MEC™ TANK FLOOR INSPECTION

Client: Client a

Facility: site b

Items Inspected: Tank c

Inspection Method: MEC™

Commencement Date: 23rd May 201x

Completion Date: 24th May 201x

Type of Report: Final Report

Report Number: K0xx-1xx

Job Number: J20xx

MEC^{TM} TANK INSPECTION REPORT

(F-15)

Executive Summary

Innospection Ltd was requested by Client a to perform a Magnetic Eddy Current (MEC™) inspection, on the floor plates of tank c.

The inspection was conducted at the Client's site from the 24th May 20xx and completed on 25th May 20xx.

This inspection report documents in detail the specific inspection that has been conducted; the individual techniques and equipment utilised, and the results and observations.

Minor topside general pitting was evident; this appears to have occurred prior to the painting of the tank floor and the lower shell wall. The paint coating was found in a good condition on the tank-floor.

No significant defect indications were detected during the inspection.

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Appendix 4 : Ultrasonic Report

1. Test Object Data

Object Identification :   Tank c

Location of Object :   Site b

Wall Thickness :   Nominal 8.00 mm

Material :   Carbon Steel

Surface Condition :   Painted, generally clean and free from loose debris.
Minor general topside pitting evident.

2. Inspection Task

As requested by Client a MEC™ inspection was performed on the Tank floor plates of Tankk c, located site b from the 24th May 20xx to the 25th May 20xx.

The inspection was performed with a MEC™ technology scanner, type MEC™.

MEC™ is the next generation and further development of SLOFEC™ (**S**aturation **Lo**w **F**requency **E**ddy **C**urrent), which is regarded as a fast corrosion screening technique for the detection of corrosion on either side of the inspected tank floor and under the coatings.

The inspection team consisted of qualified engineers from Innospection Ltd.

All areas described in Section 4 – Inspection Volume were inspected with the MEC™ scanner.

The inspection was carried out as a general inspection during the plant shutdown.

3. Inspection Personnel

Inspection Operator :   Technician a
PCN level 2 ET and UT PCN 000000

Inspection Assistant :   Assistant a
PCN Level 2 ET 000000

4.   Inspection Volume

All accessible areas on the bottom of the tank-floor were targeted for inspection.

No welded areas were subjected to inspection.

In the attached scan reports, the scanner areas are displayed with its coloured condition images.

The dead zones for this inspection were approximately 150 mm in width; this was only applicable around the sump and pipework or corners of the plates. These areas were covered by a manual pulse echo Ultrasonic inspection technique.

5.   Inspection Equipment

5.1.   Equipment

The inspection system consisted of the following MEC™ equipment and accessories:

Scanner :	MEC™ F-15 Scanner (width 300mm)
Description of Scanner :	The MEC™ F-15 Scanner is a motorised scanner system consisting of a permanent magnet for magnetisation and multiplexed electronics. Eight (8) sensors each with a width of 35mm are located between the poleshoes. A trigger encoder is utilised
Scanning Speed :	50% (approx. 24m/min)
Eddy Current Instrument :	IBM-AT-compatible computer with 2-frequency Eddy current plug-in cards Type : Acer Serial No.NXV4NEK011219050BF2000
Eddy Current Sensors :	8 x EC-B-35 mm
Software Version :	Innospectit Software
Cable :	60 metres of specific cable connection, divided in 2 x 30m
Reference Plate :	8mm from Innospection, Serial No. 158
Reference Defect :	20%, 40%, 60%, 80% FBH

5.2. Ultrasonic Equipment

The Ultrasonic equipment consisted of the following accessories:

Silver Wing D-scan 701 Ultrasonic Flaw Detector
Serial No: l001224

Capable of both "A" scan display and digital thickness readout
7.5 MHz 10mm Ø twin crystal transducer
2mm – 12mm carbon steel calibration step wedge.

6. Equipment Setting

In general, the MEC™ system is calibrated using sample test samples with artificial reference defects. The reference samples should be of the same material and thickness as the surface to be inspected.

In the case of a coating being present on the surface to be inspected, the average thickness of the coating (if applicable) should also be simulated on the reference sample for the calibration.

Typical reference defects that are used are flat bottom holes or conical bottom holes having a diameter of 5mm, 10mm and 20mm.

The depths of the artificial reference defects are typically 20%, 40%, 60%, 80% and 100%.

For calibration, the system is driven over the reference defects and the channels are set (one sensor per channel) to give a sufficient sensitivity level for the detection of underside and topside corrosion defects.

The calibration is performed at the beginning, after breaks, at the end of every shift and when significant changes are made to the settings of the equipment.

The calibration results and reference defect data from the calibration sample is always stored in the system.

The Eddy Current signal analysis is done online. The computerised equipment and the software allow the analysis of the signal amplitude [in div.] and signal phase [in °].

In discussion with the individual client, indications comparable with the reference defect indications can be marked on the floor and are usually recommended to be re-inspected by Ultrasonic (UT) examination.

7. Equipment Calibration

7.1. Equipment Calibration

For internal corrosion detection, the differential mode was used. Optimum signal / noise ratio and signal phase separation between the internal defect indications and other indications were considered when selecting a suitable test frequency.

The differential channels of all the sensors were set so that internal defects were indicated in the vertical signal phase direction as shown in the diagram below. By moving the scanner in the positive forward direction, the internal defect signal would show the first peak down, followed by the second peak up with an upward movement.
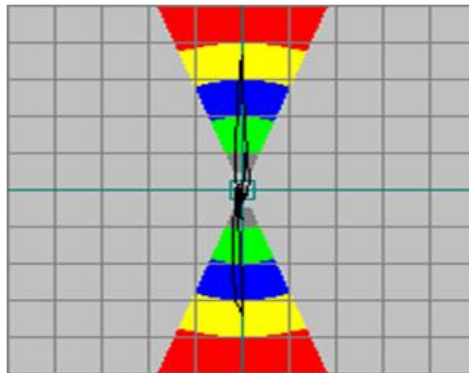
Sample signal display of internal defect

7.2. Calibration Control

The general setting and calibration was performed at the beginning of the inspection and all the calibration data was stored digitally. Calibration controls were performed at the beginning and end of each working shift as well as after any other significant interruption (i.e. breaks or lunch). Re-calibration is also deemed necessary when significant changes are made to the settings of the equipment.

Calibration samples are used for the initial set-up and for the random check of operator's settings.

Full and accurate sensitivity settings are achieved only when the first indication found on the object undergoing the test is verified by an UT operator with the corresponding depth of indication and MEC™ sensitivity being adjusted accordingly.

7.3. Calibration Samples

The calibration samples are manufactured by Innospection Ltd in accordance to the setting standard requirements.

7.4. Change of Settings

In the event of any scanner adjustment, re-calibration is performed.

8. Inspection Procedures

The inspection was performed according to the following valid procedure:

MEC™ Tank Procedure No. InnoTMECTNK-001-15 – MEC F15 – Current
and Inno-UTSL-001-12-Current

9. Inspection Performance

9.1. Scanner Movement

The scanner assistant, who was in permanent communication with the MEC™ operator, was responsible for positioning and moving the scanner on the pipe surface. The MEC™ F-15 Scanner is marked clearly on the top with the FORWARD and BACKWARD directions so that all scan directions are made clear to the operator and assistant at all times.

The scanner was moved manually with the scanned tracks being overlapped at all times. All scans for the inspection were recorded in the forward position.

9.2. Scan Track Positioning

Between the MEC™ engineers, a clear description of the track position was established.

9.3. Parameter Storage

The Eddy Current testing parameter was set during the calibration and digitally stored according to the scan direction and lift off.

10. Defect Analysis

All indications which showed a clear signal phase direction similar to that of the reference defects and had signal amplitude equivalent to that of the test piece were subjected to analysis.

Signals that are clearly out of the corrosion phase direction were not reported.

11. Comments to Inspection

Tank c had good access and egress due to the scaffolding/habitat constructed outside the manway. It was relatively clean and free from loose debris, requiring only a light sweeping due to scale falling from the upper shell course, and a good signal to noise ratio evident throughout the inspection.

12. Result Overview

12.1. Sensitivity Settings

The general overview of the inspected areas with the results is presented in the attached colour scan reports with wall loss being represented in colour classes as shown in the Wall Loss Legend below:
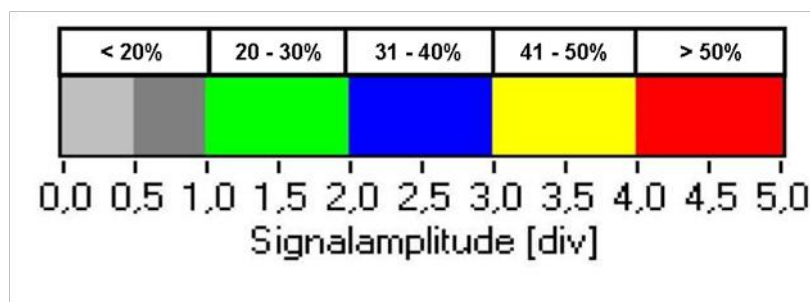
Below 20% wall loss	-	Grey
20-30% wall loss	-	Green
31-40% wall loss	-	Blue
41-50% wall loss	-	Yellow
Above 50% wall loss	-	Red

Note

Eddy Current inspection is an evaluation method of NDT; hence all results obtained are based upon the test piece used. Material and wall thickness of the test piece should be as near as reasonably practicable to the item under inspection. Artificial defects should be as near in size and shape as to the type sought.

Because MEC™ signal amplitudes are an indication of defect depth and volume, the defect depth analysis by signal amplitude can only be done in comparison with artificial reference defects having varying depths.

12.2. Result Overview

All inspections scans are shown in Appendix 2 and the Ultrasonic wall thickness readings are shown in Appendix 3. A summary of the inspection findings in each of the scanned section is given below.

Summary of inspection finding

Total number of plates   : 2
Total number of plates inspected   : 2
Number of damaged plates   : 0

Number of plates identified with main indications on underside of tank floor

Below 20% wall loss   : 0 plates
20% - 30% wall loss   : 0 plates
31% - 40% wall loss   : 0 plates
41% - 50% wall loss   : 0 plates
Above 50%wall loss   : 0 plates

Number of plates identified with main indications on topside of tank floor

Below 20% wall loss   : 1 plates
20% - 30% wall loss   : 0 plates
31% - 40% wall loss   : 0 plates
41% - 50% wall loss   : 0 plates
Above 50%wall loss   : 0 plates

13. Inspection Summary

Minor topside, general pitting was evident; this appears to have occurred prior to the painting of the tank floor and lower shell wall.

Paint coating was in good condition on the tank floor.

No significant defect indications were detected during the inspection, several minor indications were observed in a close proximity to the circumferential weld and either side of the central weld seam. These were marked up and inspected with ultrasound.

The ultrasound inspection confirmed no significant wall loss in any of these applicable areas, deeming the results from the MEC™ to be over-sensitive; hence the settings were adjusted and modified accordingly.

14. <u>Documentation</u>

The inspection result, parameters and data are stored in the Innospection Limited archive database system.

15. <u>Signature</u>

_____

Name: Technician a
Title: Inspection technician
Innospection Limited

_____

Name: Senior Engineer
Title: PCN Level 3 Senior Engineer
Innospection Limited

APPENDIX 01

Tank Floor Plate Layout

Tank c

Tank Floor Plate Layout

B1

B2
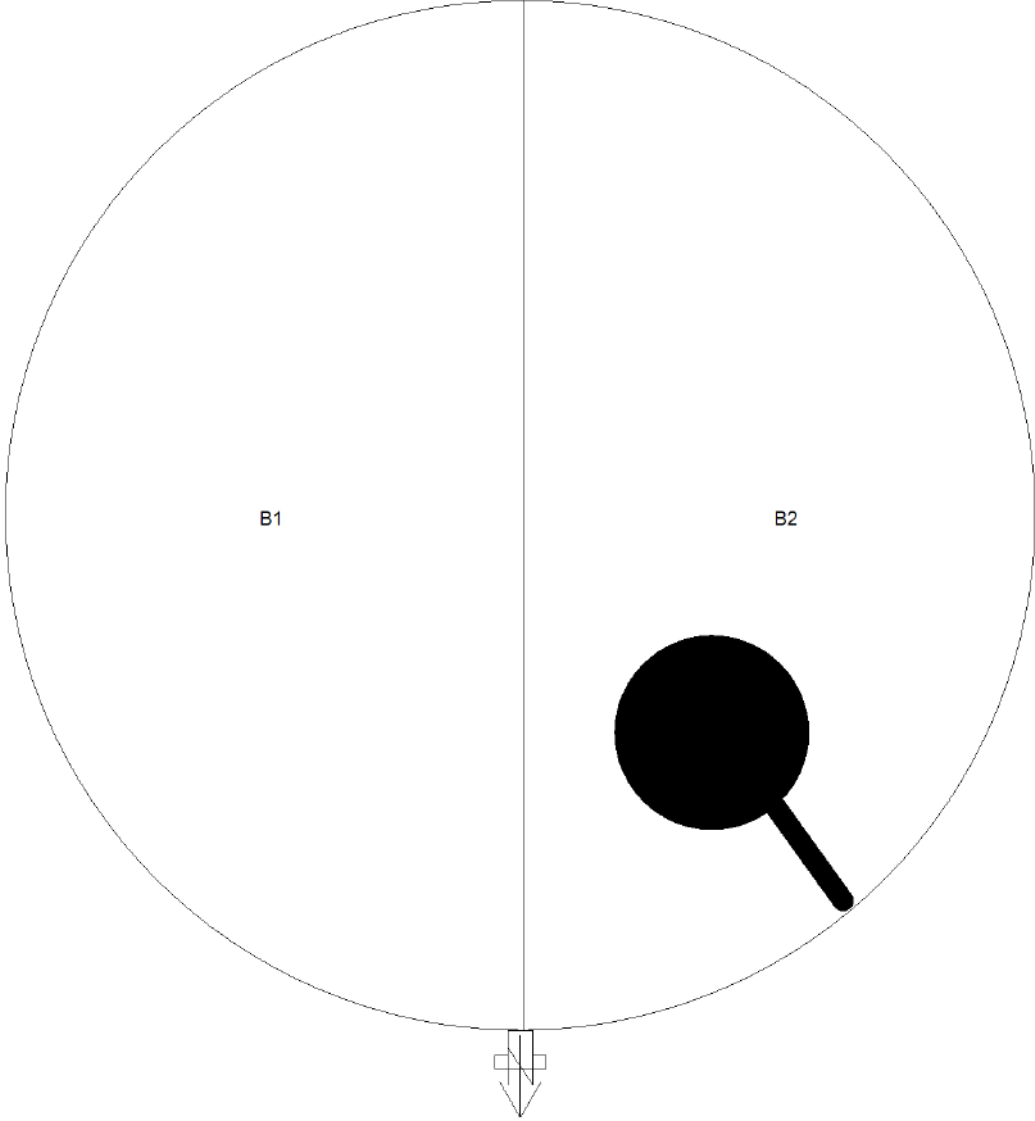
APPENDIX 02

Underside Condition Report

Tank c

Overview of Scan Results

Underside View
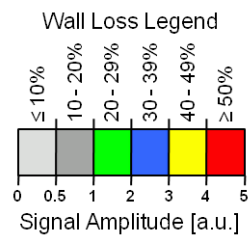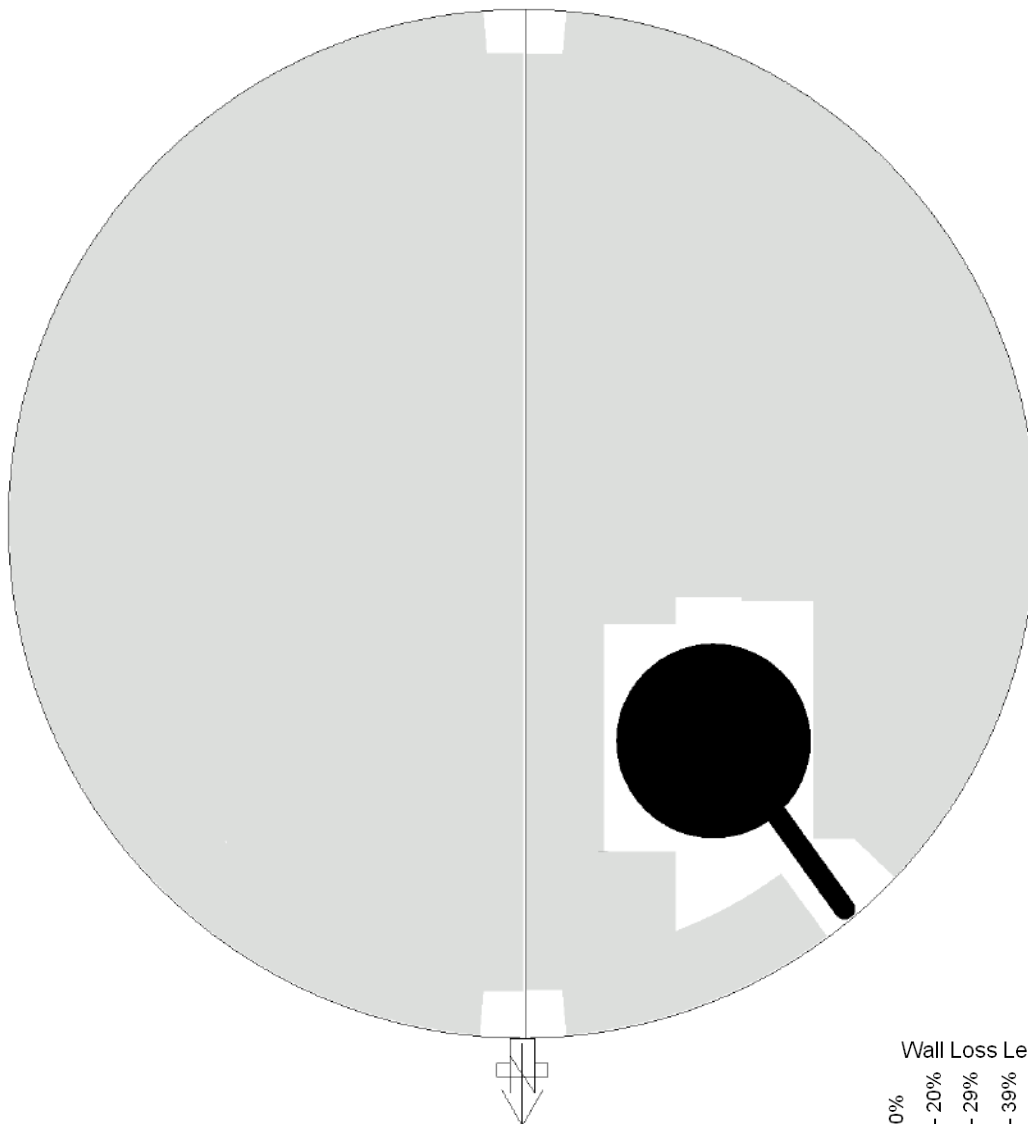
Wall Loss Legend

| ≤ 10% | 10 - 20% | 20 - 29% | 30 - 39% | 40 - 49% | ≥ 50% |

Signal Amplitude [a.u.]

Scan Results Bottom Plate B1

Bottomside View

Remarks:
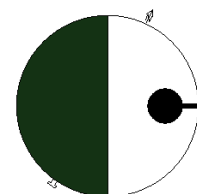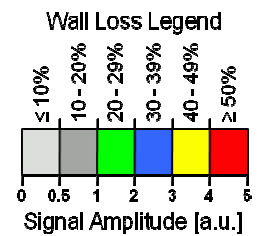
No.	Pos. x [m]	Pos. y [m]	Depth [%]	Type

Wall Loss Legend

Signal Amplitude [a.u.]

Scan Results Bottom Plate B2

Bottomside View

Remarks:

No.	Pos. x [m]	Pos. y [m]	Depth [%]	Type

Wall Loss Legend

Signal Amplitude [a.u.]
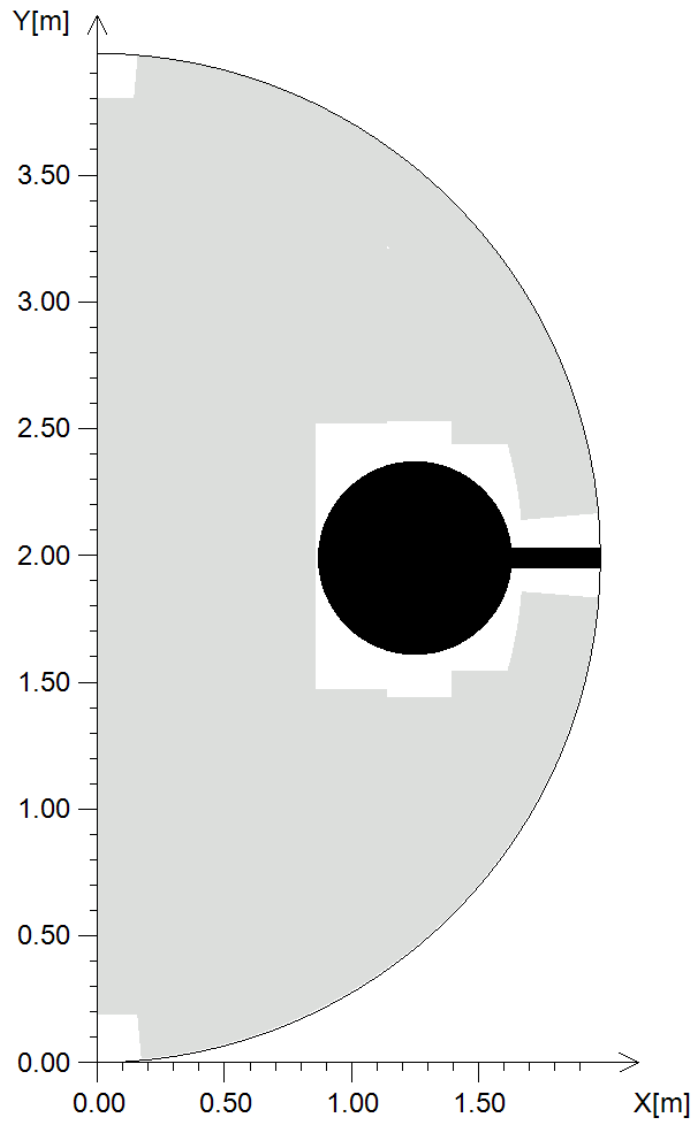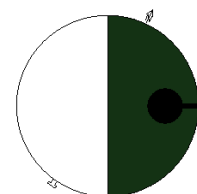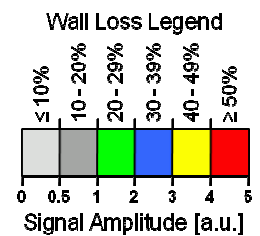
APPENDIX 03

Topside Condition Report

Tank c

Overview of Scan Results

Topside View
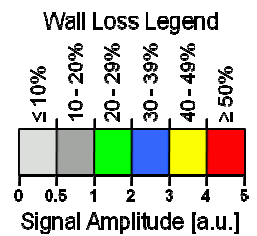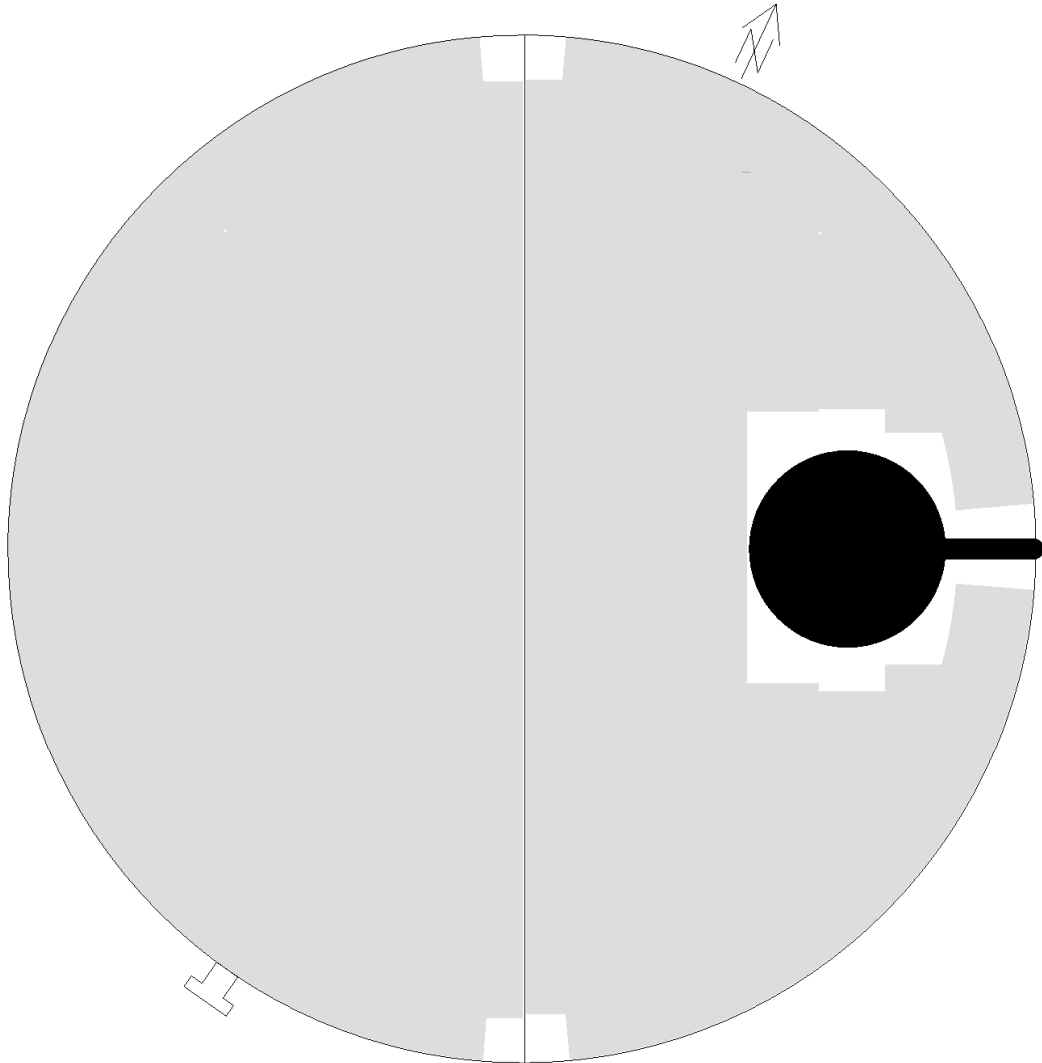
Wall Loss Legend

≤ 10%	10 - 20%	20 - 29%	30 - 39%	40 - 49%	≥ 50%

0 0.5 1 2 3 4 5

Signal Amplitude [a.u.]

Scan Results Bottom Plate B1

Topside View

Remarks:
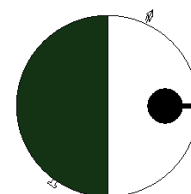
No.	Pos. x [m]	Pos. y [m]	Depth [%]	Type

Wall Loss Legend

Signal Amplitude [a.u.]

Scan Results Bottom Plate B2

Topside View

Remarks:

No.	Pos. x [m]	Pos. y [m]	Depth [%]	Type

Wall Loss Legend

Signal Amplitude [a.u.]
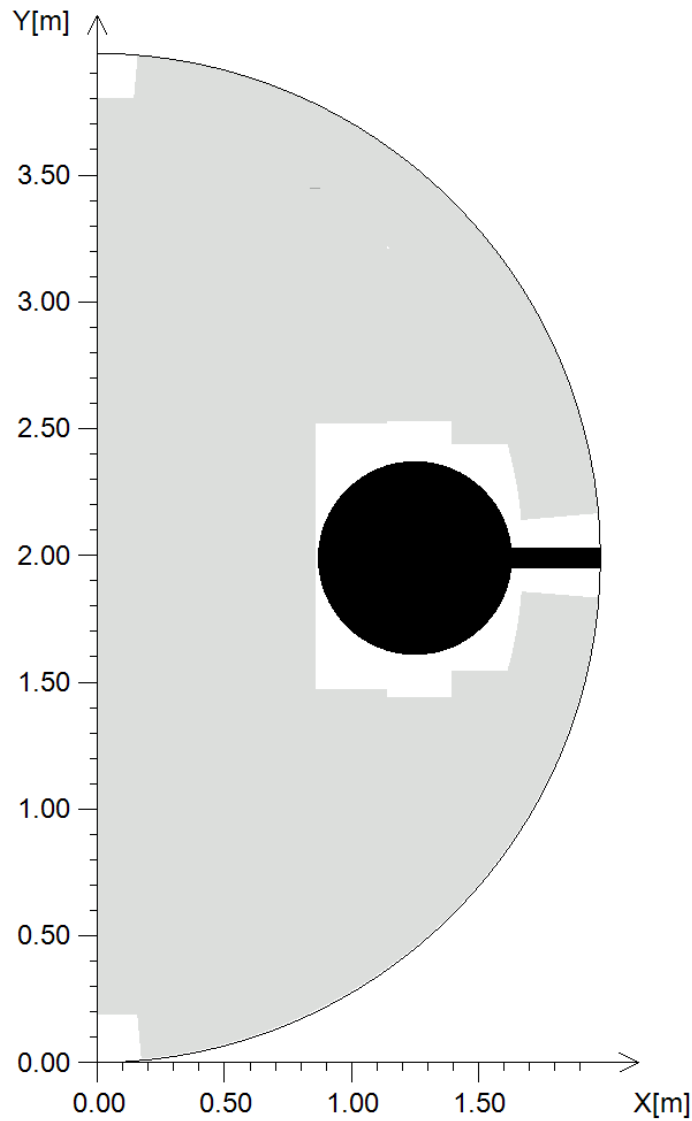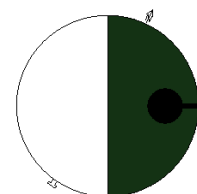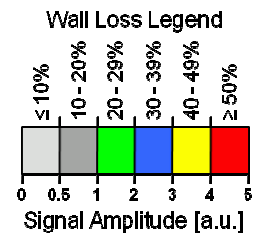
APPENDIX 04

Ultrasonic Report

Tank c

Ultrasonic Scan Results Plate B1
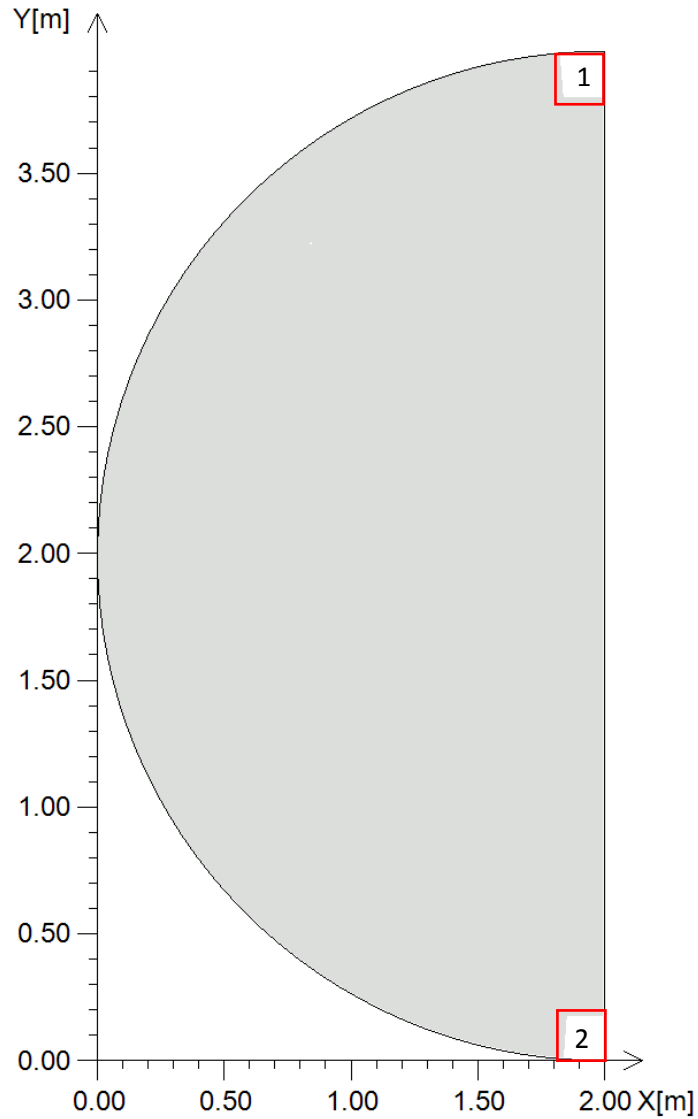
Remarks: 150mm x 150mm areas marked and scanned with UT. Lowest wall remaining reading in each square recorded.

No.	Pos. x [m]	Pos. y [m]	Depth [mm]	Type
1			8.2	Nominal wall
2			8.1	Nominal wall

Scan Results Plate B2
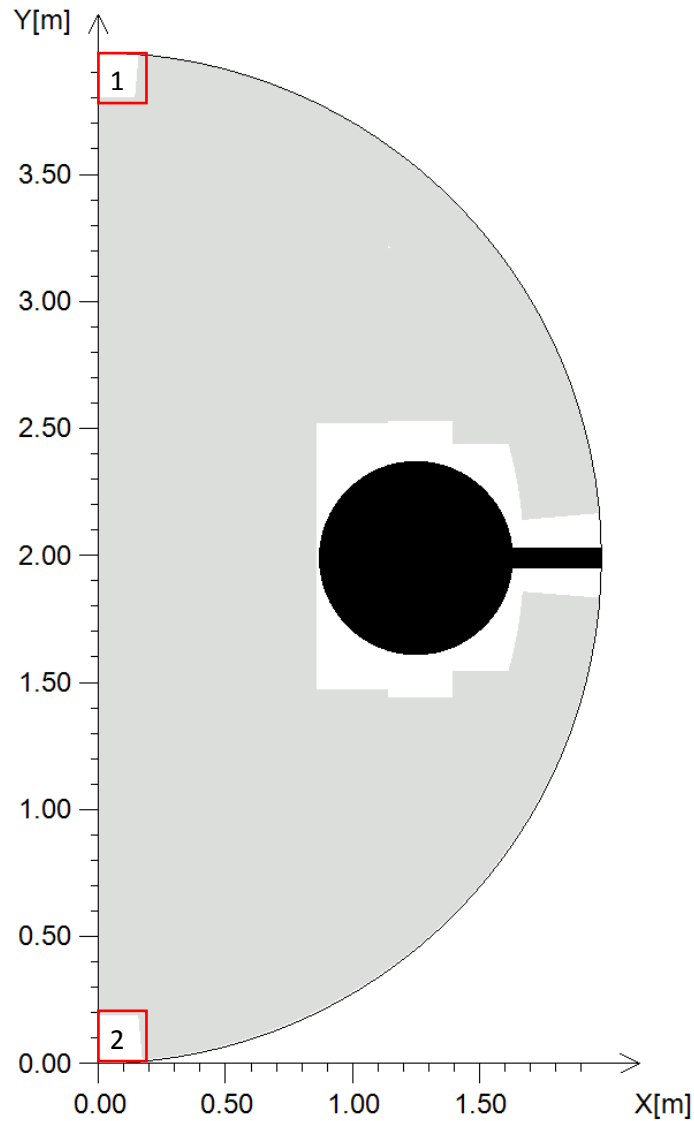

Remarks: a Maximum area of 150mm x 150mm was marked and scanned with UT. Lowest wall remaining reading in each square recorded.

No.	Pos. x [m]	Pos. y [m]	Depth [mm]	Type
1	0	2	8	Nominal wall
2	0	0	8.1	Nominal wall

Ultrasound Scan Results Plate B2

Remarks: a Maximum area of 150mm x 150mm was marked and scanned with UT. Lowest wall remaining reading in each square recorded.

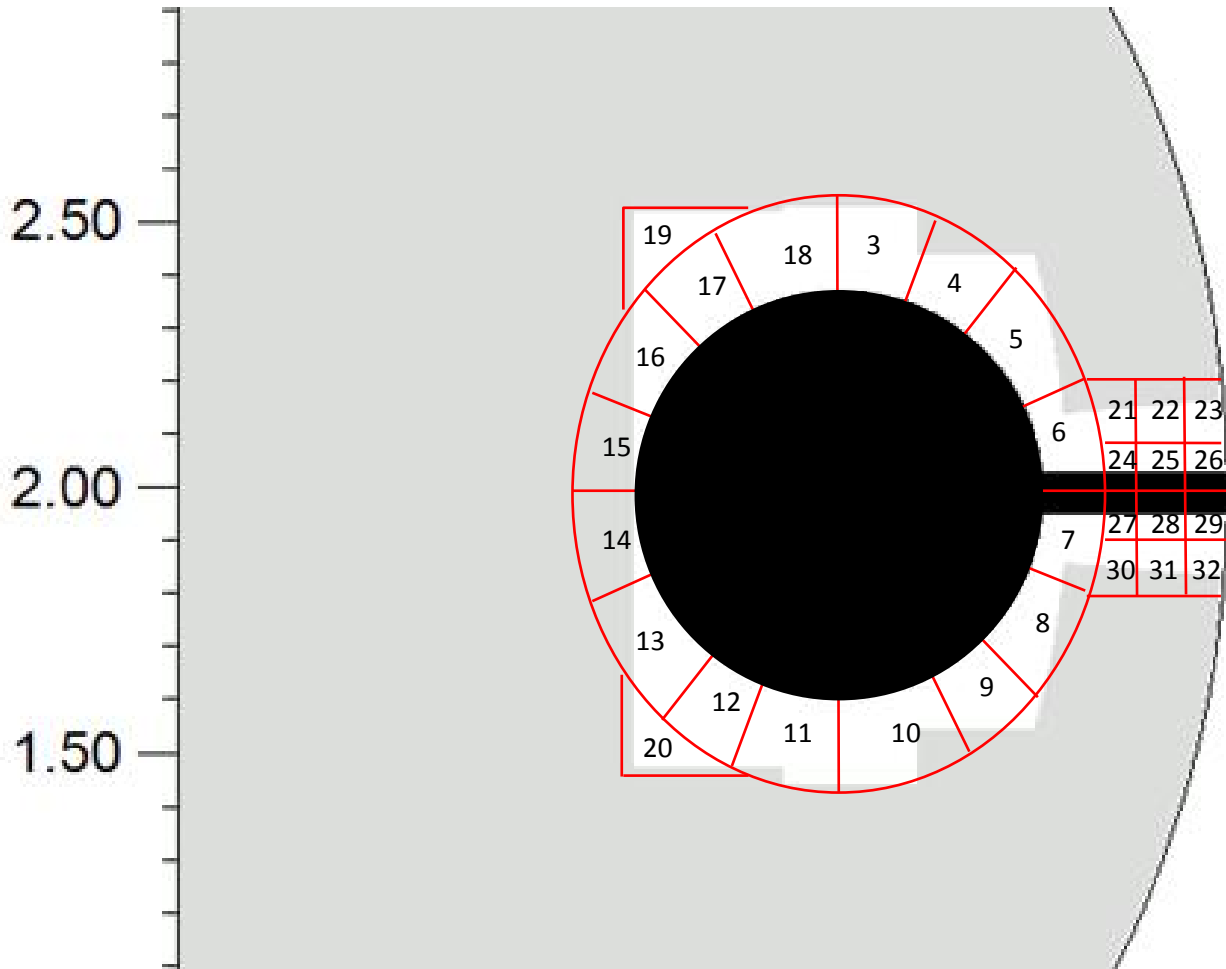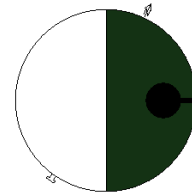| No.	Pos. x [m]	Pos. y [m]	Depth [mm]	Type
3			8	Nominal wall
4			8	Nominal wall
5			7.9	Nominal wall
6			8.1	Nominal wall
7			8.1	Nominal wall
8			7.9	Nominal wall
9			8	Nominal wall
10			8.2	Nominal wall
11			8.1	Nominal wall

Client a	Ultrasonic Inspection Report	Report No K0xx-1xx	innospection
site b	Tank c	24/05/20xx	

No.	Pos. x [m]	Pos. y [m]	Depth [mm]	Type
12			8	Nominal wall
13			7.9	Nominal wall
14			7.9	Nominal wall
15			8.1	Nominal wall
16			8	Nominal wall
17			8	Nominal wall
18			8.1	Nominal wall
19			8.1	Nominal wall
20			8.2	Nominal wall
21			8	Nominal wall
22			8	Nominal wall
23			7.9	Nominal wall
24			8	Nominal wall
25			7.9	Nominal wall
26			7.9	Nominal wall
27			7.9	Nominal wall
28			8	Nominal wall
29			8.1	Nominal wall
30			7.9	Nominal wall
31			8	Nominal wall
32			8.2	Nominal wall