak detection capability across wide areas.





WHY CHOOSE SENTRY AND SOLSTICE TO DETECT INTEGRITY LEAKS

- Sentry provides early warning to allow intervention
- Localises integrity breaches at the time of detection
- Field proven with major operators
- 360 degree, high-volume monitoring
- Solstice provides mobile AUV-based leak detection



**DATA LOGGERS, ACOUSTIC SUBSEA
MODEM AND BLUECOMM**

WELLBORE MONITORING

**ACCESS VITAL WELLBORE DATA DURING WELL TESTING OR
SUSPENSION WHEN NO UMBILICAL OR CONTROL MODULE IS
PRESENT, INCREASING RESERVOIR UNDERSTANDING AND REDUCING
DOWNHOLE UNCERTAINTY FOR INTERVENTION OPERATIONS OR
CONTAINMENT. DO ALL THIS WITH OUR SELF-CONTAINED, SELF-
POWERED INSTRUMENTS THAT BRING YOUR WELLBORE DATA TO
THE SURFACE, WIRELESSLY.**

DOWNHOLE DATA LOGGERS

Our long-life acoustic Data Loggers can provide power to read multiple gauges at pre-defined intervals, securely store the received information within the unit, then transmit it acoustically through the water column to the surface on-demand. They are compatible with Intelligent Well Interface Standardisation (IWIS) and non-IWIS gauge cards from the leading wellbore downhole pressure and temperature gauge manufacturers.

Data Loggers are ROV deployable (and retrievable) to a maximum depth of 3,000 m. Using normal gauge reading sample rates they can operate for up to three years. Longer deployments or higher sample rates are easily accommodated using external battery packs. All hardware is supplied in corrosion-resistant super duplex stainless steel cannisters for very long deployment periods.

SUSPENDED OR ABANDONED WELL MONITORING

High-availability acoustic subsea modems are designed for use with third party systems to facilitate the transfer of wellhead or wellbore data to the surface. Our modems can be designed, tested and supplied as part of a third party's well monitoring solution, including electromagnetic, and through-casing tube technologies to the wellhead or tree-mounted modem.

HIGH SPEED OPTICAL DATA OFFLOAD

Some subsea well monitoring applications, such as wellbore fibre optic distributed acoustic sensing (DAS), require very high bandwidth links to offload large quantities of recorded data. Our BlueComm 100, 200 or 200 UV through-water optical communication modems can be integrated and supplied along with our Data Loggers to offer high-speed access to all your AUV or ROV onboard data.





WHY INVEST IN SONARDYNE DATA LOGGERS

- Designed for ROV deployment and recovery
- Can remain deployed for several years without intervention
- Easily moved between wells
- Interfaces with all industry standard gauges
- Fully adjustable logging rates
- Choice of data harvesting options

ACOUSTIC BOP CONTROL SYSTEM

BOP CONTROL AND CAPPING STACKS

EMERGENCY BACKUP BLOWOUT PREVENTER (BOP) CONTROL USING ACOUSTIC COMMUNICATIONS MEANS YOU CAN STILL OPERATE THE HYDRAULIC RAMS IN YOUR STACK TO SHUT DOWN YOUR WELL AND DISCONNECT YOUR RISER, KEEPING YOU IN CONTROL. IF A BOP FAILURE OCCURS AND A CAPPING STACK IS DEPLOYED, OUR CERTIFIED CAPPING STACK ACOUSTIC MONITORING SYSTEMS ARE THE WIRELESS LINK YOU NEED TO UNDERSTAND FLOW CHARACTERISTICS.

ACOUSTIC BOP CONTROL SYSTEM

Our Acoustic BOP Control System allows you to remotely shut-in a well using a high security, through-water wireless acoustic communications link underpinned by our award-winning 6G acoustic telemetry.

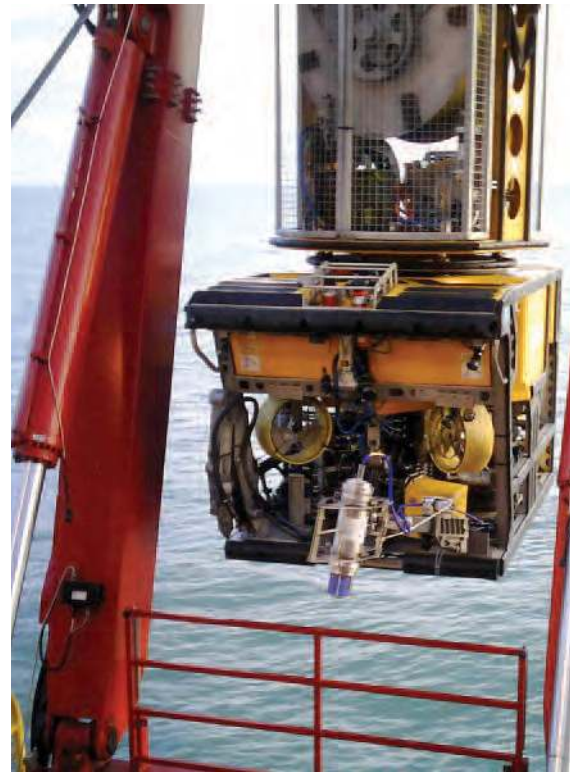
Available in single or dual redundant configurations, the Acoustic BOP Control System consists of surface and subsea control equipment, connected wirelessly. During an emergency, system components installed on the BOP are remotely activated from your control room on the rig or using a portable command system deployed from a lifeboat, support vessel or ROV.

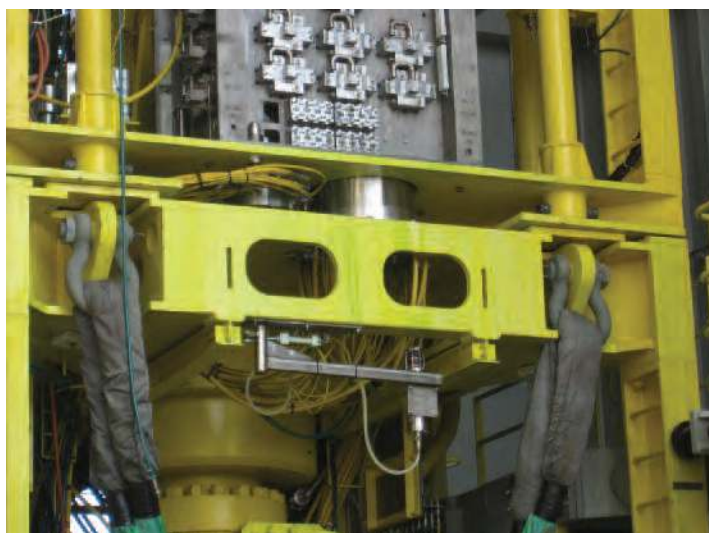
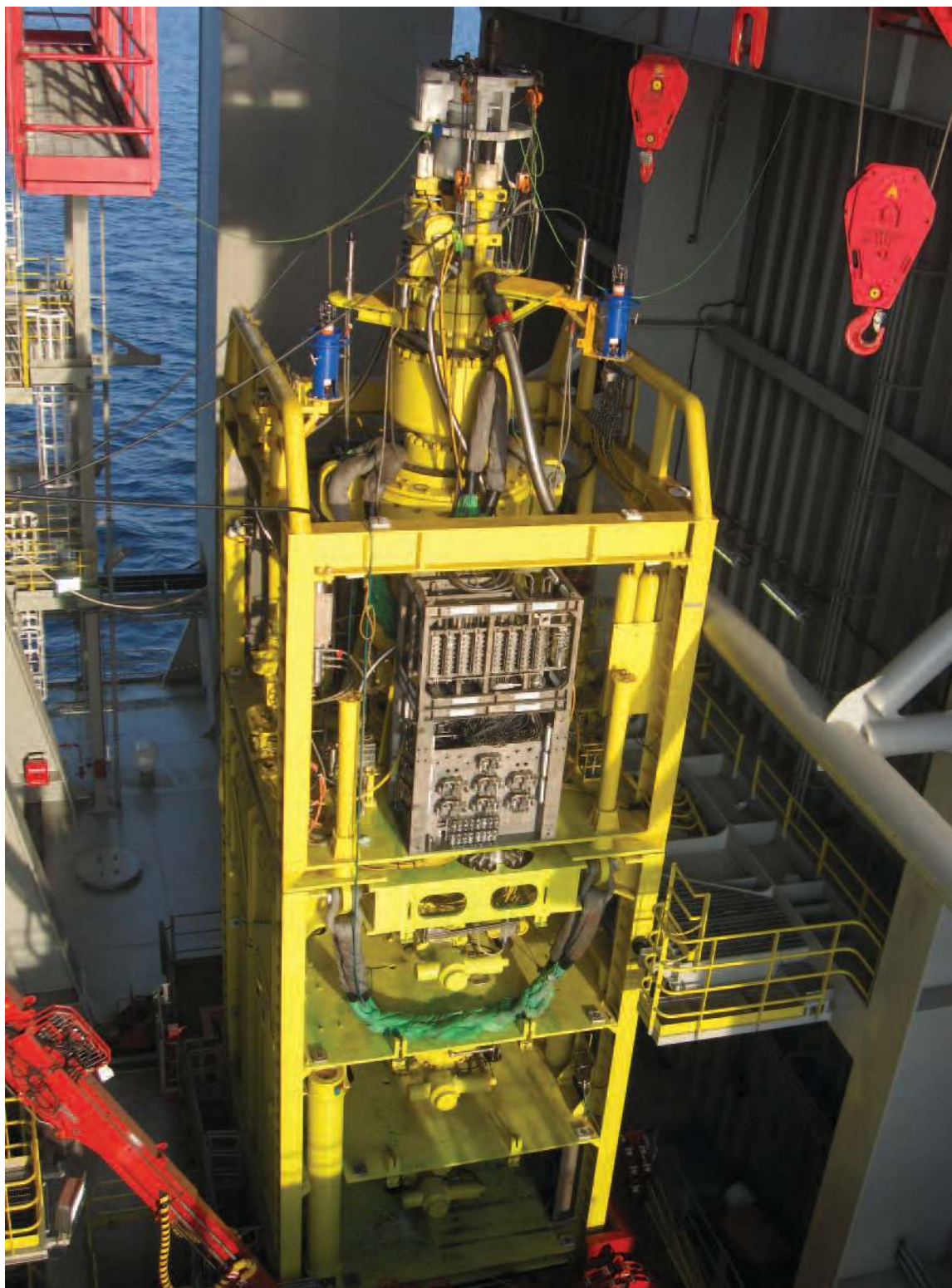
On the surface, the rack-mounted or portable command unit acts as the user interface, connected to a hull-mounted or over-the-side transceiver. Subsea, intelligent Deep Acoustic Remote Transceivers (DARTs) are cabled to a subsea electronics module (SEM). The SEM can also be supplied in single or dual form, to avoid a single point failure.

CAPPING STACK ACOUSTIC MONITORING SYSTEMS

Our capping stack acoustic monitoring system consists of a SEM, connected to a deep-rated subsea junction box, which in turn powers and connects to dual pressure and temperature sensors on the capping stack. A DART, connected to the SEM, wirelessly transmits the sensor data to a transceiver at the surface.

Our HPT transceiver, already onboard, or a Dunker 6 transceiver, deployed over the side of a vessel or rig, to receive the sensor data to a Portable Command Unit (PCU), which provides the user interface and enables onward transmission of the data to third-party control systems. To increase the working life of your DARTs, an extended housing containing additional batteries can be supplied.





WHY INVEST IN SONARDYNE BOP CONTROL

- Provides BOP control and monitoring if primary control is lost
- Highly secure two-way wireless link
- Signal technology proven in a well containment situation
- Multiple layers of equipment
- Certified integration with Trendsetter capping stack
- Rig and portable topside control hardware

ASSET MONITORING CAPABILITIES

AT A GLANCE

STRUCTURAL MONITORING> SMART / AMT

SMART and AMT deliver the precision, reliability and flexibility you need for analysing short and long-term trends in structures, pipelines, and risers. With a wide range of sensor options available, we can configure a system to meet the specific monitoring needs of your offshore assets.



- Battery options to support campaigns in excess of 10 years
- Can be deployed and recovered using an ROV
- 3,000 m standard depth rating; options to 7,000 m
- Onboard logging and processing of data, offloaded acoustically on demand

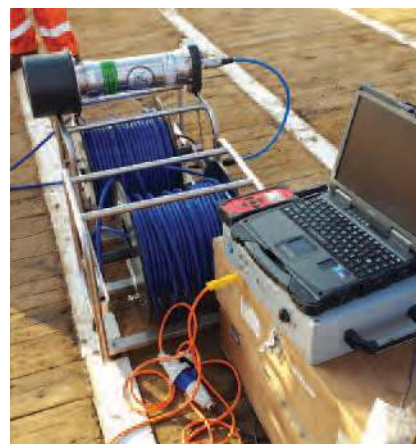


COMMUNICATIONS> BLUECOMM / DUNKER 6 / HPT

BlueComm optical modems enable real-time HD video streaming of subsea interventions and ultra-fast data recovery via AUV or ROV. Use Dunker 6 and HPT to harvest data packets acoustically on demand from a vessel of opportunity, or unmanned surface vessel.



- Up to 10 Mbps data rate
- Energy efficient to maximise power budget
- Compatible with subsea Ethernet networks
- Wideband 2 signals power HPT and Dunker 6 for reliability in all environments
- Rig, vessel, USV installation options

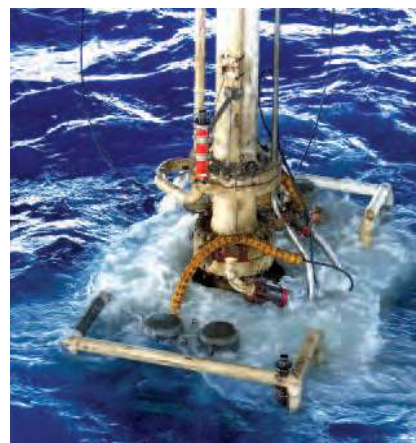


DRILLING AND PRODUCTION> RISERS / MRAMS / DPTi 6

A highly accurate solution for monitoring the differential angle between a riser and BOP in order to reduce excessive wear on wellhead components. Designed for use on both dynamically positioned (DP) and moored drilling rigs.



- Designed to prevent wear on wellhead components
- Highly accurate, cable-free solution
- Suitable for new build or retro-fit
- Uses a pair of DPTi 6 transponders mounted on riser and LMRP
- Option to integrate with Sonardyne DP reference systems



LEAK DETECTION> SENTRY / SOLSTICE

Sentry is a wide-area, deep-rated monitoring sonar capable of detecting, localising and classifying hydrocarbon integrity breaches. Solstice provides ultra-high resolution imagery and automatic target recognition on AUV-based leak detection missions.



- **Wired and battery-powered Sentry options**
- **Operationally deployed and proven**
- **Low false alarm rates**
- **Multi aperture sonar (MAS) suitable for low-logistic AUVs**
- **Suitable for search, classify and map (SCM) operations**
- **Low power, wide swath coverage**

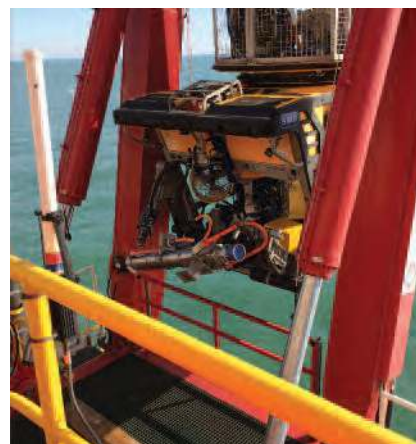


WELLBORE MONITORING> DATA LOGGER

Allows downhole data to be stored at the wellhead and uploaded on demand, via a cable-free secure acoustic communications link. Ideal solution for initial well appraisal, where frequent pressure and temperature readings need to be logged and sent to the reservoir team onshore.



- **Designed for ROV deployment and retrieval**
- **Easily moved between wells**
- **Interfaces to all industry standard gauge cards**
- **Depth rated to over 3,000 m**
- **Fully adjustable data logging rate**



WELL CONTROL> EMERGENCY BOP

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. Operational in the US Gulf of Mexico and elsewhere. Activate from rig, support vessel, lifeboat or ROV.



- **Fully API compliant**
- **Provides control and monitoring if primary BOP control is lost**
- **Highly secure two-way wireless acoustic link**
- **Acoustic signal technology field proven in a well control emergency**



SUPPORT

WE DESIGN WE TEST WE INTEGRATE WE MAINTAIN

OFFSHORE, TRUSTED, ROBUST, RELIABLE AND HIGH-QUALITY MONITORING SYSTEMS ARE ESSENTIAL. WITH HUNDREDS OF INSTRUMENTS SUCCESSFULLY DELIVERED AND INSTALLED, WE HAVE THE EXPERIENCE TO WORK SIDE-BY-SIDE WITH OFFSHORE ASSET TEAMS, ENGINEERS AND SUB-CONTRACTORS TO DELIVER HIGH-INTEGRITY, LONG-LIFE AND PREMIUM PERFORMANCE AS STANDARD.

EXPERT SOLUTIONS

Our long-term partnership with our customers has enabled us to develop a unique and extensive insight into the diverse, mainly project specific, nature of all aspects of subsea asset monitoring. From leak detection to riser monitoring, our customers have come to rely on our ability to form our technology to fit their specific monitoring challenges. We understand that the investment decisions you make today will underpin your operational capability for years to come.

That's why you can trust our global commercial and technical teams to give you expert advice, service and after sales support for your specific subsea monitoring needs. This extends to any project customisation, sensor mountings, battery life estimations and through-water acoustic telemetry and positioning performance.

FACTORY TESTING AND COMMISSIONING

Many subsea asset monitoring devices are required to operate at depth for many years without intervention. Our systems are rigorously prototyped, manufactured and tested prior to delivery at our world-class in-house facilities. These include: pressure chamber rated beyond 6,000 m water depth; Acutronic rate table for IMU testing; thermal soak chambers; large in-door test tanks; and two survey-class vessels based at our test facility in Plymouth, UK.

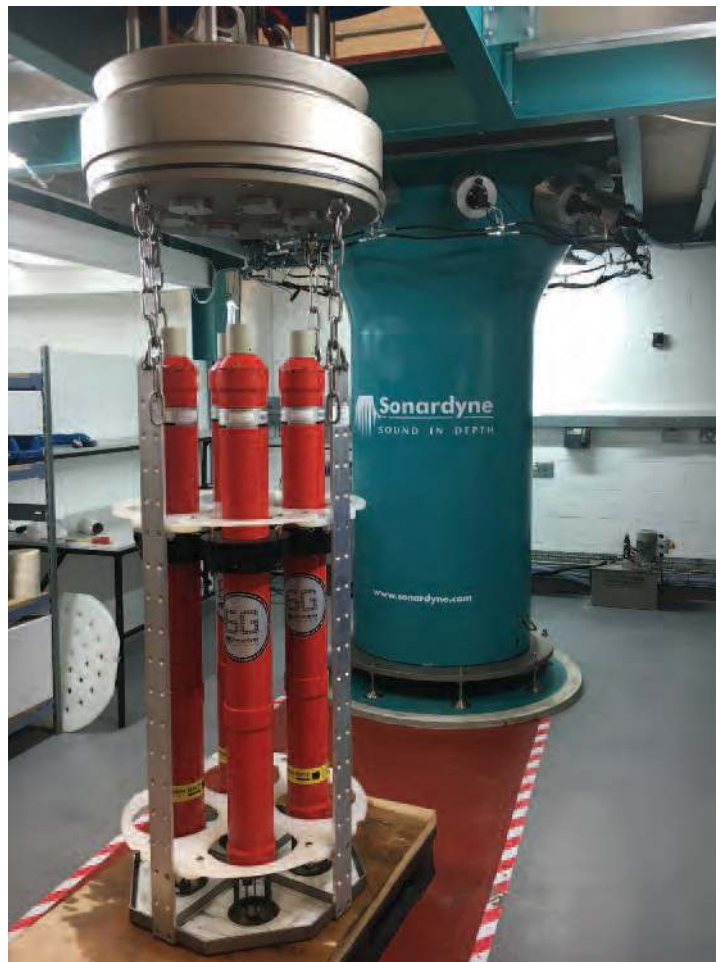
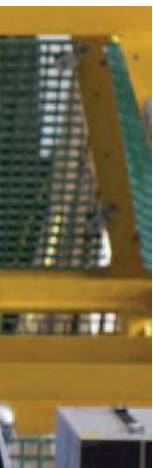
During a project's installation phase, we can supply highly experienced field personnel to ensure even the most complex of monitoring systems are commissioned safely, professionally and as promptly as possible. This can also include training of your own personnel to operate and maintain the system.

HELP WHEN YOU NEED IT

As a Sonardyne customer, you gain automatic access to our customer care programme. A dedicated email address connects you to product engineers ready to answer your questions. But if it's more urgent, our 24 hour worldwide telephone helpline is standing-by ready to resolve any operational issues.

Of course, the best way to ensure your equipment always performs as it should is to service it regularly. By booking an annual visit, one of our field engineers will inspect the health of your Sonardyne asset monitoring equipment. This will include updating software and firmware, plus inspecting any deployment systems to make sure regular checks have been carried out. If necessary, instrument sensors can be re-calibrated at any one of our international service centres.





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