Industrial Service Company

TechCorr

Who We Are Now

TechCorr is a leading corrosion engineering, inspection, non-destructive testing and industrial services company with nearly 400 highly skilled employees dispatched from sixteen (16) locations across the world. For eleven years engineering consultancy, nondestructive testing-inspection, advanced nondestructive & industrial services have been provided to the upstream, midstream and downstream oil and gas segments along with electric power generation, pulp & paper, terminal storage and structural fabrication industries.

The combination of engineering services, inspection services and industrial services are unique in that our engineers, inspectors and industrial personnel are familiar with each others overall requirements so that more comprehensive solutions to problems are achieved in a much more cost effective and reliable way.

Our Promise to The Client

There is always a Solution To Every “Problem”. As a service and consultancy company we are focused on our clients needs. We help our clients solve problems. We try not to be their problem.

Finally “Safety” is priority. We are committed to protecting our employees, our reputation, the clients employees and the clients reputation. We are committed to a safe environment and work-site.

Brief List of Clients

TechCorr maintains three-hundred and fifty (350) clients world wide. TechCorr has no revenue concentrations in excess of three (3) percent making the business financially diversified. A brief list of clients include but are not limited to:

__Downstream__

- *Valero Refinery*
- *Goodyear Rubber*
- *ChevronPhillips*
- *Pasadena Refining*
- *Oxidental Petroleum*
- *ExxonMobil Refining*
- *Huntsman Refining*
- *Flint Hills Refining*
- *Sinclair Refining*
- *Methanex Chemicals*
- *Westlake Chemicals*
- *Texas Petrochemicals*
- *Rhodia Chemicals*
- *MEMC Chemicals*

__Midstream__

- *Boardwalk Pipeline Co.*
- *Kinder Morgan Gas*
- *Williams Companies*
- *BP Americas*
- *ExxonMobil Pipeline*
- *ExxonMobil E&P*
- *Praxair Pipeline Co.*
- *Shell Americas*
- *Sempra Energy*
- *Spectra Pipelines*
- *Anadarko E&P*
- *Centerpoint Energy*
- *Northern Natural Gas*
- *OneOk – Texas Gas*

__Offshore__

- *Signal Shipyards*
- *Gulf Copper Shipyards*
- *British Gas India*
- *Enap Magallanes*
- *Pemex GOM*
- *BP Trinidad & Vietnam*

__Fabrication__

- *Gulf Coast Fabricators*
- *Spitzer Industries*
- *Exterran Compressors*
- *FMC Corporation*
- *Ameron Companies*
- *Cameron Corporation*

Current North America Infrastructure

<u>Offices</u>

Houston

Port Arthur

Palestine

Grandbury

Grand Junction

Evanston

Casper

Long Beach

Pleasanton

TechCorr grows with it’s clients. We have all intentions to expand throughout the country as demand for our services are request.

Current Latin America Infrastructure

<u>Offices</u>

Maracaibo and Puerto La Cruz Venezuela

Villahermosa, Mexico

Port of Spain, Trinidad

Quito, Ecuador

Satellite or Reps

Argentina

Colombia

Chile

Panama

Peru

Current Eastern Hemisphere Infrastructure

<u>Offices</u>

Mumbai

Abu Dhabi

<u>Satellite or Reps</u>

Saudi Arabia

Qatar

Algeria

Oman

Kuwait

Pakistan

Nigeria

INSPECTION SERVICES

Inspection & Nondestructive Services

- API 510 Pressure Vessel Inspection
- API 570 Piping Inspection
- API 653 Tank Inspection
- NACE Coating Inspection
- **Automated Corrosion Mapping**
- Automated Time of Flight Diffraction
- Phased Array Examination
- Guided Wave Ultrasonic Testing
- External Laser Scanning
- Alternating Current Field Measurement
- Tank Floor MFE Inspection
- Eddy Current Tube Inspection
- Remote Field Tube Inspection
- Internal Rotary Tube Inspection
- B-Scan Ultrasonic Inspection
- Infrared Component Inspection
- Ultrasonic Inspection
- Liquid Dye Penetrant Testing
- Magnetic Particle Testing
- Magnetic Liftoff Testing
- **Pulsed Eddy Current Testing (PECT)**
- Acoustic Emission Testing
- Radiography (Iridium)
- Robotic Crawler Visual Video Inspection

Pipeline Construction

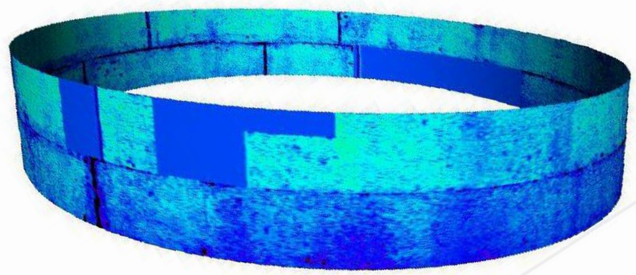
- X-RAY Pipeline Crawlers
- Automated Girth Weld Ultrasonics
- Certified Welding Inspectors

In-Service Tank Inspection

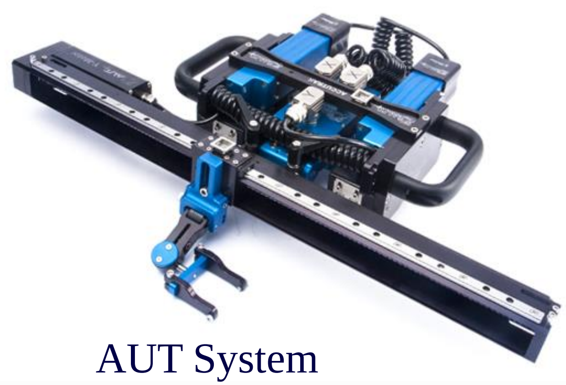
- OTIS – In Service Tank Inspection
- HD 200 – In Service Tank Cleaning
- SCAVENGER – Waste Water Pond
- OPROBE – Small Diameter Tank Inspection
- QLOOK – In-Service Video Inspection

TechCorr has over 250 API, ASNT and CSWIP Inspectors & Technicians Each Specialized In Various Techniques

Automated Ultrasonic Inspection (AUT)



3D Visualization

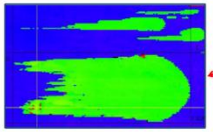


AUT System

AUT ROW DATA - DIG SITE 12-6 (0.5" INCREMENTS)

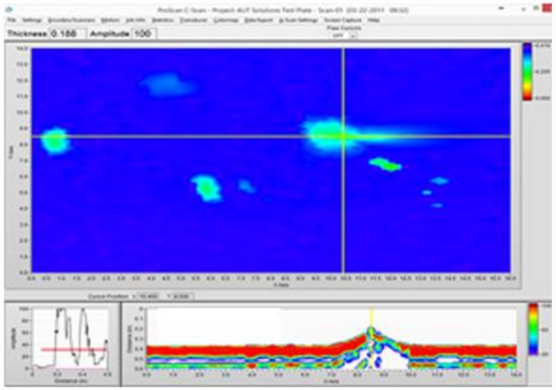
Pipe Axial Length (Y) / Pipe Circumference (X)

X \ Y	7.6	8.1	8.6	9.1	9.6	10.1	10.6	11.1	11.6	12.1	12.6	13.1	13.6	14.1
4.25	0.229	0.226	0.228	0.229	0.23	0.23	0.229	0.228	0.229	0.231	0.232	0.232	0.232	0.234
4.75	0.229	0.228	0.229	0.227	0.231	0.229	0.23	0.229	0.229	0.229	0.232	0.232	0.231	0.229
5.25	0.227	0.226	0.229	0.228	0.122	0.104	0.106	0.106	0.105	0.109	0.107	0.107	0.237	0.234
5.75	0.228	0.225	0.228	0.228	0.232	0.232	0.233	0.235	0.231	0.236	0.232	0.232	0.233	0.107
6.25	0.229	0.227	0.228	0.231	0.232	0.232	0.233	0.233	0.232	0.231	0.233	0.231	0.232	0.239
6.75	0.232	0.23	0.233	0.232	0.231	0.232	0.236	0.236	0.234	0.238	0.238	0.234	0.233	0.234
7.25	0.232	0.089	0.097	0.098	0.096	0.098	0.102	0.103	0.1	0.103	0.102	0.105	0.234	0.234
7.75	0.233	0.23	0.231	0.116	0.098	0.099	0.102	0.104	0.105	0.105	0.115	0.104	0.115	0.239
8.25	0.232	0.231	0.232	0.101	0.092	0.096	0.1	0.1	0.099	0.102	0.101	0.106	0.101	0.235
8.75	0.235	0.232	0.232	0.232	0.109	0.093	0.101	0.101	0.099	0.1	0.102	0.105	0.106	0.235
9.25	0.232	0.245	0.106	0.083	0.088	0.098	0.103	0.103	0.102	0.104	0.105	0.105	0.104	0.233
9.75	0.231	0.116	0.099	0.095	0.098	0.1	0.101	0.107	0.103	0.102	0.105	0.106	0.233	0.233
10.25	0.234	0.233	0.236	0.235	0.24	0.238	0.235	0.236	0.232	0.234	0.237	0.241	0.236	0.24



High Resolution AUT Scan

Row Data in Excel



A,B & C Scan Views

Automated Ultrasonic Testing

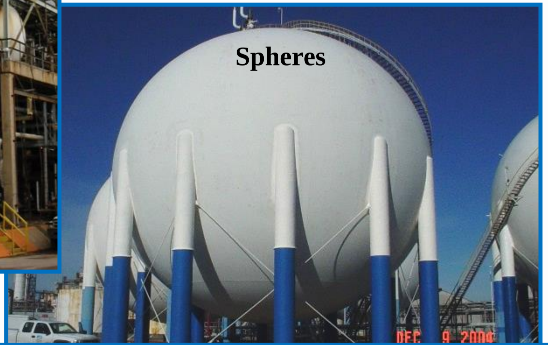
Automated Corrosion Mapping is designed to examine vessels, piping, towers and similar components suffering from internal degradation. Also utilized as an alternative to internal visual inspections as per API 510 recommended practices

How It Works – Using a multi-channel imaging system and a 2 axis robotic scanner ultrasonic mapping at a high rate with exceptional accuracy can be completed.

AUT is capable of inspecting vessels, piping, **spheres**, storage tanks, towers, welds and similar equipment to identify, size and monitor corrosion, erosion, weld flaws, cracking, inclusions, laminations, blistering, hydrogen damage and interlinking stepwise cracking.

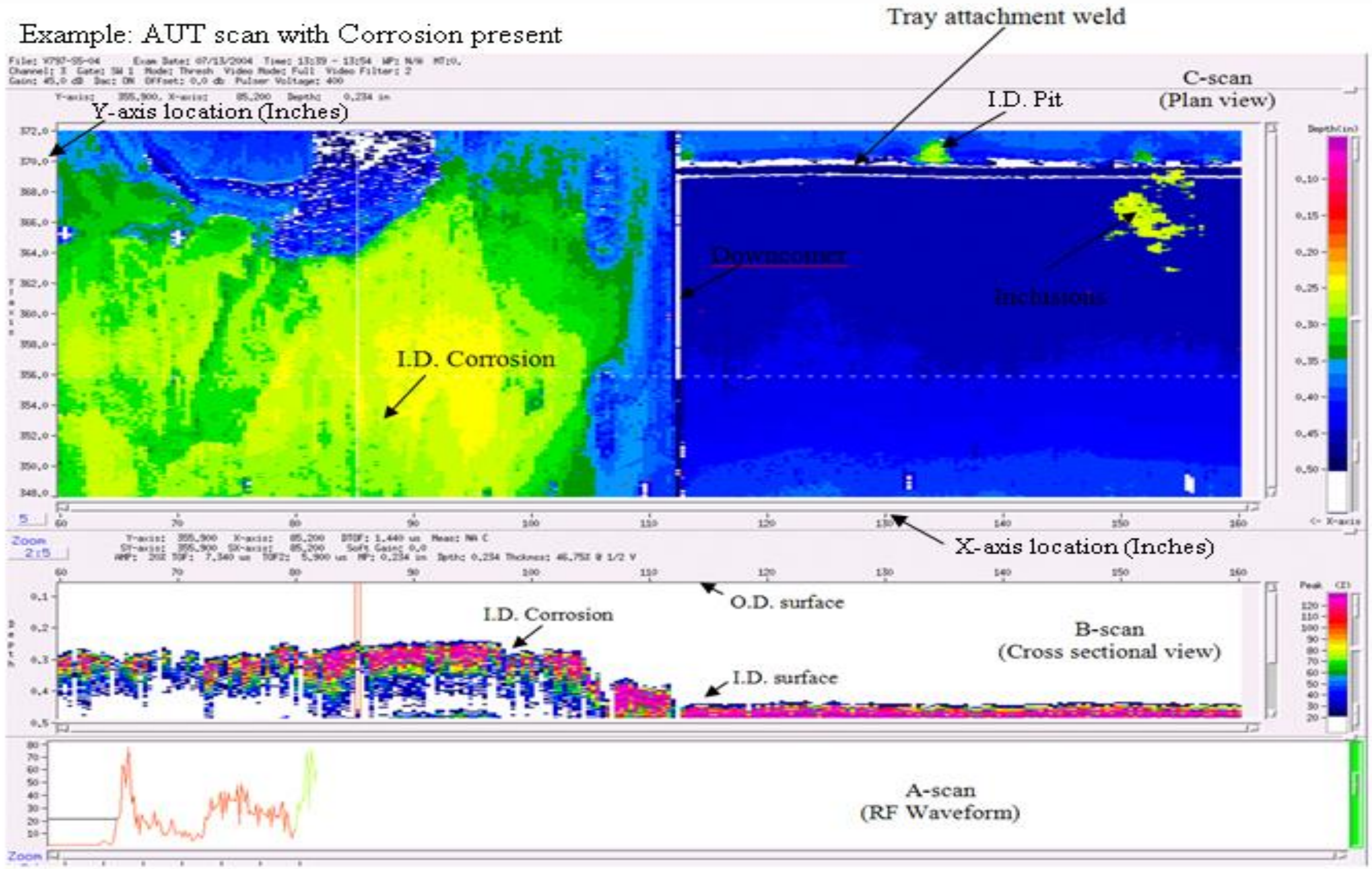
- Corrosion Mapping – API 510 Inspections
- Weld Quality Control – Phased Array / TOFD
- Hydrogen Induced Corrosion Inspections

Applications
Petrochemical Industry



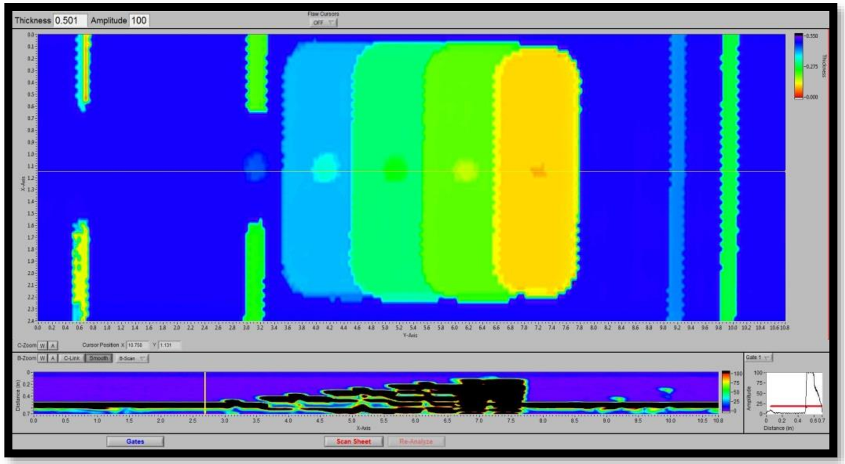
Corrosion Mapping, HIC and Service Related Crack Detection, Creep, Weld Quality, Clad Disbondment, & Weld Root Erosion Detection.

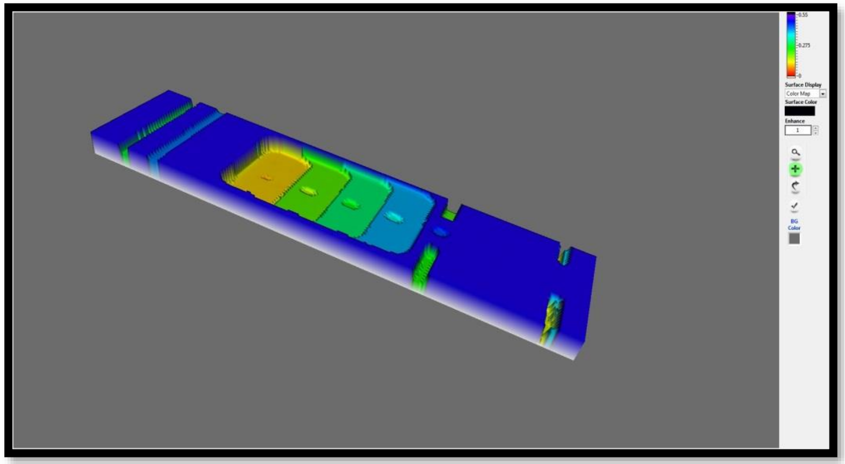
AUT Report-Interpretation

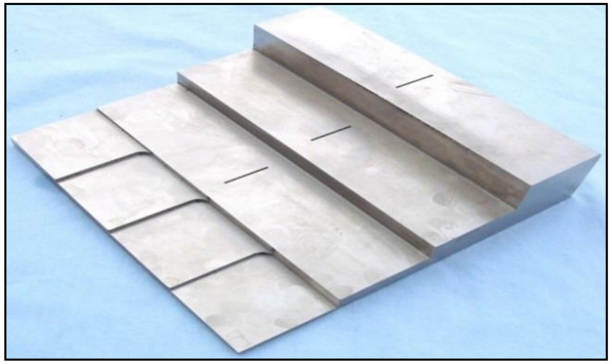


Referring to the UT Depth Color Pallet, the blue areas in the above C-scan image represent the nominal thickness and the green, yellow, red areas represent I.D. wall-loss.

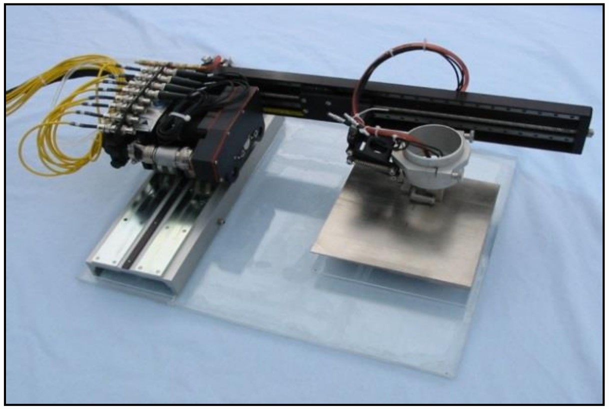
AUT Calibration







AUT Calibration Block



AUT Scanner & Calibration Block

AUT Inspection on Sphere TK-2194

Scope

To perform 8 Automated Ultrasonic examination (AUT) drops scans on Sphere.

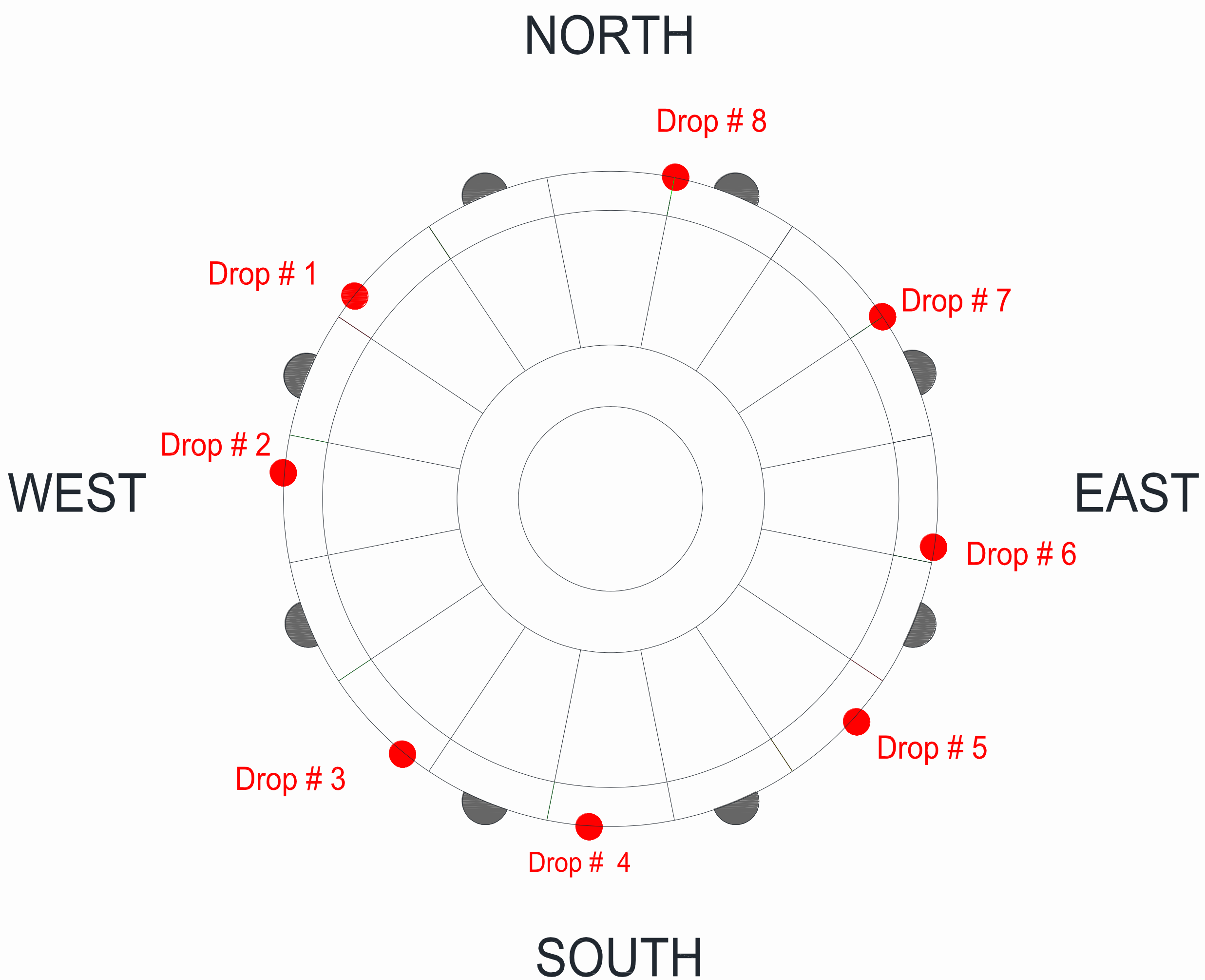
The purpose of this examination was to detect, characterize, and accurately locate ID metal loss, and indications perpendicular to the ultrasonic beam such as inclusions or laminations to provide an integrity assessment of the Sphere.

AUT Reference Points

All the AUT Drops (8) were referenced as follows:

X axis - (Circumferential Axis): 0" Ref at 5 ft. from Nozzle named as G.

Y axis - (Vertical Axis): 0" Ref at each Cardinal Point.


NORTH
Drop # 8
Drop # 1
Drop # 7
Drop # 2
WEST
EAST
Drop # 6
Drop # 5
Drop # 3
Drop # 4
SOUTH

Summary of Results

1. A total of eight (8) AUT Scan-Drops were performed from top to bottom of the Sphere. Each scan-drop was 20” wide and about 780” long.

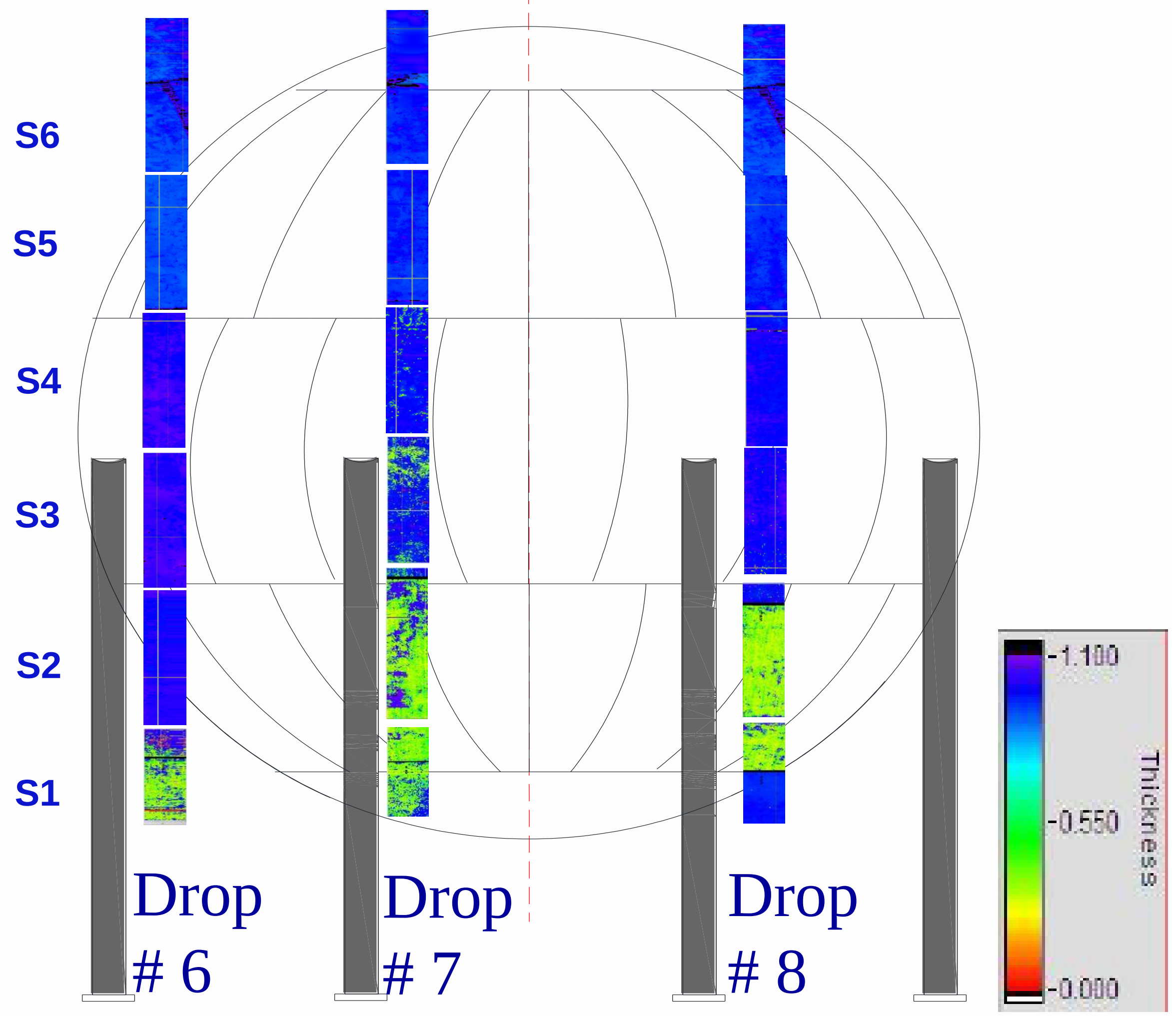
2. A total of 511024 UT thickness readings were collected in 0.5” increments during this inspection.

3. No relevant indications of metal loss were detected during the inspection.

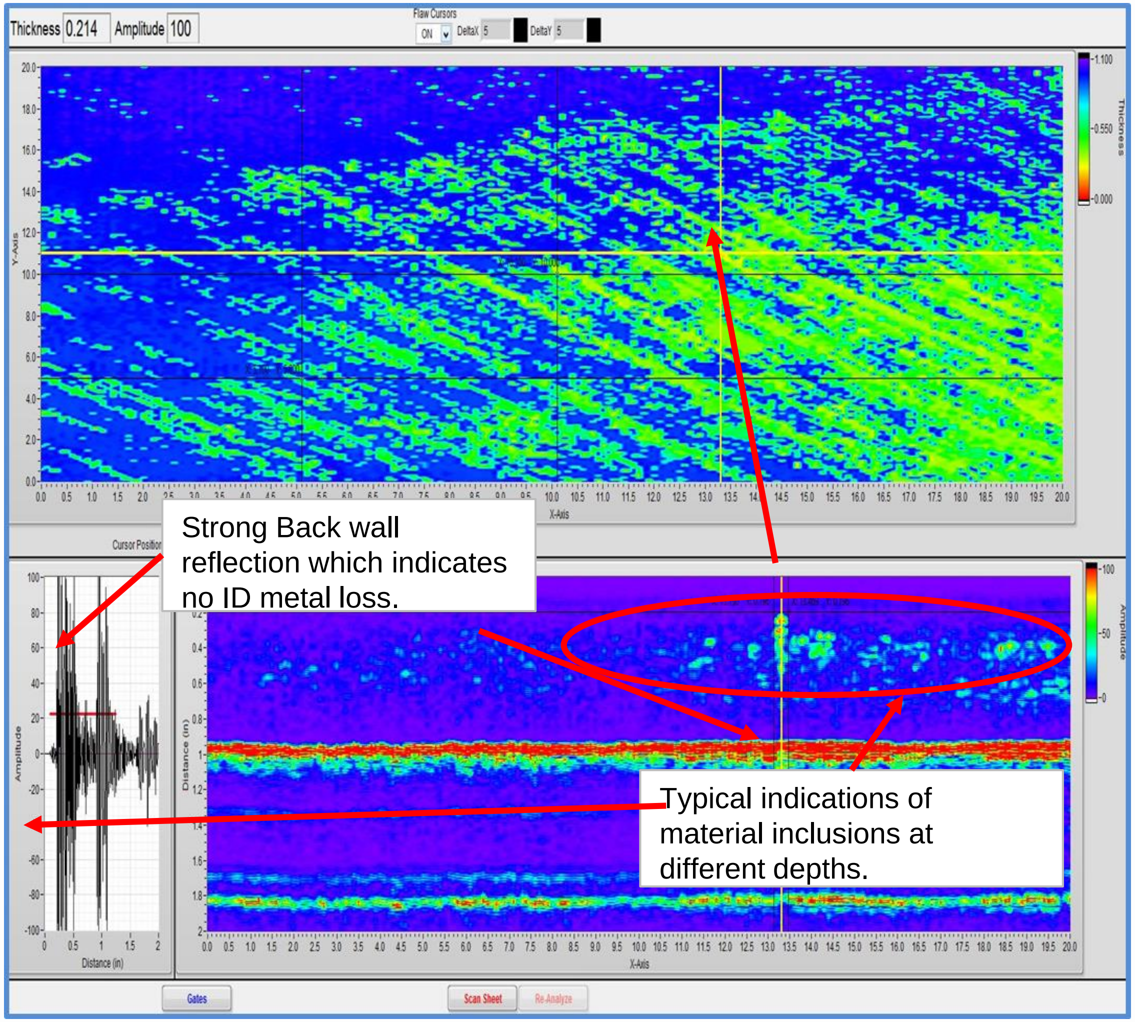
Summary of Results

4. Presence of indications perpendicular to the ultrasonic beam were found at different depths on every Scan-Drop. After further analysis by using high resolution AUT imaging they were identified as material inclusions randomly located at different depths from 0.196" to 0.564".

AUT Images on the Sphere



High Resolution AUT Scan



Snap Shot of the AUT Scan Sheet

TechCorr **SCAN SHEET**

Client:	CHEVRON PHILLIPS CHEMICAL COMPANY	**Component Specifications**		**REFERENCE (X/Y)**	
Equipment:	SPHERE TK-2194	**Circumference:**	48		
Material:	Carbon Steel	**Length:**	780"	**X-axis:**	0" Ref at 5' from Bottom Plate Nozzle G
Examination type:	High Resolution AUT Examination	**Nominal Thickness:**	0.754" - 0.946"	**Y-axis:**	0" Ref at Geographic North

File Name	X-Start	X-Stop	Y-Start	Y-Stop	X-Incr.	Y-Incr.	Readings	Depth	Ave 'T'	Nom. 'T'	% Loss	Comments
Drop 1S1	0.00"	120.00"	0.00"	20.00"	0.50"	0.50"	9881	0.787	0.854	0.858	8.284	There is a minor variation against Nominal Thickness
Drop 1S2	120.00"	240.00"	0.00"	20.00"	0.50"	0.50"	9881	0.812	0.857	0.854	4.972	There is a minor variation against Nominal Thickness
Drop 1S3	224.00"	360.00"	0.00"	20.00"	0.50"	0.50"	11193	0.850	0.98	0.845	0.000	There is a no variation against Nominal Thickness
Drop 1S4	360.00"	480.00"	0.00"	20.00"	0.50"	0.50"	9881	0.872	0.977	0.845	0.000	There is no variation against Nominal Thickness
Drop 1S5	480.00"	600.00"	0.00"	20.00"	0.50"	0.50"	9881	0.787	0.871	0.807	2.487	There is a minor variation against Nominal Thickness
Drop 1S6	600.00"	762.00"	0.00"	20.00"	0.50"	0.50"	13325	0.767	0.866	0.754	0.000	There is no variation against Nominal Thickness
Drop 2S1	0.00"	120.00"	0.00"	20.00"	0.50"	0.50"	9881	0.827	0.869	0.858	3.589	There is a minor variation against Nominal Thickness
Drop 2S2	120.00"	240.00"	0.00"	20.00"	0.50"	0.50"	9881	0.827	0.864	0.854	3.137	There is a minor variation against Nominal Thickness
Drop 2S3	240.00"	360.00"	0.00"	20.00"	0.50"	0.50"	9881	0.785	0.834	0.845	7.137	There is a minor variation against Nominal Thickness
Drop 2S4	360.00"	480.00"	0.00"	20.00"	0.50"	0.50"	9881	0.787	0.846	0.845	6.873	There is a minor variation against Nominal Thickness
Drop 2S5	475.00"	600.00"	0.00"	20.00"	0.50"	0.50"	10291	0.794	0.835	0.807	1.656	There is a minor variation against Nominal Thickness
Drop 2S6	600.00"	780.00"	0.00"	20.00"	0.50"	0.50"	14801	0.744	0.826	0.807	7.756	There is a minor variation against Nominal Thickness
Drop 3S1	0.00"	120.00"	0.00"	20.00"	0.50"	0.50"	9881	0.814	0.868	0.854	4.684	There is a minor variation against Nominal Thickness
Drop 3S2	120.00"	240.00"	0.00"	20.00"	0.50"	0.50"	9881	0.798	0.853	0.854	6.544	There is a minor variation against Nominal Thickness
Drop 3S3	235.00"	360.00"	0.00"	20.00"	0.50"	0.50"	10291	0.823	0.864	0.854	3.662	There is a minor variation against Nominal Thickness
Drop 3S4	360.00"	480.00"	0.00"	20.00"	0.50"	0.50"	9881	0.829	0.873	0.845	1.841	There is a minor variation against Nominal Thickness
Drop 3S5	480.00"	600.00"	0.00"	20.00"	0.50"	0.50"	9881	0.760	0.836	0.807	5.815	There is a minor variation against Nominal Thickness
Drop 3S6	600.00"	780.00"	0.00"	20.00"	0.50"	0.50"	14801	0.740	0.832	0.807	8.311	There is a minor variation against Nominal Thickness

Excel Row Data

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
0	0	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
20	0.854	0.859	0.867	0.879	0.852	0.847	0.85	0.841	0.834	0.843	0.838	0.836	0.847	0.852	0.861	0.863	0.85	0.85	0.845	0.838	0.85
19.5	0.865	0.865	0.865	0.854	0.852	0.847	0.841	0.852	0.832	0.847	0.834	0.841	0.845	0.856	0.863	0.863	0.847	0.859	0.85	0.847	0.843
19	0.854	0.854	0.845	0.879	0.847	0.847	0.829	0.841	0.82	0.843	0.825	0.836	0.827	0.834	0.861	0.845	0.847	0.843	0.852	0.841	0.838
18.5	0.852	0.859	0.859	0.841	0.85	0.832	0.829	0.841	0.834	0.832	0.82	0.834	0.82	0.834	0.841	0.843	0.876	0.852	0.836	0.841	0.838
18	0.838	0.854	0.845	0.838	0.838	0.832	0.827	0.838	0.829	0.836	0.818	0.832	0.825	0.832	0.827	0.861	0.841	0.843	0.836	0.85	0.843
17.5	0.832	0.845	0.852	0.836	0.829	0.827	0.825	0.829	0.823	0.827	0.825	0.827	0.82	0.832	0.825	0.843	0.827	0.836	0.841	0.838	0.85
17	0.834	0.841	0.841	0.838	0.832	0.827	0.823	0.82	0.825	0.829	0.823	0.829	0.827	0.827	0.827	0.836	0.832	0.834	0.827	0.834	0.841
16.5	0.827	0.832	0.834	0.827	0.838	0.827	0.82	0.823	0.825	0.836	0.825	0.834	0.834	0.838	0.834	0.834	0.827	0.832	0.834	0.827	0.832
16	0.834	0.838	0.827	0.827	0.825	0.827	0.823	0.823	0.825	0.82	0.827	0.836	0.841	0.843	0.832	0.847	0.829	0.827	0.836	0.832	0.827
15.5	0.818	0.827	0.82	0.832	0.832	0.816	0.825	0.82	0.818	0.827	0.823	0.827	0.843	0.836	0.834	0.832	0.834	0.836	0.829	0.834	0.825
15	0.82	0.823	0.823	0.818	0.82	0.818	0.82	0.834	0.823	0.832	0.834	0.829	0.834	0.829	0.832	0.834	0.836	0.832	0.827	0.827	0.825
14.5	0.823	0.823	0.825	0.823	0.82	0.812	0.818	0.823	0.82	0.825	0.827	0.834	0.825	0.823	0.838	0.834	0.834	0.843	0.829	0.829	0.829
14	0.827	0.82	0.82	0.82	0.823	0.825	0.82	0.832	0.823	0.834	0.832	0.829	0.827	0.827	0.832	0.832	0.829	0.836	0.829	0.832	0.832
13.5	0.825	0.827	0.823	0.832	0.825	0.827	0.825	0.834	0.825	0.825	0.827	0.829	0.825	0.82	0.823	0.829	0.827	0.829	0.834	0.832	0.827
13	0.827	0.827	0.832	0.832	0.836	0.827	0.818	0.823	0.832	0.829	0.834	0.827	0.818	0.827	0.825	0.829	0.836	0.832	0.834	0.834	0.825
12.5	0.832	0.829	0.832	0.827	0.832	0.836	0.827	0.825	0.838	0.823	0.832	0.823	0.823	0.82	0.834	0.838	0.836	0.836	0.829	0.834	0.836
12	0.827	0.832	0.829	0.836	0.823	0.841	0.834	0.838	0.829	0.832	0.823	0.832	0.829	0.832	0.843	0.838	0.85	0.841	0.832	0.847	0.856
11.5	0.829	0.829	0.834	0.838	0.829	0.845	0.832	0.834	0.829	0.845	0.829	0.838	0.836	0.845	0.843	0.85	0.847	0.879	0.852	0.845	0.854
11	0.845	0.841	0.836	0.836	0.841	0.841	0.832	0.836	0.838	0.843	0.841	0.843	0.845	0.847	0.841	0.854	0.854	0.865	0.845	0.845	0.845
10.5	0.843	0.836	0.834	0.832	0.836	0.841	0.841	0.841	0.838	0.843	0.836	0.845	0.838	0.854	0.847	0.843	0.885	0.859	0.854	0.845	0.845
10	0.834	0.845	0.838	0.832	0.836	0.838	0.832	0.834	0.843	0.847	0.838	0.847	0.843	0.852	0.852	0.852	0.856	0.845	0.843	0.845	0.841
9.5	0.832	0.836	0.841	0.834	0.838	0.838	0.834	0.838	0.838	0.841	0.856	0.861	0.854	0.856	0.847	0.852	0.847	0.847	0.845	0.845	0.843
9	0.838	0.825	0.836	0.834	0.832	0.841	0.845	0.834	0.843	0.845	0.854	0.854	0.852	0.861	0.854	0.859	0.854	0.854	0.854	0.85	0.845
8.5	0.829	0.829	0.827	0.834	0.838	0.834	0.838	0.829	0.841	0.85	0.845	0.854	0.856	0.861	0.852	0.856	0.852	0.859	0.85	0.854	0.847
8	0.829	0.829	0.827	0.832	0.838	0.834	0.834	0.85	0.841	0.847	0.85	0.85	0.861	0.859	0.854	0.867	0.859	0.859	0.859	0.861	0.85
7.5	0.827	0.834	0.827	0.834	0.834	0.841	0.843	0.843	0.843	0.847	0.847	0.87	0.87	0.854	0.865	0.879	0.854	0.854	0.854	0.854	0.859
7	0.832	0.836	0.836	0.841	0.838	0.841	0.843	0.845	0.845	0.841	0.852	0.854	0.881	0.872	0.838	0.881	0.854	0.856	0.852	0.859	0.854
6.5	0.843	0.838	0.845	0.856	0.843	0.838	0.843	0.843	0.838	0.841	0.843	0.843	0.854	0.847	0.856	0.856	0.852	0.874	0.859	0.856	0.856
6	0.843	0.838	0.85	0.841	0.847	0.834	0.841	0.836	0.845	0.847	0.838	0.85	0.836	0.85	0.841	0.867	0.859	0.856	0.856	0.865	0.856
5.5	0.841	0.841	0.843	0.836	0.841	0.843	0.836	0.843	0.841	0.847	0.845	0.852	0.845	0.856	0.865	0.867	0.879	0.872	0.854	0.863	0.856
5	0.843	0.843	0.836	0.843	0.841	0.847	0.843	0.845	0.843	0.874	0.847	0.859	0.859	0.863	0.854	0.867	0.867	0.863	0.856	0.861	0.854
4.5	0.841	0.843	0.841	0.852	0.845	0.845	0.847	0.845	0.861	0.87	0.852	0.856	0.856	0.859	0.867	0.863	0.874	0.865	0.865	0.87	0.861
4	0.843	0.85	0.838	0.852	0.85	0.859	0.843	0.854	0.872	0.861	0.859	0.856	0.863	0.859	0.859	0.859	0.861	0.865	0.865	0.856	0.863
3.5	0.85	0.85	0.847	0.85	0.85	0.865	0.859	0.85	0.85	0.854	0.867	0.85	0.865	0.852	0.845	0.854	0.856	0.863	0.863	0.859	0.863
3	0.85	0.847	0.847	0.852	0.847	0.854	0.863	0.861	0.85	0.845	0.856	0.845	0.854	0.85	0.845	0.859	0.859	0.861	0.863	0.863	0.863
2.5	0.843	0.845	0.852	0.847	0.847	0.859	0.863	0.854	0.854	0.852	0.854	0.856	0.845	0.85	0.85	0.856	0.854	0.856	0.856	0.865	0.859
2	0.845	0.847	0.847	0.85	0.852	0.863	0.859	0.847	0.856	0.85	0.85	0.852	0.852	0.845	0.85	0.872	0.856	0.865	0.863	0.872	0.859
1.5	0.845	0.847	0.85	0.852	0.852	0.854	0.847	0.854	0.852	0.845	0.843	0.874	0.845	0.865	0.852	0.888	0.865	0.867	0.861	0.867	0.876
1	0.838	0.841	0.841	0.845	0.85	0.859	0.854	0.85	0.847	0.85	0.843	0.872	0.863	0.881	0.888	0.867	0.867	0.859	0.872	0.865	0.867
0.5	0.838	0.841	0.836	0.847	0.843	0.85	0.856	0.85	0.852	0.872	0.836	0.852	0.863	0.863	0.888	0.865	0.863	0.861	0.867	0.863	0.865
0	0.836	0.834	0.847	0.845	0.847	0.845	0.845	0.85	0.852	0.863	0.881	0.854	0.865	0.872	0.854	0.861	0.859	0.874	0.859	0.881	0.865

What can we add to this inspection ?

<u>Phased Array Inspection</u>

Ultrasonic Phased Array Inspection to the Seam welds and junctions at the bottom of the sphere to discard the presence of cracking in those areas with higher stress concentration.

We applied this approach on a Sphere as follows:

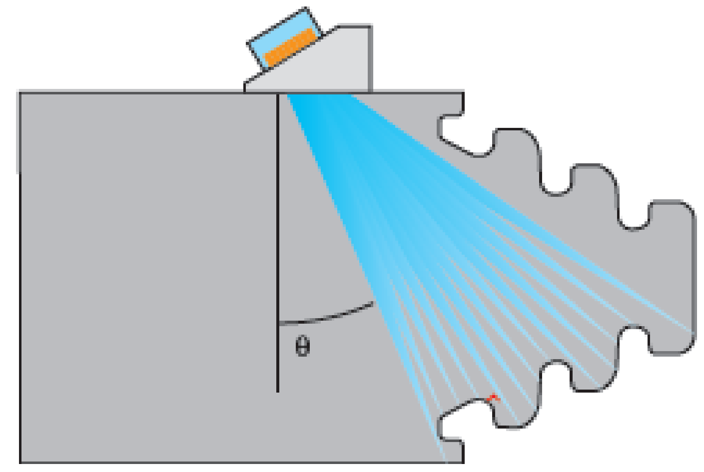
Nozzle Welds

Shell to Leg Welds

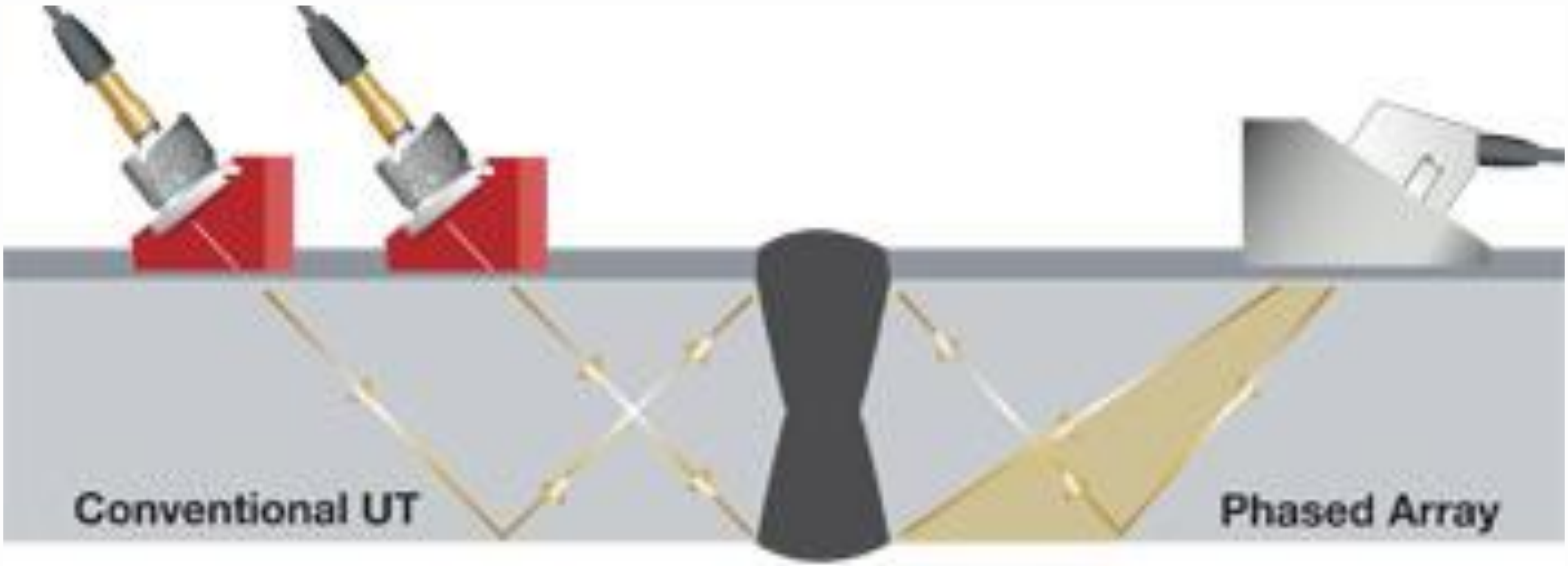
25% of the junction welds.

What is Phased Array Testing

Phased Array testing is a specialized type of ultrasonic testing that uses sophisticated multi-element array transducers and powerful software to steer high frequency sound beams through the test piece and map returning echoes, producing detailed images of internal structures similar to medical ultrasound images. It is used for inspection of critical structural metals, pipeline welds, aerospace components, and similar applications where the additional information supplied by phased array inspection is valuable.

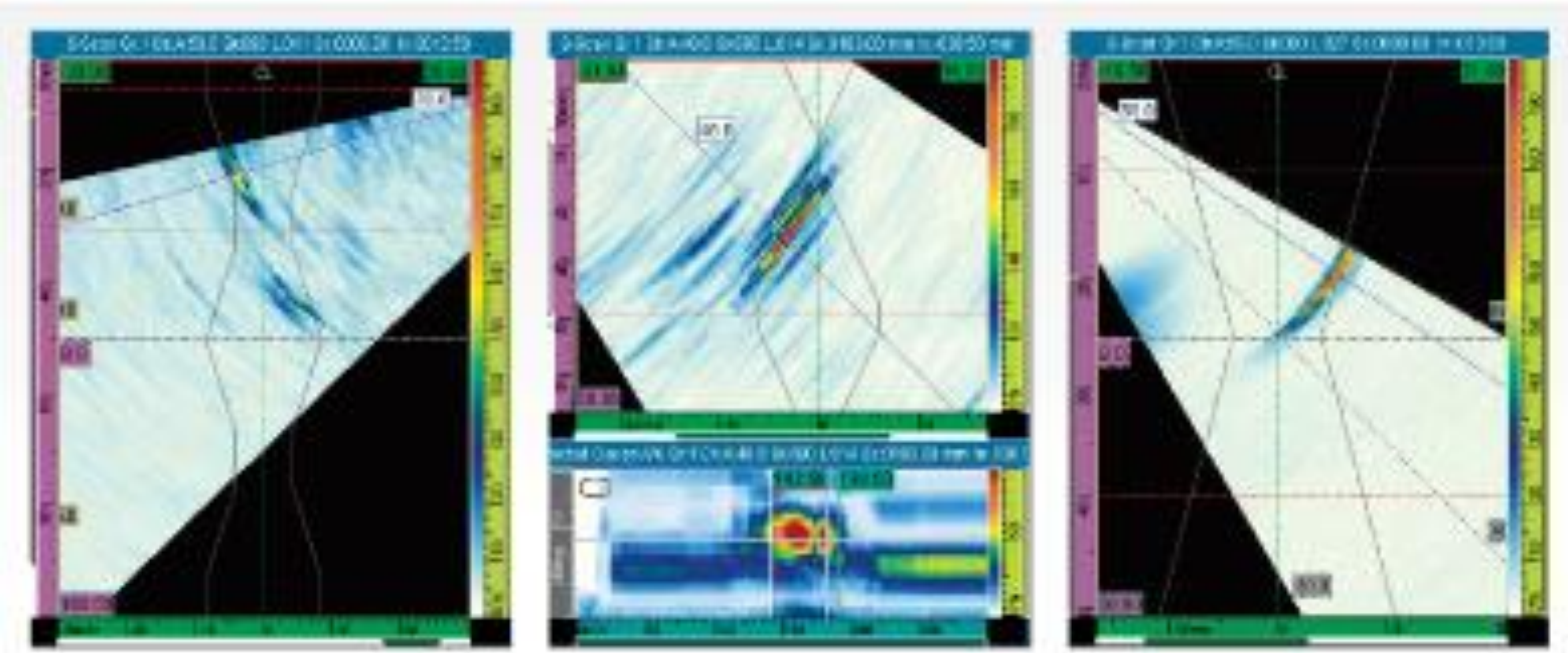


Here is an example of sound path of a phased array unit compared to conventional ultrasonics.

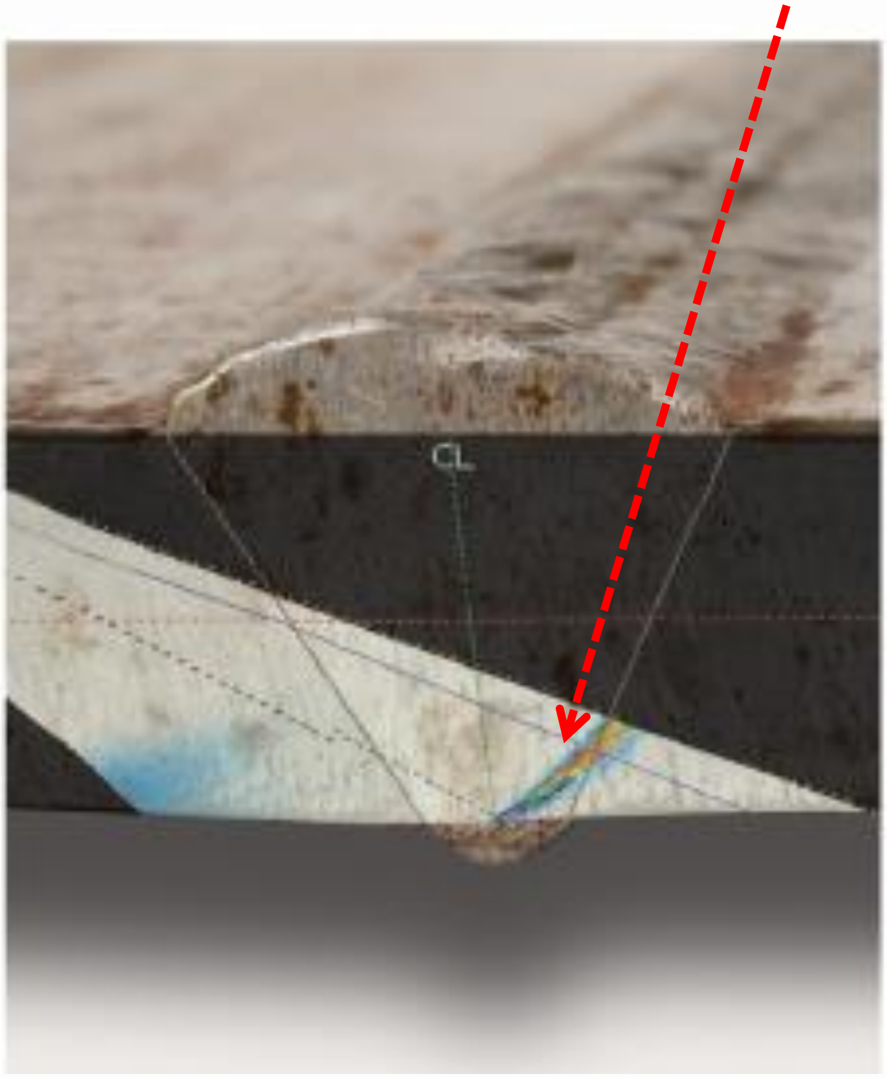


Phase Array Testing

Multiple angle scans with beam steering and sweeping can be performed from the same probe configuration providing full images of the areas tested. The combination of multiple angles also helps to identify, discriminate and size complex damage mechanisms.



Sectorial Scan overlay showing a crack indication



Advantages of Phased Array

The benefits of phased array technology over conventional UT come from its ability to use multiple elements to steer, focus and scan beams with a single transducer assembly. This can greatly simplify the inspection of components with complex geometry.

Inspection of such where there is limited access for mechanical components in situations scanning. Sectorial scanning is also typically used for weld inspection.

The ability to test welds with multiple angles from a single probe greatly increases the probability of detection of anomalies, defect location, also improves the ability for sizing critical defects for volumetric inspections.

What can we add to this inspection ?

Pulsed Eddy Current Test (PECT)

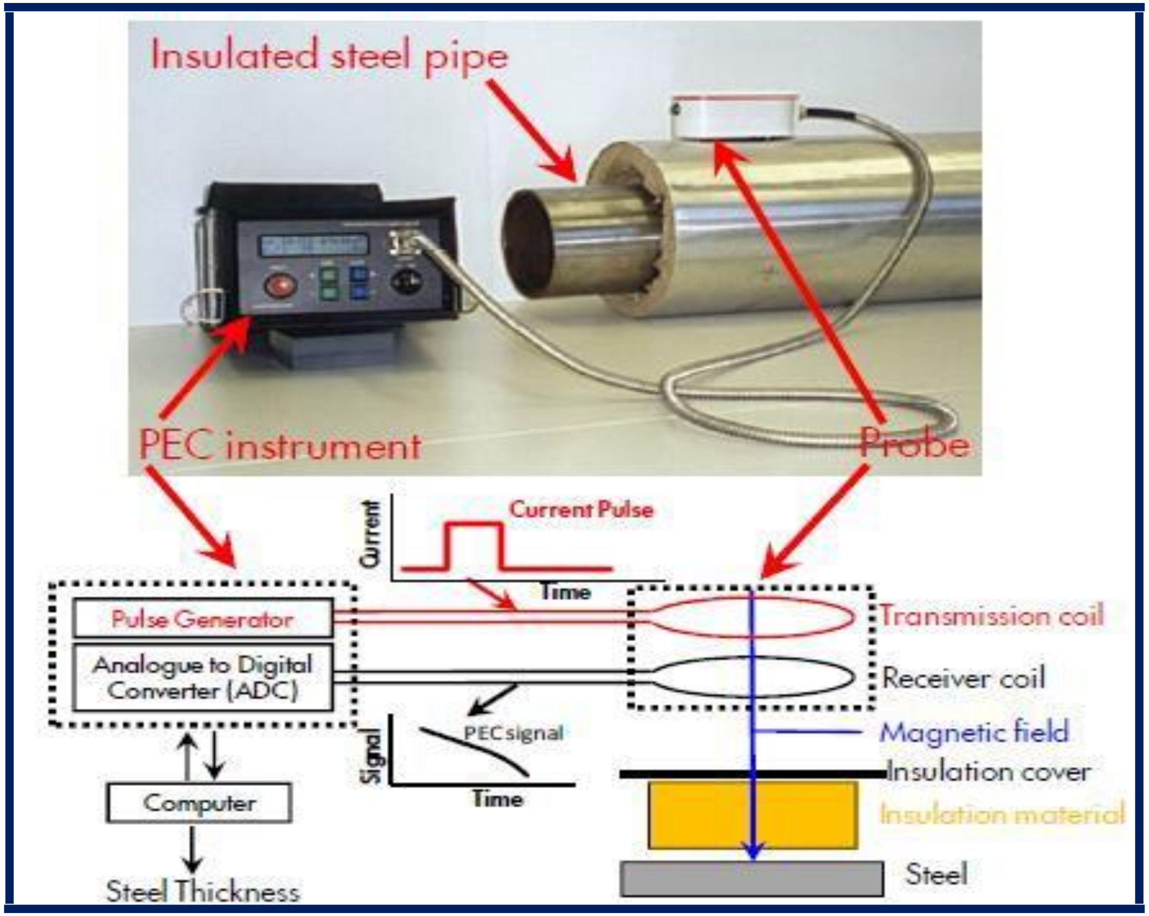
It is a common practice to use Pulsed Eddy Current testing to determine and quantify the presence or absence of corrosion under the fireproofing on the sphere legs.

What can we add to this inspection ?

<u>Pulsed Eddy Current Test (PECT)</u>

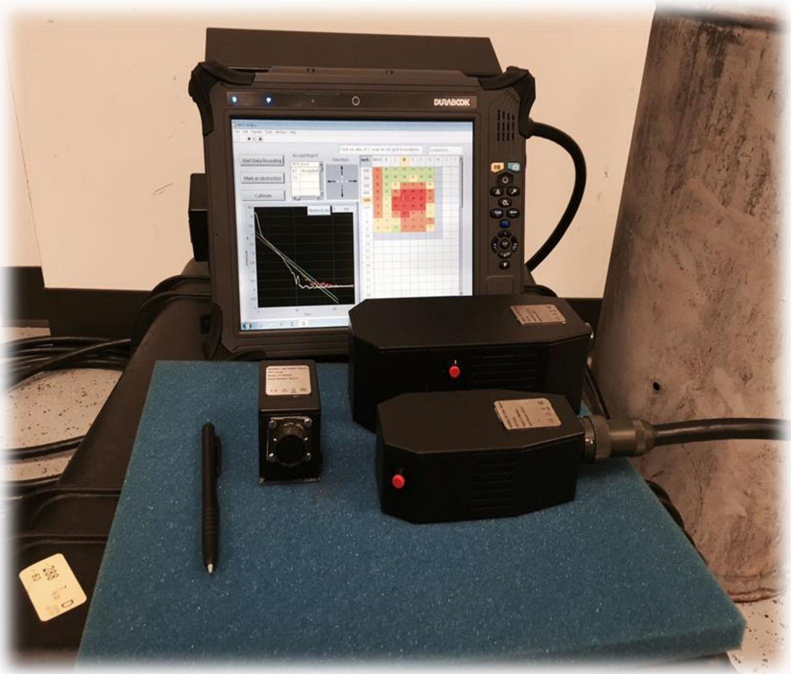
PECT is an inspection technique for inspecting carbon steel objects, such as pipes and vessels, without the need for contact with steel surface. PEC can measure percentage variations in steel thickness through any non-conductive and non-magnetic material between sensor and steel surface such as air, insulation material, concrete, plastics, coatings, paint, sea water, marine growth deposits, oil etc.

PECT


Insulated steel pipe
PEC instrument
Probe
Current Pulse
Current
Time
Pulse Generator
Analogue to Digital
Converter (ADC)
Transmission coil
Receiver coil
Magnetic field
Insulation cover
Insulation material
Steel
PEC signal
Signal
Time
Computer
Steel Thickness

PECT

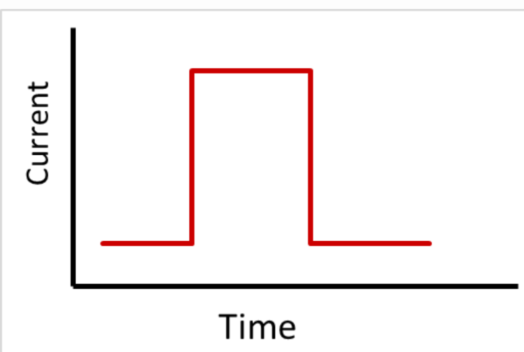
Measures Steel thickness through insulation



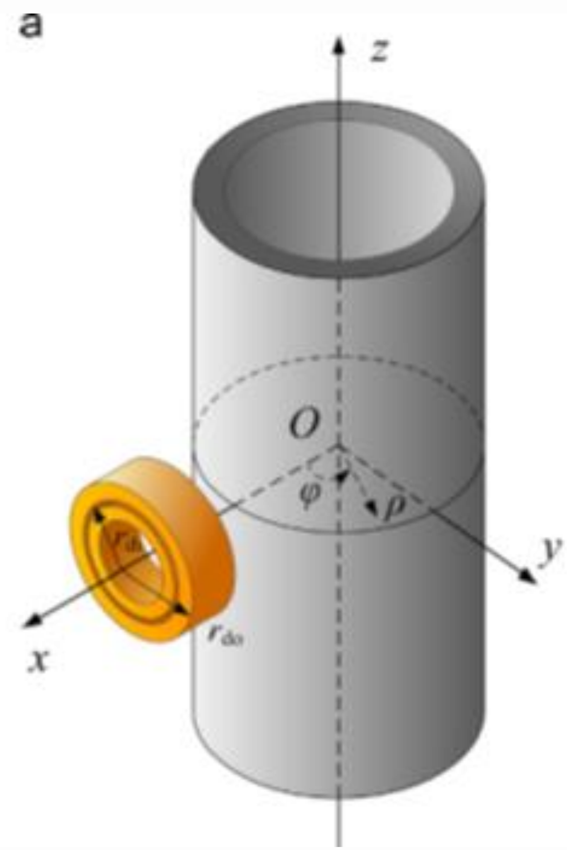
PEC instrument developed by Shell

PEC instrument developed by Maxwell NDT

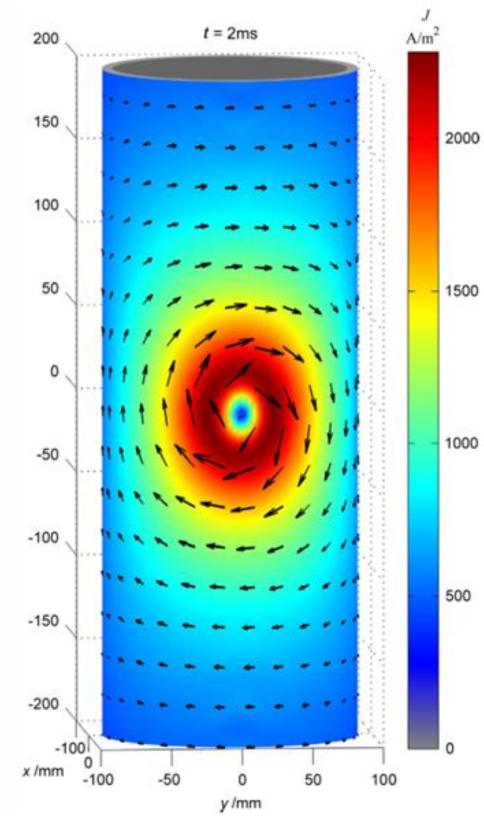
Principle of Pulsed Eddy Current Testing:
Step 1: induce eddy currents in steel with a pulsed magnetic field



Pulsed electrical current transmission coil of probe



Carbon steel pipe



Induced electrical current

Principle of Pulsed Eddy Current Testing:
Step 2: Measure time it takes for eddy currents to diffuse in steel

First in time

Top

Bottom

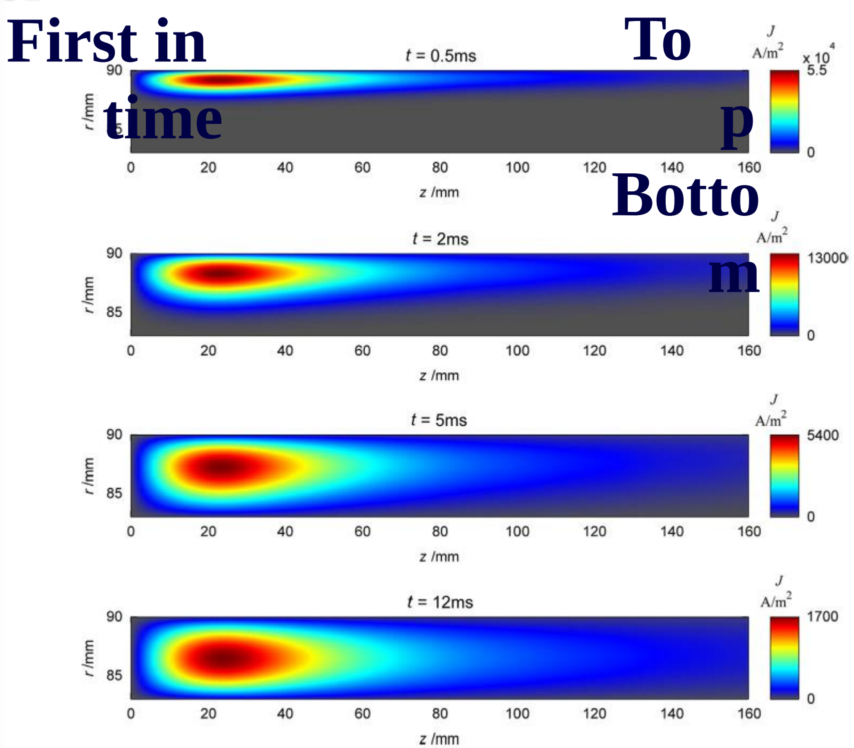
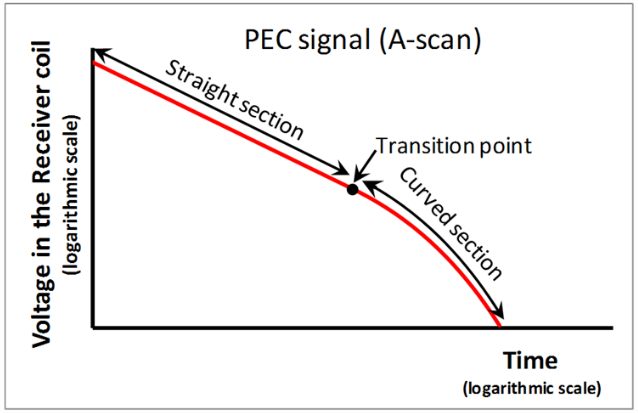
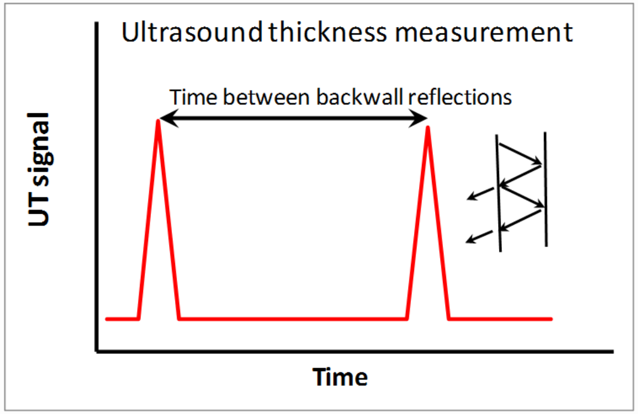


Fig. 8. The diffusion process of the pulsed eddy current density in the cross section of (φ=0, $z \geq 0$).

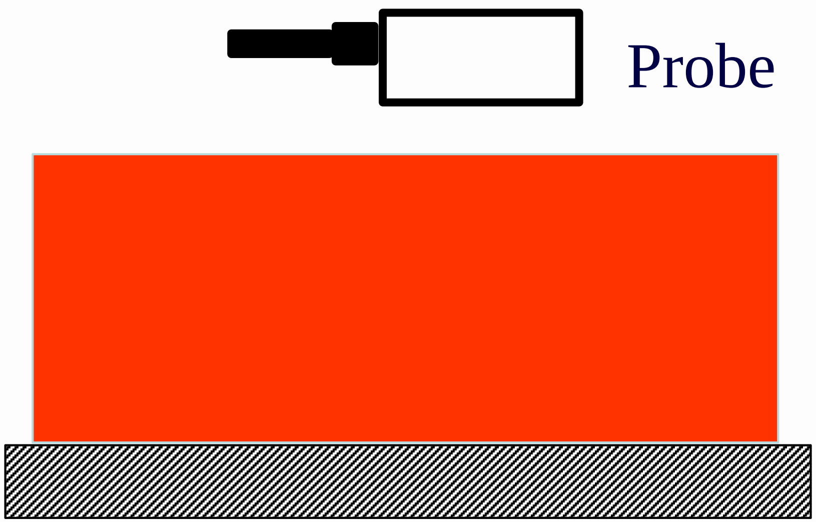
Last in time





Determine steel thickness from diffusion time

Main benefit of PECT: can measure through most materials

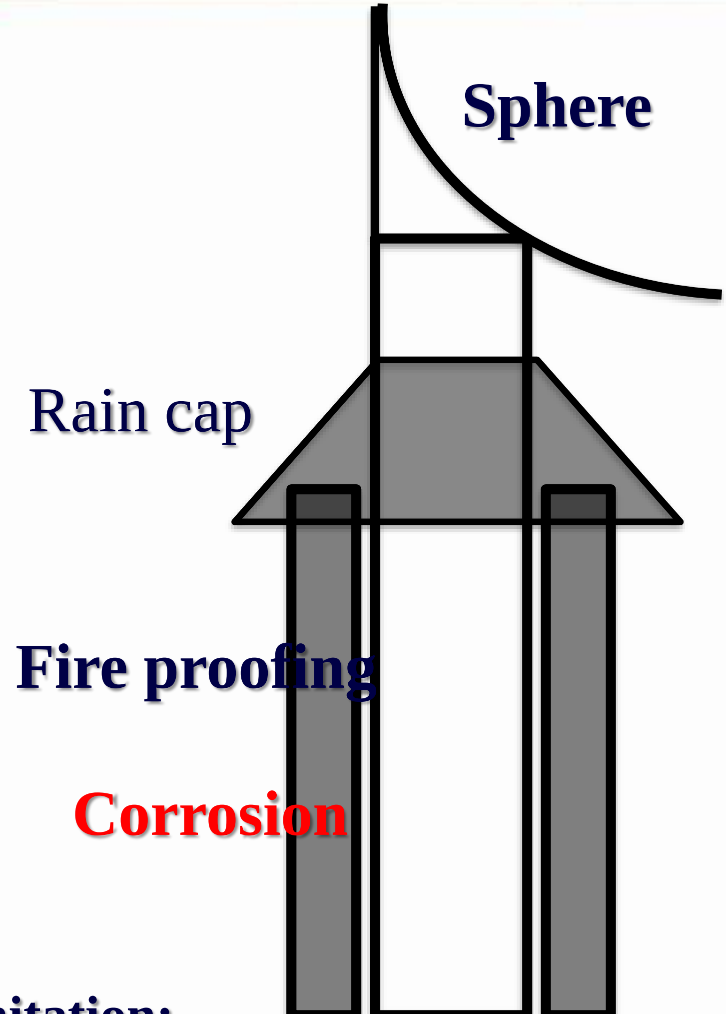


Material between probe and steel:
insulation material, chicken wire, straps, concrete,
re-inforcement bars, corrosion product,
sea water, marine growth, bitumen, etc.

Restrictions:

1. **Loose chicken wire**
   (rarely observed in insulated equipment, when insulation seriously deteriorated)
1. **Galvanised insulation covers**
   (performance depends on properties insulation covers)
2. **Close to supports and flanges**
   (requires special precautions during the inspection)

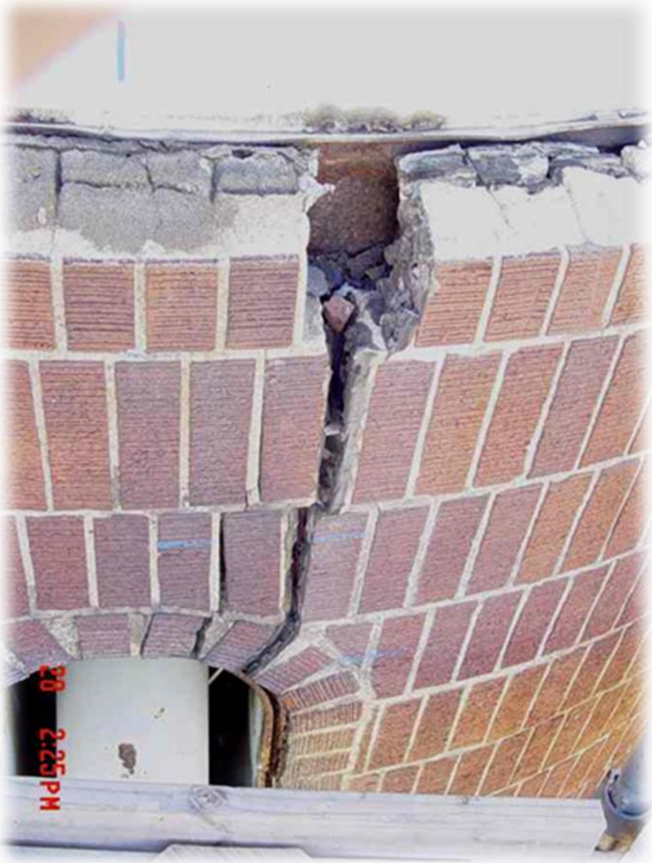
Corrosion under fireproofing



Root cause: water ingress
at rain caps and cracks in fireproofing

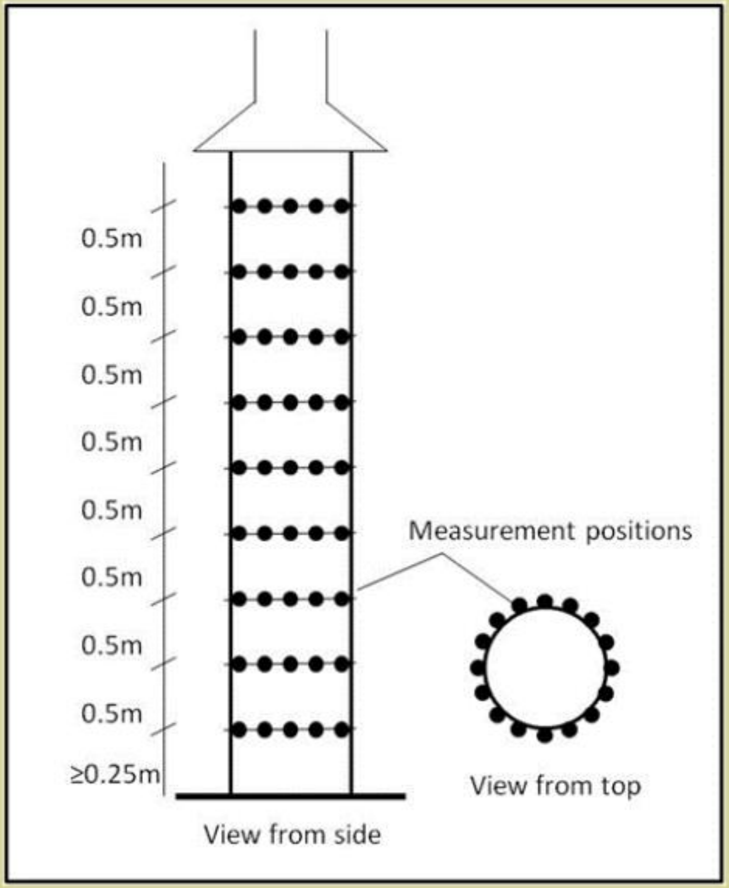
Note: footprint averaging no longer a limitation;
load-bearing structure

Water ingress: deflector not large enough and cracks



PEC inspections of sphere legs: scaffolding, poles & cherry pickers

Typical Distribution of PECT Readings on a Sphere Leg



Percentage wall thickness reading on a Sphere Leg

TOP SIDE END

Distance Between two Points is 0.1 m (positions 12 to 21)

Distance Between two Point is 0.5 m (positions 1 to 12)

GROUND SIDE END

Vertical Position	Circumferential Position at 90 Degrees			
	A	B	C	D
21	83.0	87.4	88.1	90.4
20	85.3	88.6	87.9	84.5
19	80.9	81.8	83.0	81.0
18	81.8	82.2	80.1	82.9
17	80.9	85.9	98.6	80.8
16	99.1	99.6	99.7	96.1
15	93.5	99.7	100.3	95.0
14	89.1	98.1	98.8	100.0
13	90.4	100.9	98.9	93.2
12	88.8	104.4	100.9	97.1
11	90.0	97.9	93.5	96.6
10	90.4	102.2	98.1	93.2
9	89.2	100.8	101.7	93.4
8	92.5	99.0	101.6	90.9
7	99.3	94.9	100.0	101.1
6	97.2	95.1	95.5	95.2
5	95.2	97.3	102.1	97.1
4	100.9	98.3	99.3	96.2
3	94.5	93.3	101.5	97.0
2	92.6	97.0	95.1	92.8
1	95.5	96.7	99.4	91.9

	Remaining WT
	> 110 %
	90 To 110 %
	85 To 90 %
	80 To 85 %
	75 To 80 %
	70 To 75 %
	65 To 70 %
	60 To 65 %
	55 To 60 %
	0 To 55 %