Case study: What is the optimal inspection interval for an aging pipeline?

Problem description: Aging pipeline with integrity concerns: how often to inspect and what if renewal instead?

The plant’s Chief Inspector was concerned that insufficient inspection was being carried out on the aging ethylene pipeline. The pipe is already being monitored annually using ultrasonic wall thickness measurements, following a Risk Based Inspection (RBI) study.

Nevertheless he considered that the company was at risk of being forced to repair or renew the pipeline at short notice if an ethylene leak or pipeline burst were to occur or the corrosion allowance were found to have been exceeded.

Results and benefits:

Scheduling the next inspection in 3 months time instead of waiting for the RBI-derived timing of 12 months, would reduce the risk of forced repairs and downtime by c.$31,000/month. This earlier intervention is mainly justified by the risk of forced repair and downtime if the corrosion allowance is exceeded (blue line in graph above) rather than the integrity risk (red line).

The study also considered the effect of replacing the pipe on a planned basis. This would significantly reduce the risks and need for monitoring: Overleaf, the comparison graph shows the cost/risk reduction if such a renewal were to occur: these form inputs to the Capex evaluation, which would use the corresponding SALVO evaluation process to justify investment and optimal timing.

The study we performed

We were called support a multi-disciplined team study of the optimal inspection programme using the SALVO Process. This provides a structured navigation and evaluation discipline to ensure all factors, stakeholder interests, uncertainties and scenarios were explored, quantified and evaluated on a consistent and auditable basis.

This case involved a small team comprising inspectors, operations, maintenance, finance and insurance, risk management and process safety personnel. It used a mixture of known historical data (previous measurements, costs etc.), expert knowledge and some prior RBI studies to help in estimating the ongoing degradation rates (if such information had not been available, the process facilitates the capture of optimistic and pessimistic extremes of expert opinion and explored these for decision sensitivity).

It needed just 2 hours to build the base case scenario, using the appropriate SALVO story-board and DST Inspection Evaluator software to model the risks, costs and operational options available. The team also developed a number of alternative scenarios, such as the effect of pipeline re-lining or replacement, to explore their impact of the optimum

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1 SALVO Process developed by 4-year multi-industry collaboration programme to research and develop best practices in asset management decision-making. See www.SALVOPrject.org
The study, including testing for sensitivity for all sources of data uncertainty, revealed the following:

- There was an opportunity to introduce flexible inspection schedules for critical cases such as this, instead of fixed interval corrosion monitoring. This dynamic inspection strategy is useful for ageing assets where inspections should become more frequent as deterioration progresses.

- If inspections can only be carried out during shutdowns, the evaluation process includes facility for identifying which ‘opportunity’ occasions are best exploited, as well as a potential ‘pit stop’ shutdown specifically for the purposes of the inspection.

The replacement of the pipeline which would naturally result in longer inspection intervals and reduce planned inspection costs and levels of risk associated with the pipeline. This study included an evaluation of how much this benefit would be (see graph above). However the significant Capital investment required for the pipeline replacement, the optimal timing for this, and the future pipe life cycle costs would need to be evaluated in a corresponding SALVO Process, supported by the relevant cost/risk/benefit analysis, using the DST Lifespan Evaluator™ software module.

The difference between RBI-derived strategies and the true optimal cost/risk decision was clear. Whereas RBI is an extremely powerful systematic method of developing risk-proportionate monitoring strategies, it does not adequately consider the costs (and potential downtime costs) of inspections, the probabilistic exposure to exceeding corrosion allowances and other economic factors which may justify earlier or later intervention.

To perform the complex reliability, risk and financial ‘what if?’ calculations, this study used decision-support software called DST Inspection Evaluator™. This tool was developed as part of the international SALVO project (www.SALVOproject.org) to support the analysis of asset inspection and condition monitoring decisions. Like other modules in the DST Asset Strategy Evaluator™ suite, the tool provides:

- A structured logic, with clear ‘storyboard’ checklist to ensure all factors are considered.
- Disciplined process to capture and quantify the knowledge of cross-disciplined teams, including their uncertainty.
- State-of-the-art analytical algorithms to evaluate the life cycle cost, risk and performance of decision options.
- Sophisticated, extremely rapid sensitivity-analysis to identify which assumptions have what effect upon the decision.
- Rapid creation and evaluation/comparison of multiple scenarios, enabling the study team to compare alternatives and explore ‘what if?’ ideas - instantly.

For further information about DST Inspection Evaluator™, and the SALVO Process, please contact:

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