

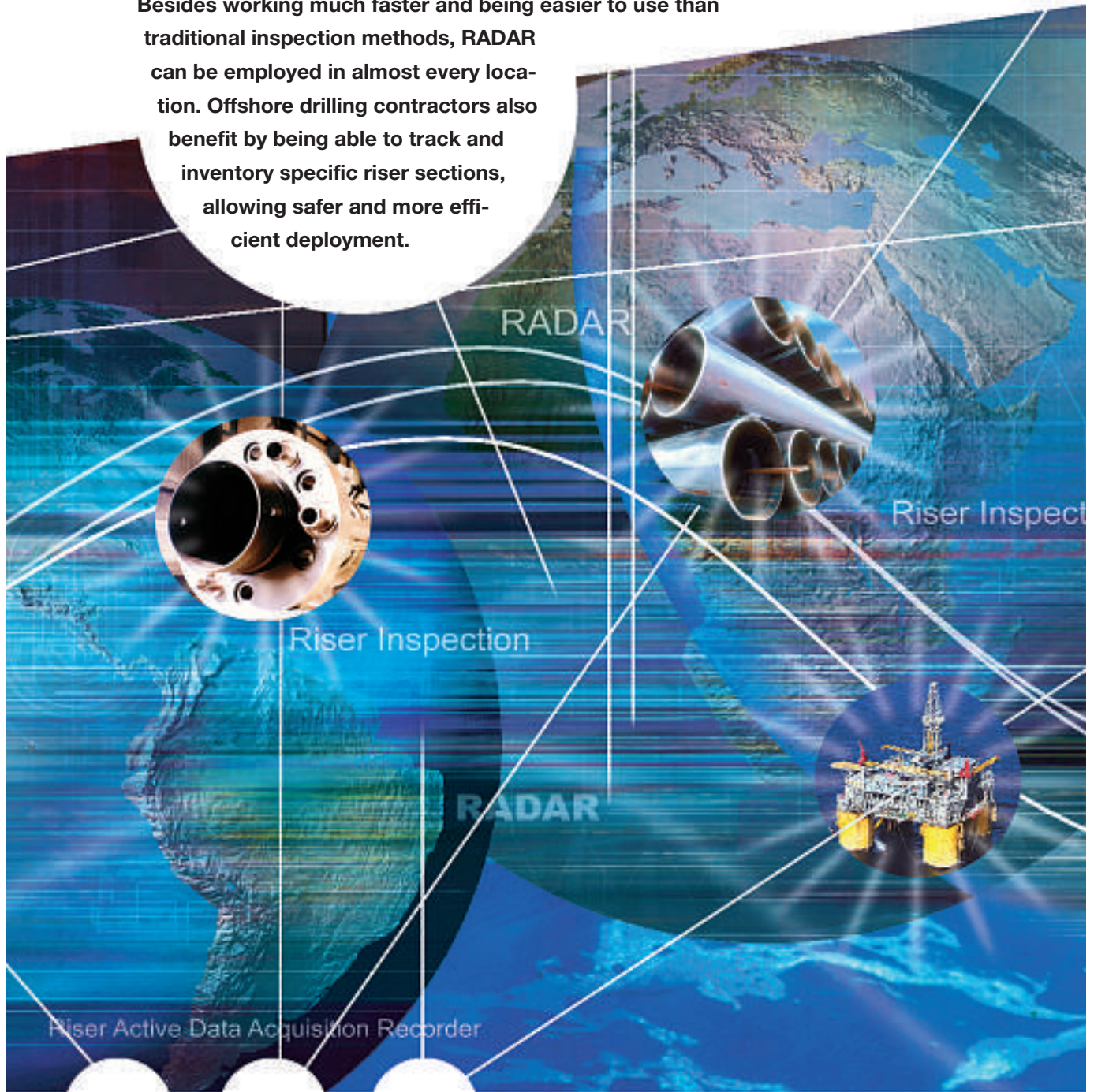
RADAR™

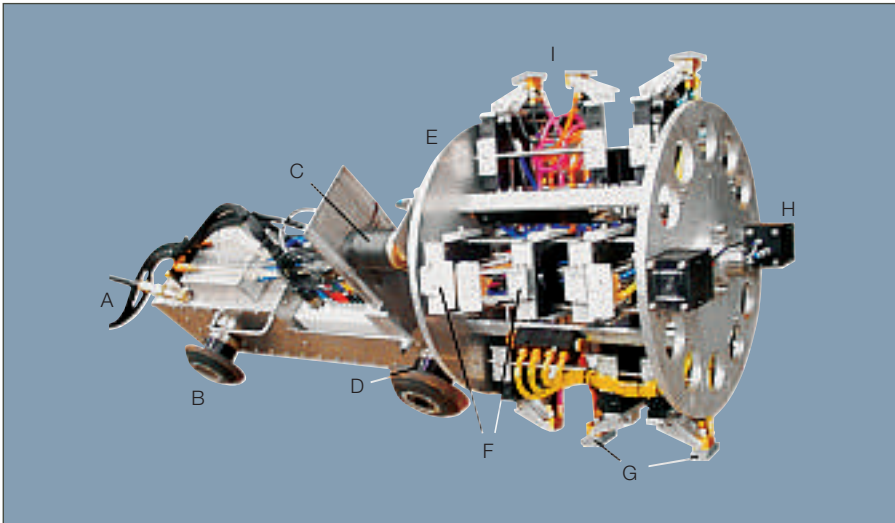
Advanced riser inspection

John Dunnihoo, Larry K. Harthorn

Risers – the pipes connecting a wellhead at the bottom of the sea with an installation on the surface – have to function in one of our planet's most challenging environments. Reliability is everything. Detecting flaws externally by conventional means, however, is time-consuming and costly. RADAR™ (Riser Active Data Acquisition Recorder) is an inspection tool that scans the walls and welds of risers for flaws from the inside and transmits the data in real time for analysis.

Besides working much faster and being easier to use than traditional inspection methods, RADAR can be employed in almost every location. Offshore drilling contractors also benefit by being able to track and inventory specific riser sections, allowing safer and more efficient deployment.





- A Power, water, air lines
- B Drive wheels
- C Head position encoders (internal)
- D Linear travel encoder (internal)
- E Rotating head
- F TOFD (2 sets at 180°)
- G Pulse-echo longitudinal wave transducers (4 at 90°)
- H Video cameras (2 at 180°)
- I Pulse-echo shear wave transducers (2 sets at 180°)

2-foot (60 cm) intervals, plus girth welds at the end connections.

A fully automated tool

RADAR is a fully automated robotics inspection tool **2**, designed to traverse the diameter of the pipe and inspect the

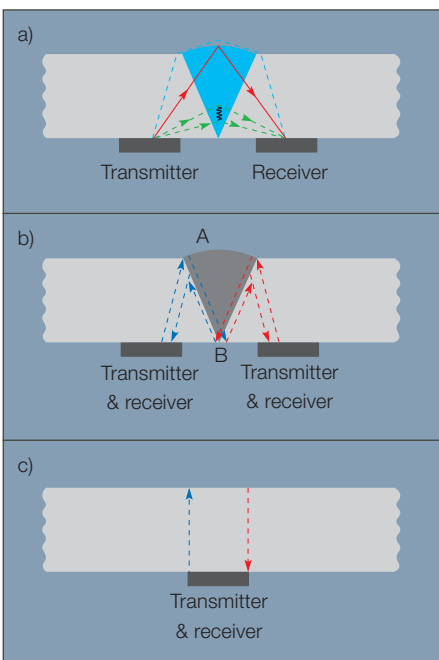
pipe wall thickness and quality of the end-connection welds by means of real-time data acquisition and analysis. To this end RADAR uses two time-of-flight diffraction (TOFD) channels, four pulse-echo shear wave transducers and four pulse-echo longitudinal wave transduc-

ers. A video record of the internal condition of the pipe is also made. Since the data are acquired and analyzed in real time, the inspectors are able to immediately identify any flaws, allowing repairs to be made before the pipe is returned to service.

Data acquisition and analysis

RADAR uses the TOFD channels to check the weld volume over the entire length of the welds. The two types of transducer – pulse-echo shear wave and pulse-echo longitudinal wave – are used to inspect and analyze the root and cap regions of the welds and to inspect the wall thickness along the length and circumference of the pipe, respectively.

The head of the RADAR tool rotates 360 degrees while two TOFD transmitters, spaced 180 degrees apart, send ultrasonic sound energy into the material at an angle **3a**. Energy diffracted by a flaw in a weld is picked up by a set of two receivers, also 180 degrees apart. The system processes this data to calculate the outline of the flaw, which it subsequently displays as a B-scan **4**. Using this method, RADAR can detect any weld flaw larger than 0.031". At the same time, RADAR produces a video record of the pipe's internal condition **4**.



TOFD weld (blue) volume inspection and flaw detection. The blue dotted line shows the TOFD inspection volume. A flaw (green) has been detected.

Pulse-echo shear wave schematic for evaluation of weld root (B) and cap (A) regions

Pulse-echo longitudinal wave schematic for pipe wall thickness evaluation

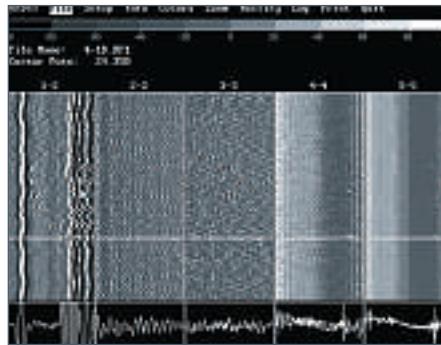
Since the system relies on ultrasonic energy traveling through the material, the equipment has to be very accurately calibrated. Calibration standards and procedures have been developed for the system, and are performed prior to every job and at intervals no greater than five riser joints or 12 hours, whichever comes first.

As already mentioned, pulse-echo shear wave transducers are used to inspect the root and cap regions of the welds **3b**. The two transmitters and two receivers are spaced 180 degrees apart and, as the tool head rotates, inspect the entire weld along the circumference of the pipe.

The four pulse-echo longitudinal wave transducers are located near the front of the tool, spaced 90 degrees apart, and are used to evaluate the thickness of the pipe wall **3c**. Data is displayed in real time as a color-coded thickness map, showing both graphically and numerically any anomalies in the wall thickness **5**.

The reporting criteria can be customized for each new application, giving the

4 B-scan display of weld area and video record of internal condition of pipe



analysis program the necessary flexibility to follow industry standards or alternative criteria based on customer or fit-for-purpose requirements.

Improving risk management

ABB's RADAR service can make an important contribution to the risk management program of offshore drilling contractors. Life-cycle wear data on drilling riser components can be measured against acceptable tolerances, helping to minimize risk by identifying marginal equipment that could be taken out of service or deployed in less stressful situations. Planned repairs, maintenance and/or part replacement can be scheduled to help avoid

costly rig shutdowns due to failure, and internal inspections can be undertaken without having to remove peripheral buoyancy and auxiliary lines, thereby minimizing handling and shipping damage and potential corrosion problems. The inspection data of specific risers can be stored digitally for easy retrieval and used, for example, to track specific riser assets by serial number and facilitate their transfer between rigs and regions.

The future of RADAR

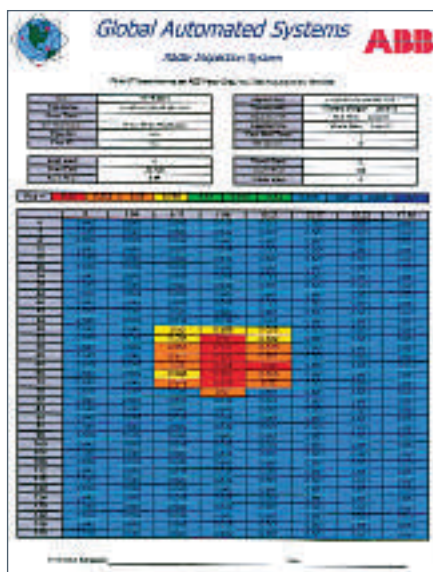
This service is suitable for use worldwide, the current generation of RADAR tools having already been used in the Gulf of Mexico and South America. Recently, RADAR was also introduced to the North Sea market following the Offshore Northern Seas show in Stavanger, Norway, in September 2002.

To further improve this service, ABB is currently developing a new tool that will enable risers to be inspected while still in position. Dubbed RADAR-V (for vertical), it will be capable of inspecting drilling or production risers without having to pull them to the surface. Offshore operators and drilling contractors can expect a very considerable saving from RADAR-V, which

ABB expects to introduce to the market in late 2003.

RADAR lets offshore operators minimize risk by identifying marginal equipment that could be taken out of service or deployed in less stressful situations.

5 Color-coded pipe wall thickness display



John Dunninghoo
Larry K. Harthorn
 ABB Vetco Gray
 USA
 john.dunninghoo@us.abb.com
 larry.k.harthorn@us.abb.com