Fundamental Principles of Risk Assessment for Oil Equipments Maintenance

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***Abstract*— For the application of the method to lead to the most relevant results, the first condition is that the system to be analysed is well defined in terms of its purpose and its elements. This limits the number and type of potential interlaces to be investigated, and implicitly the risk factors to be considered. The paper presents the principles that are the basis for the approach of the reliability and maintenance analysis of oil equipment within an integrated management system.**

Keywords*— *Maintenance; Method, Risk, Analysed

I.INTRODUCTION

At this stage, essential for the quality of the analysis, it is determined for each component of the assessed work system (ie work), on the basis of the predetermined list what dysfunctions can occur in all predictable and probable situations of operation.

In order to identify all possible risks it is therefore necessary to simulate the functioning of the system and to deduce those deviations.

This can be done either through verbal analysis with the technology, in the case of relatively dangerous jobs, in which accidental (or disease-causing) or quasi-dysfunctional dysfunctions, or by applying the event tree method.

Regardless of the solution adopted, working methods are direct observation and logical deduction.

In the case of objective risk factors (generated by the means of production or the working environment), their identification is relatively mild, knowing the parameters and functional characteristics of the machinery, equipment, installations, physico-chemical properties of the materials and materials used or the bulletins analysis of environmental conditions.

The identification of work-related risk factors is based, on the one hand, on the analysis of the conformity between its content and the work capacity of the performer to whom it is assigned and, on the other hand, by specifying possible operations, working rules, procedures wrong work.

The identified risk factors are included in the Workplace Assessment Sheet where the specific form of manifestation is also specified in the same step: the description and the size of the parameters for appreciating the factor (for example, resistance to pressure, shear, weight and dimensions). The increase of the trade links, in the conditions of the intensification of the competitive phenomenon, constituted, for all organizations, a reason for thinking about the ways.

II. THE FUNDAMENTAL PRINCIPLES OF RISK ASSESSMENT

Risk assessment is the systematic study of all aspects of the work process that are likely to generate unwanted events, hazards, and applicable prevention / protection measures to control these risks;

• Risk assessment should be driven by top management that will build and / or involve directly all affected / affected stakeholders: employer, top management, workers and their representatives;

• Risk assessment involves the following steps:

a. Identification of hazards;
b Identification of workers (or other persons) who may be exposed to these hazards;
c. Qualitative or quantitative risk assessment;
d. Examining the possibilities of eliminating the risks;

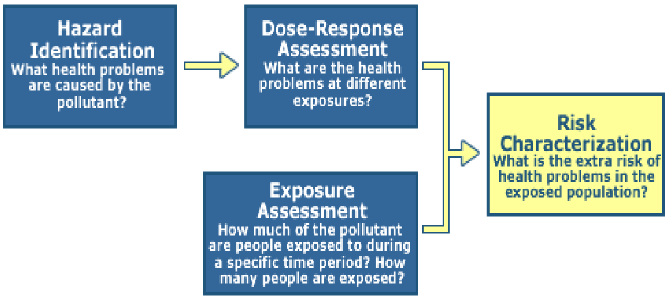

Fig.1 Assessment of the need to stop other measures to prevent or reduce risks.[1]

Risk assessment must dream of all jobs:
• Fixed jobs (for example: offices, workshops, schools);
• Evolution jobs (construction sites, docks, shipyards);
•Mobile jobs (temporary jobs for urban sewerage maintenance, inspection visits).

Evaluation of risks for unrelated workplaces (offices, workshops):
• Take into account the conditions of use;
• Will not be reiterated when jobs are comparable;

[1] Conducting a Human Health Risk Assessment https://www.epa.gov/risk/conducting-human-health-risk-assessment

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• Consider the need for a revised or different assessment when circumstances change, for example, by introducing new equipment and technologies.

Risk assessment in the workplace
where circumstances and circumstances change, implies an approach that makes it easier to take account of these changes; risks can be assessed in a general manner so that the principles of removal and control remain valid, even if the workplace changes;

Risk assessment:
• It will not be done exclusively by the employer or their representatives, who must be consulted during the evaluation process and information on the conclusions reached and the preventive measures taken;
• It will take into account the presence in the workplace of workers of other enterprises or other categories of staff; by their very presence, they are exposed to the existing risks but, on the other hand, they are likely to put new staff at risk;
• Take into account the potential interactions between own and serviced activities; employers whose staff perform work in other enterprises (eg assembly, maintenance, service) must take care of the safety and health of their staff;
• Consider visitors (students, students, the public, patients in hospitals, etc.) as they are often unaware of the risks and ignore protective measures; for this reason, a visitor regulation is recommended, and they will receive a summary of the prevention and protection measures to be followed.

III. CONDUCTING A HUMAN HEALTH RISK ASSESSMENT PLANNING

Even a human health risk assessment starts with a good plan. Before anything though there is a need to make judgments early when planning major risk assessments regarding the purpose, scope, and technical approaches that will be used.

Exposure
Assessment
Risk
Characterization
Planning

To start, risk assessors will typically ask the following questions:
Who/What/Where is at risk?
Individual
General population
Lifestages such as children, teenagers, pregnant/nursing women
Population subgroups - highly susceptible (for example, due to asthma, genetics, etc.) and/or highly exposed (for example, based on geographic area, gender, racial or ethnic group, or economic status)
What is the environmental hazard of concern?
Chemicals (single or multiple/cumulative risk)
Radiation
Physical (dust, heat)
Microbiological or biological
Nutritional (for example, diet, fitness, or metabolic state)
Socio-Economic (for example, access to health care)
Where do these environmental hazards come from?
Point sources (for example, smoke or water discharge from a factory; contamination from a Superfund site)
Non-point sources (for example, automobile exhaust; agricultural runoff)
Natural sources
How does exposure occur?
Pathways (recognizing that one or more may be involved)
Air
Surface Water
Groundwater
Soil
Solid Waste
Food
Non-food consumer products, pharmaceuticals
Routes (and related human activities that lead to exposure)
Ingestion (both food and water)
Contact with skin
Inhalation
Non-dietary ingestion (for example, "hand-to-mouth" behavior)
What does the body do with the environmental hazard and how is this impacted by factors such as age, race, sex, genetics, etc.?)
Absorption - does the body take up the environmental hazard
Distribution - does the environmental hazard travel throughout the body or does it stay in one place?
Metabolism - does the body break down the environmental hazard?
What are the health effects?
Example of some health effects include cancer, heart disease, liver disease and nerve disease.
How long does it take for an environmental hazard to cause a toxic effect? Does it matter when in a lifetime exposure occurs?
How long?
Acute - right away or within a few hours to a day
Subchronic - weeks or months (for humans generally less than 10% of their lifespan)
Chronic - a significant part of a lifetime or a lifetime (for humans at least seven years)
Intermittent
Timing
Is there a critical time during a lifetime when a chemical is most toxic (e.g., fetal development, childhood, during aging)?

IV.RISK MANAGEMENT

Environmental risk management seeks to determine what environmental risks exist and then determine how to manage those risk in a way best suited to protect human health and the environment.
As described in EPA’s Risk Characterization Handbook, risk management Help Risk Management
The process of deciding whether and how to manage risks. Risk management requires consideration of legal, economic and behavioral factors, as well as ecological, human health and welfare effects of each decision/management alternative.
Management may involve regulatory and non-regulatory responses. (source: CRS 2005) is the process which evaluates how to protect public health.

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Examples of risk management actions include deciding how much of a substance a company may discharge into a river; deciding which substances may be stored at a hazardous waste disposal facility; deciding to what extent a hazardous waste site must be cleaned up; setting permit levels for discharge, storage, or transport; establishing national ambient air quality standards; and determining allowable levels of contamination in drinking water.

-*Risk assessment* provides information on potential health or ecological risks, and risk management is the action taken based on consideration of that and other information, as follows:

-*Scientific factors* provide the basis for the risk assessment, including information drawn from toxicology, chemistry, epidemiology, ecology, and statistics - to name a few.

-*Economic factors* inform the manager on the cost of risks and the benefits of reducing them, the costs of risk mitigation or remediation options and the distributional effects.

-*Laws and legal decisions* are factors that define the basis for the Agency's risk assessments, management decisions, and, in some instances, the schedule, level or methods for risk reduction.

-*Social factors*, such as income level, ethnic background, community values, land use, zoning, availability of health care, life style, and psychological condition of the affected populations, may affect the susceptibility of an individual or a definable group to risks from a particular stressor.

-*Technological factors* include the feasibility, impacts, and range of risk management options.

-*Political factors* are based on the interactions among branches of the Federal government, with other Federal, state, and local government entities, and even with foreign governments; these may range from practices defined by Agency policy and political administrations through inquiries from members of Congress, special interest groups, or concerned citizens.

-*Public values* reflect the broad attitudes of society about environmental risks and risk management.
What is risk management and why do I need it?
Every business is prone to risk in everyday operations.
Risk is the chance of a loss occurring from some event.

Self Storage owners are faced with a variety of risks including: damage to property, liability claims such as a slip/fall or employee injury, upset customers, or legal claims such as a wrongful sale. Risk is a normal part of your business and personal life, but risk can and should be managed in order to reduce the chance or severity of a loss. Risk management is not about red tape.
What is the purpose of risk management?
The purpose of risk management is to identify and deal with problems before they occur in order to avoid surprises and loss. Most large companies have professional risk management on-staff. The average self storage operator does not possess the scale to justify such a position. Therefore, the SSRMA is here to help you manage self storage risks.

Fig.2 Risk Management[2]

V. RISK ASSESSMENT METHODOLOGY

V.1 Overview
Although there is no universally valid principle on risk assessment methodology, two rules are essential in the field:
- the assessment must be structured so that all potential hazards and risks are analyzed;
- when a risk has been identified, the first question to be answered is whether the associated danger can not be eliminated.

Operations that may be included in possible approaches to risk assessment:

• Observing the specific environment of the workplace;
• determining all work-related work tasks;
• considered to ensure that all will be taken into account in the evaluation;
• risk analysis induced by different workloads;
• observation of the way in which the work processes take place, in order to verify the conformity of the applied procedures with the established and non-existent ones with additional risks;

• Analysis of operating modes for assessing exposure to danger;
• analysis of external factors of influence;
• detailed analysis of the psychological, social and physical factors likely to contribute to the stress at the workplace, as well as their interaction with organizational and environmental factors;
• Analysis of the measures adopted to ensure security, especially with regard to the existence of risk assessment systems due to new technologies and materials, and the updating of risk information.

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[2] RISK MANAGEMENT IN SELF STORAGE OPERATIONShttp://ssrma.org/risk-management/

• Criteria applicable to risk assessment:
• legal prescriptions;
• published rules and recommendations;
• hierarchy principles of risk prevention measures:
• avoiding risks
• replacing dangerous items with other non-hazardous or less dangerous ones
• Combating risks at source
• giving priority to collective protection measures in relation to individual protection measures
• taking into account the evolution of scientific and technical knowledge
• Continuous improvement of the level of protection.

The selection of how to approach the evaluation process depends on the following elements: nature of the job (permanent or temporary); process type (e.g., repetitive operations, variable / evolution processes, job-based work); the particularities of the workload (eg repetitive, occasional tasks, type of piecework treatments or seasonal application of pesticides); the technical complexity of the workplace.

In practice, it is often useful to design the process of evaluation that a structured action on successive stages:

- global assessment - consists in making a net distinction between major risks for which security measures are widely known and applied and risks requiring detailed analysis; they must:
• review, if possible, the risks that can be eliminated; even if this goal is often unfeasible, it must always be a priority;
• Analyze the risks that do not require new actions and, consequently, additional funds;
• Identify the generally known risks for which security measures are not only easy to identify but also available;
• Indicate points for which an in-depth assessment is required based on more complex techniques.
- risk assessment requiring a thorough analysis - these steps may require the need for complex analysis techniques, depending on the actual situation.
- if the overall assessment is considered to be insufficient, further analysis will include at least the some steps.
In specialist terminology, human security in the work process is considered to be the state of the work system in which the possibility of injury and professional illness is excluded. In the usual language, security is defined as sheltering from any danger, and the risk - the possibility of reaching a reception, potential danger.
If we take into account the usual meanings of these terms, it can be defined that the state of the work system where the risk of injury and illness is zero.

Therefore, security and risk are the opposite of the abstract, contradictory, which can be mutually exclusive. In fact, due to the features of any work system, such states of absolute character can not be reached. There is no system in which the potential danger of injury or illness is completely excluded; there is always a "residual" risk, whether due to the unpredictability of human action. Unless corrective interventions are carried out in the course of time, this residual risk rises, as the elements of the labor system degrade by "aging".
Consequently, systems can be characterized by "security levels" or "risk levels", that quantitative security / risk indicators. Defining the security that a risk function y = f (fx), where:

$$y=1/x \tag{1}$$

it can be said that a system will be even safer as the risk level will be smaller and more mutual. Thus, if the risk is zero, the relationship between the two variables shows that security tends to infinity, and if the risk tends to infinity, security tends to zero.

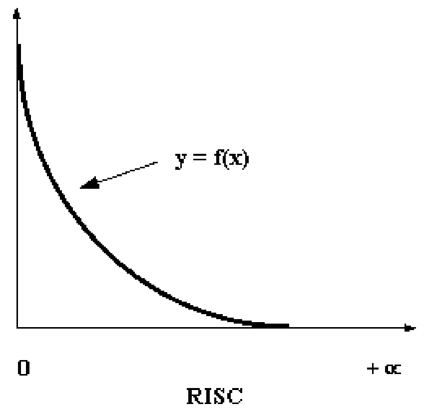

Fig. 3 Risk Security relationship

In this context, a minimum risk limit, ie a level of risk defined by zero, but low enough to be considered as safe, that a maximum risk limit equivalent to one so low security level that the system is not allowed to operate.

The notion of acceptable risk

The risk has been defined in the specialized literature in the field of occupational safety through the probability that an accident or a professional illness occurs in a work process with a certain frequency and severity of the consequences.
Indeed, if we admit a certain risk, we can represent it, depending on gravity and probability of producing consequences, through the surface of a vertically developed F1 rectangle; it follows that the same surface can also be expressed by a partition F2 or by a horizontally extending F3 rectangle.

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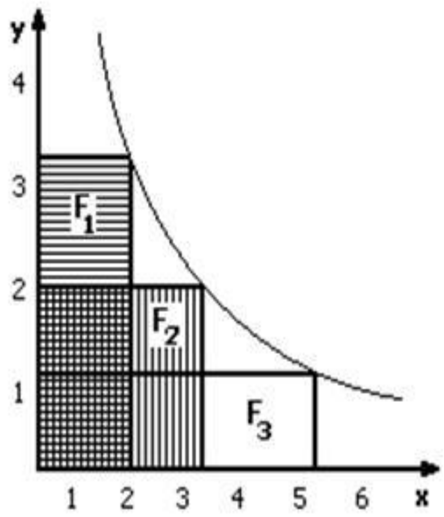

Fig. 4 Graphic representation of risk equivalence characterized by couples of different severity - probability

V.2 Assigning risk levels according to the severity and probability of the consequences of the action of the risk factors

With these two scales - quotation probability severity of the consequences risk factors (Annex 3), we can associate to each risk factor a system a couple of elements characteristic, severity - probability for each torque setting a risk. For the assignment of risk / security levels, the risk acceptability curve was used.

First, because gravity is a more important element in terms of the output of labor, it is assumed that it has a much higher incidence on risk than frequency. As a consequence, 7 levels of risk were established according to the 7 severity classes, in ascending order and 7 security levels, given the inversely proportional relationship between the two states (risk-safety):

N_1-minimum risk level → S_1-maximum security level;
N_2-level very low risk → S_2-very high level of security;
N_3-low level of risk → S_3-high level of security;
N_4-medium risk level → S_4-medium security level;
N_5-high level of risk → S_5-low security level;
N_6-level very high risk → S_6-very low security level;
N_7-maximum risk level → S_7-minimum security level;

If we consider all the possible combinations of the variables specified by two, we obtain a matrix M_ (g, p) 7-g line, which will represent the grades of severity and 6 columns p - probabilistic classes:
In all three, the risk is just as great. Consequently, we can assign severity couples - different probabilities with the same level of risk.

If we join the three rectangles in a line drawn through the peaks that are not on the coordinate axes, we obtain a hyperbola alloy curve, which describes the link between the two variables: gravity-probability.

For the representation of risk according to severity and probability, CEN - 812/85 defines such a curve as "risk acceptance curve"

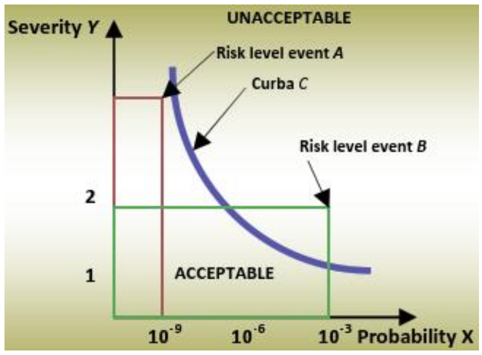

Fig. 5 Risk acceptability curve[3]

For this reason, if we use the intervals specified in IEC 812/1985, we obtain 5 groups of events ordered as follows: If we take into account all the possible combinations of the specified variables, two, we obtain a matrix M_ (g, p) with 7 lines-g, which will represent the classes of gravity, and 6 p-columns of the probailylated classes:

$$M_{g,p} = \begin{matrix} (1,1) & (1,2) & (1,3) & (1,4) & (1,5) & (1,6) \\ (2,1) & (2,2) & (2,3) & (2,4) & (2,5) & (2,6) \\ (3,1) & (3,2) & (3,3) & (3,4) & (3,5) & (3,6) \\ (4,1) & (4,2) & (4,3) & (4,4) & (4,5) & (4,6) \\ (5,1) & (5,2) & (5,3) & (5,4) & (5,5) & (5,6) \\ (6,1) & (6,2) & (6,3) & (6,4) & (6,5) & (6,6) \\ (7,1) & (7,2) & (7,3) & (7,4) & (7,5) & (7,6) \end{matrix}$$

A type of deterioration model that utilizes a graph to represent the relationship between potential failure (**"P"**) and functional failure (**"F"**). P-F curves are used to map and avert failures. The P-F interval represents the second (middle) phase in a three-phase life cycle model and deterioration model of assets.

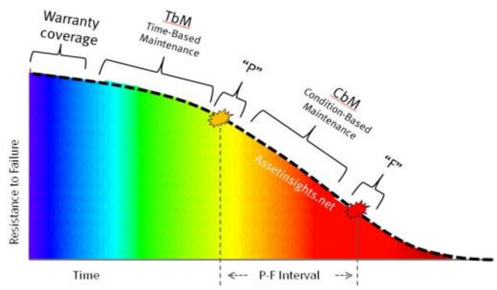

Fig. 6 The risk spectrum[4]

VI. CONCLUSION

At this stage, essential for the quality of the analysis, it is determined for each component of the assessed work system (ie work), on the basis of the predetermined list (Annex 1), what dysfunctions can occur in all predictable and probable situations of operation.

[3]A Romanian Occupational Health and Safety Risk Assessment Tool: Premises, Developmentand Case Study
https://www.researchgate.net/figure/Risk-acceptability-curve_233992759
[4] http://www.assetinsights.net/Glossary/G_P-F_Curve.html

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In order to identify all possible risks it is therefore necessary to simulate the functioning of the system and to deduce those deviations. This can be done either through verbal analysis with the technology, in the case of relatively dangerous jobs, in which accidental (or disease-causing) or quasi-dysfunctional dysfunctions, or by applying the event tree method. Regardless of the solution adopted, working methods are direct observation and logical deduction.

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The identified risk factors are included in the Workplace Assessment Sheet where the concrete form of manifestation is also specified in the same step: the description and the size of the parameters for appreciating the factor (for example, shear, shear, weight and dimensions, etc.).

To determine the possible consequences of the action of the risk factors, the list in shall be used. The severity of the consequence thus determined shall be appraised on the basis of the scale in . Important information for assessing as accurately as possible the severity of the possible consequences is obtained from the statistics of occupational accidents and diseases produced in the workplace or similar jobs. In order to determine the frequency of possible consequences, the scale is used. The classification in the probability classes is made after being determined, based on the statistical or calculation basis, the respective intervals subsequently transform into probabilities expressed by number of possible events per year.

The result obtained from previous procedures is identified in the Risk Assessment Grid (Annex 4) and is included in the job sheet . With the help of the risk / security level scale, these levels are then determined for each risk factor (partial risk levels). This gives a hierarchy of the size of the risks at the workplace, which makes it possible to prioritize preventive measures, depending on the risk factor with the highest level of risk.

The global (No) risk level at work is calculated as a weighted average of the identified risk levels. Because the result obtained to reflect as accurately as possible the reality, we use the weight-bearing element of the risk factor, which is equal to the level of the risk. In this way, the highest risk factor was the highest. It eliminates the possibility that the offset effect between extremes, involving any statistical mean, masks the presence of the factor with the maximum level of risk.

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