



SENSORS AND INSTRUMENTATION FOR THE OIL AND GAS INDUSTRY





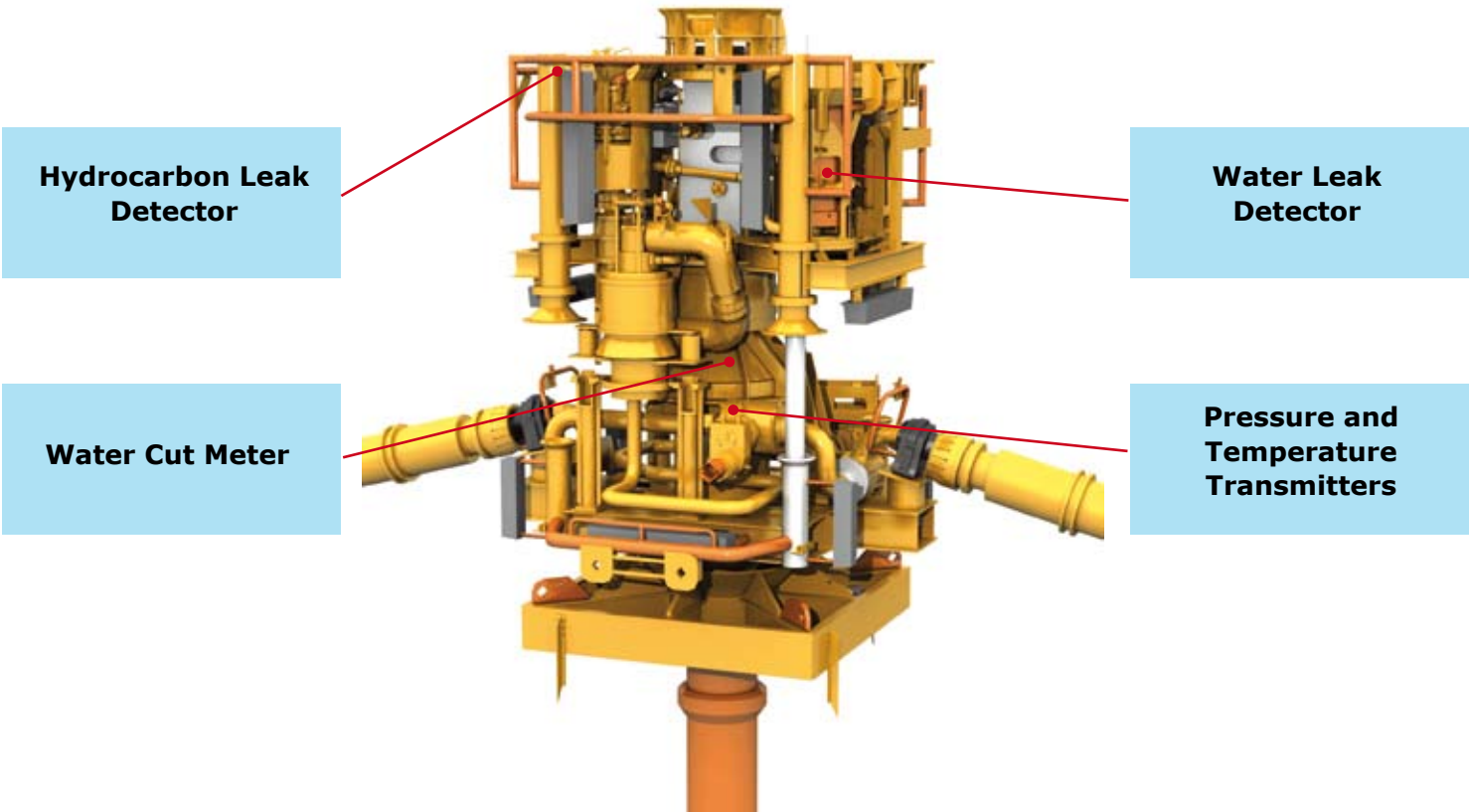
PHAZE TECHNOLOGIES - WELL ENHANCEMENT THROUGH INTELLIGENT SENSOR TECHNOLOGY

Phaze is a relatively new name in the market for high-end sensors and instruments for the oil and gas industry. However, the people behind Phaze have played a role in this challenging market since the late 1980s, mainly through Phaze's sister company Benestad. By being a supplier of subsea tree instrumentation to market leaders in the 1990s and presenting numerous innovations to the subsea industry, Benestad has gained valuable experience. It is, however, by supplying sophisticated sensors through leading instrument companies like Roxar that Benestad has excelled. Since 1993 the company has supplied advanced sensors based on glass/ceramic-to-metal sealing. These are sensors that have been exposed directly to the well fluid, giving crucial know-how about the properties of glass/ceramics in this corrosive and erosive environment.

Today Phaze make sensors and instrumentation based on that experience.

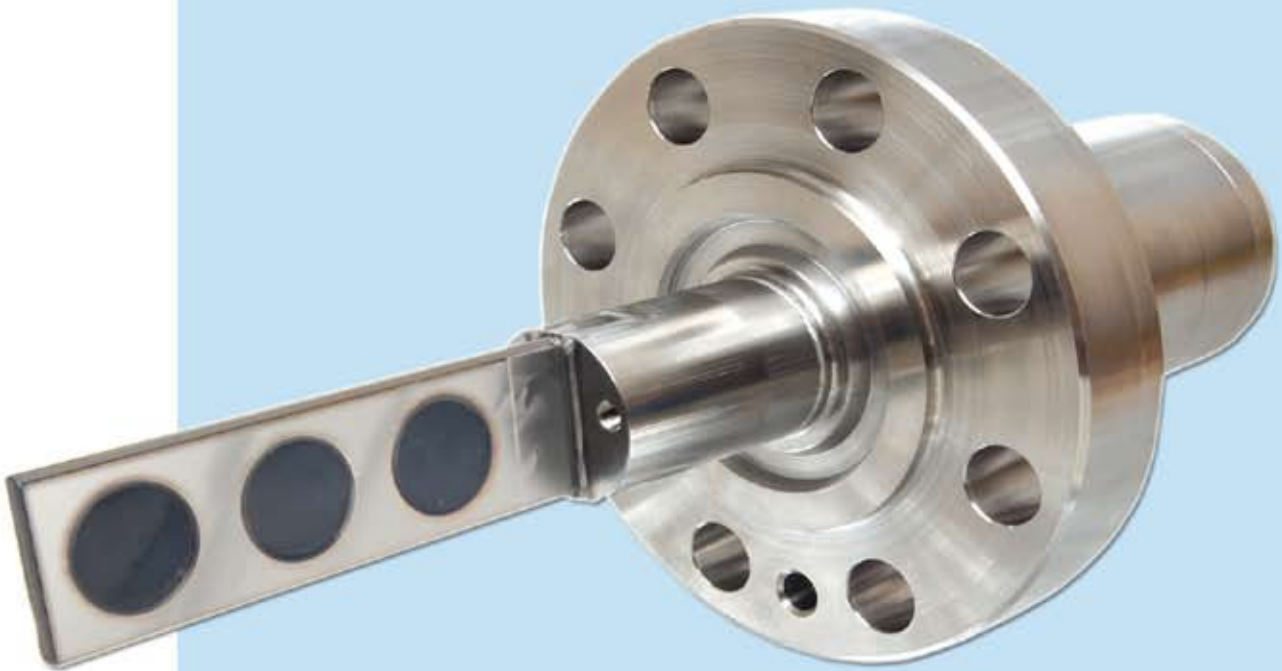
In addition to many years of experience, we offer a scientific approach to some of the world's most demanding applications. Our technology base is founded on the innovative appliance of inorganic material technology – materials with properties that do not change over time. This material technology has proved to be perfect for the harsh environment of subsea wells.

The key features for all our instruments are extreme stability and reliability over time.



WATER CUT METER – INTELLIGENT WELL ENHANCEMENT

The Phaze Water Cut Meter is a multi-instrument providing the end user with vital information about produced water in addition to pressure and temperature readings. It bolts onto a standard API/ANSI flange and will therefore fit almost anywhere without having to re-engineer or modify the production system or pipeline. The patented capacitive sensor system is based on glass/ceramic-to-metal sealing technology, a material technology which is field proven in well-exposed sensors since 1995. This unique material selection and design of the sensor ensures ultra stable measurements over time.



The pressure and temperature range of the Water Cut Meter complies with all existing industry requirements and the WCM is perfectly suited for HP/HT applications.

- The Phaze WCM - A Multi Instrument:
 - Capacitive measurement of Water Cut
 - Pressure measurement
 - Temperature measurement
- Replaces standard Pressure/Temperature sensors on X-mas trees, subsea or surface
- Standard API/ANSI flanged interface
- Standard electrical interfaces: 4-20mA, CANBUS, RS 485, GPRS and Bluetooth
- Available in all pipe/bore sizes
- Subsea and surface compatible; Ex-certified for surface use
- Easy to install and retrofit with standardized flange interface
- Ultra stable, inorganic materials based on glass/ceramic-to-metal sealing
- Material selection has proved to provide extreme long term stability
- Patented
- Field proven

PRESSURE & TEMPERATURE TRANSMITTERS

The people at Phaze have been involved in pressure and temperature sensors for subsea applications since the late 1980's. Over the years we have worked with various challenges of pressure and temperature monitoring in extreme environments. Operating closely with our sister company Benestad, we have the advantage of in-house thin-film technology and glass/ceramic-to-metal sealing. This puts Phaze in a unique position to integrate sensor technology and penetrator technology in the design and manufacturing process.



The new generation high accuracy pressure and temperature transmitters from Phaze feature:

- Pressure range: 10 000 psi and 15 000 psi /690 bar and 1035 bar
- Pressure accuracy: $\pm 0,02\%$ FS
- Temperature range: $- 40^{\circ}\text{F} - 356^{\circ}\text{F}$ / $- 40^{\circ}\text{C} - 180^{\circ}\text{C}$
- Temperature accuracy: $\pm 0,2\%$ CR
- Flange mounted sensor reduces thermal stress and improves thermal hysteresis and the lifetime of the sensor
- Piezoresistive sensor technology
- Secondary barrier to process at flange
- No load bearing welds – only seal welds
- Price competitive alternative to quartz
- Superior to quartz in dynamic applications
- Standard and compact API flanges
- Standard electrical interface: CANBUS

We also supply strain gauge/thin film sensor technology for standard accuracy transmitters.

HYDROCARBON LEAK DETECTOR – PROTECTING THE ENVIRONMENT

The environmental aspects of subsea oil & gas production are critical. Operators have a responsibility to protect the environment from negative effects of oil & gas production. A leakage from a subsea manifold or X-mas tree can be disastrous for the environment and extremely costly for the operator. By continuously monitoring the environment, the Hydrocarbon Leak Detector will limit the environmental impact and cost of an incident by enabling fast and efficient implementation of corrective measures. The HLD will also help operators to comply with current and future environmental requirements.



The Phaze Hydrocarbon Leak Detector represents an intelligent monitoring solution for general subsea operations worldwide.

- Monitors hydrocarbon leakages to the subsea environment
- Meets increasing environmental concerns
- Facilitates cost efficient intervention through early warning
- Easy to install and retrofit
- Capacitive sensor based on glass/ceramic-to-metal sealing technology
- Glass/ceramic-to-metal sealed penetrator with bootseals
- Standard electrical interfaces: 4-20mA, CANBUS or RS 485
- Qualified for ultra deep water (13 100 ft/4 000 m)
- Patented
- Field proven since 1995

WATER LEAK DETECTOR – INTERNAL LEAKAGES

The Phaze Water Leak Detector is designed to detect water ingress into an enclosure filled with dielectric oil.

Typically, the application is a subsea control module. In such a case, the WLD will also detect an internal leakage from the hydraulic system, as the sensor also distinguishes between hydraulic oil and dielectric oil.

The WLD can be applied to all leakage-exposed systems, as long as the dielectric constants of the two media are different. The WLD will detect leakages of water or oil in gas, gas in oil, oil in water etc.



The Phaze Water Leak Detector will tell you the status of your subsea enclosure.

- High-end sensor with extreme reliability
- Monitors internal environment
- Indicates leakage rate
- Facilitates cost efficient intervention through early warning
- Easy to install and retrofit
- Capacitive sensor based on glass/ceramic-to-metal sealing technology
- Glass/ceramic-to-metal sealed penetrator with bootseals
- Standard electrical interfaces: 4-20mA, CANBUS or RS 485
- Qualified for ultra deep water (13 100 ft/4 000 m)
- Patented
- Field proven since 2003

APPLICATIONS FOR THE OIL AND GAS INDUSTRY

Water Cut Meter (WCM)

Subsea examples:

- X-mas Trees
- Booster Pumps
- Gas Compressors
- Subsea Separators

Topside examples:

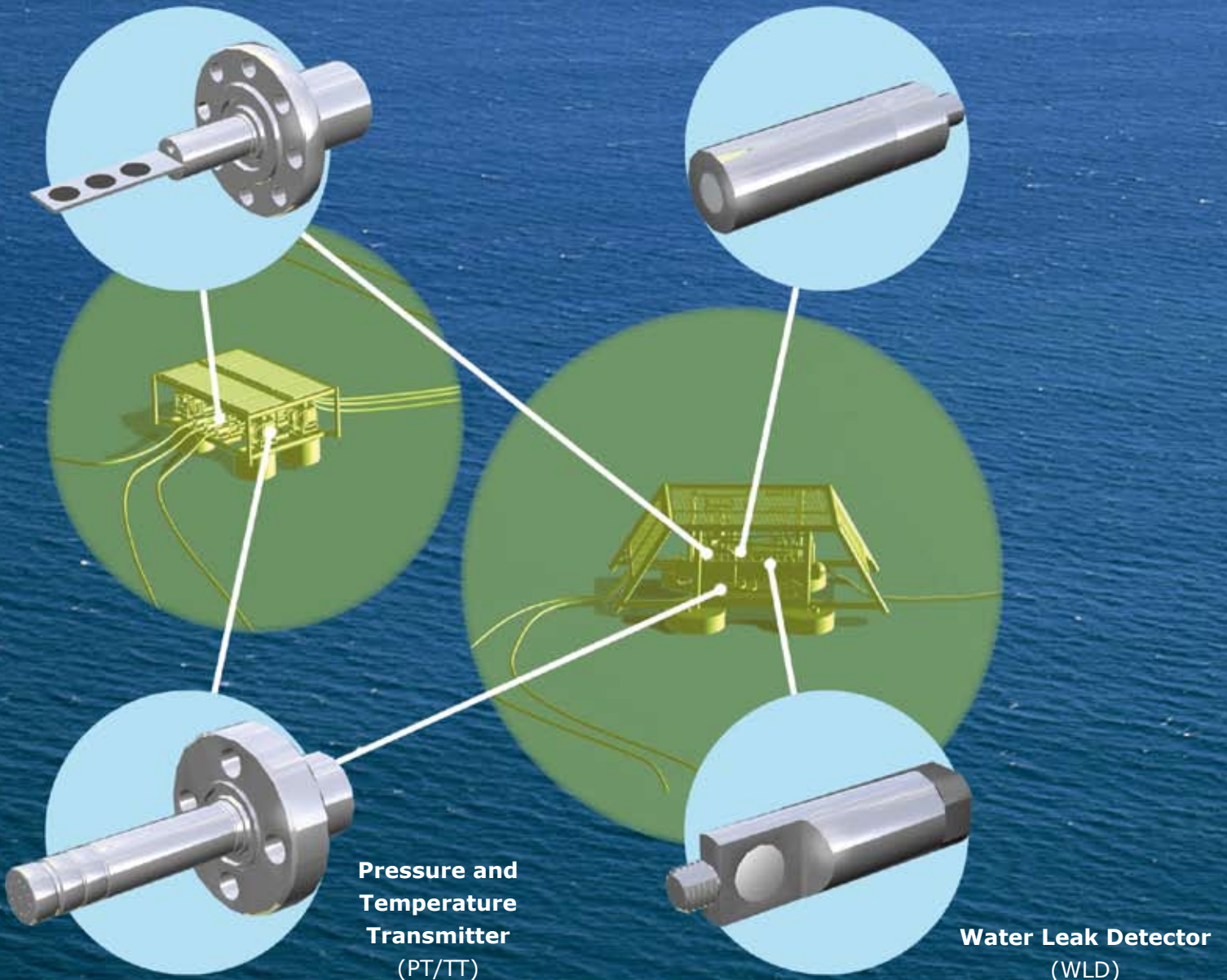
- Wellhead X-mas Trees
- Separators
- Flowlines
- Tankers

Pressure and Temperature Transmitter (PT/TT):

- X-mas Trees
- Booster Pumps
- Subsea Separators

Water Cut Meter (WCM)

Hydrocarbon Leak Detector (HLD)



Pressure and Temperature Transmitter (PT/TT)

Water Leak Detector (WLD)

Hydrocarbon Leak Detector (HLD):

Subsea examples:

- X-mas Trees
- Manifold Template
- Subsea Flanges

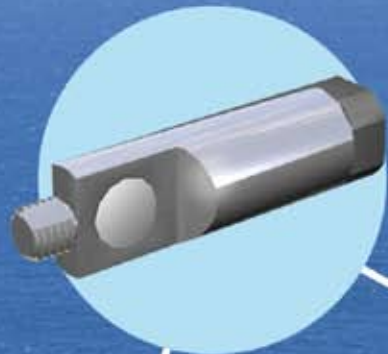
Water Leak Detector (WLD):

Subsea examples:

- Subsea Control Modules
- Booster Pumps
- Gas Compressors
- Subsea Hydraulic Systems

Topside examples:

- Flowlines
- Tankers

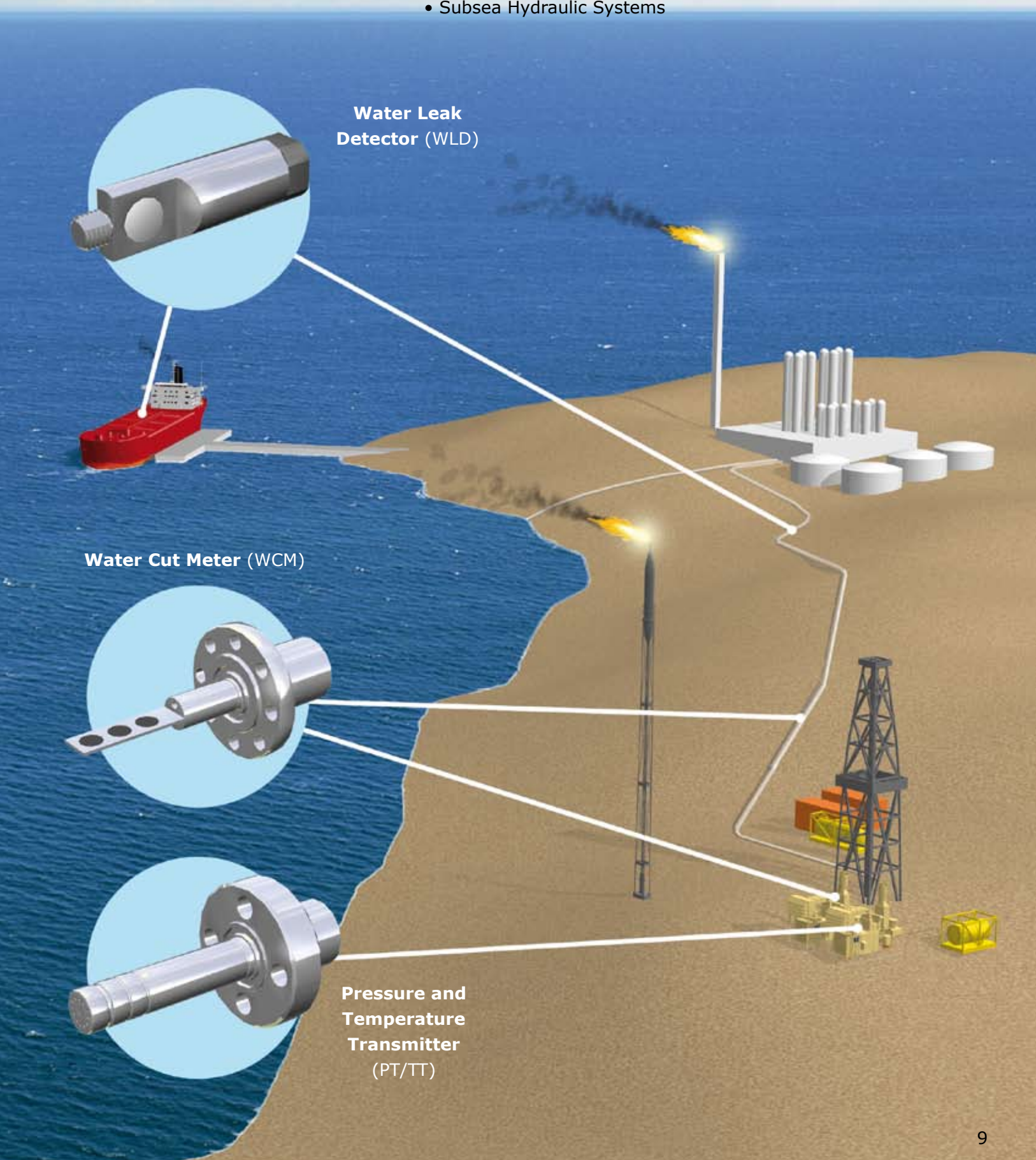


**Water Leak
Detector (WLD)**

Water Cut Meter (WCM)



**Pressure and
Temperature
Transmitter
(PT/TT)**



REFERENCES

Hydrocarbon Leak Detector:

- More than 300 units delivered
- Field proven since 1995
- Excelled in 2007 feasibility test funded by 7 major oil companies
- Patented design qualified for ultra deep water in 1998 (13 100 ft/4 000 m)



Water Leak Detector:

- More than 150 units delivered
- Field proven since 2003
- Second generation with bootseals qualified in 2007
- Qualified for ultra deep water in 2007 (13 100 ft/4 000 m)
- Patented



Pressure and Temperature Transmitter:

- More than 350 units delivered (1989 – 1997)
- Field proven since 1990
- First high accuracy digital sensor qualified in 1993
- First all-welded design qualified in 1993
- Third generation high accuracy PT/TT qualified in 2007



Water Cut Meter:

- Qualified for subsea use in 2007
- First subsea delivery completed Q2 2008
- Ex-certified for topside use in 2008
- First topside delivery completed Q2 2008
- Patented





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