

# Improving Railroad Safety through Understanding Close Calls

## Summary

Railroads can reduce risk before an accident by systematically studying close calls. Analyzing close calls is a proactive way to manage safety. A close call is “an opportunity to improve safety practices in a situation or incident that has a potential for more serious consequences.” When individual events are analyzed collectively, railroads can identify safety hazards and develop solutions to these threats.

The development of successful close call systems share several common features that involve building trust to encourage disclosure of close call information. These features include using a third party to collect and store the information, confidential reporting, and limited protection for sources from liability or enforcement.

The Federal Railroad Administration’s Office of Research and Development is sponsoring a workshop for the railroad industry to learn more about the safety benefits of studying close calls. The workshop will also provide a forum for participants to discuss issues and build trust.

## Introduction

Accidents may be preceded by ‘close calls’ that warn us of a safety problem.

During the last 23 years, the Concorde jet suffered a series of tire blowouts on the landing gear. The blowouts ruptured fuel tanks, damaged hydraulic lines, electrical wires, and engines. Except for the damage to the aircraft, there were no fatalities.

On July 26, 2000, an Air France Concorde jet blew a tire, rupturing a fuel tank and catching fire. The plane crashed shortly after takeoff killing 109 passengers and crew.

A tragic accident like the Concorde may be preceded by several close calls similar to the accident, that do not result in catastrophe or harm to people, equipment, or the environment. These close call events provide an opportunity to proactively manage safety. Instead of waiting for an accident to occur, these events provide valuable information on which the railroad can act to reduce risk.

Railroads can target the greatest risks to safety.

Over the last decade, the railroad industry achieved significant progress in improving the safety of railroad operations. However, as the number of reportable events declines, additional reductions become more difficult to obtain. When the number of reportable accidents decreases, accident data becomes less valuable in determining the sources of risk. Also, when safe outcomes do occur, there is nothing to capture the organization’s attention: safety is invisible<sup>1</sup>.

Railroads maximize safety by addressing areas that pose the greatest safety risk. Close calls can provide information to monitor risk and manage safety.

Other modes and industries successfully use close call information to manage safety.

The aviation industry uses close calls as part of its safety management process. In the United States, the aviation industry created the Aviation Safety Reporting System (ASRS) and the Global Aviation Information Network (GAIN). The success of these industry-wide systems led to the

creation of company-specific systems for evaluating close calls. The analysis of close calls within airlines enables them to identify safety concerns specific to their organization.

ScotRail, a passenger railroad in Scotland, created the Confidential Incident Reporting and Analysis System (CIRAS). After a trial period, other railroads in the United Kingdom adopted this system to improve their safety management processes.

Evaluating close calls is also part of the safety management process in other industries like the chemical process and nuclear power industries. In those industries the probability of an accident is relatively low, but the adverse consequences are high.

This paper discusses the safety benefits of analyzing close calls and the lessons learned by organizations that successfully use those events as part of their safety management process.

### What Is a Close Call?

A commonly used definition of a “close call” refers to an event that *could have* resulted in personal injury, property damage, or environmental damage, *but did not*. However, this definition is too narrow. For example, events that cause injuries, or property damage, but do not reach the threshold for reporting can still provide information about system safety. When these events are used to evaluate system safety, they signal a weakness that, if left alone, could result in more serious consequences. Small accidents may be predictive of larger accidents to come.

Instead, the following definition is proposed:

*An opportunity to improve safety practices based on a condition or incident with a potential for more serious consequences.<sup>2</sup>*

This definition ties close calls to the safety management process. It highlights the opportunity to reduce risk by understanding the factors that lead to an unsafe event.

Using this definition, a threshold must be set to decide what events count as close calls. This definition could be used broadly to include many cases, or narrowly to include only a few cases. Potential cases include:

- Events that happen frequently, but have low consequences (e.g., lifting objects that put employees at risk for minor injuries such as sprains)
- Events that happen infrequently but have the potential for

Decide on a threshold for what events count as close calls.

high consequences (e.g., a train that proceeds past a red signal without proper authority)

- Events that cause an accident that is below the Federal Railroad Administration's (FRA) reporting threshold (e.g., an event that causes an injury requiring first aid, such as a cut)
- Events that are above the FRA threshold where the potential exists for a far greater accident (e.g., a slow speed collision with only minor damage to the equipment)

Ultimately, what events are considered close calls depend on how these events are used in the safety management process.

## Safety Benefits of Analyzing Close Calls

The benefits of using close calls lay in how they are systematically used in the safety management process. A safety system is the combination of procedures, equipment, training, etc. used to manage safety. Close calls represent an opportunity to identify and correct weaknesses in the railroad's safety system prior to an unsafe event.

After implementing changes in safety, managers can use close calls to monitor the effectiveness of these changes in railroad operations over time. Safety managers and labor organizations can use information gathered from close call events in ways that range from reactive to proactive.

### Reactive Approach

Reactively analyzing close calls identifies why unsafe events occur *after* safety has been compromised.

In a reactive approach, close calls are analyzed like reportable accidents to understand the contributing factors. Analyzing individual events makes it possible to identify where safety is compromised and develop solutions to these threats.

Recommendations made by the Switching Operations and Fatality Analysis (SOFA) working group illustrate how the analysis of accident and injury data can improve safety<sup>3</sup>. The SOFA working group analyzed fatalities and injuries in switching operations and identified several contributing factors. Based upon this analysis, the group proposed five safety recommendations to the railroad industry.

### Proactive Approach

Proactively analyzing close calls looks at several cases to find trends or patterns *before* safety is compromised.

In a proactive approach, close calls and reportable accidents are collectively analyzed to identify trends or patterns related to failures or weaknesses in the safety system.<sup>4</sup> As the number of *reportable* events, like accidents have declined, the predictive value of this information has decreased, since there are fewer outcomes to suggest trends.<sup>5</sup> Close calls provide additional information to guide decisions related to safety

management.

Also, proactively using close call information in safety management focuses attention on the future, so that the past does not repeat itself.<sup>2</sup> There are many benefits to using close call events proactively.

***Close calls can show where current weaknesses exist in the safety system.*** Close calls occur more frequently than reportable events, like accidents. Therefore, monitoring close calls can identify trends where protection is missing or could be improved, prior to an accident.

For example, a train collision took place in 1999 at Paddington in the United Kingdom, when the locomotive engineer passed a red signal. Following the accident, investigators discovered that the red signal at this location had been violated on eight previous occasions due to problems with the signal system.

***Close calls can be used to monitor changes in safety over time.*** The higher frequency of events increases the sensitivity for detecting new failures as well as existing ones. Thus, the railroad can adapt to the conditions that change gradually over time as well as unexpected events.

***Monitoring close calls can uncover hidden conditions previously not exposed by looking at reportable accidents alone.*** Hidden conditions such as design defects, gaps in supervision, unworkable procedures, and inadequate training may be present for years before they combine with local circumstances to result in an accident.<sup>5</sup> Where observable failures may be unique to an event, hidden conditions are more likely to be consistent across a range of events. Close calls can identify patterns over time and across facilities.

### **Who Benefits from Analyzing Close Calls**

Everyone benefits from using close calls to control safety.

When close call events are analyzed, everyone benefits:

- An effective program for collecting information about close call events shifts safety awareness to individuals at all levels of the organization. Safety becomes a concern for everyone.
- All groups see economic benefits in reducing costs associated with reductions in time lost from injuries, damage to railroad property, damage to the environment, and time required to move the customer's goods. Productivity improves when the railroads can more effectively schedule train and maintenance operations.

## Lessons Learned from Organizations that Analyze Close Calls

Organizations that successfully analyze close calls share information well. They:

- Encourage disclosure by building and maintaining trust between the railroad parties;
- Engage front-line staff in the design of the system to build the trust necessary to foster disclosure;
- Structure the system so that information can be easily organized and analyzed;
- Provide continuous feedback to people at all levels of the railroad.

### Encourage Disclosure by Building and Maintaining Trust

Features that encourage the disclosure of close call events include: using a third party to collect and store the information, screening close calls for inclusion, confidential reporting, and limited protection for sources from liability or enforcement.<sup>6</sup>

Third parties are neutral organizations that collect and store the close calls. In addition to collecting the information, they can check the information for accuracy, appropriateness, and completeness. With CIRAS, the reporting system developed by ScotRail in the United Kingdom, individuals provide information about a close call by mail or telephone to an independent third party. After receiving the initial report, the source may receive a call from the third party to acquire more detailed technical, environmental, and personal information and to verify the accuracy of the information.

It is important that only appropriate information is entered into the system. Does the event meet the definition of a close call? When a close call is reported, someone must determine whether it should be included in the system. One positive way of filtering close calls is to include the stakeholders in the decision. For example, in the GAIN system, two representatives, one from the FAA and one from a labor organization decide whether to include the information in the system, a ‘team approach’ to handling close call events that provides mutual protection.

Assuring confidentiality makes individuals more comfortable disclosing information.

Confidentiality in reporting encourages individuals to feel more comfortable disclosing close call information. CIRAS removes identifiers (e.g., name, location) and the information is stored in a database, to protect the identity of the individual reporting the information. The original forms are returned to

Limited protection from liability and enforcement allows freer information exchanges.

the individual and no copies are made.

Protecting people and organizations from liability and enforcement creates an environment where employees and managers feel comfortable disclosing information. Successful close call systems, like the ASRS database also protect the person disclosing information from disciplinary action. However, this protection does not provide immunity from all unsafe behavior. Behavior that willfully or recklessly places others in danger (i.e. sabotage or substance abuse) must be dealt with responsibly.

Drawing the line between acceptable and unacceptable behavior and communicating that information throughout the organization poses a significant challenge to the successful use of close calls.

### **Engage Front-line Staff in the Design of the System**

Successful implementation of a close call system requires acceptance by a broad segment of the railroad community. The best way to achieve this is to involve users from all stakeholder groups in the system's definition and design.

### **Structure Systems to Organize and Analyze Information**

To facilitate the analysis of close calls, effective systems are structured to easily obtain information for an accident model of how the system should work. In CIRAS, information is grouped in terms of human factors and plant/technical failures. The model addresses factors at both the individual and organizational level. This includes errors made by the front-line staff such as detection failures and application of the wrong rule. It also includes errors associated with management such as resource allocation, staffing, procedural failures, and equipment design.

### **Provide Feedback to All Levels of the Organization**

Sharing information with individuals at other locations sensitizes them to the potential hazards. Successful safety management systems that use close call events provide feedback at all levels of the organization. There are several advantages.

*Feedback from close call systems enables people to track the threats to safety and weaknesses of the system over time.* The railroad industry can better adapt to emerging threats to system safety as conditions change. Several close call systems (CIRAS and ASRS) produce reports for the industry that describe trends or patterns across an organization.

Feedback, however, must be used properly to manage safety. While it is helpful to measure the effectiveness of a solution in resolving a problem using close calls, it is counterproductive to set a goal of simply reducing the total number of close calls. One nuclear power plant that set goal of reducing the total number of disclosed close calls achieved a 50% reduction in disclosures in the first month followed by a greater reduction in subsequent months.<sup>7</sup> However, none of this had impact on the actual occurrence of the problem.

***Feedback allows people to monitor the success of specific solutions.*** It is important to determine the degree to which a solution corrected a failure.

***Timely feedback from the system can be given to the person who reported the close call.*** Giving timely feedback after someone discloses a close call shows that the information is valued and encourages continued disclosure.

### Next Steps

Learn more about using close calls and discuss issues at a workshop.

Successful implementation of a close call system requires acceptance by a broad segment of the railroad community. Creating acceptance requires a dialog about how close calls will be used to build trust among the stakeholders. Any discussion will need to involve the participation of all stakeholders. While some members of the railroad community are familiar with the use of close calls, many others are not.

The Federal Railroad Administration's Office of Research and Development is sponsoring a workshop for railroad industry to learn more about the benefits of using close calls to manage safety within a railroad. Several speakers will:

- Share how their organization or industry uses close calls to manage safety
- Identify challenges to the development and use of close calls, and discuss solutions to those challenges

Then the workshop will provide an opportunity for participants to raise issues that concern the railroad industry and propose solutions.

## References

- <sup>1</sup>Weick, K. (1991). Organizational culture as a source of high reliability. *California Management Review*. 29: 112-127.
- <sup>2</sup>Phimister, J.R. Oktem U., Kleindorfer P.R., and Kunreuther H. (2000). *Near-Miss Management Systems in the Chemical Process Industry*. <http://opim.wharton.upenn.edu/risk/downloads/01-03-JP.pdf>.
- <sup>3</sup>Switching Operations Fatality Analysis Working Group. (1999). Switching Operations Fatality Analysis: Findings and Recommendations of the SOFA Working Group.
- <sup>4</sup>van der Schaaf, T.W. (1991). A framework for designing near miss management systems. In *Near Miss Reporting as a Safety Tool* (ed. Van der Schaaf, T.W., Lucas, D.A., and Hale, A.R). Boston: Butterworth Heinemann, 27-34.
- <sup>5</sup>Reason, J. (1998). Safety culture: Some theoretical and practical issues. *Work and Stress*. 12 (3): 293-310.
- <sup>6</sup>(Davies, J.B., Wright, L., Courtney, E., and Reid H. (2000). Confidential incident reporting on the UK railways: The 'CIRAS' System. *Cognition, Technology, and Work*. 2:117-125.
- <sup>7</sup>Ives, G. (1991) "Near miss" reporting pitfalls for nuclear power plants in *Near Miss Reporting as a Safety Tool* (ed. Van der Schaaf, T.W., Lucas, D.A., and Hale, A.R). Boston: Butterworth Heinemann, 51-56.

To obtain additional copies of this paper or for more information about the workshop, contact:

Jane Saks  
EG&G Services  
Volpe Center  
55 Broadway, DTS-920  
Cambridge, MA. 02142

Email: [saks@volpe.dot.gov](mailto:saks@volpe.dot.gov)  
Tel. 617.494.3861