Here's a systematic process for first defining and then documenting incidents

Risk-based approach to near miss

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Sean, the superintendent of a cracker unit, is suffering from sleepless nights. From the Internet, he accessed the gruesome details of a recent catastrophe at another, similar cracker. The plant in Asia-Pacific suffered near total destruction—a minimum of $500-million damage. The disaster has claimed 12 lives. Five people are still missing and 21 are hospitalized.

Sean's plant is identical to the one in Asia-Pacific—same process, capacity and detail—except that his was built three years earlier. Sean is anxious to know the future. Will he face a similar disaster at his plant? Who can tell? A fortune-teller? Or perhaps mathematical modeling would be more scientific.

But his corporate study team wants past incident data. Sean proudly informs them that only two injuries and a case of one gasline explosion have been recorded during the past nine years. Thus, he gets an e-mail back from the study team: "Cannot proceed with the study due to insufficient data."

Illogical situation? Sean is confused. Are fewer accidents a disadvantage? He remembers a safety guru once telling him, "The plant that identifies and resolves near-miss incidents is safer than the one that does not." Being a forward-looking manager, Sean once tried a near-miss reporting scheme. The scheme was inaugurated with much fanfare, and the first month seven near misses were reported. Gradually, however, reportings tapered to naught. A safety suggestion scheme was also tried, but met the same fate. Now, no one talks about such "fancy" experiments.

How many of us share Sean's dilemma? The Near Miss Project at the Risk Management and Decision Science Center of the Wharton School, University of Pennsylvania, interviewed over 100 individuals in 20 plants in six Fortune 500 companies to understand the near-miss program framework, strengths and weaknesses. They found that "no one company has across-the-board exemplary performance."

Zero-cost learning tool. Near miss is a cheaper learning tool than learning from an actual injury or property loss accident. In fact, almost zero-cost. Moreover, they are numerous. We learn *more* from a greater number of near misses occurring around us. These forerunners are smaller in size and easier to deal with.

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The red box of random variation in Fig. 1 is like the proverbial cancerous cell and "gates" with the near miss to result in injury and/or property damage. By very definition, such chance factors are beyond normal control and, to a great extent, they decide the consequence's size. An example would be a hydrocarbon vapor leak (immediate cause). An improperly boxed back switchbox (which, as originally installed, is explosion proof) could provide the energy required to create an explosion. A possible chance factor (the red box in Fig. 1) is direction and wind force. A strong wind may blow the vapor cloud away from the switch box. On the contrary, dull and cold weather could let the vapor accumulate over the switch box, eventually resulting in that catastrophic explosion Sean is fearful of.

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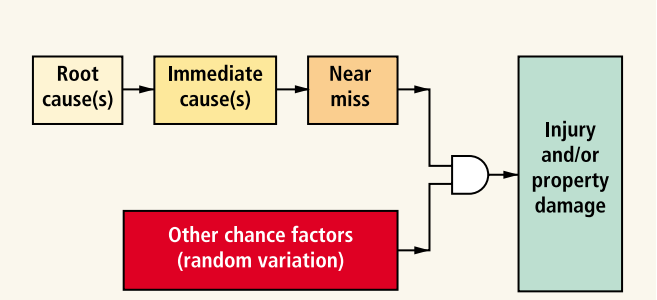


FIG. 1 Simple accident model.

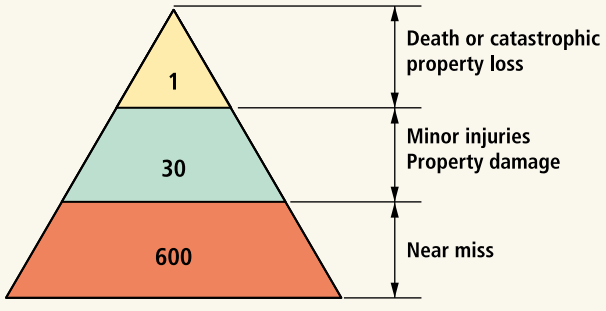


FIG. 2 Accident triangle.

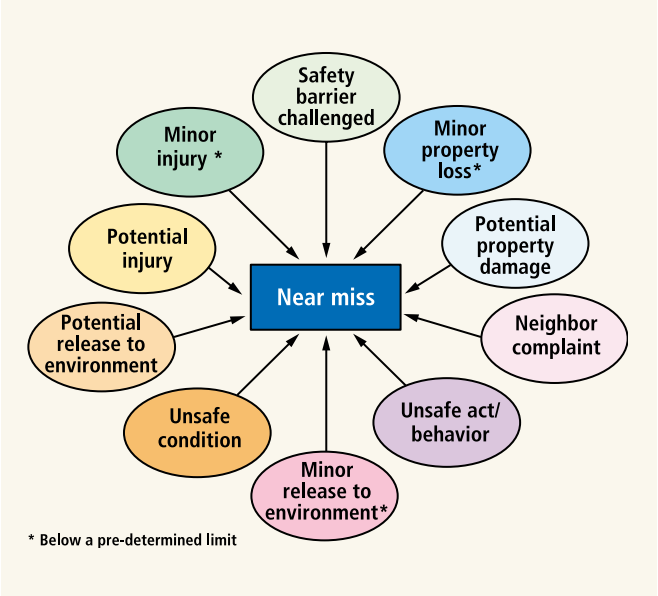


FIG. 3 **Possible near misses.**

If only he knew how many times the switchbox was put back improperly sealed after each maintenance. Or how many times hydrocarbon vapor leaked during the past nine years.

Fig. 2 shows the oft-researched "triangle of accidents." For the HPI, the currently accepted ratio of injury/property loss to near miss is between 15 and 25.

Near misses are smaller in scale, relatively simpler to analyze and easier to resolve. Thus, documenting near misses not only provides an inexpensive means of learning, it has some equally beneficial spinoffs.

- Captures sufficient data for statistical analysis and trending studies
- Provides an immense opportunity for employee participation—a basic requirement for a successful environment, health and safety (EHS) program. This embodies principles of behavior shift, responsibility sharing, awareness and incentives, etc.

Causes of failure. Given that there is such value in near miss, why do the Seans of today shy-off from adopting the system? Sean's system fails due to lack of simplicity, sustainability and support from management. Here's an examination of why:

Lack of management commitment. This could stem from lack of proper understanding of the process. The telling symptoms are inadequate resources, man-hours, training or corrective action.

Fear of negative action. A blame culture—i.e., reproaching the near-miss reporter or personnel named in the report—still hangs over several companies, at least covertly.

Lack of appropriate incentives for reporting near misses. This could be present in the organization in several forms:

- No incentive at all or a small, inadequate one
- Not viewed favorably by the peer group (considered sissy or embarrassing)
- Reporting discouraged because it is mistakenly viewed as reducing performance figures and bonuses
- Incentives not directly linked to the report
- Incentives not rewarded immediately
- Reporting not addressed or not addressed in time.

Sean, however, is one of those open-minded managers who had seen that incentives were built into his system. He has introduced free family dinners for the selected near-miss reporters. Still he failed. Why? The most likely answer is a faulty design for the near-miss system.

Inadequate system. This is by far the most common reason for failure. The system may be failing due to one or more of the following problems: difficult definition, misunderstood objectives, inappropriate addressing procedure, inadequate feedback, improper use of data, no proper investigation and follow-up.

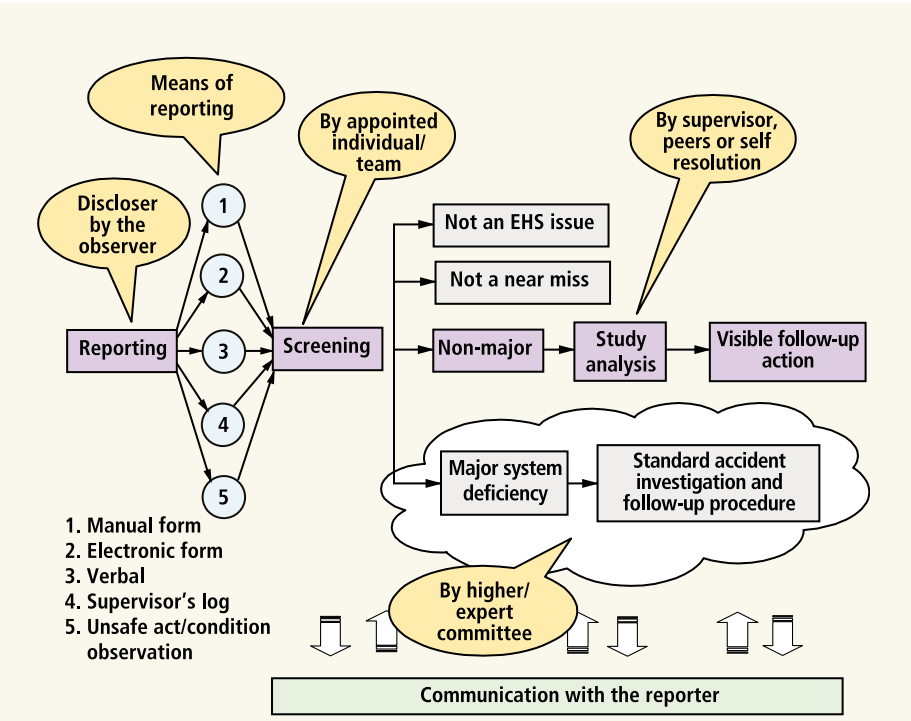


FIG. 4 **Simple near-miss model.**

Successful program. As a corollary to what has been discussed, a successful near-miss program is possible only with management committed to a positive EHS culture in the organization. A standard program package should have the following elements:

- Participative management; spending time and money
- Documented process
- Innovative incentive schemes
- A specified body (individual or team) to implement the process
- Standard communication vehicles including intranet/LAN/state-of-the-art software support.

Definition. The first step in a systematic near-miss process is a well-communicated definition. Considerable variations exist in the textbook definition of near miss. Also, individual companies have differing interpretations. A simple and all encompassing approach is to *include both unsafe conditions and unsafe acts* in the definition. Having said that, here's an example of poor phrasing:

"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." This and similar definitions leave the intended user, who could be an unskilled workman, absolutely confused. When following the above definition, how many of us could identify an example "relief valve opening on demand" as a near miss or otherwise?

Alternatively, is this a near miss: "During a scheduled inspection, a safety relief valve is found to be outside of set tolerance limit"? Companies run safety suggestion or unsafe condition reporting schemes. For instance, a damaged crane wire rope is discovered by a rigger. Shouldn't such a situation be considered a near miss?

We should take advantage of near miss as an opportunity to improve safety practices. Thus, a very simple definition of near miss is:

> **An incident or unsafe condition with potential for injury or property damage.**

Fig. 3 graphically presents one such all-encompassing, but simple, definition of near miss.

Reporting process. Having a definition is not enough; the aim is to encourage reporting. How? The reporting process should possess the following well-tried and proven ingredients:

- Include in the awareness program an array of in-context examples, updated regularly.
- Keep the topic high in the everyday agenda, using meetings, other gatherings and coaching opportunities to capture further near-miss reporting.
- Keep the reporting form simple. Use less text. Checkboxes will also help in computer scanning for analysis. Use intranet forms with radio buttons or pull-down menus.
- Use collection boxes, computer terminals, fax, intranet and telephone messaging. People should know how to report a near miss as well as they know how to press the fire alarm.
- Implement a policy of not holding near miss against the reporter or other personnel. Consider discipline for not disclosing near misses.
- Avoid both the spotlight and anonymity for the near-miss reporter.
- Run incentive schemes with fresh and varying ideas, such as bonuses or freebies.
- Encourage self-evaluation.
- Maintain a high level of communication between the reporter, near-miss administrator and implementer.

Resolution. Reported near misses must be addressed quickly and consistently. The process needs high visibility. This is the "make or break" step for the whole system's success. Fig. 4 suggests a simple near-miss processing model. Depending on site convenience, number of near-miss reports and other EHS programs, the processing step itself may have the following substeps.

Screening. A designated individual or team scans the report for admissibility. The criteria are predetermined:

- What learning value does the reported near miss have?
- Who benefits from learning of it?
- What could the consequences be if the circumstances were a little different?

The screening will also flag any immediate action that may be required. A risk-based approach to evaluation is given later in the article.

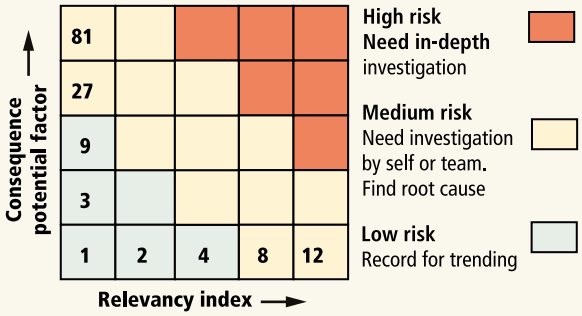
By definition, near miss is not an accident. It, therefore, needs a special treatment that differs from real accident cases. The two systems do have some common ground when a near miss has been identified as "high level" and needs an involved investigation. After identification, such cases could be dealt with per the standard accident investigation system. Typically, there would be only a few of these. The bulk of near-miss reports would be those innocuous-looking aberrations.

Problem analysis and solution. Many near misses could be resolved by the identifier. A supervisor or peers may help. Self-resolution by the individual or department ensures involvement and ownership, speedy resolution and increased reporting. However, formal reporting to the designated body is still required for information dissemination and trending study.

While self-resolution is encouraged, the near-miss administrator should review the problem and its resolution, do informal or formal root cause analysis as needed and document the findings.

Implementation and follow-up. The identified recom-

Risk-based near-miss screening



Data for decision matrix

Near-miss relevancy index	
Criteria	**Weighting**
1. Proximity index	
How far away was the near miss from becoming a disaster?	
One step away (challenging last line of defense)	3
Two steps away	2
More than two steps away	1
Remote	0
2. Learning value index	
Is the learning value...	
Useful for the entire organization	3
Can be used by all across the site	2
Applicable to concerned section/unit	1
No learning value	0
3. Visibility index	
Is the near miss visible before it leads to an accident?	
With great difficulty	3
Some insight	2
Obvious	1
Widely known	0
4. Utility index	
Near miss is valuable for...	
Current, future operations and past; should be looked into	3
Affect future and current	2
Only current	1
No effect	0
Relevancy index (1+2+3+4)	**0 to 12**

Consequence potential factor	
a) Death	3
Serious injury	2
Injury	1
b) Property Loss	
$ 500,000 or more	3
$ 50,000 – 500,000	2
$ 0-50,000	1
c) Environmental releases/ Exceeding standards	
8 hours or 100%	3
1 hour or 10%	2
30 minutes or 5%	1
d) Evacuation	
More than 100 individuals	3
50 - 100 individuals	2
Less than 50 individuals	1
Consequence potential factor (a × b × c × d)	**1 to 81**

FIG. 5 **Near-miss decision matrix.**

mendations should be implemented and followed until closure. The same vehicle and mechanism could be used as in standard accident cases. Close tracking of open items and information dissemination at each stage reassures individuals of the program's value.

Communication. To harness the real power of a near-miss system, it is absolutely necessary to disseminate the information. This increases awareness of an identified hazard. Communication should address issues such as: Who shall benefit from the information? Is the format appropriate for that agency?

For near misses that take a long time to be resolved, the near-miss administrator should not wait for complete resolution before passing the information on. This way, people will at least be aware of the hazard, even if it is not removed/contained.

Risk-based evaluation. An effective near-miss program may result in three to five near-miss reportings per person per year. For a site with 500 employees, this could mean 2,500 near misses a year! When such a floodgate is opened, a mechanism is necessary to filter the reports so that only high-value disclosures are passed on for further detailed analysis. Detailed investigation is an expensive proposition.

Risk-based pre-analysis screening of all the reported near misses is an ideal way to deal with the large number. This will address all reportings quickly, while maintaining the investigation quality. A near-miss decision matrix provides a simple to understand and follow mechanism (Fig. 5). The matrix is based on the potential consequence and criticality. Criteria and their respective weightings could be customized to suit local needs.

The analysis can be automated. The reporter or his or her supervisor can use check-box type forms, which can be subsequently scanned. Alternatively, workstations—if available onsite—could be used for online reporting and evaluation. Professionally designed electronic forms with radio buttons and pull-down lists of options would help in easy reporting and standardized analyses. Close manual supervision is still required, however. HP

REFERENCES

Bird, Jr., Frank E., *Practical Loss Control Leadership,* Det Norske Veritas, 1996.
Geller, E. Scott, *The Psychology of Safety,* Chilton Book Co., 1996.
Guidelines for Investigating Chemical Process Incidents, Center for Chemical Process Safety, American Institute of Chemical Engineers, 1992.
The Near-Miss Project Report, Risk Management and Decision Processes Center, the Wharton School of the University of Pennsylvania, 2002.
Performance Metrics, *Conoco Sustainable Growth Report,* 1999.
Ritwik, Ujwal, *HSE Performance Measurement,* Process Safety Management Conference, Institute of International Research, Dubai, October 2001.
Ritwik, Ujwal, "Ways to measure your HSE program," *Hydrocarbon Processing,* July 2000 (International Edition), p. 84-B.

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