

# Near-Miss System Analysis: Phase I

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**Other related reports:** Near-Miss System Analysis Phase I - *In-depth information on Near-miss concepts and benchmarking*  
Corporate Specific Near-Miss Analysis Reports - *issued to each participating corporation*

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Phase II is now underway. For further information or to participate in the project please contact

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## SECTION I – THE NEAR-MISS PROJECT

### 1.1. The Importance of Near-Miss

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 – 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. A poignant example is the U.S. election balloting system. Prior to the 2000 U.S. presidential election, a large number of electoral near misses had occurred where problems with balloting had resulted in the voiding of ballots. As these near-misses did not have bearing on the outcome, they were overlooked. However, were the near-misses recognized, properly managed, and followed with subsequent changes to the balloting system, much of the debate surrounding the 2000 presidential election outcome would have been avoided.

Near misses can also be observed in operational supply chains and logistics, financial markets, and medicine and healthcare, among many others disciplines. Some of the most salient examples are in the disciplines of environment, health and safety (EHS). 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. Had the near-misses been properly recognized and resolved these disasters would have been avoided.

Phase I of the Near-Miss Project commenced after the Wharton near-miss roundtable meeting at the University of Pennsylvania. During Phase I, near-miss programs managed by Environmental, Health and Safety departments at five Fortune 500 companies were assessed. On review of the results it is observed that although some sites manage near-misses better than the others, based on criteria presented in this paper, no one company has ‘cross-the-board’ exemplary performance.

In this report, impacts of key issues on near-miss programs are outlined, and benchmark characteristics of successful near-miss programs are identified.

The benefit of having a good near-miss program is clear. The well-known safety pyramid<sup>1</sup> is shown in Figure 1. Near-misses, which constitute the base of the pyramid, occur much more frequently than more serious accidents. They are also smaller in scale, relatively simpler to analyze, and easier to resolve. Usually each major accident can be linked to a number of incidents that happened earlier. Therefore, by addressing these precursors effectively, large and expensive accidents may be avoided.

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<sup>1</sup> See *Practical Loss Control Leadership*, F.E. Bird and G.L. Germain, Det Norske Verita, Loganville, GA, 1996, Chapter 1 for a discussion of the safety pyramid.



Figure 1. Safety Pyramid

Apart from safety improvement through the identification and resolution of isolated near-misses, there are additional safety and management benefits of a near-miss program. Benefits include:

1. **Delegation of Safety Responsibility:** An effective near-miss program shifts the task of identifying unsafe operations from Environmental, Health and Safety (EHS) management, to a much larger workforce that has intimate contact with process operations/equipment. By harnessing this larger workforce a greater number of safety related issues can be identified and addressed.
2. **Increased Safety Awareness:** By making individuals more safety conscious and by shifting the responsibility of identification of near-misses, unsafe conditions and behavior to each individual in the work force, both on and off the job safety of employees can be improved significantly.
3. **Creation of an Information Pool:** The collection and analysis of near-miss data can reduce accident frequency through a) identification of similar incident precursors at other facilities, and b) pattern observation and trend analysis over time. Such a knowledge base would reduce risk exposure in on-going operations as well as future equipment, process and plant designs.

At this juncture it is helpful to address a central question with respect to this study. Is the identification of a large number of near-misses indicative of a safe or unsafe process? It could be argued that a large number of identified near-misses suggest unsafe operations. However, simply the fact that near-misses are *identified*, suggests that employees are more safety conscious, safety management actively looks for near-misses, and accidents are resolved proactively before they occur. Hence, a large number of reported near-misses is indicative of safe operation.

If the issue is posed slightly differently, the answer is clear. Consider two identical manufacturing sites, except Site 1 reports one hundred near-misses a year, Site 2, none. Is Site 1 safer than Site 2? In this case, the unequivocal answer is yes. The plant that identifies and resolves near-miss incidents is safer than the identical plant that does not identify or resolve incidents. This is because *both* plants experience the near-misses (they are identical) whereas only one has taken steps to resolve the issue to reduce the chance that these incidents cannot recur. Every plant has the opportunity to be either Site 1 or Site 2. Plant management can attempt to identify and resolve many near-misses, or can choose to identify and resolve none. With all else being equal the site with near-miss conscientious plant management will be the safer plant.

Based on recognition of the above argument, **the collection of near-misses must always be viewed favorably**. It is our view that any attempt to associate a positive correlation between an accident rate, and the number of reported near-misses is unwarranted and moreover, is bad practice. To suggest that a high number of identified near-misses translate to a high accident rate, will only suppress the disclosure of incidents, which in turn will increase risk exposure. If there are instances of both high disclosure rates and a high number of accidents, what must be scrutinized is whether near-miss disclosures are suitably managed.

## 1.2. Near-Miss Management

Based on interviews with participating member companies it is concluded that ‘near-misses’, remain a recognized, yet largely untapped safety improvement resource. This resource, if effectively utilized and managed has the potential to significantly reduce the frequency of both minor and severe accidents.

The difficulties that companies have had in tapping this potential has not simply been for lack of investment, or for lack of a formal near-miss program. On the contrary, all of the companies that have participated in The Wharton Risk Center Near-Miss Project have some form of a near-miss program in place. Furthermore, successful near-miss programs are attainable. Some companies, or more specifically, some facilities or groups, have proven effective in most aspects of near-miss management. Rather, what is evident and emphasized in this report is that a successful near-miss program is achieved through carefully designed management systems with a positive organizational safety culture. Through analysis of near-miss programs and interviews with plant personnel and Environmental, Health and Safety management, elements common to effective near-miss programs have been distilled and will be outlined.

To best utilize a near-miss and ensure that the incident does not recur, a near-miss must be managed through seven consecutive stages. These are:

1. Identification
2. Disclosure
3. Distribution
4. Root-Causes Analysis
5. Solution Identification
6. Dissemination to Implementers
7. Resolution

These seven stages represent areas where management practice must be honed. Near-Miss practice starts by identification. Though some near-misses are readily apparent, others are not,

and these have to be actively sought after. Once an individual recognizes a near-miss he or she must disclose this information to the appropriate people. It is critical for the individual to feel confident that incident disclosure is encouraged, and that punishment (either directly or indirectly) will not ensue. After a near-miss is disclosed a mechanism for distribution must be in place to ensure the information is transferred to decision makers in a timely fashion. These decision makers, who may vary depending on the nature of the near-miss and could range from a couple of people to an investigation team, must determine the underlying root-causes that resulted in the incident, and must determine solutions to prevent incident recurrence. Subsequently, these solutions must be disseminated to individuals who can implement the solutions. Finally, the incident must be resolved such that recurrence is considerably less likely, in both an effective and timely manner.

On viewing execution of a near-miss as having potential for failure in one of these seven stages, it is readily apparent why near-miss programs have limited success. If a 75% success rate is attributed to each stage the probability of each near-miss being fully resolved is  $(0.75)^7$  or roughly 13%. This would suggest that nearly 87% of all near-misses are mismanaged. It is not surprising therefore, that near-miss programs face adversity.

For successful management of a near-miss program, the seven stages of near-miss processing must be fully recognized and monitored. Further, interaction between stages must also be recognized. For example, if employees observe rapid and effective resolution of a near-miss, they will subsequently be encouraged to identify and disclose a near-miss in the future.

Site visits with participating companies are designed to understand and appraise the systems used to manage these stages, and to evaluate whether the systems in place are operating effectively, or if there is opportunity to improve in a particular stage.

## **SECTION II - EVALUATION**

During interviews a systems analysis approach similar to ISO 14000 management system audits<sup>2</sup> is used. In this approach, management systems that are considered best practice are analyzed and assessed. Specific to this study, sub-systems to facilitate the seven stages of near-miss processing are analyzed. This approach allows development of a matrix to compare across companies and sites. Note, participating companies have processes with different chemistries, operations, site sizes, and locations. As a consequence it is necessary to determine evaluation criteria that allows for useful comparison between sites and companies. Hence, sites are evaluated according to management systems rather than undertaking disparate analyses on idiosyncratic process specific events.

Each stage of near-miss processing is assessed based on pre-set criteria as briefly explained below. The assessment involves identifying sub-categories and using a scoring system to determine each site's performance in every stage.

### **2.1. Identification**

Identification of a near-miss is the first stage of near-miss processing. Unlike other industries (e.g. -airline industry) in the industries analyzed identification of near-misses is not always obvious, and many near-misses probably occur that are never recognized as such. In this stage, among other criteria, having consistency in definition and perception of the near-miss event within various levels of the organization is emphasized.

### **2.2. Disclosure**

Though a near-miss is identified, its value may be lost if management does not both facilitate and encourage disclosure of the recognized occurrence. Management must create a culture where disclosure of near-misses is actively encouraged, and individuals do not feel pressure not to disclose because of fear of disciplinary action, or peer pressure.

### **2.3. Distribution**

In the distribution stage, near miss information is transferred from the discloser to 'decision makers', that is – the person, or people, who will make decisions as to what preventive actions are necessary. Rapid distribution of information pertaining to near-misses is paramount. Just as information can be lost when accidents that occur are not quickly followed up, so may information that relates to near-misses. Further, quick distribution helps ensure fast resolution, which reduces the likelihood that the potential accident could occur. To assess this stage, among other criteria, extent of integration of near-miss systems into incident investigation, lateral and vertical distribution channels, and distribution protocols are analyzed.

### **2.4. Direct and Root-Cause Analysis**

In the analysis of an incident it is necessary to:

1. Assess the direct and underlying root causes that enabled an incident.
2. Determine corrective actions or solutions to rectify the root cause such that recurrence is much less likely.

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<sup>2</sup> J. Voorhees, R. A. Woellner. International Environmental Risk Management: ISO 14000 and the Systems Approach, Lewis Publishers, Boca Raton, FL, 1998.

Root-cause analysis is a well-developed field in accident investigation and many of the techniques can be transferred to near-miss investigation. When transferring techniques it is necessary to ensure that the methods do not overburden the investigation such that future reporting is deterred.

Depending on the potential severity and complexity of the near miss, determination of causes may be performed informally between discloser and direct supervisor, or may require formation of an investigation team for a thorough analysis with subsequent recommendations.

## **2.5 Solution Identification**

For each cause corrective actions need to be determined. Ideally these corrective actions should eliminate the potential for recurrence, though this may not always be feasible. Therefore, it is desirable that solutions reduce the likelihood of recurrence (mitigation) or reduce the potential impact in case of recurrence (contingency planning).

All solutions should also be scrutinized to assess whether there are other detracting factors (such as expense, employee acceptance, management acceptance, new incurred risks, etc.)

## **2.6 Dissemination to Implementers**

In the dissemination stage, corrective actions must be sent to all parties that can benefit from the information. This should include people implementing corrective actions at the location where the near-miss occurred. However, at this stage, it may also be appropriate to disseminate the near-miss to a much larger audience. For example, it is quite possible that other business units, as well as other sites can benefit from the information pertaining to the near-miss. And consequently vehicles to support this information dissemination must be available.

## **2.7. Resolution**

Not only is it important to resolve a near-miss to ensure that the potential accident does not occur, it is intrinsic to the success of a near-miss program. If, based on their observations, individuals perceive that near-misses are not acted on, they will not disclose near-misses in the future. Consequently, in this stage, systems that ensure the full value of near-misses is assessed using criteria, such as good tracking mechanisms and effective promotion of resolutions.

## SECTION III – FINDINGS

In this section elements intrinsic to all seven stages are outlined, and results and observations provided.

During company and site visits, sites were evaluated across four dimensions:

1. Identification
2. Disclosure
3. Information Transfer (Distribution and Dissemination to Implementers)
4. Resolution

Due to the wide variation of incidents that would need to be analyzed, and the expertise that could be required to evaluate suitability of Direct/Root-Cause Analysis and Solution Identification, these stages were not analyzed during site visits.

### 3.1. Identification

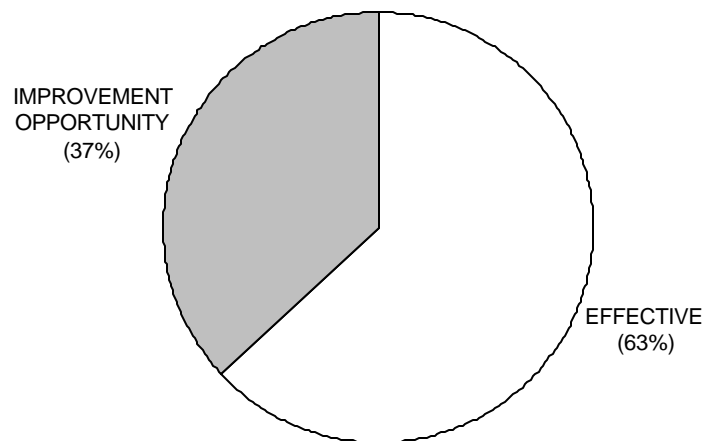


Figure 2. Identification Performance of Participating Companies

Among the sites evaluated it is estimated that nearly a third of the sites did not have effective systems to aid in the identification of near-misses.

Two examples are presented to illustrate the difficulty sites have when attempting to identify near-misses. Neither of the examples was, at the time, considered near-misses. These examples were elucidated from a participating company during a ‘safety suggestion contest’, where plant personnel suggested ideas to improve plant safety.

**Suggestion 1:** It is observed that pipes that span roadways do not have clearance signs. There is potential that a truck may hit these pipe ways causing property damage and possibly a catastrophic accident. **Resulting Action:** Clearance signs were added to reduce the likelihood of an accident.

**Suggestion 2:** It is observed that both plant exits exit to the south of the plant. In the case of a possible release, if the wind was blowing in a southerly direction, evacuation could be seriously compromised.

**Resulting Action:** Plans are being developed to add an additional evacuation route to the north of the plant.

Is either of these examples a near-miss? By a classical definition neither is – they are at best, observations of unsafe conditions. And yet, there are many reasons why both examples should be considered near-misses.

First, note both suggestions may well have been observed though nonetheless not recognized during conditions that could have resulted in the accident. For example, in the first instance, a

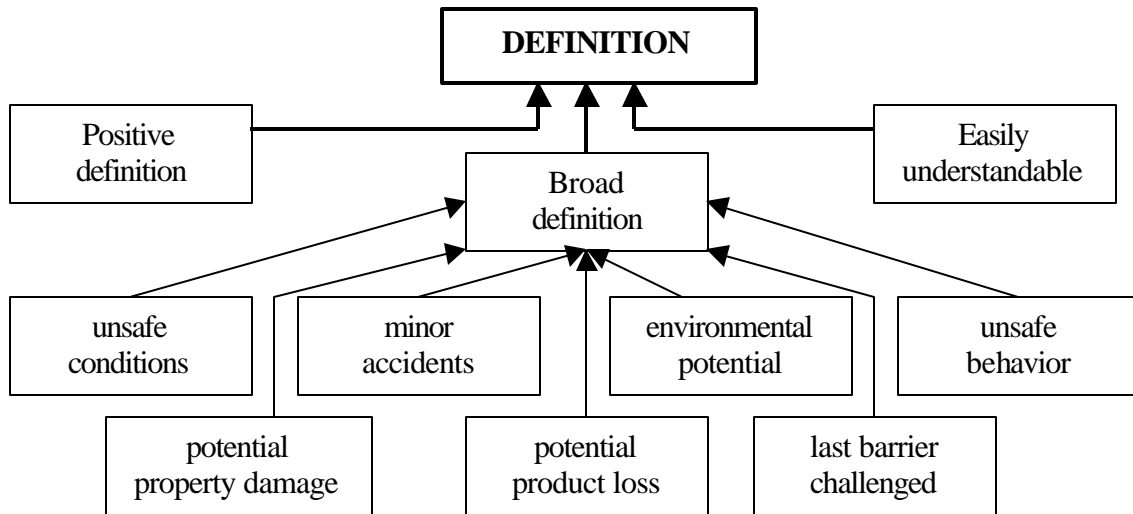


Figure 3. Definition Tree

person may have observed a truck nearly collide with overhead pipe work, in the second instance the observation may have been made during a simulated evacuation. Yet, in both cases it is quite likely that there was never explicit recognition that a near-miss had occurred. Rather, the potential incident was recognized from an indirect route by holding a safety contest.

Second, what purpose is served if the above examples are not considered to be near-misses? From the standpoint of management, the recognized unsafe condition, or ‘event-driven’ near-miss must be processed similarly, and in both cases the underlying objective, safety improvement is served. By being too restrictive in the definition of a near-miss, plants run the risk of not gathering safety related information, simply because plant personnel believe that the observed situations that could improve safety do not fall into the definition of a near-miss.

**Near-miss: A New Definition**

There is an overwhelming need for an encompassing and indeed helpful definition of near-misses. During interviews, individuals were questioned as to their definition of a ‘near-miss’. Responses varied from ‘an incident that under slightly different circumstances would have resulted in loss’ to ‘you know it when you see it’, to a number of individuals who could not describe a near-miss. Confusion over what, exactly, a near-miss is, is an area that should be addressed by everyone. For example, an individual might not report an unsafe condition since an

event has not occurred, regardless of whether resolution of the situation can be used to improve safety practice.

In choosing a definition, the issue should not be whether an occurrence is an event with potential for more serious consequence, an accident or simply the identification of an unsafe condition or unsafe behavior, but rather, by identifying the occurrence can site safety be improved. In search for a new definition the tree shown in Figure 3, which includes desirable definition features, is generated

In light of the representation in Figure 3, a new definition is offered:

*Near-miss: An opportunity to improve safety practice based on a condition, or an incident with potential for more serious consequence.*

This definition captures the ephemeral quality of a near-miss, without dwelling on how an event should be classified. Near-misses are opportunities that should be seized, and if the underlying hazard is quickly identified and remedied, the likelihood of the event recurring is either greatly reduced or eliminated. If not identified, disclosed and properly managed the incident will likely soon be forgotten and the latent potential for damage will remain.

In this definition ‘an incident’ or ‘condition’ is anything that a witness views worthy to address to eliminate a potential to cause harm. Note by this definition a wide variety of occurrences are defined as near-misses. These 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 resulted
- Events where a safety barrier was challenged
- Events where potential environmental damage could result

Note that while there is certainly merit in distinguishing these categories and analyzing and resolving them by different means, since the overriding objective is to improve site safety, encompassing these items into one broad definition is also beneficial.

### 3.2. Disclosure

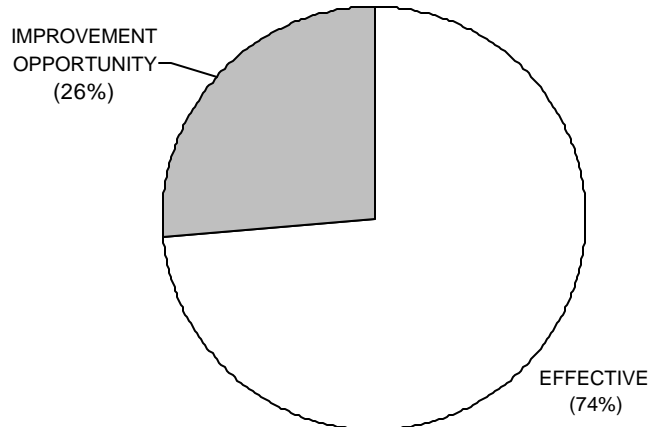


Figure 4. Disclosure Performance Among Participating Sites

Even if a near-miss is recognized, it is not assured that the near-miss will be disclosed. Significant improvements in disclosure are possible if the many sub-systems to encourage and facilitate disclosure are recognized and addressed. The disclosure stage must not be considered in isolation. Successful dissemination and resolution of near-miss incidents can favorably impact disclosure. For example, a sentiment often expressed by plant personnel was ‘I would disclose incidents if management actually was going to act on them’. This sentiment shows a negative feedback where poor resolution can badly impact disclosure rates.

To encourage disclosure of near-misses the following sub-systems must be honed:

**Disclosure must be quick and simple:** Completion of long forms will discourage disclosure. Though the follow up action may require a more thorough investigation, a quick summary investigation of the near-miss, write-up and submission, generally suffices for the majority of near-misses. Note, even if filling out the disclosure form is a quick process, if retrieving a near-miss form involves going to other rooms, lengthy initial delivery times, or trolling through web sites, disclosure rates will decrease.

**There should be multiple routes for disclosure:** As summarized by an EHS manager ‘We will take it any way we can get it’. Only one method of disclosure may discourage reporting, for example – though there has been a movement towards near-miss intranet systems, some people are still not computer savvy, and this may discourage people from disclosing a near-miss if this is the only avenue for disclosure.

**People must know at least one disclosure mechanism:** Despite systems being in place to capture near-misses, frequently interviewees were still unclear on whom to, or how to report near-misses. For example, often EHS management presumed that plant personnel would disclose near-misses to their direct supervisors, though plant personnel did not indicate they would do this.

**Encourage Disclosure:** Disclosure is encouraged by several means. Most notably, and as mentioned previously, disclosure is encouraged by quickly acting on, and deriving and promoting value from previously disclosed near-misses. Additionally, incentive programs can help increase

disclosure (see below). Finally, at some sites fear of discipline for *not* disclosing near-misses was stressed, and this in-turn encouraged disclosure.

**A Note on Incentive Programs:** Some form of disclosure incentive was in place at half the sites visited. Incentive programs can work effectively in disclosing near-misses, though are certainly not a cure-all.

Benefits of incentive programs are:

1. People will often submit near-misses if the incentive is attractive enough. For example at one site, near-misses acted as entries into a lottery program with the biannual lottery prize being an extra day off. Disclosure spiked dramatically to roughly 4 disclosures per person per year (this program was also facilitated by allowing individuals to disclose near-misses that happened to them at home).
2. Incentives highlight and promote those people who participate, which further increases site-wide awareness.
3. Incentives stress to plant personnel that disclosure of incidents and near-misses is actively wanted and yields positive rewards.

Limitations of incentive programs include:

1. Incentives can grow 'stale' or result in incentive inflation. People can grow tired of certain incentives; for example, people need only so many cups, pens etc. Further, incentive inflation can occur, where ever-increasing rewards are needed to promote the program. Further, discontinuation of incentives, or a decrease in incentives can be viewed as management disinterest, and hence discourage disclosure.
2. 'Safety is part of people's jobs.' This sentiment was voiced by several EHS managers. They stressed that people should not be rewarded for disclosure, since they were simply performing their job requirements. Personnel occasionally also expressed this same sentiment by sometimes viewing the prizes as belittling. Note that the counter argument that people are often rewarded for completing their job well should also be considered.

**Remove fear of punishment:** Though often thought of as a problem of the past, sites where fear is still part of the culture pervades. As one EHS manager lamented:

*"There always seems to be that fear of reprisal, though these are mostly built on folklore or misconstrued past incidents. Since discipline is personal the actual facts may never truly surface. Also the doings of a poor manager can take years to undo, if the doings ever do get undone. I have heard folklore stories which predate me by a wide margin; and I have been here since 1978."*

To help remove fear from the disclosure process, some management teams have developed a policy against disciplinary action. A policy that helps encourage disclosure could be of the form:

*Provided a cardinal rule has not been broken and no damage done, disciplinary action will not be taken.*

These policies must be rigidly adhered to, for as noted above, failure of management to stick to their own policies can take years to undo. Note however, that dwelling on, or promoting a non-disciplinary policy can also prove detrimental to disclosure, as this can suggest that near-misses are perceived by management to be negative events.

Lastly, management must scrutinize all follow-up action items that develop from a near-miss to ensure that indirect punishment does not occur, as this too, can greatly deter from future disclosure. For example, at one site, a near-miss was disclosed that resulted in personnel wearing additional, cumbersome and perceived to be unnecessary PPE. This was viewed by personnel as punishment, and subsequently the near-miss program has floundered.

**Ensure involvement/allow self-resolution:** Many near-misses are often lost in work orders, and though resolved as an isolated incident, full-learning value from the near-miss is not obtained. As one operator voiced:

*'I fix unsafe conditions and near-misses all the time – I just put in a work order – it is much quicker than putting in a near-miss form, and a lot less headache.'*

Soliciting the discloser for follow-up action items, and allowing for self-resolution where possible increases the likelihood of capturing a near-miss in the system. Further, near-miss program integration with the work order system can facilitate disclosure.

**Avoid Spotighting:** Spotighting appears to be a common problem at many sites. Of the 19 non-corporate sites visited 8 showed disclosure rates per year per person of 0-0.3, 4 between 0.3 -1, and 7 greater than 1. A high number of disclosures, can in-turn encourage more disclosures, as individuals can submit reports without casting the spotlight on themselves. In effect, anonymity is effectively created if there participation in the near-miss program is widespread.

**Avoid anonymity schemes:** Making the disclosure anonymous was generally viewed as unfavorable, since, (i). it was often necessary to follow-up with the discloser to ascertain what the root-causes were, and (ii). it suggests that near-misses are unfavorable and undesirable events. As noted in the previous item, artificial anonymity is likely to result of there is widespread participation in the program. Three of the sites visited offered anonymous disclosure, though these were also run in conjunction with incentive schemes that encouraged identity disclosure, and hence anonymous disclosure was never utilized by the submitter.

### 3.3. Distribution and Dissemination to Implementers

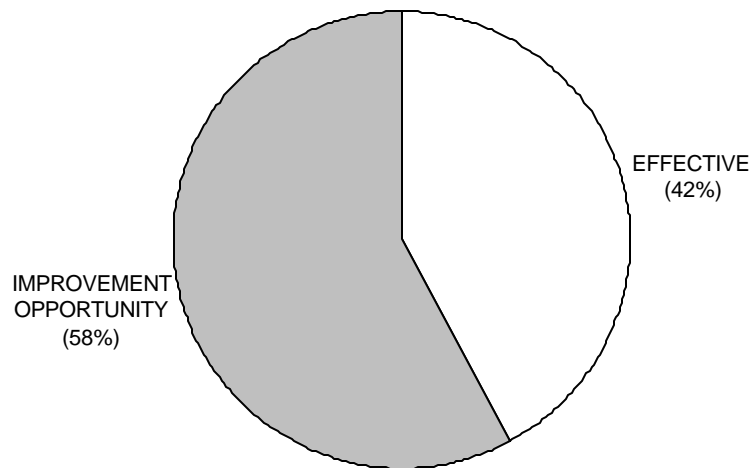


Figure 5. Dissemination Performance At Participating Companies

In evaluating the stages, 'Distribution' and 'Disseminations to Implementers' together, procedures in both stages that enable and facilitate information transfer are analyzed.

Information dissemination and management remains a primary obstacle to the success of most near-miss programs. In a number of tragedies (e.g. – space shuttle explosion<sup>3</sup>, Paddington train crash<sup>4</sup>) failure specifically in distribution of identified near-misses resulted in the catastrophe coming to fruition. Fortunately, there remains considerable opportunity to improve in these two stages since much of the operations can be automated. In this section, the importance of the stages is discussed and a number of sub-systems that are necessary to successful stage performance are outlined.

Three common information transfer mechanisms were observed at sites visited. These are summarized in Table 1. The differences between the mechanisms are small, though important and pertain to when and how near-misses are brought to a wider audience.

In creating systems to transfer near-miss information, whether that is to allow disclosure information to travel to EHS, to increase awareness of an identified condition or hazard, or to disseminate and track follow-up items, the following mechanisms must be ensured:

1. Information must be transferred quickly.
2. Information must reach all appropriate parties.
3. Information must be presented in a useful and understandable format.

<sup>3</sup> Harris, CE, Explaining Disasters - The Case For Preventive Ethics, IEEE Tech. & Scty Magazine, 14: (2) 22-27 1995

<sup>4</sup> See [http://news.bbc.co.uk/1/hi/english/special\\_report/1999/10/99/london\\_train\\_crash/newsid\\_465000/465503.stm](http://news.bbc.co.uk/1/hi/english/special_report/1999/10/99/london_train_crash/newsid_465000/465503.stm)

The following sub-systems help achieve these three maxims:

**Program Integration:** At all companies there is ample opportunity to seamlessly mix a near-miss program in with other safety management systems. For example, all companies surveyed either integrated their near-miss program with a similar program to resolve unsafe conditions, or integrated the near-miss program with the accident investigation system. However, only at three sites were event-driven near-misses, unsafe conditions and accidents all managed in the same system. This is not to suggest that promotion of disclosing near-misses, or indeed creating awareness of near-misses not be performed independently of an accident awareness program, but rather that the information is processed, monitored and managed within the same system. In doing so, information management is systematic, which thereby encourages both system familiarization, and consistent resolution.

Table 1. Near-Miss Dissemination Mechanisms

Mechanism	Type I	Type II	Type III
Description	<ol style="list-style-type: none"> <li>1. Identifier discloses to supervisor.</li> <li>2. Immediate action items taken.</li> <li>3. Report written independently or with/by sup. and disclosed to department/group/site-wide depending on opinion of discloser. EHS cc'd.</li> <li>4. EHS helps determine follow-up items and whether to disseminate off-site.</li> </ol>	<ol style="list-style-type: none"> <li>1. Identifier discloses to supervisor.</li> <li>2. Immediate action taken.</li> <li>3. Supervisor writes NM report gives to EHS.</li> <li>4. EHS or supervisor determines follow up actions.</li> <li>5. EHS discloses to groups/site and off-site as necessary.</li> </ol>	<ol style="list-style-type: none"> <li>1. Identifier discloses and resolves NM.</li> <li>2. Reports NM to central collection group.</li> <li>3. NMs reviewed by Safety committee during weekly/monthly meeting with follow up items determined.</li> <li>4. All NMs summarized and published on bulletin boards.</li> </ol>
Benefits	<ul style="list-style-type: none"> <li>• Ensures that NMs are relayed widely.</li> <li>• Empowers discloser to decide who benefits from information.</li> <li>• Ensures quick knowledge of NM.</li> </ul>	<ul style="list-style-type: none"> <li>• Ensures supervisor checks.</li> <li>• Dissemination standardized as deemed by EHS.</li> </ul>	<ul style="list-style-type: none"> <li>• Allows collective collection and analysis of NMs.</li> <li>• Ensures publication venue of all NM to all parties.</li> </ul>
Detractions	<ul style="list-style-type: none"> <li>• Potential for 'info-glut' or over-communication.</li> <li>• Potential for misuse – e.g. disclosing non EHS issues through system</li> </ul>	<ul style="list-style-type: none"> <li>• May slow dissem. of event information.</li> <li>• Potential for dilution of info. from discloser to EHS.</li> <li>• Can over-burden EHS.</li> </ul>	<ul style="list-style-type: none"> <li>• Slows dissem. of event information.</li> <li>• Slows determination and hence implementation of resulting action items</li> </ul>
Comments	Generally observed in large plants with automated systems	Generally observed in smaller plants – more often with paper based systems	Most often run as isolated NM programs and not integrated with incident/accident management

**Automation:** Automated, computer-oriented systems can greatly expedite management of near-misses. Systems that were in place at participating companies varied dramatically, with roughly half of the sites either not having an automated system, or having very low utilization of the system. Some systems were impressive, and heavily utilized.

**Fast Routing/Processing:** Getting information to the appropriate people, independent of the types of systems used, is essential. Overly cumbersome and slow dissemination routes, can result in management or supervisors not encouraging and even discouraging disclosure. Further, and more importantly, slow dissemination can extend the time until resolution. If, for example, near-misses are sent electronically, but only reviewed monthly, the hazard is still present with latent potential for a long period of time. This increases the likelihood of an accident and further discourages disclosure in the future.

**Lateral distribution/dissemination:** Ensuring lateral transferring of information, for example, enabling operators to inform other operators on site that a near-miss has been entered, serves two important purposes:

1. It makes people aware of an identified hazardous condition, or potential for accident.
2. It self-promotes a near-miss program.

**Two-tiered or above, classification:** Having some classification system to assist in the dissemination and processing of incidents is recommended. Many near-misses can be self-resolved, and still be a valuable learning lesson that should be disclosed. Allowing some incidents to be self resolved, without a full investigation can encourage disclosure, as well as allow investigation teams to focus attention on more complex incidents and near-misses.

**Off-site Reporting:** Though most sites said that off-site reporting of near-misses would occur if the near-miss was significant enough, only half had formal systems to assess when information should be sent off-site, and rarely were these systems utilized. This is regrettable. One of the main reasons why accidents are shared off-site is to help other people to benefit from the event. In many cases, there is just as much benefit in learning from near-misses as from accidents, and hence, these reports should also be shared off site.

### 3.4. Cause Analysis and Solution Identification

When a near-miss has been disclosed and passed to appropriate parties, the next objective is to determine what action is required to ensure that the near-miss (or accident) could not recur. Two stages are required in deciding the appropriate actions to take:

1. Identify the root cause or causes.
2. Identify solutions (action items) based on root causes that significantly reduce the likelihood, and/or significantly reduce potential impact of recurrence.

In many instances, an informal root cause analysis and action item determination is done between discloser and direct supervisor. This can be beneficial as the first four stages of near miss processing are often quickly managed between two individuals. However, for some near misses, where the root cause may not be readily apparent, an investigation team is formed to determine the root causes and subsequent solutions.

It should be noted that identification of root-causes is not an easy task, and in many cases some root causes may be perceived and remedied, whereas in fact the true root cause went unidentified. Further, even if root causes are identified, determination of remedying solutions may not be possible, or determined solutions may be prohibitively expensive.

Gauging how well near-misses are resolved at participating sites is a difficult endeavor, as there is an inherent 'quality of resolution' issue, for which there is no good metric. For example, if someone slips on an icy patch, two solutions are to salt the area, or to have the individual wear better shoes (or both), and a plethora of other solutions is also possible. In this case it may not be obvious which solution is superior. Generally, for an identified near miss, safety improvements can be ranked from most to least beneficial as follows:

1. The cause of hazard is eliminated.
2. The potential hazard 'level' is reduced.
3. Safety devices are installed to manage incident recurrence.
4. Warnings are installed to alert people of hazard.
5. Standard Operating Procedures (SOPs) are changed to account for hazard.
6. Employee awareness is increased.

Unfortunately, this ranking can be simplistic, and does not take into account other mitigating factors, such as expense of solution or creation of new hazards if changes to the system result. Also, if the cause of hazard cannot be eliminated several of the other improvements can be implemented concurrently increasing the number of barriers to recurrence of similar situation.

For sites to appraise their own systems, sites should ensure that the above two sub-stages, root cause identification, and solution determination are clearly defined stages in the near miss processing. Additionally, systems should ensure:

**Discloser Involvement:** Often the discloser will have useful ideas and perceptions as to what caused the near miss and how it may be avoided in the future. Hence, where possible, the discloser must be involved in the Decision Making process.

**Management of Change:** Management of change issues must be carefully monitored. Often the remedying of one problem can result in the creation of other unforeseen hazards, particularly for subtle changes. Hence, managing change, and ensuring no new hazards are created is critical to near-miss program success.

### 3.5. Resolution

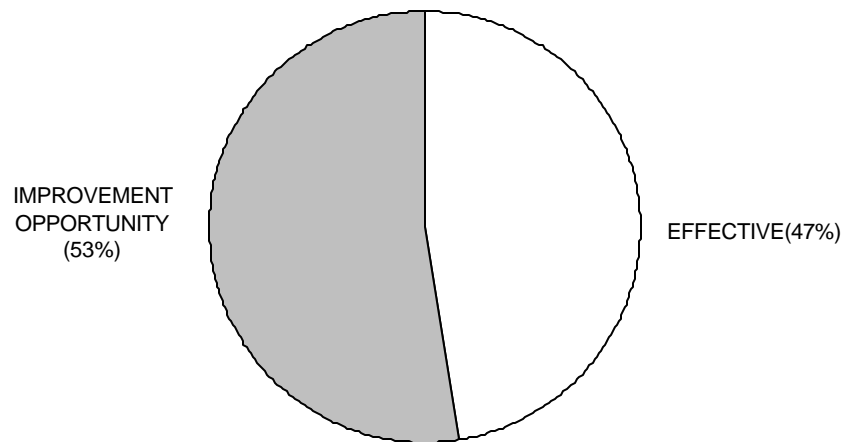


Figure 6. Resolution Performance.

In the resolution stage, action items that are determined in Solution Identification are implemented. However, for successful performance in Resolution a wider set of criteria needs to be assessed to ensure full extraction of near-miss information occurs. Hence, in rating performance in this stage, systems that showed whether a near-miss program was being used to its full potential, were analyzed. For example, in a successful program it is envisioned that information will be extracted from multiple near-misses such that an underlying root cause becomes evident, whereas in resolution systems that could likely use improvement, such instances would not be observed.

The following are criteria that are indicative of a good resolution system.

**Tracking:** It is imperative that systems to ensure that all action items that result from the analysis of an identified and disclosed near-miss are followed until closure. All sites in this study had some system to ensure open action-item tracking, though there was wide variation in both the mechanisms of these systems and the extent to which they were employed

**Promotion:** A system that promotes open remedial action-items that result from the analysis of a near-miss, and also promotes near-misses where all action-items have recently been closed, ensure management accountability, and provide valuable feedback to the initial discloser.

During interviews a common complaint was

*'I would disclose near-misses if something would get done about them'*

Posting and promoting closed near-misses eliminates this common gripe.

**Pooled Usage:** As mentioned, analysis of a collection of near-misses helps ensure full value is extracted from a near-miss database. Often, near-misses are collected and stored, though rarely is benefit garnered from this wealth of information to address underlying safety issues.

**Full Benefit:** Though near-misses most often occur in case-specific circumstances, the benefit from near-misses should, where possible, have farther-reaching benefits, outside of the given circumstance.

**Consistent Resolution:** Action items, and follow up must be carefully scrutinized to ensure that they cannot cause damage to a near-miss program. Failure to do so can result in an undesirable reduction in disclosure rates.

**Off-site near-miss benefit:** Successful near-miss programs seek to benefit from near-misses that occur at other sites, but are still relevant.

**Information Dissemination:** An effective resolution ensures that everyone has a thorough understanding of the outcome and the underlying reasoning. This would prevent miss interpretations of the implementation such as "exaggerated " or "not viewed as important".

## SECTION IV – CONCLUSIONS AND FUTURE WORK

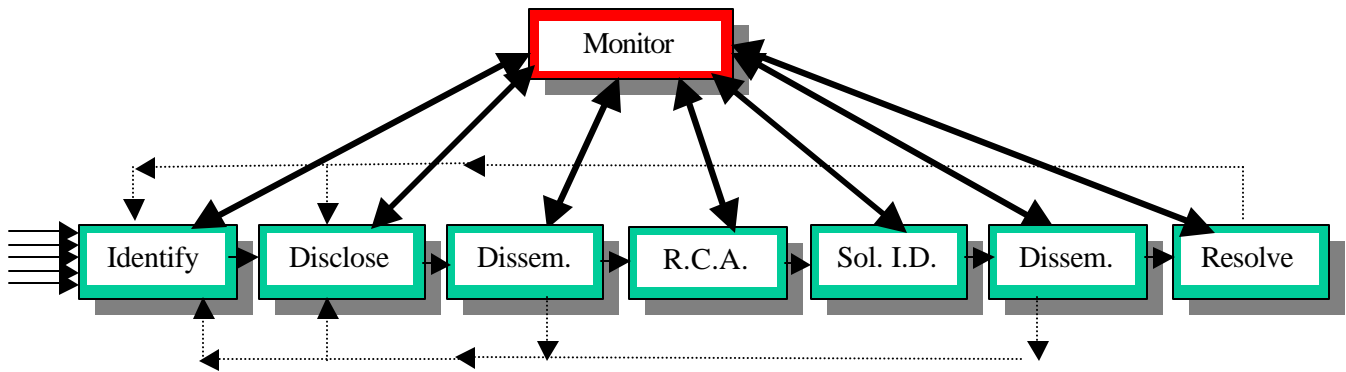


Figure 7. Near-miss Management

As shown in Figure 7, Near-miss management must identify and hone the seven stages of near-miss processing. External to the management of an individual near-miss, systems must be in place to manage and monitor a collection of near-misses. In addition, process management must be aware of the positive feedback loops between stages; for example, if through dissemination people are more aware of previous near-misses, they will look for similar near misses and are more likely to disclose them. Similarly, if personnel see that management will act on, and resolve near misses they are more likely to disclose them in future.

The report has addressed and evaluated site systems for the seven stages of near-miss processing and has highlighted key issues as well as elements of best practice in each stage. Future work will address how all seven stages, as well as monitoring and analysis can be successfully synthesized into one, intranet aided, near-miss program.

Based on the success of Phase I, and interest from many other companies to join the project, Phase II of The Near-Miss Project was initiated in November, 2000. During Phase II the following projects have been undertaken:

1. The development of an intranet based near-miss/incident reporting tool that companies integrate into their safety system. The tool is available to participating companies. The Beta-version is due for completion in October 2001.
2. Site Self-Audit Tool. An audit tool for sites to analyze, assess and improve their own near-miss programs is available to participating companies. This tool can be easily implemented at a site and corporate levels and enables sites to hone attention on under-performing stages.
3. A document of statistical, analytical and managerial methods applied to each stage of management is under development. It will be released in December 2001.
4. A publication is being submitted to a peer review journal. It is envisioned to be published by January, 2002.

We continue to seek additional companies to join The Near-Miss Project, to participate in the project please contact:

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**Section V – Appendix: Site Summaries**

<b>SITE<sup>1</sup></b>	** ** ** ** **	** ** ** ** **	** ** ** ** **	** ** ** ** **	** ** ** ** **	** ** ** ** **	** ** ** ** **	** ** ** ** **	** ** ** ** **	** ** ** ** **	** ** ** ** **	** ** ** ** **	** ** ** ** **	** ** ** ** **	** ** ** ** **	** ** ** ** **	** ** ** ** **	** ** ** ** **	** ** ** ** **	
<b>Identification</b>																				
Rating		•			•	•	•	•	•	•	•		•		•		•	•		
<b>Disclosure</b>																				
Rating		•	•	•		•	•	•	•			•	•	•		•	•	•	•	
<b>Dissemination<sup>2</sup></b>																				
Rating	•	•	•			•					•	•	•							•
<b>Resolution</b>																				
Rating	•	•	•	•	•	•						•	•	•						•
Total Rating (4 Max.) <sup>3</sup>	2	4	3	2	2	4	2	2	2	1	2	3	4	2	1	1	2	2	3	
<b>Self Rating (ave.)<sup>4</sup></b>	6.8	8.8	7.6	6.8	7.9	8.3	7.3	7.0	8.8	4.8	6.6	8	8.3	6.8	7	6.8	7.8	8.0	7.0	
<b>Rating Man/Persnl<sup>5</sup></b>	6/8	9/9	7/8	7/6	8/7	8/9	7/7	7/7	9/9	5/-	7/6	7/10	9/8	6/8	7/-	8/6	8/7	8/-	7/-	
<b>Disclosure Rate</b>	0.2	1.3	0.7	0.2	0.3	1.0	0.2	0.3	2.0	0.1	3	0.7	1.0	1.1	0.5	0.6	1.2	4.0	0.2	
<b># Interviewed</b>	5	5	5	4	5	6	2	3	4	3	6	5	6	6	2	4	6	3	2	

- indicates effective performance, blank indicates improvement opportunity
- 1- Corporate site surveys and interviews are neither applicable nor captured in the table results.
- 2- Includes ‘Dissemination to Decision Makers’ and ‘Dissemination to Implementers’)
- 3- Sum of the four rated stages (note – Decision making is *not* rated and Dissemination stages are combined)
- 4- Interviewees were asked ‘On a scale of 1-10 (ten highest) how would you rate the site near-miss program?’
- 5- Average management/personnel ratings to one significant figure.