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# Near-miss reporting as an integrated tool for the proactive Management of safety, health, environment, security And quality in Geophysical Operations

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***Summary***

*Near-misses as an integrated tool for the proactive management of safety, health, environment, security and quality would make the geophysical field party personnel to have potential risk barriers. It is pointed out that all of us in the Geophysical industry must focus on and encouraging proactive measures, and recognizing the similarities and relationships between various QHSE issues and make our suggestions/regulations/rules more easily applicable but also more effective. Already a lot has been done and may be something more is in pipeline. Attempt has been made as far as Geophysical Operations are concerned. An effort has been made to jot down some of my personal experiences may be known to all the knowledgeable scientists present here.*

## Introduction

Near-Misses are the best leading indicators of accident potential Furthermore, efficiency and effectiveness in managing QHSE functions, their integration with newly heightened security systems, and their link to well established quality practices have become very important in improving a company's business operations and reducing the cost of production. May we say that the turn of the century has seen a paradigm shift in the approach towards Q+HSE=QHSE. The latest trends in economic, political and regulatory arenas have created the need for

- Developing an integrated Quality, health, safety, and environment (QHSE) management system; and
- Focusing on proactive measures to protect employees, community and environment.

It is imperative to maintain a good image of the company more attention be given on QHSE issues. Nowadays Health, Safety and Environment issues in the field of Geophysical Operations are given much attention for the benefit of Seismic crew for trouble free conduction of Seismic survey. The exposure to HSE issues has gained higher degree of importance as most of the Companies world wide are getting accreditation to the International standards and ours is no exception .All the parties are ISO certified and this help us in international bidding for seismic activities in the developing economy like ours and opening up of fields for exploration under NELP. Some of the field activities for seismic data acquisition like lying of Geophone cables, control of explosives, vibrators etc have to be dealt carefully in line with International safety & environmental norms / guidelines. Increase in the crude oil price lead to accelerated exploration programs including higher quantities of area coverage by deploying large number of seismic channels (of the order of few thousand channels laid for each line) with multiple energy sources. Now a days QHSE issues are also incorporated in the contractual documents and contractors has to follow the obligations .Seismic data acquisition activities in the field are following corporate QHSE guidelines and operation of the equipment by maintaining OEM standards with clear cut documented instructions for 'Dos and Don'ts that would generate a healthy and safety environment for both men and machine**. This paper throws light on these issues, generating a thought process for minimizing the probable risks involved with the operation and maintenance of the equipment and related machinery**. Safety is top priority in our organization. **Good QHSE means good business**. Our geophysical service is no exception. Risk is a measure of human injury, environmental damage, or economic loss in terms of both the incident likelihood and the magnitude of the loss or

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injury. **A traditional approach to managing the risk in Geophysical industry is by providing layers of protection between the hazardous agent and the people, environment, or property that is potentially impacted.** *The layers of protection are intended to reduce risk by reducing either the likelihood of potential accidents, or by reducing the magnitude of the impact.* **The risk can be reduced to very low levels by providing a sufficient number of layers of protection, and by making each layer highly reliable. But this gradually increases the cost of safety and system on whole.** In increasingly competitive market companies try to achieve more with fewer resources to reduce cost. QHSE practices and records are now being recognized as an important reflection of the performance of the business as a whole and one of the important aspects of competitive advantage and external performance evaluation criteria. In addition, QHSE practices and records are now being recognized as an important reflection of the performance of the oil business as a whole and one of the important aspects of competitive advantage and external performance evaluation criteria.

**Description and Application of work:**

As the search for the "ever-elusive hydrocarbon" have become increasingly difficult, the advanced technologies adopted to predict the likelihood of significant reserves. Preliminary assessment of different types of risks , safety are important .We may take measures for reduction of risks keeping in mind over all cost cutting for exploration. The exploration of hydrocarbon possesses serious health, environmental, operational and invest mental risks. The health risk includes injury, chronic diseases from exposures to handling of explosives at shot points chemicals released from the subsurface through shot hole drill cuttings. **The risks involved in decision making for investment in exploration include whether the exploration venture will commercially viable or not. .We must be prepared for emergency .Proper planning, training and safety** are required. Further inadequately regulated exploration activities have also harms the sensitive ecosystem. Before implementing the safety measures systematically analysis of origin of risks and its extent is brought in to the discussion Risk is a measure of human injury, environmental damage, or economic loss in terms of both the incident likelihood and the magnitude of the loss or injury. A traditional/common approach to manage the risk in Geophysical Operations is by providing layers of protection between the hazardous agent and the people, environment, or property which is potentially impacted**. In Geophysical Services QHSE practices are now being recognized as an important reflection of the performance of the business as a whole . We may accept that near-Misses are the best leading indicators of accident potential and we must meticulously record and take corrective action. By having a comprehensive near-miss system, where near-misses are not only recognized but also resolved properly, we can expect to both reduce the number of accidents and improve the quality/and no of shots taken during its operations. The near-miss concept is a bottom to top approach and is a timely indicator of all possible disturbances as well as opportunities for improvement. We may prepare our employees and nearby communities to respond to control such events effectively to a safe and healthy conditions.**

**Observation and Analysis:**

There has always been an endeavor to have some systematic frame work for analysis and improvement of near miss programs in Geophysical operations. This frame work will enable our Geophysical Services to analyze our own near miss programs, identify weak management links, and implement system wide improvements. Discussions were carried out at in the field at different seismic parties during my stay in the eastern sector in Assam,Mizoram and Tripura as co-ordinator QHSE and field supervisor and it was observed that near misses were recognized and reported by overcoming some potential barriers like 1) Fear 2) Motivational issues 3) May be lack of commitment. 3) Individual confusion on method of reporting However may suggest that we may record all kinds of near misses and take corrective action. May be something is happening daily and during a field season near misses may be in thousands. I personally believe every body will appreciate if things are done and taken in right spirits.

**Near-Miss Process**

Investigation of major accidents adds new data and shows that for every major accident there are several preceding minor accidents with limited impact and near-miss incidents with little or no significant damage. Therefore, it has been recognized that by focusing on minor incidents it

is possible to reduce the probability of having major accidents.

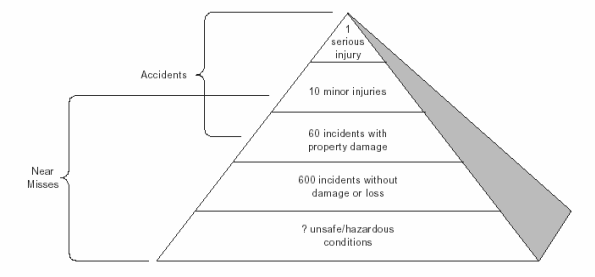


Fig 1: Famous safety Pyramid

In the safety pyramid we can see that Near- misses comprise the lower portion of the safety pyramid. Near-misses are often less obvious than accidents and are defined as having little if any immediate impact on individuals or processes. Despite their limited impact, near-misses provide insight into potential accidents that could happen. A well-designed near-miss process includes:

- Analysis of potential problems,
- Determination of their causes,
- Finding solutions and implementing them.

Therefore, it perfectly fits into the category of proactive measures. The exact definition of a near-miss varies from one company to another. Some of them are rather narrow while others are more inclusive. Broader definitions increase the probability of identifying potential problems at their earliest stages. Most widely accepted definition of near-miss is as follows. A Near-Miss is an opportunity to improve safety, health, environmental and security of an operation based on a condition or an incident with potential for more serious consequence. In the above definition all disciplines, safety, health, environmental and security are included explicitly. The relationship, at the basic level, between the three disciplines of EH&S and the potential of considering some of the problems from a security perspective are recognized. Due to the closely integrated relationship, especially between EH&S issues, it is hard to improve the practice in one discipline without improving the practice in the other. It should also be noted that in the above definition, near-misses are viewed as opportunities for improvement. Hence it can be said that near-miss management can be systematized and managed to provide an important reinforcing element of accident prevention and preparedness at hazardous facilities. In the following sections elements intrinsic to the successful performance of each stage are discussed. In each section stage objectives are defined, Key elements of high efficiency performance are identified, Common obstacles that impede stage performance are outlined, and General observations of practice to overcome these obstacles are presented.

**Let us understand and** identify a near-miss and individuals must recognize an incident or a condition, with potential for serious consequence. They may include:

- Unsafe conditions.
- Unsafe behavior.
- Minor accidents/injuries that had potential to be more serious.
- Events where injury could have occurred but did not.
- Events where property damage results
- Events where a safety barrier is challenged
- Events where potential environmental damage could happen

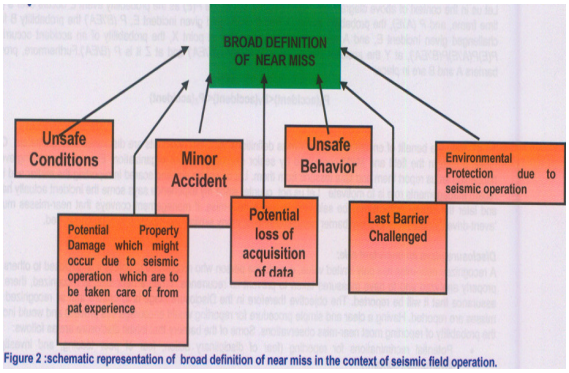


Figure 2: Broad definition of Near Miss

The broad definition proposed captures the ephemeral quality of a near-miss, without dwelling on how an event should be classified. *Near-misses are opportunities. If the underlying hazard is quickly identified and remedied, the likelihood of the event recurring is greatly reduced or eliminated.* ***If not identified, disclosed and properly managed the incident may be forgotten and the latent***

***potential for damage remains.***

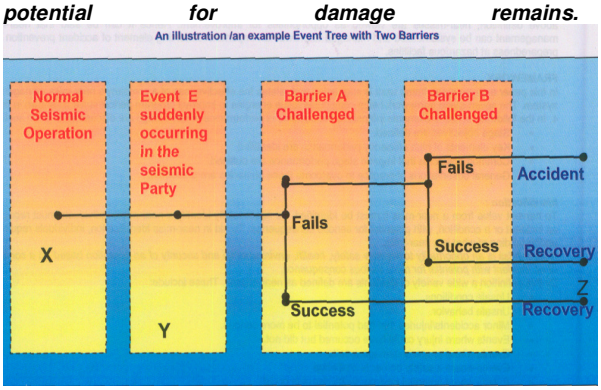


Fig 3 : Illustrates a process in operation, and how it responds after an event E. In the given case of event E, two barriers, A and B, are in place to prevent an accident coming to fruition, and an accident occurs only if A and B fail.

To illustrate the benefit of encompassing near-miss definitions, different incidents are discussed during different QHSE meeting both in the field and MRM conducted by our Geophysical services both at the party and head quarter level. Senior executives of our organization. Everyday something/event is happening let us report them and take lessons from them. Let us not be shy and scared in reporting the matter and in this regard managements role is to motivate Let us not counter since my experience says some the incident actually happen and later the earlier incident may be said that it was a near-miss. Let us not insist that near-misses must be 'event-driven' or the result of a last barrier being challenged, many similar opportunities may go unreported. ***Disclosure plays an important role .But people some time do not report because of following reasons.*** Near-miss has to be analyzed. The objective therefore in the Disclosure stage is to ensure that all recognized near-misses are reported.

**Distribution of information:**

It is critical to distribute near-miss information to a broader audience for their information especially to knowledgeable people who can assess the situation.

- Analysis or remedial action & whether these are adequate or further investigation is necessary;
- Identify potential broader implications and make sure that the given near-miss is addressed at a level that is necessary to prevent similar occurrences from happening elsewhere in the organization. Hence, there are two objectives in the Distribution stage:

1) To inform both MR of the party, party chief ,safety officer of the party and coordinator QHSE who will in turn bring it under the notice of higher authority in the Head Quarter management investigators of the near-miss.
2)To alert a broader audience of the hazard, and any interim solutions in place.Take help of supervisors to relay near-miss information, 2) proper paper distribution systems that do not specify a timeframe for review, 3) Distribution systems where information is transferred in series and not in parallel; and 4) Over-distribution where many investigators are required to analyze relatively straight forward reports. Some suggestions: a)Merge distribution stage with disclosure. Automate the Distribution stage. Automation of distribution through electronic, intranet systems enables instantaneous transfer of information. In addition, checks can be added to ensure that reported incidents are considered and action taken. Specification of time frames on information transfer. This has been observed in paper based systems where protocols specify that reported near-misses must be reviewed by QHSE managers within a time frame. c)Automate systems to ensure QHSE review. These systems require QHSE management to respond to the reporter, or reporter's supervisor of the Geophysical Field Party to confirm review. d)Enable reporters and supervisors to perform initial investigations. In many instances direct causes and solutions are obvious. Allowing reporters and supervisors to perform investigations engages employees, quickens investigations and decreases QHSE workload. Lastly, stage performance may improve by integrating distribution of near-miss information with mechanisms used to distribute accident related information. This strategy familiarizes site management with accident information distribution protocols, and eliminates duplicate energies expended to design two separate distribution systems.

**Direct and Root-Cause Analysis:**

Once a near-miss is disclosed and reported to appropriate parties like MR and Party Chief of the Party, it is necessary to carry out steps to ensure that the near-miss does not recur. Two stages are performed for remedial actions follow:

1) Identification of direct and root causes (herein referred to as Root-Cause Analysis).2)Based on identified causes, identification of solutions or action items that significantly reduce the likelihood of recurrence, and/or significantly reduce potential impact in the event of recurrence.

The objective in Root-Cause Analysis is to determine what are the direct and underlying factors that enable an incident or unsafe condition. Short-term solutions resolve direct causes, farther-reaching and more permanent solutions rectify root-causes. While in structuring near-miss programs it is important to recognize the interaction between Root- Cause Analysis and Solution Determination it is equally important to recognize that these are two distinct activities.

There are a number of obstacles that limit Root-Cause Analysis performance. Factors that deteriorate stage performance include:

- Lack of availability of tools or frameworks to analyze incidents.
- Insufficient expertise available to analyze the incident.
- Dilution of relevant information due to information transfer or lapsed time prior to incident investigation.

**Techniques to study Root-Cause (from available literature):**

- Event and Causal Factor Diagrams: The detailing of events leading up to, during and following an incident, followed by the deconstruction of each sub-event into enabling causal factors linked through AND/OR gates.
- Event tree analysis: The deconstruction of an event linked through AND/OR gates of the sub-events that would have to, or had to occur to lead to the undesired incident.
- Fault tree analysis: A deconstruction of an event based on system and component failures.
- Failure mode and effect analysis: An evaluation of individual subsystems, assemblies and components and assessment of how subsystem failures interact to lead to total system failures.
- The 'Why Test': A recursive procedure for challenging premises of potential root-causes.
- Factorial and Taguchi Methods: Experimental procedures for evaluating influencing factors on measurable outputs.

**Developing systems to overcome Root-Cause Analysis**

- Reporter Involvement. The reporter who discloses must be involved in determining event causes.
- Two-tiered or above, classification. Having a tiered classification system to assist in the processing of incidents is recommended .Multi-tiered investigation systems enable a large number of near-misses to be reported without straining HSE resources or deterring disclosure.

**Solution Determination:**

It is important that at least one solution be identified for each cause determined in the previous stage. In most cases a given solution may address more than a single cause. Some solutions may be easy to implement while some others may require extensive resources. ***It is recommended that all potential solutions be identified and only those be selected that can be implemented based on the potential impact (value) of the incident and effectiveness of the solution which can be implemented with the available resources in the seismic Party.***

**Near-miss management and corporate governace**

Near-Miss management is a very powerful tool for identifying system weaknesses. It engages all employees who are intimately familiar with daily operations; therefore, it can easily detect potential problems on a timely basis. But, there are several important issues that have to be recognized and addressed to effectively integrate near-miss management into corporate governance. These are:

- Management support and encouragement.
- Ensuring a uniform and seamless operation across all businesses.
- Having a seamless and efficient system for handling near-misses as well as accidents.
- Linking to Quality Concepts

**Process sub-stages**:
*Let us generate potential solutions for a given cause.*

- Comparative evaluation of solutions.
- Selection of solutions to be implemented.

With a set of potential solutions identified, the solution set must be reduced to determine which to implement. Gauging how well identified solutions successfully reduce risk exposure is not a simple endeavor since generally metrics are not easily applied. Nonetheless, proposed safety improvements can be rated from most to least beneficial by the following ranking:

- The solution eliminates the hazard.
- The solution reduces the hazard level.
- Safety devices are installed to manage incident recurrence.
- Warnings are installed to alert people of hazard.
- Standard Operating Procedures (SOPs) are changed to account for hazard duly approved in the MRM of Geophysical Services.
- Employee awareness is increased.

In addition to the proposed solutions reducing the likelihood or impact of the exposed hazard, the solution must also not infer new risks. Hence, solutions must be carefully screened to ensure new and unexpected risks are not inferred upon implementing new solutions. ***Solutions should also be evaluated across non-risk dimensions, to assess the 'ease of implementation'. It is noted selecting solutions based solely on risk-reduction is very undesirable.*** If solutions are unfavorable to either management or employees further participation in a site near-miss program may be adversely affected. Among other dimensions, solutions should be assessed according to:

- Solution cost.
- Potential increased revenue on solution implementation.
- Potential improved process/product quality of implementation.
- Employee acceptance of solution.
- Management acceptance of solutions.
- Time duration to implement the solution.

Common obstacles that limit Solution Determination success are:

- Failure to generate more then one solution for an identified cause.
- Lack of procedures to reduce the number of identified solutions to implement.
- Failure to address Management of Change issues, whereupon solutions can give rise to unrecognized new risks.
- Identified solutions fail to achieve their intended purpose. Specifically, the solution does not remedy the identified cause.
- Adhering to above practices during solution determination would help to eliminate these obstacles.

**Dissemination:**

Dissemination stage may consist component like 1)Transfer action of near-miss investigation to implementers. 2)Inform a broader audience of the incident to increase awareness. Common obstacles that limit successful Dissemination are 1) reviewing incidents, 2) delays in transfer of information to implementers, and 3) under-dissemination In such instances it is critical that HSE or similar incident overseers intervene to determine suitable alternative solutions that satisfy the same intended purpose.

Recommendations provided in the Distribution stage apply equally to Dissemination. Particularly intranet systems can be excellent vehicles to transfer information, initiate action item tracking and inform a broad audience of the incident. Action item monitoring to ensure that individuals or departments are not overwhelmed with assignments that stem from incident investigation have been observed and applied successfully.

***Resolution:***

Resolution is the final stage where all investigation action items are completed and that all remaining activities prior to closing an incident report are fulfilled. Remaining activities prior to closing an incident file include:

- Updating the incident report if deviations from the intended action item were implemented.
- Reviewing/auditing the action items upon completion to ensure the implemented action item fulfills its intended purpose.
- Informing the reporter, and others when appropriate, that all items that stemmed from the report were completed and the incident file is closed.

To get the full benefit (lessons and corrective actions) from a fully and completely. That is, not only all the steps should

be executed but also each step must be carried out as completely as possible

***Seven stage frame work***

***Identification -→2) Disclosure-→3) Distribution-→ 4) Root Cause Analysis-→5) Solution Determine--→6) Disseminate_--→7) Resolution***

***Quality(Q) and Near-Miss Management(NMM)t:***

The use of quality tools as part of a near-miss system can materialize at two levels:

- Using quality tools as part of ***Near-Miss Management System(*** NMMS),
- Implementing a continuous improvement concept to better NMMS.

Both applications should be part of the design of a NM system and should be used regularly. An important benefit of using quality tools as part of a near-miss system is identifying repeat events and adjusting the priorities of future near miss incidents accordingly. By using quality tools for improvement of a NMMS both the performance of each step (or a group of several related steps) and the evaluation of the whole system can be accomplished more easily. The second overlap is a direct relationship between near-miss and quality issues. **All are aware that risks are involved in plantation of /laying of cables drilling of shot holes specially in hilly terrains but still we have to do them nicely for collecting good quality seismic data. Risk is involved in transportation, storage and loading of explosives but still we have maintain stringent quality controlled control measures .There are process related incidents where both near-misses and causes for quality problems are strongly interconnected.** We experienced resolving one can also address the other in case we have awareness about the interconnection.

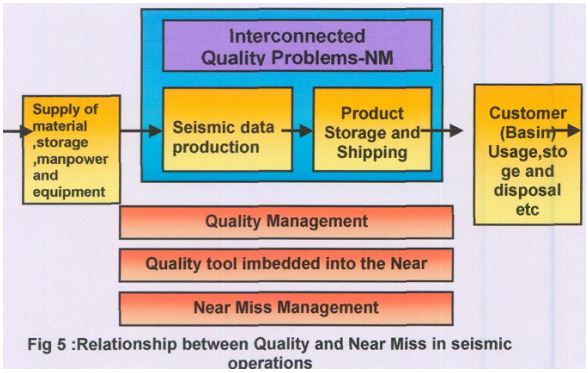


Figure 5 : Relationship between Quality and Near Miss in Seismic operation

**Near-Miss Management System**

Although it takes sometime to fully develop a system, a well-designed near-miss management structure should have the following components:

- A Near-Miss Management Oversight Team - at the corporate or headquarters level.
- A Near-Miss Management Team - at site that is in the seismic party level.
- A well-defined near-miss process - principles defined at the corporate level, preferably based on the seven steps outlined above, details developed at the site level.
- An electronic near-miss management system to report, analyze and track near-misses immediately.
- An audit system to check the effectiveness of the near-miss practice, identifying weaknesses and strengths of all steps.
- Training programs for system/party managers and employees without any exception.

There are two types of near-miss systems:

- A single system for all near miss and accident incidents.
- Two separate (parallel) systems for each one: near-misses and accidents.

Single systems are based on accident management processes that are usually too cumbersome for most near-

miss reporting. Parallel systems usually cause confusion among employees reporting minor incidents: They cannot decide to which system an incident should be reported to - the accident or the near-miss system.

***It is possible to design a hybrid process that eliminates problems associated with each one of these systems. In a hybrid system, the same procedures for accidents and incidents would be used for some of the steps, such as identification, disclosure, distribution, dissemination, and resolution, but separate procedures would be developed for others, such as prioritization, causal analysis and solution identification.*** To be able to implement the most suitable design for a given facility it is important to first understand the pros and cons of processing each step individually or jointly for near-misses and accidents. Then a customized process can be developed to best meet the needs of the facility.

**Conclusions:**

***In this paper a seven stage frame work is suggested*** that relates the effectiveness of a company's near-miss management system. **The seven-stage framework** helps companies focus energies to improve program performance as shown above. They are in sequential order as *follows **1) Identification2) Disclosure3) Distribution4) Root Cause Analysis 5) Solution Determination 6) Dissemination 7) Resolution***

An effective near miss management framework is the one that adds operational and strategic value to corporate environment, health and safety practices. **Effective near-miss system in Geophysical Field Parties should address safety, health, environment and security issues, while being closely related to quality**. **A well designed and properly managed near miss reporting system in the Geophysical Field Party may have one of the best proactive protection systems consisting of following components 1 )Empowering employees 2) observation and resolution of issues in a timely manner3) up-to date information 4) problems which require management's attention in MRM and 5) forces which provide an invisible control over all operations at every stage of a plant's life. May be much job has already been done in this direction in Geophysical Field Party and if something is yet to be done ,may be taken up.**

Finally, using near-misses as an integrated tool for the proactive management of safety, health, environment, security and quality would make the work load of QHSE professionals much more efficient and manageable in the Geophysical Operations. Lastly **People are key components of processes.** By following the above simple principles we can provide a safe working environment that relieves the worker from undue physical and psychological stress and fatigue. This also keeps our process working safely and continuously.

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**Reference**

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