### 2000 CCPS Conference and Workshop Proceedings Get Near Misses Reported

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# **Get Near Misses Reported**

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### ABSTRACT

The need for effective root cause analysis is finally gaining the spotlight in the chemical process industry. But, if we don't find out about an incident, we can't investigate to root causes. We do find out about accidents (harm done) because they are hard to hide. However, there is only one accident for about 10,000 errors and failures (sometimes called unsafe acts and unsafe conditions). The definition of a near miss (a potentially damaging sequence of events and conditions, but without harm) can be vague and varies from site to site. But data indicate that there are probably on the order of 100 near misses for every accident. Learning from near misses is much, much cheaper than learning from accidents, yet many companies get fewer than one near miss reported for each accident. This article describes the reasons why near misses are not reported and shares how companies have increased the reporting ratio to as high as 80:1.

### Introduction

We must learn from accidents and near misses to prevent recurrence. The first step in the learning process is investigation to determine the causes and underlying reasons why accidents and near misses occur. A thorough investigation to root causes will identify the management system weaknesses. Learning which management system weaknesses are leading to near misses and accidents is one of the highest value activities in which a company can invest. And learning from near misses is much cheaper than learning from accidents. Many chemical companies have implemented process safety management systems, and now they are beginning to focus on root cause analysis. This is a very exciting trend. Unfortunately, the chemical industry gets very few near misses reported (the chemical industry is certainly not the only industry with this problem).

To understand more about near misses and getting them reported, let's first review the basic definitions.

An incident is either an accident or a near miss.

An accident is a sequence of unplanned events and conditions that result in harm to people, environment, process, product, or image.

A near miss is an unplanned sequence of events that could have caused harm if conditions were different or is allowed to progress, but did not in this instance.

Using just these basic definitions, it is very difficult to make a consistent determination on whether a specific event is a near miss or a "nonincident" (neither an accident nor a near miss). If the users of the investigation system do not identify an event to be at least a near miss, then the event will not be investigated and valuable lessons will be lost. We'll discuss this aspect of near miss reporting later.

We also need to define causal factor and root cause; we'll use these definitions later in this article:

A causal factor is a human error (typically an error by the at-risk employee performing a task/job in the process) or a component fault/failure. Note that these human errors and component failures are probably caused by other humans making mistakes, and all errors are controlled by management systems. An incident typically has multiple causal factors.

A root cause is a management system weakness that results in a causal factor. A casual factor typically has multiple root causes.

Given a consistent understanding of the definition of a near miss, it is possible to estimate how many near misses should be reported for every accident. Studies in several industries indicates that there are between 50 and 100 near misses for every accident. Also, data indicates that there are perhaps 100 erroneous acts or conditions for every near miss. (This gives a total population of roughly 10,000 errors for every accident.) Figure 1 illustrates the relationships between accidents, near misses, and nonincidents.



Figure 1: Relationship Between Errors and Potential or Actual Impacts

The ratios cited above depend heavily on the definition of a near miss and also depend on the type of loss. For example, we have found that for quality incidents, there appear to be far fewer near misses and erroneous acts per accidents; in many cases, the ratio appears to be 100 errors per accident, instead of 10,000. The reason for the lower ratio is that quality events typically results from fewer severe excursions than a safety events -- we design our chemical processes to prevent

the safety event, which usually means a far greater number of failures is required to result in harm to people. A general corollary is: as the process gets simpler, and the path of events to reach harm becomes shorter, we have fewer near misses and errors per accidents. This is good and bad. If two processes handle the same materials, the simpler one is typically inherently safer (simplicity usually implies that operating conditions are closer to ambient). However, the simpler process will also produce fewer near misses and therefore fewer chances to learn from mistakes before an accident occurs.

Most of the over 400 chemical companies we deal with indicate that they get only one or fewer near misses reported for every accident. And though some companies achieve a ratio of 20 or higher, many others get fewer near misses reported than accidents (ratio less than 1). So, regardless of the theoretical limit on the ratio of near misses in an industry or for a specific process, why do we have so few near misses reported? To find the answers, we have conducted several surveys (both formal and informal) over the past few years. The rest of this paper describes the surveys and the results of the surveys, and explains the barriers to getting near misses reported and how companies are successfully overcoming these barriers.

# **Informal Surveys**

Over the past 8 years, we have asked more than 3,000 students of our process safety management (PSM) courses and 2,000 students from our investigator leadership training courses how many near misses they get reported for every accident. The students represented about 300 companies, predominantly in chemical-related process industries (chemical, polymer/plastic, petrochemical, refining, oil and gas exploration, pharmaceutical, pulp and paper, etc.). The answers are quite disturbing. More than 95% said that their ratio of near misses reported to accidents reported falls in the range of 0 to 20. Less than 5% of the individuals said the ratio was greater than 5, and less than 2% said the ratio was higher than 10. Students noted that fear of disciplinary action, lack of management commitment, and lack of understanding of the difference between a near miss and a nonincident were the main reasons why near misses do not get reported.

In conducting about 75 PSM audits and 1,700 process hazard analyses (PHAs) over the past 10 years, we have found ratios from 0 to 15. For the first half of the 1990s, more than 90% of the facilities had ratios in the range of 0 to 0.5, and more than 95% had ratios in the range of 0 to 1. In the last half of the 1990s, over 90% of the facilities had ratios in the 0 to 1 range, and more than 95% had ratios in the 0 to 2 range. In addition, only a few (less than 2% of the facilities) had a ratio higher than 5. The auditors and PHA leaders commented that the primary reasons for lack of reporting were:

- 1. Fear of disciplinary action
- 2. Lack of understanding of what constitutes a near miss versus a nonincident
- 3. Lack of management commitment (no training provided on investigation) and lack of followthrough once a near miss is reported (time not allocated to investigate near misses)
- 4. Apparent high investment of resources to investigate near misses compared to low return on the effort (too much paper work, too much time required)
- 5. No incentive to report near misses
- 6. Disincentives for reporting near misses (e.g., reporting near misses hurts the department's safety performance and reduces safety-related bonuses/perks)

The good news is that near-miss reporting appears to be improving and the industry appears to recognize most of the barriers to near-miss reporting. The bad news is that the ratio is still very poor and improvement appears slow!

The number of companies that participated in the informal surveys suggests that the results are a statistically significant representation of the chemical industry. Table 1 summarizes the results of both the informal and formal surveys.

	Informal Surveys			
	Classroom	Found During		
Survey Items	Polls	Audits and PHAs	<b>Formal Survey</b>	
Current Near-miss Reporting Ratio	urrent Near-miss Reporting Ratio		0 to 80	
Range (0-5 years prior)	0 to 10		01080	
Previous Near-miss Reporting Ratio	01010	0 to 10		
Range (5-10 years prior)		0105	INA	
Current Near-miss Reporting Ratio	rrent Near-miss Reporting Ratio		2	
Average (0-5 years prior)	1	5		
Previous Near-miss Reporting Ratio	1 0.25		ΝA	
Average (5-10 years prior)		0.23	NA	
Goal for Near-miss Reporting Ratio	10 NA		20	
(average)	10	INA	20	
Theoretical Upper Limit on Near-	50 NA		50	
miss Reporting Ratio (average)	50	INA	50	
Number of Participating Companies	300	250	12	
Number of Participating Facilities	600	400	300	

### Table 1: Summary of Survey Results

# **Formal Survey**

A formal (written) survey was developed and e-mailed, faxed, and/or mailed to more than 100 companies. Of these, 12 replied prior to the deadline for submittal of this article. These 12 provided data from 298 facilities, including 56,000 employees in manufacturing and operations. The data were from the chemical industry, polymer industry, refineries, drug/pharmaceutical companies, pulp and paper mills, petrochemical companies, and oil exploration/production. Some of the companies that contributed prior to publication of this article were:

- AG Fluoropolymers USA, Inc.
- Amoco Oil Offshore Business Unit (now BP-Amoco)
- Chevron
- Exxon Co. USA Upstream (now Exxon-Mobil)
- Mead Paper
- National Starch & Chemical Company
- Olin Corp.
- Procter & Gamble
- Saudi Arabian Fertilizer Company (SAFCO)

Other companies wished to remain anonymous. A copy of the formal survey form is provided in Exhibit 1 at the end of this paper. Table 1, introduced earlier, provides a summary of the formal survey results. Key findings are:

- The companies' ratio of near misses reported to accidents report ranged from 0 to 80, but the average value was about 3. This is higher than the informal poll; however, we believe that many of the companies with very low or no reporting of near misses chose not to participate in the formal survey. Also, we know that many of the companies that reported data have completed an intensive effort over the past 3 to 5 years to improve near-miss reporting ratio of 1 about 5 years ago, but recently was able to increase reporting to a ratio as high as 80 just 2 years ago; the ratio now appears to have leveled at about 25. Another company recently increased reporting to 20, and another has reached 15; both of these companies had ratios of below 1 just 3 years ago.
- Companies believe that the theoretical value of the ratio is in the range of 3 to 100, but most believe the theoretical value of the ratio is near 50. This value matches the value found during the informal surveys.
- Companies believe they can practically achieve a reporting of 0.3 to 0.5 of the theoretical ratio; so most believe a ratio of 20 is achievable. This is a higher expectation than found during the informal survey (probably because only the better-performing companies replied to the formal survey). Based on our experience in helping clients optimize their near-miss reporting and incident investigation system, we believe a ratio of 20 is achievable, and we have found that investigating more than 15 near misses for every accident may be counter productive.
- The barriers to getting near misses reported were the same as those found during the informal surveys, but some of the solutions were novel. The barriers and solutions are described in the next section of this paper.
- The number of formal surveys collected prior to submittal of this paper probably does not reflect a statistically significant sample of the chemical process industry.

# **Barriers and Solutions**

The formal and informal surveys identified many barriers to reporting of near misses. Most of these were mentioned earlier. Below is a listing of the barriers gathered from the surveys and from our experience. The most critical barriers are listed first, but some of the later barriers can still keep the reporting ratio below 2. Solutions are discussed for each barrier; the solutions have been tried and have worked, but we do not claim that everyone will achieve the same level of results. Also, some solutions may not fit your company's culture.

### 1. Fear of disciplinary action

This barrier easily ranks highest on the list. Who wants to report a near miss if they believe the bosses will hold the near miss against them or a peer? If this barrier is not overcome, near misses will not be reported. To overcome this barrier, we must first recognize that all accidents (and near misses) are the result of error by some human(s). Our goal should be to find the reasons why this human made a mistake (management system weaknesses) and fix them so that other humans are less prone to repeat the mistake.

According to all respondents with high near-miss reporting ratios, the best approach for overcoming this barrier is to:

# Implement a policy to NOT punish individuals when their errors lead to accidents and near misses (except for acts of malicious intent, such as fights and sabotage).

This solution is difficult for some managers to accept because it appears to contradict the valid concept of holding individuals accountable for their performance to standards. Actually, the two concepts (policies) apply to different levels of the error universe shown in Figure 1. Individual accountability should be enforced (using one or more of the successful practices, such as self-directed work teams, behavior-based management, supervisors, etc.) in the "nonincident" portion of the universe. There are roughly 50 to 100 opportunities in this region for every incident, and if management is really keen on instilling discipline (using positive and negative reinforcement, etc.), these are the proper opportunities for action. Conversely, once a sequence of errors and failures propagate to the "incident" level, enough precursor errors have occurred (50 to 100 for each near miss and 1,000 to 10,000 for each accident) to indicate that the current chain of events represents a systemic problem. And systemic problems should not be "blamed" on the individual; we should instead find the system weaknesses and fix these before the next individual runs into a similar problem. Therefore, another important step in overcoming this barrier is to:

# Find the root causes (management system weaknesses) of each causal factor and only write recommendations to fix root causes.

A causal factor may be a mistake someone makes, but finding the reasons why the individual made the mistake is more productive in preventing recurrence than punishing the individual for his or her mistake(s). If we focus on finding the root causes, then ensure that we write recommendations and follow through on them, then we will not blame individuals. Omitting the blame will result in less fear of punishment for future incidents. (This solution is closely related to the first solution of establishing a blame-free culture for incidents.) By the way, remember to not blame the "managers" either; fix the system instead.

A related fallacy is: "If we train enough investigators, near misses will get reported; so we don't need to establish a blame-free system." We have seen this assumption proven false when fear is not addressed. At one facility, we trained roughly 10% of the operating and maintenance staff in how to lead investigations (this percentage is not too high by the way). However, management still used the incidents to assign blame to the individuals involved in the chain of events and, in some instances, used the incident as the reason to terminate employment. Because of the fear of continued blame, the ratio at that facility has not increased past 1 (granted, 1 is better than 0, but statistically you need a larger sample of incident data to prevent future incidents related to the same management system weaknesses).

Another fallacy somewhat related to the fear of discipline is this misconception: "If we can just get rid of the accident-prone individuals, we can prevent future accidents." Studies have shown that fewer than 20% of the accidents involve "repeaters" (Ref. 1). It is probably more likely that "repeaters" are just less adept at hiding near misses and accidents; or perhaps they are more proactive or open about fixing the problems when they are involved.

Management must enforce a "no blame" policy once it is implemented. Exceptions should be made very rarely or not at all. One slip by management can wipe out years of hard work to get near misses reported. Once enforced, the system may need months or years to show results. We

have seen tremendous results in just 1 year (a 10- to 100-fold increase in near-miss reporting) when management proves that they will not assign blame due to an incident. Building trust is the key. Management must "walk the talk."

There are some events that warrant discipline. However, these are not accidental in nature; instead they are more criminal in nature. These events include sabotage, severe horseplay, fights, and other acts of malicious intent. Therefore, management must be very clear on when discipline is still right; and it is only right for these criminal incidents.

A third and fourth solution to reinforce the first two is to:

Have peers investigate incidents involving peers.

Make sure the employees are the owners of the incident reporting and investigation system

Peers are less intimidating than bosses; and the urge to publicly place blame (or to negatively impact job appraisals) is reduced when peers investigate peers. Management may be reluctant to relinquish control of the investigations, partly because they believe the peers will conspire to "hide" the truth. And cover-ups may occur on some incidents. But isn't it better to get 10 to 100 times more incidents reported by lowering the fear of the investigation? The companies who have used peers as the investigators have seen dramatic improvements in near-miss reporting; and most reports appear thorough and the results typically appear reasonable. If you do not have the "at risk" employees trained to lead investigations, then consider at least using the peers to "interview" peers. Then over time, train employees to lead investigations and let them "own" the investigation system. Another important benefit of using peers to investigate peers is that this will give you more trained investigators, and therefore your company will be able to begin investigations more quickly (particularly on night shifts and weekends).

As mentioned earlier, management must be committed to keeping incidents "blame free." One method to demonstrate commitment to a blame-free incident reporting and investigation system is to:

Tell the employees about the new policy to not assign blame and state that they can hold management accountable to this commitment.

Another method is to:

Offer (at least at the beginning of implementation) incentives (rewards) for reporting near misses.

One company gave away tickets to local college basketball games for each near miss reported. This increased near-miss reporting from a starting value near 1 to a high of 25 (during basketball season). Once the incentives were terminated, the near-miss reporting ratio leveled at about 10. The investment during one winter was well worth the long-term gain in accident prevention.

Another company offered an award for the most beneficial near-miss report each month, rather than giving a reward for each one reported. This approach has advantages over the prior approach.

An alternative that can be used with or without implementing a blame-free incident system is to:

Begin with a system for reporting incidents anonymously.

This approach has worked well as a kickoff, but it does not directly solve the problem of building trust. This approach does help get employees in the habit of reporting near misses while management builds trust with the employees. This approach also helps to reduce the other barriers discussed later. One specific example of this approach is to provide self-addressed, postage-paid cards that the employee can fill in and drop in a public mailbox on the way home. They can even have their spouse or friend fill in the card to protect themselves in case the company decides to use handwriting experts to find the guilty party!

### 2. Fear of teasing by peers (embarrassment)

Some employees are reluctant to report incidents because they are too embarrassed or because they know their peers will never let them hear the end of it. In my first couple of assignments as an operator and shift supervisor (before I finished my engineering degree), we would name the "part" after the "dummy" who broke it. So in my case, I had pumps and reactor lids named after me; and others had similar dubious honors. If done in good humor, such playful banter is not harmful; however, I can speak from personal experience in saying that some shifts will never let the other shifts find out what mistakes they made. The solutions to this barrier include the following:

Ensure that all employees understand the importance of near-miss reporting.

Demonstrate, through feed back of lessons learned, the importance of near-miss reporting.

This could include showing that the recommendations implemented as a result of nearmiss reporting have improved the overall safety of each worker. Also:

Ensure that all employees understand the harm that teasing can cause to the near-miss reporting system.

Ensure that all employees know that everyone is fair game once the teasing starts.

*Time.* (*New employees get picked on more than the old hands; so given enough time, at least the employees with more tenure will be reporting near misses.*)

### 3. Lack of understanding of what constitutes a near miss versus a nonincident

In training about 2,000 investigators, we have found that the definition of a near miss is vague. When quizzed, it is common for 30% of a class at a facility to believe that one example event, such as a relief valve opening on demand, is a "nonincident," while the rest of the class believes it is an "incident." The ones who believe it is a nonincident cite that "it worked as designed." On the other hand, the rest of the class believes the relief valve opening is a near miss because, if it hadn't opened, there could have been a catastrophic loss of containment.

Several solutions may be necessary to overcome this barrier. First:

Develop a list of "in-context" examples that illustrate what you consider to be incidents (particularly near misses) and what you consider to be nonincidents.

This list should be created with input from various disciplines in the facility. Start the list by reviewing emergency work orders, process excursions, trouble reports in operating logbooks, etc.

The list will be used as a training tool for all personnel who work in or near the process. We recommend creating this list in a two-column format, with examples of incidents listed in one column and examples of nonincidents listed in the other. The examples should be as parallel as possible so that the users (employees) can clearly see the differences. See Table 2.

 Table 2: Example Training Tool for Teaching the Difference Between an Incident and a NonIncident

Incident (we will spend the necessary resources to promptly investigate these)	Non-Incident (do not report as an incident; may be trended though)
Safety relief device opens on demand	Safety relief device found to be outside of tolerances during routine, scheduled inspection
Pressure reaches relief valve set pressure, but relief valve apparently does not open	Pressure excursion occurs but remains within the process safety limits
High-high pressure trip/shutdown (one layer of defense against overpressure of the system)	High pressure alarm (possible quality impact)
Toxic gas detector in the area tripped/alarms	Toxic gas detector found to be defective during routine inspection/testing
Walking under a suspended crane load	Not wearing a hard hat in a designated area
Suspended crane load slips	Crane wire rope found to be defective during pre-lift check

Important near misses to get reported are process excursions that reach or exceed the specified safety (or quality) limits of the process. Any time a process parameter reaches or exceeds the stated "process safety limit," the event should be reported as a near miss so the causes can be determined. Nearly every major investigation we have led had multiple "warnings" in the moths, days, or hours prior to the accident. However, the employees did not know that reaching the "high-high pressure alarm point" or reaching the "rupture disk set pressure" constituted a near miss. They checked the system to make sure the disk was still intact, made sure the pressure returned to normal, and then continued operating. They also did not understand (or believe) they had the authority to shut down the process for a near miss.

The types of questions to ask when developing the list of near misses include the following:

- What could the consequences be if the circumstances were a little different?
- How likely is it for the near miss to be spotted before it continues to an accident?
- How complex is the process (operation) and how many layers of defense are there against the accident? Is the near miss one step away from disaster (are we challenging our last line of defense)? Two steps away (which may be a near miss for a high hazard/high complexity system)?
- Is the risk associated with the potential accidents well understood?

• Is there high learning value in this near miss?

Once you have the starting list of examples:

Train personnel on the examples.

This will paint the picture of what the company means by the term "near miss." Over time, expect the list to change and grow as you are faced with unanticipated events. Along the way:

Clearly differentiate between a near miss and a "behavior-based management observation."

Many companies have implemented a system to have peers observe and try to correct (by coaching, etc.) the behavior of peers. This system should operate in the "nonincident" portion of the error universe. Include examples in a listing, such as Table 2, to illustrate the differences.

Finally:

# Use morning (safety) meetings to capture near misses that were not previously identified.

This will keep the topic of near misses high on everyone's mind and will continually improve the understanding of what a near miss is. This system works best when you dedicate a scribe in the meetings for this topic.

# 4. Lack of management commitment (no training provided on investigation techniques and procedures) and lack of follow-through once a near miss is reported (time is not allocated to investigate near misses, or corrective actions not implemented)

Management must demonstrate commitment. What is one measure of commitment? Funding. Management must provide training for investigators and lesser training for interviewers. All operations and maintenance staff must be trained on how to recognize and report near misses. And selected staff must be trained on how to "quality assure" the results of investigations and tabulate and query the data for systemic trends. Management must allow the employees the time necessary to investigate incidents and generate reports. Management must communicate incidents and lessons learned to all affected employees, and management must forward this information to other sites where the lessons would be important. Finally, management must show an interest in the results and enforce follow-through and documentation of the resolution of recommendations. The solutions to this barrier are rather straightforward, but can take many forms. It begins with the following:

Provide training to an appropriate number of operations and maintenance personnel on a consistent approach to investigation, which includes causal factor and root cause determination.

Based on experience within several companies with mature near-miss reporting systems, we recommend training 10% to 20% of the operating and maintenance staff on how to lead investigations. This training should be 1.5 days or longer. Also, train more staff on interviewing

skills, and train all staff on how to recognize and report near misses (these modules are typically 2 hours and 1 hour in length, respectively)

Hold regular meetings with employees to discuss the successes (and weaknesses) of near-miss reporting. Praise employees for submitting near misses.

Emphasize to employees how important it is to you for them to invest the time to investigate near misses, including spending overtime labor if necessary.

Investigation typically does not require much overtime, but management needs to allocate the time necessary to obtain the required data and to emphasize the importance of investigation to employees.

Hold management accountable for achieving a near-miss reporting ratio of 15.

Managers will get the message and implement the solutions above if their performance is judged against this parameter. Judging by performance measures is important, and this ratio is a primary indicator of trust between management and employees. It is also the direct gage of whether nearmiss reporting is high enough. As mentioned earlier, upper management should be very concerned when there are few near miss reports because this means weaknesses in the management systems are not being discovered and corrected.

# 5. An apparently high level of effort is required to report and to investigate near misses compared to low return on this investment

This barrier is typically related to the fact that we never truly know how many accidents have been prevented by improved near-miss reporting. But, organizations that have seen dramatic increases in near-miss reporting have also seen dramatic reductions in losses (the root causes of near misses of safety consequences are the same management system weaknesses that lead to adverse impact to operability, quality, and profitability).

Share with employees the benefits (subjective and tangible) that are expected from increased near-miss reporting.

Increased reporting provides more opportunities to learn of weaknesses in the management system, and near misses are far cheaper to learn from than accidents.

Ensure that the data are entered in a database and queried regularly. Also ensure that the results of the query are shared with employees so they can see the value of the near misses they are reporting.

One company increased its near-miss reporting ratio from 1 to roughly 80 in just 1 year. The company entered all the data in a Microsoft® Access<sup>TM</sup> database (which the company developed itself) and then queried the data regularly. One of the first observations from the database was that the most frequent near miss was "suspended crane loads slipping." The second most common near miss was "employees walking under suspended crane loads." Based on this data, what is likely to occur very soon? Management shared these findings with the employees and let them draw their own conclusions. Two great benefits were achieved. People stopped walking

under crane loads because now they knew that it is fairly likely for a crane load to slip and smash them! Second, the employees saw immediate benefit to reporting near misses.

Track the benefits of near-miss reporting and trend these versus the near-miss reporting rate (or the near-miss ratio).

This solution will take time to bear fruit, but time will prove what others have learned.

Implement user-friendly tools (forms, software, and/or database applications) that ease the burden of documenting and disseminating incident results.

Simple forms for inputting/reporting of near misses can ease the burden of notification (reporting) that a near miss has occurred, but forms are only the start for easing the overall burden. You will also need tools to ease the burden of the investigation process and documentation of the results. There are several software tools available for investigating incidents, along with databases for storing and performing trend analysis and queries of the incident data. Some commercial applications combine both major features (which is ideal). However, there are many companies (including Exxon-Mobil, BP-Amoco, Eli Lilly, and others) who have created their own databases. In some cases, the investment was staff-months; in others it was staff-years. The tool(s) should allow ease of:

- Inputting (recording) results of the investigation
- Categorizing the events according to location, material, etc.
- Tracking and closing recommendations
- Performing queries of the data across many investigations
- Trending against type of events, categories, root causes, etc.

The tool should not get in the way of a team's job of deductive reasoning. We have found that several of the tools claim to "help you solve the mystery and deductively reason to the causes and root causes." We have found that most of these tools get in the way of that task. Properly trained investigators do not need software to help them lead and manage an investigation; however, the techniques they use to structure the investigation are critical. We have found that training the users on how to investigate is more effective that relying on software. However, software, and particularly those tools with database capabilities, can be critical to managing the large amount of data that can be stored from all investigations.

### 6. No incentive to report near misses

Considering all the negatives you will initially face when trying to improve near-miss reporting, this barrier is important. This barrier has already been addressed in the discussion of Barriers 1 and 5. The most straightforward remedy is to offer incentives for near-miss reporting.

# 7. Disincentives for reporting near misses (e.g., reporting near misses hurts the department's safety performance [as measured versus incident rates] and reduces safety-related bonuses/perks)

This barrier has stopped near-miss reporting in several instances. One plant manager was even called to headquarters to explain why his "incident" rate climbed so suddenly; his bosses failed to understand that this was an expected and good outcome of implementing an effective near-miss reporting system. The company culture was "enforcement" of standards, and the company has a history of disciplining employees who cause accidents; many in that company still do not believe that giving up the freedom to punish employees when an incident occurs is a good business decision.

Disincentive occurs when department goals are tied to lower incident rates. The solution here is obvious and necessary:

Ensure that goals and incentives are not tied to lower incident rates (since this discourages reporting), but instead consider providing incentives for achieving higher near-miss reporting ratios.

There is still value in tying incentives to business (profitability and productivity) goals, because the company will learn that reporting and investigating near misses will enhance overall business performance (particularly since the near misses of a safety accident or environmental release have the same root causes as incidents that detract from quality and productivity). There have been many papers written on how preventing accidents pays for itself indirectly through improvements in productivity.

### 8. Not knowing which accident investigation system to use.

One consideration that is not related to any of the barriers mentioned above, except marginally to Barrier 3 (lack of understanding of what a near miss is), is the scope of the investigation program. Some companies have one investigation system for occupational safety incidents, another one for process safety incidents, another for environmental releases, another for reliability issues, and yet another for quality and customer services issues. We have found that the same investigation approach and investigator training works well for incidents in any facet of a business. We believe there is merit in combining the systems and, in particular, in combining the incident databases. Combining the incident systems will require more work on defining near misses and in determining success in report near misses.

A related consideration is that most incidents affect more than one aspect of a business. Table 3 illustrates this point for an incident involving a 1,000 lb release of cyclohexane from a decanter system at a polymer production facility. The event did not harm any people and did not noticeably damage the environment (though reporting of the release to regulators was required). The event and the actions taken after the release caused the process to be shut down for about 9 hours and caused 3,000 lbs of product to be rejected. (The values in Table 3 are from a qualitative scale, where 10 is very high impact and 0 is very low or no impact.)

Business Aspect	Actual Impact of the Incident	Potential Impact of the Incident
Safety (harm to people)	0	10
Environment (harm to nature)	1	3
Quality (harm to product)	3	3
Reliability (harm to process	5	10

### Table 3: Example of the Impacts of a 1,000 lb Cyclohexane Release

efficiency)		
Capital (harm to property,	1	10
facilities, equipment)		
Customer Service (harm to	2	10
relationship with clients)		

From the view of both actual and potential impact, the cyclohexane release affects all business aspects. The incident is a near miss for safety, and a minor-major accident for other aspects of the business. Performing six (or more) investigations would be fruitless. Performing one investigation that meets the needs of all business aspects is ideal, and yet also easy. The near-miss definition and related training will need to explain the potential impact of an event in relation to each business aspect, so that the users of the system can identify a near miss. Therefore, the solution includes:

Emphasize during training (1) how to report near misses (perhaps you will want different reporting methods for different possible outcomes, though we do not recommend this) and (2) where to go for an answer if you do not know if the event is a near miss.

Consider having ONE incident reporting system with ONE approach for teaching employees the definition of a near miss and with ONE approach for doing incident investigations (including one approach for root cause analysis).

# 9. Company discourages near-miss reporting due to fear of legal liability if these are misused by outsiders.

There is legitimate concern that near-miss reports can be used detrimentally against a company. In summary, liability typically occurs when:

- if a company has many near misses reported, an outsider can claim this shows a history of "unsafe conditions" that apparently is fostered or tolerated by the company
- a near-miss report is used to show that a company knew that a certain accident was possible at one site but failed to take effective action to prevent it's occurrence at all sites
- a near-miss report directly incriminates the company due to inappropriate wording

Liability is mainly an issue in the USA, where we graduate 40 attorneys for each engineer. But, the near misses and accidents don't have to occur in the USA to create a problem for companies based in the USA. An accident that occurs outside can be used in litigation in the USA, to either show a pattern of unsafe conditions, lack of management follow through on key learnings, etc. Even without direct legal liability, opponents of a company can use reports to sway public opinion against a company. And, legal liability for accidents that occur outside of the USA is increasing.

Possible solutions to the barriers mentioned above include:

Ensure, through investigator training and through auditing of reports, that investigators refrain from broad conclusions and that the language used in the final report is appropriate. Involve legal on major near misses and accidents (any incident where liability could be high) to ensure the results are protected as much as possible under attorney/client privilege.

Company attorneys have provided excellent guidance to internal and external investigators on how to conduct and document an investigation to limit liability. Key guidance needs to apply to near misses as well. Such guidance includes:

- Don't use inflammatory statements such as disaster, lethal, nearly electrocuted, and catastrophe.
- Don't use judgmental words such as negligent, deficient, or intentional.
- Don't assign blame.
- Don't speculate about potential outcomes (for near misses and minor accidents), lack of compliance, or liabilities, penalties, etc.
- Don't offer opinion on contract rights or obligations or warranty issues.
- Don't make broad conclusions that can't be supported by the facts of this investigation (let queries of the database demonstrate these conclusions as necessary).
- Avoid unsupported opinions, perceptions, and speculations.
- Don't oversell recommendations; allow for alternative resolutions of the problems and weaknesses found.
- Do follow through on each recommendation and document the final resolution, including why it was rejected if that is the final resolution.
- Do involve legal as soon as possible if the incident appears to have potential liability for the company.
- Do report, investigate, and document near misses to demonstrate the company's commitment (1) to learning where there are weaknesses and (2) to improving risk control.

Even given the possible liabilities, most companies decide that it is better to get near misses reported and to learn how to prevent accidents, rather than to discourage near-miss reporting or record keeping. Therefore, a solution most companies have found critical is:

### Ensure that technical and business managers understand that:

- *it is in the company's best interest to get near misses reported and learn from these, in order to prevent future accidents*
- legal liability concerns should never discourage reporting and investigation
- proper investigation and documentation of near misses demonstrates that the company is behaving responsibly to learn lessons and continually improve risk management

## **Other considerations**

Finally, if you are very successful at getting near misses reported, you may have the nice problem that only a few companies have experienced: "We have too many near misses reported!" One oil company implemented most of the solutions above and was able to increase their near-miss reporting ratio to 80! But they didn't have the resources to investigate 80 near misses for every accident (the actual number was about 500 near misses across about 20 sparsely staffed, facilities). So, the foremen and operators decided on a case-by-case basis which of the 500 events had high learning value, and those were the ones they investigated. The events that were

not investigated were still categorized and entered into the master database. By the end of the year, they found they had investigated roughly 15 near misses for each accident. They took the lessons learned from this first year, re-trained the personnel on the definition of a near miss, and now their reporting ratio is 25.

A company should strive to reach a ratio of 15 and investigate all incidents up to this ratio.

This will provide a statistically significant sample of all incidents (and all important errors) and provide a company with sufficient feedback on which management system weaknesses are causing the errors and component failures. Various companies with different cultures have achieved this ratio.

## Conclusions

It is possible to get near misses reported, but you must first recognize and address each barrier. Reducing fear of discipline is most important, and various may need to be taken to achieve success. All of the solutions presented in this paper have been proven in one or more companies and, therefore, should be seriously considered.

# Acknowledgements

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## **References and Resources**

- 1. Hammer, Willie, *Occupational Safety Management and Engineering*, Prentice-Hall, Englewood Cliffs, NJ, 1985.
- 2. *Guidelines for Investigating Chemical Process Incidents*, Center for Chemical Process Safety of the American Institute of Chemical Engineers, New York, NY, 1992.
- 3. *Level II Incident Investigator Training (Course 106),* Student Textbook, Process Safety Institute of EQE International, Inc., Knoxville, TN, 1993-2000 (revised).

# Exhibit 1: FORMAL SURVEY How to Get Near Misses Reported

E-mail or fax to: Bill Bridges (of Process Improvement Institute,	formerly of EQE International,
Inc.) at <u>wbridges@p-i-i-i.com</u> or (865) 671-4944	

Background data about your company/facility				
1.	My data represents	facility(s) and a total of		employees.
2.	The data provided below i	s from the following chemic	cal-related indu	stry(s):
	Chemical production Polymer production Refining Food/beverage Drug/pharmaceutical Manufacturing		Pulp and Pape Petrochemical Oil exploratio DOE/DOD/D Utility Other	er l n/production OT site
Nes peo cau	ar miss and accident data ople, property, product, or e use harm in this instance)	from your company/facilit nvironment; a near miss is	y (an accident a sequence of	is an event that caused harm to events that could have, but did not,
1.	Current ratio of near misse	s reported to accidents repo	orted:	_
2.	What was your ratio of ne	ar misses/accidents in prior	years?98	979695
3.	What ratio would you like	to achieve in the next 2-3 y	ears?	_
4.	What do you believe is the	practical upper limit of this	s ratio?	
5.	What are the key factors p	reventing you from achievir	ng a higher ratio	o?
6.	List any means you have f	ound effective for improvin	g near miss rep	(more on separate page?)
				(more on separate page?)
7.	Optional: How many accid	ents were reported in 1999?		
8.	Optional: How many near	nisses were reported in 199	9?	_
Co inf	ntact Information (to send ormation will be kept conf	you the article and survey idential)	y summary, an	nd to clarify data, if necessary; this
1.	Your company's name:			
2.	Your name:			
3.	Your phone number:			
4.	Your e-mail address:		Today	y's date:
We	ask to list your company as	a respondent in the article	(your name and	d company will not be used in relation

to the data you provide). Permission granted: <u>Yes</u> No