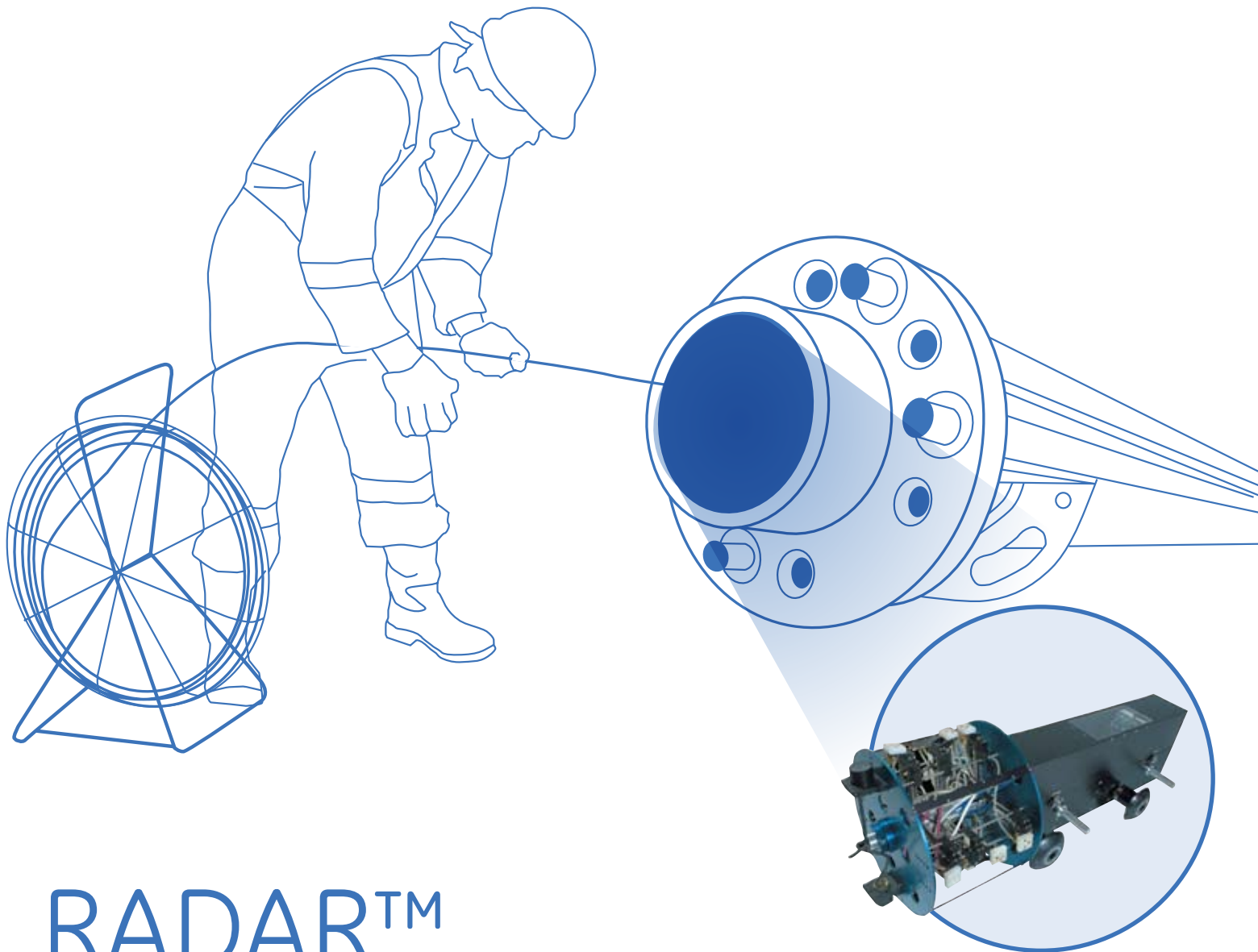




**vetco gray**<sup>TM</sup>

a GE Oil & Gas business



# RADAR<sup>TM</sup>

For fast, reliable in-field riser inspection



# Riser integrity

Marine Drilling Risers must function in one of our planet's most challenging environments. Reliability is crucial. In today's offshore drilling environment it is vital to maintain your drilling riser in a safe operational condition, without causing downtime for the rig.

## RADAR – the superior in-field solution

VetcoGray's Riser Active Data Acquisition Recorder (RADAR™) is a compact, fully automated in-line robotics solution. It runs inside the riser using real-time data acquisition and analysis to assess pipewall integrity. RADAR's combination of both Pulse Echo and T.O.F.D. inspection methods provide weld quality assessment unequalled in the industry. RADAR can be employed in almost any location – eliminating the need for off-site testing and dramatically cutting associated time and cost.

## Revolutionary technology

The conventional approach to riser inspection requires pipes to be transported from the rig to a pipe yard or dockside facility where buoyancy and coatings are removed to enable external inspection. The inspected joints are then transported back to the offshore rig. This approach has proven extremely costly and time-consuming.

As an alternative to this costly method, RADAR is a fully automated inspection tool that traverses the internal diameter of a riser pipe (both main tube and auxiliary lines) - using proven ultrasonic technology to measure pipewall thickness and assess quality of end-connection welds.

RADAR allows complete inspections to be made on-site without wasting valuable time transporting risers to a land facility or removing buoyancy and coating (as required with traditional inspection methods). After the on-site RADAR inspection is complete, only the riser joints in need of repair are transported to a shore facility.

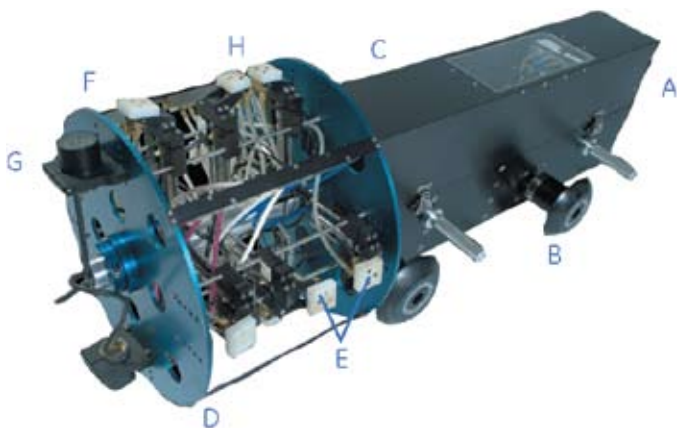
## Immediate results

The RADAR inspection itself takes just one third the time of a conventional inspection. An average of six riser joints can be inspected in 24 hours (assuming data acquisition frequency of 2-foot intervals, and girth welds at the end connections).

## Exceptional service

All data acquisition and analyses are performed in a single pass, in real time, enabling technicians to immediately identify flaws and direct repairs so risers can be returned to service without delay.

VetcoGray's systems include both large- and small-diameter tools, and are fully portable for efficient use in almost any location. We regularly perform inspections on operational offshore rigs and drill ships in transit.



- A Power, water and air lines (attached at rear of tool housing)
- B Drive wheels
- C Head position and linear travel encoders (in tool housing)
- D Rotating Head
- E Time-of-Flight Diffraction (TOFD) sensors (2 sets at 180°)
- F Pulse-echo longitudinal wave transducers (4 at 90°)
- G Video cameras (2 at 180°)
- H Pulse-echo shear wave transducers (2 sets at 180°)





## Tool configurations

Our large-diameter tool is used to scan drilling and production risers and other large pipe bodies ranging from 19-24 inches in diameter. A separate tool is used for choke and kill lines and other small pipes ranging from 3-4.5 inches in diameter.

Each RADAR tool contains a series of technologies designed for the unique characteristics of in-line riser inspection. As the RADAR head rotates 180°, three sets of transducers work together to determine the specific location, orientation, type and size of reportable flaws.

## Technologies

### Time-of-flight diffraction (TOFD)

Two TOFD transmitters check the weld volume over the entire length of the welds. The transmitters (spaced 180° apart) send angled ultrasonic waves into the pipewall (Fig. a). Energy diffracted by a weld flaw is picked up by the receivers (also 180° apart). The system processes this data in real time and calculates the flaw outline, which is subsequently displayed as a B-scan. This method enables detection of weld flaws as small as 0.031 inch.

### Pulse-echo shear wave

Four transducers inspect and analyze the root and cap regions of the welds (Fig. b). Two transmitters and two receivers are spaced 180° apart to inspect the entire weld along the circumference of the pipe.

### Pulse-echo longitudinal wave

Four transducers inspect the pipewall thickness (Fig. c). They are located near the front of the tool and spaced 90° apart for increased acquisition speeds. Data is displayed immediately as a color-coded thickness map, showing all anomalies both graphically and numerically.

## RADAR evaluation methods

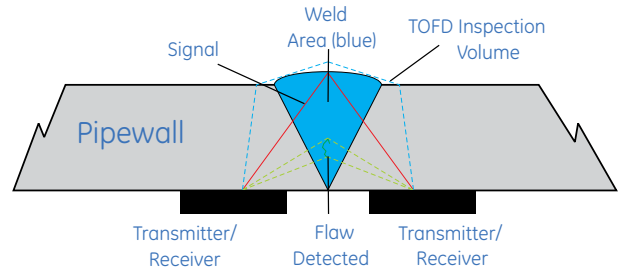


Fig. a: TOFD inspection volume (blue dotted line) and detected flaw (green)

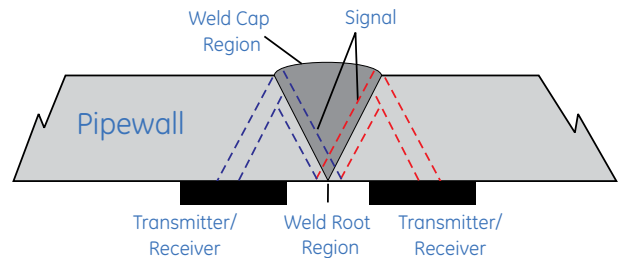


Fig. b: Pulse-echo shear wave schematic for evaluation of weld root and cap regions

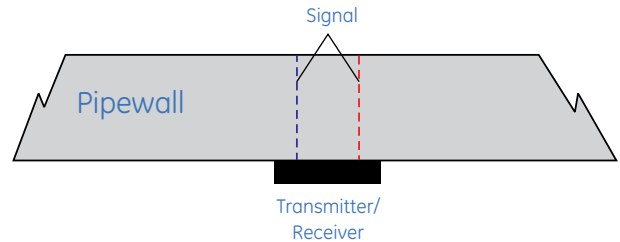
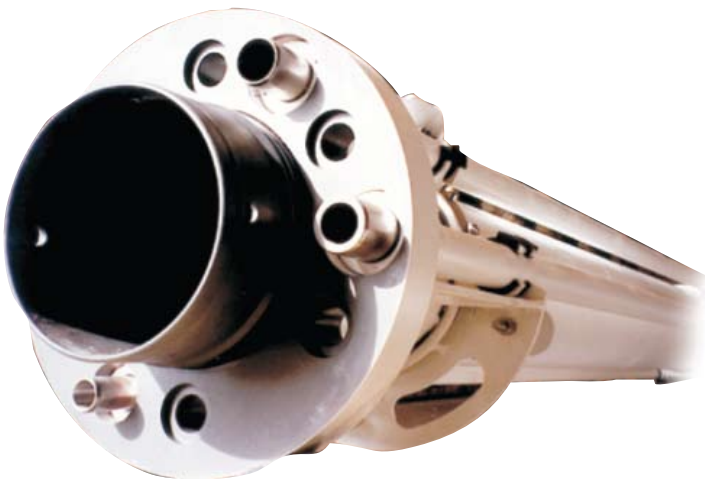
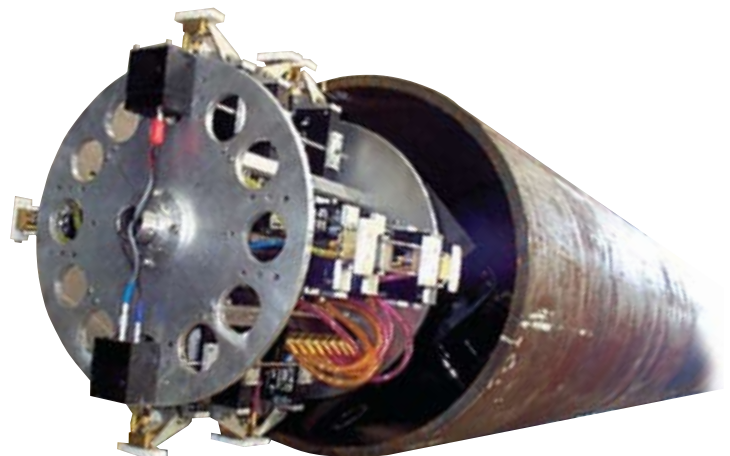


Fig. c: Pulse-echo longitudinal wave schematic for pipewall evaluation



Flanged drilling riser joint ready for inspection



Large diameter RADAR tool exiting riser

## Analysis and reporting

### Inspection parameters

Reporting criteria can be customized for each new application, giving the analysis program the necessary flexibility to follow industry standards or alternative criteria based on customer or fitness-for-purpose requirements.

### Color-coded thickness map

Ultrasonic data is displayed in color codes determined by defect depth and position along the length and circumference of the riser.

### B-scan display

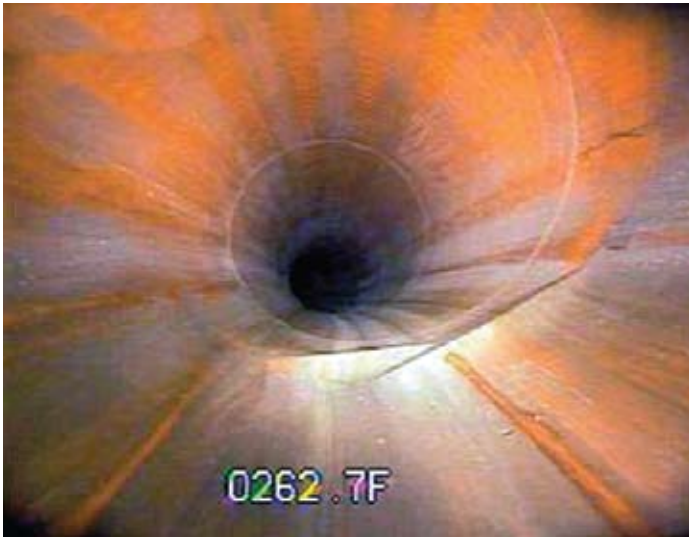
Operator can use critical Rf waveform data and the B-Scan images created from these waveforms to accurately identify and assess flaws.

### Seamless presentation

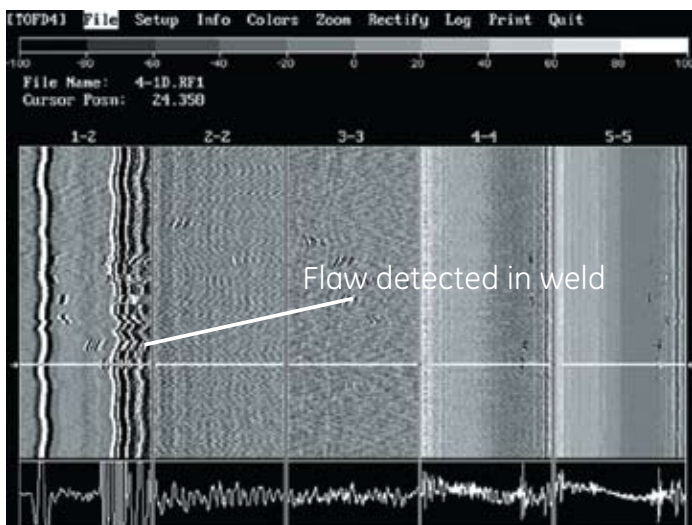
RADAR's data acquisitions system and analysis programs operate on a single software platform. The processed data are displayed in two presentations.

### On-board video

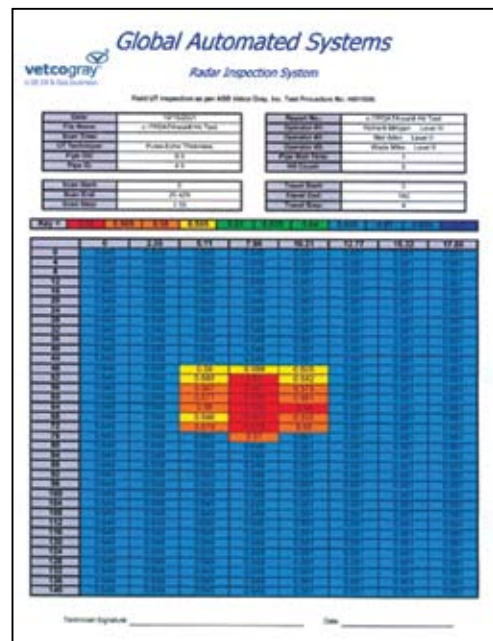
Each tool records a video of the complete inspection run to assist in further visual assessment of the pipe's internal condition.



Video image of interior of riser body



B-Scan display of weld area indicating detected flaw



Color-coded pipewall thickness display

## Managing risk

By more effectively – and economically – measuring actual lifecycle wear of drilling riser components, RADAR enables more accurate comparison with industry-accepted tolerances. RADAR clearly identifying marginal equipment enables timely decision making, and repair when necessary, in less stressful situations – enhancing both safety and cost management.

## Optimizing inventories

In addition to RADAR's immediate inspection and repair advantages, its data is stored digitally for easy retrieval to improve the ongoing inventory tracking of specific riser sections, enabling safer, more efficient deployment across rig fleets and regions. Data will also assist in optimizing repair, maintenance and replacement schedules in order to help avoid costly rig shutdowns due to failure.

## Pushing boundaries

Since 2001, VetcoGray has provided RADAR inspections at customer sites throughout the Gulf of Mexico, South America and the North Sea. With an expanding tool fleet, we are taking this value-adding service worldwide. The RADAR tools and processes are fully certified by DNV.

As part of GE's Oil & Gas business, we can also draw on the 40 years of experience residing in PII Pipeline Solutions, an industry-leading technology developer for advanced metal-loss and crack detection technologies and pipeline integrity services.



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GE imagination at work