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ASSET INTEGRITY INTELLIGENCE

A LIFETIME OF INTEGRITY—OVERCOMING THE CHALLENGES IN MANAGING THE LIFE-CYCLE OF AGING ASSETS

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INTRODUCTION

Life-cycle management, more commonly known as Asset Integrity Management, like with anything, begins as a concept. Thought is then given to the design, the metallurgy, the thickness, resistance to degradation, and many other factors that give an asset its character and allow it to perform in the environment it must operate. Once conceived, designed and fabricated, the stamp of approval is placed and its life-cycle begins.

Throughout its life, the management of an asset's integrity may involve some challenges. The dynamic nature of operations, including start-ups and shutdowns, process upsets (excursions), environmental factors, and external incidents may alter an asset's ability to achieve and maintain its desired levels of integrity and reliability. Despite these challenges, through properly implemented mechanical integrity, maintenance and operations programs, assets can produce a favorable return on investment and operate optimally for many years. Though they may experience a few “bumps” and “bruises”, with effective integrity management, an asset's health can remain intact throughout its lifetime.

As assets get older and production demands grow, it becomes increasingly critical to implement sustainable, effective long-term asset integrity management (AIM) strategies and programs. This can be challenging due to a number of factors, including age of plant equipment, availability of information required for assessments, a retiring workforce of industry experts with the potential loss of many years of valuable industry knowledge, a new generation of integrity management professionals entering the workforce, and ever-developing and emerging technologies (IT, NDE, technical and management analytics). According to the U.S. Senate Committee on Energy & Natural Resources, “energy worker retirements are occurring at a rate more than double the percent of new energy apprentices are being trained. The average energy worker is seven years older than the average worker across all industries in the United States, and more than 500,000 workers are expected to retire in the next 5 to 10 years.”[1] This compilation of challenges and contributing factors is most recently known as “The Great Crew Change.”

The ever-evolving digital offerings and instruments required to implement said solutions, and the task to maintain compliance and relativity in the AIM realm can often seem daunting leaving some with a “do it how we've always done it” mentality and a reluctance to innovate and frustration in trying to retain knowledge in this generation of digital transformation.

This article will focus on the first of these challenges, aging assets, and offer an optimistic overview of the elements that will largely assist in the success of managing equipment throughout



Figure 1. Example of critical aging refinery asset.

their life-cycle well into their golden years, facilitating change and offering opportunity. Effectively managing aging assets is a challenge requiring operators to address where to start, where to invest, and how to best institute and sustain effective practices and programs.

MANAGING AGING ASSETS

Assets are aging. In the United States, new refineries of significant capacity have not been constructed in about 40 years.[2] Many were constructed in the early 1900's with the invention and popularity of the automobile, and others were constructed later as a source for refined fuels during WWII. These facilities have expanded in capacity and complexity over the years. While some of these very early processing units have been abandoned, many are still operating and are key assets to the facilities. As assets get older, they deteriorate and typically require increasing levels of maintenance to sustain both integrity and reliability. Decisions must be made to approve and direct expenditures for things like

inspection, to increase the level of confidence in the known condition of equipment, assist in remaining life predictions and plan for subsequent repairs or replacement, if needed. The tug and pull between production, equipment integrity, reliability, and regulatory compliance, is typically the first and most critical balancing challenge for most owner/operators in this asset integrity management effort.

If asked, “What is the primary driver for change within your asset integrity management organization?” more often than not, the owner/operators answer will simply be “maintaining compliance,” with risk (usually consisting of safety, environmental and some other owner/operator-defined parameters like production or reputation) following close behind. Following major release incidents and casualties in Bhopal (1984) [3] and additional disasters at chemical facilities and refineries in the United States, the OSHA Process Safety Management (PSM) Standard became law (1992).[4] This standard requires facilities to develop and implement program elements to assess risks, maintain information about the process and equipment, properly inspect and maintain equipment, train and qualify process operators and maintenance personnel, and to develop emergency response procedures in the event of a release.

EPA’s Clean Air Act Amendments (CAAA) became law in 1990 and also require the elements of OSHA’s PSM program with further emphasis on risk management and protection beyond the facility fence line. Penalties for non-compliance can be in the millions of dollars, as evidenced by fines levied over the last several years.

TECHNOLOGICAL ADVANCEMENTS

Fortunately, we live in a time full of technological advancements that, when aligned and implemented effectively, afford owner/operators a more secure, manageable, and available set of asset information and analysis and reporting tools that ultimately make the task of compliance more achievable.

Asset integrity management software solutions, whether at the site and/or enterprise level, provide several capabilities that we, as humans, would not be able to achieve without them. Their ability to collect, centralize, categorize and store massive amounts of data relevant to asset integrity, then sift through said data to determine how sensitive each data point is to the task at hand makes data retrieval, analysis and reporting more effective than ever.

Combine these tools and their ability to effectively analyze data with the common sense of qualified Subject Matter Experts (SMEs) and the academic force of experienced engineers, and the solution to the compliance effort is at the very least achievable, if adopted and implemented from a proactive maturity level.

Although new technology and advancements sound promising, they fall on mute ears if a champion for change is not identified and appointed as captain to this initiative. Adoption of these tools to assist in achieving our regulatory compliance begins with someone willing to invest the time, money and resources to implement such changes and see them through to fruition. Sometimes these ideas are identified where the boots meet the



Figure 2. Asset integrity management is not only reliant on strategy and engineering assessments. Investing in personnel is critical in the long-term management of aging equipment.

ground and sometimes they are enforced by corporate mandate. Either way, buy-in and employee engagement are imperative to success. A culture change is often required, or the initiative will stall and ultimately fail, ultimately generating large amounts of unexpected and discouraging expenditures along the way.

INVESTMENT IN PERSONNEL

Another pitfall in this drive to achieve compliance is investment in people. Employing and maintaining qualified, competent, and willing personnel is imperative to long-term success. The people you place in positions of change-management will either improve or derail your chances of achieving your objectives. The process doesn’t end with selection. People need grooming. They need development and a pathway to personal and professional enrichment. They need purpose. Without these primal human elements and an investment in their future within your organization, retention is difficult and the sustainability of a mature asset integrity program is futile at best.

MANAGING RISK

Increased risk, a by-product of age, is another primary driver for the adoption of new methods and technology. Risk, and the categories that they are comprised of, is defined and a line is drawn in the sand. Acceptable vs. unacceptable, the choice has been made. The categorical choices like safety, the environment, productivity, reputation and other drivers will collectively relate to some level of cost (e.g., risk) which the stakeholders are willing or unwilling to take. It is then left up to us engineers, analysts and boots on the ground folks to manage such risk at or below that level, if achievable.

Risk-based inspection (RBI) typically begins with identifying high-risk assets followed by an assessment of equipment condition, evaluation of inspection strategies, study of operating protocols, and estimation of life consumption of priority assets. This process takes into account the combination of likelihood and consequence of loss of containment. This information is then used to modify and optimize inspection plans, strategies, audit procedures, operating limits, and safety information.

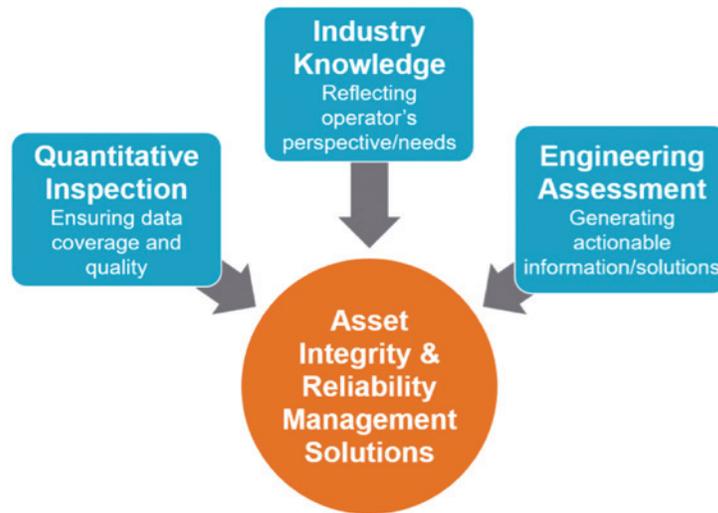


Figure 3. The numerous factors that ensure effective Asset Integrity Management.

Mitigation of risk, usually a set of activities assembled into some sort of strategy, is at times achievable with or without the support of tools such as RBI software, which can be deployed as a stand-alone program or as a module of an Asset Integrity Management solution, as mentioned above. Although, again, in the spirit of time management and cost to complete, the utilization of these tools can greatly improve productivity and accuracy if used and managed by qualified personnel.

Furthermore, an accepted set of strategies can be applied, producing a consistent, organized and applicable set of activities that are optimal to address risks. These strategies consist of activities to manage assets and mitigate risk, typically based on the degradation, equipment type, and risk level. For example, these activities will include recommendations to define inspection requirements based upon the level of risk and damage mechanism identified and the when, where, what type, and how much to do questions, to be included in your planning efforts. Now, albeit most solutions offer a developed set of strategies for the masses, most of these solutions also allow for the modification of the aforementioned strategies, which may allow for increased refinement and optimization of your AIM/RBI program and overall return when managing by exception.

RBI RETURN ON INVESTMENT

Additional benefits of the adoption of RBI methodologies and technology to facilitate the management and overall reduction of risk consist of both immediate and sometimes delayed or lagging returns.

One important and immediate return is visibility or awareness of risks and vulnerabilities, and the identification and understanding of risk drivers. The benefits of the availability of data and analytics can be invaluable, depending on the baseline availability and health of your information. Data gaps and inaccuracies can also be closed as they are discovered and processes can be developed or optimized during this journey to ensure completeness and fidelity of the program.

The return on investment of risk-based asset Integrity management strategies can include, for example, a 30-60% reduction in the number of pieces of equipment that require inspection, although in contrast to this reduction, the following conditions may contribute and impact your results:

- The extent of cost savings from the reduction in inspections also depends on the quality of the existing program. If little or the wrong things are being done then it will likely result in a cost increase. We typically find that most operators will readjust their focus once they understand the risk drivers.
- When RBI is implemented, the cost of inspections may initially increase due to the lack of previous inspections and data.
- The long-term cost savings will be realized once basic inspections are conducted and confidence in the data allows accurate analysis of the risk.

Plant reliability improvements and cost savings from the prevention of on-stream failures is where several have experienced big payouts (100 times cost over 10 years). Based on research we've conducted, the level of savings from implementation of RBI is typically on the order of 10 to 20 times the initial investment over a 5-year period.

Defining and then setting up an RBI program typically requires a significant amount of front-end engineering and SME support to develop. Expertise is required to define and select damage mechanisms for a particular process and corrosion control documents should be developed for this purpose. Asset strategies need to be defined, verified, and selected based upon knowledge of key parameters affecting the likelihood of a specific damage type and the appropriate methods for detecting and quantifying the rate of deterioration. Information which may affect asset integrity, such as process operational deviations, maintenance and repair history, and management of change history, needs to be understood and well-documented. This level of information and

the decisions made in the setting up and maintenance of an RBI system requires well-qualified and experienced personnel, both from the facility owner as well as those assisting or leading the implementation.

Although costly upfront, investment in technology can save and be a wise ROI, if managed correctly. The following cost-saving actions may be realized through the implementation of applicable technology and solutions:

- Ineffective inspection activities may be eliminated
- Inspection of low risk items may be eliminated
- On-line or noninvasive inspection methods may be substituted
- More effective and infrequent inspections may be substituted for less effective and more frequent inspections

In addition to the above changes, solution and strategy optimization can also contribute greatly to the ROI. Inspection activities and resources should be optimized to focus on high-risk assets, as they have the potential to cause serious disruption in plant operations or unplanned shutdowns. This priority treatment of high-risk assets must be balanced with providing sufficient inspection and mitigating actions for other lower-risk equipment in order to avoid the emergence or growth of problems over time.

ASSET HEALTH VISIBILITY

As information and trends are continually updated in the AIM system, visibility into the health of assets becomes identifiable. Process operations, maintenance, reliability and inspection engineers and technicians have access to data from which they can make informed decisions and define improvements. Improvements such as material upgrades, changes in inspection or preventive maintenance, evaluation of key process controls, integrity operating windows, can be integrated into the system.

When damage is discovered or to evaluate the potential, Fitness-for-Service assessments can be undertaken. These assessments can help extend and avoid costly premature repairs and/or replacements. Engineering assessments for general or local metal loss, pitting corrosion, hydrogen damage, weld misalignment, and creep can be performed when damage is found or may be expected.

These can also include brittle fracture assessments, operation at changed process conditions. The availability of information and data enhances the ability to make informed engineering decisions throughout the asset life-cycle, along with technology and solutions, to help mitigate risk and drive down cost.

CONCLUSION

While effective integrity management is based on a number of symbiotic factors, one thing is clear - our industry is changing. Facilities are not only aging, but are now required by increasing industry demand to maintain optimal output while avoiding loss of containment. The "Great Crew Change" is putting further pressure on owner/operators as decades of experiential knowledge leaves the workforce, and an overwhelming number of new technologies are available for adoption. By utilizing new technologies

with proven engineering solutions and qualified Subject Matter Experts, owner/operators are able to better ensure the successful management of assets throughout their life-cycle and well into their golden age. ■

For more information on this subject or the author, please email us at inquiries@inspectioneering.com.

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James Wilson is currently the Asset Integrity Manager for Quest Integrity. He has over 12 years of experience in the industrial Asset Integrity/Asset Performance Management theatre, with a primary focus on Risk Based Inspection. James has implemented numerous AIM/APM/RBI projects and has expertise in a variety of software platforms.