Safety in Focus

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Loss Prevention Department

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Chemical Hazard Bulletins

By Anthony B. Martinez, Dhahran Area Loss Prevention Division

Employees in industrial settings, especially those in oil and gas operations, often handle many different chemicals on a daily basis. To easily access health and safety information about each chemical, Saudi Aramco employees can read the relevant Chemical Hazard Bulletins (CHBs).

A CHB is a one-page summary that lists the main health hazards and precautions for a specific chemical. It helps employees recognize a chemical's hazards and how to use and handle it safely. As part of Saudi Aramco Safety Management System (SMS) Element 6, "Safe Operations," and General Instruction (GI) 150.100, *Hazardous Materials Communication* (HAZCOM) *Program,* every department that handles chemicals needs to include CHBs in their industrial hygiene program. There are roughly 1,400 CHBs available in English and Arabic — all available on Saudi Aramco's intranet.

Obtaining CHBs

Within Saudi Aramco, CHBs can be retrieved through the Environment Health & Safety (EH&S) site on the corporate portal (see Figure1). Click on the EH&S tab and a menu will appear on the left hand side of the screen. Click on the last option, Chemical Hazard Bulletins & Labels, at the bottom of the menu and complete the following three steps:

1. Select CHB or chemical label.
2. Select the chemical name or CHB number.
3. Click on GENERATE and you can save or print the CHB.

CHB format

CHBs provide information in a standard format for chemicals used in Saudi Aramco. Five main sections enable you to find the information you need quickly. The sections are:

- **Heading** — Summarizes the chemical's characteristics and includes a color-coded hazard rating for health, fire and reactivity risks that indicates "at a glance" how dangerous a chemical is based on its rating.
- **Health hazard** — Describes how the chemical affects human health, lists the safe exposure limits and lists the required appropriate personal protective equipment (PPE).
- **Fire and reactivity** — Indicates if the chemical is a fire hazard and the degree of the fire hazard, and describes how the chemical may react with other chemicals.
- **Handling, disposal and storage** — Provides information on how to use and store the chemical safely, what precautions you need to take and what PPE you need to wear when handling the chemical.
- **Emergency first aid** — Lists specific procedures in case of exposure to the chemical.

At the bottom of the CHB, there are Industrial Hygiene help numbers if additional information is needed for that particular chemical.

Requirements and responsibilities

Any purchased or Saudi Aramco produced chemical must have a CHB. The Environmental Protection Department (EPD) develops each CHB according to GI 150.100. This GI identifies proponent, EPD and the Materials Supply Department responsibilities with respect to CHBs.

Figure 1. Procedure for obtaining CHBs

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- Relevant CHBs (or material safety data sheets [MSDSs] if CHBs are unavailable) are posted where particular chemicals are stored and used.
- EPD develops CHBs for hazardous materials used and produced by Saudi Aramco, and makes an electronic copy available.
- The Materials Supply Department ensures that suppliers of all chemicals provide Saudi Aramco with MSDSs and forwards them to EPD three weeks prior to introduction of each chemical.

Once CHBs are developed and properly posted, employees need to be trained on how to understand them.

Employee training

All Saudi Aramco employees who work with hazardous chemicals need to attend in-classroom chemical hazard awareness training initially and complete the online computer-based training refresher every three years to ensure that they stay abreast of current information on hazardous chemicals.

Human Behaviors in Emergency Planning

By Salman E. Al Mughais, Ras Tanura Area Loss Prevention Division

The severity and consequences of any emergency can be influenced by the behaviors of those involved. That is why understanding how people actually behave versus how they should behave is critical during all phases of the emergency planning process (i.e., mitigation, preparedness, prevention, response and recovery). In an effort to protect the lives, assets and the environment from the effects of hazardous events, an organization must develop an effective emergency response plan (ERP) and then conduct drills to monitor employee behaviors.

Mitigation phase

The mitigation phase (the action taken to reduce and eliminate losses) of an ERP includes hazard identification, risk assessment and risk reduction. During these stages, it is important to include experienced, knowledgeable employees who operate and maintain the facilities, as they can identify the unique hazards in their facilities and operations. Technical experts can help identify and plan the corrective actions needed in the event of an emergency. When an alarm is unexpectedly activated, typically people don't react immediately, but instead look to see what others are doing — paying particular attention to the actions of more experienced employees. If experienced employees are putting on personal protective equipment or evacuating the facility, others will do the same.

Research indicates that the credibility of an emergency team delivering the ERP messages is an important factor in preventing losses. Experienced employees who take part in the hazard identification process can demonstrate and model the necessary corrective actions, which, with proper training, others will follow.

Prevention phase

This phase deals with the equipment, systems and personnel actions required to avoid an incident, lessen the consequences or intervene and stop an incident from occurring. Control and alarm systems, such as pressure control valves and flammable gas detection systems, provide proactive measures to prevent an emergency situation from escalating. Drills help employees identify and understand what needs to be done, so they can demonstrate appropriate behaviors in a real emergency.

Enforcing safety rules and regulations, such as the work permit system, also helps prevent incidents or minimize their severity. Correct safety behaviors and adherence to safety rules ensure that personnel can respond appropriately to alarms. When management uses behavioral safety observations, it frequently improves the individual response actions during an emergency.

Preparedness phase

The preparedness phase is a continuous cycle of planning, organizing and training, exercising, evaluating and taking corrective action to ensure effective incident response. Predisaster actions are developed and assessed by the individual organization. Because each organization has unique hazards, operations and employees, each ERP must be tailored to meet those specific conditions.

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The ERP must:

- Include emergency management policy, purpose and scope.
- Include general and hazard-specific response procedures.
- Contain a description of management's fundamental responsibilities.
- Identify and evaluate credible incident scenarios.
- Determine the emergency controls.
- Assess the capabilities and resources.

The ERP describes key positions, such as incident manager and incident commander, and outlines their roles. It also details the strategies and tactics during an incident and what specific resources are needed.

Since human behaviors play a significant role in the success or failure of the ERP, behavior modification starts with training key personnel in their roles and responsibilities. Success depends on the ability to understand, predict and direct behavior.

Response phase

The ERP addresses the immediate and short-term effects of emergency and disaster situations. This is the point where expected human behaviors in an emergency can be observed. The desired behaviors, which were identified during the planning process, increase the likelihood that employees will respond appropriately in disaster and emergency situations. If the proper behaviors are not observed, more drills and training are necessary.

Training and drills prepare employees to take quick action. In dangerous situations, it is difficult to change the usual pattern of panicking behaviors. Drills equip employees with the skills to react and behave appropriately.

Recovery phase

The final phase is recovery, where efforts are aimed at returning the facility to normal operation. This phase includes social and environmental restoration through:

- Assessment of damage.
- Restoration of safety and emergency systems.
- Recovering resources and cleanup operations.
- Securing the scene.
- Authorization of an investigation.
- Assistance for affected personnel.

A fundamental element of the recovery phase is proper incident evaluation to identify lessons learned and mitigate the effects of future incidents. Fear and panic among personnel during the emergency can alter perceptions of the incident and therefore lead to incorrect or incomplete conclusions. Long-term care and treatment may be needed for the affected personnel. Allowing employees time to recover and assisting the families that have been affected has corporate as well as humanitarian benefits.

What Is Radiation?

By Nicolae Marius Vasile, 'Udhailiyah Area Loss Prevention Division

Just like Spider-Man, the Incredible Hulk and the Fantastic Four, you have been exposed to radiation. Everyone has been exposed, although comic book superheroes appear to be the only ones who gain superpowers as a result.

Natural radiation exists in and around us. We are subjected to external and internal radiation because the ground that we walk on, the building materials for our houses, the air we breathe and the food that we eat all contain naturally occurring radionuclides. Even our body contains small quantities of radionuclides from carbon, water and potassium.

Radiation is a form of energy. There are two categories based on the way the energy interacts with normal chemical matter, **ionizing** radiation (alpha, beta, X-ray, gamma and neutron) and **nonionizing** radiation (radio waves, microwaves, infrared and [sometimes] visible light).

Both ionizing and nonionizing radiation can be harmful to organisms and cause changes to the natural environment.

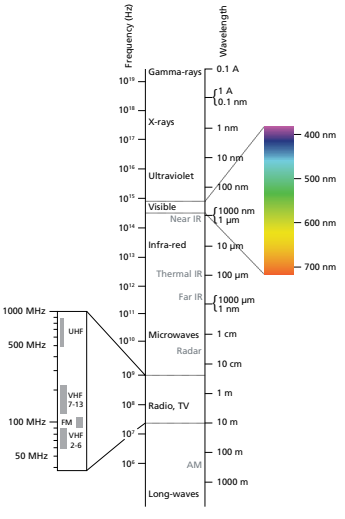

Figure 1. Radiation frequencies and wavelengths

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In general, however, ionizing radiation is far more harmful to living organisms per unit of energy deposited than nonionizing radiation, because the ions that are produced by ionizing radiation, even at low radiation powers, have the potential to cause genetic damage.

Sources of high-energy radiation

There are many sources of harmful, high-energy radiation. It is important to understand that 80% of human exposure comes from natural sources, such as outer space, rocks and soil, naturally occurring radioactive materials (NORM), radon gas and the human body. The remaining 20% comes from radiation sources such as those used in medical and dental diagnostic procedures, lab analysis and construction.

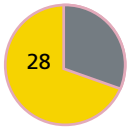
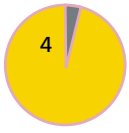
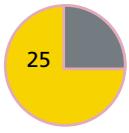
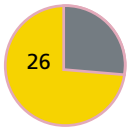
Natural Sources		Annual Dose (mrem/year)
	Cosmic Rays (Radiation from the sun and outer space)	
	Building Materials	
	The Human Body	
	The Earth	

Figure 2. Sources of radiation (excluding NORM)

Benefits of using radiation

Different forms of radiation are used in a variety of disciplines and areas that are beneficial for health, science and even cooking convenience. In medicine, radiation and radioactive substances are used for diagnosis, treatment and research. X-rays are used to find broken bones and to locate cancers. Radiation is also used for cancer treatment: to kill modified cells or change genes so the harmful cells cannot grow.

All modern communication systems, including mobile phones, use several forms of electromagnetic nonionizing radiation.

When most people think of radiation in the workplace, they think of nuclear power plants, uranium mines, hospital workers or dental X-rays, but radiation is used in many workplaces. Construction, drilling and lab analysis all use radiation.

The construction of buildings and highways use powerful radiation sources to measure the density of concrete and road surfaces and the integrity of structural steel. In drilling, radiation can be found in oil drilling muds and slurry from core cutting. In science, researchers use radioactive atoms to determine the age of materials that were once part of a living organism.

For industrial use, radiation is a major element of nondestructive testing, using the ability of short X-rays and gamma rays to penetrate various materials. Infrared and microwaves are nonionizing radiations used in our kitchens.

Biological effects of ionizing radiation

Ionization in industrial materials is usually not a big concern. In most cases, once the radiation ceases, the electrons rejoin the atoms and no damage is done.

But ionization exposure does cause damage to living tissue. High doses cause skin burns, radiation sickness and even death. Long-term or continual exposure to low doses can cause cancer, tumors and genetic damage. Therefore, despite the many benefits of ionizing radiation, it has serious negative effects and needs to be used with care.

Ionizing radiation can cause two main types of biological effects:

1. Somatic effects — the damage appears in the irradiated person.
2. Genetic effects — the damage arises in the offspring of the irradiated persons as a result of radiation damage to reproductive cells.

Control of exposure and protective measures

We can be affected either externally, by direct effect of a radiation source or internally, if the radiation source enters our body by ingestion or inhalation. Alpha (α) radiation consists of a fast moving helium-4 (^{4}He) nucleus and can be stopped by a sheet of paper. Beta (β) radiation, consisting of electrons, can be halted by an aluminum plate. Gamma (γ) radiation, consisting of energetic photons, is eventually absorbed as it penetrates a dense material. Neutron (n) radiation consists of free neutrons that are blocked using light elements, like hydrogen, which slow or capture them.

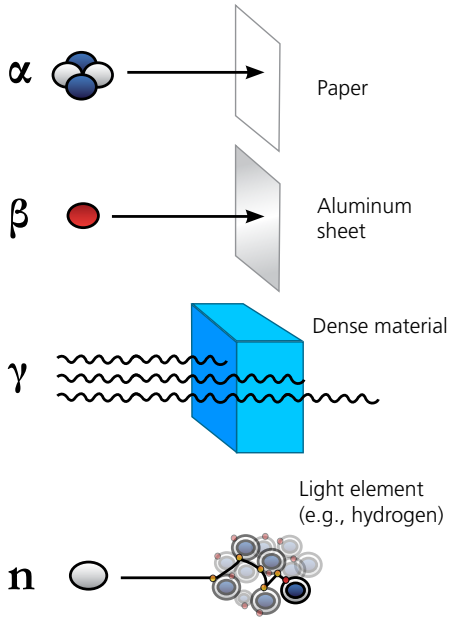


Figure 3. Radiation barriers

Any person working with, or in the vicinity of, radiation sources will inevitably be exposed to some radiation. Some basic protective actions can minimize the dose:

- **Distance** — The dose received is inversely proportional to the distance

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from the radiation source. Distance is a very effective way of reducing the amount of exposure.

- **Shielding** — A shield in the radiation path causes the radiation to be attenuated and scattered in various directions.
- **Time** — Radiation dose is proportional to the time spent in the radiation field. Work in a radiation area should be carried out quickly and efficiently. Workers should not be distracted by other tasks or by conversation, and take care not to make mistakes, which might lead to greater exposure.

Radiation is an important tool of many work and other processes, but like all tools, it should be used with care, observing the recommended safety standards, rules and procedures.

Figure 4. 2007 ISO radioactivity danger symbol

Safely Dispense Flammable Liquids

By Hocine Ait Mohamed, Loss Prevention Department

Flammable and combustible liquids are present in nearly every industrial workplace and are especially prevalent in Saudi Aramco operations. Flammable liquids are normally stored in enclosed drums or pails to contain any combustible vapors. If dispensed or stored improperly, they can present significant safety hazards — serious fires, severe burn injuries and even death. Knowing the right way to dispense flammable liquids, and understanding how to operate or use the equipment involved, will make for a safer workplace.

Flammable liquid hazards

Dispensing flammable liquids represents a serious hazard because any ignition sources, such as electrical sparks, static electricity or open flames, can ignite flammable liquids if they spill from a container. The size of the fire, however, is not always limited to the spill itself. Burning liquids can spread and ignite nearby combustibles, creating an even larger fire and possibly an explosion.

To reduce the fire hazard of a potential release, it is vital to keep vapors contained, eliminate possible ignition sources and limit the fire area. Prevention and control efforts can eliminate liquid losses and potential damage. If safe-guards are provided and employees handle flammable liquids safely, losses and injuries can be minimized.

Some equipment safeguards that enable workers to safely dispense flammable liquids from drums include the following.

Figure 1. Self-closing faucet, safety bung and grounding clamps

Liquid drums

In general, liquids are dispensed with the drum on its side or upright. Using a self-closing faucet and safety bung significantly reduces the likelihood of a fire during on-side dispensing (see Figures 1 and 2). The inherent hazard of on-side dispensing is that the drum can empty due to a faucet failure.

The safest way to dispense liquids from a drum is with a drum pump (see Figure 3). The drum remains vertical

Figure 2: Safety bung and self-closing faucet installation on steel on-side drum

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and there is no chance of accidental discharge unless the drum is physically damaged. Drum pumps are designed to fit into the 2-inch drum opening. They either provide a vapor-tight seal or have a flame arrester at the drum connection. Some drum pumps have vacuum venting while others require a safety bung.

Figure 3. Drum pump with grounding clamps

Safety bung

During on-side dispensing, the steel drum must have a safety bung. A safety bung prevents the failure of a drum filled with flammable liquid when it is exposed to a fire. Safety bungs have an emergency vent that operates between 3 and 8 psig.

They are also designed to permit liquid dispensing from the drum without creating a vacuum. In this case, a manually operated vent is located at the top of the safety bung. When dispensing, the vent is open to permit air to flow into the drum through a small hole that is just below the vacuum vent.

Safety bungs are designed to vent pressurized flammable vapors and prevent a flame from entering the drum. Safety bungs have flame arresters designed to extinguish a flame before it enters the drum.

Self-closing faucet

Another key safety measure when dispensing a flammable liquid from a drum is to use a self-closing faucet designed to ensure that liquid cannot be accidentally released — when the faucet handle is released the valve automatically closes. The faucet is also equipped with a flame arrester that prevents any flames from entering the drum.

Static electricity

In addition to controlling the release of flammable liquids and vapors, potential static discharge must be controlled during dispensing operations. Flammable liquids will always produce some flammable vapor when they are dispensed and a static discharge could easily ignite them. To control static, the drum must be grounded by connecting a grounding clamp between the drum and an electrically grounded object. The drum must also be bonded to the container receiving the liquid.

Workers who dispense flammable liquids correctly and who are familiar with all the equipment involved present much less of a risk to themselves, their coworkers and their workplaces. Proper training and implementation are critical to safe dispensing operations.

It's Time to Stop H_2S Incidents

By Abdulrahman M. Bagais, Planning and Technical Services Division, Loss Prevention Department

An employee at a plant in the US who breathed hydrogen sulfide (H_2S) gas lost consciousness and died after rescuing a coworker. The veteran employee had worked at the plant for nearly 30 years. He and a coworker were exposed to the H_2S gas when it leaked through a sewer line into their work area. The victim stayed behind to help a fellow worker who had been caught between two pipes. Nine workers plus the victim and his workmate were evacuated by ambulance and helicopter to hospital. Most of them recovered within hours. The coworker was released from hospital a couple of days later, but the victim fell into a coma at the scene and never recovered.

When will it stop? How many times have we heard or read about fatal incidents, such as this, involving H_2S in different industries worldwide, including the oil and gas industry? Most frequently, the root causes of these incidents are less than adequate hazard assessments or failure to adhere to procedures. H_2S is an unforgiving hazard and one of the leading causes of workplace gas inhalation deaths.

H_2S is a naturally occurring substance found in hydrocarbons (hence the term sour gas or sour crude). It can be produced as a byproduct during the hydrocarbon refining process. H_2S is also found in many other industries, such as paper manufacturing and chemical plants producing sulfur or sulfuric acid. In the environment, it is a byproduct of the decay of organic material.

Global markets are expanding the need for hydrocarbon processing and distribution infrastructure. At the same time, the average sulfur content of the hydrocarbons being processed in the world's refineries is increasing so it is

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even more crucial to learn from the mistakes of the past.

H_2S is a colorless, toxic and flammable gas with a strong odor of rotten eggs at low concentrations. Odor is not a reliable indicator of its presence as high concentrations or continuous exposure to H_2S deadens the sense of smell. At low concentrations, H_2S causes eye irritation, sore throat and coughing. As the concentration increases, symptoms include shortness of breath, headache, dizziness, nausea, vomiting and pulmonary edema. At high levels H_2S is fatal.

These contributing factors (or ineffective management systems and poor process safety practices) are routinely cited by H_2S incident investigators:

- Inadequate operating procedures and operator training.
- No or improperly implemented control measures limiting access to areas during activities involving potential H_2S releases.
- Poor knowledge and communication regarding the hazards of H_2S. This lack of awareness is shown by the fact that several employees enter affected areas or remain to help rescue coworkers immediately after an H_2S incident, without using the appropriate respiratory protection.
- Poor communication of lessons learned from incident investigations.
- Inadequate integrity and reliability programs to ensure proper calibration, inspection and maintenance of H_2S detectors.

Facilities must be designed, constructed, operated and maintained to minimize the possibility of a fire, explosion or any sudden release of hazardous materials (e.g., H_2S), which could threaten lives, damage physical assets or harm the environment. Management systems must be in place that consist of policies, procedures and work instructions that identify and define required actions, assign responsibilities and provide necessary training, oversight and verification.

If properly implemented, the following management system elements can help prevent H_2S incidents:

- Clear policies defining the goals of the program (i.e., compliance with all standards and regulations, and protecting the safety of workers, property and the environment).
- Written procedures for managing the facility's safety program, assigning responsibilities and work instructions.
- Adequate and structured hazard identification and evaluation programs while performing critical tasks.
- Proper training on established procedures and critical tasks.
- Management oversight to ensure adherence to procedures and identification of hazards through regularly scheduled audits and inspections.
- Communication of lessons learned from incident investigations.

It is important to understand the hazards involved and the need to keep H_2S contained. It is also vital to be familiar with the proper emergency response procedures in case of an H_2S release.

Resources

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

1. **Safety Films** available from the LPD Film Library:
   - 100.036 – MSDS – Material Safety Data Sheets
   - 100.073 – Radiation Safety
   - 100.281 – HazCom: In Sync With GHS
   - 900.156 – Flammable Liquids
   - 901.226 – The Silent Sniper
2. **Courses**
   - Course # 40012602 HAZCOM – Chemical Hazard Awareness (classroom)
   - Course # 40036918 HAZCOM – Chemical Hazard Awareness (online)
   - Hydrogen Sulfide Safety (e-Learning)
   - Hazard Recognition (e-Learning)
3. **Special Publications**
   - Visit LPD's special page dedicated to protection from Hydrogen Sulfide Hazards at: http://lp.aramco.com.sa/site/education/campaigns
   - *Understanding Hydrogen Sulfide Hazards* pamphlet (Arabic and English)
4. **References**
   - Saudi Aramco *Safety Handbook*
   - Saudi Aramco General Instructions (GIs) 150.100, *Hazardous Material Communication* (HAZCOM) *Program* and 150.003, *Ionizing Radiation Protection*
   - Saudi Aramco Engineering Procedure (SAEP)-1141, *Radiation Protection for Industrial Radiography,* and SAEP-390, *Radiation Protection Assessment (RPA) Program*
   - "What is Radiation?"p.4, Figure 1, courtesy of McGill University, Quebec, Canada
   - "What is Radiation?" p.5, Figure 2, courtesy of NDT (Non Destructive Testing) Resource Center
   - "What is Radiation?" Figure 3, Wikipedia

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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