

Technical Workshop 2006, Aberdeen



**External Pipe & Vessel Inspection using
complementary NDT techniques with example
for interactive reporting & monitoring**

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Content



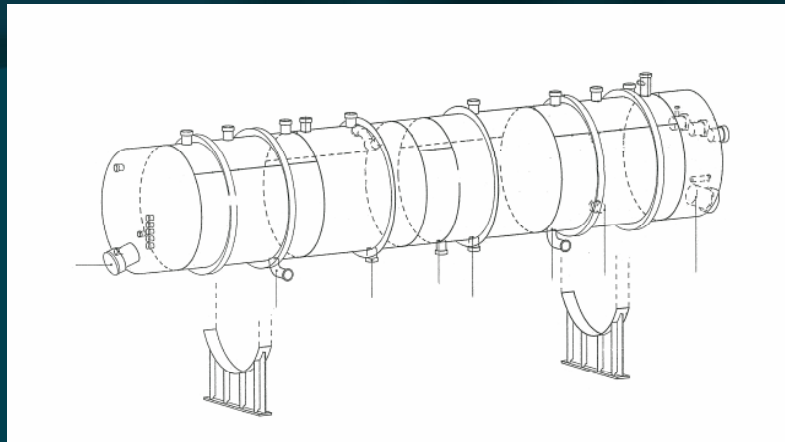
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Complementary NDT techniques



Examples of selecting a combination of NDT techniques to cover inspection areas as Vessels & Caissons – using combined teams , combining reports

Vessel Inspection/Monitoring

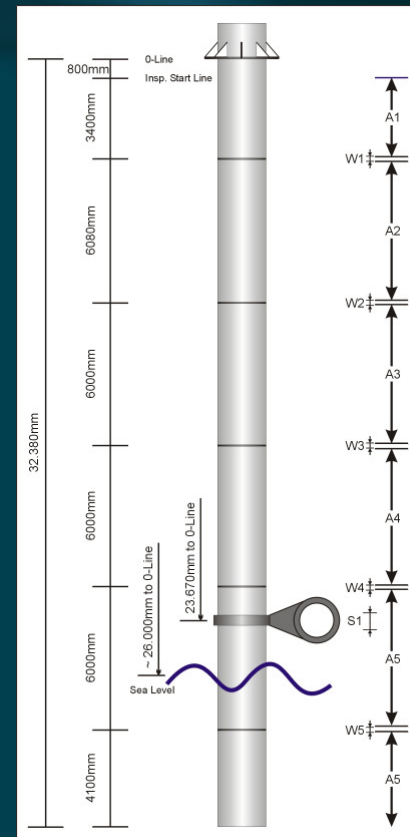


Applying Autom. UT, TOFD, LRU, SLOFEC

Team:

- 1 advanced UT Operator
- 1 SLOFEC Operator

Caisson Inspection



Applying SLOFEC, PEC, Visual Insp., Manual UT

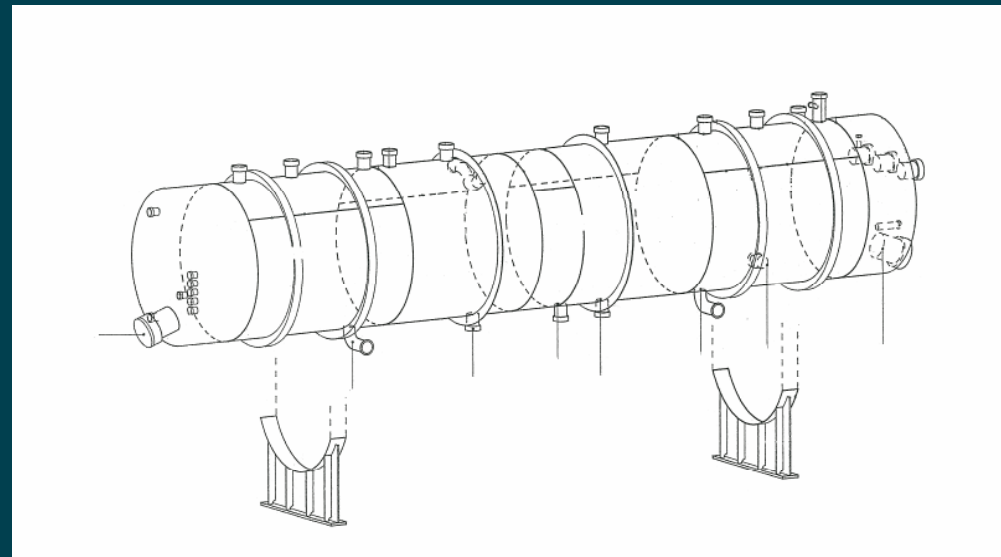
Team:

- PEC/Visual Operator (Rope access LIII)
- 1 Rigging Rope access LIII
- 1 Rope access LII Manual UT
- 1 SLOFEC Operator
- 1 Rope access HP jetting

Example, Vessel Inspection



- Initial Inspection task:
 - Avoid opening the vessel, so Non Intrusive Inspection required
 - Inspection to fulfill HSE requirements (Existing corrosion to be monitored)
- Secondary aims of the inspection
 - Perform inspection during operation (high temperature, $\sim 60^{\circ}\text{C}$)
 - Monitoring for maintenance planning (reproducibility)
 - Full coverage of areas with expected problems (4-8 o'clock position)



UT and SLOFEC for In Service Inspection



- **UT and ET detection capability as a Non Intrusive Inspection tool for vessels and pipes**

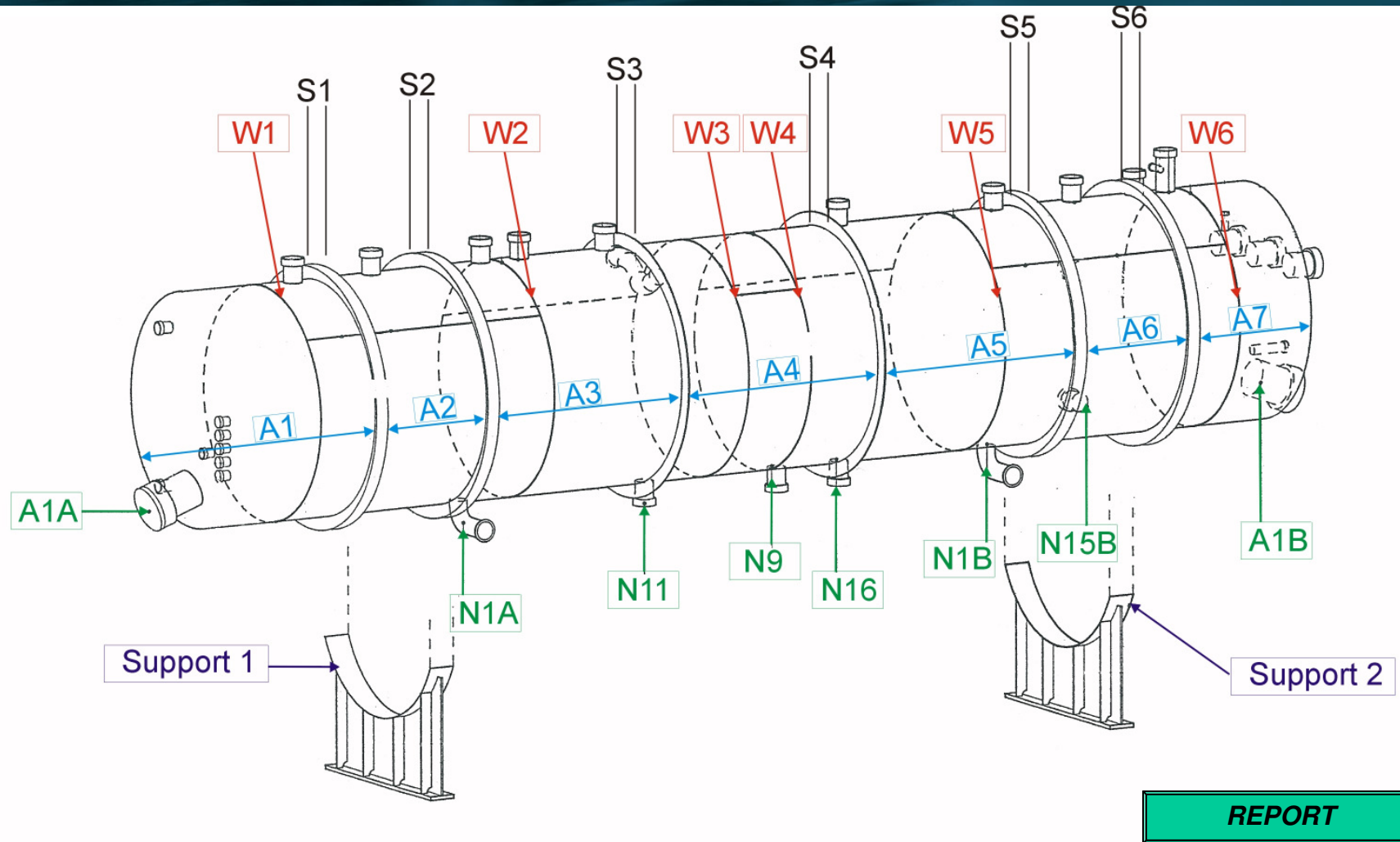
Item	TOFD	UT mapping	LRUT	ET	SLOFEC
Welds	Yes			Yes (crack detection)	
External corrosion	Partially	Partially	Partially	Yes	Yes
Internal corrosion	Yes	Yes	Yes		Yes
Pipework		Yes	Yes	Yes	Yes
Welds, high temperature	Yes (<400 °C)				
Corrosion, high temp		Yes (<350 °C)			Yes (<150 °C)

UT and SLOFEC for In Service Inspection

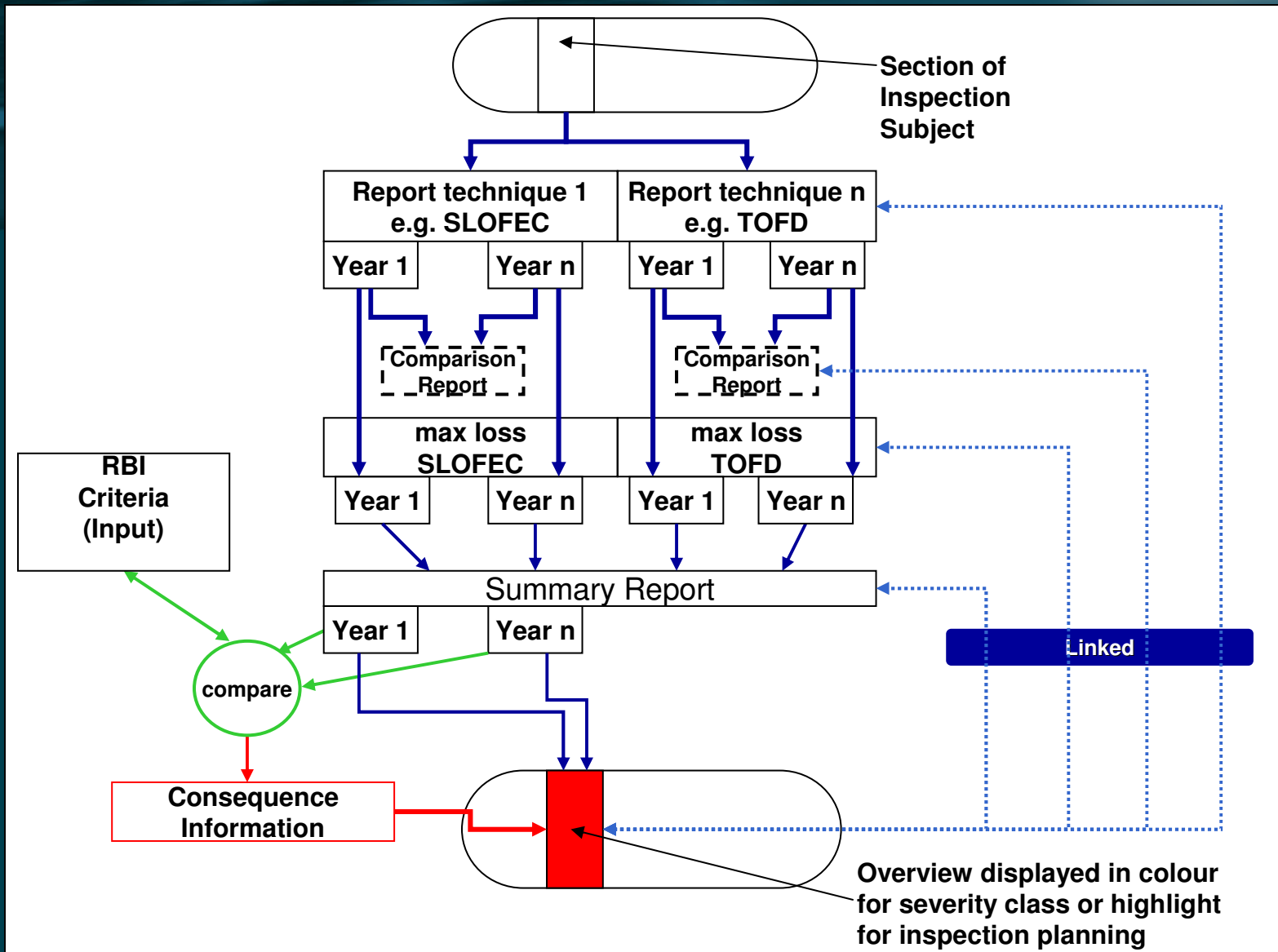


- UT and SLOFEC combined as complementary tools
 - SLOFEC is a fast detection and screening tool for large areas
 - UT is a reliable method for further evaluation of indications found with SLOFEC (depth and size measurement)
 - UT can measure in less accessible areas I.e. underneath stiffeners, near nozzles
 - SLOFEC and UT can be used to reliably distinguish between inclusions and corrosion

Interactive Reporting – Example Vessel



Interactive Reporting – future concept for monitoring



NDT Techniques – Capabilities & Limitations



	Capabilities:	Limitations:
SLOFEC	High sensitivity for localised corrosion (which is mostly expected type of defect) and cracks (subject to orientation)	Does not measure absolute thickness
	Inspects full thickness of material i.e. inspection surface through to opposite surface	Insensitive to smooth, gradual defects (relatively common on caissons)
	Differentiates internal from external damage	Highly specialist application/interpretation/reporting
	Minimal cleaning/ preparation of surface (up to 10mm/15mm stand-off)	Relatively heavy tool – have to consider rigging (but existing experience from other caisson inspections)
	Rapid large area coverage: 200mm wide inspection band scanned at 0.5m/s	No experience yet with marinised tool
	Quantified data allowing detailed reporting	Specific pole shoes required for each diameter for the marinised tool or inspection from internal side (one off cost)
Manual UT	Measures (actual) thickness	Relatively Slow; measures on a point by point basis, but now more automated
	Good for specific wall loss	Confidence in wheeled probes – still relatively new
	Quantified data	?sensitive to cracks and localised corrosion
	Can work with limited stand-off from surface – therefore cleaning required	Easier interpretation and reporting
	Substantial experience and understanding within Shell	Deployment an issue, would have to have specific system made