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Life After a Risk-Based Inspection Implementation

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Abstract

Many chemical and oil and gas organizations have Risk-Based Inspection (RBI) programs in the form of the American Petroleum Institute (API) API Recommended Practice (RP) 580 Risk-Based Inspection program. Numerous organizations have software databases or software tools that enable the RBI program to function. These same organizations also struggle to ensure that the RBI program performs to expectations following the initial implementation project. Organizations purchase a software expecting this tool to produce the results claimed about a RBI program once it is populated with their data, but then fail to identify that their RBI program requires a systematic approach, combined with personnel expertise and knowledge of the processes to achieve a fully functional and effective RBI program. "Life After a Risk-Based Inspection Implementation" gives simple examples through case studies to identify what to do after a RBI Implementation to produce the kind of results that can be achieved through an effective and sustainable RBI program. These case studies reveal that when a RBI program is managed appropriately, it becomes sustained and valuable, thus leading to the prevention of failures, the added effectiveness and value creation of the inspection, reliability, and maintenance program, and an increase in knowledge to help aid the decision makers produce high yield results.

Keywords: Risk-Based Inspection, RBI, API RP 580, Implementation, RBI Software, RBI Database, Inspection Plans

Introduction

Risk-Based Inspection (RBI) Programs have been implemented and executed within the chemicals manufacturing and oil and gas industries for decades now, but these same organizations are learning how to extract more value from these programs. Initially, the conversation revolving around RBI was about the software tools used to run the program. This software would collect, collate, and analyze the data to produce when and where you would inspect to prevent failures. As programs matured, organizations learned after they purchased a software tool and implemented a RBI program, that the software was just a tool and not the RBI program itself. Initially, when a mechanical integrity (MI) program was audited, stating that the organization has a known RBI software tool would create credibility with the auditor that the organization had an established RBI program, and it was perceived that the organization was proficient enough to run and maintain this program. Given time and experience, these initial assumptions have been shown to be inaccurate for many organizations within this scenario. The software tool may be implemented, accessible with data, and have personnel with logins, but it does not imply that the organization is utilizing a RBI methodology. This article attempts to show how a mechanical integrity program intending to use a RBI methodology following an RBI implementation to start extracting value and continuously improve the results of the RBI program for the operator/facility.

This article focuses on the RBI program after the initial implementation. It is assumed that the RBI Implementation was completed, accurate, and followed a best practice methodology of documenting, executing, and establishing the initial results for an RBI program, inclusive of a damage mechanism review (also known as a "corrosion study") and Integrity Operating Windows (IOWs). This assumption would also include that the history of the facility, and the experience of the teams involved in the implementation were experienced and competent with RBI implementations. Thus, after the completion of the implementation, the operator would have RBI results within a software program, established deliverables and organization of their equipment, and documented damage mechanisms of their processing impact on the facility's equipment. After the implementation, how does an RBI program progress? It is often thought that the path is straight forward. As a result of the new RBI program, the facility has equipment risk rankings with corresponding inspection plans for each item, therefore it would be normal to think that the next steps are to execute the recommended inspections. Unfortunately, this is where organizations can misstep. The RBI program shouldn't be considered a "wait until you inspect" type of program, RBI is and should be embedded into the daily methodology of a mechanical integrity program. Then, following the implementation, how does an organization progress forward with their new RBI results?

For life after an RBI implementation, instead of accepting the results of an RBI study and moving forward with the inspection schedules, the organization may want to consider the below approach to enhance the RBI program to ensure effectiveness and value returned to the operator. These items should be addressed by the operating organization:

- Management and execution of the RBI program
- Actions from the RBI implementation
- Review and confirmation of assumptions and update data gaps
- Verify risk rankings
- Overdue inspections and optimize inspection planning
- Sustaining an RBI program

A summary of each topic is addressed within this article.

Management and execution of the RBI program:

A key to having an effective RBI program, post implementation, is to establish the management system, complete with goals and an established framework to achieve the desired results through management and execution of the RBI program. Establishing an effective management system is ideal for the sustainment of an RBI program. That management system should identify how the program is managed, for example, by defining expectations regarding decision making, information management, and how RBI enhances the mechanical integrity program and other related programs within that organization through integration with operations. Data extracted from the RBI program can feed into other areas to ensure feedback and effectiveness of programs affecting production or asset life. A good example of this feedback is to incorporate RBI into the Management of Change (MOC) process. Within the MOC process, RBI may identify an issue as a result of increased production rates that will increase the degradation of certain equipment. This finding being addressed in the MOC process may then influence the decision to increase or decrease production based on a cost benefit analysis or perhaps influence how the RBI program manages the risk and resulting actions from the decision to increase production. The management system will also define a management decision process. If RBI identifies an asset with high risk with an overdue inspection, how is this addressed by the mechanical integrity program and by the facility's management? The equipment may be shut down and inspected, but the facility must also produce products; having an effective management system provides a framework to address these difficult decisions. For most programs, this management system may already be established with the MI program, but with the changes in philosophy from a traditional time-based inspection approach to managing integrity through equipment risk, the existing management system may need to address these changes when the goals of the MI program shift. This shift may realign mechanical integrity's role in the organization's decision making.

Actions from the RBI implementation:

Following a recommended methodology for an RBI Implementation, the resulting study will identify actions for the facility to execute upon handover of the RBI results. Identifying and executing these actions should be completed immediately following the conclusion of the implementation. This timing is convenient because the data is available, the results are still relevant, and the organization is encouraged by the incorporation of the RBI program. The RBI results at this point should be considered preliminary as completion of these actions may modify the results of the RBI study. As an example, if the RBI study did not incorporate the business impact, also known as production loss, but these results were included as an action following the implementation, this will have a significant impact on the risk results which has an effect on the inspection schedules and planning.

Review and confirmation of assumptions and update data gaps:

Every RBI implementation must make assumptions as some information is not always readily available. Some of the most common assumptions will facility wide, for example atmospheric conditions, but other assumptions, such as equipment insulation, will have a major effect on risk as it relates to the external condition of the equipment and the prevalence of the corrosion under insulation (CUI) damage mechanism. Therefore, these assumptions should be verified, and the data gaps reviewed to ensure the appropriate decisions are being made on the equipment.

Verify risk rankings:

This is one of the more critical steps to executing an RBI program methodology. The risk rankings define and establish how the equipment will be managed and inspected. If the risk is not accurate, then the organization may under inspect equipment or over commit resources by over inspecting the equipment. It is recommended that the organization, following the implementation, revisit the risk ranking of the equipment, to ensure and verify the risk results prior to scheduling inspections. As mentioned previously, if the actions have been completed, and the data assumptions and gaps have been addressed, this may have altered the risk results.

Verifying that the risk is as expected is often an overlooked step for life after an implementation. The consequences of one high risk item being miscategorized as lower risk could drive an early outage causing a loss in production. When reviewing risk, the following are common places to ensure the risk of the equipment is more accurate.

Example Case:

- Equipment Item: Production Separator
- Design: Carbon Steel, Typica Wall Thickness, Manufactured in the 1990s
- Process Environment: Produced Hydrocarbon Service, Operating within Normal Operating Ranges
- Primary Failure Mode: Internal Wall Degradation
- Risk Ranking for the Vessel: High
- What is Driving the Risk: High internal corrosion rate with a high consequence of failure due to the available hydrocarbon inventory associated with the vessel

The risk of this asset was reviewed and verified to be accurate during the RBI implementation. As shown, the primary issue with the vessel is a thinning wall, thus leading to a loss of containment of a hydrocarbon process service. Once the vessel fails, the hydrocarbon will de-inventory and release the hydrocarbon to the atmosphere and causing a potential for safety, environmental, and business impact consequence.

Upon reviewing the results of the study, the measured corrosion rate, for example, was 0.020in/yr. (20 millinches per year). By reviewing the equipment's inspection history, the location that was driving the corrosion rate was an older monitoring location reading due to what was found as an impingement flow causing a localized erosion area within the separator. It was also found that this impingement was mitigated several years prior and that the corrosion rate at this location was within expected ranges for a vessel in this service. During the RBI implementation, the guidance from the operator to the RBI team was to use the historical inspection thickness readings for the corrosion rates of the equipment. Due to the software tool that was being used for the RBI implementation, the "most conservative" rate was used as a default for the RBI analysis and thus the probability of failure (POF) was calculated to be high. By going back and adjusting the corrosion rate to reflect the mitigation of the higher erosion rate, the adjusted risk for this vessel decreased to a medium risk and was no longer a driver for an outage and inspection. This resulted in the inspection interval changing from a 12-month interval up to a 90-month inspection interval, yielding an improvement of 750%, thus saving the organization unnecessary cost, time, and effort.

This is only one typical example of verifying the risk within an RBI program. By doing the extra due diligence and review of the equipment, the operator improves the confidence of the results and ensures that the appropriate risk drives the integrity program for the facility.

Overdue inspections and optimize inspection planning:

The initial RBI implementation will uncover many areas of a mechanical integrity program that may have been overlooked or not considered as part of a time-based regulatory driven inspection program. Some items may be specific inspections for specific damage mechanism, or perhaps the including of pressure equipment considered outside of the MI scope under the previous mechanical integrity program. Therefore, overdue or past due inspections will be identified as inspection activities that must be addressed by the operator.

Not only will overdue inspections be an area that must be addressed, but as a deliverable to an RBI implementation, the operator will receive all inspections to be completed on relevant risk items for the facility. This may result in thousands of inspection activities provided to the facility upon the completion of the implementation. Depending on the software tool's business processes established during the software implementation, thousands of tasks and planned maintenance activities could be released into the maintenance planning system, thus causing an overwhelming scheduling issue for the RBI team. An alternative to this could be an intermediate step where the RBI team reviews the inspection planning results and then optimizes the inspection plans to correspond to budget years, planned outages, inspection campaign cycles, and even optional inspection lists based on the organizations approach. This will ease the impact on the scheduling process and create opportunities for cost savings.

Both the issues of overdue inspections and the large number of inspection plans as a result of the RBI implementation need to be optimized in similar processes. Each of these need to be planned accordingly to address the main intent of the inspection, which is to gather as much relevant data on the equipment as safely and efficiently as possible. Some organizations may lose sight of this goal and will determine that if an inspection is considered "overdue" that they stop everything at the earliest convenience and accomplish this inspection. For some inspections, this behavior may be required, but for most of these types of inspections, they can be completed at the next best opportunity. Likewise, for the large amount of inspection plans generated, it is recommended that the facility review the inspections due and align and organize these inspections based on safety, outage dates, types of inspections, budgets, specific inspection criteria, and similar information to affectively organize the inspections.

Sometimes as a result of an RBI implementation, a group of inspections will be due at the end of the calendar year. This does not necessarily imply that they must be done in December of that year, it may actually imply that the inspections are due sometime before the end of that calendar year. Therefore, these dates should be reviewed with the correct context and planning information such that the inspections are scheduled appropriately for the organization.

Sustaining an RBI program:

Life after an RBI implementation must address the operational aspects to sustaining an RBI program. As an example, RBI does not change the requirements of a normal API 510 pressure vessel inspection, but it may dictate how the inspection results are documented and evaluated, using API 581 inspection effectiveness as an example, as the inspection pertains to the RBI program and its requirements. If the RBI program is more quantitative and not qualitative, the results of the pressure vessel inspection may be recorded and applied differently within the software application and RBI program itself. Thus, to assist in sustaining an RBI program, some considerations should be made for what work processes are required to meet the goals of the mechanical integrity program. Once the work processes are established, documented, put in practice, and kept evergreen, the RBI program will yield significant value through efficiency and optimization for the organization by focusing integrity on the most critical items.

In summary, as discussed throughout these topics, the result of not preparing for life after an RBI implementation often leads to results accuracy, data issues, which leads the organization to potential re-implementations or regression back to a time-based program. By understanding the topics addressed in this paper, the organization can help ensure that their RBI program reaches maximum effectiveness and does not result in a shelved program. Life after a RBI implementation brings value, but to capitalize on the most value, consider these topics as areas to help enhance that value.