Optimising the use of inspection results

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With a range of inspection methods in common use by operators, it can be hard to know how to best utilise that information in managing risk. This article discusses how the results from modern inspections and integrity assessments can be used to give comprehensive insight into the health of a pipeline, including using results where no deficiencies are found.

A limitation that continues to plague older risk assessment methodologies is the inability to fully include the results of inspections. No one disputes the value of inspection and its critical role in failure avoidance; yet neither the classical statistics-centric quantitative risk assessment (QRA) nor the common relative risk ranking methodologies can capture inspection activity in a meaningful way.

A modern risk assessment methodology should recognise exactly what has been learned from an inspection and how that knowledge should be used in risk management. The age of each inspection and its detection/sizing capabilities are crucial, as are the inspection findings themselves.

INSPECTION OF INTEGRITY VS INSPECTION OF DEFENCES

A previous article, 'ILI vs DA – The Risk View' (2016), compared inline inspection (ILI) versus direct assessment (DA), external corrosion DA or (ECDA) in particular. This article highlighted a fundamental difference between the two types of inspection. The main conclusion was that one is a forward-looking technique while the other is backward-looking technique.

Fully utilising the data from an inspection must include scenarios where an asset was 'inspected with no findings of deficiencies or weaknesses'. Despite finding no deficiencies, the inspection still provides valuable data.

The ECDA is a forward-looking technique, since it mostly yields information on mitigation and how well protected the system is. The ECDA, and especially its overline surveys, show deficiencies in protection that may lead to future damages.

ILI and pressure testing are primarily backwards-looking techniques, showing damages that have already occurred. Both techniques are important, though neither tells us everything; each contributes to risk reduction but in different ways. Good risk assessments demonstrate the role of each technique and help operators make better decisions.

WHEN 'NOTHING' IS FOUND

Fully utilising the data from an inspection must include scenarios where an asset was 'inspected with no findings of deficiencies or weaknesses'. Despite finding no deficiencies, the inspection still provides valuable data. Conducting an inspection and finding no deficiencies is not the same as not inspecting at all. That probably seems obvious, yet some risk assessments fail to make that differentiation.

In the case of ILI with no deficiencies detected, inspection has shown that there are no weaknesses within detection limits existing on the date of inspection. Prior to the ILI, the risk assessment should conservatively assume that some damages have occurred from corrosion, cracking, external forces, and so on.

Since no damages were found, the clock has been reset; the assumed damages did not actually occur, so the original strength (wall thickness) can be used in risk calculations. An ILI also provides some indirect evidence regarding exposure and mitigation, which is valuable but not being discussed here. Similarly, an ECDA that finds no deficiencies also provides valuable information. It confirms, to some confidence level, that the mitigation – cathodic protection (CP) and coating – are performing as intended at all points.

Once the differing roles of inspection methods are understood, the best way to utilise the information gained from an inspection in a risk assessment can be explored.

AGE AND ACCURACY

Datasets of inspection results provide inputs for assessing mitigation effectiveness, or strength or resistance estimates. Risk assessment algorithms use these datasets, but can do so only after adjusting the values for two key considerations:

- What might the inspection have missed?
- What might have happened since the inspection?

Answers to both of these questions must accompany the use of the inspection data, while remaining consistent with the chosen level of conservatism accompanying the risk assessment. But how can that be done efficiently over many kilometres of pipeline operating over multiple decades?

A BROADCAST SOLUTION

It is not unusual for single locations along a pipeline to undergo multiple inspections of various types, spanning many years. In addition to ILI, pressure testing and DA, other types of surveys and inspections are common.

For instance, inspections measuring soil resistivity inform estimates of failure mechanism aggressiveness, also known as exposure, while inspections like depth of cover and pipe-to-soil voltage inform estimates of mitigation.

Integrity-centric inspections, including in-ditch ultrasonic technology (UT) measurements and magnetic particle inspection (MPI), inform estimates of resistance. Other inspection methods inform estimates of consequences, such as population density surveys, spill dispersion analyses, and so on.

Each inspection provides valuable risk assessment knowledge, and is subject to aging and accuracy limitations. There will sometimes be overlapping, conflicting and confounding findings from inspections, and gaps where portions of the system have not been inspected.

In order to efficiently capture and utilise a wide variety of inspections that have been performed over many years with disparate findings, a broadcast solution is needed. That is, a way to efficiently compare inspection results, resolve differences in findings, override older and less accurate information in favour of newer and more accurate information, and include in the risk assessment only the best information.

This solution should be able to very rapidly analyse information gained from many kilometres of pipeline or facility networks without much manual examination of specific locations. The key to obtaining this level of efficiency is to first identify how the inspection impacts risk estimates, and then adjust the findings of every inspection for age and accuracy. This is a matter of estimating the rate of emergence of various weaknesses, and abilities of the various inspections to detect them.

When this adjustment is done consistently and conservatively, the more optimistic findings will almost always appropriately override the more pessimistic findings. This makes it easy for a broadcast solution to assess a system that is many kilometres long and select the most useful information to include in a risk assessment.

BETTER RISK ANALYSES

Learnings from inspections are valuable and usually intuitive. Unfortunately, their use in formal risk assessments has been questionable in the past. The appropriate use of knowledge gained from inspection is yet another distinguishing feature of modern risk assessment methods compared to older techniques. P

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