ISO 55000, ISO 31000 AND API RP 581 KEY GENERATION OF VALUE IN RISK MANAGEMENT OF PHYSICAL ASSETS ALLIES.

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1. PREFACE

Risk analysis has been used informally throughout the history of mankind, always associated with decision making. These correspond to a simple questions as to crossing a street or, as complex as a design and to an operation of industrial facilities. In any case there are multiple possibilities, better and worse, the choice involves assessing and accepting the risk associated with the uncertainty future results.

The risk analysis process has evolved throughout history, but has always been based on the collection of larger volume of information possible about the problem and experience in analyzing similar problems.

This evolution has been accompanied or preceded by the social demand for higher levels of security, in particular in areas of human activity that may involve the loss of life, severe damage to the environment or significant business losses. It has influenced obviously because of the rapid evolution of the technology that has been experienced by the industry over the past decades, which has led to an increased frequency of accidents with significant impact on people, the environment or property. This favored the growth of a generalized feeling about the need to control more precisely the risk associated with the development of industrial activity.

2. RISK DEFINITION

From a philosophical point of view, risk is a complex concept that has to do with the possibility of occurrence of future events, and therefore no situations where the future is known with certainty present. In a sense, the risk is considered as something unreal, a product of the mind, which is closely linked to individual or collective perception. We can say that the fear that infuses to face situations and that enclose doubt and endanger the physical integrity of man or his environment this sense is identify by humans as risk. However, the purpose of the engineer is to try to establish its valuation by using the techniques and mathematical models within its reach.

The word risk is understood in most cases as a derogatory term, although is there, in most mankind activities as greater or minor level, but seen to the point that it is not assumed voluntarily without expecting a benefit in return.

There is no linear relationship between risk reduction and the necessary resources which would give the allocation tools to advocate risks.

Moreover, the lower the level of risk desired the greater amount of resources is needed to reduce, and in most cases there is no zero risk term. Therefore, people talk about risk as accepted or supported accordingly to the base of resources to control any kind of risk and it is also assumed as conveniently way.

In everyday language the risk is synonymous of danger and therefore it's considers that both are interchangeable. However, a rigorous treatment by the engineer must be performed; the risk analysis requires more precise terminology.

Figure 1 shows a diagram with the most important basic concepts, whose mastery is essential to understand the basis for selecting and managing the most appropriate technique in each case within the different stages that make up the application process Risk Analysis.

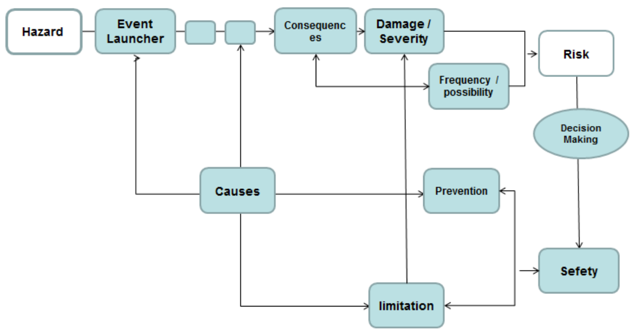


Figure 1. Conceptual scheme Risk

Hazard: is used to designate a chemical or physical condition that can cause harm to people, the environment and / or property. Consequently, the danger is something tangible and objective. Types of hazards that may be mentioned, e.g.: toxic, flammable and explosive substances, height.

Risk: For its part, the risk, in English "risk" is used to indicate the potential to cause loss or harm to people, the environment and / or property as a result of the occurrence of unwanted events. Thus, the risk can be understood as a quantitative measure of danger. The difference from hazard is illustrated in Figure 1. The danger lies in the origin of an adverse consequence on people, the environment and / or property. However for the hazard lead to adverse consequences that requires a chain of events to occur. The first link in the chain corresponds to the initiating event. In principle, in the case of facilities, initiating events are divided into two groups:

1) Internal Events, such as:

Loss of containment function active equipment such as: pressure vessels, piping, boilers, pumps, malfunction in operating processes and controls, and human errors.

2) External Events, such as:

Natural phenomena (lightning, earthquakes, floods), impacts on neighboring industries, impacts of transportation such as: airplanes, trucks, human error or sabotage.

The first group comes from industrial activity itself while the second one settles in the environment activity.

Causes: As diagrammed in Figure 1, behind each initiator or link in the accidental chain there are different causes for the particular path followed in the progression of a particular accident up to a certain type of result, which is known as sequence accidental event. The identification of the causes that can lead to different accident sequences is essential not only to quantify the risk of an accident sequence, but in particular to establish the most appropriate security policy to counter it.

Risk Components: frequency and damage are the elements that the engineer set to value and often when a definition is required is common to hear this. Each accident sequence leads to a certain type of adverse consequences for the safety of people, environment and / or property. In addition to the causes, there are two aspects that characterize a particular accident sequence; the first refers to the frequency with which this can occur and secondly the damage that their occurrence can generate. Therefore, generally speaking risk has two components corresponding to the frequency and damage. Thus, one of the simplest and most common to express risk of accidental sequence ways is by the following product:

$$\mathbf{R = F \bullet D}$$

Where F represents the expected frequency of occurrence, for example, expressed times per unit time, and D is the expected damage after this occurrence, which is the measure of the extent or severity of a particular result type, for example, expressed as the amount of economic loss per event.

3. ISO 55000 SERIES ACTIVE MANAGEMENT

This International Standard provides an overview of asset management and management systems.

Applying an asset management system according to this regulation provides assurance that organizational goals can be achieved in a consistent and sustainable over time. The ISO 55000 series is composed of three specific documents:

ISO 55000: Provides an overview, concepts and terminology in Asset Management

ISO 55001: Specifies requirements for good practice in Asset Management.

ISO 55002: Provides a guide to the interpretation and performance for Asset Management System.

4. RATIONALE ASSET MANAGEMENT

The document ISO 55000 clearly states two fundamental aspects in a successful asset management:

Creating Value: Purpose of the asset exists is to generate value to the organization and its shareholders. The Asset Management does not focus on the asset itself, but on the value that the asset may provide the organization. The value (can be tangible or intangible, financial or non-financial) includes:

- A clear statement of how asset management objectives are aligned with organizational goals.
- Focus on the lifecycle of the asset management to enhance the generation of decisions supported in value.
- Establishing decision-making processes aligned to business interests.

Alignment of Objectives: Asset Management translates the objectives of the organization in technical, financial, decisions, plans and activities:

- Decisions based on risk, information together with effective planning will be essential to transform the strategic plans of the Organization Asset Management Plans.

- It is necessary to make asset management an axis transverse to touch the entire organization (finance, human resources, information systems, logistics, production, engineering, maintenance and operations)

- Specifications design as the key element in supporting the Asset Management.

5. ASSET MANAGEMENT AND ITS INTERCONNECTION WITH RISK MANAGEMENT.

In the conceptual model of the Asset Management established by the Institute of Asset Management (IAM) shown in Figure 2, set in the document of **Asset Management – an anatomy**

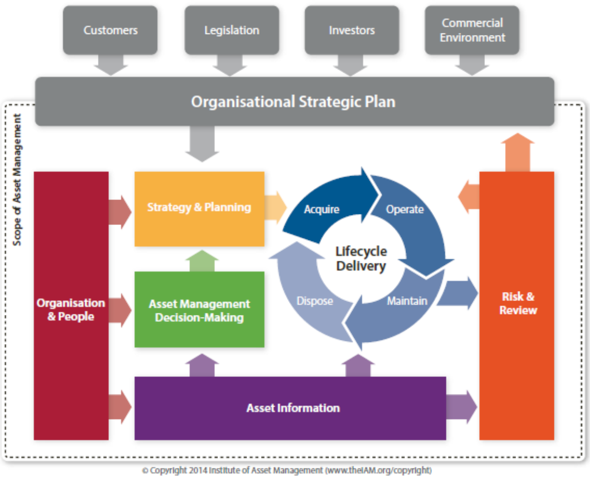


Figure 2. Conceptual Model, Asset Management. © Copyright 2014 Institute of Asset Management (www.theIAM.org/copyright)

In this figure, six major groups in the Implementation Strategy and establishing Asset Management are:

1. Strategy Planning and Asset Management
2. Planning Asset Management decision making
3. Life Cycle Activities
4. Active Knowledge
5. Organization and facilitators
6. Inspection and Risk

Each of these six groups are composed of 39 topics that shape and support the Asset Management Conceptually, these topics are consolidated in Figure 3 shown below.

Figure 3. 39 Topics, Asset management. © Copyright 2014 Institute of Asset Management (www.theIAM.org/copyright)

In this sense we can clearly see a well-established risk management that can support each of the 6 groups making up the implementation strategy of Asset management.

1. Strategy Planning and Asset Management

In this group a strategy based on risk management allows the establishment of a strategic planning for the short medium and long term, establishing priorities to facilitate routing maintenance budget for the teams that really require and clearly establishing the scope of what they need to be kept under tolerable risk levels established by the organization. All this strategic planning would be supported by the generation of plans Inspection and / or maintenance supported at risk. It is critical at this stage the input production commitments short medium and long term planning to really add value to the business.

1. Planning Asset Management decision making

In this group a management strategy based on risk compared with traditional condition-based, risk-based strategy simultaneously reduces both the risk associated with the operation of equipment such as the costs associated with the inspection effort. See Figure 4.

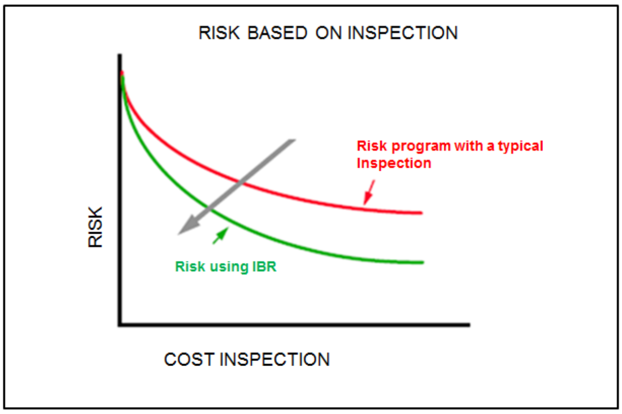


Figure 4. Comparison entity Curve Maintenance program costs between strategies based on risk-based condition. Taken from API RP 580.

Experience shows that in a processing plant in operation, a relatively high percentage of risk to a small percentage of equipment is associated.

✓The risk-based decisions seek to concentrate or direct resources available to the teams with the highest level of risk, assigning each team the level of maintenance that each individual merits.

✓There are several ways to achieve significant cost reductions in the inspection and maintenance of an asset, the most significant is affecting the scope of stops scheduled plants, allowing decisions which bring high value to the business significantly reducing the length thereof, as important contribution we will discuss:

✓ Reducing the number of teams that will be opened for internal inspection in future stops.

✓Extension of the intervals between stops.

✓Reducing the duration of the stop.

✓Reducing costs by decreasing the extent of inspections monitoring thicknesses in pipes and containers.

✓Decrease the amount of Pressure Relief Devices for maintenance per year.

2. Life Cycle Activities

In this group a strategy based on risk management can clearly enhance the activities that bring greater value on the asset life cycle clearly identifying their condition, establishing maintenance strategies in line with the needs of each team, taking into account the consequences of failure each, this as fundamental to the definition of risk and determining element associated while proactively mitigating strategies of the possible consequences of failure of each team. In this sense the calculation of consequences of failure should permit the introduction of different scenarios of occurrence and with them establish financial calculation of the impact of failure of each team, reflecting its potential on the safety of people, impact on same the business environment.

3. Knowledge of Active

The lack of awareness or uncertainty about the condition of assets is an enhancer element of risk and at the same time is one of the major causes of destruction of value in an organization, In this group a management strategy based on risk allowed in the first instance to lay the foundation for the organization of information, is very common to hear of the existence of plants with over 30 years of operation and does not have information on their computers, this reflects a culture that has been given little importance to information. In this sense the best days to start a process of improvement in an organization on the asset information is now and forget about miracles, the information necessary to build and build you have to invest time and dedication. A maintenance strategy based on risk can build such information and eliminate the uncertainty about the condition of the equipment, basing this strategy in closing cycles and this can only be achieved by compliance with maintenance and inspection programs, and that as we intervene or inspect our equipment that extent we will generate information behavior and with them to efficiently predict their future behavior, this is only achieved if we have a computer system that allow us to efficiently preserve that history which allow you to build certainty and as to the condition of each of our teams throughout the lifecycle.

The closing of cycles is the cornerstone of a successful maintenance management based on risk, as we all know the risk is a function of time and uncertainty to the extent that both components are increased necessarily going to change the probability of failure of either by uncertainty or because they actually damage mechanisms are physically acting on the integrity team component, the only way to have control over these two parameters is fulfilling the feedback loop required for the recalculation of risk and thereby efficiently define what the need is real maintenance that the team needs. In Figure 5 we can see some components of the cycle.

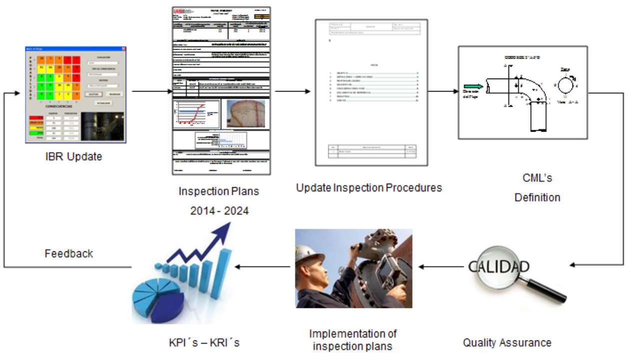


Figure 5. Cycle implementing a risk-based management.

Organization and facilitators

Outdated organizational rules and procedures is one of the first weaknesses that a company should be strengthened to ensure a successful implementation process risk, especially in those companies where outsourcing is very common, this will allow all external entities engaged in activities according to the requirement of the company, in this sense it is essential that the technical specifications of the various contracts are aligned with the internal procedures, this will ensure that activities do as we want it done internally.

In this group a strategy based on risk management requires an organization aligned to four key roles of a maintenance organization Diagnosis, Planning, Programming and Implementation, the absence of some of these roles in a maintenance organization becomes dysfunctional entity to the organization, making a comparison with the human body the absence of the senses, the brain or disabled hands makes us as human beings to fully develop the same happens in organizations such as shown in Figure 6 below.

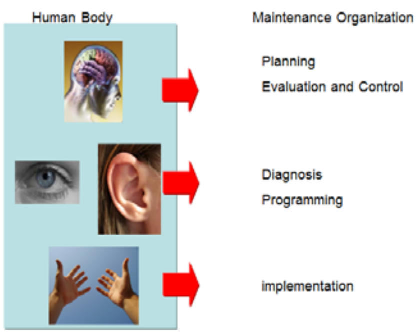


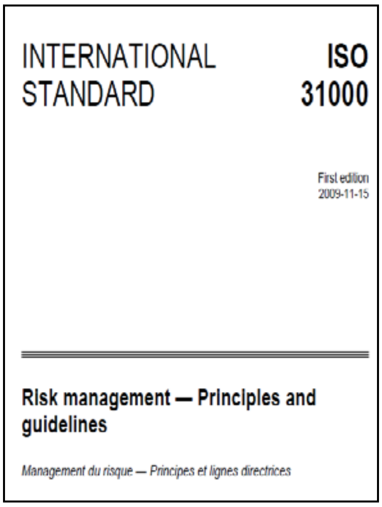
Figure 6. Simile between the human body and the roles of a maintenance organization.

4. Inspection and Risk

Among the 39 themes established by the Institute of Asset Management (IAM) as members Asset management specifically merge are risk assessment and management, for them is essential local strategies that clearly ensure the success of this important issue, It is so important that within the ISO standards, was established in 2009 the ISO 31000 standard considering that all activities of an organization involve risks. It is for them that this rule is considered a complement to ISO 55000.

5. ISO 31000 and API RP 581 RISK MANAGEMENT

While all organizations manage irrigation at different levels, ISO 31000 establishes a set of principles that must be met for risk management to be effective. This international standard recommends that organizations develop, implement and continuously improve a framework aimed at comprehensive process of risk management in government processes, strategy and planning, as well as the values and culture of the entire organization.


INTERNATIONAL STANDARD

ISO 31000

First edition
2009-11-15

Risk management — Principles and guidelines

Management du risque — Principes et lignes directrices

Figure 7. Stander ISO 31000

Although the practice of risk management has evolved over time and in many sectors in order to meet various needs, the adoption of consistent processes within a comprehensive framework can help ensure that risk is managed effectively, efficient and consistent within the organization. The generic approach described in this International Standard provides principles and guidelines for managing any form of risk in a systematic way, transparent and reliable within any scope and in any context. In this sense this is where it comes into play a fundamental role of needs to define strategies that complement these rules for defining risk of Fixed equipment, which can be developed through the joint use of API RP 581 rules Risk-Based Inspection Technology.

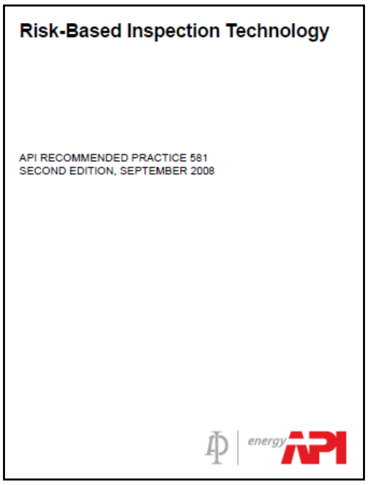


Figure 8. API RP 581 Document

According to the provisions of ISO 31000 for risk management to be effective, organizations must meet the following principles:

(a) Risk management creates and protects value: Risk management contributes in a tangible way to the achievement of the objectives and performance improvement.

(b) Risk management should be an integral part of the processes of the organization: The risk management is an integral part of all organizational processes, including strategic planning and all change management processes.

(c) Risk management should be part of decision making: Risk management should help people make better decisions from the economic standpoint and security and it also helps define priorities.

(d) Risk management explicitly addresses uncertainty: Risk management explicitly takes into account the uncertainty, the nature of it and the way it should be treated to strengthen decision-making.

(e) Risk management is systematic, structured and timely: A systematic, timely and structured risk management approach contributes to the effectiveness and consistent, comparable and reliable results.

(f) Risk management is based on the best information available: Input of the risk management process are based on information sources such as historical data, experience, observation, expert judgments.

(g) Risk management is dynamic, iterative and responsive to the changes: Risk management is sensitive to changes and it must respond to it

(h) Risk management facilitates continual improvement of the organization: Emphasis is placed on continuous improvement of risk management by establishing organizational performance goals, measurement, inspection and subsequent modification of processes. Risk indicators should allow mediate individual and organizational performance in terms of management performance.

6. FRAMEWORK FOR IMPLEMENTATION OF RISK BASED ISO 31000 AND IMPLEMENTATION BY API RP 581

ISO 31000 standard establishes the "to do" to ensure success in the process of implementing maintenance strategies based on risk, It is at this point that requires the "how to" depending on the nature of the risk being analyzed is to link standard with other standards to define the step by step and meet the different requirements that the ISO 31000 standard sets, in this sense to implement a maintenance strategy based on risk to Fixed equipment plays a fundamental role the Policy API RP 581 who will define stepper compliance with each of the elements. Then let us see how they interact with each of the two regulations associating the "what" should be done with the "how" to do it.

Successful risk management depends on the effectiveness of the management framework that provides the basis and provisions that allow their integration at all levels of the organization. The framework facilitates effective risk management by implementing the risk management process different levels and within specific contexts of the organization. In this regard a framework should clearly state the following:

✓Political Risk Management: Which shall be clearly state the objectives and commitment of the organization in risk.

✓Establishment of internal and external communication mechanisms.

✓Levels of risk tolerance, this is a fundamental element of any risk management process because it is the element that will allow decisions regarding treatment of risk, without defining this parameter is not possible to make a real implementation of risk-based management. In this sense there is no legislation establishing reference values for risk tolerance, because the nature of risk tolerance is intrinsic to every human being or each organization, in this sense should consider the following aspects to define tolerance is mentioned above:

o Impacts acceptable losses Production, Safety and Environment.

o History of past failures and general conditions of the installation.

o Own guidelines and / or risk tolerance levels of the Company or its subsidiaries.

o Values used as "Tolerable Risk" by companies in the same industry used as reference. These values can range from $ 5,000 / year for the most conservative and $ 100,000 / year for higher risk aversion.

7.1 RISK MANAGEMENT AS ISO 31000

According to the provisions of this regulation the process of risk management should be an integral part of business management, must be integrated into the culture and practices of daily work and adapt to the business processes of the organization.

A risk management must meet the following requirements as specified in the ISO 31000 standard; those requirements can clearly be seen in Figure 9.

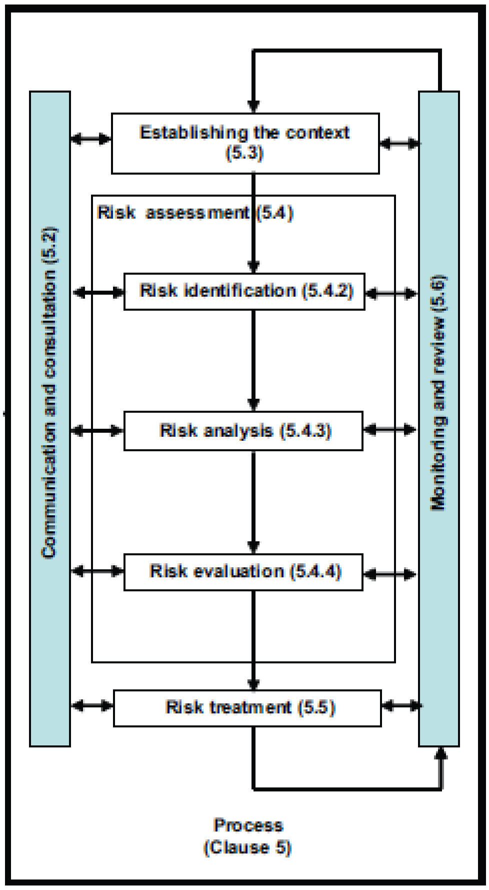


Figure 9. Requirements of a risk management system.

7.1.1. COMMUNICATION AND CONSULTATION

Communications and consultations with internal and external stakeholders should be performed in all stages of risk management. Therefore, communication plans and consultation, .are one of the first steps that should be developed. These plans should address the following points:

- ✓ Elements that influence the probability of equipment failure.
- ✓ Risk tolerance levels of the organization..
- ✓ Consequences levels of equipment failure.
- ✓ Policies equipment maintenance.

This will ensure that those responsible for implementing the risk management process and stakeholders understand the foundations that have served to make decisions and the reasons why certain actions are necessary.

7.2 ESTABLISHMENT OF OPERATIONAL CONTEXT.

The operational context is the environment in which the organization seeks to achieve its objectives. Understanding context is important to ensure that the objectives and concerns of external stakeholders are taken into account to define such an important element as is the level of risk tolerance, which may be limited by external or internal to the organization legal regulations. In this sense, the organization should define the criteria used to evaluate the importance of risk management. Which we could mention some of the following:

Legal or regulatory requirements, requirements signed by the organization.

✓Values, objectives and resources of the organization.

✓Nature and types of causes and consequences that can occur, and how to measure them.

✓ Method of defining the probability of component failure.

✓ Method for determining the level of risk.

✓ Alignment tolerances

7.1.2. RISK ASSESSMENT

The ISO 31000 standard provides that the risk assessment is the overall process of identification, analysis and evaluation of this can be seen in figure 9 where these three elements are seen highlighted in blue. This risk assessment process requires the correct understanding of each of these definitions to deepen implementation process since the ISO 31000 Standard only establishes the guidelines for its implementation, in this sense for establishing risk-based management for Fixed support team experiences and external regulations to ISO 31000 that clearly establishes the "how" the process of implementing a risk-based management is necessary.

7.1.3 RISK IDENTIFICATION

The process of risk identification is the first step to be taken for a good appreciation, we can then define risk identification as the process to locate, list and characterize elements of risk (probability and consequences of failure). The ISO 31000 standard requires that the organization should identify the sources of risk, the areas of impacts and their causes and potential consequences. The objective of this stage is to generate a comprehensive list of risks based on those events that could create, enhance, prevent, degrade, accelerate or delay the achievement of objectives. The process of identification is the most important step in the risk management process without good identification of it; it would drastically decrease the successful treatment of the risk activities.

The process of identifying risk in Fixed equipment requires the establishment of two analyzes associated with the elements that cause loss of containment function and that are directly related to the mechanisms of deterioration which are susceptible computers and depend on each the type of building material, design and process, here we speak of the need to identify each of the mechanisms of deterioration which are susceptible equipment, it is called a loss Thinning or internal or external thickness cracking attack by hydrogen at high temperature, mechanical fatigue and weakening.

Figure 10. Viewing some deterioration mechanisms

Susceptibility to each mechanism of deterioration should be clearly defined to ensure the effectiveness of the inspection plans since nondestructive testing techniques that apply in the future to risk mitigation plan are necessarily linked to the search for a mechanism of specific deterioration, this requires supported in the current international regulations exist to this day, in Figure 10 can be seen some standards that support this important stage of risk assessment.

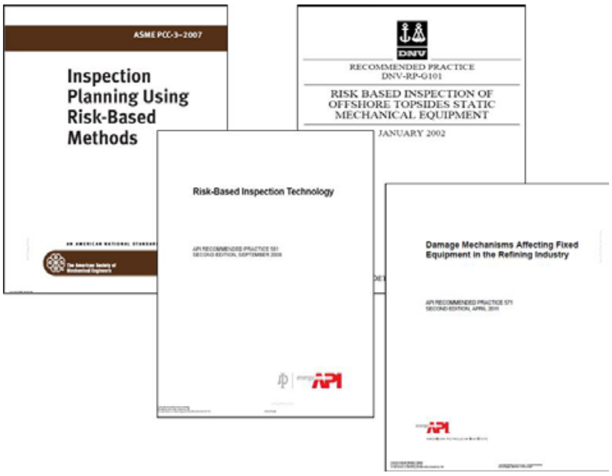


Figure 11. Regulation API RP 581 / API RP 571 / ASME PCC3 / DNV RPG support 101 for determining susceptibility to damage mechanisms.

The second analysis that we undertake for efficient risk identification is the study and assessment of the consequences of failure associated with loss of containment function, which depend on the type of team working fluid which may be flammable and cause an explosion or fire, can be toxic and generate a result to people for toxicity or no toxic or flammable such as acids or hot steam. The impact of the result should be valued as financial risk, in this sense it is essential to have a methodology to take into account fundamental aspects to assess the consequences of failure such as that associated with the impact on production cost due to the fault, environmental impact, impact to people, and damage to other equipment.

7.1.3.1 RISK ANALYSIS

The risk analysis process is the second step to be taken for a good appreciation; we then define the risk analysis as the process used to assign values of probability and consequences of failure to risk components. The ISO 31000 standard provides that risk analysis involves consideration of the causes and sources of risk, their positive and negative consequences and the likelihood that these consequences may occur. Factors of consequences failure should be identified and the probability of failure also should be identified. The risk is analyzed by determining the consequences and probabilities, the way of expressing either, semi quantitative qualitatively or quantitatively, should correspond to the type of risk, the information available and the purpose for which risk analysis is to be used.

API Recommended Practice RP 581 provides all the details required to efficiently develop a quantitative risk analysis to define the best strategy for maintaining Fixed equipment, based on calculations of this probability of failure and consequences to be developed as follows:

- **Probability of Failure**

Probability of failure, is determined as the product of a generic failure frequency (gff), a damage factor, $D_{f}(t)$, and a management systems factor, F_{MS} .

$$P_f(t) = gff \cdot D_f(t) \cdot F_{MS}$$

Details of calculation of this equation are clearly stated in the rules API RP 581.

- **Failure consequences**

The consequences of failure are the second component of risk that must be properly calculated to efficiently perform a risk analysis. For purposes of quantitative risk analysis noma API 581 has established a comprehensive procedure that takes into account all possible scenarios that occurred after the loss of containment function. In the flowchart shown in Figure 12 can be seen in detail each of the steps to be registered to obtain the consequences of failure of a Fixed team in monetary units.

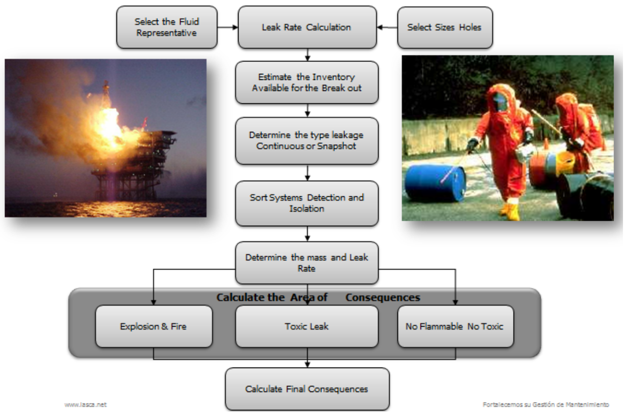


Figure 12. Steps set out in API RP 581 for calculating the consequences of failure

Under the premises aforementioned risk analysis will be complete when the equation that interrelate the probability of failure and the consequences of failure is defined, it is established as follows:

$$R(t) = P_f(t).C(t)$$

R (t) : **Risk**

P_f (t) : **Probability of Failure**

C (t) : **Failure consequences**

Based on the above explained can be concluded that an analysis of risk borne by the rules API RP 581 in monetary units get the level of risk involved in each of the teams analyzed, allowing it to make future financial assessments to make clear decisions regarding the value contribution of different maintenance strategies that a team may require.

7.1.3.2 RISK EVALUATION

The process of risk assessment is the third step to be taken for a good appreciation, the purpose of risk assessment is to help decision making, determining risks being treated and the priority to implement the treatment. Risk assessment involves comparing the level of risk found during the analysis process with risk criteria established when the framework and operational context was considered. In Figure 13 can be seen how important the establishment of tolerable risk level where based on this comparison, can be considered the need for risk treatment, defining in the case of Fixed equipment strategies associated with the scope of non-destructive inspection and dates of next inspection.

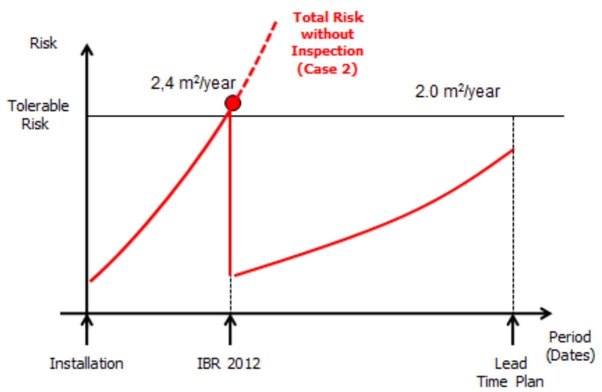


Figure 13. Setting the level of tolerable risk.

7.1.3. TREATMENT OF RISK

The ISO 31000 standard provides that risk treatment involves the selection and implementation of one or more options to modify risk.

Treatment options risks are:

a) Avoid the risk by deciding not to initiate or continue the activity causing the risk.

b) Accept or increase the risk to pursue an opportunity.

c) Remove the source of risk.

d) Modify the probability of failure.

e) Modify the consequences of failure.

f) Share risk with other parties

For purposes of risk management team of a Fixed risk treatment is the development of an inspection plan that would modify the probability of failure, at first supported the removal of uncertainty in the knowledge of the actual condition of the equipment and determining second inspection depending on the actual condition of equipment damage. Regarding the treatment of risk associated with Fixed equipment is through the creation of an inspection plan should clearly provide answers to four fundamental questions:

What kind of damage its done?

1. Where should they be detected?
2. How could it be detected?
3. When should inspection be done?

Other important aspects in the process of risk mitigation methodology that can be performed are:

- To modified process to eliminate conditions that drive the growth of risk.
- Chemical treatment to reduce the rate of spoilage and/or sensibilities.
- Changes in metallurgy to reduce the chance of failure.
- Remove unnecessary insulation to reduce the probability of any corrosion under insulation.
- Reduce inventory levels to reduce consequences of failure.
- Improve systems for detection, isolation and Mitigation.

- Changes in the fluids process for less flammable and less toxics.

6. BENEFITS OF A RISK-BASED MANAGEMENT

Throughout reading this document we realized the potential of establishing a risk management supported under these three regulations (ISO 55000, ISO 31000 and API RP 581) which together allow support an integrity management aligned to the objectives set by senior management and enhance the culture they create value and improve profitability. In this sense the most important benefits that a risk-based management can provide are:

- The greatest benefit that can provide a risk-based management is to prevent catastrophic failure of critical equipment.

- A risk-based management allows making decisions about the needs of Inspections and Maintenance of equipment carried on a technically sound method of analysis.

- An important aspect of risk-based management is the ability to shape the future performance of equipment damage.

- A risk-based management allows to direct resources towards computers increased maintenance and consequences can be generated in case of a failure, defining the most appropriate maintenance activity from the standpoint of cost benefit risk.

- Through risk management based on a significant reduction of the points of condition monitoring equipment is obtained, this leads to improved planning process inspection campaigns and significantly reduce the cost of inspections throughout the life of the asset.

- There are several ways to achieve significant cost reductions in the inspection and maintenance of an asset, the most significant is affecting the scope of scheduled shutdowns, in this sense a maintenance management based on risk allows reduction of pressure receptacles shall be opened for internal inspection in the future stop, extending the intervals between stops, reducing the duration of the stop, decrease the amount of Pressure Relief Devices for maintenance per year.

7. REFERRALS

(1) University of the Gran Canaria Palmas; "Fundamentals of Safety and Risk Management. Industrial. Year 2009.
(2) Risk Based Inspection Course Integrity Assessment Services. September 2014
(3) International Standard UNE ISO 31000; “Risk Management principles and guidelines. Edition Year 2010.
(4) API RP 580. Recommended Practice 580 Second Edition, November 2009.
(5) API RP 581. Recommended Practice 581 Second Edition, September 2008.
(6) BS ISO 55000: Asset management Overview, principles and terminology 2014. Incorporating corrigendum March 2014
(7) BS ISO 55001:Asset management systems – Requirements March 2014
(8) BS ISO 55002: Asset Management systems – Guidelines. March 2014
(9) Asset Management – an anatomy. Version 2. Julio 2014.