ABOVEGROUND STORAGE TANK

API 653 INSPECTION REPORT

FORMAL {insp\_campaign} INSPECTION

{company\_name}

TANK {tank\_no}

{site\_name}

{location}

{insp\_date}

Prepared by:

(LOGO)

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Revisions:

Rev. 1, MM/DD/YY

# INTRODUCTION

{company\_name} contracted with Dexon Technology PLC to provide API 653 Formal {insp\_campaign} Inspection for the aboveground storage tank {tank\_no} at the {site\_name} in {location}.

The inspection was carried out by a team of inspectors under the supervision of a certified API 653 inspector during {insp\_date}. June 10, 2022.

Dexon Technology PLC deployed the following personnel to execute the task and prepare inspection report for submission to client.

Inspection Co. provided the following personnel:

{name\_api\_653}

API 653 Inspector

Certification Number {cert\_no}

{name\_inspection\_engineer}

Inspection Engineer

{name\_ndt\_examiner}

NDT Examiner

# SUITABILITY FOR SERVICE

{#suitability}According to Section 9.0 of the {company\_name}Technical Specification for Formal External and Internal Tank Inspections of Large Aboveground Storage Tanks, Inspection Co.’s recommendation for service is categorized as **Class (select 1, 2, or 3)**.

Tank is/is not compliant with API 653.

Tank is suitable for service if certain repairs are made or recommendations implemented…

…

It is recommended that the following items be addressed before returning the tank to service:

CLASS 1 ITEMS

1. Repair …
2. Coat …
3. Remove …

…

In addition, while not imperative for returning the tank to service, the following items are listed for immediate consideration:

CLASS 2 ITEMS

1. Repair …
2. Install …

…

The following items are listed for continuous monitoring and should be reviewed during the next inspection:

CLASS 3 ITEMS

1. Monitor the condition of …

…

{/suitability}

Date of next FEI: (Month DD, YYYY)

Date of next FII: (Month DD, YYYY)

Limiting component: (bottom, shell, roof, etc.)

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# DETAILED TANK INFORMATION

## General

|  |  |
| --- | --- |
| OWNER: | {company\_name} |
| TANK #: | {tank\_no} |
| FACILITY TYPE: | Terminal |
| CITY, STATE: | {location} |
| YEAR BUILT: | {inservice\_date} |
| DESIGN STANDARD: | {inspection\_code} |
| MANUFACTURER: | (name) |
| CURRENT PRODUCT STORED: | {product\_code} |
| DATA PLATE PRESENT: | (Y/N) |

## Dimensions

|  |  |
| --- | --- |
| DIAMETER: | {diameter\_m} meters |
| HEIGHT: | {tank\_height\_m} meters |
| CAPACITY GROSS: | {tank\_capacity\_litre} liters |
| CAPACITY NORMAL: | [bbl] |
| OPERATING HEIGHT: | {max\_liquid\_level\_m} meters |

## Components

|  |  |
| --- | --- |
| FOUNDATION: | {foundation} |
| BOTTOM: | {component\_bottom} |
| SHELL: | {component\_shell} |
| MANWAYS: | {component\_manways} |
| INSULATION: | {insulation} |
| FIXED ROOF: | {component\_fixed\_roof} |
| ACCESS: | {component\_access} |
| DRAIN: | {component\_drain} |
| VENTS: | {component\_vents} |
| MANWAYS: | {component\_manways} |
| FLOATING ROOF: | {component\_floating\_roof} |
| TYPE: | {component\_type} |
| MATERIAL AND STYLE: | {component\_material\_and\_style} |
| PRIMARY SEAL: | {component\_primary\_seal} |
| ALL STEEL PONTOONS SEAL WELDED? | (Y/N) |
| SECONDARY SEAL: | {component\_secondary\_seal} |
| ANTI-ROTATION DEVICE: | {component\_anti\_rotation\_device} |
| GAUGE PIPE: | {component\_gauge\_pipe} |
| ACCESS: | {component\_access} |
| DRAIN: | {component\_drain} |
| AGE OF DRAIN (REQUIRED IF YES): |  |
| FLOATING SUCTION | (Y/N) |
| FLOATING SUCTION PONTOONS DRY? | (Y/N) |

## Inspection History

|  |  |
| --- | --- |
| **FORMAL EXTERNAL INSPECTION (FEI)** |  |
| LAST INSPECTED: | {fei\_last\_inspected} |
| LAST COATED: | {fei\_last\_coated} |
| LAST CLEANED: | {fei\_last\_cleaned} |
| PREVIOUSLY RECOMMENDED NEXT FEI: | {fei\_recommended\_next} |
| **FORMAL INTERNAL INSPECTION (FII)** |  |
| LAST INSPECTED: | {fii\_last\_inspected} |
| LAST COATED: | {fii\_last\_coated} |
| LAST CLEANED: | {fii\_last\_cleaned} |
| PREVIOUSLY RECOMMENDED NEXT FII: | {fii\_recommended\_next} |

## Coatings

|  |  |
| --- | --- |
| **EXTERNAL** |  |
| BOTTOM: | {coating\_ext\_bottom} |
| SHELL: | {coating\_ext\_shell} |
| FIXED ROOF: | {coating\_ext\_fixed\_roof} |
| FLOATING ROOF: | {coating\_ext\_floating\_roof} |
| **INTERNAL** |  |
| BOTTOM: | {coating\_int\_bottom} |
| SHELL: | {coating\_int\_shell} |
| FIXED ROOF: | {coating\_int\_fixed\_roof} |
| FLOATING ROOF: | {coating\_int\_floating\_roof} |

## Secondary Containment

|  |
| --- |
| {desc\_cond\_visual\_finding} |

## Miscellaneous

|  |  |
| --- | --- |
| PRESSURE (operating/design): | {misc\_pressure} |
| TEMPERATURE (operating/design): | {misc\_temp} |
| VENTING: | {misc\_venting} |
| FLOW RATES: | {misc\_flow\_rate} |
| SUCTION LINE: | {misc\_suction\_line} |
| RECEIPT: | {misc\_receipt} |

# SUMMARY OF FINDINGS

## Foundation

(include methods employed and results obtained)

## Bottom

(include methods employed and results obtained)

## Critical Zone

(include methods employed and results obtained)

## Shell

(include methods employed and results obtained)

## Fixed Roof

(include methods employed and results obtained)

## Floating Roof

(include methods employed and results obtained)

## Nozzles and Appurtenances

(include methods employed and results obtained)

## Secondary Containment

(include methods employed and results obtained)

## Miscellaneous

(include methods employed and results obtained)

# INSPECTION DETAILS

## Foundation

### Settlement Survey Data

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

{shell\_settlement\_1}

{shell\_settlement\_2}

(Show additional necessary notes, tables, data, etc. in order to explain the results of the evaluation)

### Determination of Acceptable Differential Settlement

(Show calculation and check according to API 653, Appendix B, B.3.2. Plot comparing calculated deflection vs. maximum allowable deflection is optional.)

| **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}

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

{/accept}

### Foundation Settlement Plot

See Appendix B for data.

### Shell Tilt or Plumbness Survey

| **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} |

## Bottom

### Bottom Thickness Readings

See Appendix B for data.

| **Bottom**  **Plate No** | **TP**  **Name** | **TP**  **Desc** | **Tnom**  **(mm)** | **Tmin**  **(mm)** | **Inspection Date** | **Tactual**  **(mm)** | **CR**  **(mm/yr)** | **RL**  **(yrs)** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| {#bottom\_thk}{bottom\_no} | {tp\_name} | {tp\_desc} | {t\_nom} | {t\_req} | {inspection\_date} | {t\_actual} | {scr} | {rl}{/bottom\_thk} |

### Service Interval Calculation

(Show calculation according to API 653, 4.4.5. Recommend the duration (in years) until next internal inspection.)

{#mrt}

|  |  |
| --- | --- |
| **Bottom Plate** | |
| RTbc: | {bt\_RTbc} mm. |
| RTip: | {bt\_RTip} mm. |
| Or: | {bt\_Or} years |
| StPr: | {bt\_StPr} mm/yr |
| Upr: | {bt\_UPr} mm/yr |
| Age of Tank: | {bt\_age\_of\_tank} years |
| MRT: | {bt\_MRT} mm. |
| Tmin: | {bt\_tmin} mm. |
| Result: | {bt\_result} |
| Recommendation: | {bt\_recommedation} |

{/mrt}

### Bottom Layout

See Appendix C for drawing.

(Show plan view layout drawing of tank bottom with notable appurtenances labeled, bottom plates numbered, and appropriate reference points noted. Include all locations of pits that require repair before returning tank to service.)

## Critical Zone

See Appendix B for data.

| **Plate No** | **TP**  **Name** | **TP**  **Desc** | **Tnom**  **(mm)** | **Tmin**  **(mm)** | **Inspection Date** | **Tactual**  **(mm)** | **CR**  **(mm/yr)** | **RL**  **(yrs)** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| {#critical\_thk}{plate\_no} | {tp\_name} | {tp\_desc} | {t\_nom} | {t\_req} | {inspection\_date} | {t\_actual} | {scr} | {rl}{/critical\_thk} |

### Service Interval Calculation

(Show calculation according to API 653, 4.4.5.4 Recommend the duration (in years) until next internal inspection.)

### Bottom Layout

See Appendix C for drawing.

(Show plan view layout drawing of tank bottom with notable appurtenances labeled, bottom plates numbered, and appropriate reference points noted. Include all locations of critical zone findings that require repair before returning tank to service.)

## Shell

### Shell Thickness Reading

See Appendix B for data.

|  |  |
| --- | --- |
| Tank Diameter | {diameter\_m} m. or {diameter\_ft} ft. |
| Tank Height | {tank\_height\_m} m. or {tank\_height\_ft} ft. |
| Maximum Filling Height | {max\_liquid\_level\_m} m. or {max\_liquid\_level\_ft} ft. |
| Product | {product\_code} |
| Specific Gravity, G | {g} |
| Year of Commission | {inservice\_date} |
| Year of Last Inspection | 2017 Internal/ 2021 External by law |
| Year of Current Inspection | 2022 |
| Type of Shell Weld | Butt-weld |
| Joint Efficiency, E | {joint\_efficiency} |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Shell Course** | **Course Height (mm)** | **Material** | **Minimum. Specific Yield Stress, Y (lbf/in.2)** | **Minimum. Specific Tensile Stress (lbf/in.2)** | **Allowable Product Stress, S(lbf/in.2)** | **Nominal Thickness (mm)** | **Minimum Measured Thickness (mm)** | **Minimum. Acceptable Thickness, Tmin (mm)** | **Corrosion Rate for 29 past year. (mm/year)** | **Remaining Life (year)** |
| {#tank\_course}{course\_no} | {height\_of\_course\_m} | {mat\_type} | {y\_value} | {t\_value} | 23595 | {t\_nom\_plate\_mm} | {min\_thk} | {tmin\_prod\_mm} | {scr} | {min\_rl}{/tank+course} |

### Service Interval Calculation

(Show calculation according to API 653 4.3.3.1, Recommend the duration (in years) until next internal inspection for each course.)

### Shell Thickness Calculations

(Show calculations of shell thickness according to API 653, 4.3.3. Show that all reported thicknesses meet minimum required thickness level or recommend repairs. Provide necessary explanations.)

| **Shell**  **Course** | **Plate**  **No** | **TP**  **Name** | **TP**  **Desc** | **Tnom**  **(mm)** | **Tmin**  **(mm)** | **Inspection Date** | **Tactual**  **(mm)** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| {#shell\_thk}{course\_no} | {plate\_no} | {tp\_name} | {tp\_desc} | {t\_nom} | {t\_req} | {inspection\_date} | {t\_actual}{/shell\_thk} |

### Shell Rollout

See Appendix C for drawing.

(Show elevation view rollout drawing of shell with notable appurtenances labeled, shell courses numbered, and appropriate reference points noted. Include all locations of findings that require repair before returning tank to service.)

Note: Shell circumference measurement is required. Asking any Company rep for the diameter is inadequate.

## Roof

### Roof Thickness Readings

See Appendix B for data.

| **Roof**  **Plate No** | **TP**  **Name** | **TP**  **Desc** | **Tnom**  **(mm)** | **Tmin**  **(mm)** | **Inspection Date** | **Tactual**  **(mm)** | **CR**  **(mm/yr)** | **RL**  **(yrs)** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| {#roof\_thk}{roof\_no} | {tp\_name} | {tp\_desc} | {t\_nom} | {t\_req} | {inspection\_date} | {t\_actual} | {scr} | {rl}{/roof\_thk} |

### Service Interval Calculation

(Describe evaluation according to API 653 4.2, Recommend the duration (in years) until next internal inspection given minimum roof plate thickness for CVX of 0.1”.)

### Roof Nozzle Table

See Appendix B for data.

(Show table including dimensions, thicknesses, locations, and other data applying to the various fixed roof nozzles.)

| **Roof**  **Nozzle No** | **TP**  **Name** | **TP**  **Desc** | **Tnom**  **(mm)** | **Tmin**  **(mm)** | **Inspection Date** | **Tactual**  **(mm)** | **CR**  **(mm/yr)** | **RL**  **(yrs)** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| {#roofnz\_thk}{roofnz\_no} | {tp\_name} | {tp\_desc} | {t\_nom} | {t\_req} | {inspection\_date} | {t\_actual} | {scr} | {rl}{/roofnz\_thk} |

### Roof Layout

See Appendix C for drawing.

(Show plan view layout drawing of fixed roof with all appurtenances labeled and appropriate reference points noted. Include all locations of findings that require repair before returning tank to service.)

## Nozzles and Appurtenances

### Nozzles and Appurtenances Table

See Appendix B for data.

(Show table including dimensions, thicknesses, locations, and other data applying to the various nozzles and appurtenances.)

| **Shell**  **Nozzle No** | **TP**  **Name** | **TP**  **Desc** | **Tnom**  **(mm)** | **Tmin**  **(mm)** | **Inspection Date** | **Tactual**  **(mm)** | **CR**  **(mm/yr)** | **RL**  **(yrs)** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| {#shellnz\_thk}{shellnz\_no} | {tp\_name} | {tp\_desc} | {t\_nom} | {t\_req} | {inspection\_date} | {t\_actual} | {scr} | {rl}{/shellnz\_thk} |

### Service Interval Calculation

(Describe evaluation according to API 653 4.3.9.2 or 50% metal loss (whichever is greater), Recommend the duration (in years) until next internal inspection.)

### Shell Rollout

See Appendix C for drawing.

(Show a second elevation view rollout drawing of shell, this time including all nozzles and appurtenances as they correspond with the above table. Alternatively, show up close drawings of only those plates with nozzles and appurtenances instead of a second rollout.)

Note: Shell circumference measurement required. Asking any Chevron rep or relying on other data is unacceptable.

## Service Life Summary Table

Table of results of calculated Service Intervals – **Pre Repairs**

|  |  |  |
| --- | --- | --- |
| Tank Component | Time to Next Inspection by this Component Service Interval (Years) | End of Life Span of this Component (Years) |
| Bottom |  |  |
| Critical Zone |  |  |
| Shell |  |  |
| Roof |  |  |
| Floating Roof |  |  |
| Nozzle |  |  |

Table of results of calculated Service Interval – **Post Repairs** (if any)

|  |  |  |
| --- | --- | --- |
| Tank Component | Time to Next Inspection by this Component Service Interval (Years) | End of Life Span of this Component (Years) |
| Bottom |  |  |
| Critical Zone |  |  |
| Shell |  |  |
| Roof |  |  |
| Floating Roof |  |  |
| Nozzle |  |  |

## Corrosion Rate Detailed Key Data and Calculations

(Report details of all corrosion rate calculations in this section.)

### Bottom Corrosion Rate

(Show data and calculations. Report maximum rates)

Include: Stockside Pitting - Calcs & Rate

Soilside Pitting – Calcs & Rate

### Critical Zone Corrosion Rate

(Show data and calculations. Report maximum rates)

Include: Stockside Uniform Corrosion – Calcs & Rate

Soilside Uniform Corrosion – Calcs & Rate

### Shell Corrosion Rate

(Show data and calculations. Report maximum rates)

### Fixed Roof Corrosion Rate

(Show data and calculations. Report maximum rates)

### Floating Roof Corrosion Rate

(Show data and calculations. Report maximum rates)

### Nozzle and Appurtenance Rate

(Show data and calculations. Report maximum rates)

# NDE INSPECTION SUMMARY

## NDE Inspection Scope

(List NDE inspection methods used and briefly describe the reason for using each.)

## Significant Findings

(Report any significant findings/overall conclusions from NDE inspection methods.)

## Bottom Examination

(Report how it was conducted and which NDE tools/methods were used.)

## Critical Zone Examination

(Report how it was conducted and which NDE tools/methods were used.)

## Shell Readings

(Report how it was conducted and which NDE tools/methods were used.)

## Fixed Roof Readings

(Report how it was conducted and which NDE tools/methods were used.)

## Floating Roof Readings

(Report how it was conducted and which NDE tools/methods were used.)

## Nozzle and Appurtenance Readings

(Report how it was conducted and which NDE tools/methods were used.)

## Sump Readings

(Report how it was conducted and which NDE tools/methods were used.)

# APPENDIX A – EQUIPMENT

(List the major pieces of equipment utilized and any basic specifications for each.)

Level Measurement Gauges (Make, Size, and Model)

Vents (Make, Size, and Model)

# APPENDIX B – DATA

(Show tables of data collected from equipment as required by the preceding sections of this report.)

{#picture\_log}

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

{/picture\_log}

# APPENDIX C – DRAWINGS

(Show all drawings as required by the preceding sections of this report.)

{#annular}

| **Annular** |
| --- |
| {marked\_up\_drawing} |

{/annular}

{#bottom}

| **Bottom** |
| --- |
| {marked\_up\_drawing} |

{/bottom}

{#coil}

| **Coil** |
| --- |
| {marked\_up\_drawing} |

{/coil}

{#critical\_zone}

| **Critical Zone** |
| --- |
| {marked\_up\_drawing} |

{/critical\_zone}

{#piping}

| **Piping** |
| --- |
| {marked\_up\_drawing} |

{/piping}

{#roof}

| **Roof** |
| --- |
| {marked\_up\_drawing} |

{/roof}

{#roof\_nozzle}

| **Roof Nozzle** |
| --- |
| {marked\_up\_drawing} |

{/roof\_nozzle}

{#sump}

| **Sump** |
| --- |
| {marked\_up\_drawing} |

{/sump}

{#shell}

| **Shell** |
| --- |
| {marked\_up\_drawing} |

{/shell}

{#shell\_nozzle}

| **Shell Nozzle** |
| --- |
| {marked\_up\_drawing} |

{/shell\_nozzle}

{#projection\_plate}

| **Project Plate** |
| --- |
| {marked\_up\_drawing} |

{/projection\_plate}

APPENDIX D – PHOTOGRAPHS

(Display all photographs with captions or titles and separate external from internal.)

***GENERAL***

**External**

**Internal**

***FOUNDATION***

***BOTTOM***

**External (Leak detection ports, chime underside if possible)**

**Internal – DIFFUSER, WATER DRAW PIPING,**

***CRITICAL ZONE***

***FLOATING SUCTION (IF PRESENT)***

***(SWIVEL JOINT, PONTOONS, ROLLERS, ROLLER TRACK, CLEANOUT PORTS, HOLD DOWN SYSTEM)***

***SHELL***

**External**

**Internal**

***FIXED ROOF***

**External**

**Internal**

***FLOATING ROOF***

**External**

**Internal**

***NOZZLES AND APPURTENANCES***

**External**

**Internal**

***ACCESS STRUCTURE***

**External**

**Internal**

***SECONDARY CONTAINMENT (TYPICAL AND FINDINGS)***

***MISCELLANEOUS***

# APPENDIX E – CHECKLISTS

(Attach completed checklist for applicable inspection, i.e. FEI or FII.)

{#checklist}

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **{no}** | **{header\_content}** | | | | | |
| {#sub\_header}{no} | {subheader\_content} | | E | OK | NA | Comments: |
| {#topic} | {no} | {topic} | {#result}{E} | {OK} | {NA} | {comments}{/result}{/topic}{/sub\_header} |

{/checklist}