Preventing Exposure to Workplace Chemicals

Systems of Safety

Training from the

NJ Work Environment Council

WEC

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About WEC

The New Jersey Work Environment Council (WEC) is a non-profit collaboration of organizations working for safe, secure jobs, and a healthy, sustainable environment.

Visit WEC's website at www.njwec.org

For more information about WEC programs and services, contact:

New Jersey Work Environment Council
Telephone: (609) 882-6100 x 308
Website: www.njwec.org

Preventing Chemical Accidents

Unexpected releases of highly hazardous toxic, reactive, or flammable chemicals create the possibility of a disaster for workers, employers, and communities.

OSHA's Hazard Communication Standard (HAZCOM) helps to ensure that the hazards of all chemicals produced or imported are evaluated and details regarding their hazards are transmitted to employers and employees.

OSHA's Process Safety Management Standard (PSM) helps prevent accidental releases of highly hazardous chemicals, thus protecting employees, as well as plant neighbors.

Effective worker training about HAZCOM and PSM helps achieve safer, healthier, and more productive workplaces.

In New Jersey, PSM regulates *approximately* 100 facilities, including certain chemical plants, oil refineries, food processors, electric utilities, warehouses, and public and private sector water and sewage treatment operations. PSM may also cover other types of facilities. PSM has special provisions for contractors working in covered facilities.

This training module will introduce the concept of Systems of Safety and accident prevention and its relationship to the Hazard Communication Standard.

The Small Group Activity Method

Basic Structure
The Small Group Activity Method* is based on a series of problem-solving activities. An activity can take from 45 minutes to an hour. Each activity has a common basic structure:

- **Small Group Tasks**
- **Report-Back**
- **Summary**

1. Small Group Tasks: The training always begins with groups working together at their tables. Each activity has a task, or set of tasks, for the groups to work on. The task asks that the groups use their experience and the factsheets to solve problems and make judgements on key issues.

2. Report-Back: For each task, the group selects a scribe that takes notes on the small group discussion and reports back to the class as a whole. During the report-back, the scribe informs the entire class as to how his or her group solved the particular problem. The trainer records each scribe's report-back on large pads of paper in front of the class so that everyone can refer to them.

3. Summary: Before the discussion drifts too far, the trainer needs to bring it all together during the summary. Here, the trainer highlights the key points of the activity and brings up any problems or points that may have been overlooked during the report-back.

*The Small Group Activity Method (SGAM) is based on a training procedure developed by England's Trades Union Congress (TUC) in the 1970s. The Labor Institute and Oil, Chemical, and Atomic Workers Union (now part of the

United Steelworkers) used a similar method around economic and health and safety issues for workers and further developed the procedure into SGAM. The New Jersey Work Environment Council has used SGAM since 1986.

Three Basic Learning Exchanges

The Small Group Activity Method (SGAM) is based on the idea that every training is a place where learning is shared. With SGAM, learning is not a one-way street that runs from trainer to worker. Rather SGAM is a structured procedure that allows us to share information. It is based on three learning exchanges:

- **Worker-to-Worker**
- **Worker-to-Trainer**
- **Trainer-to-Worker**

Worker-to-Worker: Most of us learn best from each other. SGAM is set up in such a way as to make the worker-to-worker exchange a key element of the training. The worker-to-worker exchange allows participants to learn from each other by solving problems in their small groups.

Worker-to-Trainer: Lecture-style training assumes that the trainer knows all the answers. With SGAM it is understood that the trainers also have a lot to learn and this is the purpose of the worker-to-trainer exchange. It occurs during the report-back and it is designed to give the trainer an opportunity to learn from the participants.

Trainer-to-Worker: This is the trainer’s opportunity to clear up any confusion and make points they think are key. By waiting until the summary section, trainers know better what people need to know.

The Factsheet Reading Method

The process described below focuses everyone on the important information in the factsheets.

The process is as follows:

First, select a scribe for this Task.

Each of you will be assigned a small number of factsheets to read. You will then share the factsheet information with your table.

Your trainer will assign your individual factsheets this way:

Starting with the scribe and moving to the left, count out loud from 1 to 8. Keep going around the table until all numbers (factsheets) are distributed. The assigned numbers correspond to Factsheets 1 through 8 on the following pages.

Once everyone has read their assigned factsheets individually, your scribe will go around the table and ask each of you to explain to the group what you have learned. Factsheets should be explained in the order assigned (1 through 8), since the factsheets build on the previous one. In this way, we all start at the same place and with the same information.

Systems of Safety

Purpose

To introduce the concept of Systems of Safety and accident prevention and its relationship to the Hazard Communication Standard.

This Activity has two tasks.

Task 1

Scenario 1:
Two wings of a local nursing home were temporarily evacuated after fumes from a cleaning product spill caused some staff members and residents to experience dizziness, and others reported eye, skin and throat irritation. The chaotic evacuation process took place at 9 pm and the manager in charge of the evacuation plans had left for the day. A health and safety committee investigation of the incident revealed the following:

a. An unmarked chemical spilled onto the floor, in the storage closet. A week after the incident, it was determined that the product was a spa cleaner. Hospital staff were never trained on the hazards of chemicals or where to find the chemical safety data sheets.

b. The exhaust fan inside the closet, used to control odors, was not working properly and the chemical fumes permeated through the ductwork.

c. The emergency back-up generator and emergency outlets were not working. Regular inspections and maintenance for the emergency systems had not been performed for over two years.

d. A day prior to the incident a worker noticed the odor, felt lightheaded and went home sick. The odor was not reported to maintenance or investigated.

e. The staff experienced defend-in-place fire drills, but they were never trained for an actual evacuation.

f. The corrosive chemical SDS first aid instructions indicated a 15 minute or longer flush after exposure and there was no eyewash station.

g. It was dark outside and the lighting was limited along the sidewalk and in parking lot. Picnic tables were blocking the evacuation route.

Task 1

Scenario 2:
On January 25, 2005, an explosion at Acetylene Supply Company (ASCO) in Perth Amboy, New Jersey, occurred when acetylene gas leaked from a generator room to a nearby lime shed. A wall-mounted heater was used in the lime shed to keep the pipes from freezing. Acetylene gas is extremely flammable and autoignites at 580 degrees Fahrenheit. The surface of the heater was 1100 degrees Fahrenheit when the acetylene came in contact with it. The resulting blast destroyed the lime shed and hurled debris as far as 450 feet away. Three workers were killed and one seriously injured.

An investigation by the U.S. Chemical Safety and Hazard Investigation Board and OSHA found:

a) The open check valve in the decant water line was relied on to prevent backflow of acetylene. The acetylene generator was started an hour before the explosion producing a pressurized source of acetylene that could then flow to the lime shed through the water line.

b) The unventilated lime shed was built between six decanting tanks and linked to the generator room through a decant water line. The lime shed had a residential grade propane heater to keep the pipes from freezing in the winter. The surface temperature of the heater typically reached 1100 degrees Fahrenheit.

c) In 1996, ASCO conducted a process hazard analysis (PHA), but failed to identify the hazards created by the location of the decant water line drain in the lime shed. The PHA was never updated.

d) The check valve had been observed to leak by an employee on at least one occasion prior to the explosion.

e) ASCO had an operator's manual for the generator, but it did not address the recycled water system. As a result, the operators had no written guidance on the correct operation of the recycle system. Employees also did not receive hazard communication training.

Task 1

Scenario 2 continued:

f) The accident took place the morning after a heavy snowfall. Workers shoveling snow just outside the building were unaware of the imminent explosion. There were no warning systems in place for acetylene leaks.

g) Inside the building, sprinkler heads for the emergency system were improperly maintained and clogged.

h) ASCO did not provide Flame Retardant Clothing and workers were not fit tested for the personal protective equipment they used.

Source: CSB Safety Bulletin at ASCO available online

Task 1

1. Review the factsheets on pages 7 - 20. Then in your groups, pick a scribe and list the safety systems *and* subsystems that are flawed in each paragraph above. You can list *more than one* failed system or subsystem for each paragraph.
   - Factsheet 1 defines Systems of Safety.
   - Factsheets 2-7 explain each of the systems.
   - Factsheet 8 includes a chart showing all the systems and examples of subsystems. You will also find a tear-out version of Factsheet 8 on page 25.
   - Factsheets 9 -13 show how systems of safety can relate to OSHA's Hazard Communication and Process Safety Management Standards.

Flawed System(s) and Subsystem(s)
a. System(s): **Subsystem(s):**
b. System(s): **Subsystem(s):**
c. System(s): **Subsystem(s):**
d. System(s): **Subsystem(s):**
e. System(s): **Subsystem(s):**
f. System(s): **Subsystem(s):**
g. System(s): **Subsystem(s):**
h. System(s): **Subsystem(s):**

Safety Systems and Sub-Systems Worksheet

Safety Systems	**Design/ Engineering**	**Mitigation Devices**	**Mechanical Integrity**	**Warning Devices**	**Training & Procedures**	**Personal Protective Factors**
Safety Sub-System Note: There may be additional sub-systems that are not included in this chart. Also in the workplace many subsystems are interrelated. It may not always be clear that an issue belongs to one subsystem rather than another.	Job Pre-Planning Resource Allocation Design of Work Area, Equipment, Procedures, and Software Safe Siting Chemical Selection and Safer Chemical Substitution Management of Change Process Design Standards, Codes, and Policies such as: OSHA Standards, and Fire or Electrical Codes **Work Organization** Staffing, Scheduling, and Workload Skills and Qualifications Management of Personnel Change Joint Committees Communications	Shutdown and Isolation Devices Relief and Check Valves Enclosures, Barriers, Fencing, Dikes and Containment Machine Guarding Seat Belts and Air Bags Fire and Chemical Suppression Devices Back-up Generator System and Emergency Outlets	Inspection and Testing Preventive Maintenance Parts Quality Control Turnarounds and Overhauls Equipment Failures Machinery or Equipment	Monitors Emergency Notification Systems Process Alarms Facility Alarms Community Alarms Life Support Systems Smoke or Carbon Monoxide Detectors Back-up Alarms on Vehicles Caution Signs, Cones, or Movable Barriers	Up-to-date Operating Manuals and Procedures Emergency Preparedness and Response Training HAZCOM Training Hazard Assessment and Analysis Maintenance Procedures Pre-Startup Safety Review Permit Programs Refresher Training Communications Proper Disposal Spill Preparedness Process Safety Information Recordkeeping OSHA 300 Logs Mold Removal Training and Procedures	Personal Protective Equipment Respirators, Gloves, Eye and Hearing Protection Worker Participation and Decision-Making (HF)
Hierarchy of Controls	Elimination or Substitution	Engineering Controls	Administrative Work & Practice Controls	Administrative Work & Practice Controls	Administrative Work & Practice Controls	Personal Protective Equipment

(HF) Indicates that this subsystem is often included in a category call Human Factors.
* There may be additional subsystems that are not included in this chart. Also in the workplace many subsystems are interrelated. It may not always be clear that an issue belongs to one subsystem rather than another.

Factsheet #1

Systems of Safety

When we think about safety we usually focus on injuries and fatalities suffered by individual workers. We generally don’t spend much time thinking about the safety systems that exist.

A system of safety can be defined as the use of specific labor/management programs that actively seek to identify and control hazards (a proactive system). This begins in the conceptual (planning) phase of a new project or work application and continues throughout the entire process.

There are many subsystems that make up these major systems of safety. For example, process alarms would be subsystem of warning devices.

Major Systems of Safety
Design & Engineering
Mechanical Integrity
Mitigation Devices
Warning Devices
Training and Procedures
Personal Protective Factors

You may have additional systems of safety at your site. They may be organized differently and have different names, but all of our facilities have systems of safety in place.

Source: Adapted in part from Harold Roland and Brian Moriarty, *System Safety Engineering and Management*, New York: John Wiley and Son, 1983.

Factsheet #2

The Design/Engineering System

A central purpose of the Design/Engineering System of Safety is to eliminate hazards through the selection of safe or low-risk processes and chemicals whenever possible.

One example of good design safety is the substitution of a less hazardous chemical such as sodium hypochlorite (bleach), for chlorine in treating cooling water. A release of toxic chlorine gas can travel in the wind for miles, whereas a spill of bleach is inherently less dangerous.

Primary prevention eliminates or significantly reduces the possibility of injuries on the job.

Important elements of the design/engineering system may include:

- Design and engineering of equipment, procedures and software;
- Management of change;
- Chemical selection and substitution;
- Safe siting;
- Workload; and
- Work organization.

Factsheet #3

The Mechanical Integrity System

Properly designed equipment can become unsafe if it isn't appropriately maintained, inspected and repaired. An effective mechanical integrity system should be evaluated based on its performance in eliminating the use of breakdown maintenance.

Important elements of the mechanical integrity system include:

- Safety and skills training for employees and subcontractors involved in installing, maintaining, repairing or inspecting equipment;
- Maintaining regular preventive maintenance schedules;
- Keeping spare parts readily available;
- Adequate staffing to eliminate work order and preventive maintenance backlogs;
- Employee involvement in developing and overseeing this system;
- Written procedures for each task performed; and
- Use of proper materials, equipment, tools and spare parts, including use of a quality control program.

Factsheet #4

The Mitigation System

The mitigation system of safety involves the use of equipment that automatically acts to control or reduce the adverse consequences of hazardous incidents. Mitigation devices do not require any action on the part of employees in order for the equipment to function.

The mitigation system provides opportunities for secondary prevention. Mitigation equipment does not eliminate hazards; it only controls the severity of incidents.

Typical examples of mitigation devices are:

- Backup generator systems;
- Other automatic trip devices;
- Automatic sprinkler systems;
- Enclosures, barriers, fencing, dikes and containment ;
- Machine guarding; and
- Seat belts and airbags.

Factsheet #5

The Warning System

The warning system of safety includes the use of devices that warn employees that a dangerous or potentially dangerous situation is occurring. These warning components require worker intervention to control or mitigate the hazardous situation. Workers must be able to understand the warning. They must also be able to respond in a timely manner and understand what actions are necessary.

Examples of warning devices include:

- Facility alarms;
- Process alarms;
- Emergency notification systems;
- Caution signs, cones or movable barriers;
- Community alarms;
- Monitors; and
- Back-up alarms on vehicles.

Factsheet #6

The Training and Procedures System

Work practice procedures reduce the likelihood of exposures and injuries. The process relies on a comprehensive system of training and written procedures. The greater the hazard, the greater the need for training and procedures.

Parts of an effective training and procedures system include:

- Procedures and training that consistently incorporate an emphasis on the importance of the safety;
- Employee involvement in developing and overseeing training and procedures activities;
- Methods developed by management and employees to ensure that training is understood, promotes safety, and is not punitive;
- An emergency response plan and training that are in place and routinely practiced; and
- Procedures and training that identify all potential hazards, the possible consequences of these hazardous conditions and the actions needed to prevent or respond to each hazard or potential hazard.

Factsheet #7

Personal Protective Factors

Personal protective factors are the last line of defense among the various systems of safety. They define the traditional roles that employees play in health and safety and generally include obeying the rules (individual behavior) and wearing Personal Protective Equipment (PPE). Unfortunately, in far too many situations, PPE and behavior are used to compensate for hazards that are built into the work process.

Being Proactive

A better approach is to view the role of workers as proactive and engaged in the process of making the facility a safe and healthy environment. This perspective requires the entire staff to look critically at the workplace, work together to identify the hazards and then contribute ideas, experience and know-how to correct the system flaws.

When workers are actively engaged in the process of identifying systems flaws and correcting them using higher-level solutions such as Design and Engineering, the hazards can be eliminated or significantly reduced.

Factsheet #8

Safety Systems and Sub-Systems Worksheet

Safety Systems	**Design/ Engineering**	**Mitigation Devices**	**Mechanical Integrity**	**Warning Devices**	**Training & Procedures**	**Personal Protective Factors**
Safety Sub-System Note: There may be additional sub-systems that are not included in this chart. Also in the workplace many subsystems are interrelated. It may not always be clear that an issue belongs to one subsystem rather than another.	Job Pre-Planning Resource Allocation Design of Work Area, Equipment, Procedures, and Software Safe Siting Chemical Selection and Safer Chemical Substitution Management of Change Process Design Standards, Codes, and Policies such as: OSHA Standards, and Fire or Electrical Codes **Work Organization** Staffing, Scheduling, and Workload Skills and Qualifications Management of Personnel Change Joint Committees Communications	Shutdown and Isolation Devices Relief and Check Valves Enclosures, Barriers, Fencing, Dikes and Containment Machine Guarding Seat Belts and Air Bags Fire and Chemical Suppression Devices Back-up Generator System and Emergency Outlets	Inspection and Testing Preventive Maintenance Parts Quality Control Turnarounds and Overhauls Equipment Failures Machinery or Equipment	Monitors Emergency Notification Systems Process Alarms Facility Alarms Community Alarms Life Support Systems Smoke or Carbon Monoxide Detectors Back-up Alarms on Vehicles Caution Signs, Cones, or Movable Barriers	Up-to-date Operating Manuals and Procedures Emergency Preparedness and Response Training HAZCOM Training Hazard Assessment and Analysis Maintenance Procedures Pre-Startup Safety Review Permit Programs Refresher Training Communications Proper Disposal Spill Preparedness Process Safety Information Recordkeeping OSHA 300 Logs Mold Removal Training and Procedures	Personal Protective Equipment Respirators, Gloves, Eye and Hearing Protection Worker Participation and Decision-Making (HF)
Hierarchy of Controls	Elimination or Substitution	Engineering Controls	Administrative Work & Practice Controls	Administrative Work & Practice Controls	Administrative Work & Practice Controls	Personal Protective Equipment

(HF) Indicates that this subsystem is often included in a category call Human Factors.
* There may be additional subsystems that are not included in this chart. Also in the workplace many subsystems are interrelated. It may not always be clear that an issue belongs to one subsystem rather than another.

Factsheet #9

Root Causes

When we look at the causes of an injury, accident or chemical exposure we have to look beyond employee behavior. Unsafe acts, unsafe conditions and accidents are symptoms of failed systems of safety. System failures are the "root" causes of accidents and exposures.

Root causes are sometimes referred to as "basic" causes because they are the prime factors that cause an accident. There are almost always several root causes involved in an incident, accident or near-miss. For example, the root causes of an electrocution might include improperly designed or maintained equipment, poor lockout procedures or inadequate training. Root causes are always found in management safety systems. Effective prevention of similar incidents requires changing management systems.

The Environmental Protection Agency emphasizes "root causes":

> "...an operator's mistake may be the result of poor training, inappropriate standard operating procedures (SOPs), or poor design of control systems; equipment failure may result from improper maintenance, misuse of equipment (operating at too high a temperature) or use of incompatible materials. Without a thorough investigation, facilities may miss the opportunity to identify and solve the root problems."

What we see is above ground, but what really matters is sometimes hidden from initial view.

Factsheet #9 continued

Examples of Root Causes:

- Poor design of process units and equipment;
- Poor layout of control room indicators and controls;
- Difficult access to equipment;
- Unsafe siting and spacing of process units and equipment;
- Lack of preventive maintenance or inspection;
- Inadequate procedures or training for both normal and emergency situations;
- Excessive overtime; and
- Inadequate staffing levels.

Sources: Mine Safety and Health Administration, Accident Prevention, 1990, pp. 35-38. Center for Chemical Process Safety, *Guidelines for Investigating Chemical Process Incidents*, New York: American Institute of Chemical Engineers, 1992, pp. 129-131. American Institute of Chemical Engineers, *Guidelines for Auditing Process Safety Management Systems*, Environmental Protection Agency Proposed Rule, Risk Management Programs for Chemical Accidental Release Prevention.

Factsheet #10

Systems vs. Symptoms

When attention is focused on worker injuries, we are only seeing the tip of the safety iceberg. Focusing on "unsafe behaviors" when a worker is injured does not take us down the road to prevention. Worker injuries, unsafe conditions and accidents are symptoms of something wrong in the facility's systems of safety. The root causes of incidents are found in system failures such as faulty design or inadequate training which lead to worker injuries, illnesses and accidents.

Too many facilities use injury and illness statistics (the ones recorded in OSHA 300 injury and illness log) as a key measure of safety in the workplace. There are serious problems with this. Recent studies have demonstrated that OSHA 300 logs seriously under-record actual job injuries and illnesses.

Using employer-kept injury and illness statistics as a key measure of workplace safety can focus attention away from extremely hazardous conditions. The U.S. Chemical Safety and Hazard Investigation Board (CSB) illustrated this in the report of their investigation of the March 2005 explosion and fire at the BP refinery in Texas City. In the Executive Summary of the report, the CSB wrote:

> "One underlying cause [of the explosion and fire] was that BP used inadequate methods to measure safety conditions at Texas City. For instance, a very low personal injury rate at Texas City gave BP a misleading indicator of process safety performance. In addition, while most attention was focused on the injury rate, the overall safety culture and process safety management (PSM) program had serious deficiencies. Despite numerous previous fatalities at the Texas City refinery (23 deaths in 30 years prior to the 2005 disaster) and many hazardous material releases, BP did not take effective steps to stem the growing risk of a catastrophic event."

Process safety management involves the use of management systems to control hazards and reduce the number and seriousness of process-related incidents and accidents. **Accident prevention requires making changes in systems of safety.**

Sources: Center for Chemical Process Safety, Guidelines for Investigating Chemical Process Incidents, New York: American Institute of Chemical Engineers, 1992; Rosenman, K.D., Kalush, A., Reilly, M.J., Gardiner, J.C., Reeves, M., Luo, Z., "How much work-related injury and illness is missed by the current national surveillance system?," Journal of Occupational and Environmental Medicine 2006; 48:357-365; U.S. Chemical Safety and Hazard Investigation Board's Investigation Report: Refinery Explosion and Fire, Report No. 2005-04-1-TX, March, 2007.

Factsheet #11

Hazardous Chemicals in Our Workplaces

The Occupational Safety and Health Administration (OSHA) requires all employers to comply with the Hazard Communication Standard (HAZCOM). It requires employers to inform employees about the chemical hazards they are potentially exposed to on the job.

The Process Safety Management Standard also requires employers to train employees about safety and health hazards, including effects of chemical exposures from highly hazardous process chemicals.

Under HAZCOM, employers must develop a hazard communication program that includes training employees on how to safely use the chemicals they work with.

A basic HAZCOM program must include the following:

- A list of the hazardous chemicals used at the workplace;
- Chemical labeling procedures; *
- Safety Data Sheets;
- Employee training; and
- A written plan explaining how the employer will comply with the hazard communication standard

Public Employees in New Jersey

The Public Employees Occupational Safety and Health Act, which covers non-federal government employers in New Jersey, enforces a very similar hazard communication standard.

*For more information on chemical labeling refer to *A Guide to The Globally Harmonized System of Classification and Labeling of Chemicals (GHS):* https://www.osha.gov/dsg/hazcom/ghsguideoct05.pdf

OSHA's Hazard Communication Standard, 29 CFR 1910.1200, addresses the informational needs of employers and workers with regard to chemicals. The HCS was first promulgated in 1983, and covered the manufacturing sector. It was later expanded to cover all industries where workers are potentially exposed to hazardous chemicals. In 2012, the HCS was modified to align its provisions with the United Nations' Globally Harmonized System of Classification and Labelling of Chemicals (GHS).

Factsheet #12
Hazard Communication in the Maritime Industry

The hazard communication requirements under OSHA's Hazard Communication Standard (HAZCOM) 2012 are applicable to maritime employment. See standard numbers §1915.1200 (shipyard employment), §1917.1(a)(2)(vi) (marine terminals), §1918.1(b)(4) (longshoring).

While several changes were made as part of the standard's revision, employers' obligations remain largely the same. Employers are still responsible for maintaining a written hazard communication program at each workplace, maintaining labels on shipped containers of chemicals, labeling secondary (in-house) containers of chemicals, using Safety Data Sheets (SDSs), providing workers information and training, and ensuring the effective communication of potential exposure to hazardous chemicals. Where multi-employer worksites exist, the hazard communication program must also include steps for the communication of hazards to the workers of the other employers.

Categories of Chemical Hazards: A chemical hazard is any substance that can cause harm. These chemical hazards are typically divided into three categories *Physical*, *Health* and *Hazards Not Otherwise Classified*. *Physical Hazards* include corrosives, flammables and combustibles. *Health Hazards* from exposure to chemicals can cause acute or long-term detrimental physical or health risks. *Hazards Not Otherwise Classified* covers health or physical hazards whose effect falls below the cut-off value/concentration limit or GHS hazard category that has not been adopted by OSHA.

Information and Training Workers must be trained on hazardous chemicals that they may be exposed to during work in a manner and language that they can understand. At a minimum, training must be conducted at the time of initial assignment to the work area, and whenever a new hazard is introduced. Workers must also be informed of the requirements of the HAZCOM standard, any operations in their work area where hazardous chemicals are present, and the location and availability of the written hazard communication program, including the required lists of hazardous chemicals and SDSs.

For more information on HAZCOM and the Maritime Industry go to OSHA's website: www.OSHA.gov.

Source: OSHA.GOV, Hazard Communication in the Maritime Industry factsheet: https://www.osha.gov/Publications/OSHA3694.html

Factsheet #13

OSHA PSM and Systems of Safety

The Occupational Safety and Health Administration's (OSHA) Process Safety Management (PSM) Standard provides an example of how systems of safety are used in other hazardous industries. For instance, the PSM Standard requires that, at a minimum, companies formally establish certain systems and subsystems of safety. The chart below shows how some of OSHA's PSM requirements fit into a system of safety framework.

System of Safety	Related PSM Standard
Mechanical Integrity	Maintenance and Inspection Subcontractors
Training & Procedures	Operating procedures Training Hot Work Emergency planning and response
Design/Engineering, Warning Devices and Mitigation Devices	Process safety information Process hazard analysis Management of change Pre-startup safety review

Task 2

In your groups, pick a scribe. Discuss an accident or near miss situation that you or a coworker experienced. Then, based on your own experience and what you have learned about systems of safety, complete the worksheet on the next page.

In the first column: Describe what happened.

In the second column: Identify the failed systems and subsystems (there may be more than one system or subsystem involved). Also list any systems and/or subsystems you think may have failed but would need more information in order to determine if it's flawed.

Be prepared to discuss any recommendations you may have to address the failed system(s).

What Happened? *(Please explain in detail)*	**Flawed Systems/Subsystems**
	System: Subsystems: Do you need more info—Yes or No? If so, where will you find it? Recommendations:
	System: Subsystems: Do you need more info—Yes or No? If so, where will you find it? Recommendations:
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Summary: Systems of Safety in General Industry

1. Proactive Systems of Safety are the key to preventing disasters and injuries.

2. Major Systems of Safety include:

   Design and Engineering;

   Maintenance and Inspection;

   Mitigation Devices;

   Warning Devices;

   Procedures and Training; and

   Personal Protective Factors.

3. The Design and Engineering System can provide primary prevention by eliminating the possibility of a serious accident. The other Systems of Safety provide secondary prevention by reducing the probability or severity of an accident.

4. Each plant may have different structures and names for its Systems of Safety, but all plants have Systems of Safety.

5. Active management and union/employee involvement in Systems of Safety are essential for these systems to be effective.

6. Understanding the hierarchy of Systems of Safety (with design as the primary system) enables workers to become active participants in developing and implementing safe work practices (“training and procedures”).

7. Unsafe conditions, unsafe acts, and accidents are symptoms of failures in Systems of Safety. System failures are the “root” causes of accidents and exposures. Effective prevention of similar incidents requires changing and improving the systems.

8. Effective Systems of Safety help fulfill the requirements of OSHA’s Process Safety Management and HAZCOM Standards.

Safety Systems and Sub-Systems Worksheet Tear-out Page

Safety Systems	Design/ Engineering	Mitigation Devices	Mechanical Integrity	Warning Devices	Training & Procedures	Personal Protective Factors
Safety Sub-System Note: There may be additional sub-systems that are not included in this chart. Also in the workplace many subsystems are interrelated. It may not always be clear that an issue belongs to one subsystem rather than another.	Job Pre-Planning Resource Allocation Design of Work Area, Equipment, Procedures, and Software Safe Siting Chemical Selection and Safer Chemical Substitution Management of Change Process Design Standards, Codes, and Policies such as: OSHA Standards, and Fire or Electrical Codes **Work Organization** Staffing, Scheduling, and Workload Skills and Qualifications Management of Personnel Change Joint Committees Communications	Shutdown and Isolation Devices Relief and Check Valves Enclosures, Barriers, Fencing, Dikes and Containment Machine Guarding Seat Belts and Air Bags Fire and Chemical Suppression Devices Back-up Generator System and Emergency Outlets	Inspection and Testing Preventive Maintenance Parts Quality Control Turnarounds and Overhauls Equipment Failures Machinery or Equipment	Monitors Emergency Notification Systems Process Alarms Facility Alarms Community Alarms Life Support Systems Smoke or Carbon Monoxide Detectors Back-up Alarms on Vehicles Caution Signs, Cones, or Movable Barriers	Up-to-date Operating Manuals and Procedures Emergency Preparedness and Response Training HAZCOM Training Hazard Assessment and Analysis Maintenance Procedures Pre-Startup Safety Review Permit Programs Refresher Training Communications Proper Disposal Spill Preparedness Process Safety Information Recordkeeping OSHA 300 Logs Mold Removal Training and Procedures	Personal Protective Equipment Respirators, Gloves, Eye and Hearing Protection Worker Participation and Decision-Making (HF)
Hierarchy of Controls	Elimination or Substitution	Engineering Controls	Administrative Work & Practice Controls	Administrative Work & Practice Controls	Administrative Work & Practice Controls	Personal Protective Equipment

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