

ACCIDENTS & INCIDENTS MANAGEMENT IN SONATRACH

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Abstract: Sonatrach had embarked upon a programme to design and implement a comprehensive, integrated HSE Management Systems to address the management requirements of all Sonatrach's assets in Algeria. Sonatrach has identified and published a ten elements programme which will be designed to integrate a series of activities and processes to manage and control risks and requirements relating to HSE. The implementation of the eighth element "Accidents and Incidents Management" has encountered some barriers that impede its effectiveness.

The aim of the project is to systemise and improve reporting and investigation process by:

Emphasizing opportunities to prevent incidents through early identification of unsafe behaviour and near-misses.
Improving analysis incidents/accidents.

For this purpose, a review of literatures has been undertaken to identify safety observation programmes as well as existing accidents investigation tools and techniques. Then, benchmarking and comparative studies have been carried out of best practices. From the results of the study and the literature review, crucial techniques for improving reporting and investigation were identified.

Keywords: Near-miss, Behavioural safety, Reporting, Investigation

1. NEAR-MISSES

A "near-miss" is an event that signals a system weakness that if not remedied could lead to significant consequences in the future. As such, a near-miss is also an opportunity to improve system structure and stability, and an opportunity to reduce risk exposure to potential catastrophe.

Near-misses can be observed in a wide-variety of systems. For example, the Space- Shuttle Challenger explosion had near-misses on previous missions, where O-rings (the mechanical source of the catastrophe) had potential for catastrophic failure. The 1999 Paddington train crash catastrophe where 31 people died was preceded by eight near-misses at the same location that the subsequent catastrophe occurred. And many other well-known, highly publicized disasters had numerous precursors, or near-misses, that were not properly recognized and managed.

2. THE ACCIDENT TRIANGLE

An accident can be defined as an unplanned event that results in injury or ill health to people, damage or loss to property or the environment, or a loss of business opportunity. The relationship between the numbers of such accidents leading to various outcomes is often represented by the so-called accident triangle (Figure.1). Studies have shown that for every serious accident resulting in absence from work for more than three days, there may typically be ten times as many minor injury accidents, (requiring first aid only) and several hundred non injury accidents, which could for example, involve substantial property damage.

Furthermore, the cause of a minor accident may in other circumstances have led to much more serious results [1].

3. BEHAVIOURAL SAFETY PROGRAMMES

It is a proactive approach to safety improvement, and provides an early warning to accidents/incidents, allowing the measurement of safe/unsafe behaviour in the workplace. It gives individuals the opportunity to share feedback on safety performance with their peers, encourages involvement in safety, improves self-awareness and heightens risk perception, within a fair and just culture. Behavioural safety challenges traditional safety management thinking towards prevention of events.

A key process in any journey to safety excellence is the promotion of safe behaviours to reduce accidents and incidents, using communication skills. They enable, empower and encourage employees to organise, control and improve their own safety. Employees often have the best solution if we take time to listen. The aim is to instil a



Figure.1. Accident triangle

questioning attitude and personal responsibility towards health and safety in all employees [2].

4. ACCIDENT INVESTIGATION

The main reasons for performing accident investigations are to find the root cause of the problem, and to prevent the recurrence of a similar accident [3]. The root causes of the problem should be eliminated, as a part of the continuous improvement work, in order to strive for higher quality [4].

Accident investigation is “like peeling an onion. Beneath one layer of causes and recommendations, there are others, less superficial, layers. The outer layers deal with the immediate technical causes while the inner layers are concerned with ways of avoiding the hazards and finding underlying causes, such as weaknesses in the management system.” Very often only the outer layer, the immediate technical causes are investigated. Although it is possible to prevent the latest accident from happening again, considering the indirect causes and immediate causes together may prevent similar accidents from happening again [5].

The overall process of incident investigation within the safety field is similar across many of the methodologies. Differences arise however, in the particular emphasis of the techniques. Some focus on management and organisational oversights and omissions while others consider human performance/error problems in more depth.

5. PRESENT SITUATION OF SONATRACH

Currently, the Association of Oil and Gas Producers (OGP), to which Sonatrach belongs, refer to Bird triangle (Accident triangle) to elaborate its strategy to prevent accidents and incidents. OGP statistics of 2004 [6] are shown in figure.2:

The evolution of accidents and incidents of Sonatrach Group [7] recorded during 2004 and the first semester of 2005, are illustrated in figures.3 and 4.

From these figures, we notice that the incident reporting pyramid is up side down, Sonatrach is getting more major accidents than minor ones. The incident reporting system did not working the way it should, which due to:

- Not all incidents/accidents with minor injuries are reported.
- There is no systematic investigation for all incidents/accidents.
- There is neither reporting nor follow up of near-misses and unsafe behaviour.

Follow up of corrective actions is done only for fatalities and lost time injuries

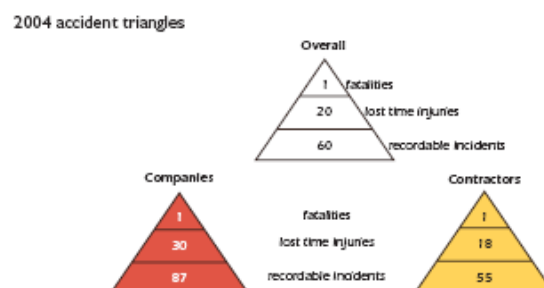


Figure.2. Accident triangles 2004 (OGP)

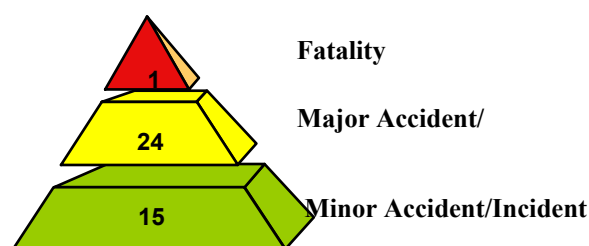


Figure.3. Sonatrach's accident triangle, 2004

6. METHODOLOGY

Effective implementation of Accidents and Incidents Management System requires both reactive and proactive strategy (Figure.5). Pro-active monitoring provides information in the absence of any incident, ill health or damage to the receiving environment. Pro-active performance indicators are forward looking and predictive, aimed at raising the awareness of the possibility of incidents that might happen.

Reactive monitoring provides information on incidents that have occurred and provides insights into means of preventing similar incidents in the future. Reactive performance indicators provide evidence of deficient HSE performance.

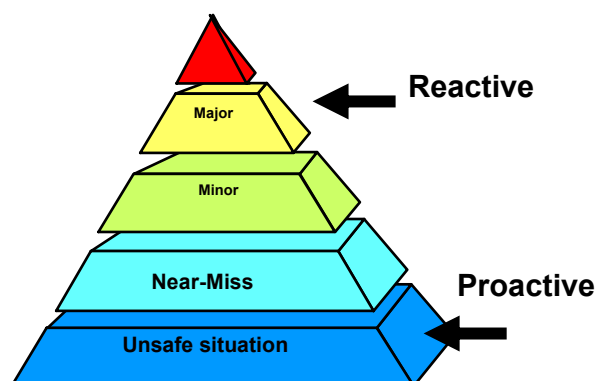


Figure.5. The reactive and proactive strategy

7. BEST PRACTICES OF OBSERVATION BASED PROGRAMME

7.1 Safety Training Observation Programme (STOP)

STOP is designed to encourage safety observations and conversations at the work site, and allow the identification and correction of unsafe trends in behaviour or working conditions. Training and supervisor-led coaching is used to introduce employees to the five-step STOP "safety observation cycle" (Figure.6), which involves:

Decide to make observations

Stop or pause during other work, to make time for observations

Observe people at work, and working conditions to identify unsafe behaviour/conditions

Act on observations, for example speaking to a colleague observed working safely/unsafely, and providing encouragement or taking corrective action as required

Report observations and corrective actions on using a pocket sized STOP card, which is then handed to a supervisor for review, collation and any further action required.

The card is signed by the observer; however an important principle of STOP is that the identity of the person(s) observed remains anonymous [8].

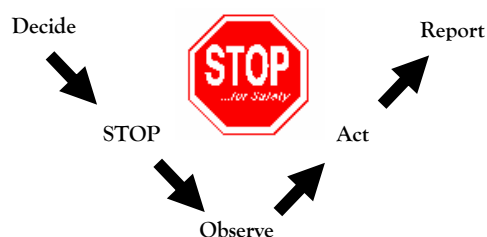


Figure.6.The STOP Cycle

7.2 Advanced Safety Auditing (ASA)

Audits involve observing other people at work, and focus on behaviours. Auditors attend to those aspects of work which are critical to safety, using all of their senses. Following a period of observation, the auditor initiates a conversation, using an open questioning technique. Ideally the audited should be speaking for at least 75% of the time, whilst the auditor listens carefully. The aim of this form of conversation is to guide the audited to recognise any hazards and unsafe behaviour, and formulate solutions. Good work performance and safe working practices are commended. The final very important element of the ASA process is to gain commitment to what the audited will do in the future to ensure safe working and confirming any actions necessary to the auditor. Fellow-auditors are encouraged to share learning from ASA's with as wide an audience as possible [9].

7.3 Time Out For Safety (TOFS)

TOFS is a behavioural practice which allows team members to stop any operation if they are uncertain about anything or have safety concerns. Employees 'call a TOFS' by making the T sign with their hands; this signal is useful in noisy environments where it can be difficult to hear colleagues. The technique provides a medium to promote this positive behaviour, which was encouraged before the advent of TOFS. The technique makes it clear that employees are able, and in fact expected, to stop a job if they feel this is necessary [10].

8. BEST PRACTICES OF ROOT CAUSE ANALYSIS

8.1 Barrier Analysis

This method identifies barriers/controls that are in place to prevent accidents. These barriers may be physical and/or administrative and must be absent, inadequate, or bypassed in order for the accident to occur [11].

8.2 Change Analysis

As its name implies, this technique emphasizes change. To solve a problem, an investigator must look for deviations from the norm. Consider all problems to result from some unanticipated change. Make an analysis of the change to determine its causes [12].

8.3 Fault Tree Analysis

FTA involves backward reasoning through successive refinements from general to specific. As a deductive methodology it examines preceding events leading to failure in a time-driven relational sequencing. The resulting fault tree is a graphical representation of the potential combinations of failures that generated the incident, as shown in the following figure. The tree starts with a 'top event' representing the analysed incident and decomposes it into contributory events and their relationships until the root causes are identified.

8.4 Management Oversight and Risk Tree

This technique provides a thorough and detailed analysis of occupational accidents and other incidents. It uses a decision-tree diagram to arrange safety-program elements logically and completely, and detects the errors and omissions of an activity in order. MORT consists of two main branches: "barriers" (specific control factors) and "management system factors," which are connected by an "And Gate." Thus, an incident is the result of both a barrier and management system factor that was less than adequate. The management system factor allowed the barrier to be less than adequate.

8.5 Savannah River Plant (SRP) Root Causes Analysis System

Essentially the SRP system follows a similar structure to MORT, starting with a description of the incident using Events and Causal Factors Charting, and using a pre-defined generic tree to identify root causes. However, there is no logic incorporated into the SRP tree structure. Furthermore, there is less emphasis on management oversights, because the system was developed for use in the investigation of human performance related events at nuclear power plants.

The initial divisions in the tree relate to 'operator difficulty', 'equipment difficulty' and 'technical difficulty', with aspects of management being incorporated lower down the structure.

8.6 TapRooT

The TapRooT incident investigation system is a technique that is based closely on the SRP system. The two techniques use Events and Causal Factors charting. The Cause Trees used in TapRooT would appear to be virtually the same as SRP.

Three steps are included in the TapRooT incident investigation system approach to root cause analysis, namely:

1. Collection of information
2. Development of Events and Causal Factors Chart
3. Use of Root Cause Tree

8.7 Causal Tree Method

CTM involves the development of a tree of causes. The method utilises deductive logic, but attempts have been made to make the construction of the trees and the logic easier to apply.

The underlying principle of the method is that an accident results from changes or variations in the normal process. The analyst must identify the changes in the system, list the changes, organise them into a diagram and define their interrelationship. Unlike a fault tree, the method only includes the branches actually leading to the incident.

8.8 Reason Root Cause Analysis

Reason Root Cause Analysis helps the analyst sort information about an individual problem; models and analyses the problem to get real solutions; provides results to assist in the selection of the best control options.

It involves the input of information about an incident resulting from the data collection phase of the incident investigation. The analyst develops a logic tree by entering the sequence of events. The software prompts and questions the analysts about the reasoning and logic included in the tree in order to establish the logic links between events within the incident sequence [13].

9. ANALYSING AND COMPARING REPORTING BEST PRACTICES

More and more oil and gas companies are either implementing or considering a behavioural safety programme for their workers. The following case studies include the types of behaviour modification programmes mentioned in section 7.

When the STOP programme was initially launched in Conoco, it was therefore expected that everyone would participate, and this expectation was coupled with a prescriptive requirement for every employee to complete two STOP cards per trip. However, managers and supervisors initially accounted for the majority of STOP programme participation. The mandatory requirement has then been relaxed, and since the re-launch participation by core platform employees has increased significantly. Conoco management regards the re-launch of STOP as a success as they have noted a downward trend in his accident statistics. Managers and supervisors' participation in the programme has been enhanced, and they believe they have now enlisted the core crew's acceptance of STOP. Core crew now understand that via STOP they can make a real difference to safety with very little additional time and effort.

In 1997 a number of BP Amoco's offshore production platforms implemented STOP behavioural safety programme. Around the same time, BP Amoco's senior management had been introduced to Advanced Safety Auditing (ASA) techniques. The Miller platform introduced ASA approximately six months after implementing STOP. By mid November 1999, the Miller platform had not had a lost-time injury for over 800 days, and had no high-potential incidents for over 400 days. The main behavioural effects of ASA were described as its success in changing management and supervisory behaviour, by giving them a simple tool to engage in constructive, non-threatening conversations with their work force about safe and unsafe behaviour, and wider aspects of safety. The positive style of interaction and the commitment gained is believed to have had a knock-on effect on safe behaviour across the platform.

Miller management judges that ASA has had an important role in increasing safety awareness, and combating complacency. By receiving ASA training, the safety representatives' role has also been enhanced.

On Miller, STOP and ASA were implemented in parallel with self-managing teams, and these developments are seen as being mutually supportive.

The Andrew drilling crew developed TOFS prior to platform hook-up.

It is difficult to establish the impact of TOFS on safety because it was introduced before platform hook up and therefore there is no accident data prior to its introduction. The Andrew has an impressive safety record, as there have only been four lost time accidents since hook up.

The main behavioural effect of TOFS is enabling all platform personnel to stop any operation for safety reasons. The programme states that personnel have a responsibility to stop a job if they believe it is unsafe. Andrew platform management believes that TOFS has been instrumental in developing the installation's safety culture by increasing front line employee ownership for safety. This attribute could be developed through the use of other interventions such as ASA or STOP.

The simplicity of TOFS is part of the appeal, but it is also its Achilles' heel, because people often think that it must be more complicated. Others reject it on the basis that personnel already do stop the job if they have any concerns.

10. ANALYSING AND COMPARING INVESTIGATION BEST PRACTICES

In order to improve accident/incident investigation process in Sonatarch, I did a comparative study on the effectiveness' of the root cause analysis techniques (mentioned in section 8), using these criteria:

- Degree to which opinions are used to identify root causes
- Average cycle time required to complete tool use
- Number of root causes identified per use/problem analyzed
- Quality of corrective actions developed
- Degree to which the problem is resolved and does not come back
- Degree to which human factors research is used to identify causes of human error

With causal tree and fault tree tools, it is up to the investigator to draw the diagram. The quality and breadth of questions they ask when doing this will determine tool effectiveness to a large degree (they are very opinion-based tools). The Reason root cause analysis process, is similar to a fault tree analysis Barrier analysis is good for finding human error, but its use will not lead to root causes. Investigator will have to use one of the other tools to analyze why a barrier failed or was not in place. Barrier analysis is a part of TapRooT, it is used to collect information and to identify causal factors prior to doing root cause analysis on those causal factors.

Change analysis is also a part of TapRooT, and it is used in the same manner as barrier analysis. By itself, it is not a root cause analysis tool. MORT and SRP system are versions of TapRooT.

In general, most root cause analysis approaches identify human error and then proceed to developing corrective actions to prevent future human errors of a similar nature. With the TapRooT process (Figure.7), investigator identify human error at the front end of the problem solving process, and then use the root cause tree to determine the systemic factors (root causes) of that error. Once investigators have identified those root causes, they develop corrective actions for them. Because in TapRooT, investigators look for the systemic causes of human error before developing corrective actions, the TapRooT process tends to identify more root causes on average and more effective root causes on average.

TapRooT is used by leading companies (BP, Halliburton, ExxonMobil...) around the world to investigate and fix the root causes of major accidents, everyday incidents, minor near-misses, quality issues, human errors, maintenance problems, medical mistakes, sentinel events, productivity issues, manufacturing mistakes, production delays, environmental releases.

11. CONCLUSIONS

The proposal of this project is the improvement of Incidents and Accidents Management. For this purpose, and Based on the results of the study conducted in Sonatrach's sites and on the comparative study of best practices used in incident/accident management I suggested the implementation of:

- STOP programme to develop the proactive strategy of Sonatrach,
- TapRooT system to develop the active strategy.

The STOP program requires time and effort from the entire organization, and in particular from Management. But this proactive tool also yields a lot, less pain and suffering, less costs, time and effort associated with injuries

TapRooT works for investigations of all sizes, from major accidents to minor incidents, equipment failures, and near-misses. However, TapRooT system also requires time and effort, and in particular training.

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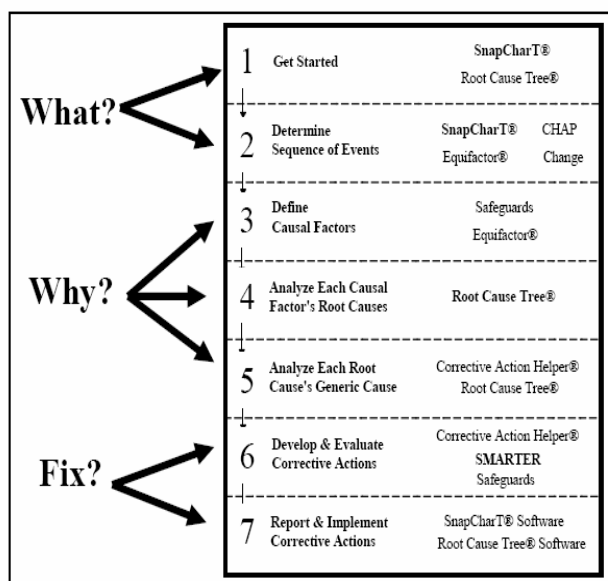


Figure.7.The TapRooT Process

12. RECOMMENDATIONS

Effective near-misses and unsafe behaviour reporting requires:

- Do not refer to STOP observations or audits during any disciplinary action. This will also help to keep STOP separate from the organization's progressive discipline system.

Implementation of ASA after the effective implementation of STOP

Effective incident/accidents investigation requires:

- Sufficient training and practice for the investigation facilitator (team leader) and the investigations team.

Avoid waste time investigating small problems that do not deserve to be investigated. Instead, use trending to spot developing problems from small issues and then apply root cause analysis.

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