Case Study: optimal functional testing interval for 11kV circuit breakers

ASSET STRATEGY EVALUATOR

Problem description: ***What is the optimal functional testing interval for a 11kV circuit breaker?***

The SALVO Process (www.SALVOproject.org) provides a storyboard for evaluating different asset interventions. For functional testing strategies, it introduces the DST Inspection Evaluator tool, to enable the storyboard–guided consideration and quantification of:

Risks of different circuit breaker failures modes

- Degradation mechanisms, with probability patterns and possible consequences as injury, damage to assets, environmental impact and downtime to the customer.
- Random damage and *introduced* risks, including those associated with the testing activity.

Direct and indirect costs, quality and reliability of testing and methods

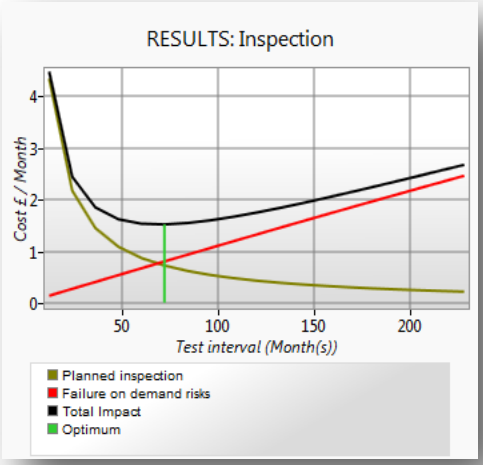
- Switching costs, labour and travel time/costs.
- Outage/downtime impacts of isolating the breaker for the test, including risk of secondary problems and period of reduced standby flexibility).

Results and benefits:

*The study determined the optimal testing strategy, including sensitivity analysis to uncertain data. It revealed the optimal interval to be 36 months. Compared to the present interval of 12 months, the benefit of moving 5000 circuit breakers to 36 months is c.****£162,000 per year****.*

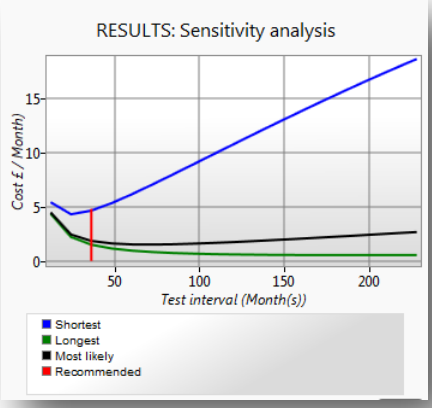
Circuit breakers perform a critical role in an electrical supply network. If they are in a failed state (which might not be evident to the operational personnel at the time), major incidents can occur if their protective function is not available. So a cost-effective testing programme is needed to find and fix any failures.

The organisation has 5000 circuit breakers across their network, currently tested every year. By using the SALVO process and the DST Inspection Evaluator tool, this strategy was shown to be inappropriate.



The structured SALVO process, supported by instant cost/risk modelling, revealed the optimal testing interval to be 6-yearly (using 'most likely' assumptions).

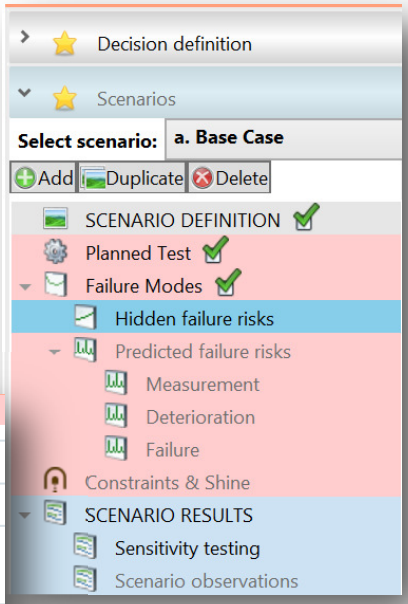
However DST enables data *uncertainty* to be considered too, and this showed that different assumptions could justify a wide range of testing intervals, but a 3-yearly frequency is an appropriate strategy (best value mix of costs and risks) *in all possible interpretations.* This provides management confidence in implementing the recommended strategy, with clear audit trail and demonstration of why the strategy is appropriate.



Analysing functional testing of protective devices and stand-by systems

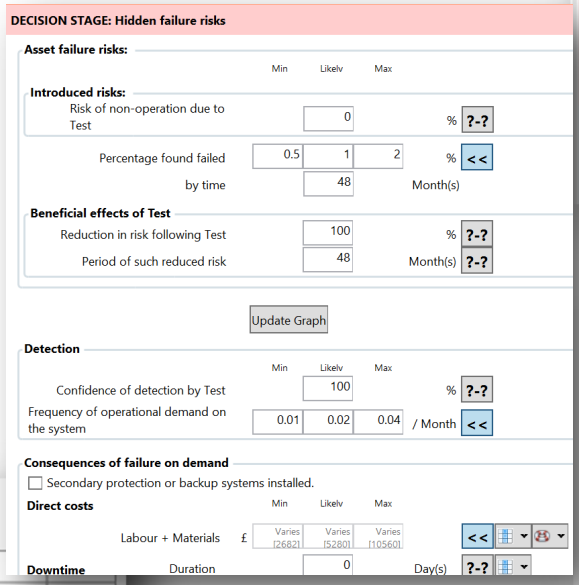
DST Inspection Evaluator was developed as part of the international SALVO project to guide and support the analysis of functional testing and inspections of assets subject to hidden failure modes. It provides:

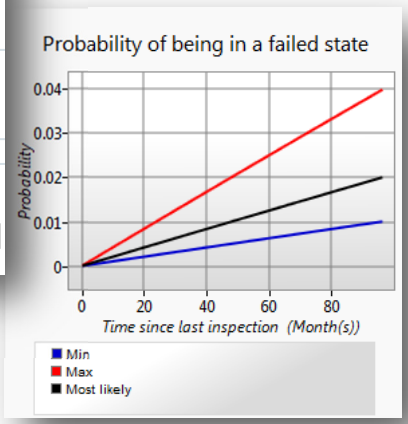
- A structured logic, with clear 'storyboard' checklist to ensure all factors are considered
- Disciplined process to draw out and quantify the knowledge of cross-disciplined teams and subject matter experts,
- State-of-the-art analytical software to evaluate the cost, risk and optimal timings of inspections or testing strategies.

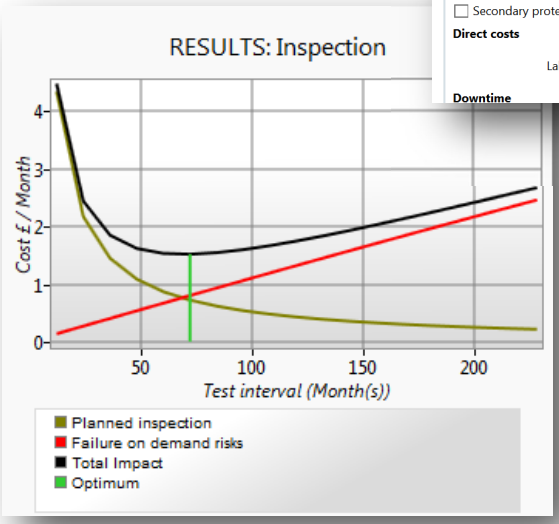


This case involved a small team comprising inspectors, operations, maintenance and process safety personnel. It needed just 2 hours to build a 'base case' model of the risks and costs and operational options available, and identify the optimal strategy. Sensitivity analysis then automatically explored the effects of data uncertainty, showing the best strategy to minimise the impact of this uncertainty.

Finally, a formal decision-recording stage ensures capture of the optimal strategy, the implementation actions and audit trail for *why* the testing interval is correct. If there are mandatory requirements, it also shows the 'cost of compliance' compared to the cost/risk optimum.







Further work:

The next stage for such studies is consideration of the optimal *bundling* of these functional tests with other planned maintenance, inspections or engineering projects that occur across the network. This stage is facilitated by another part of the SALVO process, and the DST Schedule Optimizer tool (which finds the optimal shutdown/outage and work bundling opportunities for competing priorities and constrained resources or budgets).

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

Decision Support Tools Ltd.
Prince Henry House
Kingsclere Business Park,
Hampshire RG 20 4SW
Tel: +44 (0)1635 299200

www.decisionsupporttools.com

www.SALVOproject.org