



Winning the battle with downtime

Tony Musgrave

In continuous manufacturing 90 percent of all potential failures are likely to be caused by just 10 per cent of the installed equipment. When planning preventive maintenance, it therefore makes good business sense to focus on this high-risk group. Risk Based Inspection (RBI) enable people to do exactly that. Recent experience has shown that ABB customers can benefit from a dramatic saving in time and cost by using this tool.

Operational profitability

Plant engineers fight a continuous battle with downtime. Although key contributors, maintenance and repairs are not, however, the only cause for concern; increasingly, it is the threat of business interruption, with its effect on output and profitability. The viability of a process, even the business itself, may be on the line as a result.

ABB Eutech¹⁾ has developed a Risk Based Inspection (RBI) method that enables companies to substantially increase plant reliability, reduce the number of plant failures and cut the time re-quired for regular inspection/maintenance.

Recent results with four customers in the chemical and petrochemical industry provide compelling evidence of major savings. The total cost of inspection, for example, could be reduced by 49 to 80 percent. Average inspection intervals were increased by between 35 and 57 percent, with an average increase of 44 percent. And more than half the plant equipment could be removed from the invasive inspection programs.

The bottom line is that RBI reduces downtime, planned or unplanned, for a saving in maintenance costs. The time and capacity/availability that is released as a result has a direct, positive effect on a plant's output.

The principles of RBI

RBI is a knowledge-based method that uses risk as a basis for prioritizing and managing an inspection program. In this definition, "risk" is seen as the result of the probability of future failure and the likely consequence of that failure.

Generally speaking, the level of risk associated with the different pieces of

equipment that make up a plant is variable. However, this fact is seldom reflected in the inspection routines applied across the inventory of equipment. Risk-based inspections focus the inspection and maintenance effort on those areas where the risk and its potential effects are greatest.

The prime objectives of an RBI program are to:

- Focus effort on identifying and reducing the safety and business risks.
- Achieve increased plant availability by ensuring that outages only take place for essential inspections.
- Reduce the maintenance costs associated with unnecessary or excessive dismantling and preparation.
- Improve safety by getting rid of hazards associated with preparing for inspections.

RBI is becoming the preferred tool by which "good engineering practice" is measured. Its predictive approach is designed to eliminate excess and inadequacy by concentrating inspection effort on real risks ¹. Use of RBI has shown to be effective in reducing the number of unforeseen breakdowns.

The ABB approach to RBI

ABB's RBI process is built around an asset care strategy that is designed to monitor the plant throughout its life-cycle. This involves the acquisition of detailed knowledge and requires a good understanding of the behavior of every component in the plant under its current duty conditions. Multi-disciplinary in its approach, it looks at parameters such as the design/construction quality, inspection/maintenance history, and the service conditions, including normal and abnormal excursions. The review identifies all failure mechanisms and associated risks.

This accumulated knowledge and experience helps engineers to decide what equipment needs to be inspected and when, as well as to establish where failure would be least acceptable and cause the most problems. This makes it easier to see where effort has to be focused in order to maximize the return. It facilitates the optimization of examination intervals whilst at the same time identifying equipment for which non-invasive examinations would be equally effective.

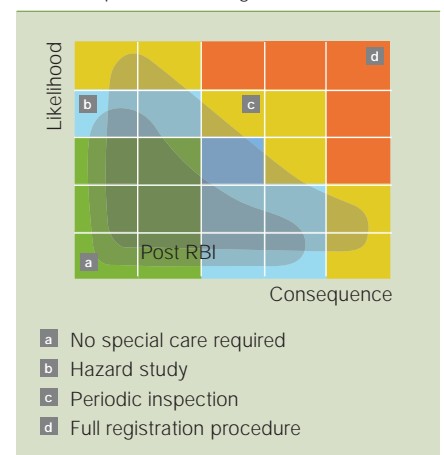
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Up until now, ABB's experience has been mainly with pressure vessels. However, exactly the same approach is adopted when assessing risks for rotating equipment, critical instrumentation and structures.

The company's RBI approach relies on harnessing company and consultants' expertise as well as the use of sophisticated software tools.

ABB has refined its proven RBI approach into an efficient, streamlined solution called Risk Based Inspection⁺ ². The result of experience gained through hundreds of projects, it focuses on delivering tangible results by:

- ¹ RBI risk matrix: moving the operating risk envelope to a safer region



Factbox Typical recent results

Study	A	B	C	D
Average inspection interval before/after RBI study (months)	31/44	No data	54/85	48/65
Vessels moved to non-invasive inspection	16 out of 26	76 out of 157	90 out of 179	41 out of 82
Reduction in inspection costs	58%	49%	61%	81%

- Accumulating comprehensive knowledge of the risks associated with specific plant assets.
- Significantly reducing the total cost of inspections.
- Achieving longer intervals between inspection/maintenance turnarounds and reducing the time needed for them.
- Ensuring much improved equipment availability and reliability, and minimizing unforeseen breakdowns, resulting in more uptime.
- Building greater confidence in equipment integrity.
- Providing an established path to all necessary regulatory approvals.

An outstanding example of the success of Risk Based Inspection+ implemented in close partnership with a customer is a project ABB undertook recently for Victrex plc, a UK polymer producer.

RBI delivers for Victrex

Victrex manufactures PEEK™ polymer, a high-performance thermoplastic with exceptional chemical, wear, electrical and temperature resistance. It is used in critical applications in the industrial, automotive, electronics, medical, aerospace and food industries around the world.

The company is actively expanding its markets for PEEK polymer through intensive marketing, customer-focused service and a commitment to product quality. Victrex is in the fortunate position of enjoying very high demand for its product. Its major challenge is to increase production while controlling overhead and investment costs.

Working with ABB, Victrex engineers were aiming to break out of the vicious loop that had always linked higher output to investment in new

plant. The general rule was that an annual increase of 100 tons in output always required an investment of \$ 1.5 million.

In recent years output has been raised from 1000 tons per year to 2000 tons in two jumps of 500 tons, first in 1996 and then again in 2000. In each case almost \$ 10 million was invested in new plant 3.

Saving time, saving cost

The inspection and maintenance routines were a prime target for close examination. It was seen that time and cost savings could make a vast difference to output, efficiency and profitability of the plant.

Before RBI the inspection regime was prescriptively invasive on all items, regardless of the risks associated with them. It is a fact that, very often, extensive inspection during the shut-down periods reveals no deterioration. However, there are occasions when unexpected problems are found, and these can lead to unplanned repairs that increase the outage time.

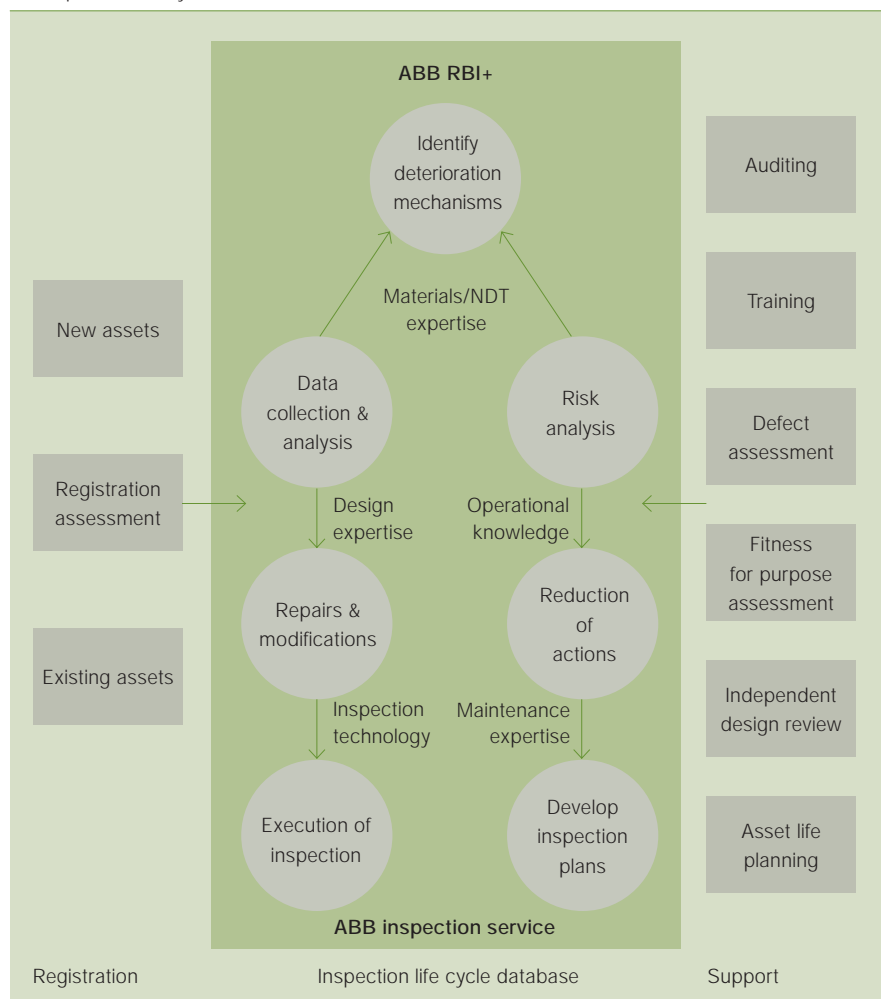
All inspection and maintenance work on the main pressure vessels must comply with Pressure Systems Safety Regulations 2000. These look mainly at how the safety performance and condition of the vessels reduce workplace risks as far as is reasonably practical.

As a Victrex engineer puts it, “The total cost of inspection includes decommissioning, decontamination and preparation for internal inspection. All this time and effort just to find that, more often than not, everything is OK! This led us to question our approach.”

It was this questioning that steered the company toward a knowledge-based approach to understanding the behavior of the plant.

The RBI objective was to raise plant availability from 80 to 85 per cent – from 290 days to 310 days per year – which is the “world-class standard” for similar batch specialty chemical processes.

2 Inspection life cycle database



Operational profitability

It was concluded that the main contribution to increasing plant availability would come from a reduction in the annual shutdown time. This would need to be cut from 35 days to 21 days.

The potential financial benefit of saving a large amount of downtime was estimated to be almost \$ 10 million. Such an amount would result from an improved gross margin and reduced short-term investment needs.

None of this means that future plant expansion is ruled out, but Victrex immediate priority was to get the most return from its existing facility before embarking on further major investment.

For both ABB and Victrex there were some essential steps in ensuring that RBI delivered the desired benefits. Above all else there was the need to harness all existing in-house knowledge and experience and link it to ABB expertise. As a starting point, the in-house team members were to pool all their knowledge and experience. This data, both qualitative and quantitative, together with historical records of previous inspections and a thor-

3 The Victrex plant



ough analysis of the causes of lost output in the last 12 months, provided the basis for the knowledge base on which the RBI plan would be developed.

For Victrex, a UK polymer producer, the potential financial benefit of reducing downtime through RBI was estimated to be almost \$ 10 million.

A full understanding of the results of past inspections of pressure vessels during shutdowns was vital, since preparing for and carrying out invasive inspections accounts for much of the time and effort involved in a shutdown. Knowing and understanding the failure mechanisms each item is susceptible to, and where to look for them, helped the team decide on the adequacy of non-invasive inspection. This proved to be a major benefit. Thoroughly gathering and assessing salient historical data, plus the use of ABB advanced software tools, enabled the team to develop an inspection routine that prioritizes and responds to risks and foreseen failure scenarios. It also minimizes the risk of unexpected failure.

Having carried out the full review and created an RBI program, the results have proved immediate and impressive. The first shutdown to be affected, in October 2001, required only

nine days. The necessary engineering and maintenance work was completed in four days. The total cost of the exercise was half the amount budgeted.

The next shutdown period, a little less than a year later, was cut from 35 days to 20 days. The team expects shutdowns to be kept to this level in future years as some of the equipment gets older and wear and tear increases.

Besides the welcome time saving it provides, RBI has met and exceeded expecta-

tions. During a recent period of high demand, the gross margin has been improved by more than \$ 9 million over eighteen months of operation and other savings on capital investment and associated depreciation exceed \$ 3 million. Year on year shutdown savings are running at almost \$ 100,000. Victrex engineers admit that their initial desire to apply RBI was an act of faith. They saw the opportunity and believed that the goals would be achieved, but they had no previous experience to refer to. As Andrew Anderson, Engineering Manager of Victrex says, "The past experience, professionalism and expertise of ABB were vital elements in steering the work forward and in providing the confidence in the achievability of our objectives."

The Victrex experience shows quite clearly that Risk Based Inspections can provide the benefits businesses need to save on preventive maintenance while minimizing the risks of failure.

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Factbox ABB Risk Based Inspection[®] in brief

- What equipment should be inspected? Where would failure be unacceptable?
- Where should effort be focused?
- Which techniques should be used?
- How can the examination intervals be optimized?

Benefits

- Increased knowledge of the risk of operating assets
- Significant reduction in the total cost of inspection
- Longer turnaround intervals, and reduced turnaround durations
- Improved equipment availability and reliability, helping to maximize uptime
- Increased confidence in equipment integrity
- Established path to regulatory approval

Footnote

¹⁾ ABB Eutech is the process solutions center of excellence within ABB's petroleum, chemical, life science and consumer goods industries business area.