Near-Miss Reporting

and

Avoiding Pyrophoric Iron Sulfide Fires

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Editorial

To achieve continuous improvement in safety, everyone in the company must understand that he or she has an important role to play. This comes from realizing that one’s actions and behaviors can impact the safety of others. When a near miss occurs it is in everyone’s interest to report it, determine what went wrong, and take actions to prevent something worse from happening in the future. The article on pages 3 and 4 discusses the importance and benefits of near-miss incident reporting to an organization’s overall safety performance.

The hydrocarbon industry has experienced devastating fires and explosions from pyrophoric (spontaneously igniting) materials such as iron sulfide sludge inside equipment. These fires often occur during shutdown operations when columns, tanks, exchangers, and piping are exposed to the atmosphere for inspection or routine maintenance. The article on pages 5 and 6 focuses on recognizing and minimizing the hazard posed by pyrophoric materials.

Focus on Basic Safety Rules
(Refer to the Saudi Aramco Safety Handbook)

Rule # 10
Smoking is permitted in designated areas only. Matches and lighters are prohibited in restricted areas.
Near-Miss Reporting

An effective way to make positive changes in an organization is to gain an understanding of the source of problems when they arise. Proper near-miss incident reporting and investigation can provide that source of understanding.

A common definition for a near miss is an event which did not result in injury or loss, but had the potential for injury or loss if circumstances had been slightly different. According to the U.S. National Safety Council (NSC), about 75% of industrial injuries can be forecasted by near misses.\(^1\) Identifying the causes of a near-miss incident enables an organization to make corrections before circumstances change slightly and lead to real injury or loss.

Here are some additional benefits of proper near-miss reporting and investigation:

- Reduces tolerance for risk.
- Avoids complacency.
- Identifies workplace hazards.
- Tracks corrective actions.
- Communicates potential hazards to other shifts, departments, etc.
- Involves employees in the safety program.
- Demonstrates management’s commitment to safety.

Saudi Aramco recognizes the need and benefits of a near-miss reporting process. Element 9, “Incident Reporting and Analysis,” of the Saudi Aramco Safety Management System (SMS) manual addresses the need for formal reporting and investigation of near misses with apparent high potential for more serious consequences so that lessons can be learned and shared. Also, Saudi Aramco General Instruction (GI) 6.004, Near Miss Reporting Process, provides general guidelines, a reporting procedure, requirements for communication and follow-up, and a description of responsibilities.

Although Saudi Aramco has a defined system in place and many employees realize the benefits of near-miss reporting, too few near misses are reported. The company’s ratio of reported near misses compared to the number of serious incidents is one to one. A recent study\(^1\) suggests that the ratio should be a minimum of 30 to one. Other studies suggest an even higher ratio.

So why do employees hesitate to report near misses? The most cited reason is fear of disciplinary action.\(^2\) No one wants to report a near miss if they believe it will be held against them.\(^3\)

Some other commonly cited reasons are:

- Personnel confusion (e.g., individuals do not know what constitutes a near miss and how to properly report one)
- Lack of near-miss reporting training
- Time not allocated to investigate near misses
- No incentive to report near misses
- No injury sustained
- Just another form to complete, too much paperwork, too much time required
- Company property damaged — not my problem
- Corrective actions are frequently not implemented
- Disincentive for reporting (e.g., reporting near misses hurts the department’s safety performance and may reduce safety-related perks/awards).
Near-Miss Reporting ... continued

Companies that have increased their near-miss reporting have done so by making a serious effort to address the above issues. These companies also state that the first and most important issue is placing a greater emphasis on creating a No Blame Policy. 4 Saudi Aramco already recognizes this and addresses it in GI 6.004, which states that:

“Departments should promote and publicize that near-miss reporting is a positive attribute to be encouraged and supported.”

A company culture that rewards near-miss reporting versus perpetuating a fear of disciplinary action is the key to greater reporting. 3 Employees need to perceive that by reporting near misses, the time and effort they spend on it will result in positive safety changes. Management needs to demonstrate that reporting near misses is critical to their operation’s safety performance. The following are actions that management can take to encourage proper reporting of near misses and overcome obstacles to reporting them:

• Alleviate the fear of potential reprimand by ensuring a non-disciplinary policy is implemented.
• Form employee teams to evaluate near-miss report results. Publicize improvements resulting from reported near misses.
• Motivate personnel to report near-miss incidents by ensuring quick and easy reporting — completing long complicated forms often discourages reporting.
• Ensure employees are aware management supports and encourages near-miss reporting.
• Handle near-miss reports seriously and appropriately.

In addition to the above, another tool that can be used effectively at Saudi Aramco is the Performance Management Program (PMP). Element 1, “Leadership and Accountability,” of the SMS manual offers the PMP as a key loss prevention accountability tool. Integrating near-miss reporting into employees’ PMPs at all levels of the organization can be valuable leading indicators of both individual and company performance.

References:

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Safety Films

- 901.093 Proactive Safety in Action – Accidents Don’t Have to Happen
- 901.114 Things That Burn – Flammable and Combustible Chemicals
- 901.325 Handling Pyrophoric Materials (MPD)
- 901.507 Accident Investigation – Employee Awareness
- 901.686 Incident Reporting – You Can Save a Life

The safety films listed above relate to the topics covered in this issue of the LP Newsletter and can be borrowed from LPD’s Film Library. You can order your films online at http://lp.aramco.com.sa.

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Avoiding Pyrophoric Iron Sulfide Fires

Over the years, Saudi Aramco has recorded a number of pyrophoric incidents. These incidents involved the introduction of air into dry process equipment or resulted from dried pyrophoric material left in trash containers or on scaffolding. The process equipment most affected were screens, filters, and tube bundles.

Local landfills have also reported pyrophoric fire incidents when the ground was being graded by bulldozers. Incident investigations attributed these landfill fires to waste pyrophoric materials mixing with other combustibles.

Pyrophoric iron sulfide oxidation

Pyrophoric materials can ignite or burn spontaneously in air. Iron sulfide (FeS) is an example of a pyrophoric material that generates heat when exposed to air. Iron sulfide is generated when iron oxide (rust) is chemically converted to FeS by hydrogen sulfide (H₂S) when the H₂S concentration exceeds that of oxygen (O₂). If FeS is exposed to air, it is oxidized back to rust, and either free sulfur or sulfur dioxide (SO₂) gas is formed. The reaction between FeS and O₂ is pyrophoric and generates considerable heat.

Pyrophoric materials should never be mixed with waste chemicals, such as xylene, benzene, or gasoline, because the mixture can cause a serious explosion. Trapped hydrocarbons that are not adequately cleaned during the washing/steaming out process can ignite from the heat of a pyrophoric reaction. The resulting fire could be fatal to personnel performing maintenance or inspection work inside a column.

Preventive measures

Pyrophoric incidents can be avoided if safe procedures are followed. When opening hydrocarbon equipment, assume that it contains iron sulfide sludge or scale, particularly if the hydrocarbons are known to contain H₂S. Safe procedures should include removing all combustibles and neutralizing pyrophoric materials by segregation and wetting. Use these guidelines to minimize the potential for fires when cleaning a distillation column or a vessel and its associated piping.

Removal of liquid or gas

Remove hydrocarbon liquid or gas according to the specific safety procedures outlined in Saudi Aramco operating instructions for the particular unit/equipment. Pay particular attention to preventing the introduction of air into the system because this can start the oxidation process and lead to a fire. Make sure to safely drain all hydrocarbons from the equipment, column, or vessel and associated piping in a closed piping system.

Displacement of flammable vapors

Displacing flammable vapors is usually accompanied by steaming and nitrogen (N₂) purging. Follow your department’s guidelines for the particular equipment. The following steps should be included:

- Introduce an appropriate medium (e.g., low-pressure steam) to free equipment, vessel, piping, etc., from residual hydrocarbons. Continue the process for the required length of time, maintaining the proper temperature throughout the procedure.
Avoiding Pyrophoric Iron Sulfide Fires ... continued

- Take frequent gas tests to ensure that hydrocarbon levels have decreased. Introduce N₂ if your procedure requires it.
- When the equipment, vessel, piping, etc., are clear of residual hydrocarbons, slowly introduce water then repeat the process several times.
- Cool the equipment, vessel, piping, etc. Never leave vents and drains open during the cooldown period because air will be drawn inside the vessel. Make sure no vacuum is created.
- Open the equipment, vessel, piping, etc., as soon as practical and inspect it to determine if there is any remaining sludge or scale. Always have a fire watch present when opening the equipment. For work to proceed, gas tests must be conducted to ensure that gas levels meet the LEL, O₂, and H₂S levels identified by the work permit system and the Saudi Aramco Safety Handbook.
- Never allow personnel to be directly exposed when opening process piping and equipment. Any residual pressure or even gravity can cause hot condensate or pyrophoric materials to strike workers.
- If scale or sludge is present, keep the equipment wet until the cleanup procedure is completed.

Removal of sludge or residue
High-pressure water washing is usually used to remove sludge or residue from process equipment as follows:

- Use an electrically grounded air remover during this process to remove any residual vapors that may be released from the sludge.
- Segregate and keep all removed sludge or scale wet until it can be safely removed.

For more information on handling pyrophoric materials, watch the video “Handling Pyrophoric Materials,” which is available from the Loss Prevention Audiovisual Library.