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Near-Miss: A Tool for Integrated Safety, Health, Environmental and Security Management.

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ABSTRACT

This article discusses the elements of the Near-Miss process and its implementation as a tool for integrated safety, health, environment and security management. A corporate structure for near-miss application is recommended. Linking elements of the near-miss system with quality concepts and tools are presented.

1. INTRODUCTION

The latest trends in economic, political and regulatory arenas have created the need for

a) developing an integrated environmental, health and safety (EH&S) management system, and
b) focusing on proactive measures to protect employees, community and environment.

The inherent nature of near-miss incidents makes them well suited for addressing both of the above needs. Near-Miss management in all three disciplines, environment, health and safety, has the same basic processing steps. As one of the indicators of potential problems in product operations, detecting near-misses early and addressing them correctly can improve a corporation's EH&S performance.

In this paper a Near-Miss Management System, which focuses heavily on leading indicators of process upset and stimulates the development of proactive measures to preserve process integrity and can form an important part of the backbone of the next evolution of EH&S management systems is presented. Also, consideration is given to the possibility of including security issues in EH&S near-miss systems and the degree to which establishing a link with quality management systems may be useful.

Background

An increasingly competitive market place is forcing corporations to achieve more with fewer resources. In addition, a corporation's EH&S 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. Furthermore, efficiency and effectiveness in managing EH&S 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.

The rising influence of NGOs (non-governmental organizations) and their expectations around transparency of a firm's operations have put new demands on corporate EH&S management. In the regulatory arena there is an increased interest in encouraging enterprises to use pro-active EH&S practices which are integrated into the business operations. Standards which reflect this new regulatory interest include, but are not limited to, Occupational Safety and Health Administration's (OSHA) "Process Safety Management of Highly Hazardous Chemicals Standard" (the PSM standard) and "Voluntary Protection Program" (VPP), and the Environmental Protection Agency's (EPA) "Rule for Risk management Programs for Chemical Release Prevention" (the RMP rule).

The resulting ever-increasing load placed on corporate EH&S professionals was the subject of the recent article published by Art Dowell [1]. He described how new and independently generated safety, health and environmental standards, combined with the corporate practice of having separate departments for different aspects of EH&S compliance (e.g. a safety department concentrating on OSHA regulations and an environmental department concentrating on EPA regulations), are overburdening EH&S professionals. Recently heightened awareness of security issues have also added to the responsibilities of facility EH&S teams. This suggests a need for an integrated EH&S management system, a point also addressed by Shillito [2] who called for an intermediate approach based on the British Standard 7750 (BS7750) concept.

2. PROACTIVE PROTECTION AND THE NEAR-MISS MANAGEMENT

The pyramidal structure of incidents, known as the "Safety Pyramid" (Figure 1, Appendix 2), was first developed by Frank E. Bird, Jr. [3] and is now widely accepted by most EH&S professionals. 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. That is, by paying special attention to the lower portion of the pyramid and using the information extracted from this relatively large number of incidents occurring on an on-going basis, it is possible to identify potential problems. Addressing such problems as soon as they are recognized enables corporations to reduce the probability of accidents and/or to minimize the damage that an accident might cause if it actually takes place. When managed effectively such an approach helps identify structural weaknesses in processes, and hence, not only reduces the accident rate and intensity but also provides guidance for overall system improvement.

Since September 11, 2001 there has been a heightened awareness and an increased emphasis on security for all commercial operations. Facilities where chemicals are processed or stored have become special points of interest due to their potential selection as targets by terrorists. Most chemical facilities ranging from those locations where large quantities of chemicals are processed or stored to those where small quantities of toxic materials are used for research now have to consider additional security measures. This duty also falls to EH&S professionals. Since in this paper security aspects of some of the near-misses are also considered, mainly by looking at a problem not only from the EH&S perspective but also from the security perspective, the combined interests are expressed as an EHS&S concern in the following sections.

Any well-designed proactive prevention scheme would continuously utilize the information provided by minor incidents and other indicators. Proactive prevention systems are inherently based on an analytical approach. They employ a systematic procedure from identification to resolution of potential problems. They develop a prognosis of the situation and treat each input as an opportunity to improve the system. 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.

Near-Misses are the incidents and observations at the lower portion of the pyramid. 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. The following recommended definition is similar to the one used by the Risk Management and Decision Processes Center of the Wharton School of the University of Pennsylvania (Wharton Risk Center) and can be taken as one of the broadest ones:

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.

Near-misses always reflect the current status of a system; thus, the data provided by this approach is timely and immediately applicable. Therefore, it would be a prudent practice to include near-miss management as a key component of any EHS&S system that focuses on leading performance indicators.

3. NEAR-MISS PROCESS

The Wharton Risk Center is conducting a project on near-miss practices in the chemical process industry. Until now the study mainly focused on safety, health and environmental issues related to a facility's operations within its boundaries. Over 100 interviews were held with the employees, at all levels, of a number of Fortune 500 companies. During these interviews a broad near-miss definition was used; "incidents, as well as observations, with the potential for more serious consequences." The term "consequence", which was elaborated during the interviews, included but was not limited to the following:

- injury of an employee
- property damage
- damage to the environment
- business interruption

Based on best practices observed in the participating companies, feed-back received on initial company specific reports prepared right after interviews, and discussions held at the several project meetings, a several-step process for an effective near-miss management system was developed and explained in detail by Phimister et al. [4]. (More information about the on-going project and its participants can be found at http://opim.wharton.upenn.edu/risk/proj/nearmiss.html.

Below, an expanded version of the original process, incorporating the most recent progress, is presented.

Eight-Steps of an Effective Near-Miss Process

Identification

Identification is the first step of the process where an individual recognizes an incident or a condition as a "near-miss". To execute this step successfully there must be a) a clear

definition of a near-miss, and b) the means to ensure that every employee across a facility knows this definition at all times.

Disclosure (Reporting)

Once a near-miss is identified it must be disclosed, preferably in a written form. This can be done either by the person who identified the near-miss or by a supervisor to whom a near-miss is reported verbally. Having a clear and simple procedure for reporting would encourage this process and would increase the probability of reporting most near-miss observations.

Prioritization

Once an incident is reported it needs to be prioritized. This very critical step determines the path to be followed in the subsequent steps; the level of attention that will be given to the incident, the depth of analysis that will be performed in finding causes, the amount of resources that will be dedicated to finding and implementing solutions, and the extent to which the information about this incident will be disseminated. It is important for each corporation to set their own criteria for prioritization. This can be achieved by first a central (corporate) group determining the key factors for prioritization including their importance and their application guidelines. Next, sites would develop a detailed prioritization mechanism based on the guidelines set-forth by the central group and local specific requirements.

Not all near-misses are high nor are all of them low in priority. While a large number of high priority near-misses overburden the site, EHS&S professionals**,** having all near-misses as low priority items, prevent identification of major issues. It is important to monitor the system initially until a thorough understanding of prioritization criteria is established among the employees who will most likely determine the priority at the time of disclosure. Training programs can play a very important role in accomplishing this objective.

Distribution

Based on the priority and the nature of a near-miss, the information is distributed to the people who would be analyzing the cause of incidents. For low priority, straight forward items this may be the reporter or his/her supervisor. If potential security or quality issues are detected, the information may be forwarded to other departments. If a seemingly simple near-miss happens too often, it may increase its priority requiring more resources to be dedicated to the following steps.

The distribution mechanism for various priority levels must be determined during system development by the management team.

Identification of Causes (Causal analysis)

This step includes identification of both direct- and root- causes of a near-miss. During implementation this step can be as simple as the reporter inputting his/her ideas for what the causes are. On the other hand, for highest priority near-misses, a committee may

form to do a full-blown root cause analysis. Again, the extent of this step is determined by the prioritization step.

Solution Identification

The most important feature of this step is looking for a solution for each identified cause. Sometimes, several causes can be corrected with a single solution. In other there may not be a feasible, effective solution, hence a less than ideal corrective action may need to be taken. All solution decisions, even "no solution for the time being", should be noted. In the end, each cause must have been addressed.

Dissemination

Once solutions are identified the information should be communicated to the people who will execute these decisions assuming they have not been part of the solution identification process. This step also includes an important intermediate function, which, if overlooked, can stall the system: Obtaining permission from the manager with resources to implement the solutions. Another function of the dissemination step is to inform all possible interested parties of the particular near-miss. This may extend well beyond the site or corporate functions and may include customers, contractors, suppliers, etc. Having a well-defined distribution list for each near-miss, limited to the interested people only, can improve effectiveness of these messages.

Resolution (Tracking)

Once solutions are identified and implementers are informed, it is important to track all suggested changes to ensure that they are properly executed. Also, when all the changes are completed, for future encouragement purposes, the reporter of the near-miss should be informed of the results from his/hear identification of a given near-miss.

Two important factors should be noted about the above process:

1) To get the full benefit (lessons and corrective actions) from a near miss system, all of the above steps should be performed 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. (An example is finding all possible causes not just immediately apparent ones.)
2) Although the above process is derived from a study focused on large chemical corporations, the logic flow represented by these steps would apply to any size or sector organization. Even a single person enterprise can easily follow the above steps to learn from a near-miss and to prevent future problems.

4. 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 level.
- A well-defined near-miss process – principles defined at the corporate level, preferably based on the eight steps outlined above, details developed at the site level.
- An electronic near-miss management system to report, analyze and track near-misses.
- An audit system to check the effectiveness of the near-miss practice, identifying weaknesses and strengths of all steps.
- Training programs for system managers and employees.

Near-Miss Management Oversight Team (NMMOT)
Having a corporate level NMMOT is very important for establishing an agreement among middle and top management on key issues and obtaining support from various business units. The charter of NMMOT must include

a) defining local NMMTs' objectives, make-up, and operating principles,
b) providing high level guidance in specific issues, such as setting criteria for prioritization and determining when, if at all, to reprimand an employee, and
c) monitoring local NMMTs' performance.

Ideally this team includes top business as well as safety, health and environmental managers. Establishing NMMOT should be the first step in implementing a near-miss management system (NMMS).

Near-Miss Management Team (NMMT)
Each site would have a NMMT that is in charge of designing and managing a facility based near-miss program. Here again a diverse team make-up, including not only EH&S professionals but also managers, supervisors and employees from representative businesses at the facility, would ensure site-wide buy-in; an important fact for a successful near-miss operation as discussed in the next section.

The NMMT's responsibilities include the following:

- Designing the site near-miss system.
    - Identifying roles and responsibilities of site employees, supervisors, etc.
    - Defining details of the near-miss process flow and administration.
    - Designing formats for reports and action tracking.
    - Setting-up prioritization, distribution and dissemination criteria.
- Resolving conflicts
- Providing training to employees and management
- Monitoring system performance
    - Each stage performance
    - Overall system performance

Electronic Near-Miss Management System – recommended but not a must
Most global companies have corporate intranet systems and computer connections to these systems accessible by the majority of employees. A few even collect process control information in a central electronic system. These facilities can best manage a company's near-miss process by implementing an electronic format for reporting as well as tracking the

progress of each near-miss investigation and solution implementation. Where available, electronic process control data can also be integrated into the near-miss system where unusual events, such as temperature and pressure exceedances, can be identified automatically as a near-miss.

At the Wharton Risk Management Center we developed a prototype electronic near-miss management system for project participants who's feed-back has been integrated into the product design. Each corporation can implement this software program locally or corporate-wide. The program is designed to handle both near-misses and accidents (see section 5) and includes the following additional capabilities:

- Tracking activities.
- Sending announcements and reminders.
- Adding new information as it becomes available.
- Having documents attached to near-miss files.
- Providing customized reporting.
- Linking to a corporation's database for employee information.

There are also commercially available accident-tracking software packages that can be used as an electronic near-miss management system as well.

Auditing the Near-miss System

One of the first principles of quality control is to periodically check if a given system is performing up to the expectations set-forth as part of its design. Another is continuous improvement.

Auditing a near-miss system's performance is the first and the most critical step in understanding what is working well and what needs to be improved. At the Wharton Risk Management Center we developed an "Audit Tool" for a corporation to perform facility specific, as well as, corporate wide audits of its near-miss systems. This tool, which initially was developed as a paper system, has also been converted to a web-based application for easy implementation by large corporations. Although the "Audit Tool" is based on the above-mentioned eight-step process, due to the universal nature of the principles that this tool is based upon, anyone can use it to audit their near-miss system. The tool is a several step, well-defined process that, in the end gives a quantified rating for the performance of each step at each facility.

When a near-miss system is first designed and implemented, auditing often can be very helpful to identify and to fix problem areas. It is also highly recommended to include the "Audit Tool" or a similar near-miss system auditing process into the standard corporate EHS&S audit procedures.

An important point in a near-miss audit is inclusion of all levels of employees in data collection and analysis. This is the only way one can find-out if management's understanding and expectations match the other employees' – a significant factor for an effective near-miss implementation.

Training
There are two types of training associated with near-miss systems - administrative training and employee training. The first, involves training of the people who will be managing the near miss system. Among other subjects this training should include development of guidelines for prioritization, tracking, performance measurement and improvement of the system on an on-going basis.

The objectives of employee training are more focused on actual use of the system. This type of training must include, but need not be limited to, the following topics:

- What are near-misses and how one can identify them?
- Why are near-misses important and how can each employee help?
- What is the role of each person involved in near-miss reporting?
- What is a near-miss management system, how does it work (including responsibilities of all management levels)?
- Who are the near-miss management team members?
- What is the near-miss process (eight steps)?
- How do you report a near-miss?
- How would you prioritize a near-miss?
- How can one get help?

Employee training should be performed periodically and if possible should be available at all times on the corporate intranet, including a frequently asked questions section.

5. NEAR-MISS MANAGEMENT AND CORPORATE GOVERNANCE

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
- Addressing security issues
- Linking to Quality Concepts

Management Support
An effective and efficient implementation of a near-miss management system requires the full support of all levels of management. This goes beyond just management approval. There must be active involvement. It is important to continuously follow-up on system progress, encourage reporting, reward participation, and most importantly lead by example.

Seamless Integration into Corporate Governance
The near-miss concept applies to all operations. Most of the time issues that are identified at one location equally apply to other areas as well. Sharing problems, solutions and lessons learned greatly enhances the value of a near-miss system.

Near-miss recognition and reporting should become part of a corporate culture. If employees are sensitized to notice problems or conditions that can become a source of problems, and if their concerns are properly addressed, the result would not only reduce EHS&S concerns but also would significantly improve operational efficiency.

Single System for Near-Misses and Accidents
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. For example, a detailed data gathering and causal analysis would be excessive for most near-misses and can discourage employees from reporting. Also, prioritizing an accident can be quite straight forward, while near-misses may need to be screened in a more detailed fashion to discover the hidden potential for safety, health and environmental consequences, hence to determine the right level of causal analysis.

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.

Extending Near-Miss Concept to Security
The September 11th attacks followed by the anthrax problems and various other threats increased the awareness of the terrorism risk, not only in the United States but also in countries around the world. Both public and private sectors began searching for ways to minimize possible attack and to reduce the impact of any incident that might occur. Facilities began to consider means to avoid being a terrorist target to inflict damage on people and the environment and to minimize the impact of any unexpected attack. It is a daunting, if not impossible, task to identify all possible acts of terrorism, and even more difficult to protect people and facilities against these unknowns. Contrary to accidents, due to a very low number of future terrorism acts expected in the United States, hopefully none at all, the learning from these incidents would be limited, if any. However, including identification of security gaps in near-miss definitions and, when appropriate, considering security issues during the analysis of the near-misses may be able to provide a wealth of information,

helping to identify weaknesses of the currently installed system against potential terrorist attacks.

In an integrated near-miss system security issues can be handled by

a) looking for the full list of potential causes (including terrorism) associated with a near-miss,
b) increasing the awareness of employees about the possibility of terrorist acts and encouraging them to identify gaps in the operating system that might facilitate such actions.
c) considering the consequences of an accident or unaddressed near-miss as a way of determining potential terrorist targets.

The following are some suggestions for possible security near-misses in a chemical facility:

- Being able to access any area, material or information without proper authorization.
- Being able to cause mass confusion in a facility.
- Being able to release even small doses of toxic material into the environment.
- Being able to admit a stranger or material into the facility without any record or permission for entry.
- Being able to carry off material from a facility without any record of or permission to do so.

A specific list developed specifically for each facility and displayed prominently together with the near-miss definition can be used as a reminder to employees. More comprehensive examples of near-misses with multiple implications are given at the end of the paper.

Quality and Near-Miss Management

There are two separate overlaps possible between quality and near-miss applications (See Figure 2, Appendix 2): The first is the use of quality tools to improve near-miss systems and the second is to identify near-misses from quality issues or visa versa (See example in Appendix 1).

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

- Using quality tools as part of NMMS, such as Pareto charts indicating trends in different types of near misses.
- 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. These are mostly process related incidents where both near-misses and causes for quality problems are strongly interconnected. In these situations resolving one can also address the other if there is awareness about the interconnection. An example for such a situation is given at the end of this paper.

6. NEAR-MISS ACROSS A PLANT'S LIFE CYCLE

The near-miss concept, as broadly defined in this paper, would apply at every stage of a plant's life cycle. During *the design phase* one must consider future problem areas. This can partly be accomplished by reviewing the near-miss records of similar plants and by building avoidance measures into the current or new design.

Engineering and Construction phases require both integration of accident prevention methods into the specific engineering details and avoidance of accidents among construction workers by reporting and correcting near-misses.

Start-up is probably the most critical time for near-miss management. All new mechanical and chemical processing will create lots of opportunity for accidents. Hence, a keen attention to near-misses at this stage and the implementation of corrective measures can prevent a number of future problems.

Routine plant operations require the site EH&S group to establish an effective near-miss management system to monitor all eight stages of the near-miss operation. Although a good rule of thumb is to expect one near-miss reporting per year per employee, this number should be determined empirically based on the nature of the operations taking place at each site.

Shut-down or decommissioning and demolition will present new challenges, hence should be treated similar to start-up. These are transition periods and everyone deals with numerous unknowns. Usually these operations require employment of contractors who may not have the same safety discipline required of the regular employees in the facility. There should be a heightened awareness of near-misses that could occur during these stages. Some near misses may be indicators of long-term problems such as contamination. Some others can be precursors of an imminent danger. In any case, each near-miss should be treated with extreme diligence and discipline.

7. CONCLUSIONS

Near-Misses are the best leading indicators of accident potential. By having a comprehensive near-miss system, where near-misses are not only recognized but also resolved properly, a facility can expect to both reduce the number of accidents and improve the quality/productivity of its operations.

A near-miss system is an all encompassing one; addressing safety, health, environment and security issues, while being closely related to quality. 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. A well-designed and managed near-miss program is one of the best proactive protection systems since it

- empowers employees,
- enables observation and resolution of issues in a timely manner,
- reflects up-to date information,
- brings-out new sources of problems to management's attention,
- provides an invisible control over all operations at every stage of a plant's life.

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 EH&S professionals much more efficient and manageable. The same advice can be extended to the public sector and regulations mandated by governments; focusing on and encouraging proactive measures, and recognizing the similarities and relationships between various EHS&S issues, will make regulations not only more easily applicable but also more effective.

APPENDIX 1

The following example is given to demonstrate the possibility of multiple implications of a near-miss:

Pumping material to the wrong storage tank
This is a scenario where in a large facility with multiple storage vessels, a chemical (Chem A) is pumped into the wrong storage vessel unintentionally. The consequence was a low level contamination from the previously stored material (Chem B) and is determined to be tolerable for the future uses of the chemical. Following are some of the potentially major EHS&S consequences that could have occurred if the circumstances including chemicals, Chem A and Chem. B, were different:

- Chem A and Chem B could have reacted with each other violently at the storage tank or if this event is unnoticed Chem A could be used instead of Chem B in the next process run; in either case possibly causing safety, health, environmental and quality problems.
- The contamination by Chem B might cause Chem A to be totally unacceptable for the next use causing disposal or purification problems adding to the cost of production.
- Let's assume that Chem A could be used by people with alternative intentions (e.g. terrorists), and Chem B or other chemicals stored in this storage unit are non-threatening. The ability to pump Chem A to the storage vessel of Chem B would facilitate its transportation to outside the facility under a different label as a non-threatening chemical. This ability would indicate a potential security issue.
- Contaminated Chem A possibly causing major quality problems downstream in the process or at the customer's facility if not analyzed fully for all possible contamination.

Quality analysis indicating near-miss
Analysis of a product (Chem P) ready to be shipped reveals that there is an unacceptable level of impurity (Chem I) present in the material. The shipment is put on hold to resolve the issue, ship as is for a lower price, purify or dispose of the material. In the mean time the "quality team" started to search for the causes of this quality problem. It was discovered that in the reactor there was a brief temperature excursion that later was brought under control by increasing cooling to the reactor. A further search into the causes of the temperature excursion revealed the following situation:

One of the feed lines used for this reactor was slowly building deposits of chemicals inside its walls slowing down the transportation of material. To compensate for this restriction periodically the rotation speed of the pump was increased. Finally, during the maintenance period the line was changed. But, the pump rate was not adjusted to compensate for this reduction in resistance to pumping. Therefore one of the raw materials for the reaction was fed at a faster rate than indicated in the operating instructions. Luckily, in this case, an attentive operator who acted in a timely manner, increased the cooling water and controlled the exothermic reaction. The operator had not noticed this as a near-miss since the processes run in that particular reactor requires the operators to manually adjust heating and cooling for different processes. But, had this happened in the production of another material that is highly exothermic there could have been an explosion causing major damage.

APPENDIX 2

Figure 1:

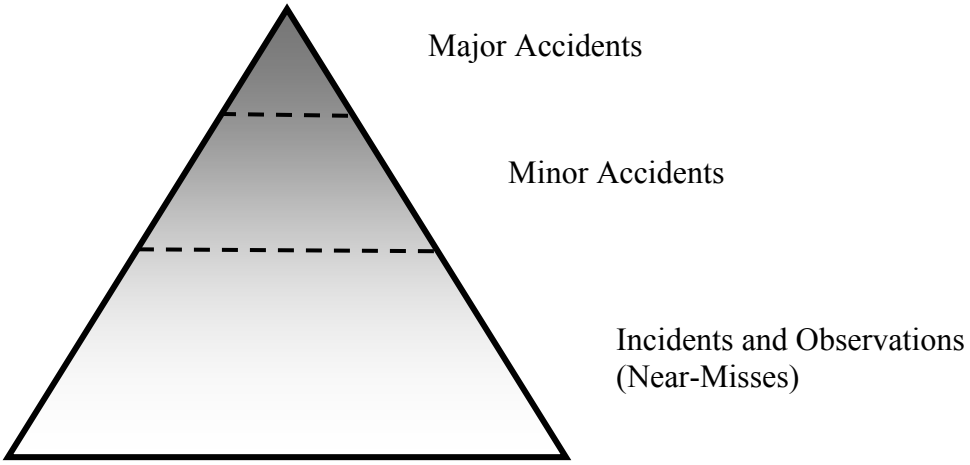

Figure 1. Safety Pyramid
(Gradual shift and overlap between different levels)

Figure 2:

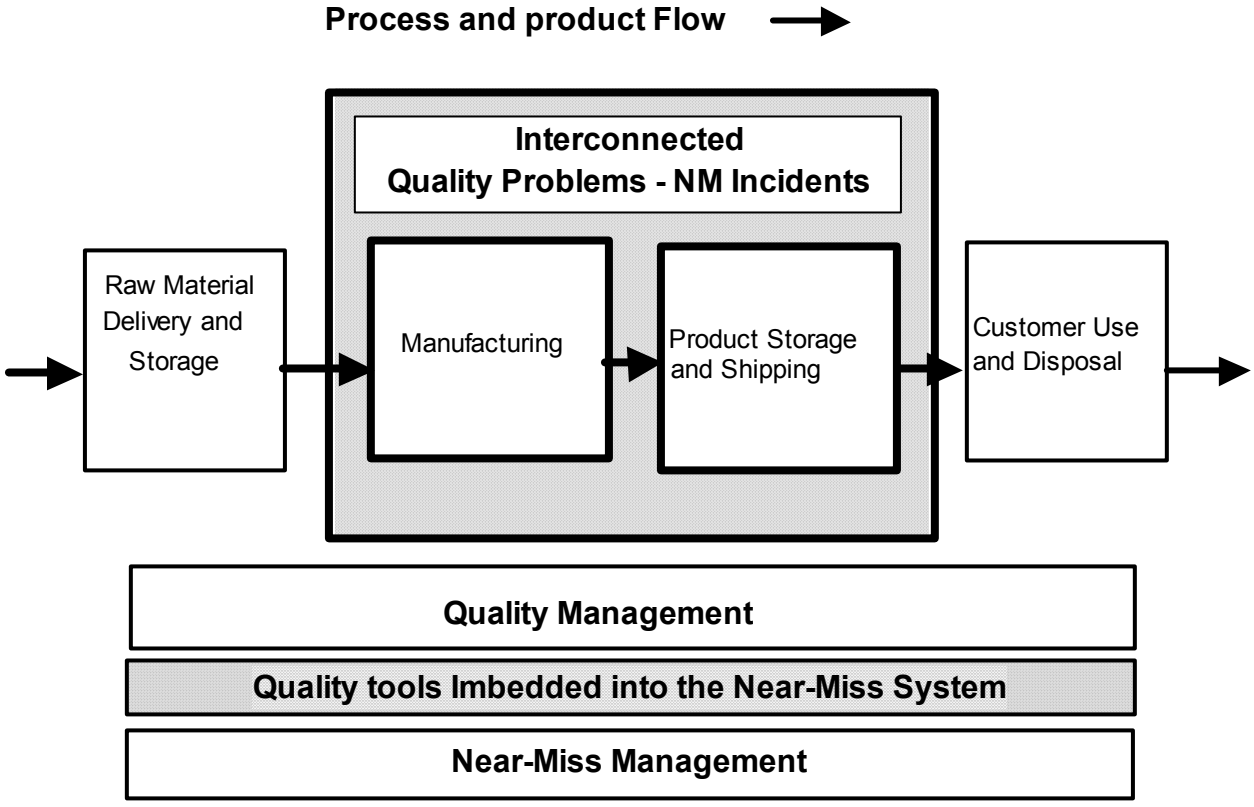

Figure 2. Relationship between Quality and Near-Miss
Shaded Areas Indicating Overlap (Integration)

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