Safety in Focus

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Loss Prevention Department

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No More Aching Back

By Serban Ionescu, Abqaiq Area Loss Prevention Division

"A sudden sharp pain in my back, but I hadn't done anything different from my usual work," Saeed told his doctor. Beside being in pain, Saeed was puzzled as to how this occurred so suddenly without any apparent cause. But it is true that musculoskeletal disorders (MSDs) often occur with no warning. MSDs are often cumulative in nature caused by prolonged or repeated low-level stress being placed on body tissue.

Each time such stress is applied, "microtrauma" — stretching, tearing and ultimately weakening — of the tissue results. If the threshold for generating pain, which serves as a warning of potential tissue damage, is not reached, the damage goes undetected. If sufficient time is allowed to elapse before the activity is carried out again, this minor trauma heals with no long-term effects.

However if the task — picking up a box, resuming poor posture at the computer, sitting asymmetrically at the reception desk, supporting the phone between shoulder and ear — is repeated without sufficient rest and recovery time, the tissue (already weakened and vulnerable to additional stress) is damaged further. Once such damage becomes significant enough, pain is produced.

Common ergonomic mistakes

Monitor placed at angle to body

Leaning forward over a workstation

Cradling phone

Background

MSDs are the most common of all reported work-related health problems. More than 44 million (one in six) members of the European Union (EU) workforce now have a long-standing health problem or disability that affects their ability to work, and as many as 40% have had to quit their jobs. In 2005 (the same year the European study was published) Saudi Aramco lost 369 work days as a result of on- and off-job back injuries.

MSDs cause a high degree of discomfort, pain and reduced mobility and motor functions that, in turn, can create safety issues, as workers move into different positions or take short-cuts to minimize discomfort and pain. MSDs are a major reason for absence from work and create a life of disability for the sufferer. Other common names for MSDs include cumulative trauma, repetitive strain injury (RSI) and Carpal Tunnel Syndrome (CTS).

Evidence for causality

Several MSDs have well-documented work-related causes, and a number of scientific reviews have been carried out examining MSDs. One review, published by the US National Institute of Occupational Safety and Health (NIOSH) concluded that there is well documented connection between certain types of physical load strains and a number of MSDs in the neck, shoulders, arms and back.

The following table outlines occupational risk factors and symptoms of the most common disorders of the upper body.

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Disorders	Occupational risk factors	Symptoms
Tendonitis/tenosynovitis	Repetitive wrist motions. Repetitive shoulder motions. Sustained hyperextension of arms. Prolonged load on shoulders.	Pain, weakness, swelling, burning sensation or dull ache over affected area.
Epicondylitis (elbow tendonitis)	Repeated or forceful rotation of the forearm and bending of the wrist at the same time.	Same symptoms as tendonitis.
Carpal Tunnel Syndrome (CTS)	Repetitive wrist motions.	Pain, numbness, tingling, burning sensations, wasting of muscles at base of thumb, dry palm.
DeQuervain's disease	Repetitive hand twisting and forceful gripping.	Pain at the base of the thumb.
Thoracic Outlet Syndrome	Prolonged shoulder flexion. Extending arms above shoulder height. Carrying loads on the shoulder.	Pain, numbness, swelling of the hands.

Prevention

Simple changes can make a big difference. Using ergonomic ideas to improve tools, equipment and jobs reduces workers' exposure to those factors that can result in injury. When ergonomic changes are introduced into the workplace, they should be accompanied by training on how to use the new methods and equipment to work safely.

Ergonomics experts recommend that managers and workers develop an ergonomics program together, so they can analyze the risk factors at the worksite and find solutions. Many companies have found that ergonomics programs can reduce injuries, improve morale and increase productivity.

Workers can be at risk in any work environment, yet problems can be prevented or reduced by:

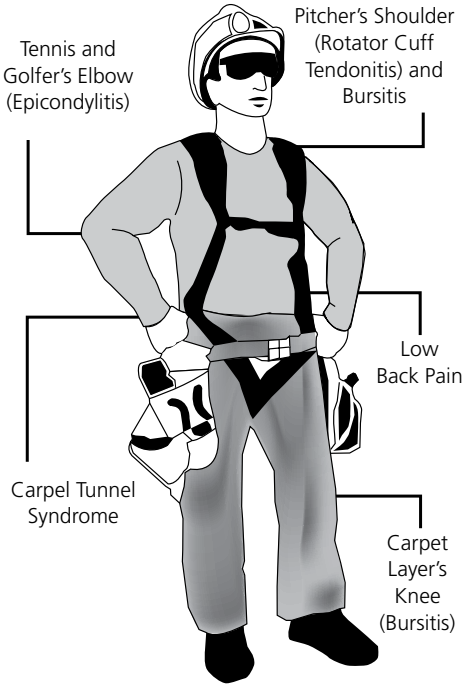
- Applying proper risk assessments.
- Instituting appropriate engineering and administrative controls.
- Following health and safety regulations.
- Checking that these measures remain effective.

The physical setup of a work area and the configuration of the tools can greatly reduce the chances of injuries. It is also important to evaluate the work process, including job organization, worker rotation, task variety, and demands for speed and quality.

Working intensely over long periods of time without taking breaks can greatly increase the risk of musculoskeletal injuries.

Solutions can be as simple as changes to tools and workstations, e.g., a longer handle on a tool or adjusting the distance of a computer screen. Moving work to a workbench and off the floor can prevent many shoulder and back injuries. Storing materials at waist level and using trolleys, dollies and other material handling devices available are other options that minimize or eliminate injuries. Encouraging workers to take regular breaks, do stretching exercises and change tasks frequently (every 20 to 40 minutes) can reduce the risk of MSDs.

Just because someone has been performing the task for a long time without a problem, doesn't mean a problem isn't developing. Making sure that a task is adapted to the human body — not asking the body to adapt to a task — can prevent long-term pain.



Common MSD Ailments Potentially Resulting from Unsafe Work Practices

Lessons Learned from Company Incidents

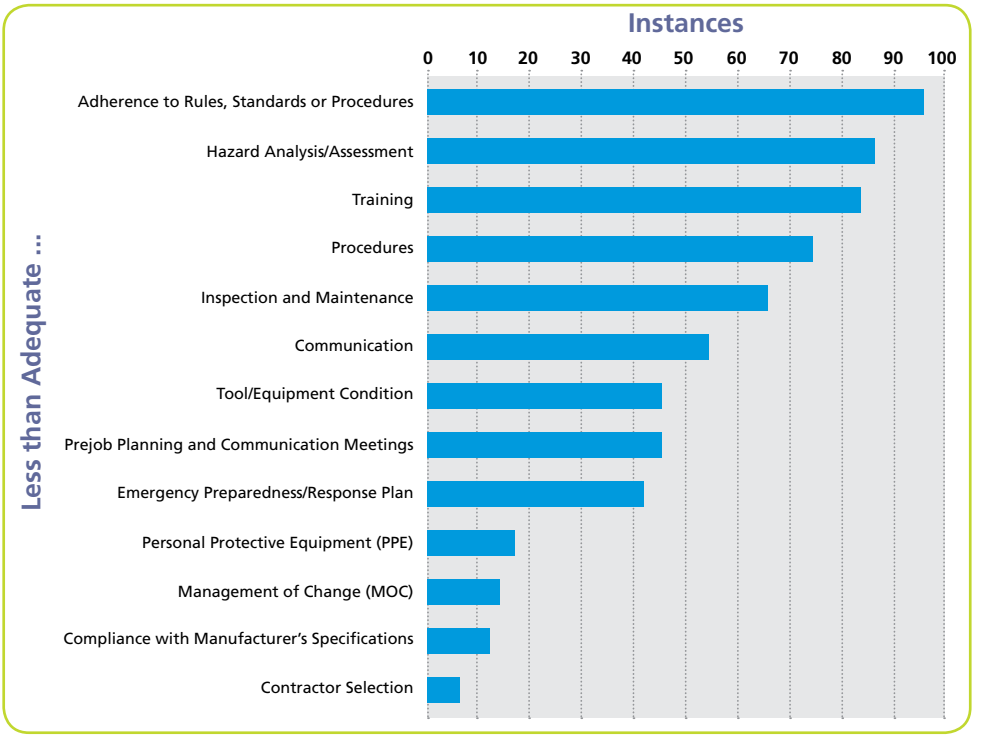
By Subhi K. Abderrezaq, Loss Prevention Department

One day in the gas plant where they worked, Ali and Tariq were discussing a recent incident they had heard about that occurred in a different plant. Ali thought the incident was due to a lack of training while Tariq said it was because of inadequate use of personal protective equipment (PPE). Tariq explained that he had read about the incident in the *Loss Prevention Bulletin.*

Loss Prevention Bulletins, which are based on incident investigation reports, are developed to share lessons learned throughout the company so incidents are understood and not repeated. Recommendations from major incident investigation reports are assigned not only to the organization in which the incident occurred, but also to other organizations that have similar operations or where the potential for a similar incident exists. This is accomplished through the Saudi Aramco Major Incident Recommendations (SAMIR) system. *Loss Prevention Bulletins* and the SAMIR system are both ways to share lessons learned to prevent recurrence of incidents throughout the company.

To categorize the causes of the incidents and discover any trends, the Loss Prevention Department reviewed 139 *Loss Prevention Bulletins* published from 2003 to 2012. This review helped identify the underlying causes for most incidents at company facilities. The top five causes are outlined here.

Incident Causes from 2003 to 2013



1. The leading cause of incidents was less than adequate (LTA) adherence to rules, standards or procedures (see chart). Such behavior exists and persists for several reasons:
   - The incorrect assumption that bypassing procedural requirements will save time and/or money.
   - Pressure from management (perceived or real) that operations and production issues are more important than safety.

How can these issues be resolved? Two possible solutions are:

- Education of departmental management that proactive loss prevention efforts improve profitability (in other words, save money).
- Actions, not just words, from management to emphasize the importance of safety to all employees as well as to positively

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reinforce proper application of safe work practices, following the minimum rules of the *Safety Handbook*, as well as other company rules, standards and procedures.

2. LTA hazard analysis/assessment. Not all critical tasks/hazards were identified, nor were credible emergency scenarios.
3. LTA training of personnel, including supervisors, operators and emergency response personnel.
4. LTA procedures (e.g., incomplete procedure or no procedure). This is a root cause, but there are other underlying reasons for this, including:
   - LTA training on the development of procedures and operations.
   - LTA peer reviews and approvals of procedures.
   - LTA time allotted to develop a procedure (this is especially true for those written for a specific construction or retrofit project).
5. LTA inspection and maintenance (including preventive maintenance). One solution for this is to assess the criticality of equipment and operations, prioritize inspections and maintenance, and carefully track implementation.

Despite *Loss Prevention Bulletins* and the SAMIR system, incidents are still occurring. Part of the problem lies in LTA corrective actions on the lessons learned and the implementation of assigned recommendations. Future editions of *Safety in Focus* will feature articles from specific incidents to help employees address the leading incident causes.

Take Ownership of Your Process

By Tareq S. Al-Hatem, Jeddah Area Loss Prevention Division

Worldwide, more and more companies are implementing safety management systems (SMSs) to manage safety in the workplace. In essence, they use a businesslike approach to define safety programs and processes in a systematic and comprehensive way. Implementing effective safety processes requires that ownership be identified and responsibilities defined.

Processes and process owners

A business or safety process is an "activity performed by more than one person to produce a desired outcome." The process owner is defined as "the person accountable to develop the process, train others in it, monitor the health of it and report back to management." Line management is accountable for implementation.

Why process owners?

Saudi Aramco has many corporate and departmental processes, programs and requirements that govern its activities. These can be engineering standards, general instructions, management guides, operational procedures or safety processes.

In line with our corporate values, accountability must be established to ensure that these documents are properly developed, comprehensively reviewed, adequately communicated to involved personnel, and continually monitored and updated for improvement.

Process owners serve as a focal point for the development, implementation and monitoring of the process. They play a significant role in bringing the process to life and transforming it from a piece of paper to an ever-evolving and improving document. Questions, comments, suggestions and concerns are evaluated by the process owner as part of the continuous improvement objective.

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Process owner selection criteria

Whether it is a business or safety objective, selecting the right process owner is the first step to successful implementation. It is management's responsibility to carefully select qualified process owners who are competent and interested. It is equally important to assign different processes to different owners to avoid overburdening a single individual.

Recommended selection criteria for identifying the right process owners are:

- **Knowledge/work experience:** The process owner must have the required knowledge and related work experience to perform the expected tasks and should be the subject matter expert in that area.
- **Communication/planning skills:** The process owner is expected to plan and prepare activities to properly develop, communicate and implement the assigned processes. Planning and communication skills are essential qualities for effective process owners.
- **Empowered to implement the process:** The process owner needs to be fully empowered by management to implement the process and have personal drive and experience in "getting things done" promptly,efficiently and cost effectively.
- **Teamwork skills:** Throughout the various stages of development, training, communication and implementation, the process owner will be working with different teams. The ability to work with others to produce the desired output is also crucial.

Process owner responsibilities

All process owners share common responsibilities that are based on the expectations of their role in meeting departmental SMS objectives. While specific process owners may have other pertinent job-related responsibilities, there are four main responsibilities shared by all:

1. **Develop the process:** The assigned process owner is responsible for developing the process either individually or as part of a team. The assigned individual will lead the development of the departmental process considering the corporate requirements, best practices and related safety recommendations.
2. **Roll out the process:** Implementing the process includes obtaining the required approvals, developing and delivering the required training and ensuring the necessary documentation (e.g., standards, responsibilities, flowcharts, forms) is available to the intended audience, and finally rolling out the process.
3. **Monitor the process:** The process owner must closely monitor process implementation, including:
   a. Verifying or consolidating process documentation and filing.
   b. Ensuring that process standards are being met.
   c. Providing management with frequent (or as requested) feedback on the status and effectiveness of the assigned process. Typical venues for this feedback are the Safe Operations Committees (SOCs) and Safety Management Committee (SMC) meetings.
4. **Review and update the process:** A process owner must routinely keep current with any changes and enhancements (e.g., industry best practices, revisions to general instructions or engineering standards) pertaining to the assigned process. He must also collect and incorporate all applicable corporate along with received comments and suggestions during the implementation period.

Selecting the right owner for the right process is a significant step toward ensuring that the corporate and business objectives are met, but more importantly, that each and every employee has a safe work environment.

Almost Human: Safety Instrumented Systems

By Luivin A. Fernandez Villalobos, Riyadh Area Loss Prevention Division

A safety instrumented system (SIS) is an engineered set of hardware and software controls composed of sensors, logic solvers, actuators and other control equipment.

An SIS is used to monitor the condition of a plant to ensure it remains within the operational limits. If risk conditions occur, they must trigger alarms and send the plant into a safe state or shutdown condition.

Inside the onion of safety

SISs offer only one layer of protection in industry processes. Catastrophic incidents occur when multiple safety protection layers fail.

Layers can either be automated or manually operated. Some layers offer quantifiable risk reduction benefits. But the risks must be identified so that the SIS can be designed, thereby preventing a potential incident. Overall safety is determined by how these layers work together.

Life cycles and SISs

Asset integrity, as described in Element 5 of the Safety Management System, is an engineering process that includes steps to achieve functional safety during the design, construction, operation and maintenance, and decommission phases, thus ensuring that SISs effectively reduce risk, while being cost effective.

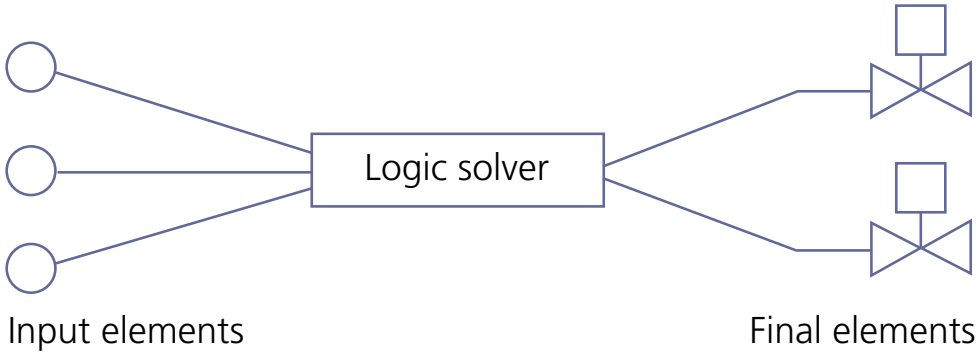
Analysis is the first step in creating a safety life cycle. A conceptual design must reduce unnecessary hazards and risks at the outset. SISs should only be considered and designed as additional safety protection layers after a risk reduction assessment has been completed. Once the conceptual process design is complete, detailed hazards and risk analyses must be performed. Various process hazards analysis (PHA) methodologies help identify residual process risk that may require an SIS.

The next step in creating a safety life cycle is realization. The specific control functions performed by an SIS, called Safety Instrumented Functions (SIF), are an important part of this process. The number and integrity level of necessary SIFs will depend on the identified risk gap. During the realization phase, a detailed design of the SIS (and its SIFs) is performed.

Finally, the operation of a safety life cycle must be considered. The SIS operation phase begins with a prestartup safety review. Once SISs are operating, procedures, periodic inspections and function testing must be followed because they assure the SISs' reliability and availability.

Reliability, availability, functionality and integrity

Integrity is the main perspective from which all fundamental concepts and engineering practices associated with SISs are applied. While functionality is essential because it defines what an SIF should do (i.e., design intent), integrity describes the performance requirements (i.e., reliability and availability).



Main parts of a safety instrumented system

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Integrity defines how well each SIF must perform, which is highly dependent on how carefully an SIS is designed, operated and maintained.

SIS performance is defined in terms of reliability and availability. Reliability is a system performing its intended function when required. Availability is a device that operates when demanded. Reliability and availability are estimated in terms of mean times to failure, failure rates and restoration times.

It should be clear, however, that no system is completely immune to failures. Even in case of failure, an SIS should at the very least provide a safe operating state.

SIS failures

Failure occurs when a device does not perform its intended function. Causes of potential failure may be introduced in design as well as in the operational phase. In the design phase, SIS failures may be a result of inadequate understanding of failure mechanisms and responses, improper selection of hardware components, and so forth.

In the operational phase, failures may be introduced because of improper testing, human errors during operation and maintenance, and environmental stresses outside the design envelope.

SIS failure can be classified into two categories: dangerous (not responding when demanded) and safe (responding when not demanded). The four types of failure modes are safe detected (SD), safe undetected (SU), dangerous detected (DD) and dangerous undetected (DU).

Since an SIS normally operates in a low demand mode, regular testing and inspection are required to reveal SIS failures. Testing frequency and coverage address the chances of detecting SIS failures, particularly dangerous ones.

Summary

SISs are special safety protection layers designed to respond to operational upsets when other preventive protection layers are ineffective. SISs must generate the correct expected output whenever demanded to prevent or mitigate hazardous events. The most important reason for considering SISs is to further reduce process risks not engineered out in the conceptual and design phases. Every company's internal practices should be calibrated to reflect the amount of tolerable risk it is willing to accept.

Resources

Resources available at Loss Prevention's homepage: http://lp.aramco.com.sa

1. Safety Films available from the LPD Film Library:

- 100.093 – Office Ergonomics: It's Your Move
- 900.306 – Understanding the Working Back
- 900.589 – Introduction to Process Safety Management
- 901.479 – Back Safety
- 901.529 – Safety Success for Safety Teams and Committees

2. E-Learning Courses

- Incident Management e-Learning Course
- Injury Reporting and Investigation e-Learning Course

3. Special Publications

- Back Owner's Manual
- Back Safety Campaign Special Page (2006)
- Loss Prevention Bulletins (2003 to 2012)

4. References

- *Musculoskeletal Disorders and Workplace Factors,* US Department of Health and Human Services, National Institute for Occupational Safety and Health, July 1997.
- Stephan Bevan, et. al., Fit for Work? *Musculoskeletal Disorders in the European Workforce,* The Work Foundation Alliance Limited, September 2009.

5. SafetySmart™

- Visit this international reference site for articles, posters, safety talks and videos on the topics covered in this issue of *Safety in Focus.*

The editorial staff welcomes readers' comments and ideas. Please email your suggestions to SafetyinFocus@aramco.com or mail them to *Safety in Focus*, Saudi Aramco Loss Prevention Department, A-117, Building 3150, LIP, Dhahran 31311, Saudi Arabia or call 872-8868.

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