SUBSEA AUT
SOLUTIONS

DEEP PRO
ENGINEERING

ABOUT US

Deep Pro Engineering proudly presents to the oil and gas industry a complete solution to perform **Automated Ultrasonic Testing (AUT)** on subsea structures and pipelines. Deep Pro Engineering system utilizes top-of-the-line technologies to investigate anomalies and providing fitness for service assessments with **high levels of accuracy**, in exceptionally **short time and effective cost**.

INTRODUCTION TO SUBSEA PIPELINES INSPECTION

Pipelines are key assets for our clients, and continued pipeline integrity is essential for successful business performance.

Maintaining pipeline integrity relies on understanding corrosion rates. **Deep Pro Engineering subsea AUT system** enables accurate corrosion rate monitoring, as well as validating ILI (In Line Intelligent pigging) results and checking the carried out corrective actions.

WHAT IS
DEEP PRO ENGINEERING
SUBSEA AUT SYSTEM ?

- Our Subsea Automated Ultrasonic Testing (AUT) can be deployed either by an ROV or a diver, on depths up to 1300m under water **(additional depth customization available)**

- Our system is **fully automated**, capable of inspecting pipelines and subsea structures featuring enhanced accuracy, high speed, cost effectiveness, all the while exceeding subsea market requirements and standards.

- The system boasts a **high resolution**, real time inspection via fiber optic cables, utilizing PAUT probes (Phased Array Ultrasonic Testing probes), TOFD probes, or combination between PAUT and TOFD.

- This uniquely **in-house** designed system is made with repair-ability in mind, and with spares available onsite.

- Each scan has a full **360 degrees coverage in Y-axis, as well as 630mm coverage in X-axis.**

- Deep Pro Engineering system is the **only subsea AUT system** in the market which can shift between successive scan areas without diver/ROV intervention.

INSPECTION CAPABILITIES

Using PAUT probes, our AUT can assess **remaining wall thickness**, and weld condition, of **in-service** subsea pipelines and structures. This is done using a scan reslution **1.0mm x1.0mm** grid (and down to even 0.2mm for **critical assessments**) on both X-axis and Y-axis, leveraging an automated **ultra-high resolutionsphased array probe**, covering a large surface, to accurately locate and assess pitting, cracking, and laminations. This solution is **more productive**, **cost effective**, and collects **higher resolution** data than unreliable rasterization of small motorized UT probes.

Our automated system is **fully adaptable**, operating on both horizontal and vertical pipes ranging from **5 inch** pipes up to **vertical walls**, without any modification on-site. A range of inspection techniques can be applied, including:
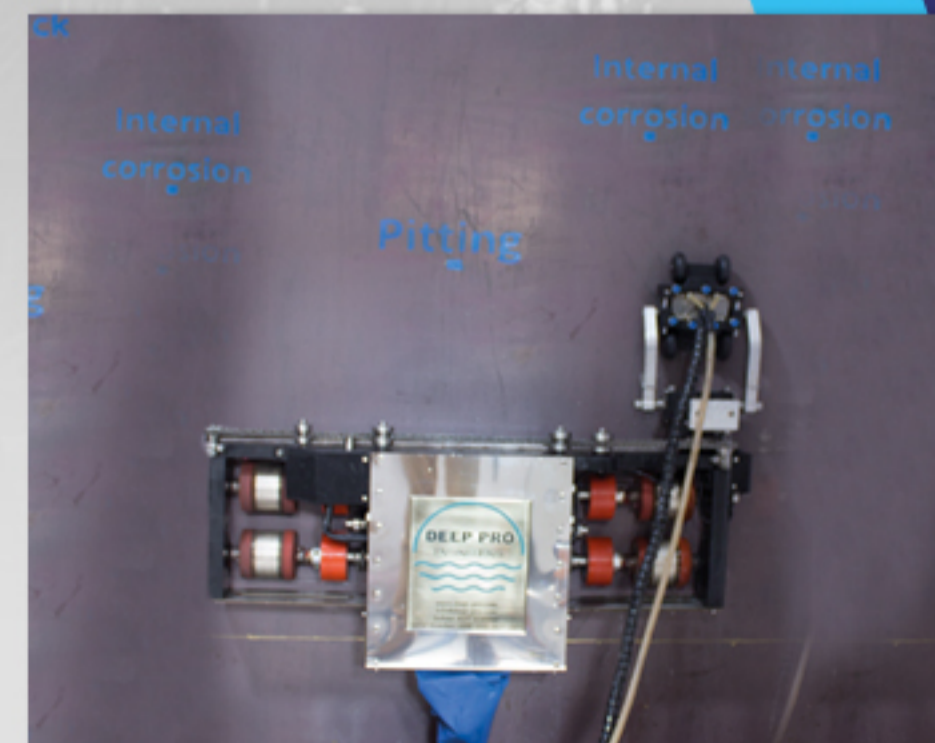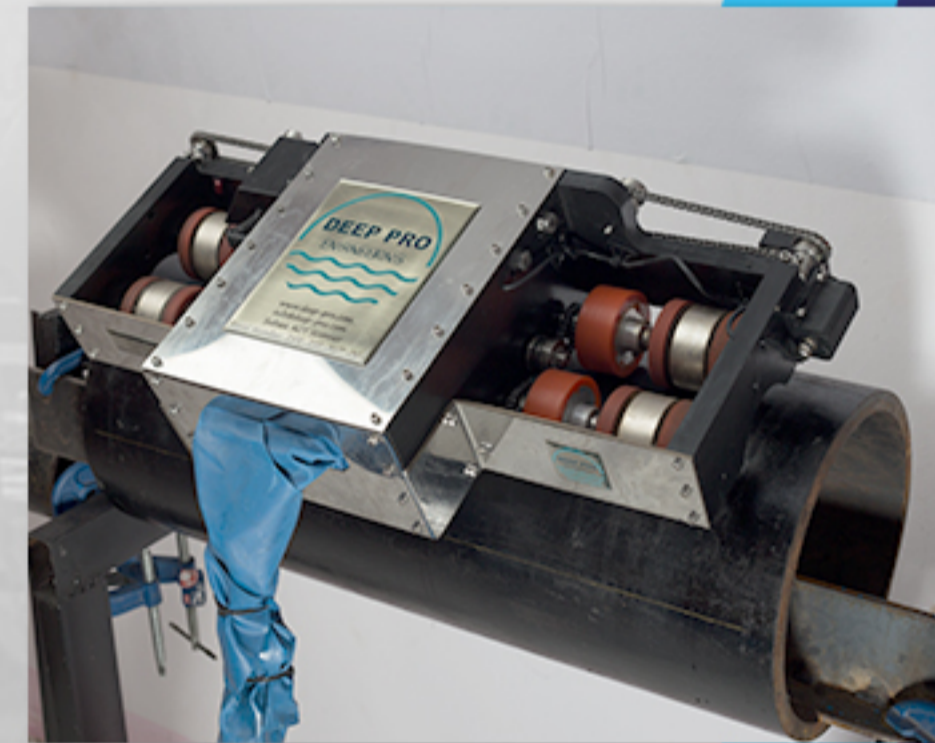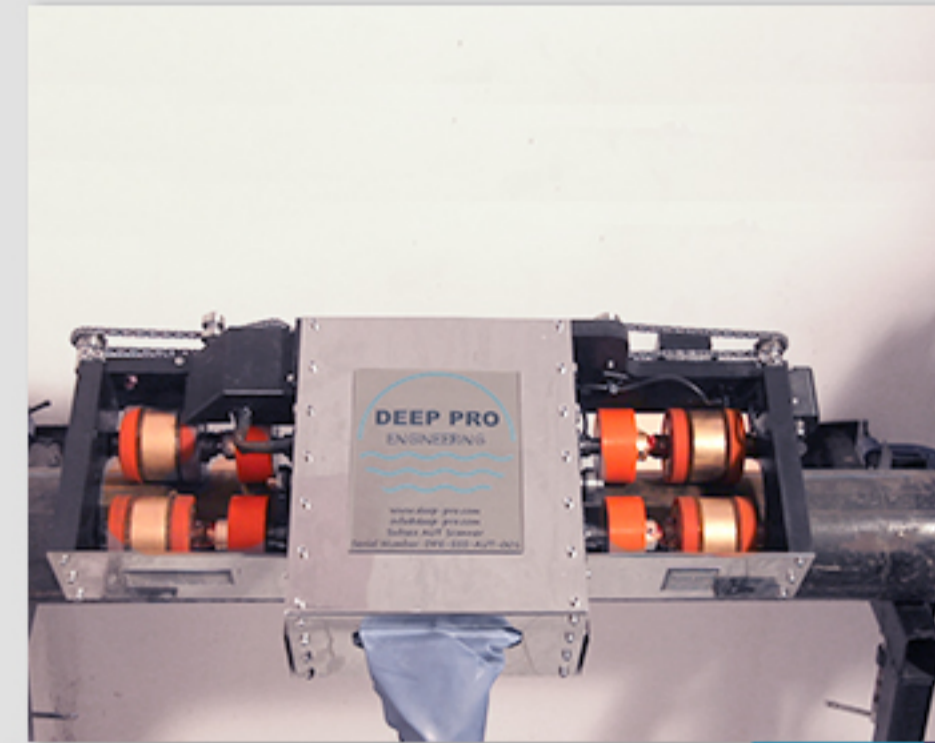

Figure 1, 2 & 3

Showing Deep pro engineering automated system, operating on 5 inch pipe,12 in pipe & vertical wall respectively.

INSPECTION CAPABILITIES

Corrosion Mapping for detecting internal corrosion, erosion, flaws and laminations utilizing PAUT and/or TOFD.
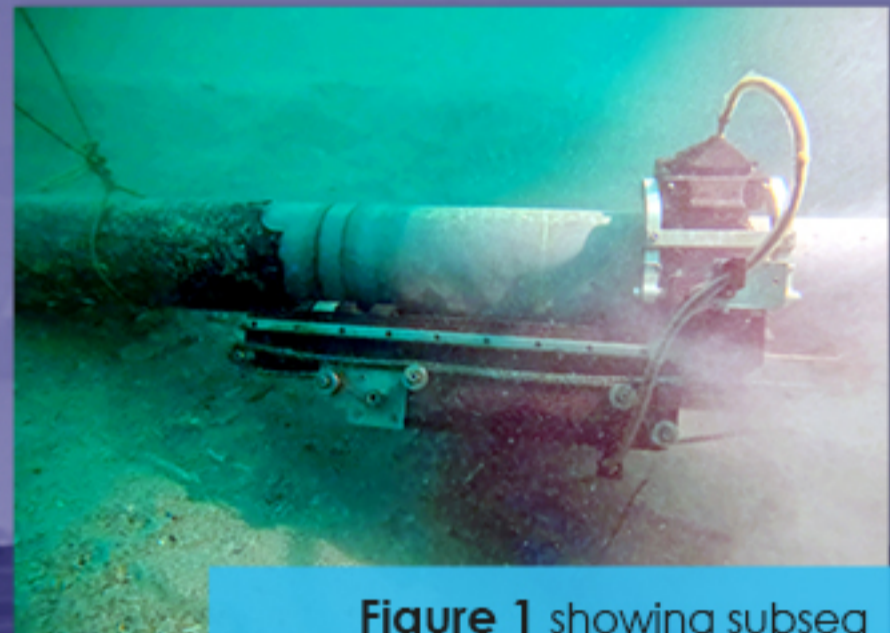

Figure 1 showing subsea corrosion mapping phased array ultrasonic testing (PAUT) probe installed on 6 inch pipeline.
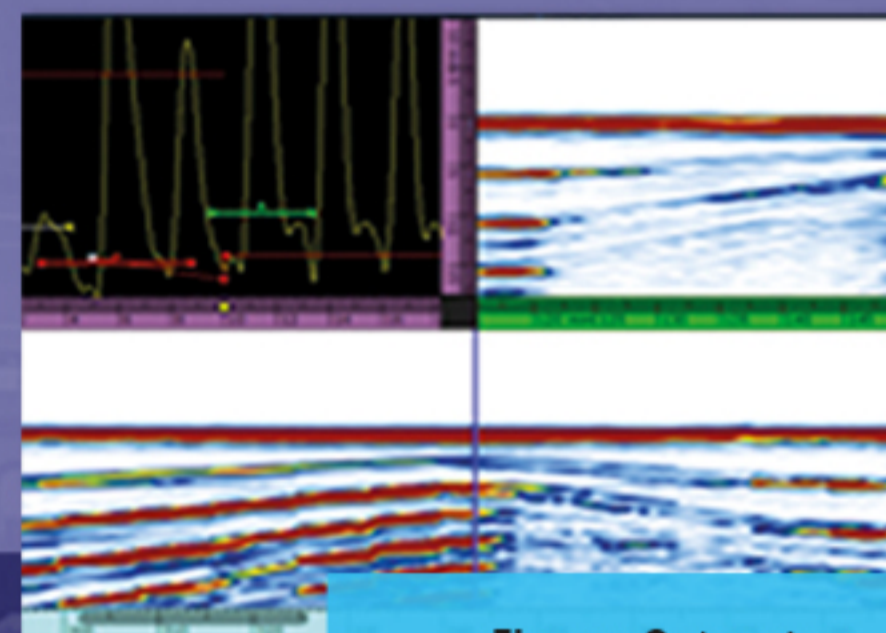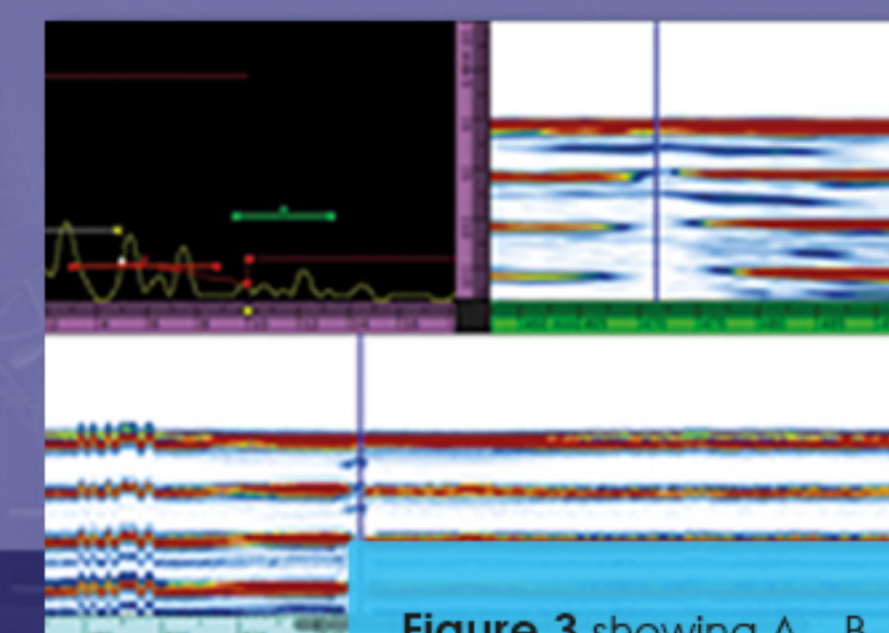

Figure 2 showing A – B – S scans for corrosion defect.

Figure 3 showing A – B – S scans for mechanical damage (crack like) defect.

Figure 4 showing C scan example for metal plate 1000mm x 600mm (scan area covered) carried out by 1mm x 1mm scan grid in 3 minutes and 10 seconds.
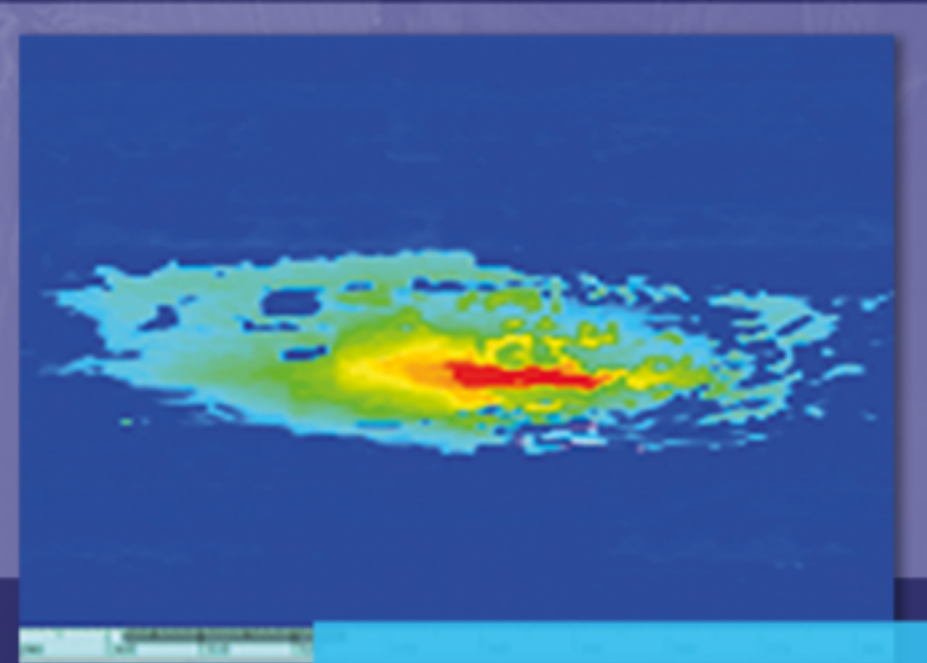

Figure 5 showing C scan for corrosion defect.
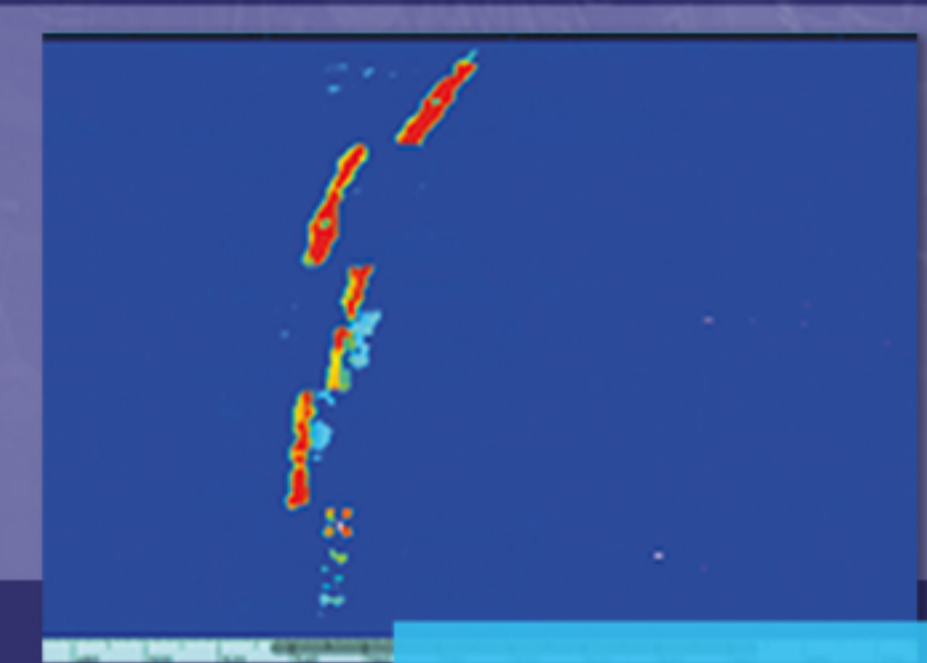

Figure 6 showing C scan for internal mechanical damage (crack like) defect

INSPECTION CAPABILITIES

- Weld inspection for detecting preferential weld corrosion/erosion, fatigue cracking utilizing PAUT and/or TOFD.

Figure 7 showing combination of phased array ultrasonic testing (PAUT) probes and time of flight diffraction (TOFD) probes for detecting welding defects on pipeline seam weld.
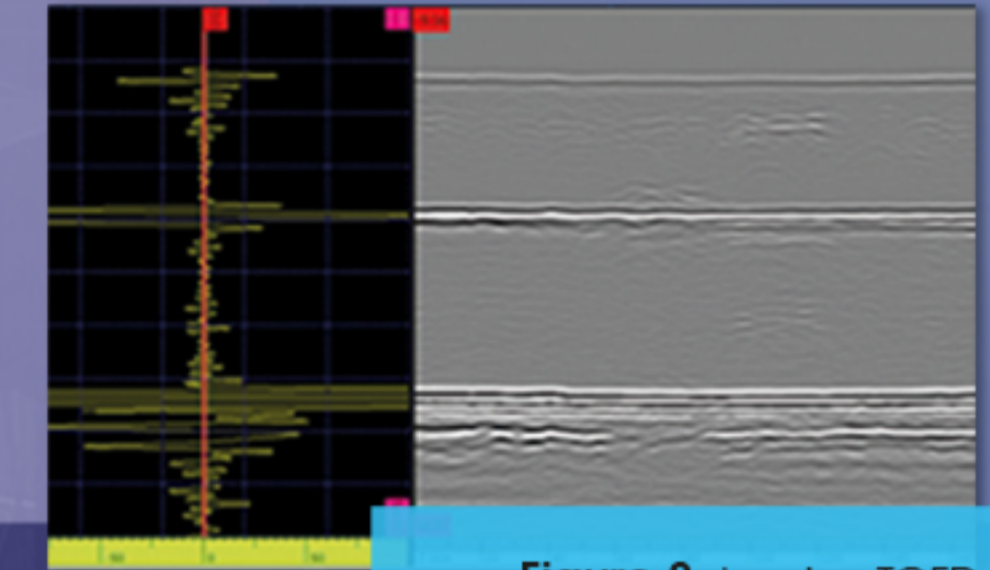

Figure 8 showing TOFD scan for lack of side wall fusion and root indication.

- Automated Shear Wave Pulse Echo utilizing PAUT/ TFM (phased array ultrasonic testing, utilizing Total Focusing Method technique)
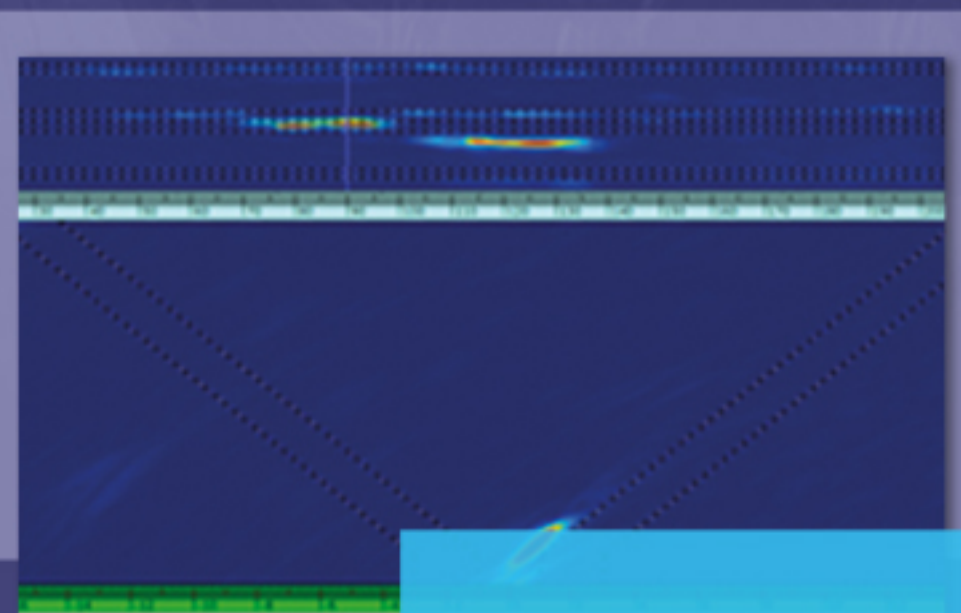

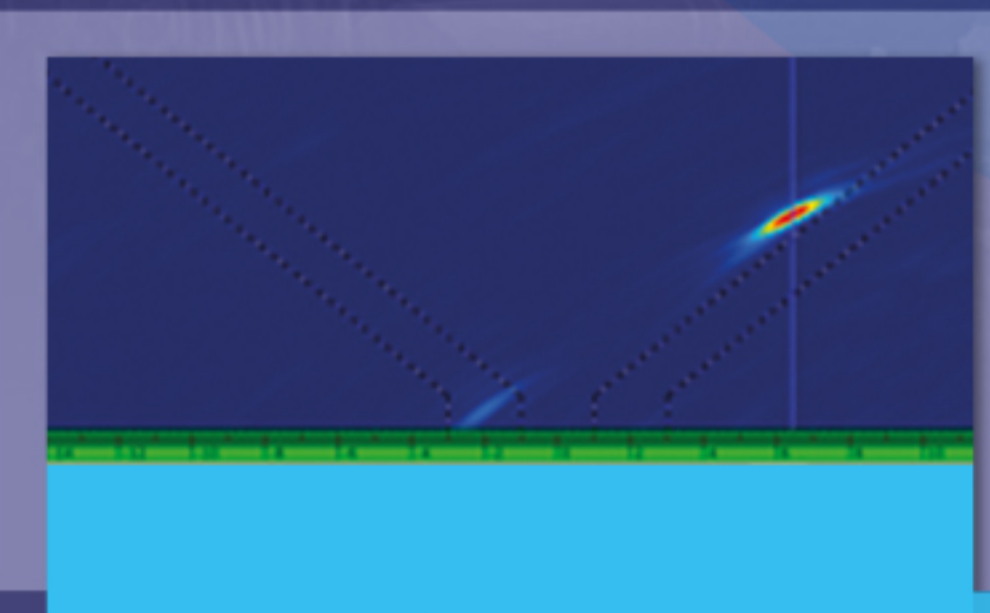**Figure 9** showing TFM technique for lack of root penetration.

Figure 10 showing TFM technique for lack of side wall fusion.

INSPECTION CAPABILITIES

PHASED ARRAY ULTRASONIC BOARD SPECIFICATIONS

| Item		Specification
Configuration	Reception/transmission	32/128
	Sound velocity	340-15240m/s
Pulser	Inspection mode	PE / PC
	Pulse voltage	50V / 100V
	Pulse mode	Negative square wave
	Pulse width	30-1000ns,step of 2.5ns
	Pulse rise time	<8ns
	PRF	40KHz
	Delay	0-20μs/2.5ns
	Damping	NA
Receiver	Gain range	0-120dB
	Bandwidth	0.5-20MHz
	Receive delay	50μs/0.1μs
	Input impedance	200Ω
Data acquisition	Sampling rate	100MHz
	Focal law number	Max 1024
	Focus type	True depth/half sound path/projection/any surface
	Detection	FW/HW+/HW-/RF
	Synchronization	Initial pulse or gate
TFM	Max point number	4M
	TFM aperture	64/128/256 transmission
	Focal mode	TT,TTT,TTTT,LL,LLL,LLLL,TLT,TLL,LTT
Scan/Display	Scan type	Sectorial/linear scan
	Display mode	A/B/C/S/3D/Top-C
	Measurement unit	mm
TCG	Point number	16
	Maximum gain	40dB
	Maximum gain slope	40dB/μs
Band filter		Full-time data average
I/O interface	Internet	100/1000M
	Encoder	LEMO 16-pin
Gate	Gate number	3(A/B/I)
	Gate threshold	0-98%
	Gate trigger mode	Peak/Edge/ Rectangle

SOFTWARE FUNCTION

SUPPORT 3D TFM / 2D TFM

- HIGH-QUALITY IMAGING IS ONE OF THE PRIMARY PRERE QUISITES FOR IMPROVING DETECTION ACCURACY OUR PAUT BOARD SUPPORT TFM DETECTION MODE WITH A, S AND C IMAGING DISPLAY ,AND GPU PARALLEL COMPUTING TECHNOLOGY CAN REALIZE REAL-TIME TOTAL FOCUSING IMAGING ABOVE 1024 * 1024 POINTS.

- DEEP PRO ENGINEERING TOOK THE LEAD IN REALIZING 3D TFM ON THE PORTABLE MACHINE USING MATRIX ARRAY PROBE,WHICH HELP TO OBSERVE THE DEFECT MORPHOLOGY MORE CLEARLY WITHIN THE SCOPE OF 3D DISPLAY
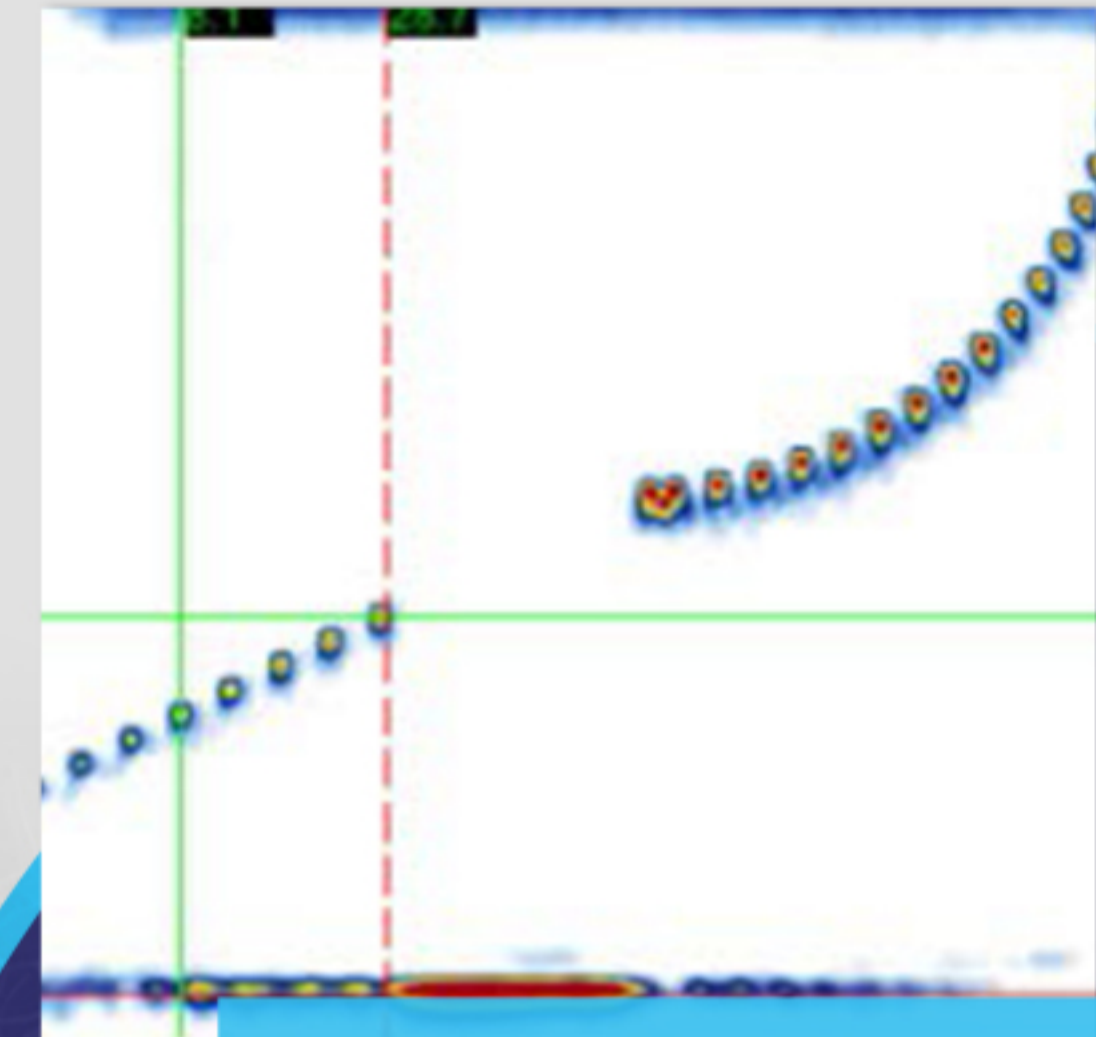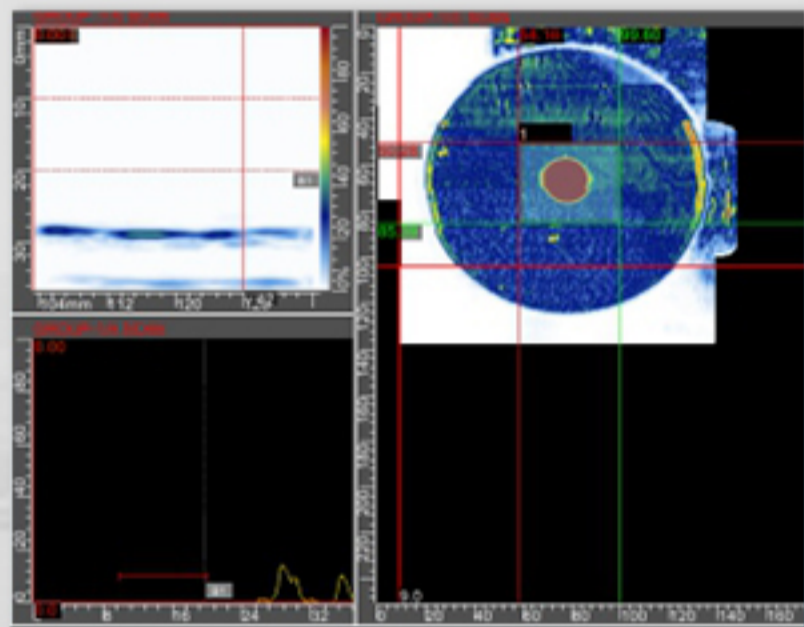

Type B phased array block
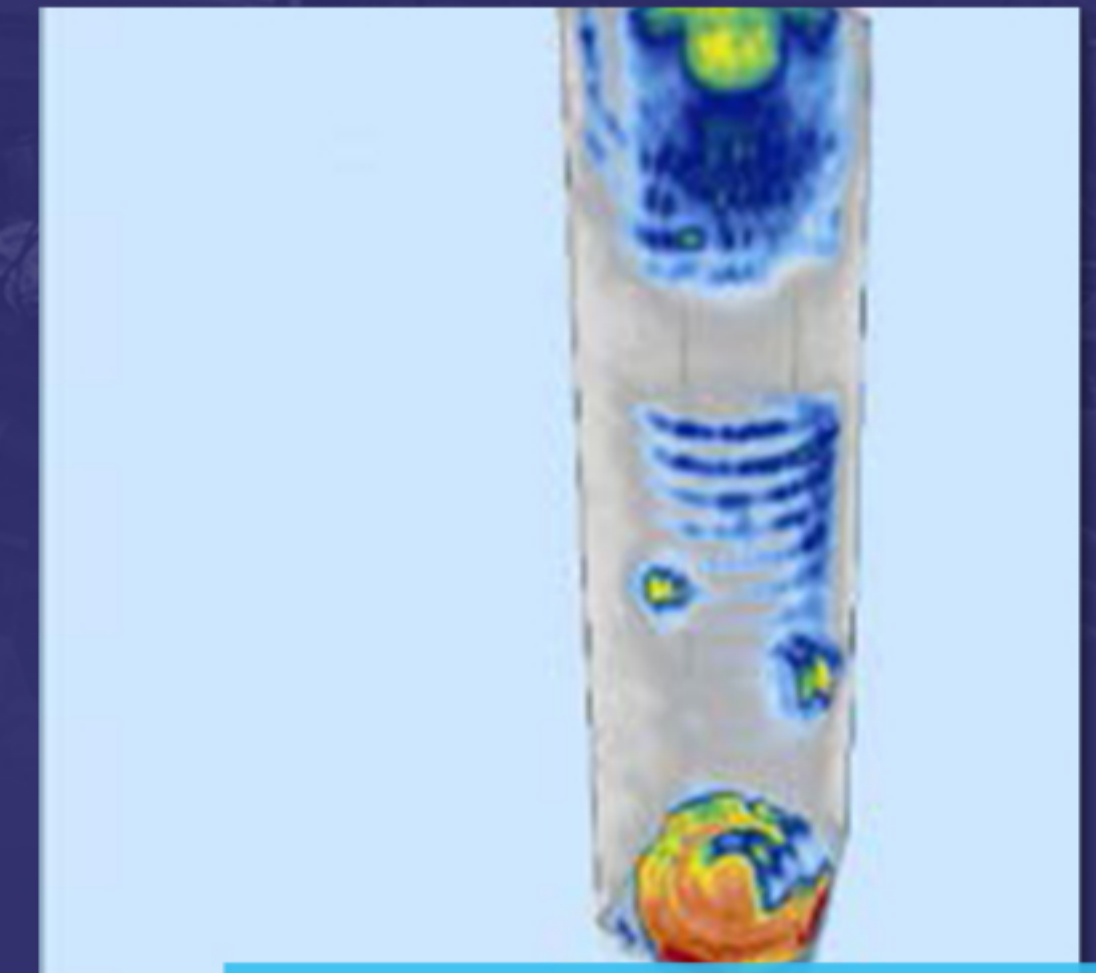
Bolt 3D imaging
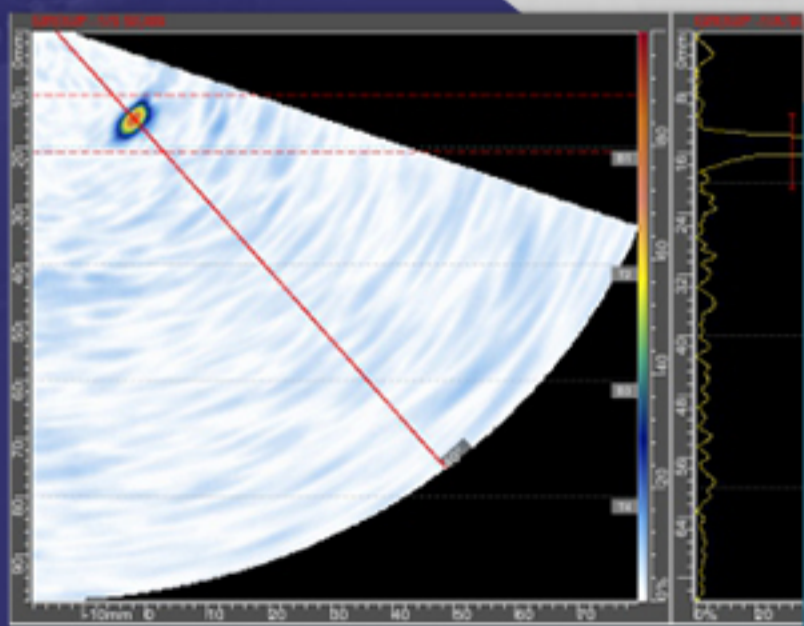
SOFTWARE FUNCTION

POWERFUL CORROSION ANALYSIS

OUR PAUT BOARD SUPPORTS DUAL-AXIS ENCODER, WHICH CAN REALIZE HIGH-SPEED TWODIMENSIONAL SCANNING, AND GREATLY IMPROVES THE DETECTION EFFICIENCY OF LARGE-AREA CORROSION DETECTION. WITH COMPLETE CORROSION ANALYSIS FUNCTION, ALSO CAN INTELLIGENTLY SCREEN THE CORROSION AREA, AUTOMATICALLY CALCULATE THE CORROSION AREA, STATISTICAL CORROSION RATE, ETC.
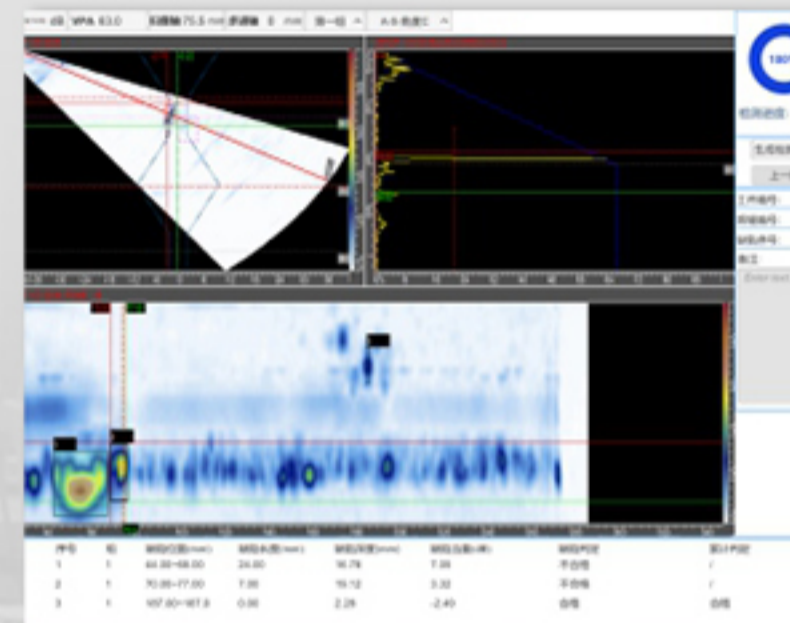
AUTOMATIC DEFECT IDENTIFICATION

HIGH-QUALITY IMAGING IS ONE OF THE PRIMARY PRERE QUISITES FOR IMPROVING DETECTION ACCURACY OUR PAUT BOARD SUPPORT TFM DETECTION MODE WITH A, S AND C IMAGING DISPLAY, AND GPU PARALLEL COMPUTING TECHNOLOGY CAN REALIZE REAL-TIME TOTAL FOCUSING IMAGING ABOVE 1024 * 1024 POINTS.

SUPPORT DLA / DMA PROBE

THE SOFTWARE SUPPORTS DLA PROBE DETECTION, MATRIX ARRAY DETECTION, DUAL-MATRIX ARRAY DETECTION AND OTHER ADVANCED FUNCTIONS.IT CAN BE USED IN A VARIETY OF ARTIFACTS AND APPLICATIONS.

FOR SOME HIGH ATTENUATION MATERIALS, SUCH AS AUSTENIT-IC STAINLESS STEEL, THE SIGNALTO- NOISE RATIO IS RELETIVELY LOW USING A CONVENTIONAL PA PROBE, AND NOT EASY TO DETECT TINY FLAWS. DMA PROBES CAN ACHIEVE A BETTER FOCUS EFFECT AND OBTAIN A HIGHER SIGNAL-TO-NOISE RATIO, THUS IMPROVING THE DETECTION EFFECT.
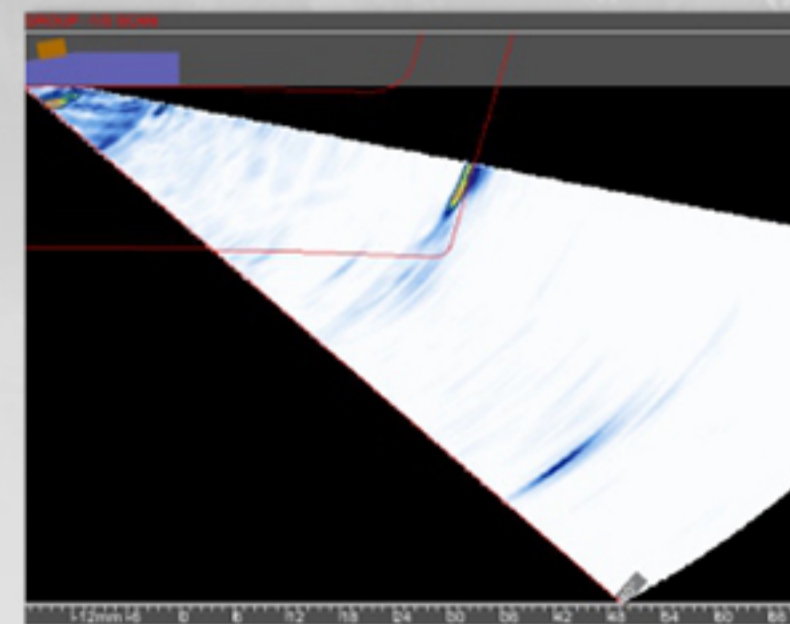
SUPPORT NOZZLE DETECTION

IN THE ACTUAL DETECTION PROCESS, AS THE GEOMETRY STRUCTURE OF THE PIPE NOZZLE IS VERY COMPLEX , IT IS DIFFICULT TO ACCURATELY AND EFFECTIVELY CONDUCT NONDESTRUCTIVE DETECTION USING THE CONVENTIONAL ULTRASONIC PHASED ARRAY METHOD, AND ALSO UNABLE TO EFFECTIVELY DISTINGUISH THE REAL DEFECTS FROM THE INNER WALL AND END ANGLE REFLECTION.

INSPECTION CAPABILITIES

Automated subsea system specifications
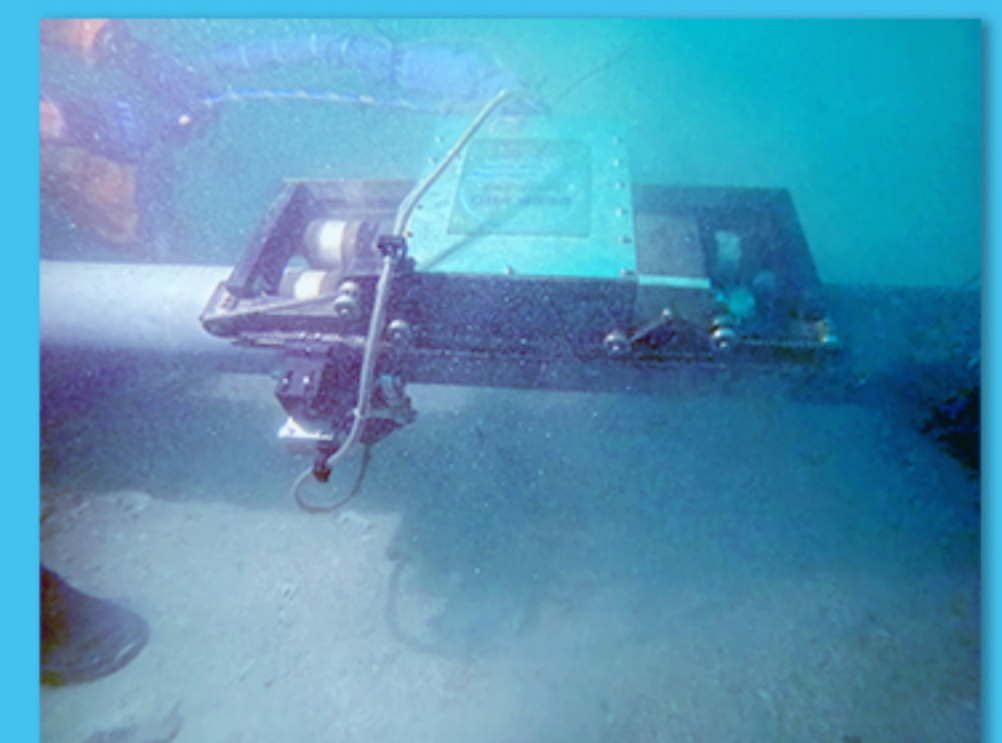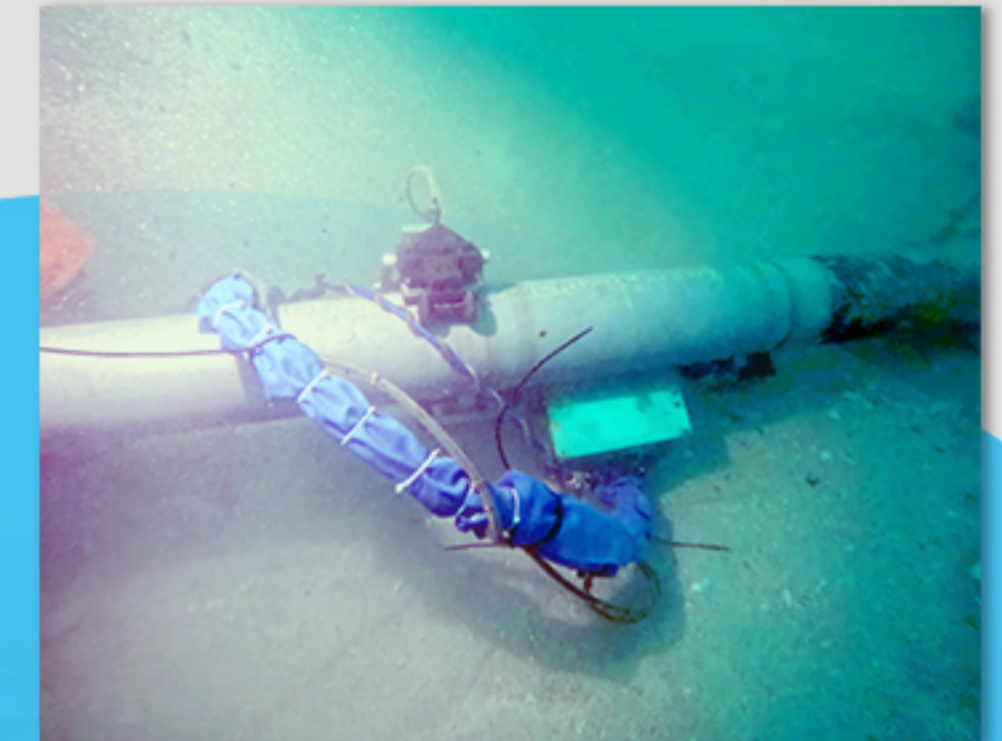
Item	Specification
Operational depth	Up to 1300 m (Additional depth customization available)
Communication to surface	Multi-mode mode fiber optics umbilical
Inspection diameters	From 4 inches up to vertical walls
Inspection thickness limitation	No thickness limitations
Umbilical Length	From 130 m Up to 1300 m
Power requirements	100 to 240 VAC - 50-60Hz
Inspection Area per single scan	360 degrees coverage in Y-axis, as well as 630mm coverage in X-axis.
Coverage per hour	8 meter square per hour (Scan resolution 1 mm x 1mm)

FEATURES

Deep pro engineering innovate subsea automated system **exceeds** subsea market standards and expectations having the following features :

- **Fully adaptable automated system**, capable of carrying out inspections to a high level of accuracy for **wall-thickness and defect sizing.**
- Safe, high-quality, rapid andcost-effective inspection options (PAUT inspection system up to **20x faster than conventional UT).**
- Fully interactive **3D scan plans, 3D mapping** during reporting stage.
- Real-time results **(A, B & C scans)**, utilizing high tech **fibre optic** cables.
- Automatic reporting capabilities, preliminary reports on site.
- Access to depths up to 1300m **(additional depth customization available)** .
- Accurate validation and verification of ILI **(In Line Intelligent pigging)** indications.
- Assist diving/ROV teams to **accurately locate pipeline sections** that require validation and verification according to ILI records.
- **Short mobilization time.**
- Accurate defect sizing utilizing **ultra-high resolution scans**, helping asset integrity divisions to accurately decide **corrective actions.**

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