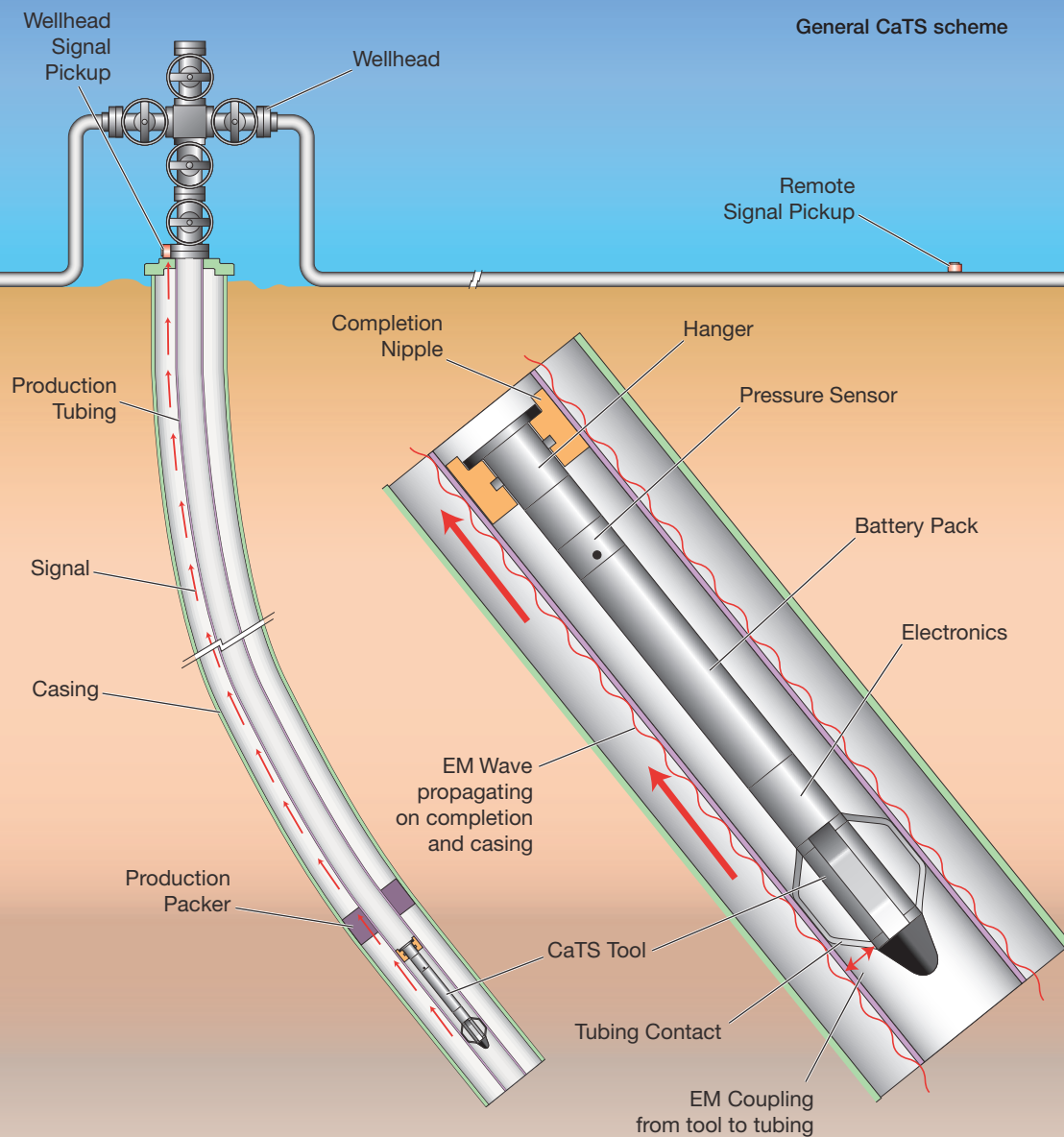


Wireless Well Solutions  
CaTS™ Cableless Telemetry System



# Innovative technology

## Excellence in operations



# CaTS™ Cableless Telemetry System



Expro's Cableless Telemetry System (CaTS™) is a field-proven, battery powered, wireless data transmission system that offers operators immense advantages in the monitoring and control of both new and existing wells.

Based on electromagnetic data transmission technology, the CaTS system transmits low-frequency EM waves from downhole to surface, or surface to downhole, using the well's tubing or casing as the transmission medium. The system can be retrofitted into existing wells using either wireline or coil tubing, or alternatively, may be completion deployed. CaTS transmits high-quality pressure and temperature information and is rapidly gaining industry acceptance as a cost-effective solution to many of the long-standing problems of acquiring downhole data. Having a flexible sensor interface, there is the option to integrate alternative sensor types in the future.

The retrofit instrumentation of existing well stock provides a real-time 'data to desk' capability that enables the reservoir engineer to manage the reservoir effectively and to optimise production. Having access to real-time data enables the early diagnosis of well production problems and allows remedial action to be taken promptly.

The addition of duplex functionality to CaTS means that it can receive as well as transmit data. This means that the telemetry can then be used for downhole control applications. The ability to communicate with and control downhole hardware without the need for a cable or control line is a significant enabling component of retrofit flow control.

## Key Features

- Uses standard completion hardware
- Extended periods of in-well operation up to 36 months are achievable
- Retrofit capability using wireline or coiled tubing, retrievable for battery replacement
- Multi-drop, multi-sensor, addressable in well
- Provides real-time BHP/BHT 'data to desk'
- Readily deployed in complex well architectures – long-reach horizontal wells, abandoned subsea wells or zones, behind screens etc
- Signal transmission is unaffected by the presence of cement or bridge plugs
- A completion-deployed CaTS mandrel variant enables full-bore well access and maximum flow rates to be achieved

## CaTS system performance specification

	Through-tubing CaTS	CaTS Mandrel
Length	10m	4m
Diameter	2.5" or 1.69"	8.325" OD x 5.125" ID
Housing Material	4130 or CRA	13Cr
Transmission Range	>12,000 ft (subject to well & formation parameters)	
Pressure Range	0-10,000 psi standard, 0-20,000 psi on request	
Pressure Transducer	Quartz Crystal	
Pressure Accuracy	±.03% FS psi (i.e. ± 3 psi for a 10K transducer)	
Pressure Resolution	0.01 psi stored in tool 0.1 psi transmitted to surface	
Pressure Drift Specification	Max. 0.02% of full scale per year (i.e. 2psi/year for a 10,000 psi range transducer)	
Temperature Range	-20 to 125°C	
Temperature Accuracy	±1°C	
Temperature Resolution	0.1°C stored in tool memory 1.0°C transmitted to surface	
Max Sample Rate	Depends on well parameters	
No. of data transmissions (single battery pack)	25-4,000 readings depending on well parameters	
Battery Life	Up to 36 months depending on well parameters and number of data transmissions	



1.



2.



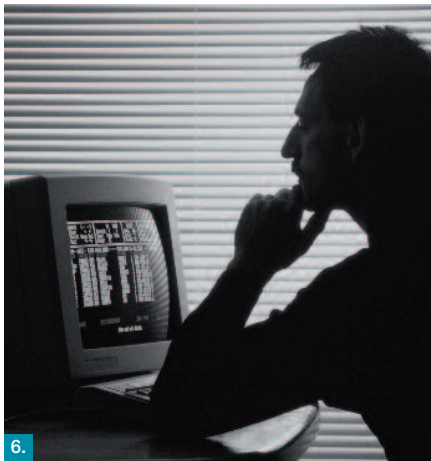
3.



4.



5.



6.

CaTS onshore retrofit process:

1. CaTS equipment arrives on site
2. Equipment checked prior to deployment
3. CaTS installed into the well utilising standard intervention equipment
4. CaTS signal pickup is installed onto the wellhead
5. CaTS receiver is installed at the well location, which can then be interfaced with a SCADA system or third-party data network (such as GSM)
6. Downhole data is delivered to desk in real-time

## CaTS for onshore production monitoring

Optimisation of the oil or gas production process requires knowledge of the bottomhole producing pressure. Monitoring of the production process using surface measurements requires approximations to be made and from which inefficiencies in production can result.

Retrofit of CaTS into existing production wells provides a cost-effective solution to achieving high accuracy, long-term monitoring, leading to improved production efficiency and longer well life.

### CaTS retrofit process

CaTS can be retrofitted into the well using standard slickline services. The gauge is typically suspended below a gauge hanger set in a nipple profile, or alternatively can be set below a bridge plug.

Where monitoring of several discrete zones in a given well is required, multiple CaTS gauges can be installed with the signals being multiplexed downhole, then decoded at surface by a multi-channel receiver.

Signal pick-up at surface is achieved simply by making an electrical connection to the wellhead. The signal is collected, decoded and stored in the topside receiver located at the wellsite. Where there is no electrical power supply available onsite, the topside receiver can be powered by solar panels.

Where real-time 'data to desk' is required by the client, the topside receiver can be interfaced to the client's SCADA system or alternatively, a stand-alone GSM link can be put in place.

When the downhole battery packs are depleted, the gauge can be retrieved to surface, the packs replaced and the gauge re-run.

### Benefits of real-time data

Where an operator may have to monitor production performance from a field of tens or even hundreds of wells on a daily basis, it simply isn't practical to visit each wellsite every day. By retrofitting CaTS into a selection of key wells in different segments of the reservoir and setting up real-time CaTS data transmission to the office, it is possible to receive vital early warning signs of pending production problems. Using CaTS enables a proactive approach to be taken to minimise downtime and maximise production.



Post Abandonment Phase

Once rig has departed, data is uploaded periodically to a supply vessel overhead

Topside data acquisition unit



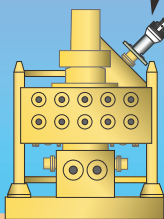
Acoustic Modem  
Acoustic Diving Sonde



Acoustic Tranceiver

Remote CaTS™ receiver stores downhole data at the seabed

CaTS™ signal connection on Wellhead



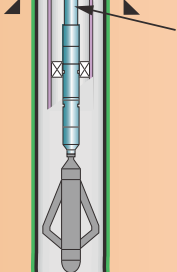
Cement Plugs

Well abandonment plug

CaTS™ data transmitted up casing



CaTS™ Pressure/Temperature Gauge suspended in tailpipe



Reservoir section remains live below abandonment plug



## Reducing reservoir uncertainty

Uncertainties in reservoir connectivity commonly exist when appraising any new reservoir and making development decisions. Information about the reservoir and estimated reserves is essential to determining if a field can be economically developed and may ultimately determine the viability of a project. Decisions taken at the reservoir development stage, especially in the deepwater subsea environment, can have major cost implications down the line. By monitoring of abandoned wells or zones, CaTS provides a significant contribution to reducing uncertainties.

### From appraisal to monitoring the well – a cost-effective solution

Consider the situation where an appraisal or step-out subsea well is drilled close to an existing producing field, or a new field under development. Today, these appraisal wells are typically permanently abandoned after logging and testing without obtaining any long-term pressure data, thus losing a valuable opportunity to gain a better understanding of connectivity in the reservoir and thus prove the reservoir model. By installing a CaTS system in the well at the time of well abandonment, and without in any way compromising the integrity of the abandonment, it is now possible to acquire high-quality reservoir pressure and temperature data for periods of up to three years. Data from the abandoned well is transmitted from reservoir depth to the seabed using CaTS wireless technology, where it is stored in a CaTS remote subsea receiver for subsequent upload to a supply vessel passing overhead using through-seawater acoustic communications.

The battery powered CaTS wireless gauge is typically deployed into the well on either slickline or coiled tubing, depending on the well deviation. In a live well situation, it can be hung off below a bridge plug that is set inside the casing above the top set of perforations. Further barriers/cement plugs can then be set above the bridge plug in accordance with accepted well abandonment legislation. The use of standard completion equipment during the final well abandonment process, streamlines the procedure and adds minimal time to the normal well abandonment operation. The absence of any cables penetrating packers/ bridge plugs or the cement, which could potentially present a leak path for reservoir fluids, ensures that the pressure integrity of the abandonment is not compromised.

The fact that this can all be achieved without having to mobilise a rig at some later date to re-intervene the well, offers significant cost savings compared with using conventional cabled or memory-type pressure monitoring technology.

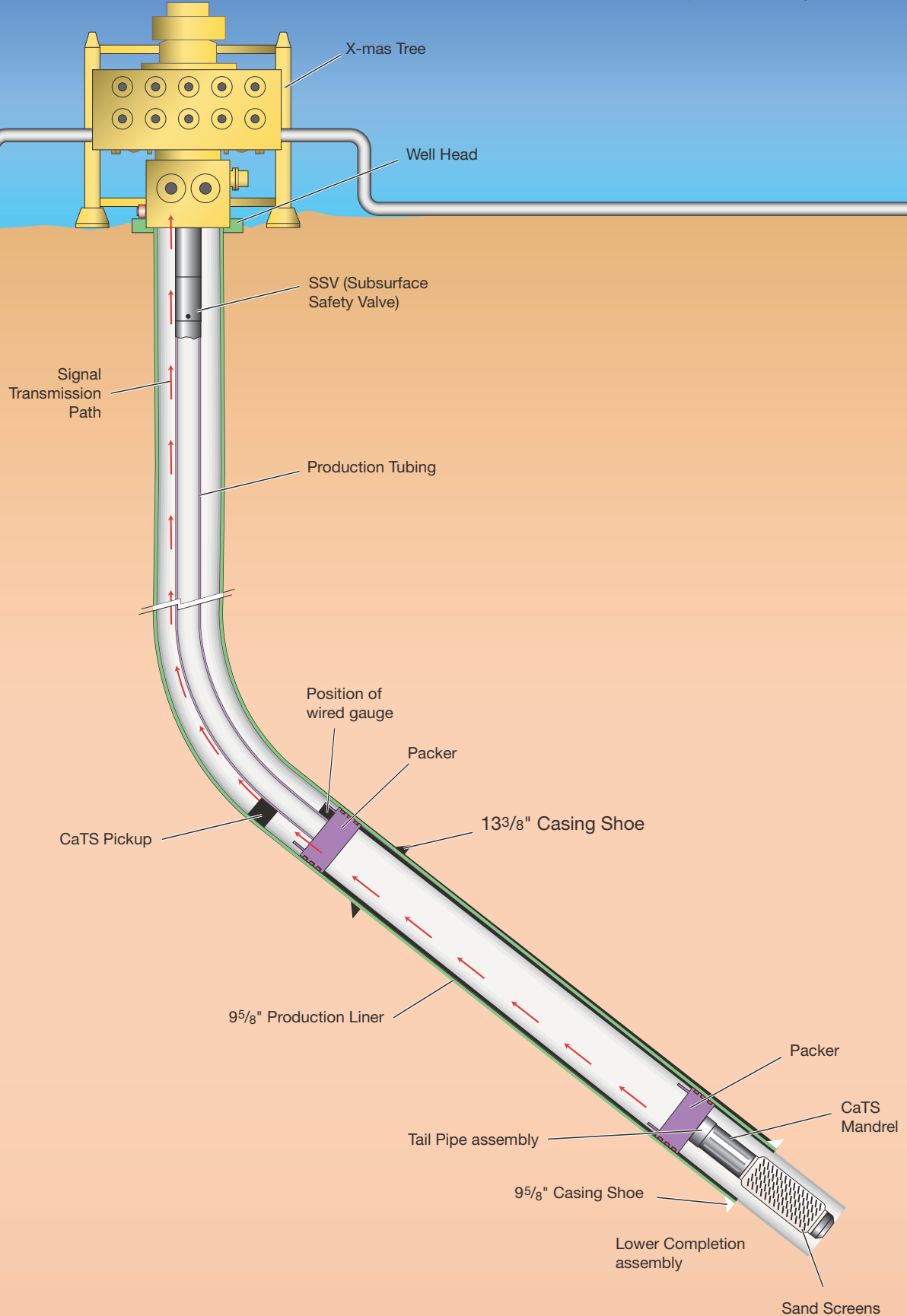


CaTS subsea receiver with acoustic transceiver



CaTS subsea receiver being deployed

CaTS deep set monitoring



## Production optimisation in high-rate gas wells

With the global hydrocarbon industry progressively moving towards a greater emphasis on gas production, the latest trend towards large bore completion designs makes traditional cabled reservoir monitoring technologies difficult, if not impossible, to apply effectively. CaTS offers a monitoring solution for high-rate gas wells that can allow the production to be optimised.

### CaTS as a deep-set monitoring solution

The trend for completion designs in high productivity gas well developments typically includes the provision of a large bore production liner that may extend for several thousand feet above the reservoir. Use of a large bore liner prevents the placement of traditional cabled-type monitoring systems (permanent gauge systems) close to the producing sand face.

This means that a cabled monitoring system must be located several thousand feet away from the flowing sand face, which due to the gravity head difference and frictional pressure drop, introduces a significant uncertainty into the accuracy of the measurement and how it relates to the actual sand face flowing pressure.

A large bore CaTS mandrel, suitable for deployment in 9<sup>5</sup>/<sub>8</sub>" casing has been developed. When conveyed as part of a lower completion assembly, this can be positioned in close proximity to the flowing sand face and then transmits the data through the casing to a pickup point located higher up in the well and somewhere above the production packer. The signal is then relayed to the seabed via a conventional 1/4" encapsulated cable located in the annulus.

At the seabed the signal is collected and processed in a CaTS subsea receiver, which is interfaced with the subsea electronics module of the tree provider to provide real-time data direct to the client's network.

Where wells are being produced on drawdown constraint, having an accurate measurement of the sand face flowing pressure enables the operator to optimise the well production and potentially, flow the wells harder.



CaTS subsea receiver on subsea tree



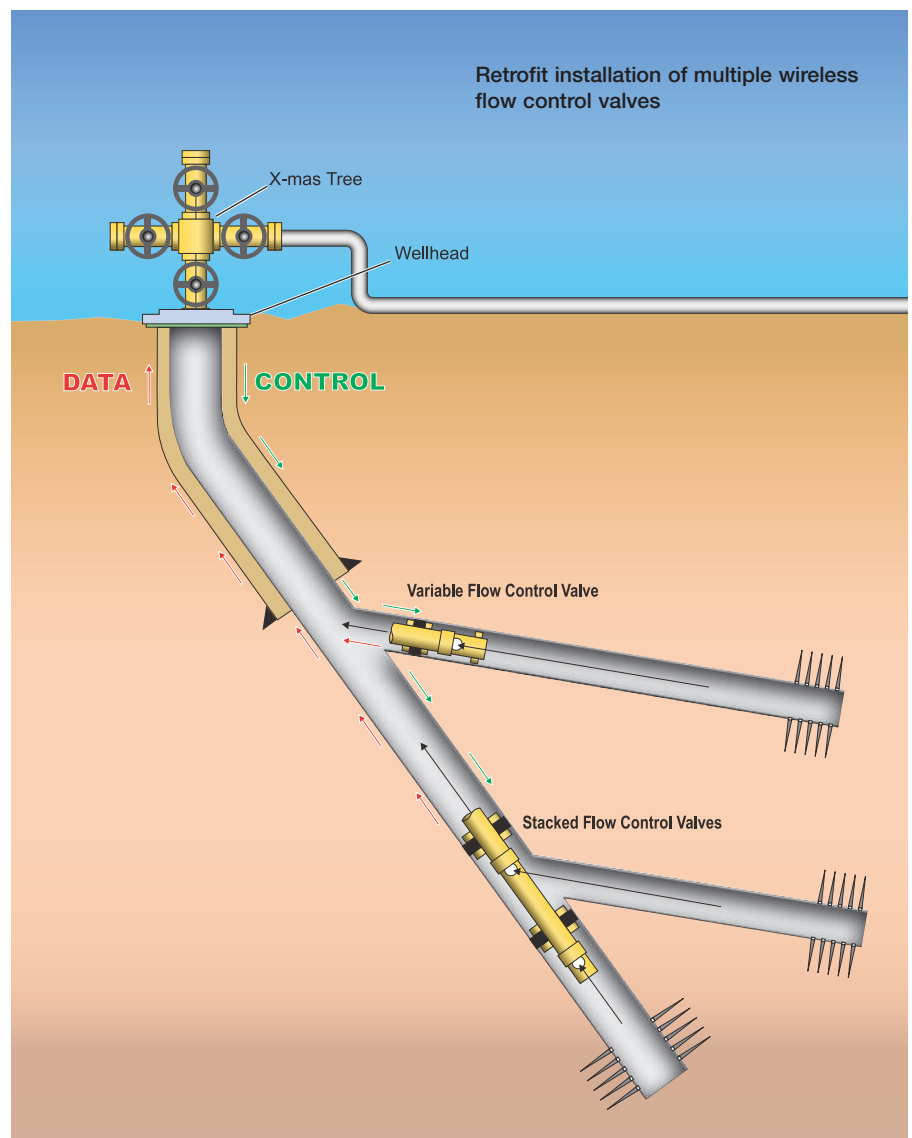
CaTS large bore mandrel

## Wireless Flow Control

The ability to retrofit wireless flow control devices into wells' through-tubing is an attractive option in several differing scenarios. Using the CaTS duplex communications capability, Expro's FlowCAT™ offers a flow control solution that does not require a cable or control line to function and that can deliver benefits in both the brownfield and the intelligent well environments.

In the brownfield environment, producing every last drop of the hydrocarbon reserve is a key priority. In an attempt to access 'stranded' reserves, it is becoming common practice to use through-tubing rotary drilling (TTRD) to drill a lateral off the existing motherbore to tap into remote pockets of oil and gas that are not being produced by the main bore. Under such circumstances, being able to control flow from the lateral, independent of the main bore, presents some technical challenges. Since CaTS is a wireless solution that does not require a cable, then it is possible to communicate instructions to a flow control valve that has been retrofitted into the lateral by sending signals from the topside, down the main bore and into the lateral. In cases where the metallurgy of the motherbore and lateral are not physically connected, a 'short-hop' wireless communication technique to bridge the gap is being developed.

The FlowCAT™ also has applications when the tubing retrievable downhole safety valves fail. There are many wells around the world today which are currently shut-in and not producing due to damaged control lines or failed safety valves. The cost of working over the well to replace the valve is frequently not justified and thus the wells remain shut-in. The FlowCAT™ can be deployed via slickline as a replacement for a failed downhole safety valve. A signal is transmitted from surface which keeps the valve open. If the signal stops, or a 'close' command is received, then the valve closes and provides a fail-safe system.



Expro's business is well flow technologies and specialised services, and our mission is to:

- **measure**
- **improve**
- **control** and
- **process**

flow from high-value oil and gas wells.

Our expertise is marketed through five segments:

**Well Testing & Commissioning, Production Systems, Wireline Intervention, Connectors & Measurements and Deepwater Intervention.**





**EXPRO**

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