EXTERNAL TANK INSPECTION REPORT

{company\_name}

{terminal}

{tank\_no}

{overview\_pic}

{insp\_date}

REPORT NO. {report\_no}

INSPECTED BY

A picture containing text, device, gauge

Description automatically generated

Dexon Technology PLC

|  |  |
| --- | --- |
| 78/4-5 Moo 6, Sukhumvit Road  Ban Chang, 21130 Rayong  Thailand | Tel: 033-012-484-7  Fax: 033-012-530 |

INSPECTION TEAM

|  |  |  |
| --- | --- | --- |
| 1. |  |  |
| 2. |  |  |
| 3. |  |  |
| 4. |  |  |

|  |  |
| --- | --- |
| ชื่อผู้ประกอบการ | {company\_name} |
| ที่ตั้งสถานประกอบการ | {site\_name} {location} |
| หมายเลขถังเก็บน้ำมัน | {tank\_no} |
| วัน/เดือน/ปี ที่ทดสอบและตรวจสอบตามวาระ | {insp\_date} |
| ผู้ทดสอบและตรวจสอบ (บริษัท) | Dexon Technology PLC |
| หัวหน้าวิศวกรทดสอบ |  |

รายละเอียดของถังเก็บน้ำมันหมายเลข

|  |  |
| --- | --- |
| เส้นผ่านศูนย์กลาง (เมตร) | {diameter\_m} |
| ความสูง/ยาว (เมตร) | {tank\_height\_m} |
| ความจุถังเก็บน้ำมัน (ลิตร) | {tank\_capacity\_litre} |
| ชนิดของน้ำมัน |  |
| ประเภทของน้ำมัน |  |
| ชนิดของถัง |  |
| ชนิดของหลังคา | {roof\_type} |
| วัน/เดือน/ปี ที่เริ่มใช้ | {inservice\_date} |

ทดสอบและตรวจสองถังเก็บน้ำมันตามวาระ

| No. | Description | PASS | NOT PASS | Comments |
| --- | --- | --- | --- | --- |
| {#checklist\_by\_law\_i}{no} | {header\_content} | {#result}{Pass} | {NotPass} | {comments}{/result}{/checklist\_by\_law\_i} |

TANK INSPECTION CHECKLIST (FIXED ROOF)

| No | Anomalies | Severe | Moderate | Slight | Normal | Comments |
| --- | --- | --- | --- | --- | --- | --- |
|  | {#checklist\_by\_law\_ii}{header\_content} | | | | | |
| {#sub\_header}{no} | {subheader\_content} | {#result}{Severe} | {Moderate} | {Slight} | {Normal} | {comments}{/result}{/sub\_header}{/checklist\_by\_law\_ii} |

VISUAL INSPECTION

{#picture\_log}

| Overview | Close-up view |
| --- | --- |
| {overview\_pic} | {close\_up\_view\_pic} |
| Findings | Recommendation |
| {findings} | {recommendation} |

{/picture\_log}

SHELL PLUMBNESS

**Plumbness Evaluation**

The measurements were made 4 directions around the circumference of the tank for tank diameter 1-12 m. and 8 directions for tank diameter > 12 m.

Shape, rectangle, polygon

Description automatically generated

**Acceptance criteria per API 653:**

1. For FR and EFR, the maximum of out-of-verticality at the tank shell should not exceed 1/100th of the tank height.

2. For IFR, the maximum of out-of-verticality at the tank shell should not exceed 1/200th of the tank height.

Acceptable where St < S

Not acceptable where St > S

| Measurement Location | Bottom of Tank | Top of Tank | Deviation | | S - mm | St - mm | Result |
| --- | --- | --- | --- | --- | --- | --- | --- |
| {#plumbness} {eval\_location} | {bottom\_tank} | {top\_tank} | {deviation} | {in\_out\_ward} | {s\_value} | {st} | {result}{/plumbness} |

SHELL SETTLEMENT

**Tank Settlement Survey**

- There must be at least 8 settlement points. The maximum spacing of settlement point is 32 ft. (9.7536 m) around the circumference.

- Points shall be equally spaced around the tank shell. There must be at least 4 equally spaced diametrical measurements.

- Measurements can best be taken at (every) vertical weld (with equal distance) of bottom shell coarse.

- Count welds from entry manhole in CW direction.

- If there is no projection plate staff on top first strake.



**Datum Point Location**

Settlement surveys are in general not carried out on small diameter tanks because, due to less weight of the product, the tanks are less susceptible to developing issues with settlement. Several internationally used specifications specify to carry out settlement surveys only for tanks with a diameter bigger than 9.75 m. If API 653 acceptance criteria are calculated for small diameter tanks the acceptance range will be very tight due to the small arc length between measurement points.

The acceptance criteria as per API 653 for this tank was found to be unacceptable. The results were also compared to the European tank inspection standard EEMUA 159. When the settlement is compared to the European standard the result is found to be within acceptance.

**Measured data**

| Survey location at the Tank  (Mark on shell map) | Distance between survey location  (mm) | Cumulative  distance around tank  (mm) | Relative Level /  Distance from Datum Point\* (mm) |
| --- | --- | --- | --- |
| {#shell\_settlement\_point} {location} | {maximum\_space} | {cumulative} | {relative\_value}{/shell\_settlement\_point} |

**Determination of acceptable differential settlement**

| Data Point | Circumferential Distance | Reduced Level | Theta Radians | Theta Degrees | Relative Level | y | Difference (Ui) | Out of Plane Deflection (Si) | Deviation | Difference(2) | Deviation(2) |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| {#shell\_settlement\_api}{location} | {cumulative} | {reduced\_level} | {theta\_radians} | {theta\_degrees} | {relative\_value} | {y} | {difference\_value} | {out\_of\_plane} | {deviation\_value} | {difference\_2\_value} | {deviation\_2\_value}{/shell\_settlement\_api} |

**The value R calculation**

{#shell\_settlement\_api\_sum}

| Sum of (Deviation)²(Syy) | Sum of (Different)²(SSE) | R² = (Syy-SSE)/Syy |
| --- | --- | --- |
| {syy} | {sse} | {r\_2} |

{/shell\_settlement\_api\_sum}

{shell\_settlement\_1}

{shell\_settlement\_2}

**Settlement acceptance determination**

{#accept}

|  |  |  |  |
| --- | --- | --- | --- |
| API653, Paragraph B.3 – Determination of the permissible Out-of-Plane settlement | | | |
| The optimal cosine curve is valid | | The optimal cosine curve is invalid | |
| ft = (L² x Y x 11) / 2 x E x H | | in = min [K x x (D / H) x (Y / E), 4.0] | |
| L: Arc length between measurement points | {l\_value} ft. | K: API 653 | {k\_value} |
| Y: Yield strength | {yield} lbf/in2 | : Effective settlement arc | {s\_arc} ft. |
| E: Youngs Modulus | {e} lbf/in2 | D: Tank inside diameter | {diameter\_ft} ft. |
| H: Tank Height | {tank\_height\_ft} ft. | H: Tank Height | {tank\_height\_ft} ft. |
| n: Number of measurement points | {points} | Y: Yield strength | {yield} lbf/in2 |
|  | {s\_value} mm | E: Youngs Modulus | {e} lbf/in2 |
|  |  | n: Number of measurement points | {points} |
|  |  |  | {s\_max\_mm} mm |
| API653, Paragraph B.2.2.4 – Determination of predicted Out-of-Plane settlement | | | |
| S or = – (0.5 + 0.5 ) | | | |
|  | | {ui\_max} | |
|  | | {ui\_before\_max} | |
|  | | {ui\_next\_max} | |
| S | | {st\_value} | |
| R² | | {r\_2} | |
| Predicted deflection | | {predicted\_tilt} | |
| at | | {direction\_degrees\_cw\_pi} | |

**Acceptance per API 653**

The maximum out of plane deflection, where the greatest deviation of the bottom from the optimum cosine curve occurs over the shortest interval between measurements, shell not exceed the maximum permissible out-of-plane deflection calculated from formula in B3.2

|  |  |  |  |
| --- | --- | --- | --- |
| Cosine Curve | (mm) | S (mm) | Inspection Result |
| Valid | {s\_value} | {st\_value} | {insp\_result} |
| Invalid | {s\_max\_mm} | {st\_value} | {insp\_result\_invalid} |

{/accept}

GROUNDING CONNECTION

**The acceptance criteria**

1. The distance between grounding connection is between 6 to 30 m.

2. Total resistance from tank to earth not more than 25 ohms (API 575) or 10 ohms (Thai regulation) or Customer criteria.

| Grounding Connection No | The measured resistance to ground (ohms) | Note |
| --- | --- | --- |
| {#grounding} {ground\_no} | {measured} | {note}{/grounding} |

{#grounding\_detail}

| Grounding Connection Detail | |
| --- | --- |
| Total Resistance (ohms) | {total} |
| Acceptance Criteria (ohms) | {acceptance\_criteria} |
| Result | {result} |
| Measurement Summary | {measurement\_summary} |

{/grounding\_detail}