THE ARROW
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TECHNICAL ARTICLE

Choosing & Using Condition Monitoring Locations (CMLs)

A facility that processes hydrocarbons needs an inspection program not only to meet regulatory requirements, but also to protect its bottom line by actively managing risk. While this goal may be a foregone conclusion, its achievement is not. So, what goes into a well-designed inspection program? And what does it produce? How can the most value be derived from inspection dollars?

Condition Monitoring Locations

The building blocks of a robust inspection program are condition monitoring locations (CMLs). As defined by API 510 and API 570, CMLs are designated locations on pressure vessels or piping systems where periodic external examinations are conducted to assess condition. Whereas random inspection would provide information about current condition, repeated inspection at CMLs enables data to be collected on change in condition, and ideally the rate of that change as well. This information allows more accurate risk-based inspection (RBI), optimized scheduling and safer more cost-effective operation.

How many CMLs are needed and how often should they be inspected?

There are no absolute answers to these questions in the codes, since the answers depend on a variety of factors that contribute to risk. Even the minimum frequency and type of inspection are left by most jurisdictions to be determined by the operator on a case-by-case basis and in each there are many factors to consider.

The most obvious factor is the service. A LOPC in high pressure gas service may have far graver consequences than a leak in a lube-oil system. Vessels containing corrosive fluids are more likely to suffer degradation than those containing dry oil or glycol.

Another factor is the material of construction. Each material carries its own unique set of capabilities and susceptibilities. In a specific set of conditions, one material might last virtually forever, while another might last only 5 to 10 years. The safe operation of a pressure vessel made from the latter, with a shorter expected design life, would require more frequent and thorough inspections to ensure integrity. Choosing an appropriate number of CMLs requires an accurate assessment of process conditions and a thorough understanding of the degradation mechanisms that may threaten integrity.

Where should CMLs be placed?

Again, the answer depends on a variety of factors. Some degradation mechanisms may be expected to occur only in certain geometric positions, while others may not. In piping where water dropout may occur, an inspection program might emphasize low points to monitor for carbon dioxide (CO_2) corrosion, under-deposit corrosion, or microbiologically influenced corrosion (MIC). Where fluid velocities and/or solids content makes erosion the most likely threat to integrity, locations of velocity change such as elbows would provide the most useful inspection data.

What kind of inspections should be performed to ensure integrity?

A wide variety of inspection techniques and technologies are available, from the human eye to handheld UT devices to permanently mounted guided wave testing devices. Which technique provides the most inspection value depends on service, materials, and risk-reduction strategy.

What should be done with CML inspection data?

The first analysis is generally to determine whether damage has occurred, and whether repairs or replacement will be required, but well-managed data can do more. A robust integrity management system will track inspection data to determine trends, and directly contribute to risk analysis and schedule optimization by means of RBI. Knowing corrosion rates can reduce "worst case scenario" assumptions and redirect resources to areas where corrosion is most likely. RBI allows operators to move beyond non-RBI maximum intervals and generate informed, optimized inspection programs based on actual risk.

With all the relevant factors taken into consideration, materials and corrosion specialists can work with an operator to determine, for each set of conditions in a facility:

- How many CMLs are enough?
- Where should they be placed?
- What monitoring techniques will be used?
- How often will inspections occur at each?

The answers to these questions impact operating budget, productivity, and safety. They should be good answers.

Conclusion

Whether it's a few dozen CMLs or several thousand, a well-designed and managed inspection plan has the right number of CMLs in the right locations, inspected with the right tools. A good inspection plan saves money on redundant or unnecessary inspection and ensures that inspections do occur where they are needed to prevent unplanned down-time or worse.

Recommended Reading

For more information on CMLs, the following codes and practices are recommended:

- API 510 Pressure Vessel Inspection Code: In-Service Inspection, Rating, Repair, and Alteration. May 2014. American Petroleum Institute.
- API 570 Piping Inspection Code: In-Service Inspection, Rating, Repair, and Alteration of Piping Systems. American Petroleum Institute, Feb. 2016.
- API Recommend Practice 580 Risk-Based Inspection. Feb. 2016.
- API Recommended Practice 571 Damage Mechanisms Affecting Fixed Equipment in the Refining Industry. American Petroleum Institute, Apr. 2011.
- API Recommended Practice 574 Inspection Practices for Piping System Components. American Petroleum Institute, Nov. 2016.