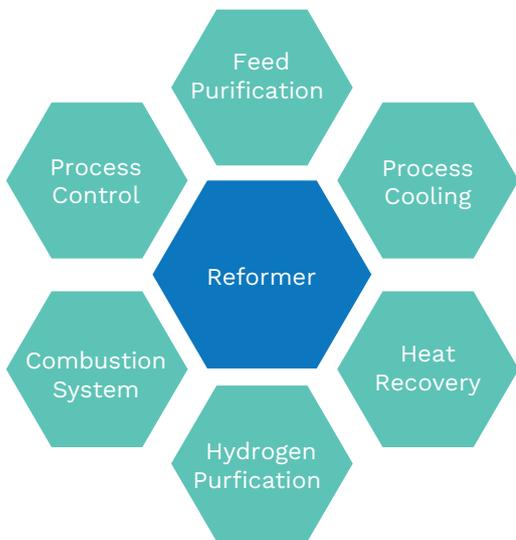


Steam Reformer Survey

A tool to evaluate operation and maximize efficiency



Technip Energies is uniquely qualified to assess all parts of the plant.

Whether in hydrogen, ammonia, carbon monoxide, methanol or syngas applications, the reliability of a steam reformer is essential for continuous, efficient operation of a processing plant.

A reformer which operates within its design parameters should ensure maximum efficiency and sustained operation. However when operating conditions differ from design, a plant's efficiency and reliability can be impacted.

Assessing critical components and benchmarking

Our Steam Reformer Survey quickly evaluates a reformer's performance. Using visual inspection and infrared technology, we can assess the mechanical status of critical components and then benchmark the operational performance against design specifications.

As a technology licensor and leader in designing complete hydrogen units, we are uniquely qualified to assess the reformer in detail, looking at the unit itself and its associated interconnections within the plant. For example, a plan to optimize a reformer's operation must also consider the catalyst performance, combustion performance, fluctuation and upsets in pressure swing adsorption purge gas fuel rate, all while keeping the existing mechanical design integrity.

How the survey works

The tool comprises two main activities.

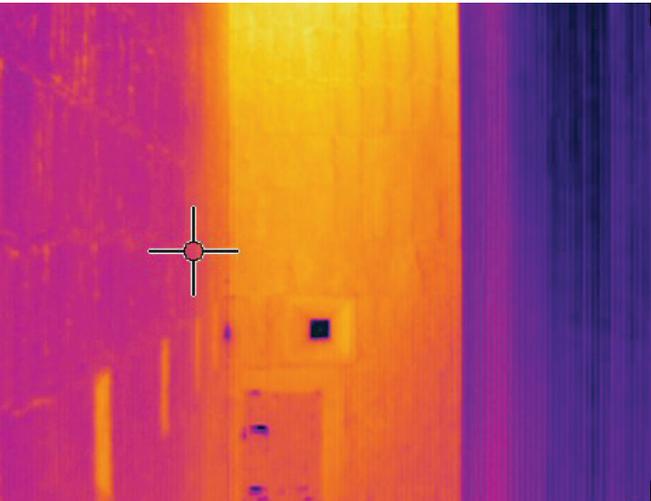
Our specialists visually inspect the online reformer section. Usually completed over two days, the inspection examines the:

- Refractory of the reformer (walls, floor, roof)
- Burner flame shape, dimension and stability
- Reformer tubes for deformation / expansion movements
- Reformer inlet and outlet systems for deformation / freedom of movements

We also inspect the heat distribution mapping of the inside of the reformer box through thermal imaging, which helps identify process issues otherwise not revealed by visual inspection or pyrometer readings.



The quick assessment is done with data provided by an infrared camera.



Temperature patterns inside a reformer box.

The mapping quickly allows us to:

- Assess catalyst tubes metal temperatures (in combination with pyrometer readings)
- Identify hot spots in reformer tubes (indication of areas with catalyst mal-performance / deactivation, or local overheating / flame impingement)
- Identify hot spots in refractory-lined equipment (reformer casing, refractory lined outlet header)

Then our engineers, with wide experience in plant design and performance evaluation, conduct a plant parameter review. They compare key operating data, laboratory data and catalyst information to plant design values to determine:

- Whether the reformer is operating within optimum design window
- If there are deviations
- Where deviations are found, what may be causing them

Depending on the complexity of the deviations discovered, we suggest corrective measures or recommend further evaluation and analysis to identify and overcome process limitations and reach optimum reformer operation.

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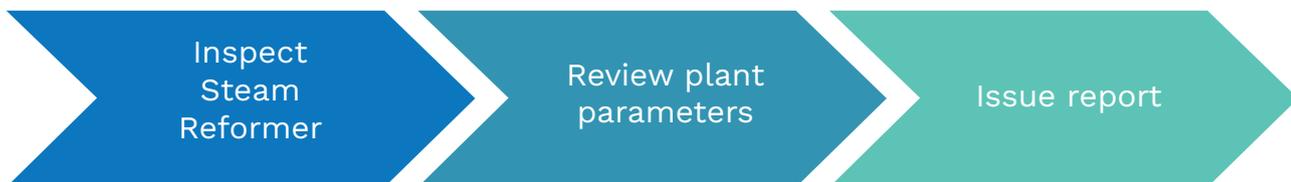
Reformer survey report

Technip Energies details its assessment of the operation and condition of the reformer in a report that combines the results of the inspection and plant parameter review. It includes suggestions for improving reliability, efficiency and lifespan of the reformer and its components.

Consistent hydrogen market leadership

Technip Energies' proprietary state-of-the-art steam reforming technology has been employed in more than 270 hydrogen plants worldwide. The workings and functional relationship of units in the plant, from feed purification and reformer to process cooling and hydrogen purification areas, is our specialty. This experience puts us in a unique position to evaluate and optimize a plant's performance.

Quick two-week assessment program



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