

ELIOS 2 IN ACTION | OIL STORAGE INSPECTIONS

OIL STORAGE TANK INSPECTION SEES IMPROVED SAFETY, COST & EFFICIENCY WITH THE ELIOS 2



PERTAMINA, THE NATIONAL ENERGY COMPANY OF INDONESIA, HIRED HALO ROBOTICS TO OVERHAUL A HUGE OIL STORAGE TANK. THE ELIOS 2 WAS USED FOR THE TANK INSPECTION, AND RESULTS FAR EXCEEDED EXPECTATIONS.

BENEFITS IN A NUTSHELL

SAFETY

Using the Elios 2 to collect visual data inside the oil storage tank removed the need for manned entry via rope access and scaffolding, significantly improving safety for the inspection.

ROI

Costly, time-consuming inconsistencies between asset owners and EPC contractors were reduced with the Elios 2. Savings were also realized from reduced downtimes and not needing to build costly scaffolding.

Efficiency

Efficiency for the oil storage tank inspection was significantly improved using the Elios 2, with processes created that can enable systematic, repeatable inspections of aging assets for long-term analysis.

INTRODUCTION

PERTAMINA is the national energy company of Indonesia.

In an effort to improve its maintenance processes, PERTAMINA recently hired Halo Robotics, a drone technology company based in Jakarta, to help with a massive maintenance project at one of its oil refineries in Balongan, Indonesia, a refinery with a capacity of 125 mbsd (Thousand Barrels per Stream Day).

The specific asset at the Balongan refinery that needed to be overhauled was a huge bulk crude oil storage tank.

The tank shares features that are identical to those found in API 650 tanks, which are used for bulk crude oil and gasoline storage throughout the world, hypothetically making the results of and methods used for the maintenance project applicable to any refinery that uses API 650 tanks.

CUSTOMER NEEDS

PERTAMINA needed to conduct a major overhaul of a bulk crude oil storage tank at its oil refinery at Balongan, in the Indramayu Regency of Indonesia.

The tank was massive, with a capacity of holding up to 37,000 m3 of oil, and was fairly old, having been built in 1972.



A picture of the oil storage tank at the Balongan refinery

PERTAMINA's requirements for this maintenance project were:

- To update the tank's original drawings from 1972 with as-built schematics and blueprints.
- To systematically inspect the interior of the tank to determine EPC (Engineering, Procurement and Construction) requirements.
- To mitigate risk for inspection personnel by reducing the need for rope access and manned entry into tanks throughout the refinery, using this tank as a test case.
- To improve the overall efficiency of EPC maintenance processes, including evaluation, planning, and project execution.

A critical factor for executing this work was that the data produced needed to be usable in common

among all aspects of both planning and execution of maintenance for the tank (i.e., for Engineering, Procurement, and Construction—EPC).

In order to achieve these requirements, PERTAMINA leadership organized the work into two distinct outputs:

1. Create a *Digital Twin*—to obtain updated as-built schematics and structural data from a 3D scan of the tank.
2. *Confined Space Inspection*—to obtain a complete systematic Close Visual Inspection (CVI) of the interior of the tank.

The overall goal of this project was to create processes that could be replicated, which could then potentially be used throughout PERTAMINA's operations in the entire country.

Note: This case study only covers the second output (Confined Space Inspection). To learn more about how Halo Robotics addressed the first output (Create a Digital Twin) [see the full white paper on the Halo Robotics' site](#).



Inspectors working inside the oil storage tank

SOLUTION

PERTAMINA hired drone technology experts Halo Robotics to help implement the use of new technology to generate both of the required outputs for the project (Create a Digital Twin and Confined Visual Inspection).

For the confined space inspection, Halo Robotics decided to use Flyability's **Elios 2 drone**, citing the following features of the drone in its decision:

- **Collision-tolerant cage**—makes it ideal for indoor inspection scenarios, allowing for frequent, safe contact with assets
- **High quality image capture**—4K high resolution RGB camera and thermal IR camera allow for high quality visual data capture while conducting inspections
- **Professional lighting capabilities**—10,000 Lumen LED lights with both direct and oblique lighting systems, which allow inspectors to mimic the techniques of manned inspectors using flashlights to identify asset defects
- **Stabilization and Distance Lock**—systems and sensors allow for stable flight even in GPS-denied environments, as well as allowing inspectors to “lock in” the distance from the drone to the object being inspected
- **Inspector Software**—allows for efficient, user-friendly data review and report generation

RESULTS

The Elios 2 exceeded the expectations of PERTAMINA personnel for the confined space inspection inside the crude oil storage tank.

Compared to traditional inspection methods, which would require inspectors to physically enter the tank supported by rope access and scaffolding, the Elios 2 provided significant improvement, including helping PERTAMINA save time and money as well as increasing safety onsite and improving overall efficiency in its inspection processes.

“The results that have been obtained with this drone technology actually exceeded our previous expectations. These types of drone operations will really support preventive maintenance operations, helping us to locate specific defects, provide the correct type of maintenance, and ultimately achieve significant increases in speed and accuracy.”

- Almuayat Librata, Oil and Gas Transportation Manager at Pertamina EP

[WATCH VIDEO] Halo Robotics' overview of the results of this project.

CRUDE OIL STORAGE TANK MISSION DETAILS

Halo Robotics created flight plans to inspect specific parts and structures of the tank, including:

- Tank shell
- Tank welds
- Rafters
- Girders
- Joints
- Roof

Over five days, 20-22 inspection flights were conducted every day with the Elios 2. In total, the inspection produced 760 Gigabytes of inspection video footage (both RGB 4K video at 9 fps in standard .mp4 video and thermal video in .thm).

After collection, the visual and thermal data collected in these flights was processed offsite into a formal inspection report using Flyability's Inspector software.

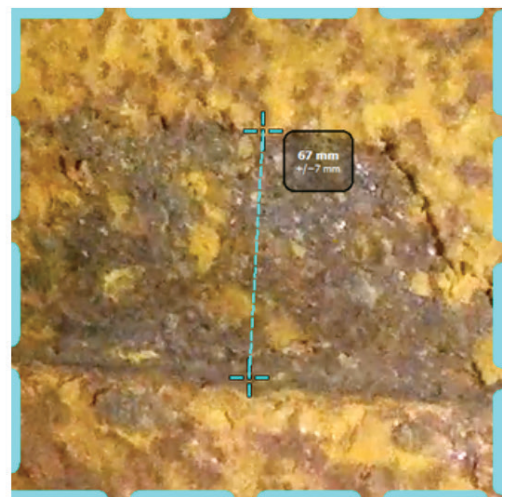


Halo Robotics shared that Inspector allowed it to “simply review large volumes of raw 4K RGB and thermal video output, select Points of Interest [POIs], and annotate those photos with inspection analysis” and generate a final Inspection Report. Halo Robotics also noted the use of Inspector to overlay thermal video on RGB color video in order to compare the two data points.

The total time required to review, analyze, and produce the final Inspection Report was 14 days. This time period included a comprehensive review and inspection annotation by an API-certified inspector.

POINT OF INTEREST (POI) REPORTING EXAMPLES

Corrosion Identified—Tank Joint Left Side

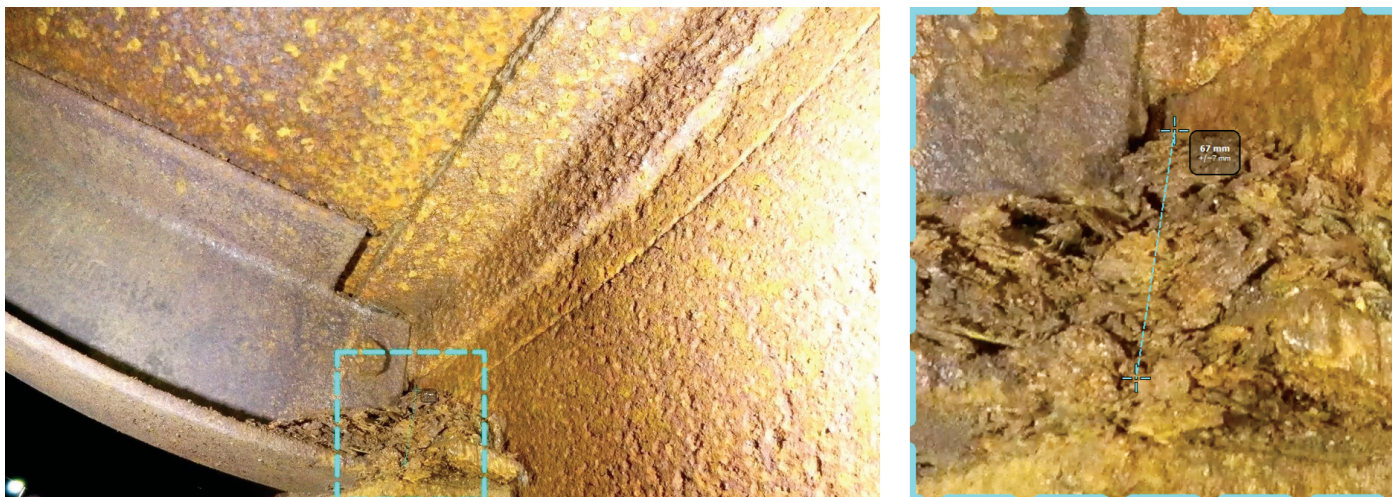


Inspector comments:

- 2x bolts counted
- Shrinking thickness of steel plating and supports
- Significant corrosion observed width 0 mm

- 67 mm from the joint
- Distance measurement: 67mm +/- 5mm

Flaking and Oil Material Build-Up Observed—Tank Joint Right Side



Inspector comments:

- 2x bolts counted
- Significant flaking or oil material deposit observed, build up in joint (67mm height)
- Homogeneous deep corrosion
- Deformation and exposure of raw metal to oxidation and galvanic reaction observed.
- Distance measurement: 67mm +/- 5mm

CONCLUSION

For PERTAMINA personnel, Halo Robotics's use of the Elios 2 for this massive maintenance project was a big success.

The confined space inspection demonstrated that even the largest oil storage tanks can be systematically inspected by drone in a manner that will be approved by an API-certified inspector, avoiding the need for manned entry, which requires costly, potentially dangerous scaffolding and rope access.

"We sincerely believe that implementing this type of drone technology will improve tank inspections, given the potential to reduce high risk and high cost activities, while also improving them to be safer and more efficient."

- Erikson Nainggolan, Operation Planning Assistant Manager at Pertamina EP

Now that PERTAMINA has successfully concluded this project, it is working with Halo Robotics to consider how to iterate out the use of drone technology for other maintenance projects at its refineries located throughout Indonesia.



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INSPECTION PICTURES TAKEN BY ELIOS 2



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TIME – COSTS – SAFETY

Flyability builds **safe drones for the inspection of inaccessible, confined, and complex places**. Focusing on the Energy, Oil & Gas, Chemicals & Maritime industries, Flyability enables end-users to save time, costs and reduce risks during visual inspections.