

Digital Asset Transformation by Continuous Corrosion (metal thickness) Monitoring: Case Studies from European Refineries

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ABSTRACT

Online continuous non-intrusive corrosion monitoring is fast becoming industry best-practice in the refining industry globally. This technique involves compact, robust battery-powered sensors placed strategically in the process units, coupled with wireless data delivery to enable continuous, high-quality data to be delivered directly to the desk of the corrosion engineer. This paper presents a collection of case studies from European refineries from the deployment of non-intrusive ultrasonic wall thickness monitoring systems. Beyond the initial goals of each project, the realised value gained from corrosion monitoring is also described, supported by the data and analysis measured by the monitoring system. This is then followed in each case study by the return on investment from the corrosion monitoring system at each refinery. These estimates of returns are based on the benefits realized by the operators, which include avoiding unscheduled shutdowns, diagnosing issues related to corrosion inhibition and extending turnarounds.

Key words: Corrosion monitoring, digital transformation, online monitoring, non-intrusive, wireless, corrosion control

INTRODUCTION

In the past years, the pressures on cost and profitability have been increasing gradually on refiners¹. The cost of crude oil is one of the major direct costs to oil production, and therefore is a key influence on profitability. Refiners can opt to blend in cheaper, so called, opportunity crudes in their process, which allow for substantial cost reductions. Such opportunity crudes are cheaper as they are typically more corrosive, can contain various contaminants, such as organic chlorides², overall making them

more difficult to process. The challenge associated with opportunity crudes therefore is how to mitigate the increased corrosion risk they introduce.

In recent years, wireless online corrosion monitoring devices have been developed with similar challenges in mind. This technique relies on the same principles as manual inspection. The purpose of this paper is not to review the technique itself, which has been in use for 10+ years, and descriptions of which are available³. It has seen rapid uptake of equipment and the realization that continuous monitoring is higher value than periodic data. Although the technology is now available, the knowledge about how to bridge the gap between the experts in monitoring technology and process chemistry, has not yet spread widely or bedded into best practices. This paper describes three case studies from European refineries, which are real examples of how corrosion monitoring can be used to increase profitability, lower costs, increase safety. These applications are very common across all refineries and so can be readily applied globally.

CORROSION MONITORING TECHNOLOGY

The permanently installed wireless corrosion monitoring system for this application was provided by Emerson. This combines established ultrasonic sensor technology with wireless communication to deliver data of the highest integrity to the user's desk. The permanently installed wall thickness sensors use breakthrough waveguide technology, enabling continuous operation even at temperatures of up to 600 °C (1100 °F). The sensors are powered by compact power modules meaning that no cabling is required: this minimizes the cost of installation and enables use in remote areas and on a large scale. The sensors and power modules are certified as intrinsically safe for use in hazardous areas. The wireless sensors form a mesh, thus ensuring multiple wireless communication pathways to a gateway. The gateway relays the data to the server, which hosts the Data Manager, giving an up-to-date picture of asset integrity at desk. The data can also be readily exported from the database to any customer application.

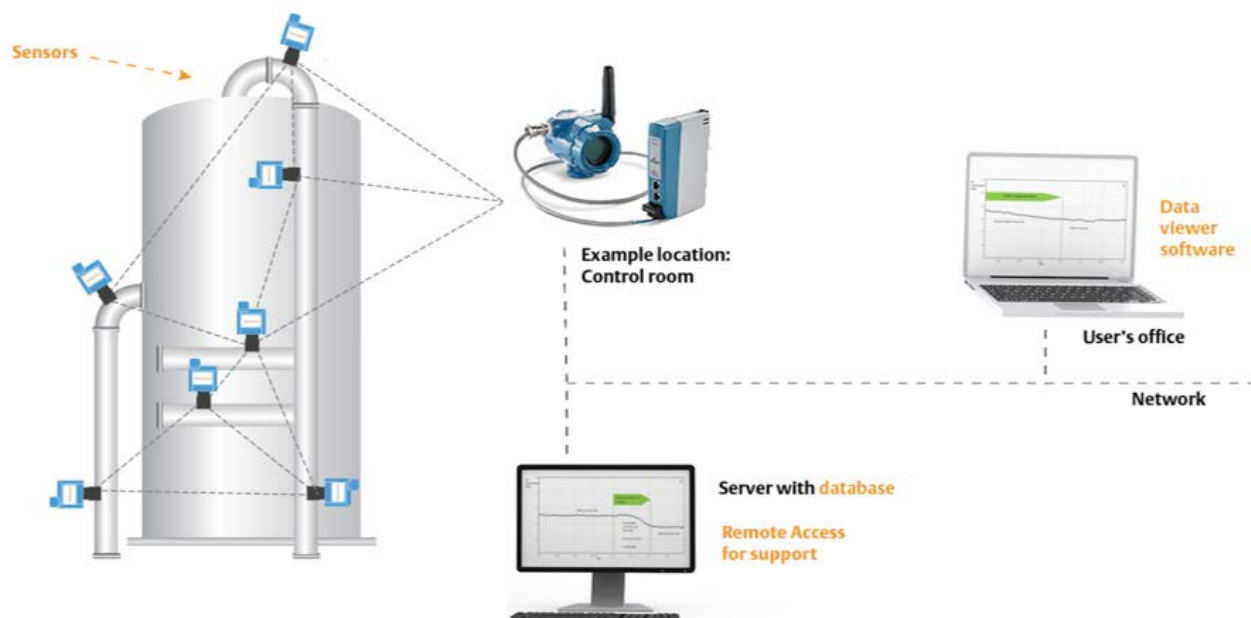


Figure 1 - The complete corrosion monitoring system

This system provides metal thickness measurements of unmatched quality and frequency that in many cases is otherwise unobtainable. These measurements enable intermittent or varying corrosion rates to be detected, measured, and acted upon. This corrosion monitoring system therefore provides the technology basis for the case studies described in this paper, which would otherwise would not have been possible.

CORROSION IN VACUUM RESIDUE RUNDOWN SYSTEM

The first case study is from the vacuum residue rundown system of an independently run refinery owned by 4 oil major shareholders. This refinery, just as all others, plans their turnarounds (TAR) well in advance with lots of preparation. The inspection department however raised concerns that it may not be possible to reach the next TAR. The inspection team relied on manual UT inspection to estimate equipment life, however accurate prediction was not possible because of the inherent low repeatability of the method. Since the prediction was not accurate, the team could not rule out the risk of an unplanned shutdown, which would incur very large costs⁴.

In order to mitigate this risk, the Emerson permanently installed corrosion monitoring system was selected. Four sensors were selected and installed on the thinnest pipe wall locations. These sensors were able to measure data, which quickly allowed the refiner to extrapolate corrosion rates and predict remaining life. The results showed that the next scheduled TAR can be reached without risk. This is show in Figure 1.

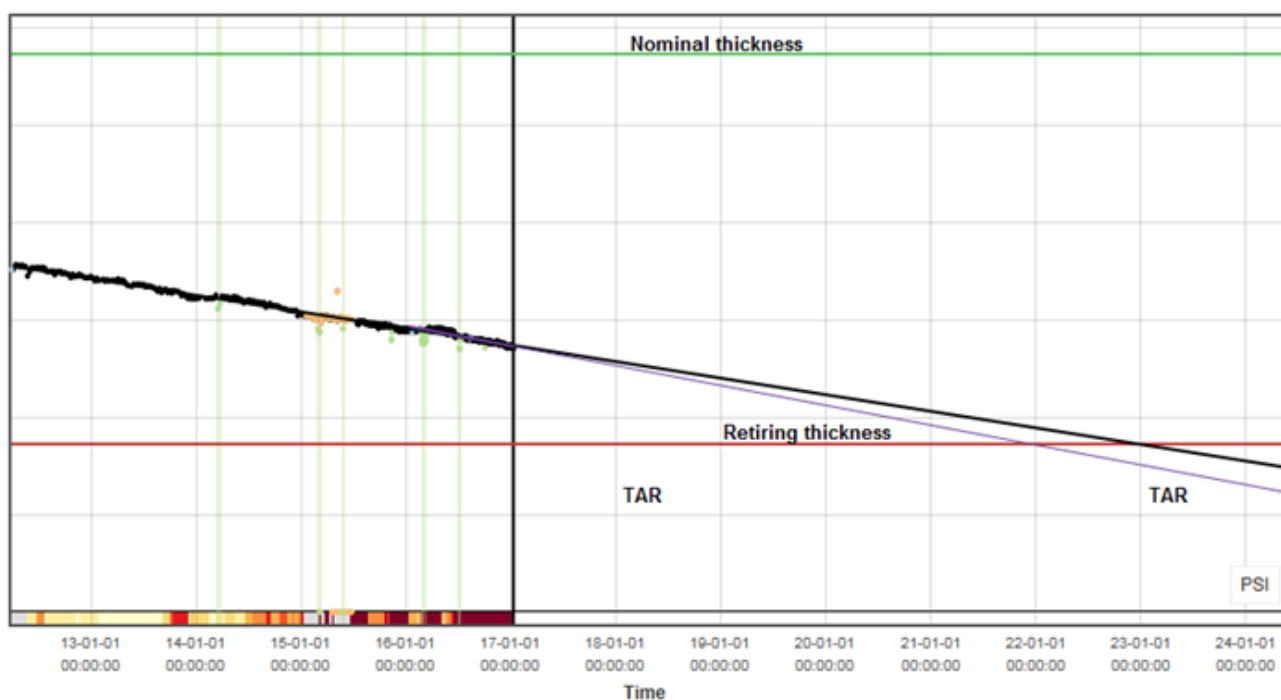


Figure 2 - Metal wall thickness measurements in the Vacuum Residue Rundown System

The data also informed the operator on expected corrosion rates in the future. It was decided that as a longer-term solution the pipe material would be upgraded to P9. The corrosion data predicted the need for replacement, but confirmed that such an action is not urgent: these decisions could be made in time so that the operator had sufficient time to design and procure the required replacement components. This therefore shortened the time of preparation and the replacement activity as well decreased associated costs.