

ELIOS 2 IN ACTION | REFINERY INSPECTIONS

LARGEST ENERGY COMPANY IN TURKEY TESTS ELIOS 2 AT REFINERY



USING THE ELIOS 2 FOR AN FCC UNIT INSPECTION ALLOWED OIL & GAS REFINING COMPANY TÜPRAŞ TO AVOID SENDING AN INSPECTOR INSIDE A REACTOR RISER, KEEPING THE INSPECTOR OUT OF A POTENTIALLY DANGEROUS SITUATION AND SAVING THE COMPANY TIME AND MONEY.

BENEFITS IN A NUTSHELL

EFFICIENCY	ROI	SAFETY
There was no need for inspectors to go inside the FCC unit's riser because the Elios 2 was able to take the place of their physical presence for data collection, making the inspection process more efficient and repeatable than manual alternatives.	The Elios 2 allowed Tüpraş to save the equivalent of 2.5 days of work (170 man hours) by not having to cut the top cap of the riser, which is the standard procedure for human entrance to perform a visual inspection. Resulting savings were significant, as downtime for a refinery process unit can cost hundreds of thousands of dollars per day.	Use of the Elios 2 for remote visual data collection meant that inspectors did not need to enter confined spaces in the riser and cyclones of the FCC unit by rope access, which significantly decreased their exposure to risk.

OVERVIEW

Tüpraş is Turkey’s largest industrial enterprise, with a 30 mn ton crude oil processing capacity. It is also the 7th biggest refining company in Europe.

Tüpraş has around 5,000 employees at four different refineries operating in four different cities in the country—Izmit, Izmir, Kırıkkale, and Batman. The Izmit Refinery alone creates 33% of the petroleum products consumed in Turkey.

As in every petroleum refinery and Oil & Gas plant, all static equipment at the Izmit Refinery must be inspected periodically to comply with legal requirements for proper maintenance of the assets used in the refining process.

One of the inspections conducted at the refinery is of the FCC (Fluid Catalytic Cracking) unit, which is a huge piece of equipment used to convert heavy crude oil into marketable fuel products like gasoline. FCC units consist of several pipes, cyclones, and reactor vessels, all of which need to be inspected periodically to ensure the unit is safe for continued use.

CUSTOMER NEEDS

The international regulations observed in Turkey require that all equipment used at oil refineries be inspected at least once every four to five years. The maximum window for FCC unit inspections is five years, but Tüpraş conducts these inspections every four years.

Traditionally, inspectors physically enter various parts of the FCC unit to collect visual data on their condition. The unit is not designed with human entry in mind regarding today’s HSE standard approach. This means that these inspections can be intensive and potentially dangerous, requiring inspectors to enter large pipes and other areas of the equipment by rope access in order to collect visual data.

To inspect the unit’s riser—a huge pipe over 50 meters (164 feet) long used to mix heavy oil with a powdered catalyst at high temperatures—maintenance workers must take the very difficult step of cutting the top cap of the riser to provide an access point. When inspectors are done with their work, the top part of the riser is welded shut with the cap until



Drone pilot preparing to inspect the FCC unit at the Izmit Refinery

the next inspection.

Once inside the riser, inspectors are lowered slowly down the pipe on a rope, visually inspecting its interior as they go. There is usually debris inside the pipe, making the air quality poor and visibility difficult.

The FCC unit at Tüpraş' Izmit Refinery was built in the late 1960s following what was then a new design, which used a Fluidized Catalyst approach to mixing the heavy oil.

Given its age, the refinery was planning to replace the unit within the next year.

However, since four years had passed since the last inspection, Tüpraş personnel were faced with the need to enter the riser by cutting the top cap so they could perform a visual inspection to ensure the unit was still safe for use, and stay in compliance with international regulations.

SOLUTION

With the FCC unit's four-year inspection due, Tüpraş personnel began researching alternatives to manual inspections, hoping they could find an alternative to the need to send someone into the unit.

In their research they learned of the **Elios 2**, a drone that could collect all the visual data needed for the inspection of the FCC unit remotely.

The Elios 2 could collect visual data for the inspectors so they wouldn't have to enter the pipe, thus keeping them out of a potentially dangerous situation. It would also remove the need for cutting the top cap of the riser and the accompanying downtime and extra costs these steps would require.

[Related reading: Can a drone be used as a formal inspection tool?]

The Tüpraş team was intrigued and decided to test the Elios 2 for the FCC unit's visual inspection to see if it might be able to replace the need for a manual inspection completely.

RESULTS

Flyability personnel spent three days at the Izmit Refinery collecting visual data of the FCC unit for inspection purposes.

Flight conditions in the unit were challenging. The pipes and other component parts were narrow, dusty, and cluttered with debris in some cases. Despite these challenges, the Elios 2 was able to collect all of the visual data the Tüpraş team needed for the inspection of the unit and no inspectors need to enter any part of the unit for the inspection to be completed successfully.

FCC Unit Inspection Details

The three main components of the FCC unit that were inspected at the Izmit Refinery were:

The riser—a 50 meter-long (164 foot-long) vertical pipe lined with wear resistant refractory where the heavy hydrocarbons from crude oil mix with a catalyst and are cracked into smaller hydrocarbons. The vapor over head pipe—the 30" pipe that carries hydrocarbon vapors into a fractionating column where they are separated into gas, gasoline, diesel, paraffin, or other marketable petroleum products. The cyclones—cyclone separators used to separate hydrocarbon vapors and strip steam from the FCC catalyst

Riser Inspection

Inspecting the riser was the top priority for the Tüpraş team, since this was the part of the FCC unit that would typically require technicians to enter by cutting an access hatch.

If the Elios 2 had not been able to fly within the riser and collect the visual data needed the entire test would have failed, since the riser would still need to be cut open and physically entered for

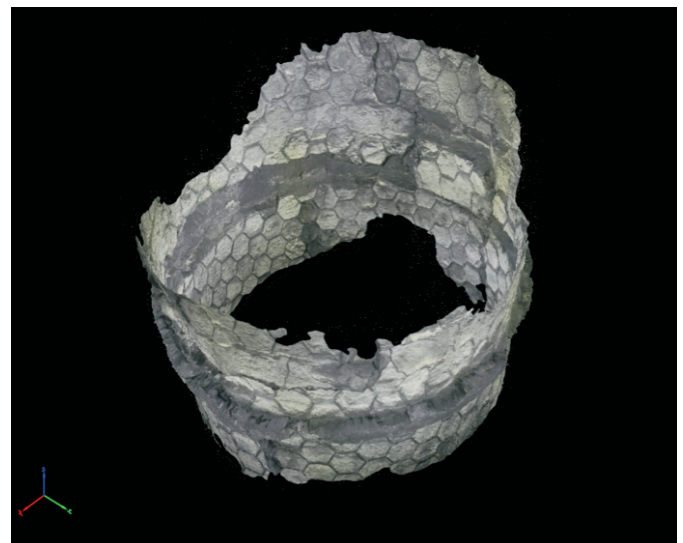
inspection.

The inspection of the riser consisted of:

- **A recon flight** to test the behavior of the drone within the pipe and to uncover any obstacles or dust present that might obstruct flying and/or the collection of visual data.
- **A general inspection flight** to the top of the riser and back down to collect visual data on the state of the entire pipe. After conducting this flight the video footage was analyzed frame by frame by the Tüpraş inspection team. The analysis revealed a potentially damaged section of the riser.
- **A detailed inspection flight** was made to further inspect the potentially damaged area revealed by the general inspection flight so that a maintenance decision could be reached. The Elios 2 was taken back to the site of the damage and then locked in place using the drone's unique distance lock. Visual footage was collected for a 360-degree view of the damaged section of the pipe. This footage was then reviewed by Tüpraş inspectors and they decided that no action was needed.

Results

The Elios 2 was able to collect all of the visual data needed for the riser inspection, saving the Tüpraş team from several days of work, which



3D map of the riser created with data collected by the Elios 2



Image taken inside the vapor pipe by the Elios 2



Image taken inside a cyclone by the Elios 2

would have been required for a manual inspection.

A 3D model of the riser rendered from the visual data the Elios 2 collected using Pix4D modeling software was crucial in making the decision about whether action should be taken to fix the defect found on the general inspection flight.

[Did you know? Pix4D and Flyability are now partners—[learn more here.](#)]

The model was created impromptu, but ended up being key in the decision making process, making Tüpraş inspectors excited about the possibility of using 3D models to track the progress of defects over time.

Vapor Overhead Pipe and Cyclones Inspection

Inspections of the vapor overhead pipe and of the cyclones within the FCC unit followed a similar approach to that used to inspect the riser.

First, a recon flight evaluated the overall conditions within the asset; then a general inspection flight collected visual data on the condition of the asset; and finally, after inspecting the data from the general flight, more detailed follow-up flights were made as needed to collect visual data on the condition of specific areas within the asset.

Throughout these missions, conditions made flying

difficult, with accumulated coke (a byproduct of oil refining) and other debris making it hard to see and to fly.

Results

The visual inspections of the vapor overhead pipe and of the cyclones with the Elios 2 were successful and found no major defects present.

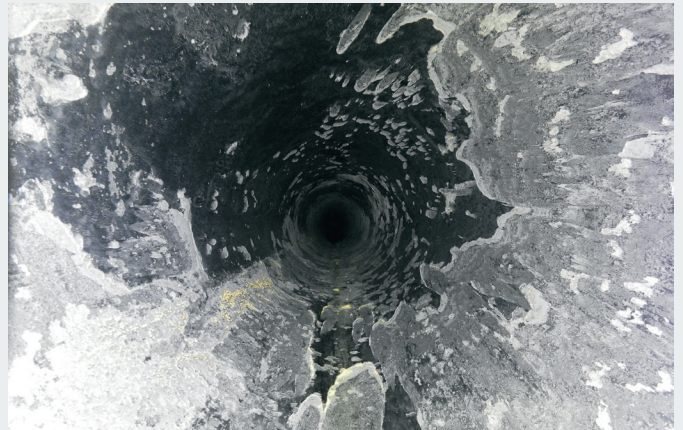
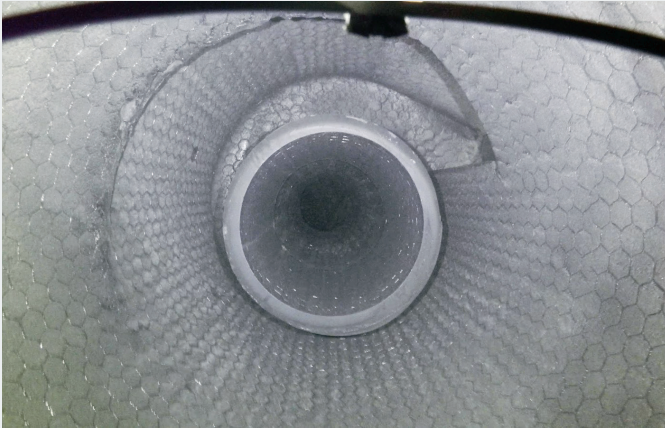
CONCLUSION

While inspecting the FCC unit the Elios 2 faced many collisions due to the confined spaces in which it was operating, as well as due to the poor visibility within the different parts of the unit.

Despite these challenges, the Elios 2 captured all of the visual data the Tüpraş team needed to conduct a successful visual inspection of the FCC unit and meet Turkey's legal requirements for the five-year inspection.

In the future, Tüpraş personnel would like to expand their use of the Elios 2 for inspections in their refineries, and use them not just for FCC unit inspections, but for use in all of the places where they need to conduct visual inspections of confined spaces

INSPECTION PICTURES TAKEN BY ELIOS 2



FLYABILITY SA

AV. DE SÉVELIN 20
CH-1004 LAUSANNE
+41 21 311 55 00
SALES@FLYABILITY.COM

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.