Integrity Management Software Solution - Managing your daily activities

By Sebastian Ruik Beyhaut

1. Abstract

Many owners of vertical above ground storage tanks have their own dedicated Asset Integrity Management System in place. However, due to increasing local and international regulations, higher operational costs, and lack of resources, implementing supporting tools for a fully compliant system is a challenging step for most organizations.

One of the primary objectives of an Asset Integrity Management System (AIMS) is to maintain assets operational condition in the most reliable, safe, and cost-effective manner. In order to overcome these challenges, ROSEN's experts have developed a supporting tool which ensures qualitative and quantitative data management, which assist the tank owner in his decision making processes throughout the system and lead him towards the direction of preventive maintenance regime.

This paper presents a tool for supporting a maintenance management process illustrated by a case study. The supporting tool is intended for professionals at every level, as part of a Total Integrity Management System. The results of the study show how the different process aspects are handled and supported by ROSEN Asset Integrity Management Software (ROAIMS) Tank Suite, helping to optimize inspection and repair expenditures based on detailed Inspection assessments.

2. Background

With advances in inspection approaches, and increasing understanding of the type and rate of degradation, inspection intervals became more reliant on the actual state of the equipment, instead of considering a predefined interval by local authorities. Codes such as API 510 and 570 evolved to an inspection philosophy defining inspection intervals based on equipment half-life, furthermore worldwide statutory authorities have opened thier minds by increasing the allowance of flexible inspection intervals.

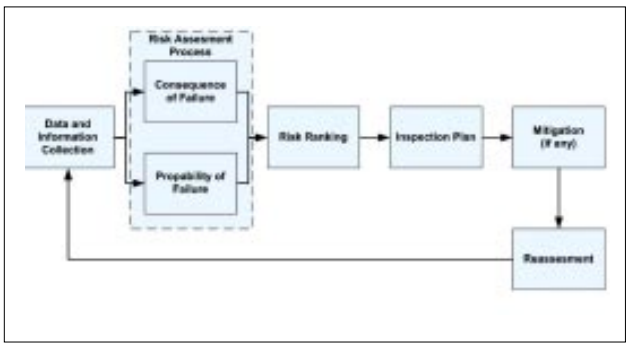

Figure 1: API RP 580 defines the following Process for RBI

API RP 580 for Risk-based Inspection provides a way and recommendations for defining inspection interval by focusing on optimizing risk reduction. May we draw your attention in the fact that ROSEN's Tank RBI methodology was compiled with the objective that it would comply with the API requirements for applying RBI. Although the risk management principle and concepts that RBI is built on are universally applicable, RP 580 is specifically targeted at the application of RBI in the hydrocarbon and chemical process industry.

RBI, as a risk-based approach, focuses specifically on the equipment and associated deterioration mechanisms representing the most risk to the asset. In focusing on risks and their mitigation, RBI provides a better linkage between the mechanisms that lead to equipment failure and the

inspection approaches that will effectively reduce the associated risks. The main targets are to avoid catastrophic failures, unplanned shutdowns, minimize and structure the In-service maintenance & inspections (NDT), last but not least optimized planned shutdown.

The final deliverable of ROSEN's Tank RBI methodology is an inspection plan for the tank and its sub-components. The inspection plan details the activities related to the current operation from a safety/health/environment perspective and/or from an economic standpoint. For risks considered unacceptable, the plan contains the mitigation actions that are recommended to reduce the unmitigated risk to an acceptable level. The plan describes the type, scope and timing of inspection/examination recommended. Ranking of the tank components by the unmitigated risk level allows users to assign priorities to the various inspection/examination tasks. This ranking is graphically done in a matrix where the components are plotted using probability and consequence outcomes.

3. RBI Benefits and Limitations

This RBI plans also identify equipment which does not require inspection or some other form of mitigation. As a knock-on effect, this can end up in an important decrease on the amount of inspection data that is collected, thus inspection and maintenance activities can be focused and more cost effective. Therefore, in some cases, RBI plans may not only result in absolute risk reductions and process safety improvements but also in cost reductions.

RBI is based on sound, proven risk assessment and management principles which play an important role during this exercise, and hence "rubbish in, is rubbish out". RBI will not compensate inaccurate or missing information, inadequate designs equipment installation, operating outside the acceptable design envelope, not effectively executing the plans in a timely manner, lack of qualified personnel or teamwork, and lack of sound engineering or operational judgment. Moreover, risk mitigation is not obtained if inspection data that are gathered are not properly analyzed and acted upon where needed. The quality of the inspection data and the analysis or interpretation will greatly affect the level of risk mitigation. Therefore, proper inspection methods and data analysis tools are critical issues which should be considered.

4. ECOPETROL S.A.

ECOPETROL S.A. is one of the largest petroleum companies in Latin America, and among other assets operates pipeline network of approximately 8,500 km and more than 250 above storage tanks in Colombia only.

During 2006-2008 ECOPETROL S.A. successfully carried out an implementation of Asset Integrity Management Software provided by ROSEN (ROAIMS) and execution of associated services which involved data integration and risk assessment. ROSEN provided ECOPETROL S.A. with the knowledge and software tools for Quality Assurance/ Quality Control of the individual processes within their system.

Before the project ECOPETROL S.A. had digital files with information of tank inspection and integrity spread all over the country. Mechanical data, tank inspections and other important data were available in printed version and excel sheets. Therefore, the need for a centralized and more robust system was recognized.

5. Project Framework for RBI implementation

Based on API 580, a detailed approach was developed to tackle a challenging implementation step into ECOPETROL S.A. system.

Figure 2: Project implementation

The core of a RBI assessment is being aware of the fact that this exercise is a team-based process. During the initial meetings between ROSEN and ECOPETROL S.A. Engineers relevant decision were made, e.g. define relevant RBI targets, describe the way of doing it, teams involvement, responsibilities, definition of roles, codes and standards to be used, the length of the assessment and future uses of the results.

Identification of the appropriate deterioration mechanisms, susceptibilities and failure modes for all tank components included in the RBI study were defined which had an effect on the quality and the effectiveness of the RBI evaluation. Corrosion specialists were consulted to define the equipment deterioration mechanisms, susceptibility and potential failure modes. Data used and assumptions

made were validated and documented. The deterioration mechanisms, rates and susceptibilities were the primary inputs into the probability of failure evaluation. The failure mode is a key input in determining the consequence of failure except when a worst case consequence analysis, assuming total release of component inventory, is used. This fact brings us to the conclusion that within ROSEN tank RBI, only credible scenarios were analyzed.

RBI is a dynamic tool that can provide current and projected future risk evaluations. As time goes by, changes are inevitable and the results from the RBI assessment are updated by the user of the system. ECOPETROL S.A. is conscious of the importance of maintaining and updating the RBI methodology assuring that the most recent inspection, process, and maintenance information is included. The results of inspections, changes in process conditions and implementation of maintenance practices have significant effects on risk and can trigger the need to perform a reassessment.

6. Acceptable and unacceptable risk

For Tanks with low Risk the inspection intervals derived from the RBI procedure may be longer than the maximum permissible inspection interval prescribed by local legislation which is governing. In order to focus on the right priorities, a distinction should be made between items qualified as "High" compared with those indicated as "Low" or "Medium".

If the risk is unacceptable, irrespective of its rating, a full tank integrity assessment (TIA) needs to be carried out by the RBI team preferably under guidance of a qualified tank Integrity Assessor. In general this assessment is a team effort. The TIA should be capable of making a sound assessment of the integrity of storage tank and foundation in order to offer guidance on the need for repair, its urgency, and the methods of affecting such repair.

7. Roles, Responsibilities, Training and Qualifications

Considering that ECOPETROL S.A. Integrity engineers did not have the background to conduct the entire RBI assessment in an effective manner, a tailored training was organized at early stages of the project. All team members (e.g. Tank inspector(s), Tank maintenance staff, Operations staff, Material/corrosion engineer(s), reliability engineer, etc) received basic training on RBI methodology and on the program(s), being used primarily geared to an understanding and effective application of RBI. Moreover, the training help them with understanding the technical integrity issues of tanks in general and its consequence if something goes wrong. It certainly brought them awareness about tank maintenance in general.

8. Rosen Asset Integrity Management Software

The ROAIMS Tank Suite was designed following ROSEN's tested and proven approach to asset integrity management. Its streamlined design, offers a range applications that simplify data organization, task planning / scheduling, inspection data management and reporting to meet both internal and external requirements.

ROAIMS for Tanks provides operators with a single comprehensive database to efficiently integrate and manage information relevant to the safe and economical operations of above ground storage tanks and related infrastructure. The software is built up modular and founded with PAS 55 and ISO 9000 requirements with respect to their ingredients and data handling.

The suite of modules consists of both asset independent applications, as well as specialized tank integrity applications. Combined in a bundle these applications manage all necessary processes: from the integration and up-keeping of the design data, to the management of inspection and maintenance tasks generated out of the Integrity Planning module.

Additionally, the Document Repository allows the integration of documents, pictures, and reports. The User Permissions ensures that employees are able to execute the functionalities they are specialized in – but only on the assets they are in charge of.

Furthermore, within ROAIMS software experts are provided with visualization tools for analyzing available data, such as historical inspection and maintenance records, which supports them during decision making activities.

Integrity Planning Module

Figure 4: Integrity Planning module

The Integrity Planning application provides operators with one detailed inspection plan for all administered tanks. This inspection plan takes into account corrosion-based degradation of all aspects of a tank including auxiliary components. The methodology used not only follows industry best practices and complies with both API 580 and EEMUA regulations but replaces the old time-based approach to inspection with highly flexible assessment programmes.

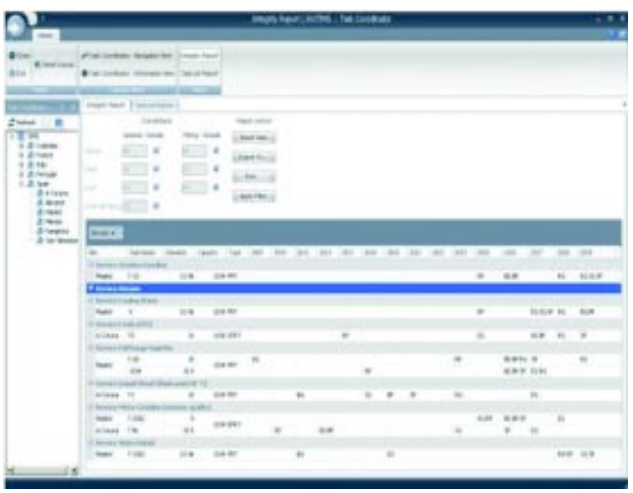

Figure 5: Task Coordinator module

Task Coordinator

This application enables the user to coordinate tasks on the basis of both risk and maintenance based tasks. Easy to use filter, sort, and group functionality supports a detailed analysis regarding the upcoming actions for all tank assets. All information can be reported and printed using pre-defined reports and user defined listings.

1. Way forward
   Considering the fact that an RBI exercise is a non-static activity and improvements are indispensable, close contact with the client is needed. As following, an example of the areas which are under evaluation and testing in order to fine-tune the client needs:

Task Development and Planning

The intention here with regard to each tank component is to develop or review inspection, maintenance, and (if applicable) testing tasks. A rigorous approach will avoid components being overlooked in the total maintenance framework. The planned and scheduled maintenance and condition monitoring (including inspection and testing) tasks are then carried out and an overview of the "actual status" will be seen.

Figure 6: Master Reference Plan

(Maintenance) Master Reference Plan

The result of the tank RBI process may lead to changes having to be made to the Master Reference Plan (the overall plan), as illustrated in figure 6. This can be done per unit or terminal / tank farm.

Inspection Manager Module

The Inspection Manager provides the ability to manage inspections data by storing those in a centralized database, in different types of formats, gaining control of the inspection activities.

8. Conclusions

The supporting tool shows how the different process aspects are handled and supported by ROSEN Asset Integrity Management Software (ROAIMS) for tanks, helping to optimize inspection and repair expenditures, organize all relevant data. The tool will enhance the audit ability of the used Integrity Management System.

During the project implementation a centralized data management was introduced allowing different level of engineers sharing relevant Tank data. Furthermore, training activities which support the Tank integrity exercise were organized in order to support the system implementation.

Last but not least, results of the integrity exercise are drawn in a tank inspection plan where 260 tanks are highlighted, organized and managed for the next period.

Inspection costs can be more effectively managed through the utilization of RBI. Resources can be applied or shifted to those areas identified as a higher risk or targeted based on the strategy selected. Consequently, this same strategy allows consideration for reduction of inspection activities in those areas that have a lower risk or where the inspection activity has little or no affect on the associated risks. The major benefit is tank maintenance prioritization; it systematically reduces the likelihood of failures by making better use of the inspection resources and will improve the reliability of tankage. Part of this planning process is the determination of what to inspect, how to inspect (technique), and the extent of inspection (coverage).

ECOPETROL S.A. is aware of the initial investment (time, money, software), but they are also aware that the return on investment is evaluated in no catastrophic failures or leakages.

Therefore, engineering experience, training, codes and so further, together with a sophisticated software solution are the key to success when comes to implementing an Asset Integrity Management into a Storage Tank Operator.

A summary of the benefits mentioned are:

- Structured approach of Maintenance & Inspection activities
- Loop based process (based on experiences and evidence)
- Development of proactive Maintenance &Inspection tasks
- Focus on critical tank (sub-) components
- Reduce out-of-service period
- Increase availability & reliability
- Better scope of work (and $) definition prior O.O.S. (out-of-service)
- Justification process for preventive Maintenance &Inspection budgeting

9. References

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PetroMin Pipeliner would like to show appreciation to Mr. Sebastian Ruik Beyhaut from ROSEN Integrity Solutions GmbH, Lingen-Germany. Sebastian has a M.Sc.; P. Master in Geoinformatics. ITC - Faculty of Geo-Information Science and Earth Observation - University of Twente, The Netherlands.

He has more than 9 years experience in managing and developing Remote Sensing & Geographical Information Systems (GIS) customized solutions. Before joining ROSEN he was part of Aerodata International Surveys (Antwerp, Belgium) team developing geo-informatics solution all over Europe.

As from 2009, Sebastian joints the ROSEN Group as one of the lead engineers for translating market needs on integrity management supporting tools. Listening closely to the Customer(s) and working very closely with tank experts, he supports the software development teams with the necessary feed for developing customized engineering or software tools.

Co- Authors:
Rick Meyer - ROSEN Europe B.V.
Mike Trinidad - ROSEN Australia
Carlos Guzmán - ROSEN Integrity Solutions GmbH
Camilo Torres and Alexander Guzman - ECOPETROL S.A.