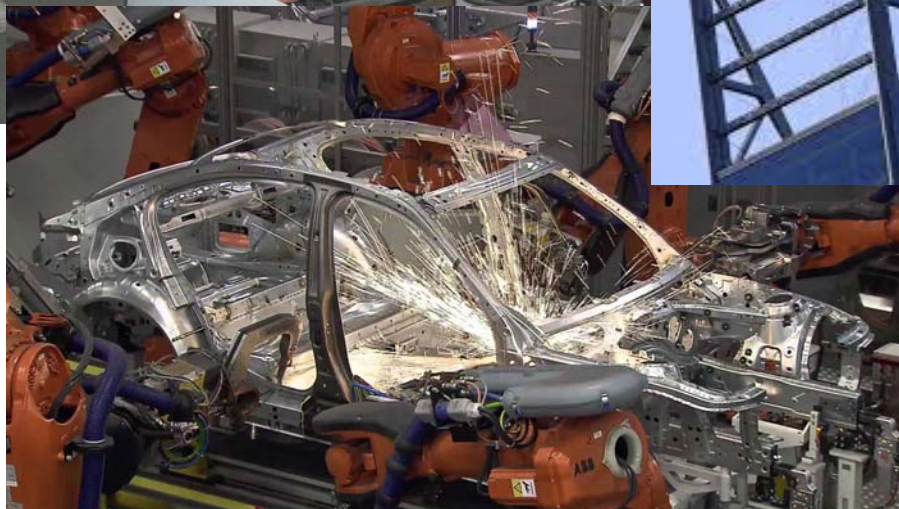




Technical (and other) challenges associated with welding and inspection of CRA pipelines

Matt Lancien, Materials & Welding Engineer, SPEC Pty Ltd

Welding in the industry

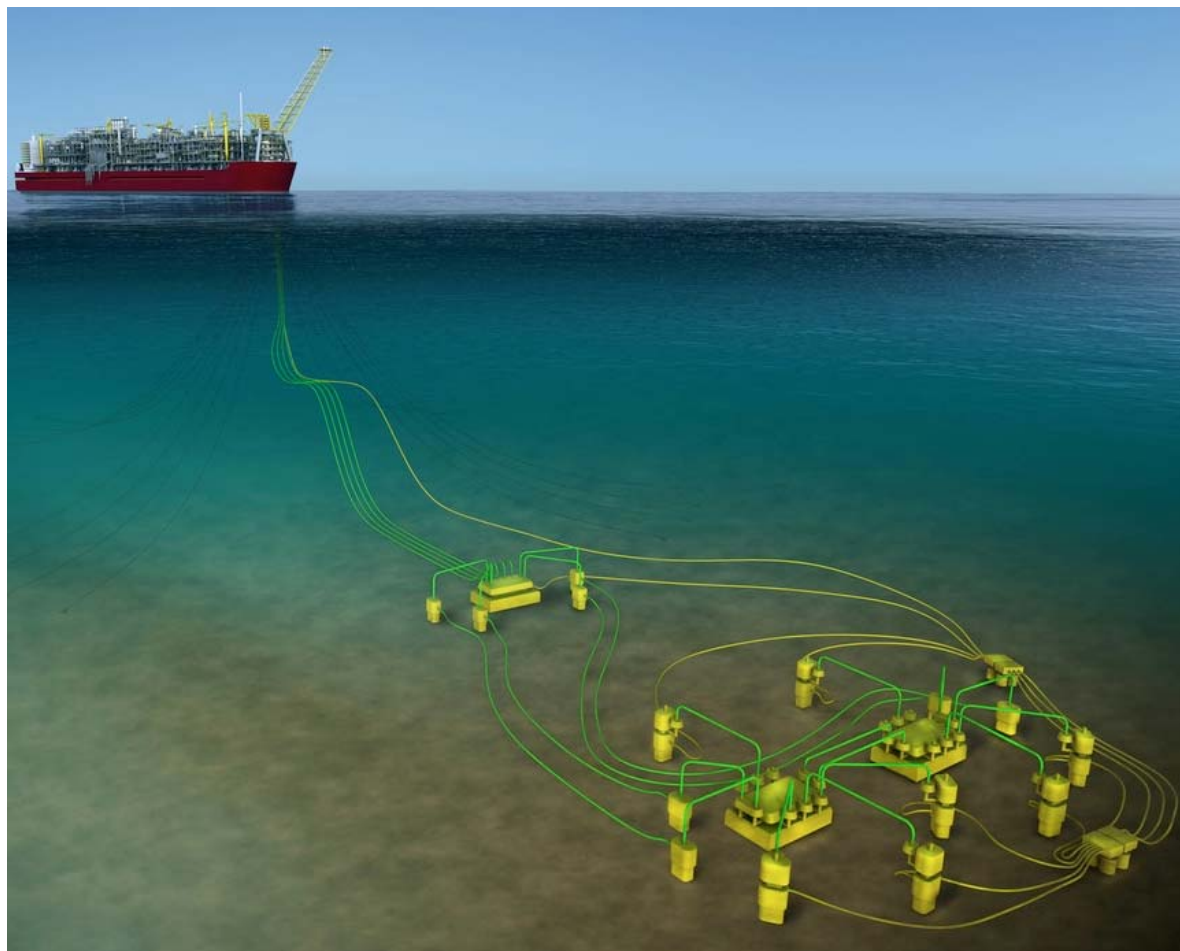




Welding in our industry



AWS D1.1

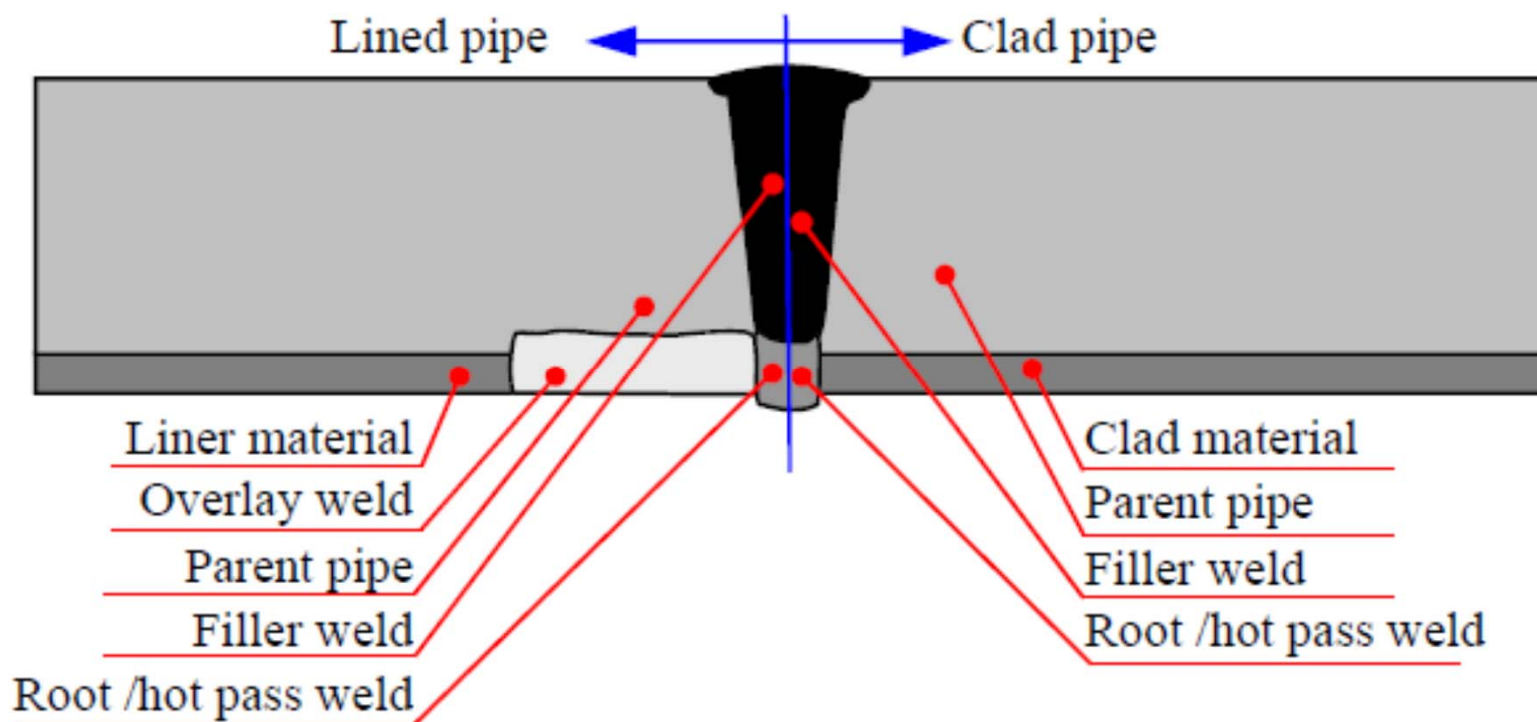


DNV

ASME

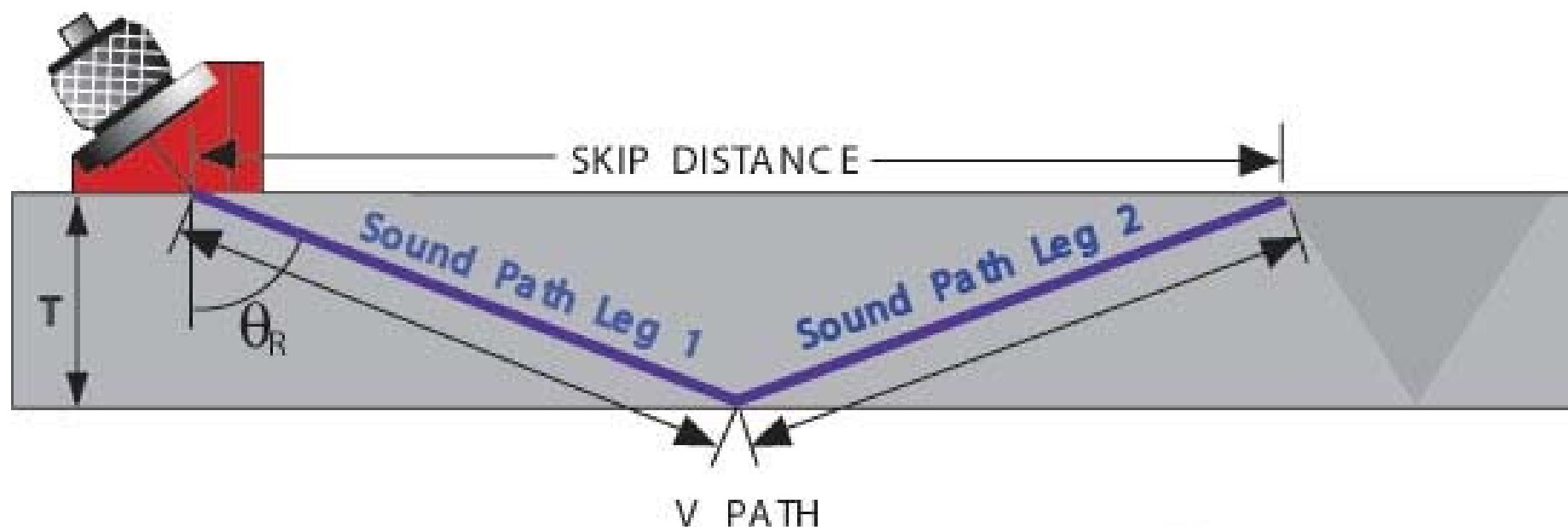
Welding of CRA HP/HT Pipelines

DNV-OS-F101 + DNV JIP + Company specification



NDT of CRA Pipelines

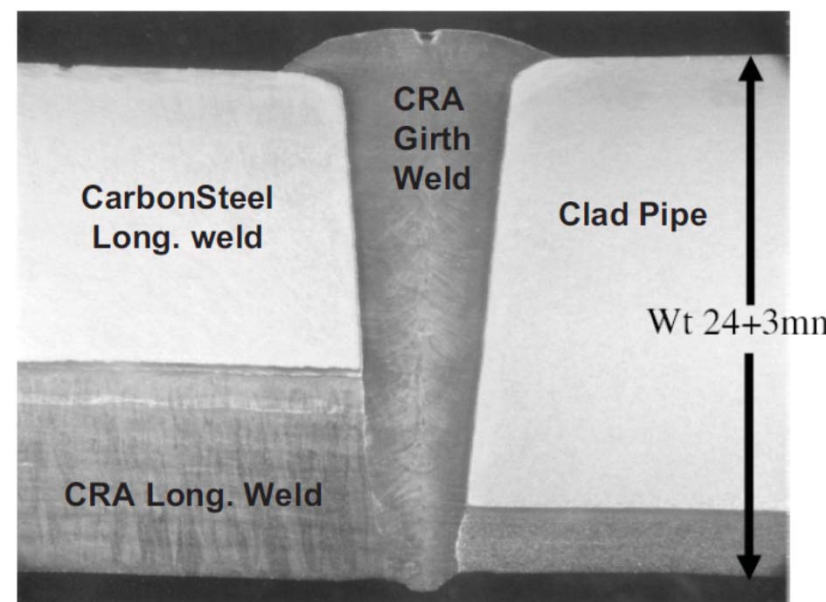
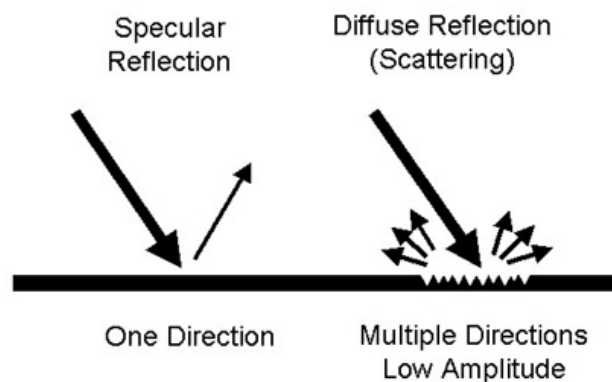
Carbon Steel Pipelines: same/similar material for pipe & weld



NDT of CRA Pipelines

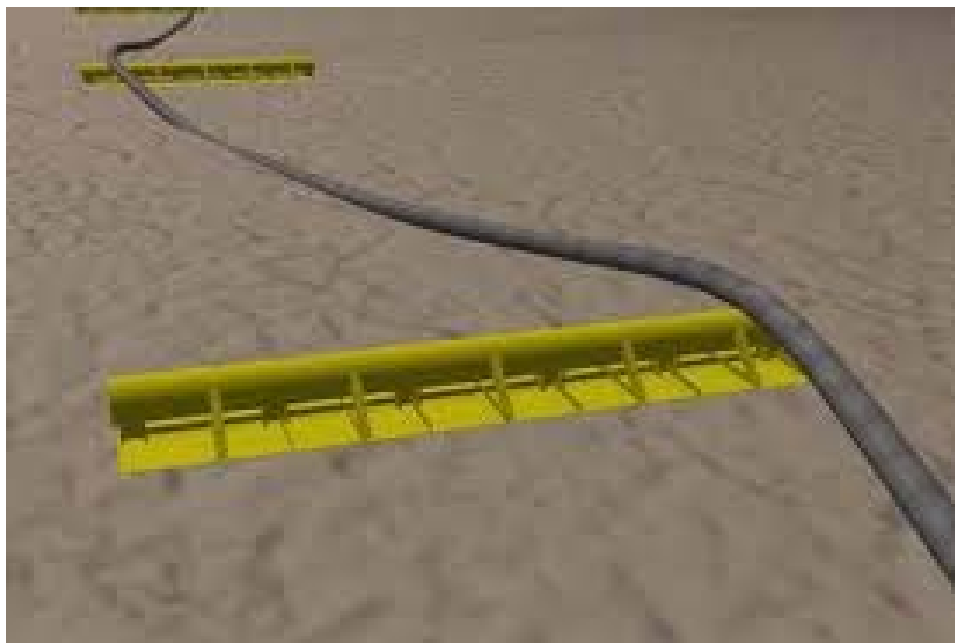
CRA pipelines: dissimilar materials for pipe & weld & CRA layer

- High anisotropy (grain orientation)
- Scatter of ultrasound
- Varying speed of sound transmission
- Specific calibration block & qualification program
- Training of operators



Design

Specify an achievable & consistent flaw acceptance criteria

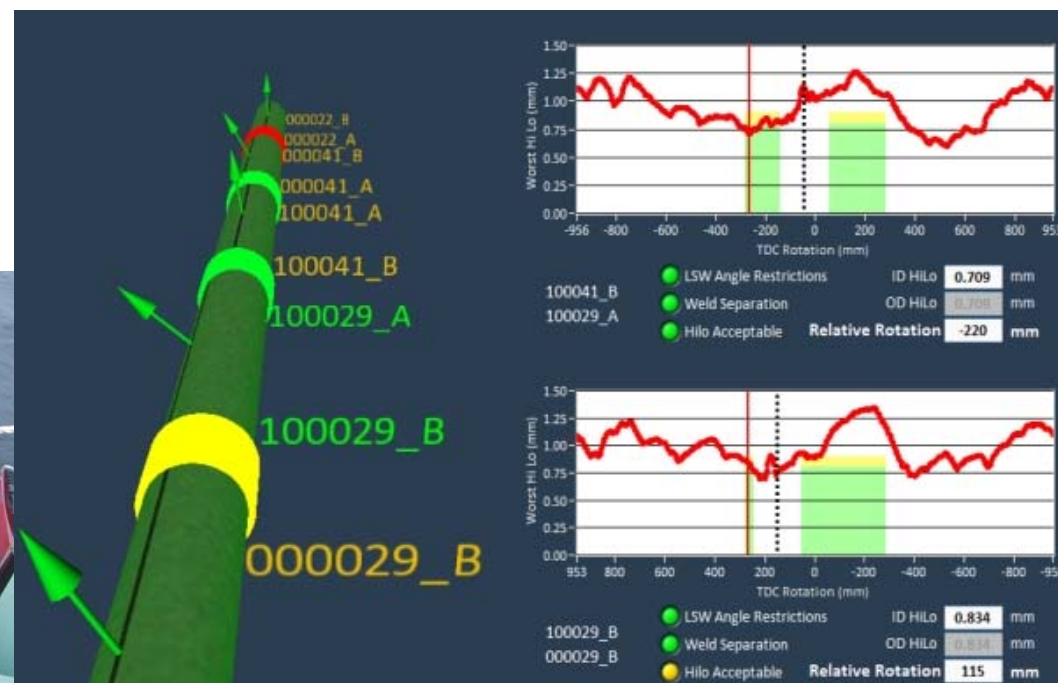


Planned buckles over ZRBs / DIs



Unplanned buckles

CRA Linepipe Procurement

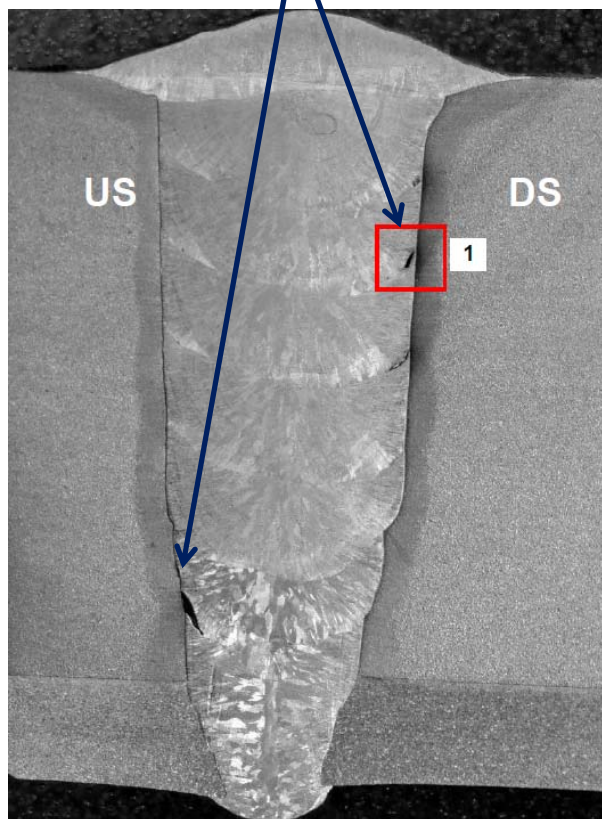


Qualifications & Testing



1: WPS & Welders qualification

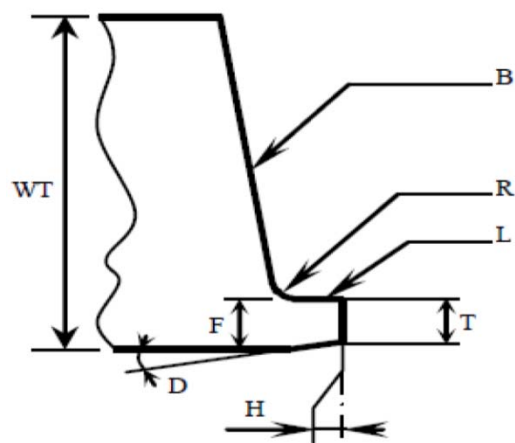
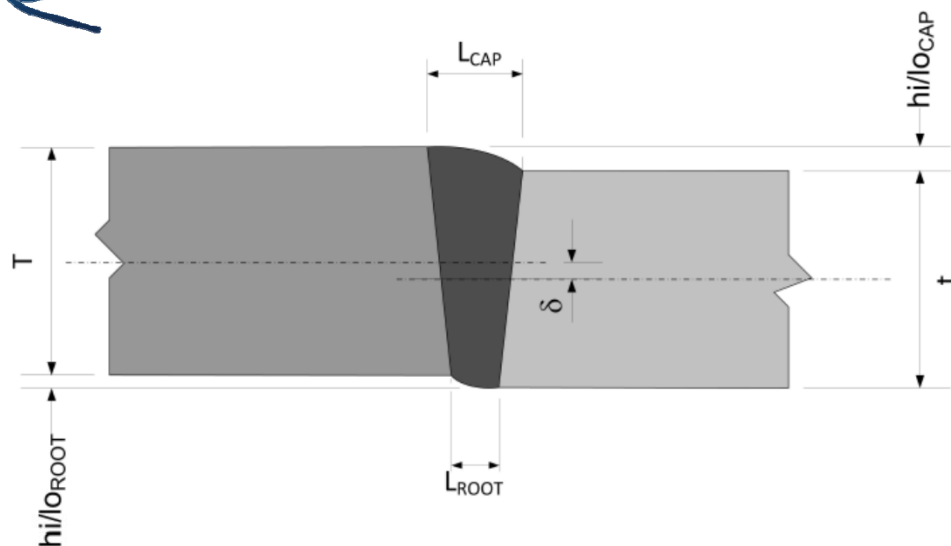
2: Inherent welding flaws



3: NDT procedure qualification



Welding Preparation

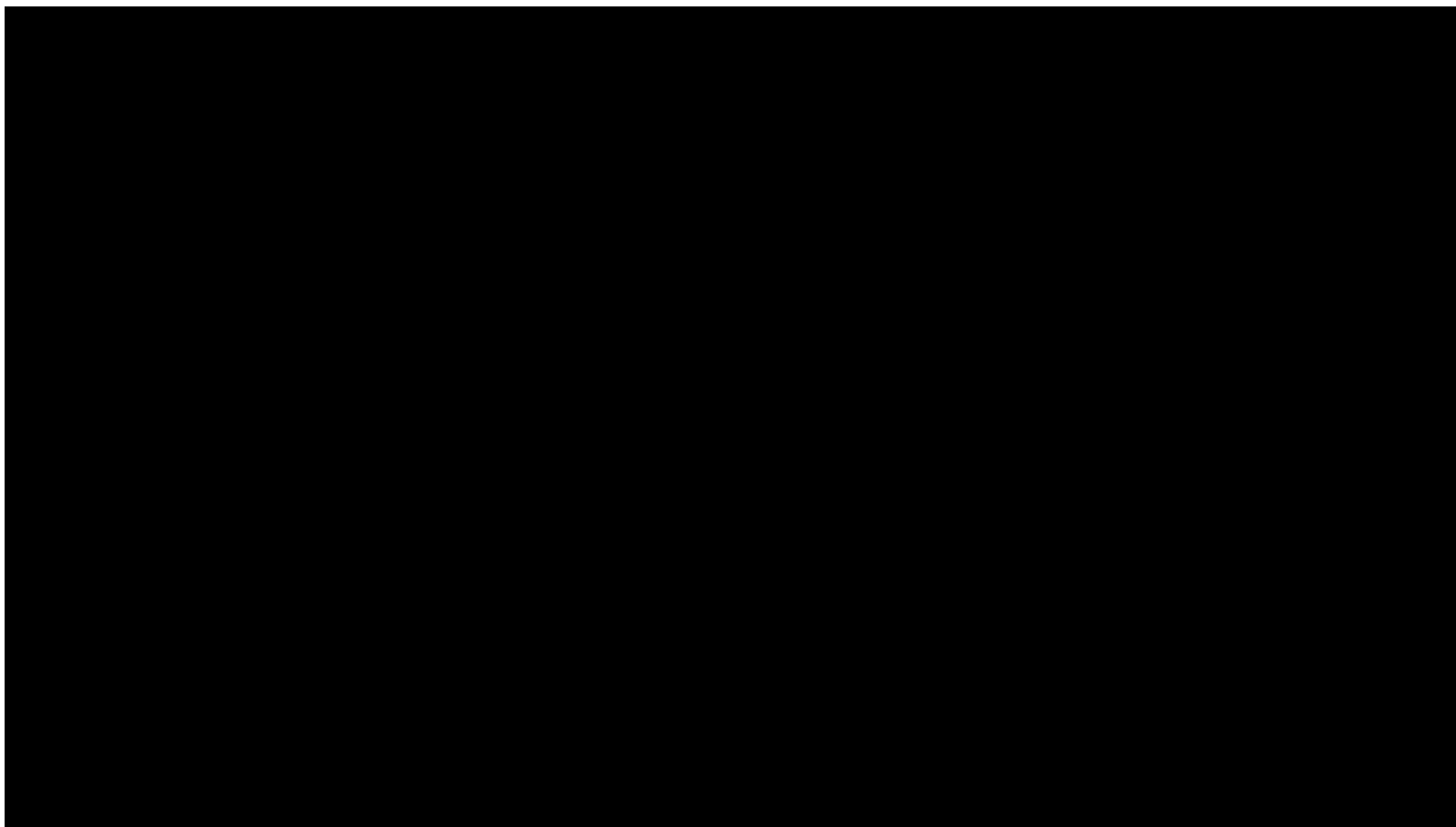


$B = 5^\circ \pm 2^\circ$
 $R = 2.4 \text{ mm}$
 $L = 1.3 \pm 0.2 \text{ mm}$
 $T = 1.4 \pm 0.2 \text{ mm}$
 $F = 1.4 \pm 0.2 \text{ mm}$
 $D = 0^\circ$
 $H = 0 \text{ to } 0.5 \text{ mm}$
 $WT = 21 \pm 3 \text{ mm}$



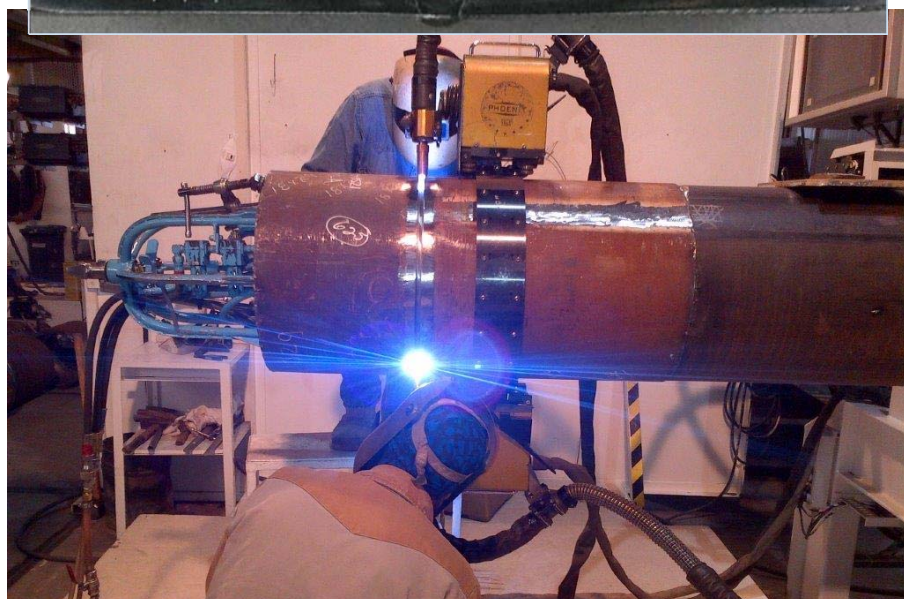
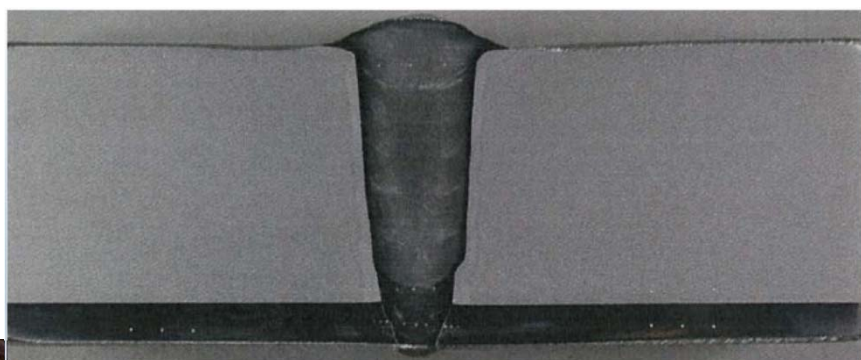


Main Line Welding Process

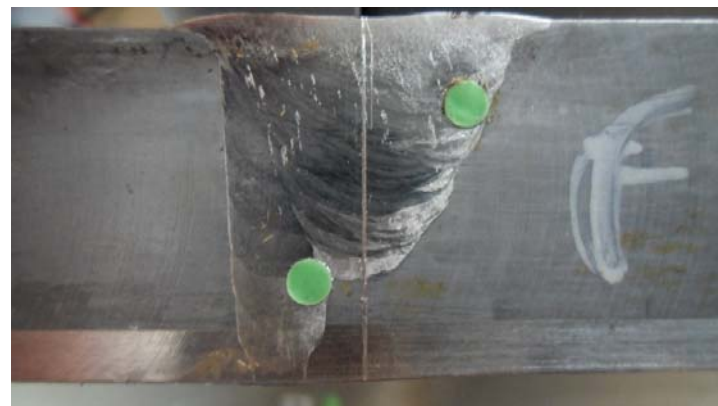


Welding Qualifications

1: Automatic welding (GMAW) for main line



2: Manual welding (GTAW) for repairs & tie-ins



Welding & Purge Monitoring

Strict control on welding parameters

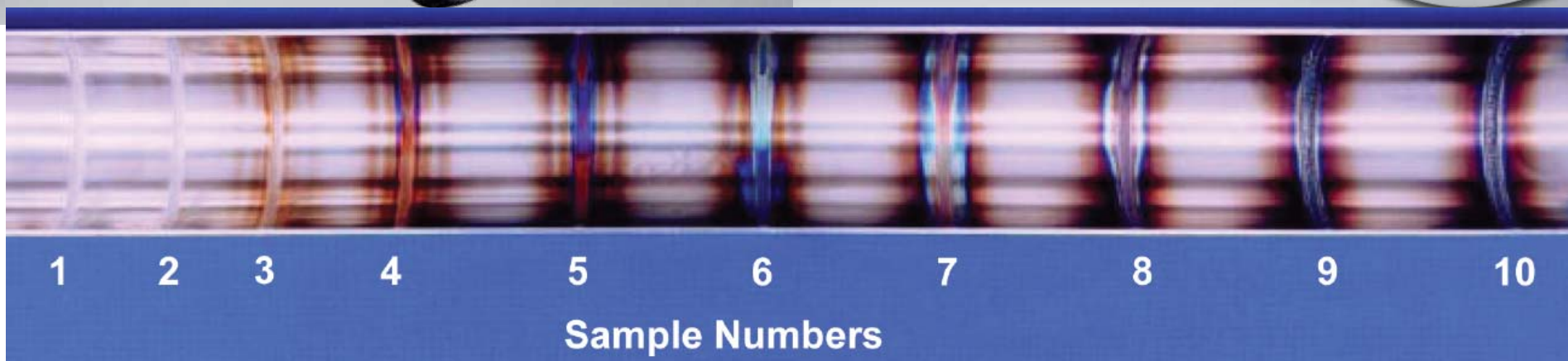
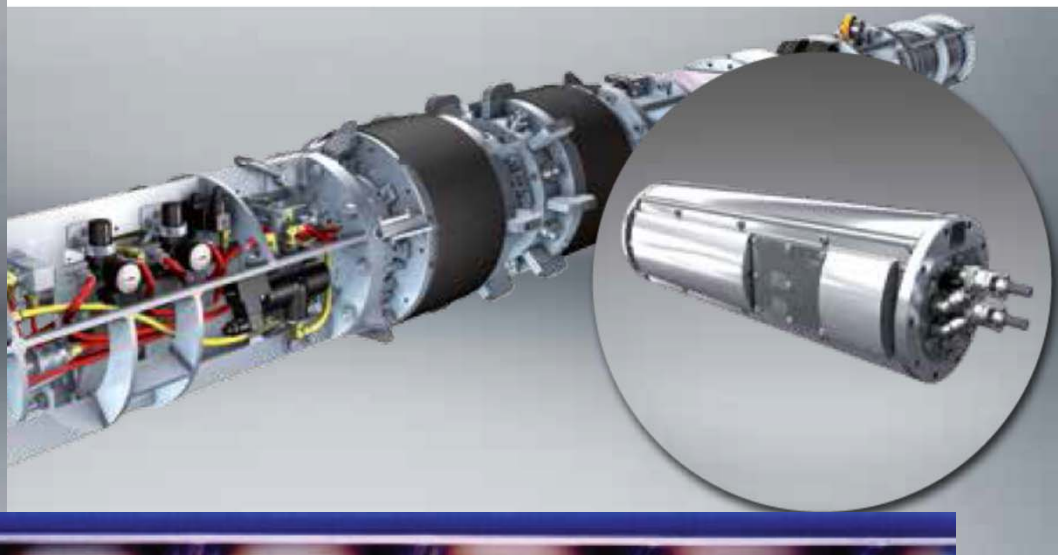


TUC ARC LOGGER X
 SET NO 18
 DATE 19/ 1/1999
 TIME 16:32:24
 PROJECT TUC
 JOB No 99101
 PROCEDURE No 190P
 WELDER C.Cathies
 WELDER No 21
 WELD No 1
 ROD/WIRE 0.8mm
 GAS TYPE Argon
 RUN NUMBER 1

HI-LO	LIMITS	UPPER	LOWER
199 19.9	99.9 1999	0	0
0 0.0	0.0	0	0
TRAV	WIRE	ARC	TIME
CM/M	M/M	VOLTS	SECS
GAS FLOW	25 L/MIN	100	2.2s
146 4.4	19.8	100	2.2s
ARC TIME		SUMMARY	
146 4.4	19.8	100	MAX
146 4.4	19.8	100	AVE
0 4.4	19.8	100	MIN
HEAT INPUT		40 J/M	
TOTALS		0.1 M	
WIRE CONSUMED		4 KJ	
ENERGY		2.2s	
ARC TIME		100 mm	
WELD LENGTH		20812 BYTES	
MEM UNUSED		20812 BYTES	

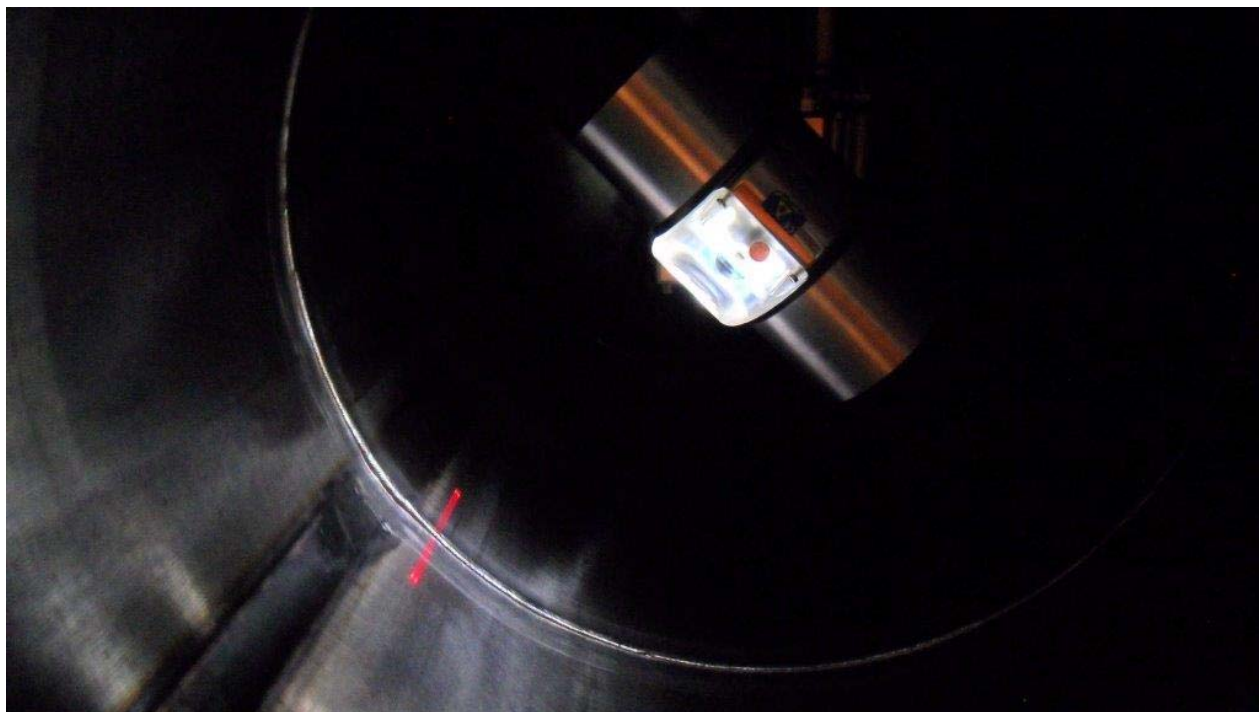
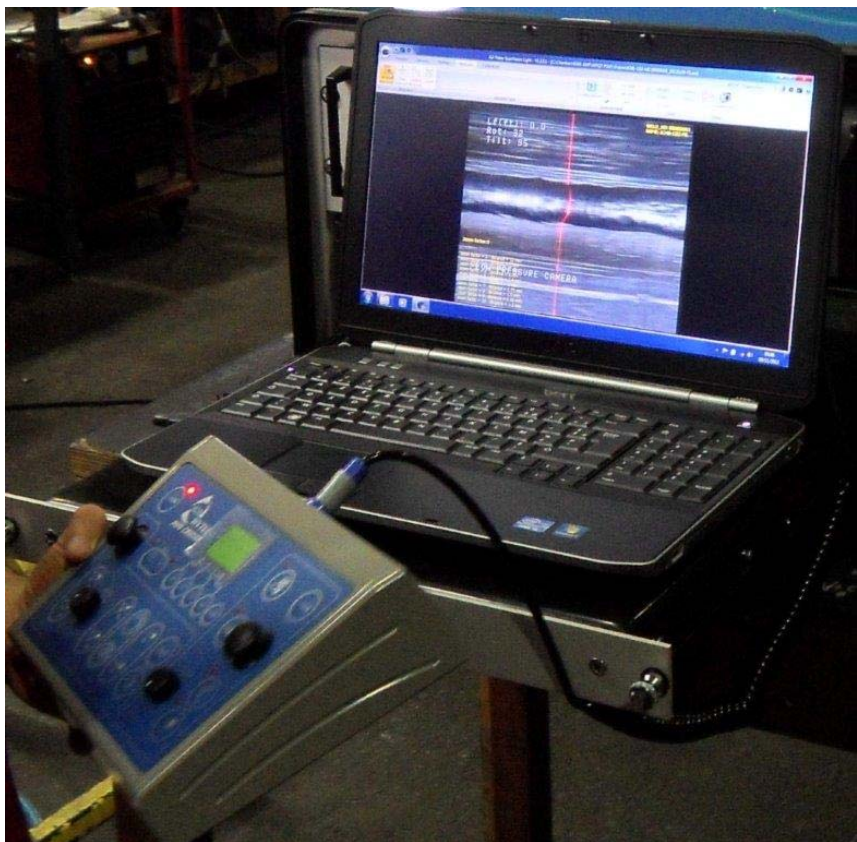


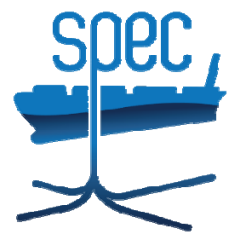
CRA Root Pass Inspection





CRA Root Pass Inspection





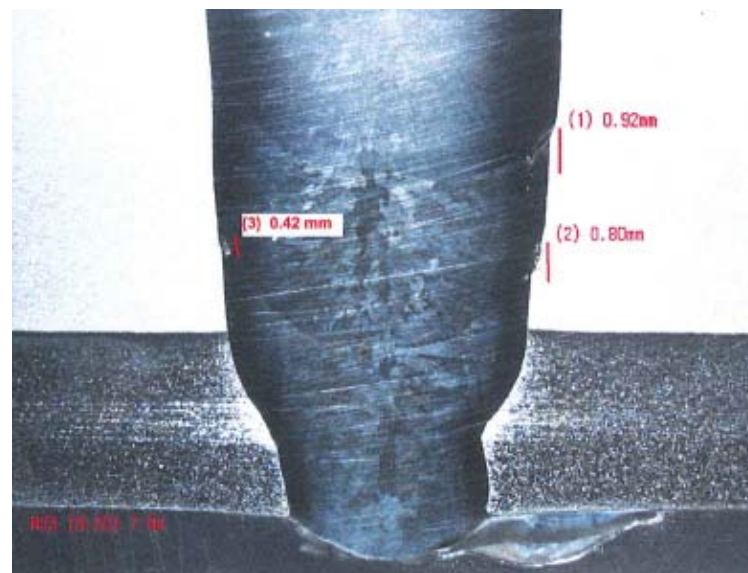
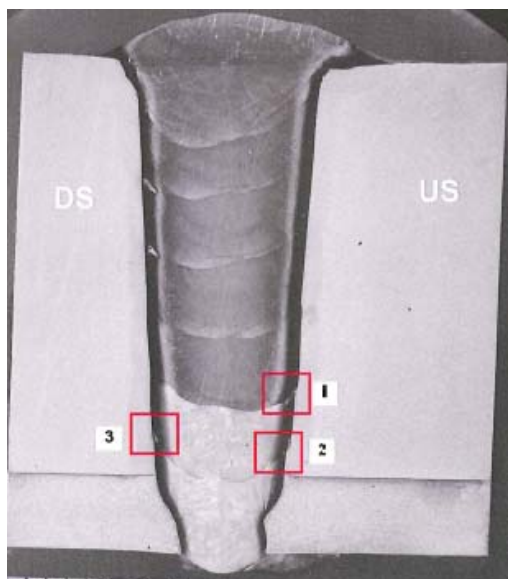
CRA Root Pass Inspection

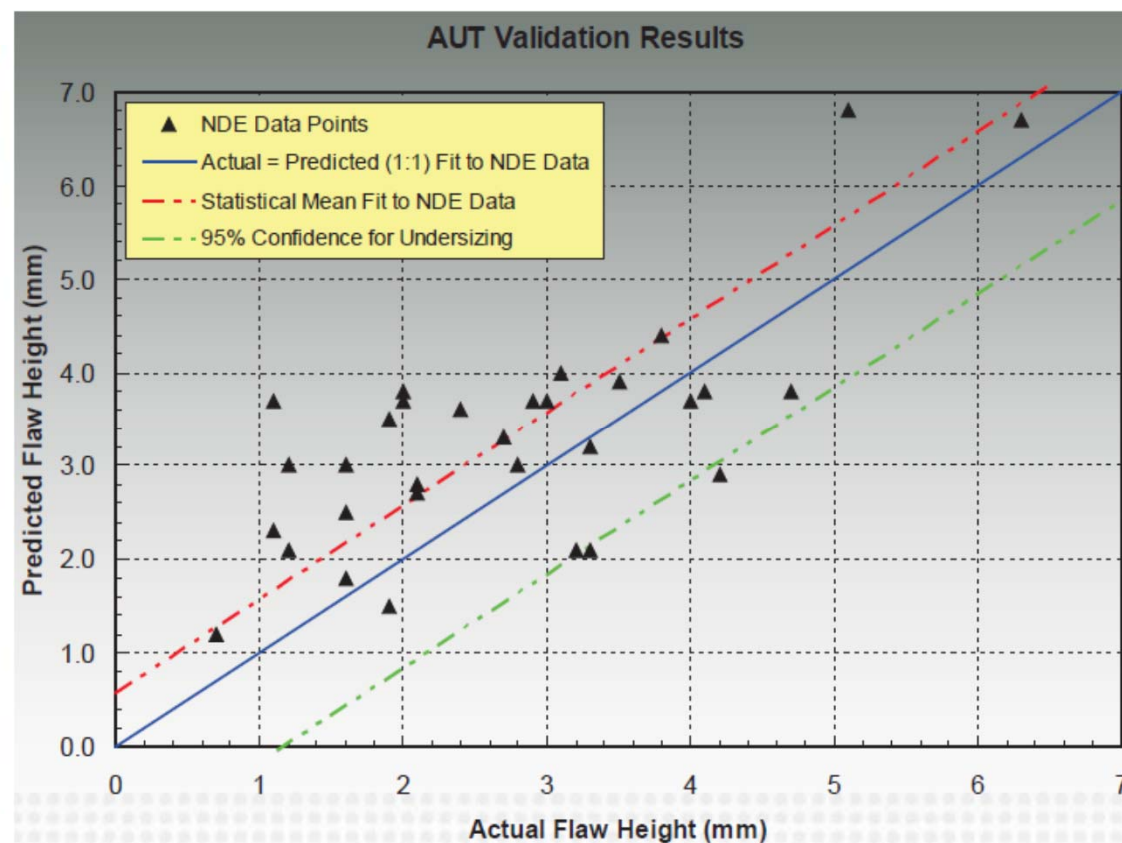


AUT Qualification

Comprehensive program to demonstrate sizing/detection capability of the AUT system:

- Significant number of defects (minimum of 122 flaws seeded across the weld volume)
- All flaws need to be representative of production inherent flaws and actual ECA criteria







Qualified Personnel



- Welding Engineer - Operator and Contractor
- NDT Level 3 in RT & UT (PA & TOFD) - Operator and Contractor
- Experienced QC Welding & NDT Inspectors (surveillance)
- Trained and familiarised welder and operators (training school and pipe cycling)

CONTINUITY is the key ! The same people involved at qualification will follow on offshore pipeline production



The Lucky Country



Engineers – 8 on / 4 off

Welders – 13 on / 3 off

Changes are needed to ensure consistent pipeline production

WA & NT – 3 on / 3 off

Bass Strait – 2 on / 2 off



Less Offshore Welding



Most of the pipeline production removed from critical path and performed outside Australia (South East Asia, etc.)





EPCI Contracting



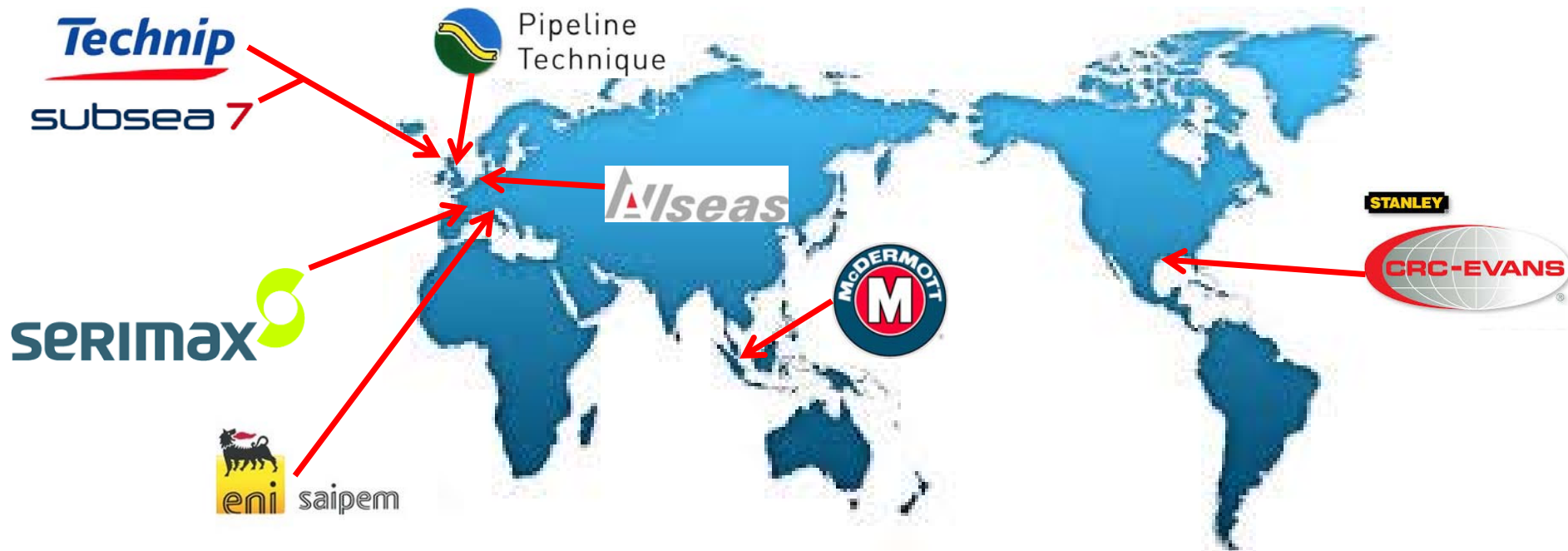
- EPCI procure his pipes according to the agreed project specification therefore they have to weld it together
- Only 3 pipe mills in the world (Japan & Germany)
- SMEs and Company reps to work as an integrated team with the installation contractors
- It's done this way for complex SURF projects overseas
- “You’re building my house but not living in it later on” so managing risks can’t be left to Contractor only who doesn’t share the same risks as the Operator



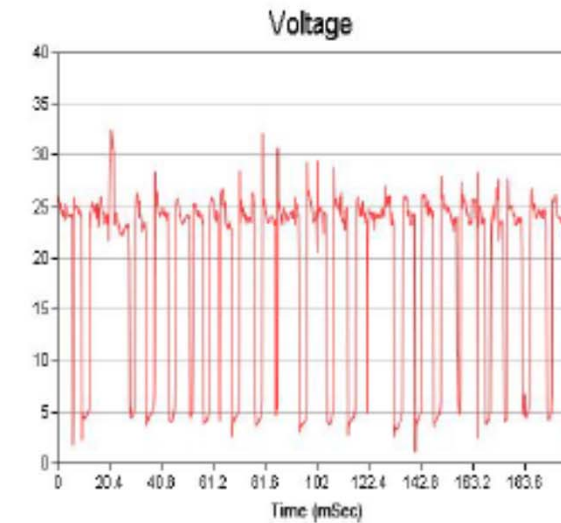
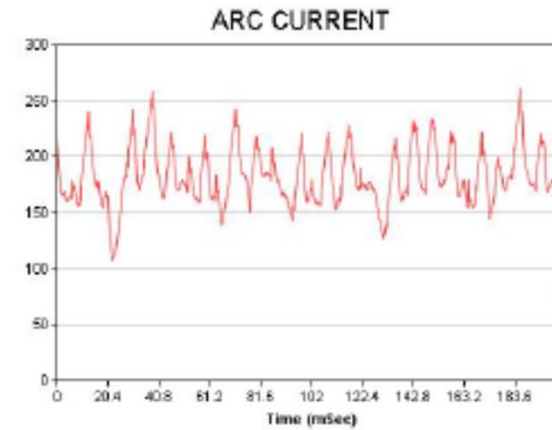
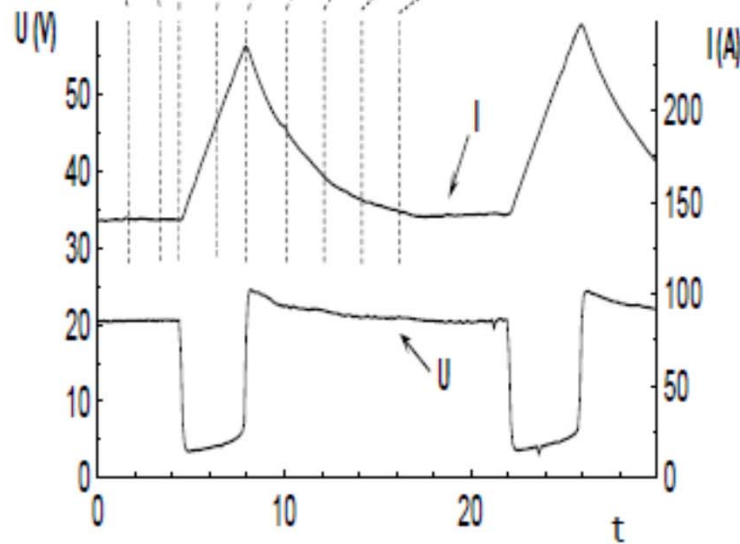
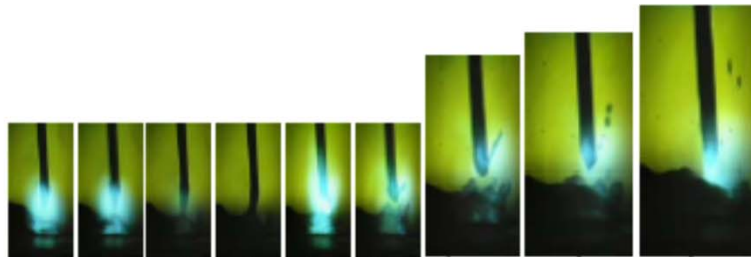
In-house expertise



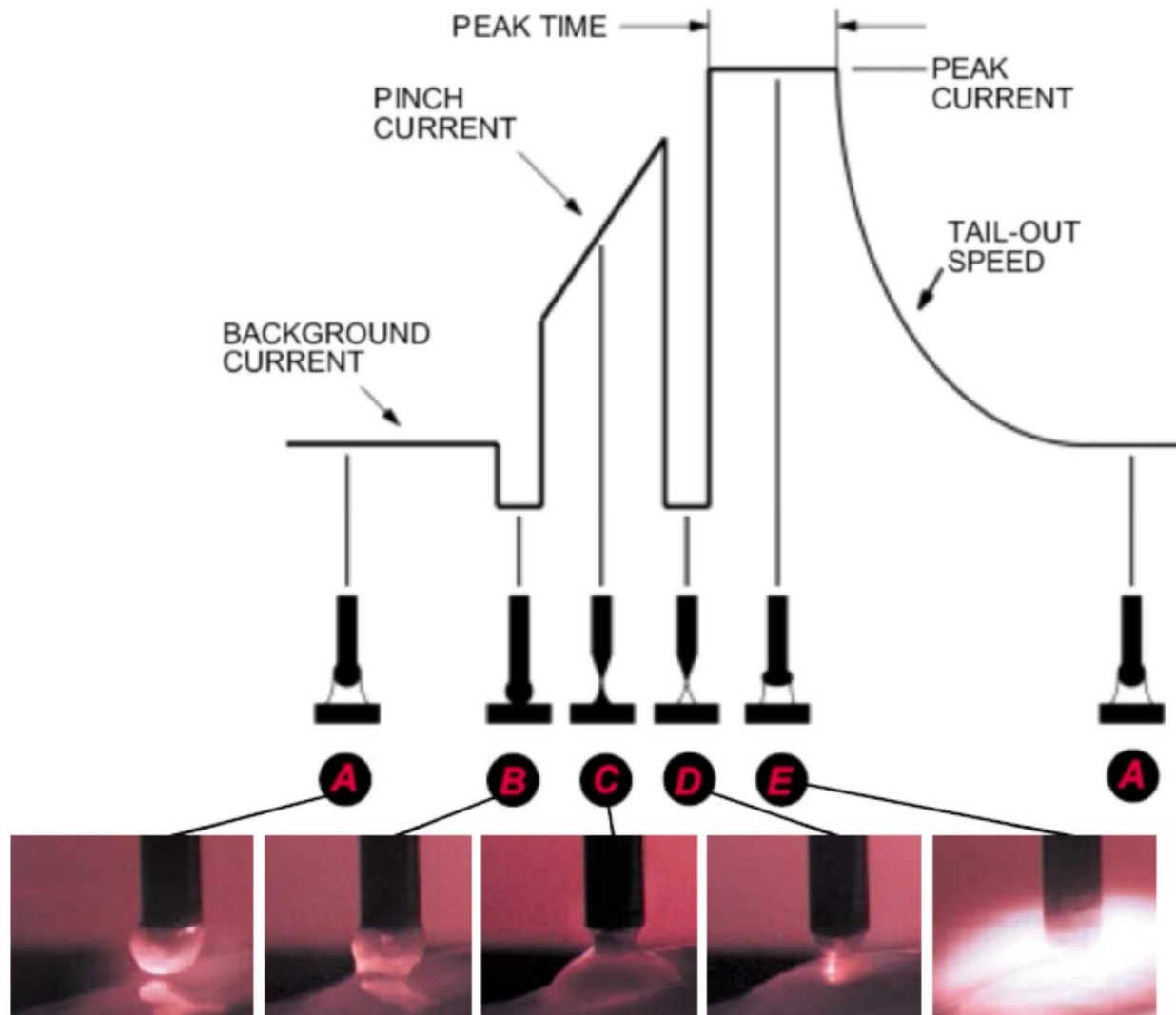
Installation contractors and specialised subcontractors have their own welding center of excellence with permanent R&D projects to improve the productivity and quality of pipeline welding and inspection.



Conventional Dip

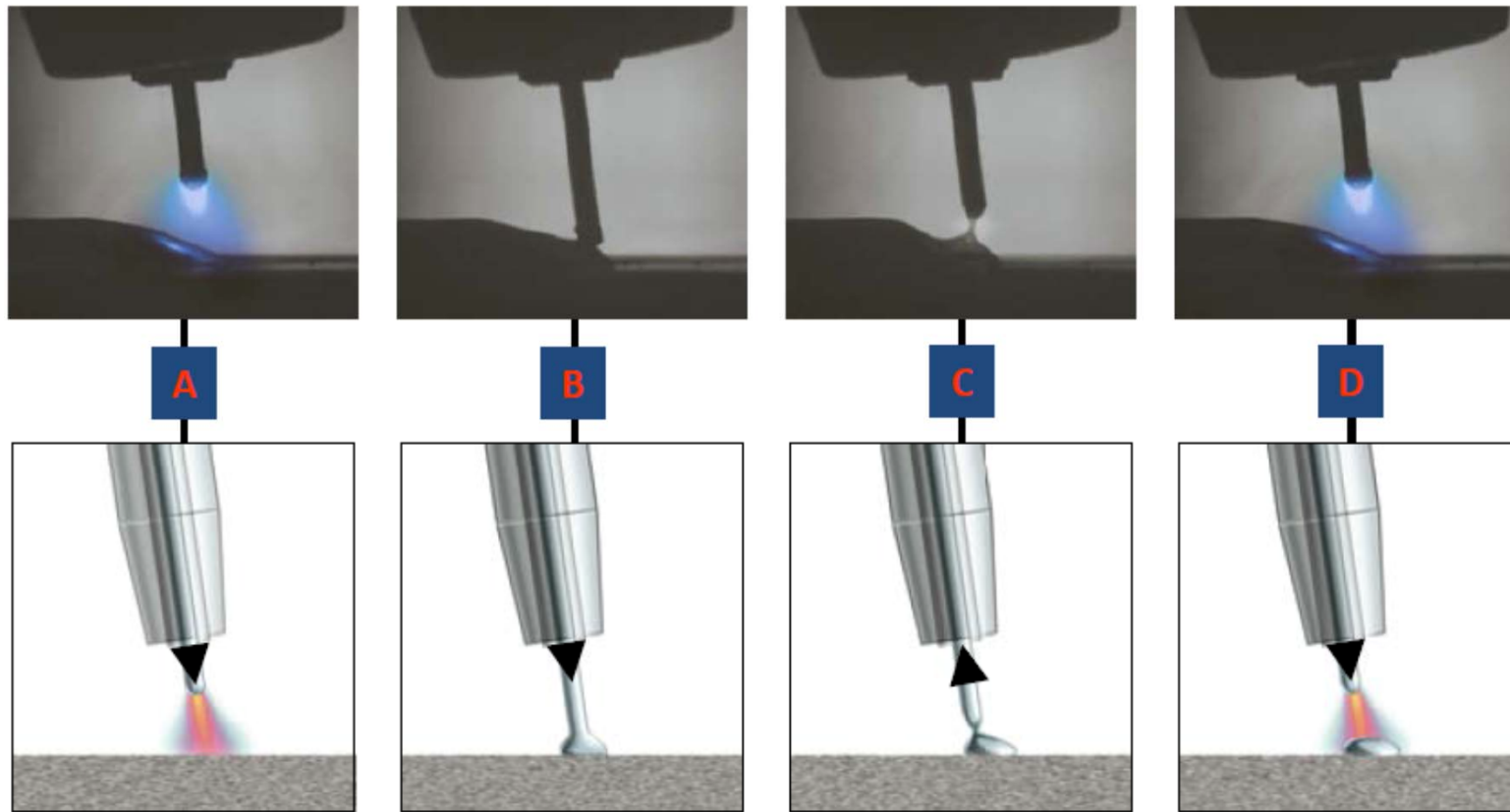


Surface Tension Transfer (STT)



Controlled Dip – Wire Retraction

CMT



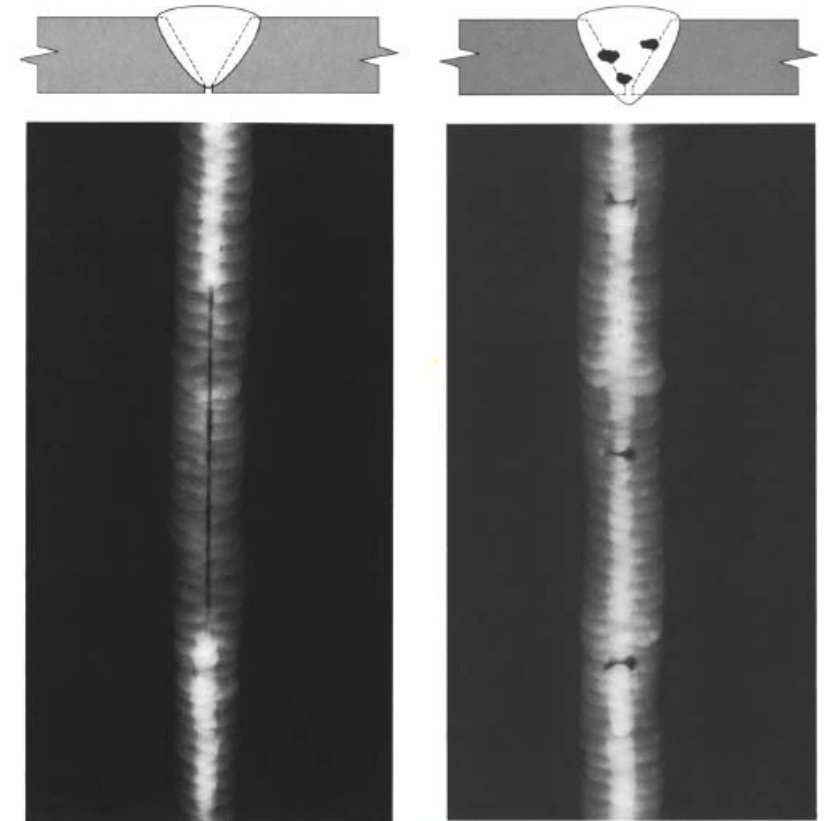


Recent welding technology



Previous NDT technology

“Old School” Radiography Technology, everybody can “see”

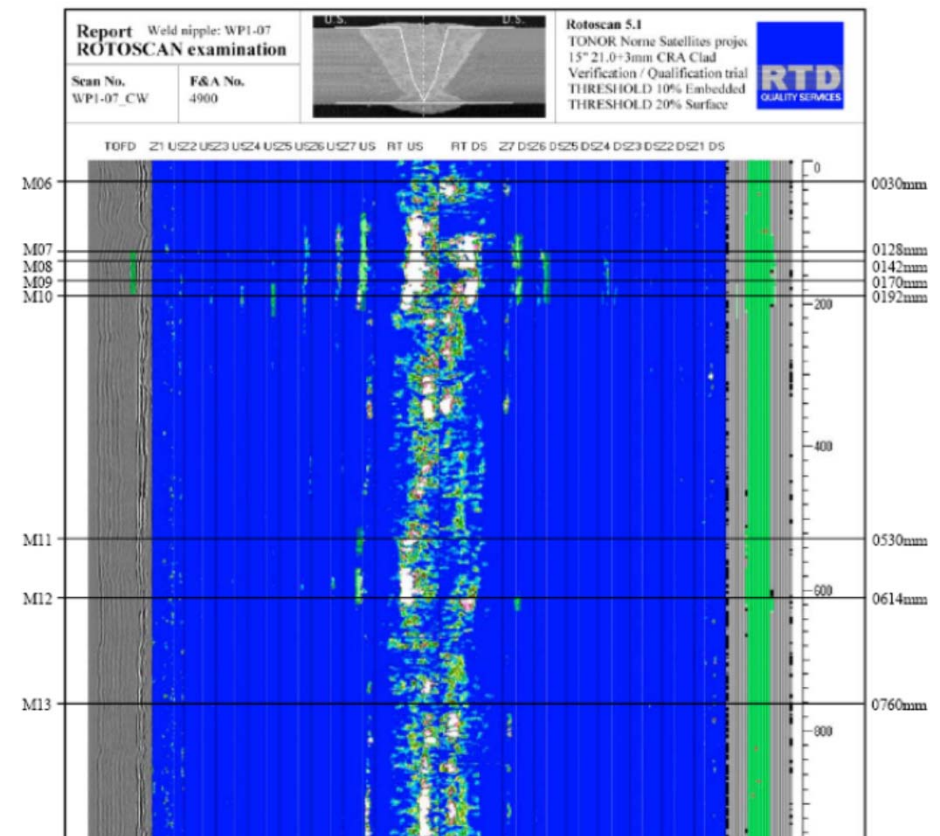




Recent NDT technology



Ultrasonic Technology, not everybody can “see” and interpret

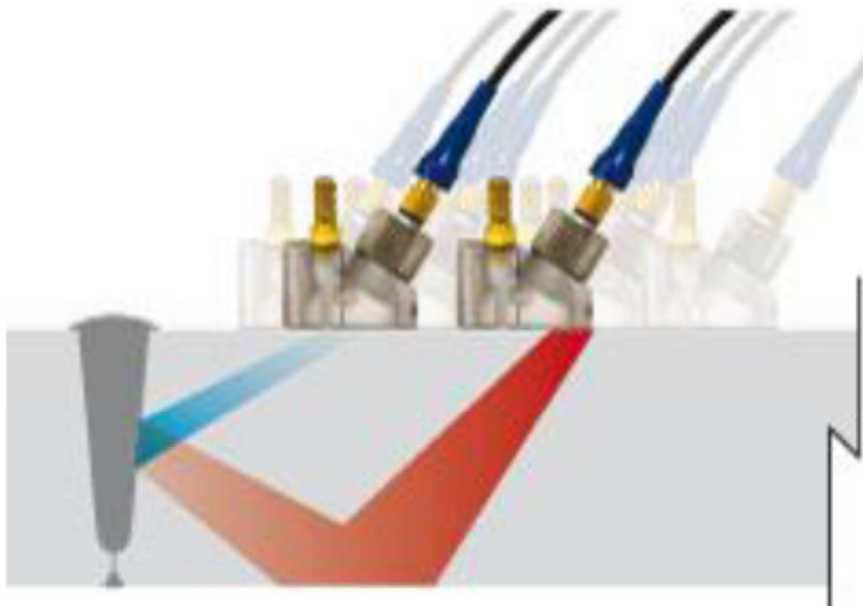




Recent NDT technology



More NDT companies = competition drives to innovation

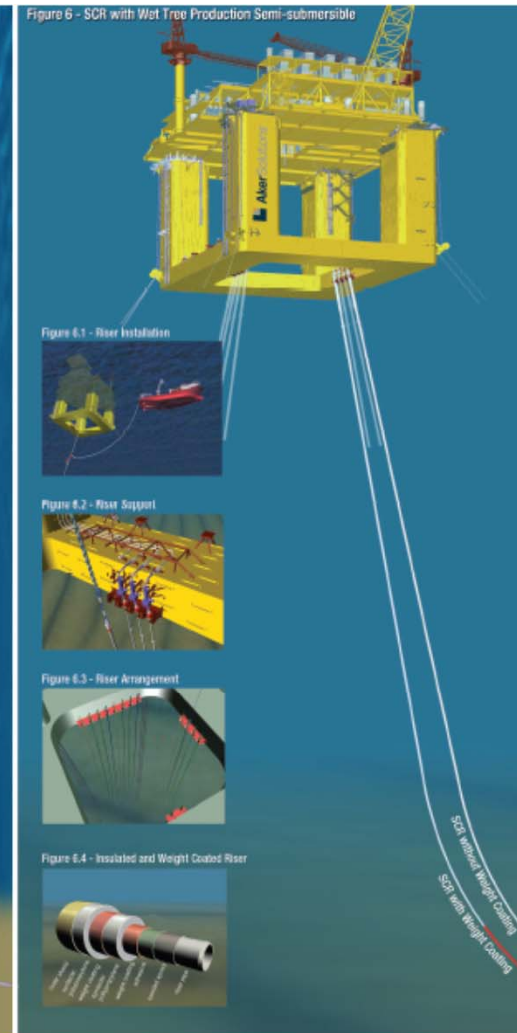
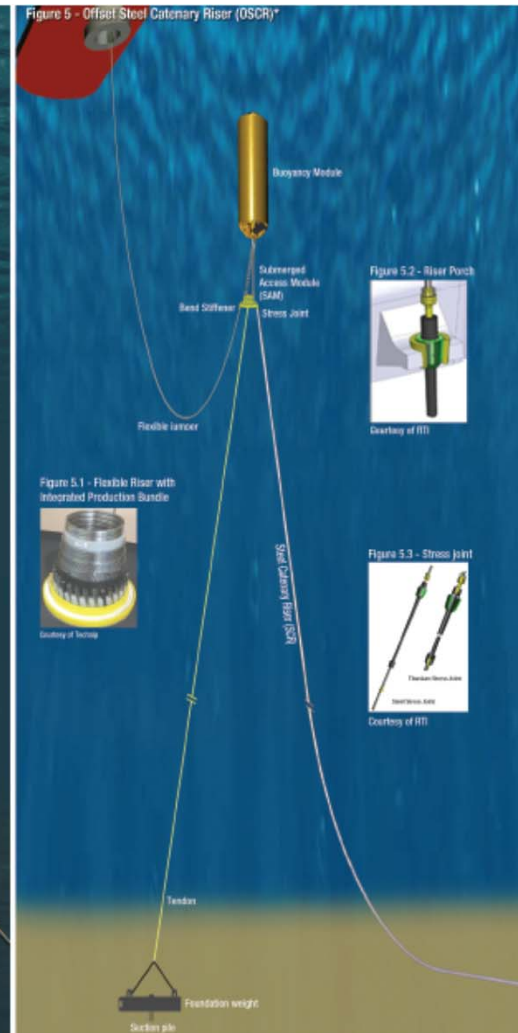
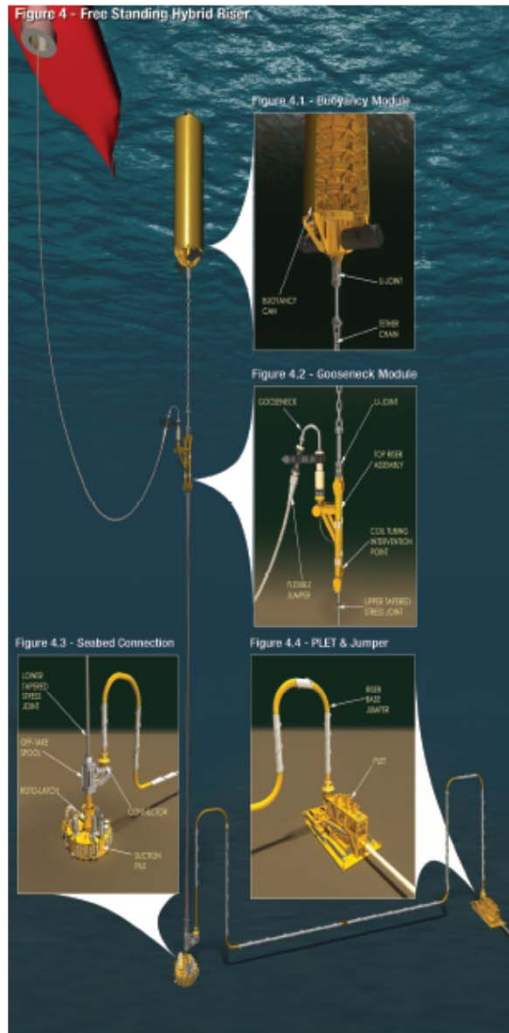


Pulse-Echo AUT – upto 20 probes (L & R)



PA AUT – 2 Probes (L & R)

The next frontier in WA?





The “Terrace”



- Talking and knowledge sharing
- We have laid more CRA flowlines in WA in the last 5 years than any other country so by now we should know how do to get it right
- But there is no silver bullet, every project is different and when technical issues arise we work together to solve it and sometimes learn to give up on specs or design !!