3D Laser Scanning for Deformation Surveys in Refineries

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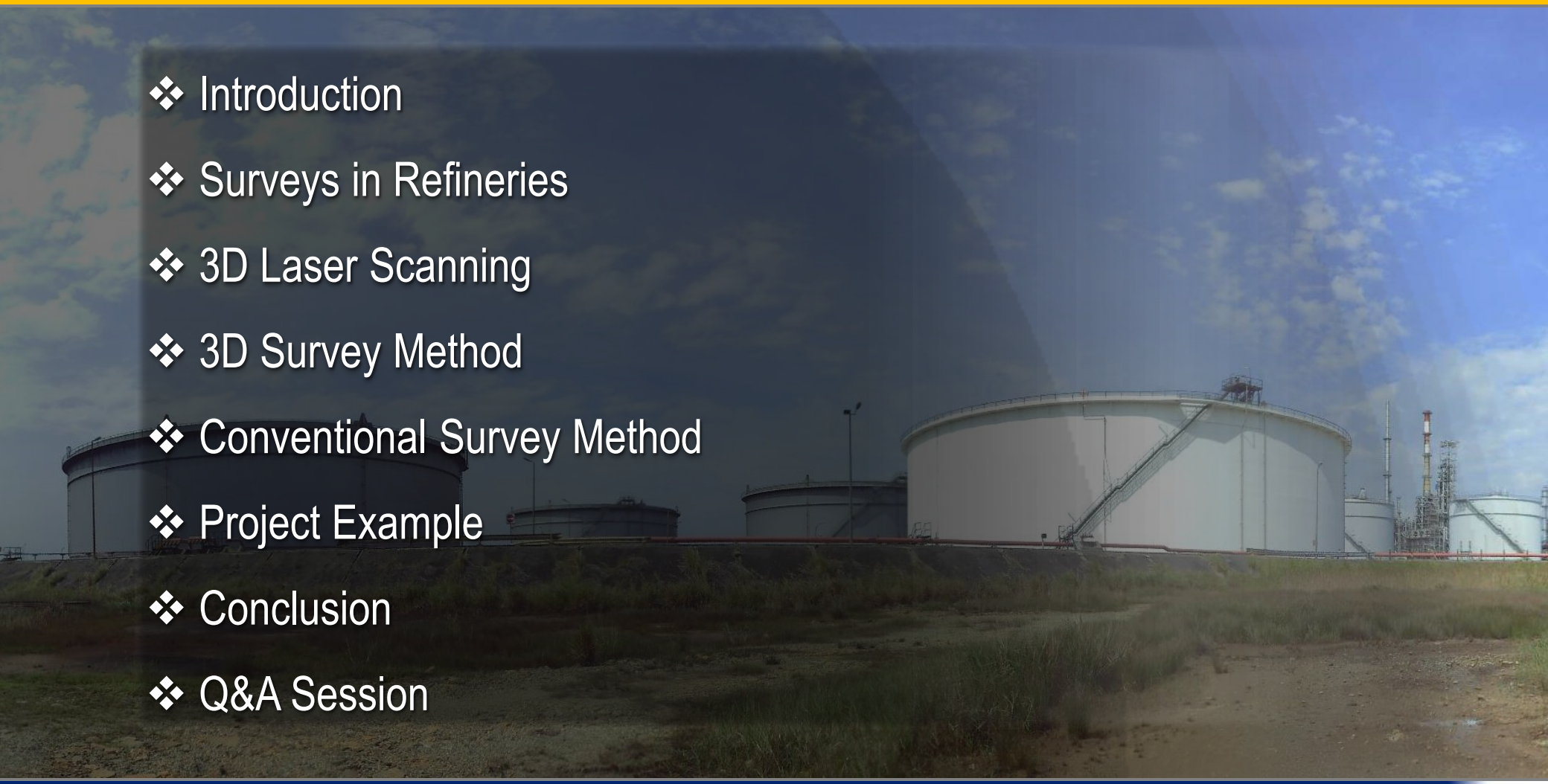
Overview



- Introduction
- Surveys in Refineries
- 3D Laser Scanning
- 3D Survey Method
- Conventional Survey Method
- Project Example
- Conclusion
- Q&A Session

Introduction

Speaker: Goh Chin Cheng

- Managing Director of Advance Survey Consultant Pte Ltd
- Registered Surveyor under the Singapore Land Surveyors Board
- American Petroleum Institute (API) 653 Tank Inspector Trained

Organization: Advance Survey Consultant Pte Ltd

- Licensed Corporation under the Singapore Land Surveyors Board
- ISO 9001 and BizSafe certified
- More than 30 full-time staff
- Survey contractor for various major petrochemical companies for over 15 years

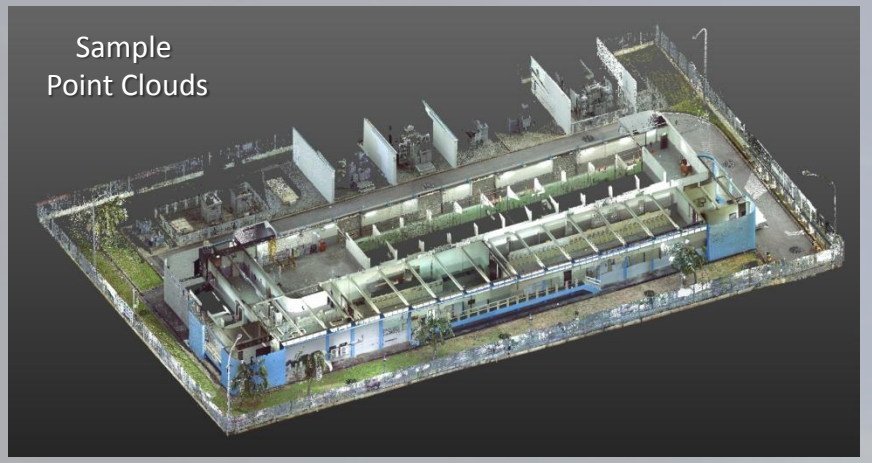
Refinery Surveys

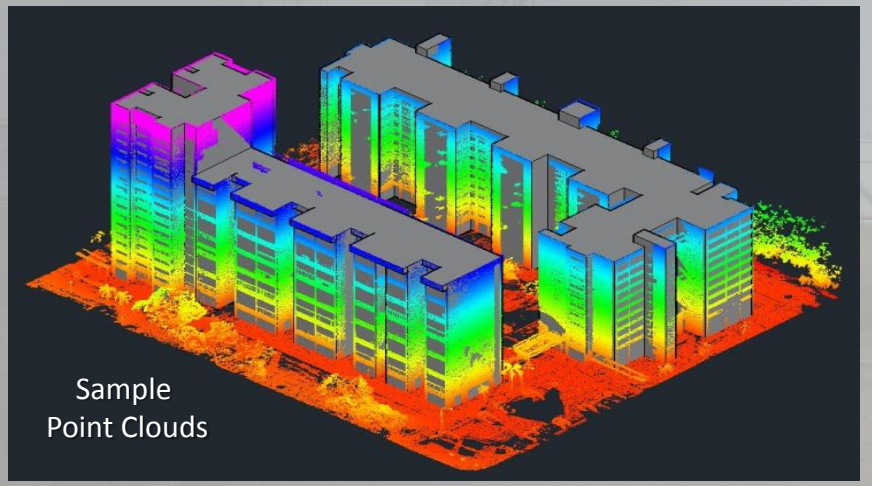
- Refinery assets require surveys for regular checking and maintenance
  - Storage tanks
  - Vessels
  - Columns
- Stress from immense weight and heat of petrochemical liquids causes
  - Deformation
  - Ground settlement
  - Tilting or slanting
- Common refinery surveys to assess condition of vessels and tanks
  - Out-of-Roundness Survey
  - Verticality Survey
  - Tank Settlement Survey
- The surveys can be carried out using the conventional method or 3D method
- The surveys are carried out according to the American Petroleum Institute (API) 653 Standard

3D Survey

Introduction to Laser Scanning

- 3D Laser Scanning is a non-contact, non-destructive technology that digitally captures the shape of physical objects in “Point Clouds” using a line of laser light
- Point clouds contain millions of 3D coordinate points and are accurate representations of the physical environment
- Point Clouds are processed with specialized software to create CAD models for inspection, analysis and design

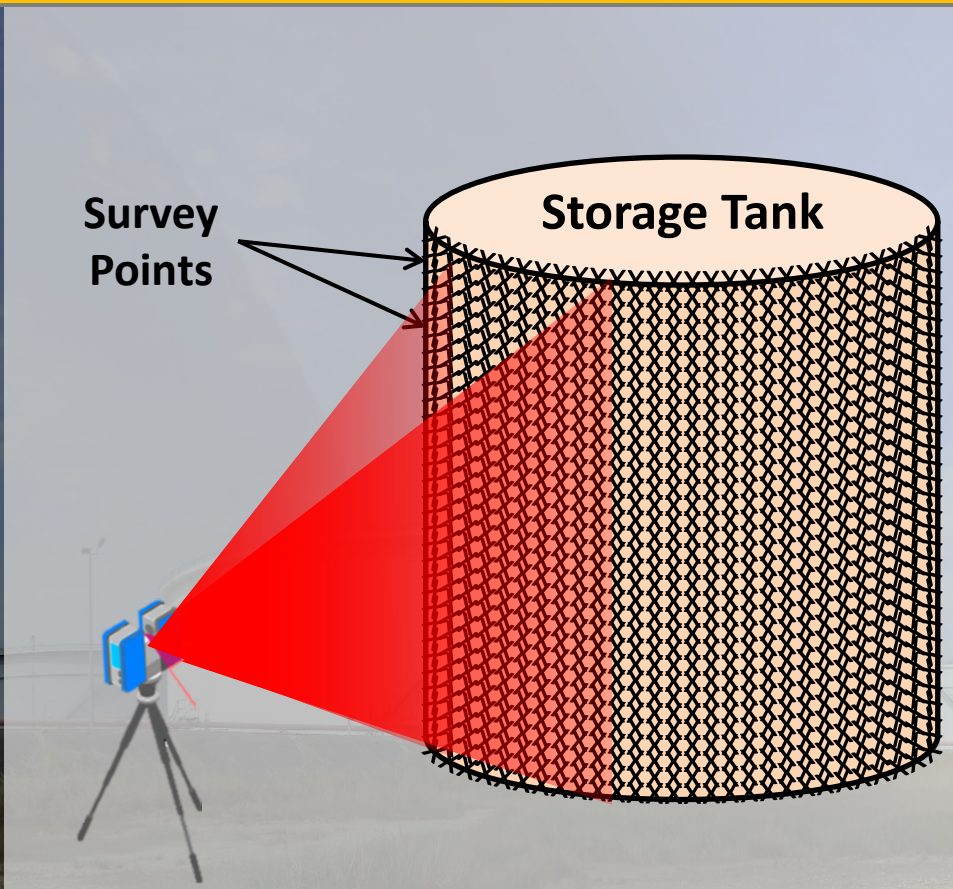




3D Survey

Survey using 3D Laser Scanner

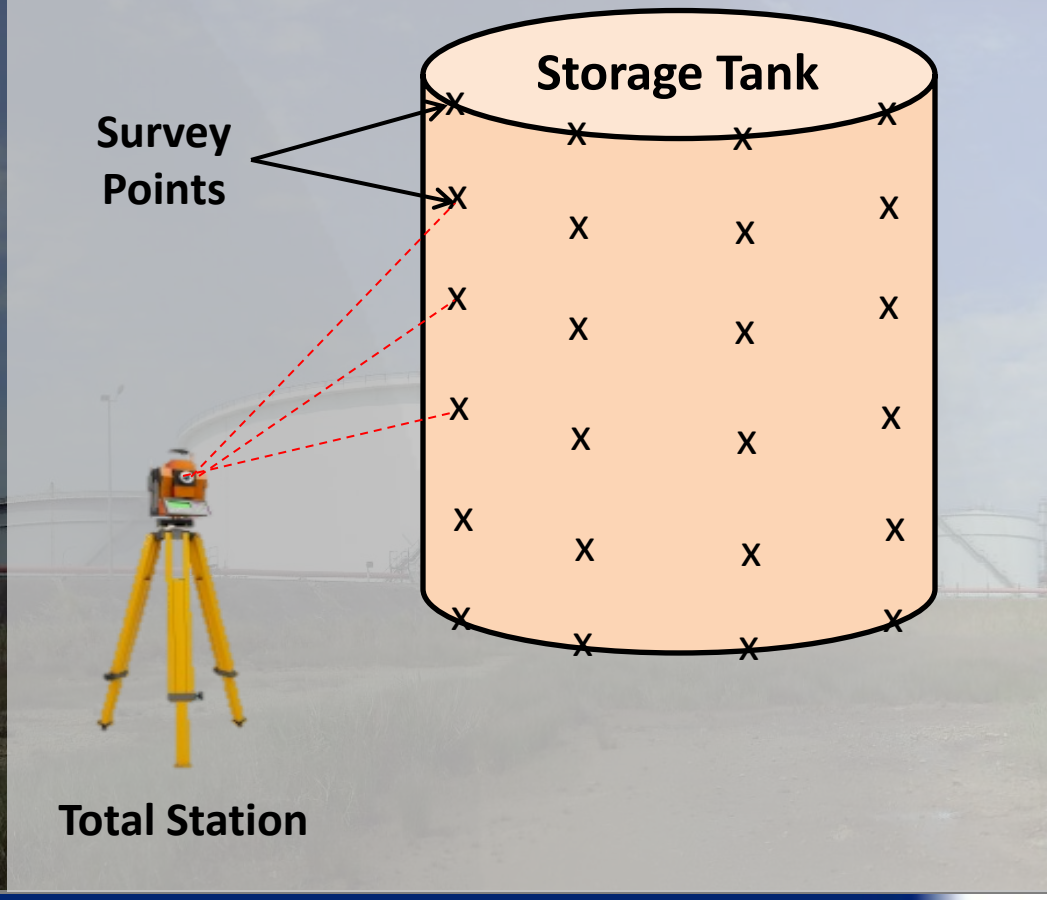
- Fast – Thousands of points captured per second
- Detailed – Millions of points captured for each object
- Accurate – Creates 3D model of real-world environment for visualization



Conventional Survey

Survey using Total Station

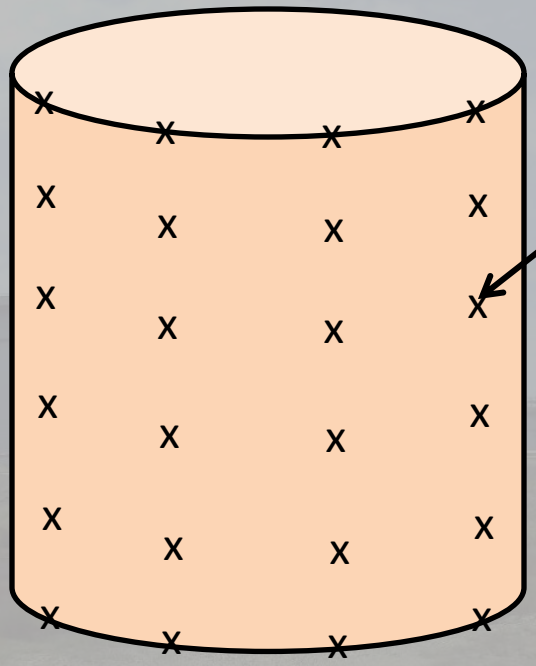
- Single points measured at a time
- Widely spaced survey points at specific intervals
- Data of object only available at points that were surveyed



Conventional Vs 3D Survey

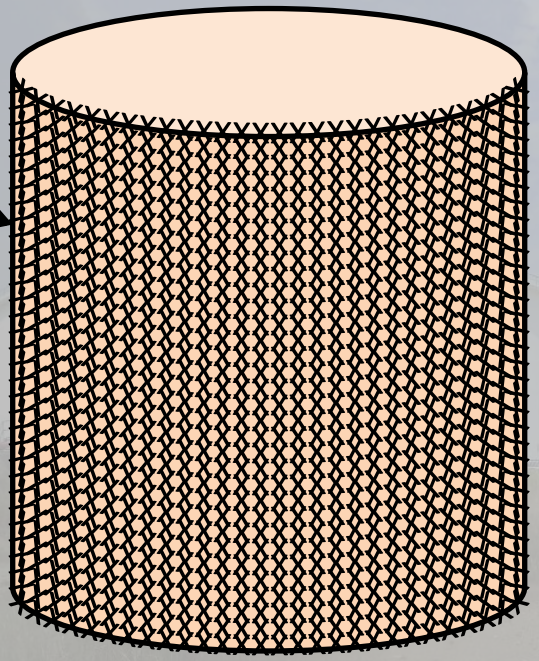
Comparison

Survey using Conventional Method



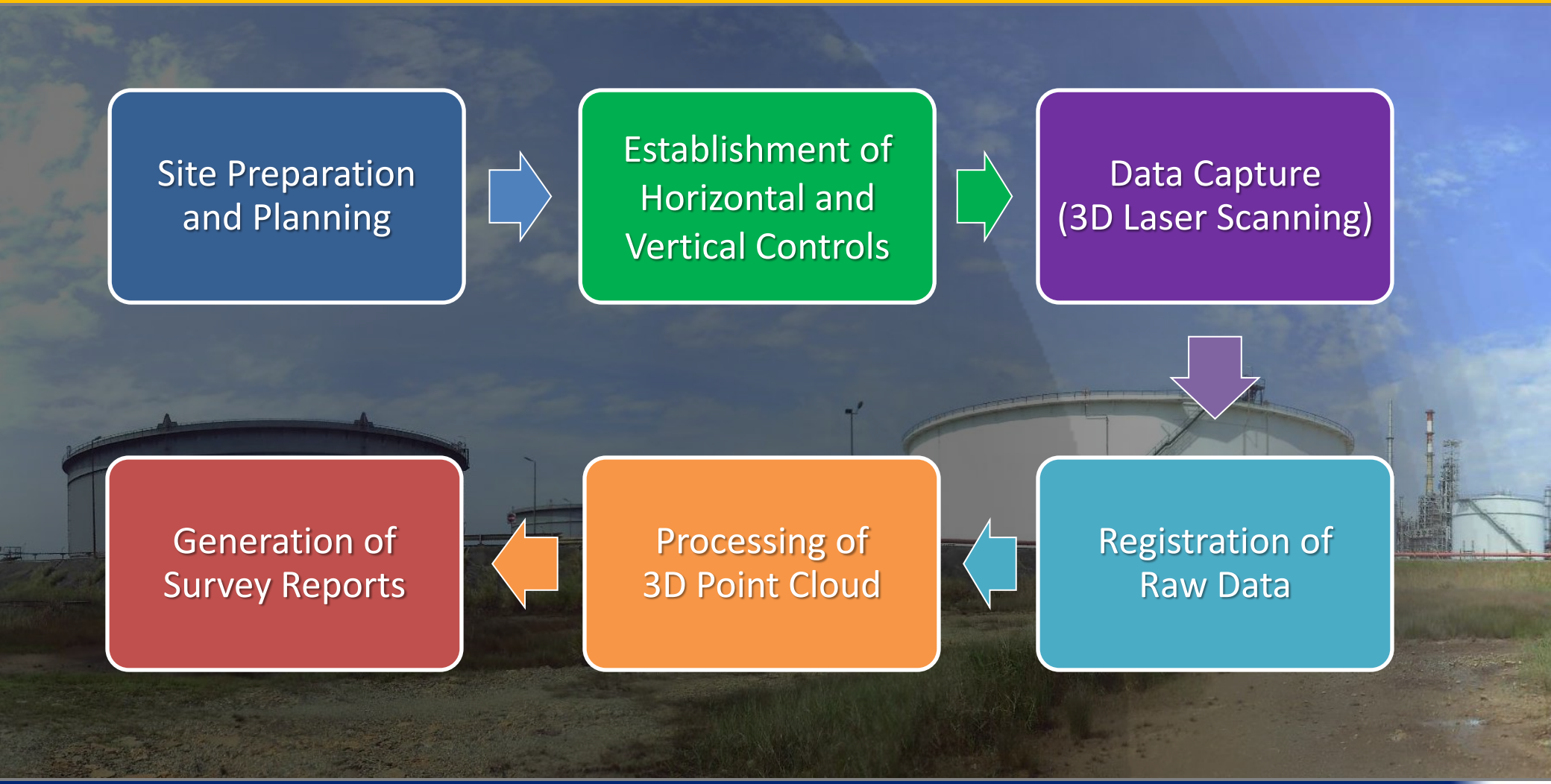
Survey Points

Survey using 3D Laser Scanning



3D Survey Process

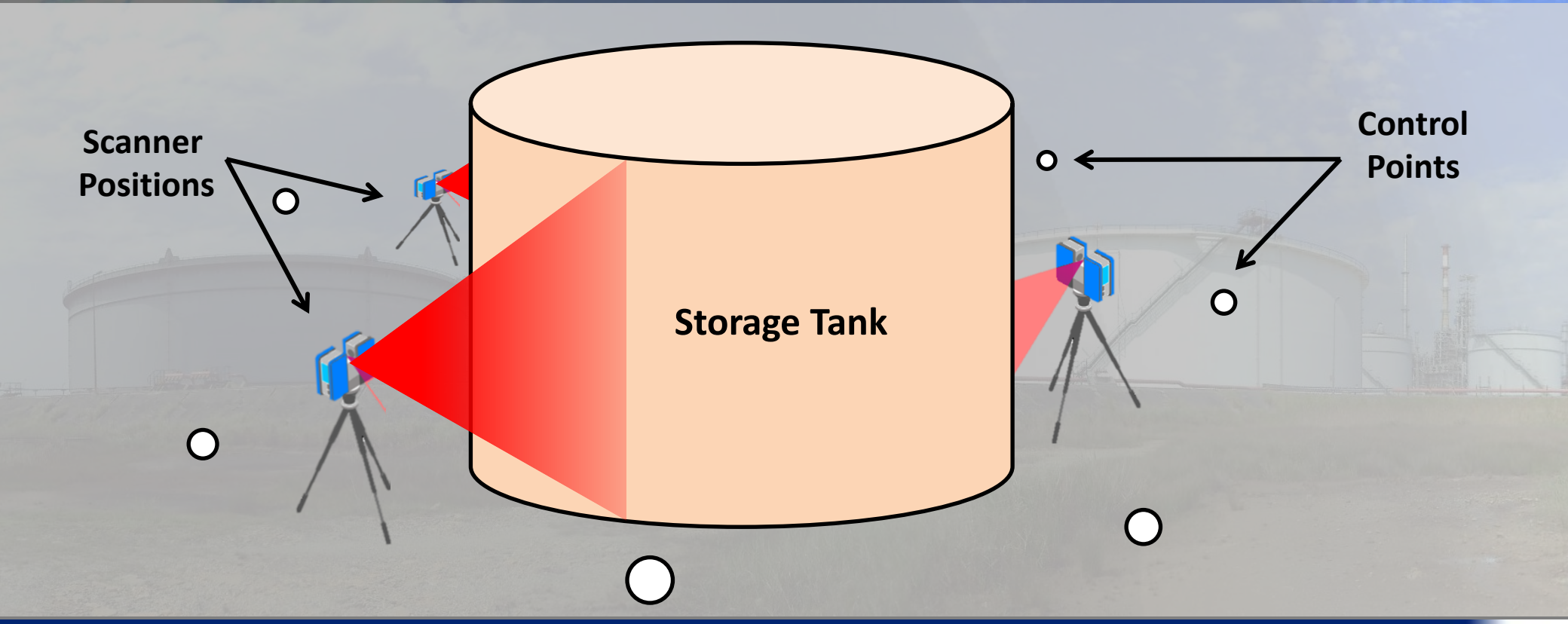
Process Flow



3D Survey Process

On-site Data Acquisition

- Placement of reference targets over control points for geo-referencing
- Laser scanning of tank from multiple locations around the tank



3D Survey Process

Data Processing

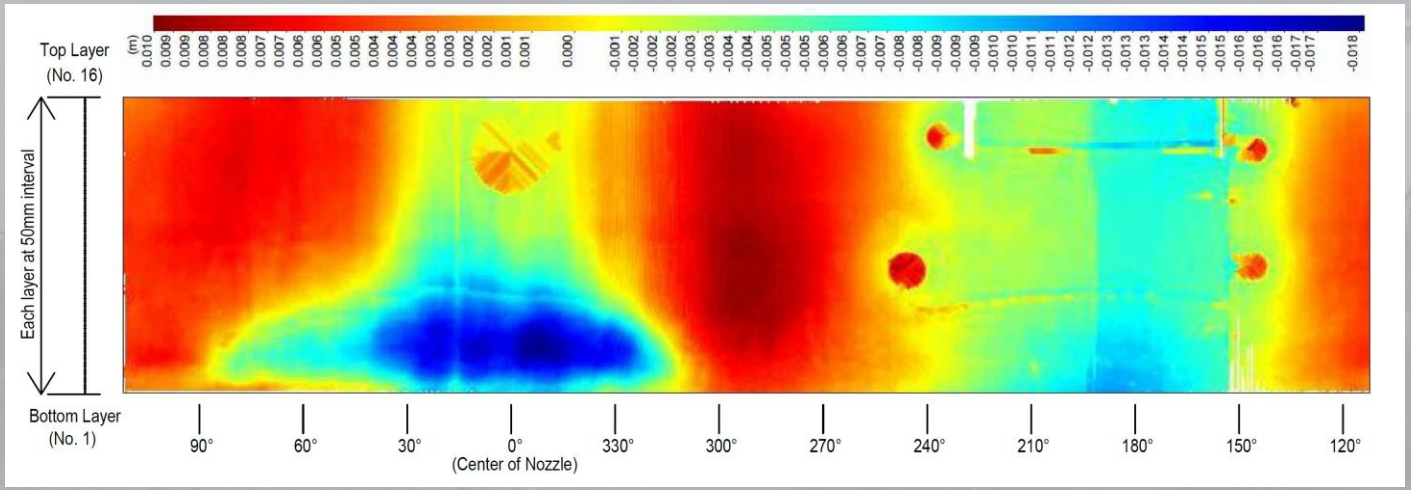
- Raw scan files are registered and merged to form a 3D point cloud
- Point cloud is edited and cleaned to show only the subject area
- Point cloud is analyzed and processed to generate detailed reports on deformation and condition

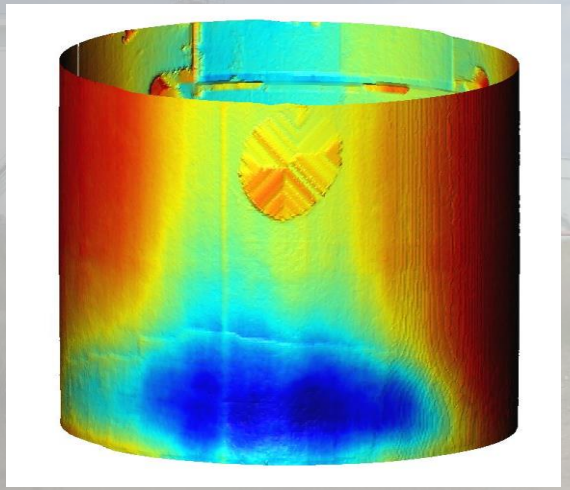
Point Cloud of Storage Tanks

3D Survey Process

Sample Reports

- Unwrapping of surveyed tank or vessel for easy visualization of deformed areas based on color mapping
- Color scale shows the extent of deformation inward and outward from the best fit circle

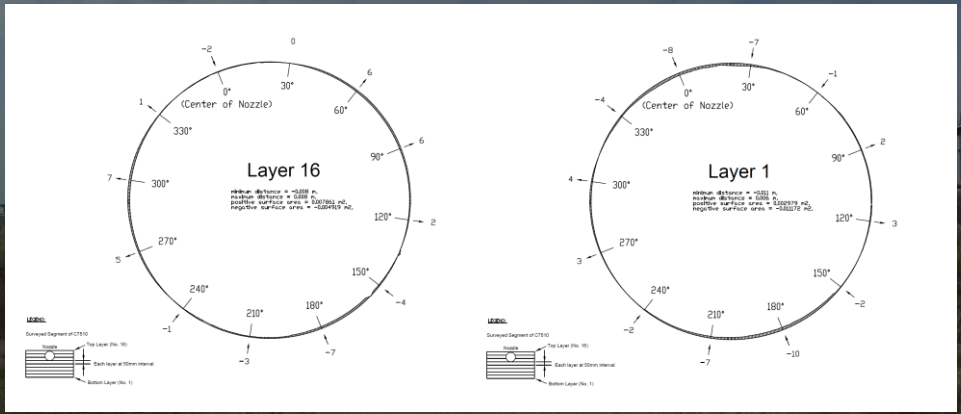


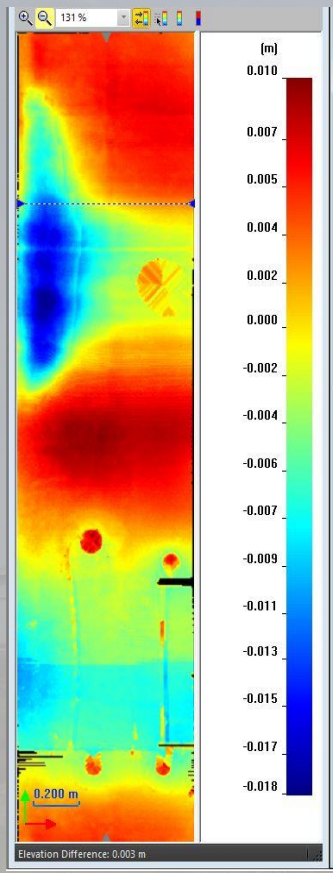


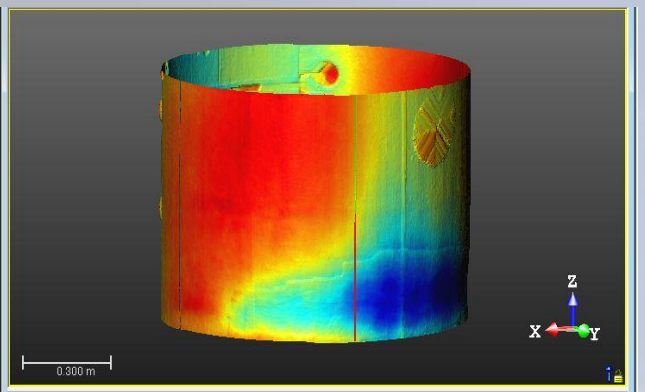
3D Survey Process

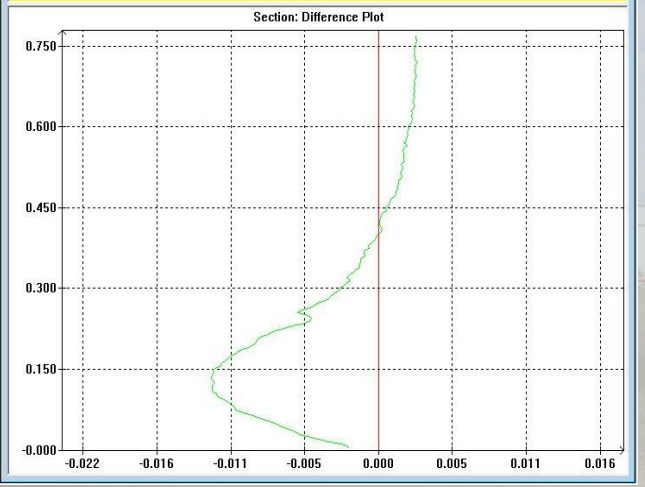
Sample Reports

- Segmentation of object into horizontal and vertical cross sections
  - Detailed analysis of each segment
  - Identification of exact areas of deformation

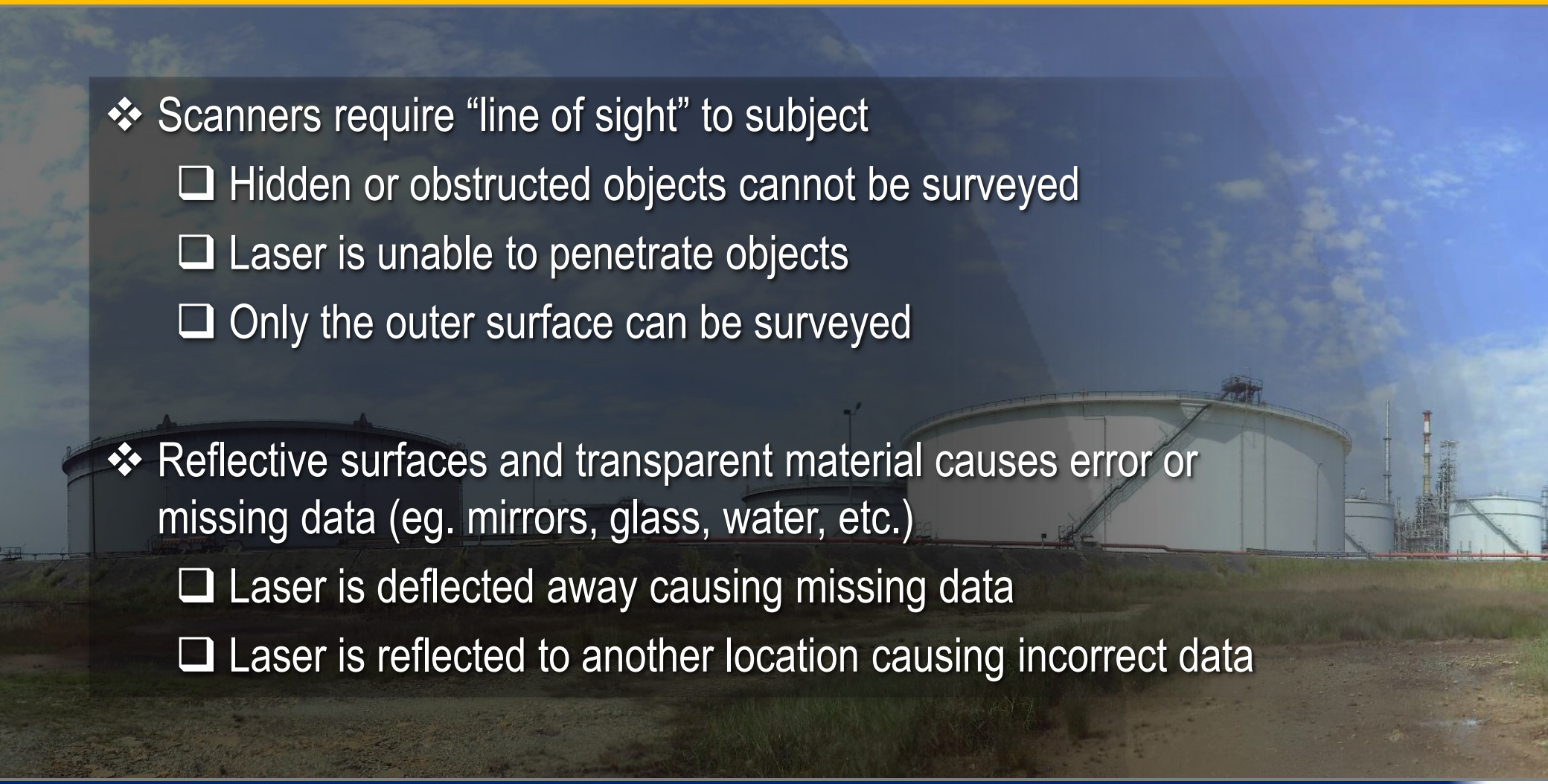








Limitations of Laser Scanning



- Scanners require “line of sight” to subject
  - Hidden or obstructed objects cannot be surveyed
  - Laser is unable to penetrate objects
  - Only the outer surface can be surveyed

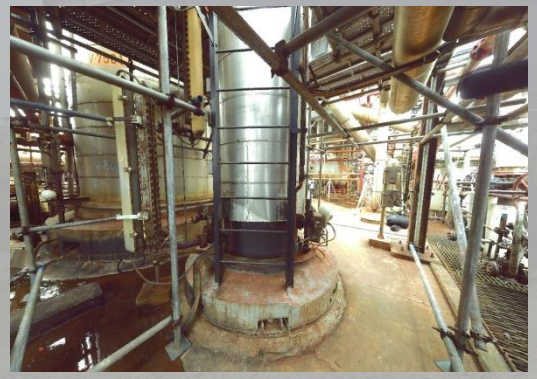
- Reflective surfaces and transparent material causes error or missing data (eg. mirrors, glass, water, etc.)
  - Laser is deflected away causing missing data
  - Laser is reflected to another location causing incorrect data

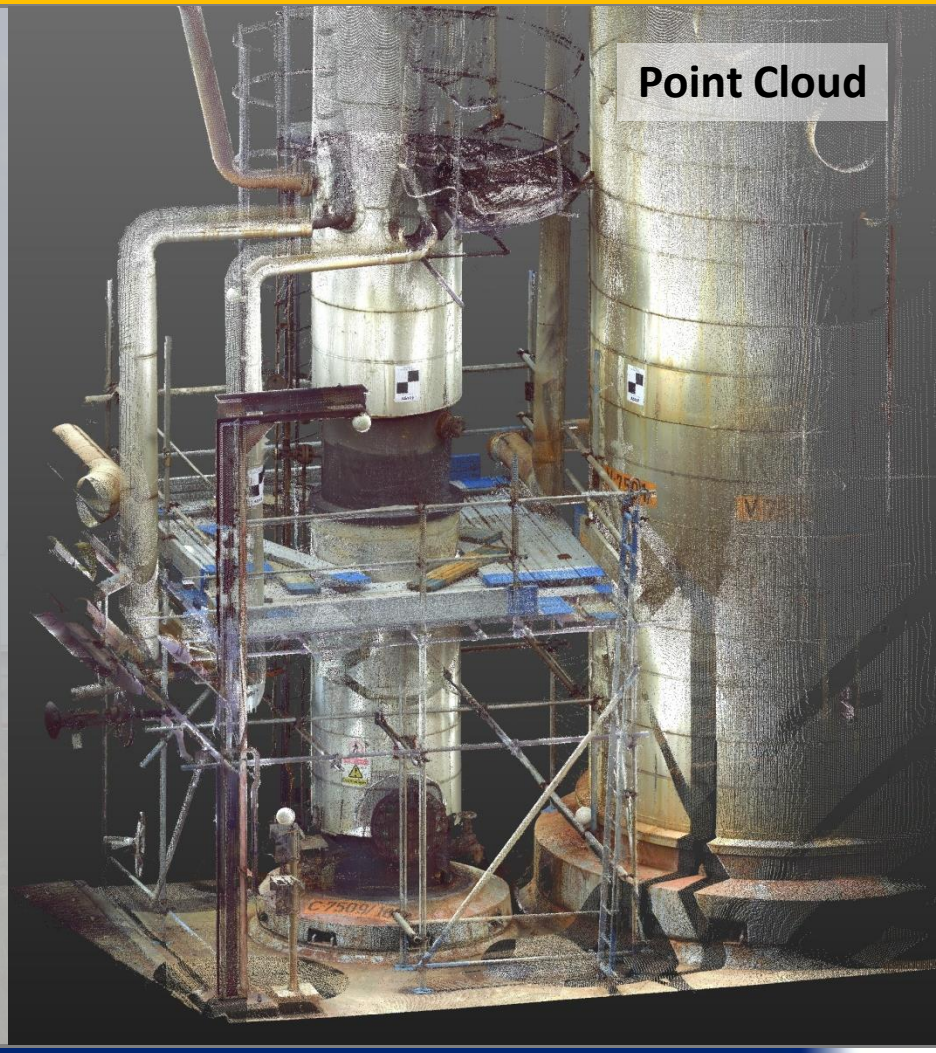
Project Example

3D Deformation Survey

Deformation Survey of Vertical Column in Oil Refinery

- Survey of column segment to determine the extent of deformation
- Insulation was removed by owner to facilitate line of sight from the scanner

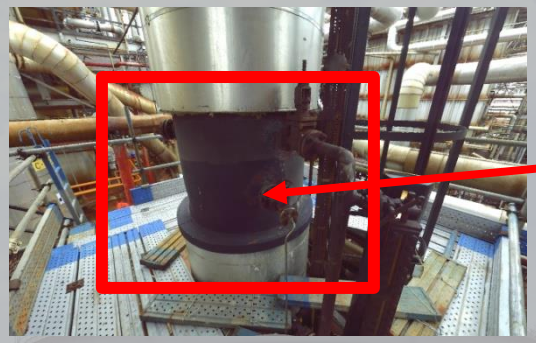




Project Example

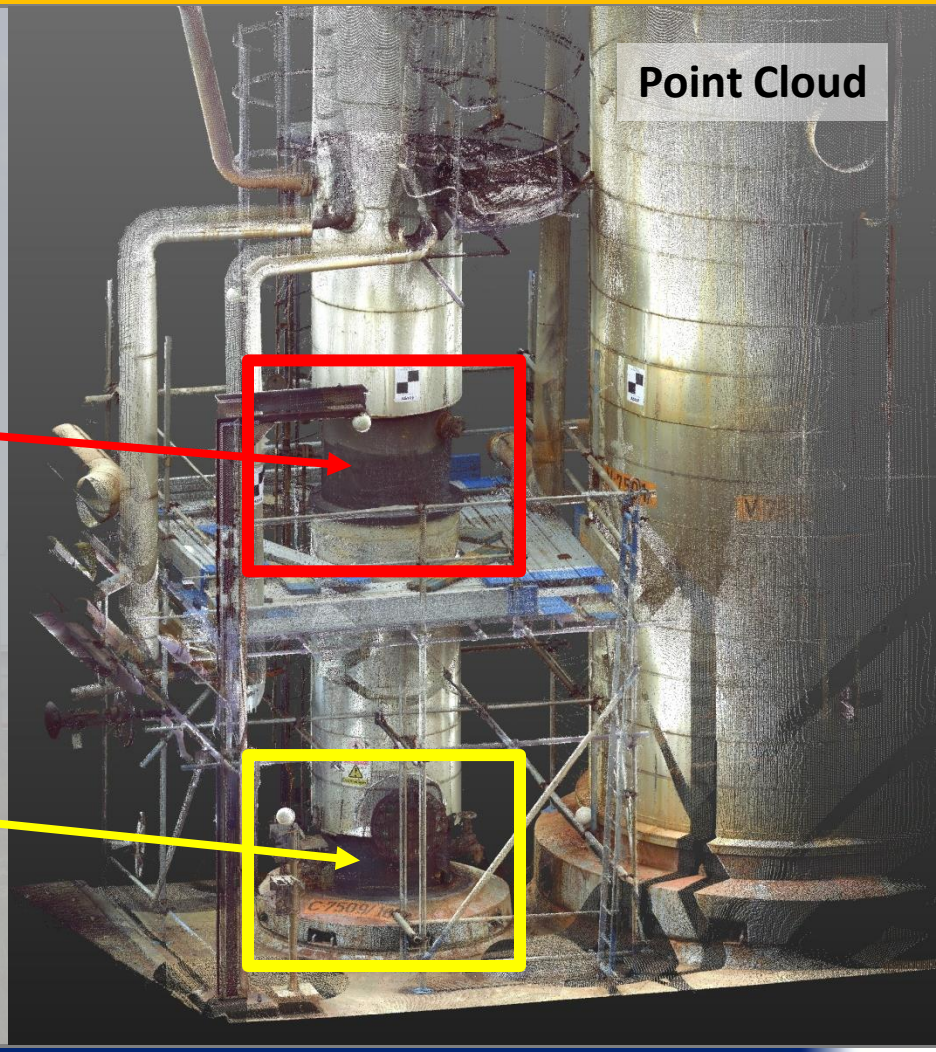
3D Deformation Survey

- Deformed segment compared to the base segment for out-of-roundness



Deformed Segment

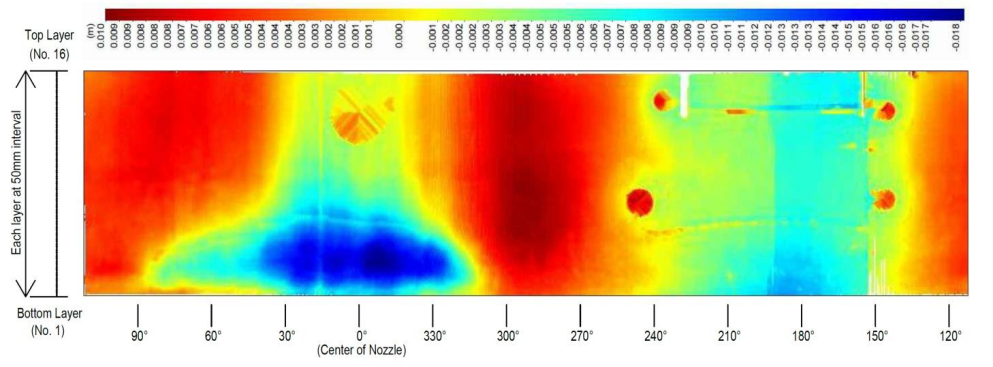
Base Segment

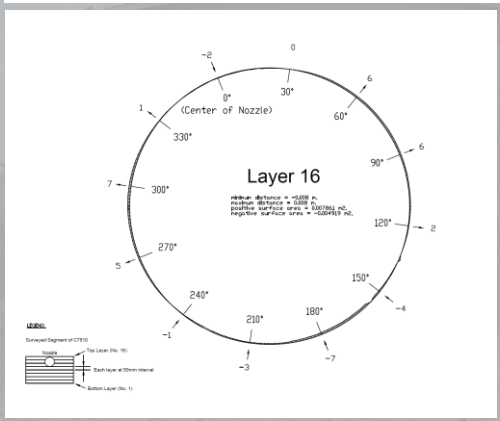


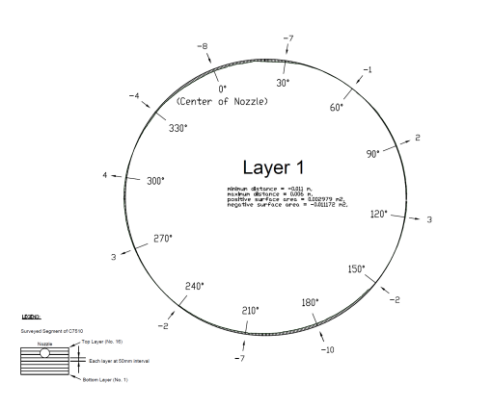
Project Example

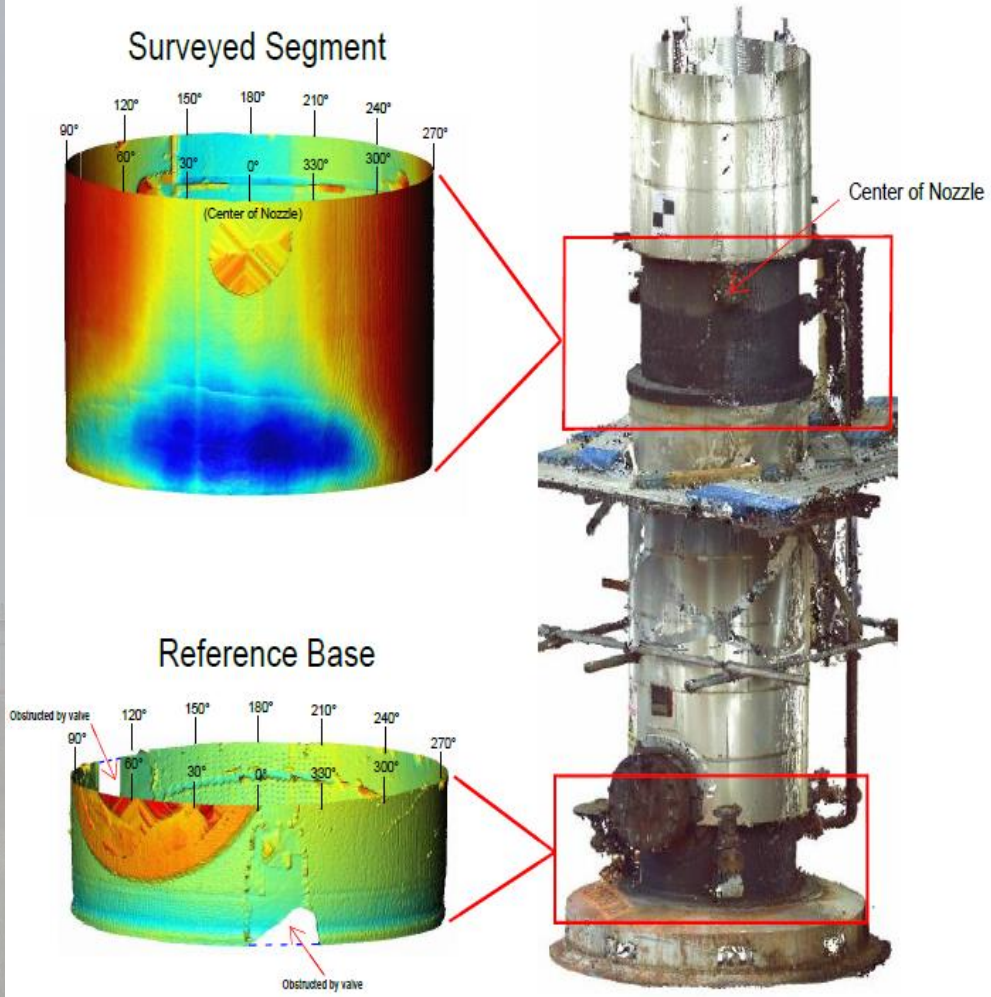
3D Deformation Survey

Deformation Survey Results

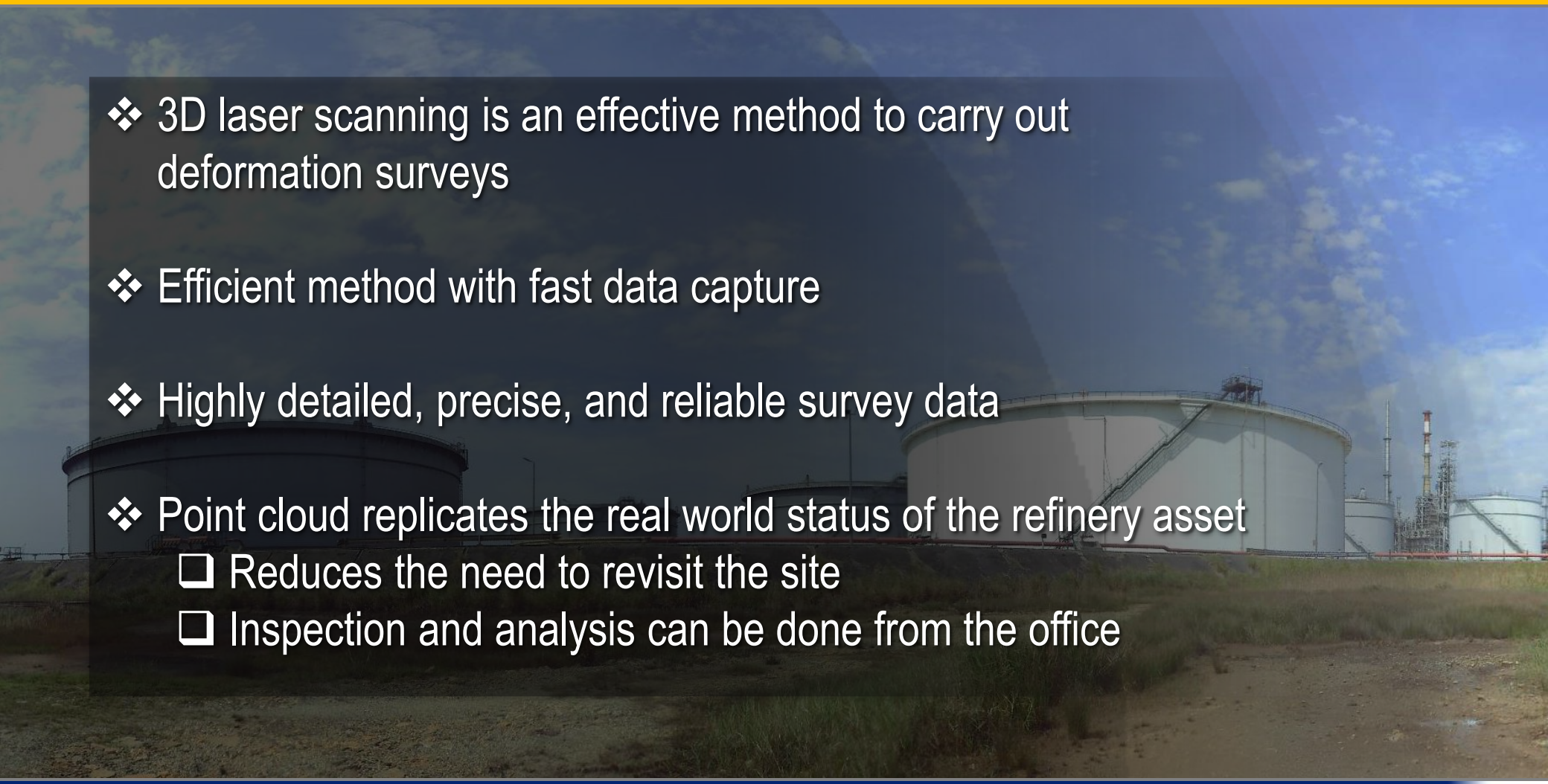








Conclusion



- 3D laser scanning is an effective method to carry out deformation surveys
- Efficient method with fast data capture
- Highly detailed, precise, and reliable survey data
- Point cloud replicates the real world status of the refinery asset
  - Reduces the need to revisit the site
  - Inspection and analysis can be done from the office

Thank You

Q & A

Questions and Answers Session