SAVING OURSELVES

A BASIC REFERENCE MANUAL FOR HEALTH AND SAFETY ACTIVISTS

industriAll global union

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INTRODUCTION

Health and safety activists make the difference between safe, and unsafe, workplaces. Whether we are:

- **organizing the health and safety activities of the union**
- **ensuring the effectiveness of the joint health and safety committee (JHSC)**
- **proposing collective bargaining goals and language**
- **keeping workplace health and safety at the centre of the union's attention**
- **simply keeping an eye on conditions in the workplace every day**

… it is our vigilance and determination that helps ensure that our sisters and brothers go home from work without injury or illness.

Truly, it is up to us to save ourselves.

We demand three fundamental workers' rights in health and safety:

1. **the right to know – fully – about workplace hazards, and obtain training and education**
2. **the right to refuse, or shut down, unsafe work**
3. **the right to participate in decision making about health and safety through Joint Committees**

The right to participate forms the centrepiece of an effective workplace health and safety programme. In many ways, the other two rights flow from this one.

Although joint health and safety committees (JHSCs) are legislated in many jurisdictions and tend to be taken for granted today, it is important to remember that they were initially products of collective bargaining. Safety data sheets on dangerous materials were patterned on right-to-know clauses negotiated in the 1970s. The right to refuse unsafe work, which has theoretically existed for a longer time, only became a reality when unions began to insist on it. Rights follow activism.

IndustriALL works for better global health and safety standards through agencies such as the International Labour Organization (ILO); and global agreements with multinational employers – in the same way that our affiliates seek better national and regional regulations; and collective agreements with employers at the national and local levels. With the advent of instruments such as the OECD Guidelines for Multinational Enterprises, and the UN Guiding Principles on Business and Human Rights, global standards can have quite an impact, particularly where national legislation is weak.

No one approach is enough. We must use every tool in our kit. Joint workplace approaches, social dialogue, political action, good regulations, good enforcement, collective bargaining and industrial action are all necessary. It is not a question of one approach being better than the other. Without a workplace consensus on the need for occupational health and safety excellence, there will never be enough regulation and enforcement to make a difference. Without the laws, however, there is no way to deal with those employers who are unwilling to make a joint approach work.

JOINT HEALTH & SAFETY COMMITTEES

It is not possible to overestimate the importance of JHSCs. They provide a right to participate in occupational health and safety decision-making by workers. They make possible the achievement of "internal responsibility", which means that employers and workers have the capacity and responsibility together, to identify and solve occupational health and safety problems without relying on an outside agency.

Joint Health and Safety Committees are an achievement of union health and safety activism and collective bargaining.

Workers' rights to know, to refuse, and to participate are guaranteed by law in many jurisdictions because without the protection of the law, they can be under threat. For example, the right to refuse unsafe work under occupational health and safety legislation is redundant in a sense, because under most systems of law there is already an understood right to protect your own life. However, the exercise of this right in a workplace was accompanied by the near-certain risk of discipline or discharge. That is why occupational health and safety legislation generally builds in a procedure in the exercise of your right to refuse unsafe work; the law is meant to protect you against reprisals from your employer if you follow the procedure.

Joint Health and Safety Committees were created because unions demanded that those with the most knowledge of the hazards and who are most directly exposed to the risks – the workers – have a voice in health and safety conditions at work. It is the JHSC that gives meaning to the workers' right to participate in occupational health and safety. We want workplace health and safety done "with" us, not "to" us; and the only people with the moral authority to assess a risk are those who face the risk.

WHAT JHSCs SHOULD DO

The primary business of the joint health and safety committee (and therefore of members of the Committee) is to improve health, safety and environmental performance – both the workplace environment, and the broader environment as it is impacted by the company's operations. The tools at its disposal are dialogue and recommendation and credibility. It is the JHSC's main role to discuss, develop, recommend, help implement, and monitor appropriate health and safety policies, programmes, and procedures; and to lead by example.

The worker members of the joint health and safety committee ARE, however, a committee of the local union. In a unionized workplace, that is the only way you can be effective. Unions make work safer!

WHAT JHSCs SHOULD NOT DO

- **The joint health and safety committee is NOT a workplace safety police force.**
- **The joint health and safety committee is NOT the company's budget and planning committee. Correcting health and safety hazards can sometimes be expensive. However, it is not the role of the JHSC to prioritize health and safety measures within the company's other financial priorities.**

MANAGEMENT ROLE

In a workplace, management retains formal authority and responsibility for occupational health and safety. That authority and responsibility are modified, however, by their legal responsibility to respond to recommendations of the joint health and safety committee. Management is not obliged to accept every recommendation of the JHSC, but they are obliged to respond. A management that simply ignores the advice of the JHSC may be in direct violation of occupational health and safety laws and regulations; and may also fail the test of "due diligence" (defined as taking every precaution that is reasonable or possible in the circumstances) should an accident occur.

The rights, responsibilities and roles of the JHSC are held jointly by the union and by management. Members of the JHSC should not act unilaterally except to reduce an immediate hazard. Ideally, no policies or programmes in occupational health and safety should exist in the workplace except those that have the agreement of the JHSC.

Occupational health and safety law also makes enforcement of internal rules and standards the responsibility of the employer. The plant safety department and first line supervisors are particularly important in making sure that this happens. “Enforcement” should be interpreted broadly, and does not necessarily mean disciplinary measures. Discipline and discharge to achieve health and safety results usually fail to achieve their desired result. Instead they guarantee that management will never hear of problems and never find the real causes of accidents; they put health and safety issues into another arena: labour relations, grievance, and arbitration, rather than improving health and safety conditions.

Individual workers and managers can behave safely or unsafely, but an organization’s health and safety performance (especially in large organizations) has more to do with the collective result of the entire organization’s values and actions (the “corporate safety culture”) than with individual actions.

Policing, and threatening, individuals are not the best means of achieving improved performance. Education and cooperation is. Good preventive measures require effective internal responsibility systems. The improvement of health, safety and environmental performance usually requires organizational change, not individual change.

STRUCTURE OF A JHSC

Internal responsibility system

HEALTH AND SAFETY	RESPONSIBILITY
SENIOR MANAGEMENT duty to respond due diligence responsibility accountability	Formal authority
CO-CHAIRS OF JHSC action and delegation run meeting assign action items ensure follow-up	Agenda setting
JOINT H & S COMMITTEE H&S policies H&S programmes H&S procedures Recommend to Senior Management	Representative body
SAFETY DEPT. Line Supervisors Everyone	Administration/ enforcement

DUE DILIGENCE

As it is a phrase that often comes up in a discussion of internal responsibility, this is an appropriate place to discuss the concept of due diligence.

Due diligence is basically a legal defence. Under occupational health and safety law, if an employer is able to successfully argue that they have exercised due diligence it means that they have taken every precaution reasonable in the circumstances. However, by allowing due diligence as a defence, the law also implies that it will be a standard of everyday safety performance.

The question is, how do you establish due diligence? It is much harder to prove that something has been done, than that something has not been done.

In circumstances such as a serious injury or fatality, the employer must show that every effort was made to prevent such an occurrence. In order to show due diligence, an employer must demonstrate a total commitment to health and safety.

The health and safety systems of that workplace must be comprehensive, meet the needs of the workers, and must perform. Simply showing good-sounding policies on paper does not demonstrate due diligence. Only hard evidence, in the form of regular inspections and audits conducted by the joint health and safety committee, and evidence of follow-up on committee recommendations, can prove that they are more than mere words.

For example, if the JHSC identifies a hazard, and suggests a means of controlling it, then if management takes no action they have failed to exercise due diligence.

IDENTIFYING AND CONTROLLING HAZARDS

When trying to develop the best possible control for a workplace hazard, it is important to understand:

1. the nature of the hazard;
2. the form of the hazard;
3. how workers are exposed to it (if a chemical hazard, the route of entry into the body);
4. what kinds of effects (injuries or illnesses) the hazard can cause;
5. what information exists about effective injury and illness prevention measures; and
6. how best to control the hazard

The following sections deals with a selected few specific hazards faced by many union members. It is not a comprehensive list.

Toxic chemicals

Consider the following table. (The terms used in the table are explained in some detail in the glossary at the end of this manual.)

NATURE	FORM	ROUTE OF ENTRY	EFFECTS	INFO	CONTROL
Toxic/poison Sensitizer Asphyxiant Corrosive Carcinogen Mutagen Teratogen Oxidizer Reactive Flammable Explosive Radioactive	Solid Liquid Gas Dust Mist Fume	Inhalation Ingestion Absorption	System(s) Organ(s) Cells Molecules Acute Chronic Latent Cumulative synergistic	MSDS Properties Toxicology Standards Codes	At the source Along path At the worker Recommend Implement Review

If you are concerned about toxic chemicals in your workplace, try to analyse the problem and develop an appropriate response by working from the left-most column of the table above, to the right most.

Nature: Determine what hazards are posed by the chemical. These are the inherent properties of the chemical.

Form: In what form is it released in the workplace? This will help you assess the potential for exposure.

Route of Entry: How does the chemical enter the body?

Effects: What are the usual target organs or systems? How does disease typically develop?

Information: Gather as much information about the chemical as you can. A good starting point is the Material Safety Data Sheet.

Control: Good industrial hygiene practice. Are there alternative means of control that could be used?

Mechanical hazards

Any equipment, tool, vehicle or device that is in motion has the potential to cause injury. Hundreds of thousands of workers suffer cuts or crushing injuries every year. Sometimes the seeming familiarity of these types of hazards can breed contempt for them.

Proper machine guarding is important. The choice of, and use of, power tools is important. Vehicle and pedestrian movement and control in the workplace are important. Fortunately, these are also the types of hazards that are easiest to identify and correct during workplace inspections.

Mechanical hazards frequently cause injuries during non-standard operations such as equipment adjustment, maintenance and repair. The purpose of a lock-out procedure is to ensure that a piece of equipment has been completely de-energized.

Lock-out procedures must be regularly reviewed and audited to ensure that they are as effective as possible and that everyone is diligent about following them. All sources of energy must be identified, isolated, locked, and verified when equipment is prepared for maintenance.

While simple enough in principle, it is sometimes difficult to ensure that all remaining energy has been secured and dissipated, and that no accidental release of energy can take place. Even when equipment has been completely prepared for maintenance, the safety of the equipment must be verified and there must be clear communication about the status of the equipment to all concerned.

Good lock-out procedures utilize the “one worker, one lock, one key.” concept; that is to say that each person verifies the status of the equipment by placing their own lock.

Electricity

The universal use of electricity in our society has tended to generate complacency about its hazards, but electricity can cause shocks, severe burns, and death. It can also provide the source of ignition for fires and explosions. These general guidelines can serve as a reminder of how to consider electrical hazards in the workplace:

- electrical work should have good pre-planning, proper documentation, correct tools and equipment;
- proper lock-out procedures are necessary for safe electrical work;
- high voltage equipment should only be touched by specially trained personnel; otherwise, keep your distance;
- insulating clothing, tools and equipment are a last line of defence;
- consider electrical hazards when using ladders, lifts, cranes, or equipment that can be raised;
- use only approved electrical equipment;
- do not use any equipment that has damaged cords or connectors;
- temporary electrical installations should have an “expiration date”, a clear date for removal;
- do not use any electrical equipment where it is unsafe to do so;
- locate buried electrical wiring before digging;
- do not replace fuses or re-set circuit breakers unless you know why it burned or tripped; and
- replacement parts, even light bulbs, should match original design standards

Radiation

Radiation is energy in transit, energy that can travel some distance from its source without a conducting medium. All of us are being exposed to radiation of various types all of the time – from heat, lighting, electronic devices, the sun, naturally occurring radioactivity, etc. - but at low levels.

The electromagnetic spectrum

With a couple of exceptions, most of the energy that we refer to as “radiation” is part of the electromagnetic spectrum. The “electromagnetic spectrum” describes a range of energy from low-frequency (e.g. AM radio) to high energy (gamma radiation). It should be remembered that electricity always produces electric fields and magnetic fields. At the low-frequency end of the electromagnetic spectrum (particularly in referring to the possible hazards of household electrical appliances, computer equipment, and the like) “field” is a more appropriate description than “radiation”. The questions surrounding the hazards of these extremely low-frequency electromagnetic fields is a separate topic.

Radio frequency and microwave radiation literally saturate our bodies every minute of every day because of their use in radio and television broadcasting, cellular telephones, microwave ovens and radar.

More intense exposure can occur with industrial heating devices of the dielectric induction, and microwave type; and medical diathermy. Radio frequency and microwave radiation can heat tissue and cause burns. It is also thought that their ability to produce heating can cause cataracts and reproductive effects. In addition to such thermal effects, these energies are suspected of central nervous system, cardiovascular, and general stress effects. In addition, radio-frequency shocks and burns, as well as interference with vital communication links, can be considered a safety hazard.

Infrared radiation is emitted by molten materials like metals and glass. Infrared heaters and incubators are other sources of worker exposure.

Visible light is something we are all obviously exposed to from artificial lighting and the sun.

Ultraviolet radiation is emitted not only by the sun, but also by sunlamps and industrial sterilizers. Welding arcs are a powerful source of ultraviolet light.

Infrared, visible light, and ultraviolet radiation can produce or worsen conditions of photokeratitis, conjunctivitis, cataracts, skin burns, premature aging of the skin, and skin cancer. Special mention can be made of laser light, which is a highly concentrated beam of coherent, single wavelength light. Lasers are increasingly being used in the workplace as scanning devices, surveying instruments, and in welding and cutting.

The higher-energy end of the ultraviolet range, plus X-rays and gamma radiation, are known as “ionizing radiation”. Ionizing radiation is radiation whose energy is high enough to be capable of producing charged particles.

X-rays and gamma rays are high-energy examples of electromagnetic radiation. They are very penetrating, a property that allows the medical use of x-rays, for example, and easily pass through bodies. Gamma rays, produced by many radioactive materials, have much higher energy than x-rays.

Everyone is exposed to ionizing radiation; from space, from radioactive materials in the ground, even from our own bodies since we all carry a certain amount of radioactive carbon-14. Medical radiation such as x-rays, and radiation used in treatments for cancer and other diseases, accounts for a further exposure.

Radioactive particles

Some of what is commonly referred to as “radiation” is actually particles emitted by radioactive materials as part of their natural process of atomic decay.

Alpha particles are heavy, positively charged particles emitted by radioactive processes such as uranium decay. An alpha particle is actually a helium nucleus containing two protons and two neutrons, but lacking electrons. Although heavy and carrying high energy, they cannot penetrate bodily tissue.

Beta particles are high-energy electrons. They too are emitted by radioactive processes. They can generally penetrate up to 2 centimetres of tissue.

Neutrons are uncharged particles that are also emitted in certain radioactive processes. They are highly penetrating and have the additional property that they can make some other substances radioactive.

Worker exposure to radiation and radioactive materials

Industrially, uranium mining and refining, fuel production and power reactors are obvious sources of exposure. Industrial radiography, luminizing, production of radioisotopes and various types of laboratory research are also occupations that may be exposed, as are those involving the mining of minerals other than uranium and the production of phosphate fertilizer.

For x-rays, gamma rays, beta particles and neutrons, the important route of entry is external, i.e. one stands near the source of radiation and is exposed.

For alpha particles, however, internal exposure is a matter of great concern. If a substance that emits alpha particles is inhaled as a dust and lodges in the lungs, for example, the tissue around the substance will receive a very heavy dose of radiation. This is because alpha particles are not penetrating, therefore they will give up their energy in a very small volume of tissue, perhaps only a few cells. This greatly increases the risk that the cells in question will eventually become cancerous. Ingestion and absorption can also be significant problems with alpha emitters.

Radioactive materials will tend to go to different parts of the body. If an insoluble substance is inhaled, for example, it will tend to stay in the lungs. If however a soluble substance is inhaled, it will be absorbed into the blood stream and will end up in other parts of the body.

Many different units of measurement of radiation have been used over the years, and literature on radiation safety may be confusing, especially if it is a couple of years old.

Respirable dusts and fibres

Some substances are hazardous because of their physical, rather than their chemical, properties. Asbestos, silica, and some (not all) synthetic fibres fall into this category.

Whether a dust is considered “respirable” or not, depends on particle size. Large particles are not inhalable at all if airborne; they are caught in the outer nose and throat.

Smaller particles may pass the larynx, but only the smallest particles will reach the alveoli (smallest air sacs) of the lung. The upper limit for particle size that can penetrate deeply into the alveoli is usually considered to be about 5 or 6 micrometres effective particle diameter.

Note: the “legal” definition of what constitutes respirable dust may differ in your jurisdiction. For regulatory compliance, make sure you consult the appropriate documents from your jurisdiction.

If the particles are able to penetrate deeply into the lung, then they may be trapped there where they can cause irritation, inflammation, and longer-term or permanent damage.

Lung diseases that may result from respirable dusts and fibres can include irritation, sensitization, pneumonoconiosis (scarring and clogging of the lung); bronchitis, asthma, and cancer.

Asbestos and silica, in particular, are two of the deadliest materials ever used in industry and are the topics of separate IndustriALL booklets, available at www.industriall-union.org

INDUSTRIALL PUBLICATIONS

INVESTIGATING ACCIDENTS

IndustriALL's preference is to investigate accidents and incidents in cooperation with our employers following a mutually agreed-upon process. However, if we do not feel that the accident investigation process is fair, or capable of identifying all of the causes of an accident; or if we believe that an accident investigation is being done to allocate blame instead of correct hazards, we reserve the right to conduct our own investigation and to file the report wherever we believe it will do the most good.

There are many reasons why investigating and analysing an accident often turns out to be more difficult than the investigator first thought it would be. Here are some examples (there may be others):

- the situation may actually be much more complex than it seemed at first;
- the investigator may find people who are reluctant to discuss or acknowledge failure - their own or others' - or who are committed to defending a bad decision or failed policy because of pride, politics, or fear;
- the investigator may jump to incorrect conclusions or be influenced by the incorrect conclusions of other people; and
- the immediate crisis and confusion in the period following the accident creates a state of panic that does not lend itself to rational analysis of the event

To avoid these and other potential pitfalls, investigators must keep the accident investigation process as clear and simple as possible.

Accident investigation is an example of the use of a basic problem solving technique. An effective accident investigation, therefore, would follow this sequence:

1. Clearly understand what the problem is. Something must happen that you would define as an accident or significant incident. This would initiate the accident investigation process and activate the accident investigation team.
2. Gather information. This can include visiting the site, recording observations, taking pictures, interviewing victims, witnesses, experts, and others. Written work procedures, engineering drawings, maintenance records, purchasing specifications, and training records, may also be relevant.
3. Analyse the data to try to determine the causes (plural) of the accident (there are always more than one).
4. Decide what must be done to prevent the accident from occurring in the future, or at least mitigate the outcome if it did. Be as specific as possible. Consider short-term measures and longer-term measures if appropriate.
5. Make sure the preventative measures are implemented. Follow up to see that they are

In occupational health and safety, it is better to have systems in place to prevent hazards from occurring, than it is to simply identify hazards and correct them. Accident investigation is an opportunity to examine safety systems.

Building or improving systems requires an understanding of basic problem solving methods outlined above. Accident investigation follows this basic structure. The first step is to understand what the problem is, i.e. define the accident.

This may seem obvious, but investigators should take time at the beginning of the accident investigation to clearly identify:

What happened? Use as few words as possible and concentrate on the actual outcome (or potential outcome if investigating a "near miss"). This should basically describe the event and why you consider it worth investigating. Do not try to list all the contributing events and causes at this stage.

Where did it happen? Was it a specific event confined to one location or would it be better described in terms of an area or even several areas?

When did it happen? The most important time to note is the time of the outcome you are concerned about, usually an injury or fatality. While recording this, however, give some thought to the following question. Was it a specific event (e.g. a fall from a ladder) or one that developed slowly over a period of time (e.g. occupational asthma)?

GATHERING INFORMATION

It is extremely important to gather as many facts as possible! Sources of information can include:

- Notes taken during direct observation of the site
- Photographs or videos
- Interviews of victims, witnesses, co-workers, experts and others
- Written work procedures
- Engineering diagrams
- Purchasing specifications
- Maintenance records
- Safety problem reports
- Previous accidents and incidents
- Training records

When gathering information (especially when interviewing victims, witnesses, supervisors, co-workers and others directly connected to the accident) it is important to remain sensitive to people's feelings. Their emotions - anger, fear, guilt, sorrow - may be running high. Be particularly diplomatic when a serious injury or fatality has occurred.

Although peoples' perceptions of the problem are important, they are not as important as facts. **Distinguish between opinion and fact.** Never ask questions that imply blame, e.g. "Why did (didn't) you…" or "Were (weren't) you aware that…" Do not look for blame. Look for the systems and components of systems that failed.

What kinds of facts should be looked for?

1. Materials, tools, equipment etc. - the "things" involved
2. Job or task: what was actually being done, procedures, required safety checks & equipment, etc
3. Management decisions - specifications, workplace design, repairs, inspection, safety enforcement, assignment of work
4. Environmental factors - heat, cold, light, dust, noise, fume, slippery floor, etc.; and
5. People - training, experience, stress, vigilance, personal factors, etc

To avoid overlooking any facts, make sure that you record everything - even if you have to add a new category.

Once you have gathered and sorted all the facts you can, you are ready to analyse them to determine the causes of the accident.

The object of an accident investigation is to discover the causes of the accident and recommend measures to prevent a recurrence of the same of a similar accident.

A few words on blaming and scapegoating

Blaming or scapegoating some person or thing is a common mistake in accident investigations. The reasons for focusing all attention on one person or one piece of equipment are obvious - it is less work, and doing so allows the rest of the system to remain unchallenged and uncriticised.

Systems that rely on 100 percent vigilance, 100 percent of the time on the part of human beings guarantee accidents. If one person in an organization makes an error, which leads to an accident, then it is very likely that someone else has made, or will make, the same error. The object must NOT be to attach blame. If an accident investigation is used to attach blame or assign discipline, no one will cooperate with future investigations.

Scapegoating on a particular component or thing is not much better than blaming an individual. Recall the explosion of the space shuttle Challenger, the immediate cause of which was fuel escaping around a leaking "O"-ring between rocket stages. If the investigators of the explosion had scapegoated the "O"-ring that failed, a great deal of understanding about the multiple failures of NASA's safety systems would have been lost. Why was earlier evidence of a problem with the "O"-rings ignored? Why were the usual safety margins disregarded in this case? What difference did the weather make? How was this particular design decided upon?

ACCIDENT ANALYSIS - TIMELINE AND FAULT TREE

Many written accident investigation procedures focus on the analysis step as being the most difficult. This is the stage of the investigation in which the investigator must try to understand what the facts are saying, in order to identify all of the causes of the accident.

There are two basic techniques investigators use to do this:

(i) sort the information into a single sequence of events, or timeline;

(ii) sort the information into a sequence of events but show separate cause and effect chains, no matter how minor, as branches and sub-branches to larger branches or the main sequence. Because of the visual representation of this analysis, it is often called a "fault tree".

Method (i) is the most frequently used for investigating ordinary industrial accidents.

Method (ii) is particularly helpful if a great deal of technical detail is involved.

TIMELINE

To develop a “sequence of events” analysis, starting at the outcome, - the injury, fatality, or loss - and work back.

1. To begin, **write down a short description of the outcome.**
2. Next, **ask the question “what was there about the situation immediately prior to this that contributed to the accident or that could have prevented the accident or injury?”** Your answer should be based on the available information or evidence, or a reasonable extrapolation from it.
3. **Write down a short description of the preceding situation** - in effect, your answer to the above question.
4. **Repeat steps (2) and (3)** until you can no longer think of an answer to (2).

For example, try to develop a sequence of events, or timeline, analysis of an eye injury suffered by a carpenter cutting used lumber on an old saw in a workplace with a poor safety attitude; as shown below:

- **The outcome: an eye injury occurred when a piece of metal struck the operator of the saw.**
  What was there about the situation immediately prior to this, that contributed to the accident or that could have prevented the injury?

- **No safety glasses were being worn, which could have stopped the metal particle.**
  What was there about the situation immediately prior to this, that contributed to the accident or that could have prevented the injury?

- **There was no guard on the saw, which might have stopped the metal particle.**
  What was there about the situation immediately prior to this, that contributed to the accident or that could have prevented the injury?

- **The saw blade struck a nail in the wood, which was the source of the metal particle**
  What was there about the situation immediately prior to this, that contributed to the accident or that could have prevented the injury?

- **The carpentry shop was poorly lit, making it more difficult to inspect the wood.**
  What was there about the situation immediately prior to this, that contributed to the accident or that could have prevented the injury?

- **There was no policy or training on the need to inspect wood for nails, and even if there had been, the job was a “rush” job, making it less likely that the operator would take the time to thoroughly inspect the wood.**
  What was there about the situation immediately prior to this, that contributed to the accident or that could have prevented the injury?

- **Complaints about the saw’s maintenance and shop lighting had not been acted on.**
  What was there about the situation immediately prior to this, that contributed to the accident or that could have prevented the injury?

- **No analysis had been performed on the hazards associated with the material change from new lumber to recycled lumber.**
  What was there about the situation immediately prior to this, that contributed to the accident or that could have prevented the injury?

- **Management had recently begun to insist on the use of recycled wood whenever possible, as a cost cutting measure. Used wood is more likely to have nails in it than new wood.**
  What was there about the situation immediately prior to this, that contributed to the accident or that could have prevented the injury?

- **The entire organization had an overall poor attitude towards safety. Safety problems, even when reported, were rarely corrected in less than three months. Evidence shows that rarely, if ever, did employees wear safety equipment such as safety glasses. This included the shop supervisor.**
  What was there about the situation immediately prior to this, that contributed to the accident or that could have prevented the injury?

- **There was a general lack of safety policies, procedures, and enforcement, and no systematic way to make sure that new situations received a proper hazard analysis, policy development, and training. Employees in general received no training or updating of skills, even when procedures or equipment changed. The shop relied upon experience, rather than training.**
  What was there about the situation immediately prior to this, that contributed to the accident or that could have prevented the injury?

- **There was no system of regular inspection or preventative maintenance of equipment.**

  What was there about the situation immediately prior to this, that contributed to the accident or that could have prevented the injury?

- **Two years ago, the company had embarked on a major cost-cutting programme, which was perceived as putting safety second to production, and also to lower the priority of preventative maintenance. This seemed to damage everyone's safety morale.**

Although one example cannot illustrate everything, the above timeline is typical in many ways. Very close to the actual event, in time, one usually finds factors that have to do with materials, tools, equipment, and the workplace environment. Further in the past, one often identifies factors such as training, maintenance, purchasing standards, policies, and so on.

Test: If you have constructed your timeline correctly, then reading it in reverse order should tell a story that makes sense. If it does not make sense, or large parts of the story seem to be missing, you should re-examine your analysis to make sure you have taken all the facts into account.

In the above example, the story might read something light this:

"In a carpentry shop with a poor attitude towards safety, and no commitment towards training, a change in source materials was made from new lumber to recycled lumber. Potential safety problems of this change were not addressed in any safety policy or training. In addition, the shop equipment was old and poorly maintained and the work environment, specifically lighting, was poor.

"On the day of the accident, a worker was asked to perform a "rush job", obtained some used lumber, either did not inspect if for nails or did not see the nail because of the poor lighting, and commenced cutting it on a saw with a missing guard. A piece of metal flew out of the saw and was able to damage the worker's unprotected eye."

IMPORTANT

A SEQUENCE OF EVENTS IS NOT THE SAME AS A CAUSE-AND-EFFECT LINKAGE!

One of the most common errors is to assume that earlier events "caused" later ones. Putting events in a sequence seems to imply this in the minds of some people. Remember that a timeline is not like a series of dominos. The age and poor condition of the saw did not "cause" the worker to be cutting without safety glasses. The decision to use recycled wood did not "cause" the saw to be missing its guard. All we are saying is that one condition probably existed prior to another, and that all played a part in the unfortunate outcome.

FAULT TREE

In contrast to a simple timeline analysis, a "fault tree" DOES attempt to link dependent causes and consequences; or, if you prefer, cause-and-effect.

The first step in constructing a fault tree is to build a "sequence of events" analysis as discussed in the previous pages. Start at the outcome, - the injury, fatality, or loss - and working back.

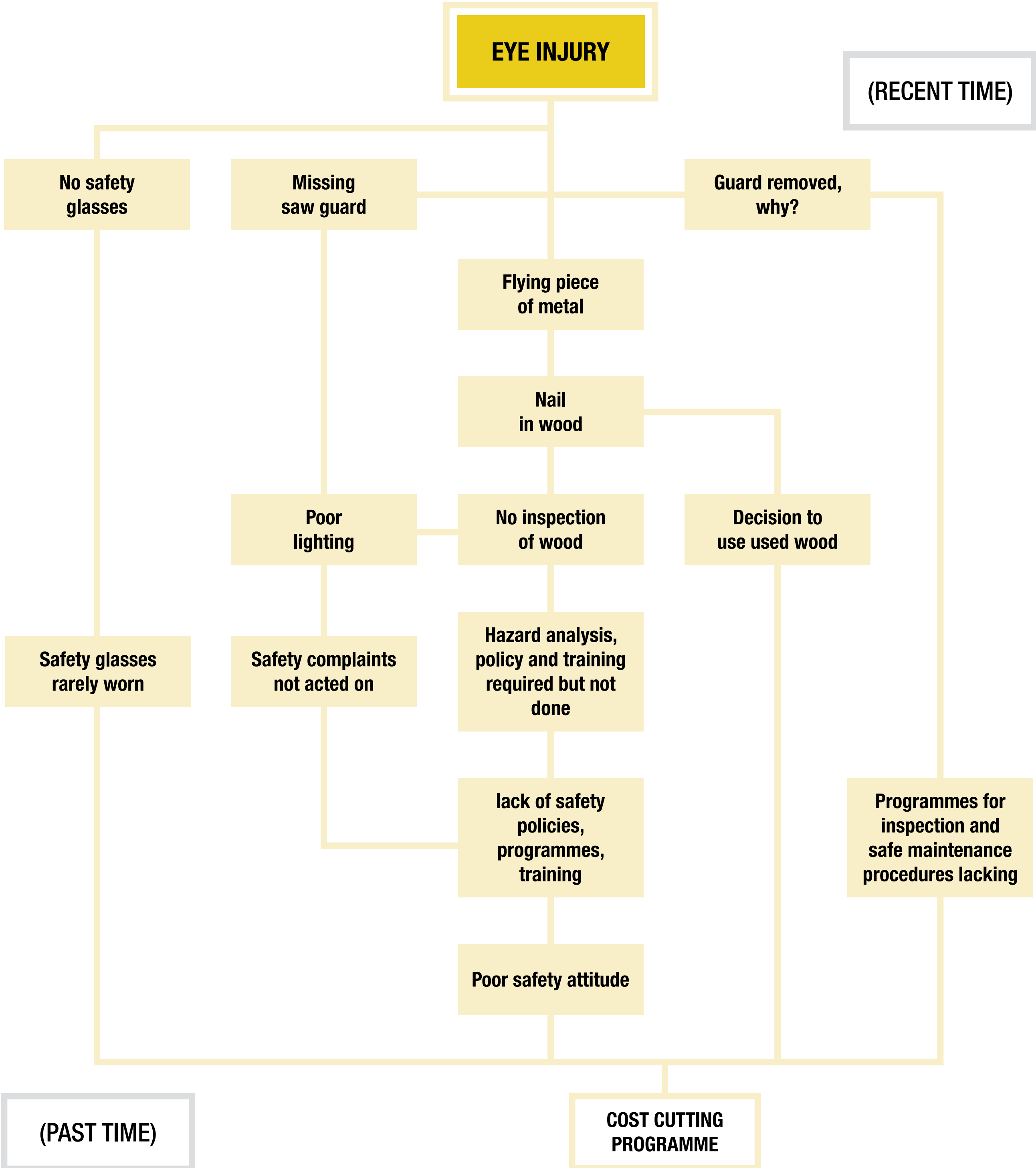
1. To begin, **write down a short description of the outcome.**
2. Next, **ask the question "what was there about the situation immediately prior to this, that contributed to the accident or that could have prevented the injury?"** Your answer should be based on available information or evidence, or a reasonable extrapolation from it.
3. **Write down a short description of the preceding situation** - in effect, your answer to the above question.
4. **Repeat steps (2) and (3)** until you can no longer think of answer to (2).
5. Examine all of your answers and **look for events related in a cause-and-effect way.**
6. **Illustrate your analysis with a diagram.** Arrange related events as separate sequences on separate "branches" to your main timeline. Branches can separate and re-join each other as necessary, and you may have sub-branches off of larger branches off of main branches if needed to fully explain an event. Following one line should always show cause-and-effect related events, however.

Let us use the same example for which we developed the sequence of events on previous pages: a carpenter cutting used lumber on an old saw in a workplace with a poor safety attitude.

You could illustrate, for example, the company's cost cutting programme, the decision to use recycled wood, the fact that a nail was present in the piece of wood being cut that day, and the resulting piece of metal in the eye as one "branch". The overall safety priority, the prevailing attitude towards safety glasses, and the fact that no safety glasses were being worn that day, as another "branch".

The branches often illustrate some of the major "systems" that should be in place to prevent accidents. For example: specification, maintenance and inspection of equipment; or procedures and training; are clearly deficient here and contributed to the injury.

Example simplified – analysis of an eye injury



LEARNING FROM ACCIDENTS - WRITING RECOMMENDATIONS

What can be done to prevent the same or similar accident from happening again tomorrow or ever again?

Don't let yourself get distracted by arguments over semantics about "root" or "immediate" causes of accidents. All identified causes need to be addressed. Rather than sort causes into "root" or "immediate," think about long, medium and short-term solutions.

A word about so-called "accident investigation" or "accident reporting" forms. A form is not an accident investigation procedure. If your organization has certain required forms to be filled out, so be it. There are legitimate reasons for keeping some of the information on a standard form. However, forms can inhibit you, in your search for all of the causes of an accident.

ALWAYS conduct the investigation FIRST, THEN fill out the form based on what you have found.

For example (using accident already analysed):

Short-term:

1. implement new safety glasses policy
2. lock out this saw until repaired
3. use new lumber until a procedure for safely handling old lumber is developed; and
4. repair burned out light.

Medium-term:

1. discuss changes to overall lighting at JHSC; and
2. training on eye protection.

Long-term:

1. revise work request system to reduce rush jobs; and
2. build safety culture through management commitment, education, and leadership by example.

Frequently, solutions to prevent recurrence of the accident in the short term focus on materials, tools, equipment, personal protection, or specific job procedures.

Solutions designed to prevent a recurrence of the accident over the long term must generally address safety systems, rather than individual specific hazards or omissions.

INVESTIGATING OCCUPATIONAL DISEASES

The previous section discussed some of the techniques to investigate occupational accidents and incidents. The investigation of occupational diseases poses significant challenges as well.

Respected scientists and epidemiologists can run into problems in proving the cause of a disease outbreak. What can local union health and safety activists do when a link is suspected between occupational exposures and diseases? Surprisingly, even a home-grown study can be very useful. Such a study is often the first step in identifying, for example, a workplace carcinogen, even if more rigorous scientific studies must follow. The basic steps involved are: (1) gathering information; (2) analysing the information; (3) reaching a conclusion; (4) making recommendations and following up. Seek advice before starting – an investigation of this nature poses particular problems and is not always the appropriate response. At all stages, it is essential to work with your union leadership to avoid potential pitfalls.

SAFETY SYSTEMS AND PROGRAMMES

These are not the same thing despite what you may be told by some consultants or management representatives.

Here is how IndustriALL defines these important terms:

A SAFETY SYSTEM is the overall framework by which an organization tries to assure that materials, tools, work environment, management and people all contribute to the safety and health of workers.

A SAFETY PROGRAMME is a process adopted to drive components of a safety system to a better level of performance.

A SAFETY AUDIT is the means of measuring your progress towards our goal of a safe and healthy workplace.

SAFETY SYSTEMS	**ARE WHAT YOU WANT**
SAFETY PROGRAMMES	**GET YOU THERE**
SAFETY AUDITS	**MEASURE YOUR PROGRESS**

SAFETY AUDITS

Audit: A systematic, independent and documented process for obtaining evidence and evaluating it to determine the extent to which defined criteria are fulfilled.

This does not necessarily mean an independent external audit (by an auditor from outside the organization).

This manual treats audits as an evaluation tool, used to measure the organization's progress towards health, safety and environmental objectives.

To implement a safety audit, the activities of occupational health and safety are usually divided into subject areas.

These are chosen to describe the key components of safety systems and are often called elements. For each element, audits seek to create a systematic approach to the identification and correction of hazards. To that end, they usually involve the following steps:

1. **Identification and measurement of appropriate indicators**
2. **Adoption of appropriate standards**
3. **Comparing final performance indicators with the standard, and revisiting the entire issue if necessary**

As previously discussed, the identification of appropriate indicators and standards is a difficulty many encounter when trying to implement a safety audit. Later, in this manual you will find suggestions on indicators.

Safety audits can be used as the basis for the development and evaluation of a safety programme. A safety programme could consist of procedures or policies designed to improve the organization's safety performance. This could include the setting of new standards for step 3 of the audit process. By performing an audit before and after the implementation of a safety programme, the audits can evaluate whether your current programmes are working and help you make decisions about future ones.

The most serious complaint about some safety audit schemes is that workers may feel left out of the loop, and if the only contact they have with the programme is an occasional encounter with auditors, they may feel spied upon. Some of the consultant companies offering safety audits have little or no experience with joint health and safety committees, and little interest in facilitating them.

To achieve the best result from safety audits, make sure there is plenty of communication.

The joint health and safety committee should be fully involved in the implementation of the programme, participate in at least some of the audits, receive the reports and make recommendations based upon them.

Everyone should have access to the reports from internal and external audits, but a special effort should be made to communicate relevant results to workers who participated in the audits, or who might be affected by recommendations arising from them.

SAFETY PROGRAMMES

If a safety programme continues to do a good job of hazard analysis and the development of effective preventative measures, there will be a gradual change of attitude and the beginnings of an improved "safety culture".

The management of change in the workplace is important, so procedures should be reviewed frequently and as needed. Contractors must conform to the same standards as direct employees. Accident/incident investigation and emergency planning form a part of the programme as well. These issues are all addressed in most safety audit schemes.

These activities are usually being done in workplaces where joint health and safety committees are functioning as they should. It is for this reason that IndustriALL considers effective JHSCs to be "our" safety programme. JHSCs are often very successful at hazard analysis and development of preventative measures such as purchasing standards and safe work procedures. Many of our Committees use audits as a way to systematically identify and control hazards.

IndustriALL believes that an effective joint health and safety committee is the only "safety programme" that is both necessary, and sufficient, to attain excellence in occupational health and safety performance.

Any other programme that an employer or government may advocate must be implemented through the joint health and safety committee, with prior union approval.

Due diligence could be affected if confusion is created around which group is the responsible body in a workplace; (i.e. the safety audit group, safety programme leaders, or the joint health and safety committee and representatives). If this is allowed to happen, then important safety issues can become lost between competing committees and a sense of frustration can set in, which will negatively affect the attitudes of everyone in that workplace towards health and safety.

BASIC PROBLEM SOLVING

In occupational health and safety, it is better to have systems in place to prevent hazards from occurring, than it is to simply identify hazards and correct them. That is why there is much more to a safety audit than a simple workplace inspection.

There are certain steps that must be followed in order to solve any problem:

1. **Clearly understand what the problem is.**
2. **Gather information.**
3. **Analyse the information. What is it telling you?**
4. **Make the decision that you think will solve the problem.**
5. **Implement your decision and follow it up to make sure the problem actually goes away.**

This basic process will help you to find the solution to most problems. However, in more complex problems, it helps to have standards or goals and indicators. This is not a different problem–solving process, but rather an elaboration of the one described above. If you know what level or standard of performance will make you happy, you have a goal. If you have some way of measuring what the level of performance is, you have an indicator.

This may be easier to understand using an example. Let's say that your joint health and safety committee has a concern about defective ladders. You decide to try to solve this problem, following the above procedure.

1. **Definition of the problem: there is unacceptably high number of defective ladders in the plant.**
2. **Your indicator is the monthly workplace inspection report. Presently, the average number of defective ladders found is five or six per month.**
3. **The goal that is agreed upon might be to find no more than one defective ladder per year.**
4. **The committee gathers some information on types of ladders, jobs that they are used for, areas where they are most frequently defective, etc.**
5. **You analyse the information. For example you might debate whether the problem is failing to buy heavy-duty ladders, lack of storage facilities for the ladders, or the inappropriate use of ladders.**
6. **The committee decides that the main problem is the ladders themselves and that heavy-duty ladders should be obtained. The lesser concerns about the use of storage areas and scaffolding are to be addressed in new policies, and an educational programme for employees.**
7. **Management accepts the Committee's recommendation. The new ladders are purchased, and the old ones are removed from the workplace. The new policies are developed, and the use and storage of scaffolding and ladders is the subject of a plant-wide educational programme.**
8. **After a few months, the committee reviews the monthly inspection reports and finds that the number of defective ladders is dramatically reduced.**
9. **The committee congratulates itself on a job well done, and continues to monitor the monthly inspection reports.**

What the joint health and safety committee has done, in this instance, is create a system for the prevention of the hazard of defective ladders. It includes several elements. Appropriate materials have been specified. Policies for their use and maintenance have been specified. Education has been carried out. Periodic review will take place.

INDICATORS AND STANDARDS

Indicator – something that you can measure which will indicate health and safety performance.

Standard – the level of performance that the indicator in question ought to be at.

Unfortunately, accident statistics are the most commonly used indicator of an employer's health and safety performance. Yet we know that they are inaccurate.

Recordable or reportable accident rates are not a suitable indicator for safety audits for several reasons:

1. **They are inaccurate because of under-reporting**
2. **They are easy to manipulate**
3. **They are rare events – they do not represent normal production or operation but instead they are the results of the abnormal or exceptional situation**
4. **Most workplaces have far too small a workforce for occasional accident statistics to have any statistical power**

Therefore, accident statistics by themselves mean little. If other pieces of information are examined at the same time, they become more meaningful. Audits require that we measure or track something. The question is, what will be the criteria for choosing an indicator? Which goals and objectives? What activities?

What indicators should do is show how seriously an organization takes the matter of safety, i.e. something about the "safety culture". If we must measure something, then there may be a few indicators that might serve in a typical workplace. Some criteria for choosing indicators could be the following. Ideally:

- **They should be based on conditions that we would actually want to prevail or are trying to prevent**
- **They should be depersonalized and non-blaming**
- **They should not primarily be linked to failures, accidents, or other crises (some indicators inevitably will be, however)**
- **They should be able to be checked frequently and should be able to provide at least qualitative information, but preferably quantitative information**
- **They should be able to be compared across differing workplace environments**
- **They should make statistical sense**

An assessment or measurement mechanism is required because it is often valuable to have some measure of performance in order to identify areas for improvement. An audit that could not provide some sort of general evaluation of how well the organization was doing compared to its own standards, and compared to other similar organizations, would not be considered as useful as one that could.

INDICATORS FOR SAFETY AUDITS

To implement a comprehensive safety audit, the essential occupational health and safety systems must be covered. For the purpose of this manual, six systems are defined below. Some commercial safety audit packages may have more, or fewer, groupings.

These six systems are:

1. **Effective joint health and safety committee**
2. **Visibly committed management**
3. **Human resources system: ensuring that the right people are assigned to the right jobs, including training and motivation**
4. **Engineering, job design and work rules and procedures system: ensuring that jobs and tasks are properly designed to begin with and that procedures exist for doing them safely**
5. **Purchasing and maintenance system: ensuring that materials, tools and equipment are as safe as possible**
6. **Safety and occupational hygiene system: ensuring, on an ongoing basis, the safest and healthiest working environment possible**

HOW TO MEASURE AND EVALUATE HEALTH AND SAFETY SYSTEMS

The following "bouquet of indicators" is intended mainly for those interested in designing and implementing a qualitative safety audit. On an ongoing basis, a periodic review of these indicators will allow users to monitor whether their safety performance is improving, deteriorating, or remaining the same.

Alternatively, local unions can simply use them as a self-evaluation technique to judge which areas of their health and safety system are in need of attention.

Each indicator which follows is described by a series of questions, which suggest what sorts of systems and subsystems should be in place. In addition, some general idea of who to ask or where to look for the answers to the questions is provided.

Indicators of an effective joint health and safety committee

1. **Engagement:** Does the JHSC participate in the planning, development and implementation stages of all OHS issues? Estimate this by surveying JHSC members.
2. **Effectiveness:** Are JHSC recommendations generally implemented (percent of times)? How many "old business" action items are older than three months? What percentage of JHSC action items are resolved in one month or less? One year or more? Estimate this by examining JHSC minutes.
3. **Priority and management support:** What is the average length of time for the engineering department to respond to inquiries from the safety committee, compared to the average length of time for engineering to respond to inquiries from production managers? Estimate this by examining JHSC minutes, surveying JHSC members, surveying members of the engineering department.
4. **Technical support:** Do technical people refrain from "taking over" the committee, but is technical support available to the committee when needed? Estimate this by examining the JHSC minutes and surveying JHSC members.
5. **Worker awareness:** Is a complete record of all JHSC recommendations and their status (accepted, rejected, complete, pending), as well as the reasons for their current status, available to all workers? Do worker members of the JHSC report regularly at local union meetings? Estimate this by checking for written records available to workers, and surveying the workers.
6. **Company safety programmes:** Does the company participate in a "packaged" safety programme? Do company safety programmes support, circumvent or undermine the JHSC? To further clarify, does the JHSC: (a) Direct the programme? (b) Participate in the programme's implementation? (c) Receive information about the programme's status? (d) Have no role whatsoever in the programme? Estimate this by surveying JHSC members.

Indicators of a visibly committed management

1. **Safety culture:** Can any employee report that at least once in the previous year they had been encouraged, coerced or forced to disregard the rules or procedures by supervisors or fellow employees? Has discipline ever been imposed for a health and safety infraction? (A negative indicator – if discipline is used to ensure compliance with health and safety hazards, workers will respond by concealing problems.) Estimate this by surveying employees. Surveys of overall health and safety attitudes are an excellent source of information. Also useful are surveys of present and past workers (anonymously) asking them about injuries or illnesses they attribute to their work, as well as their perception of the "safety culture".
2. **Compliance:** Is the company in compliance with the applicable legislation and regulations? Has anyone (management or worker) in the organization been charged with a health and safety violation by the enforcement agency?
3. **Right-to-know:** For chemicals and some other hazardous substances, there is a Globally Harmonized System of Classification and Labelling of Chemicals (GHS) that prescribes some minimum standards of labelling and information availability. All workers should have knowledge of, and access to, this information; and be provided the necessary education and training to understand it. Note that this system may be known by different names in different jurisdictions, for example the Workplace Hazardous Materials Information System (WHMIS) or simply the Hazardous Materials Information System (HMIS). The material Safety Data Sheets (SDS, or in some jurisdictions MSDS) library should be complete and up to date. Management must insist on accurate SDS from suppliers. Are suppliers challenged by management when they provide SDS that appear to contain inaccuracies or omissions? Estimate this by checking with the regulatory authorities. Also check the SDS library for completeness. Check for SDS with unsupported claims for trade secrecy. Is there any written evidence that management followed the matter up with suppliers, or demanded a complete SDS?

4. **Accident/Incident investigation:** Are accident investigations led by an impartial person (i.e. NOT the supervisor of the department in which the accident took place)? Is the JHSC actively involved in accident investigations? Are accident investigations sending a positive message (what can we learn?) or a negative message (who can we blame?)? Do accident investigations result in tangible improvements? (A tangible improvement means that something changed — equipment, procedures, policies, and training. If accident investigations frequently identify causes like "carelessness" or worse still assign blame, little will change; and the message to the organization becomes "do not report accidents".) Estimate this by checking the last six accident investigation reports.

5. **Overtime:** Are the total number of overtime hours worked excessive? This may mean several things: the organization is understaffed, the organization is covering up significant absenteeism, and the organization is creating a lot of additional stress for its employees. An interesting detail to examine is whether a lot of requested overtime goes unfilled. When workers are unwilling to work extra hours even for premium pay, there are probably unresolved problems — including health and safety issues in the workplace. Consider the workload — do workers perceive that it is increasing, or decreasing? Estimate this by checking overtime records, and by surveying employees.

6. **Management of change:** Changes to chemicals, technology, equipment, procedures, and facilities must be assessed for health and safety implications and appropriate changes to procedures and training implemented. Estimate this by checking the JHSC minutes for evidence of a discussion regarding a recent equipment or process change proposal.

7. **Absenteeism:** If fear of discipline or discharge discourages accident reporting, workers may use sick time instead to deal with minor injuries. Are absenteeism rates and disability benefit usage higher or lower than the norm? (If accident reporting and/or workers' compensation claims are discouraged, occupationally injured or diseased employees may be dealing with their injuries or illnesses in other ways.) Check records and compare with workers' compensation usage.

Indicators for the human resources system

1. **Hiring and placement:** How well matched are peoples' skills and capabilities to their jobs? Are job descriptions accurate and up to date, neither too vague nor too detailed? Are posted job postings realistic and accurately linked to job requirements? Estimate this by examining the last six job postings and surveying the people who got the jobs.

2. **Accommodation:** Is there a programme to accommodate workers with disabilities? Does it apply to all workers with disabilities or only to those who became disabled while working at this workplace? Does it have the full cooperation of both union and management? Note that the duty to accommodate workers with disabilities may need to be discussed between the union and management separately from the JHSC.

3. **Training:** Is training assessed for both quantity and quality? Is there worker participation through the JHSC in the needs analysis, programme development, and delivery — reviewed on a regular basis? Is training a proper proactive programme or is there a lot of reliance upon "on the job training" (on the job training is often used as a euphemism for no training at all). Is training to understand Safety Data Sheets training complete and regularly reviewed?

4. **Safety promotion:** How is health and safety promoted? Is there an H&S "reward" programme? Does it reward "safety", or "concealment"? What measurement/indication of performance is it based on? Estimate this by comparing any documented safety promotion programme with the perceptions of workers about it, obtained by surveying them.

5. **Contractors:** Employers must evaluate contractor safety performance. Contractors must train and inform their workers and comply with plant safety rules, reporting any irregularities. Estimate this by examining any documented evidence of a contractor-training programme and also by surveying contract employees on the site.

6. **Employee assistance:** Is there an effective, confidential employee assistance or counselling programme? Is it jointly governed by the union and by management? Is it administered by an independent medical professional? How frequently is it used by employees? Estimate this by examining a documented employee assistance programme, any usage statistics, and employee perceptions of it obtained by survey.

Indicators for the engineering, job design, work rules and procedures

1. **Engineering controls:** Are hazard control strategies developed with priority given to control at or near the source by elimination, substitution, isolation, effective local ventilation? In controlling hazards, is personal protective equipment the first resort or the last? Estimate this by looking for evidence of such priorities in the engineering department as a matter of standard practice. Also survey JHSC for their impression of the priority given prevention by the engineering department.

2. **Ergonomics:** What degree of care is taken in initial design of new work areas? Have surveys and studies been done? How frequently are "unofficial" employee modifications made to work areas to improve worker comfort? Estimate this by using a physical conditions inspection as well as surveying workers.

3. **a) Safe operating procedures and safety rules:** are rules and operating procedures specific to health and safety concerns in the workplace? Does the JHSC participate in the formulation of rules? Are safety rules stated in clearly understandable terms? Are rules stated in positive terms ("employees shall" not "employees shall not")?

   b) Hazardous job and safe work procedures: are there up to date safe work procedures for hazardous jobs? Are too few, or too many, tasks classified as "hazardous"? Are job safety analyses used? Do all employees understand the safe work procedures? Are rules available to all employees in written form? Are rules periodically reviewed to evaluate effectiveness and to make improvements? Is compliance with health and safety rules a condition of employment for direct employees and for contract employees? Are rules explained to new employees when they start work or when transferred or retrained?

   Are rules followed by management, union leadership, and JHSC members? Do all employees understand the safety rules? Does everyone clearly understand when special permits or rules apply to e.g. start-up, emergency shutdown, hot work, confined space entry, use of mobile cranes, opening of live systems, etc.? Estimate this by surveying workers for knowledge of such rules and procedures, and their compliance with them.

4. **Pre-start-up safety review:** Applies to new and significantly modified facilities, and requires confirmation that specifications have been met, procedures for start-up, operation, maintenance, and emergency to be in place, and training to have taken place. Estimate this by examining in detail the records of the last significant start-up situation.

5. **Protective equipment:** Is the use of personal protective equipment, where required, described in the operating procedures for the job and included in the training programmes for the job in question? Survey workers for knowledge of personal protective equipment policy and also compliance with it.

6. **Emergency plan:** Is there an emergency preparedness and response plan for potential major disasters? Is it practiced? Estimate this by looking for evidence of such a plan and the training and practice necessary to support it.

Indicators for the purchasing and maintenance

1. **Purchasing standards:** Are health and safety part of the criteria for selecting materials, tools and equipment for purchase? Is there a standard for noise emitted from equipment? Is there a standard for the ergonomic design of purchased tools or work stations? Is the toxicity of common workplace chemicals and materials (e.g. cleaners, solvents, paints, coatings) considered when alternatives are available? Or is "low bid" the only criteria? Estimate this by checking the purchasing department for evidence of policy.

2. **New equipment and technology:** Does the organization address the health and safety issues of changing technology? Are the training requirements of the maintenance department considered when purchasing new technology? Estimate this by checking the purchasing department for evidence of policy, and surveying maintenance workers for evidence of their use.

3. **Process safety information:** As new materials, tools and equipment are purchased, does the employer obtain and maintain information such as SDS, etc. Are maintenance and craft personnel trained in how to use this information? Estimate this by examining records and surveying maintenance workers.

4. **Process hazard analysis:** As the plant is slowly modified by the purchase and installation of new equipment and new technology, does the employer ensure that a complete evaluation of the hazards of the production process is performed/updated annually? Estimate this by surveying maintenance personnel for awareness of such information.

5. **Mechanical integrity:** Are vessels, piping, controls, pumps, and safety/emergency devices covered by written procedures to perform periodic inspection and maintenance to preserve the mechanical integrity of the equipment? Is production frequently interrupted by mechanical breakdown (an indicator of poor maintenance standards)? Estimate this by examining plant reliability data.

6. **Personal protective equipment (PPE):** Is personal protective equipment subject to appropriate selection, maintenance cleaning and usage procedures? Does the employer have a PPE programme or standard which addresses the above? What is the level of compliance with the PPE policies? Estimate this by examining PPE policy and surveying employees for awareness of, and compliance with, the PPE policy.

Indicators for the safety and occupational hygiene system

1. **Safety hazard identification and control:** Does the JHSC deal with hazard identification and control? How many safety hazards are identified in regular inspections, and how quickly are they corrected? Does the JHSC conduct regular inspections? Are records of previous inspections examined periodically? Is special attention given to material handling, moving equipment, electrical installations, sampling points, chemical and biological hazards, very hot and very cold areas or equipment, dust, vapours and fumes, radiation, noise, potential for slips, falls, ladders, hoses, vehicles, fire hazards and fire protection? Estimate this by examining the last six workplace inspection reports and verifying that all action items have been completed.

2. **Occupational hygiene:** Does the JHSC participate in occupational hygiene monitoring programmes? Are industrial pollutant levels in compliance? Are industrial pollutant levels improving or getting worse? Are there any worker complaints about air quality? Estimate this by examining any records available from the occupational hygiene department and by surveying JHSC members.

3. **Occupational disease:** How many cancer cases are there, especially in longer-term workers or retirees? How does the observed number of cancer cases compare with the expected? Estimate this by examining JHSC minutes for evidence that this is considered.

4. **Stress:** How many stress complaints or breakdowns does the work force experience? How many grievances are there per year? Is the rate increasing or decreasing? Is there a high rate of staff turnover, resignations, or early retirements? Is job security high or low? Is there a high rate of vandalism and theft? Are there many customer complaints about product? Have there been incidents of serious conflict or violence? Have there been suicides or attempted suicides within the employee group? Is there an Employee Assistance Programme (EAP)? How heavily is it used? Is there a drug testing programme (a negative indicator — creates additional stress and does not solve the drug abuse problem)? Is the employer proactive in trying to prevent harassment, bullying, and abuse? Is this a workplace where shift work is required? Are workers trained in how to cope with shift work? Estimate this by looking for evidence of any of the above, by examining statistical records of EAP use, harassment complaints, training programmes and services for shift workers.

5. **Housekeeping:** Are physical conditions and work environment clean, well lit, free of clutter and conducive to safety? Estimate this by a physical conditions inspection of a part of the workplace.

6. **Work refusals:** Are there a lot of safety related work refusals? What role does the JHSC have in investigating work refusals? How well are they handled? How are they resolved? If there are very few work refusals, is fear a factor? Estimate this by examining JHSC records of work refusal investigations.

STANDARDS FOR SAFETY AUDITS

In the previous section, a variety of indicators were suggested. Some suggestions were also made on how to estimate or evaluate each one.

For some of them, a written record could be examined. Thus, in the case of indicators for the effectiveness of the joint health and safety committee, an obvious place to look would be in the Committee's minutes. Other records that may be used include work permits, maintenance records or reports, laboratory results, etc.

For others, a survey technique works. Ask the workers their opinion, and tabulate the results.

Direct observation of conditions is another obvious way of evaluation an indicator.

Once you have determined what the actual measurement or observation technique is, the next step is to consider the type of information that will be yielded.

Setting a standard for each one requires that you determine what, in the case of each indicator would be an acceptable observation.

If quantitative information can be yielded, start with a scale that rates the result. Where, on that scale, is the acceptable performance level?

In a few cases, a statutory, technical or other generally accepted standard may exist. Packaged safety audits will often prescribe the indicators, measurement techniques, and standards to be used.

You are now ready to compare your results against the standard you have selected. As time goes on and experience with your audit system develops, you may wish to re-examine your standards to see whether they can be made as tight as possible.

CORRECTIVE POLICIES AND PROCEDURES

When designing corrective policies and procedures, it is important to think of both short-term and long-term correction.

Short-term correction asks the question: What must be done to prevent an accident from happening today?

Long-term correction asks the question: What must be done to prevent an accident from ever happening?

As can be seen, the answers to these two questions will frequently differ.

The actions of individuals do play a role in accident causation, but workplace design is not an accident! Someone made a conscious decision to do it a certain way. To solve the problems of the workplace, we must first carefully look at it. We may wish to tap the knowledge of hygienists, engineers, doctors, scientists, toxicologists or others, but ultimately, the experts in the workplace are the people in that workplace: YOU.

Consider some of the traditional explanations of occupational accidents and illnesses:

1. "Some workers are simply 'accident prone'. Their bad luck draws accidents to them." Despite research into the statistics of accidents, no evidence has ever been found to prove that "accident proneness" exists.
2. "Workers tent to be 'careless'. Worker carelessness is the cause of most accidents." The notion that workers do not care whether they injure themselves or not assumes a great deal, and often has the effect of blaming the victim. Some employers have recently bought into "behaviour based" approaches to safety that focus on controlling risk-taking behaviour by individual workers. Yet these same employers often encourage risk-taking, unconsciously or not. People tend to take more risks when they are rewarded for taking them, when they receive mixed messages about the importance of safety compared to production, and when risk taking seems to make sense of what are otherwise incomprehensible aspects of the workplace environment ("…at least the risks I take are the ones I control"); in other words, where a "safety culture" is lacking.
3. "Some workers are more susceptible to injury or disease than others." This theory leads to intensive pre-employment screening to ensure that only the healthiest, fittest applicants are hired. Despite all this effort, research has shown that pre-employment medicals are rarely predictive of future illness. As for injury, workers who have at some point received Workers Compensation, and workers who were previously healthy, have similar statistics for injuries, illnesses, and absenteeism.
4. "Most diseases are caused by lifestyle choices." We all have a right to make lifestyle choices; some will make wise choices, some not so wise. How far does the power of the employer extend into our private lives? Consider cancer for a moment. Smoking and diet are considered to be the two leading causes of cancer. What is often forgotten is that occupation is at least the third leading cause. This represents an enormous number of cancer deaths that the victims had no choice in.
5. "All activities, including work, contain an element of risk. When workers come to work here, they voluntarily accept the risks that come with the job." This statement assumes that: — the labour market is totally open with zero unemployment; — the pay in different jobs is based solely on the risk; and — people make decisions about their careers for only one reason, i.e. comparing risk to pay. These are all false assumptions. People work to live, not to die.

WORKERS ARE NOT TO BLAME

In all of these "theories" of accident causation, the focus is on the individual worker. Prevention therefore consists of protecting workers from themselves.

In reality, work is not primarily an individual activity, but is social and organizational in nature. The ability of each worker to make decisions about how to work at any given moment is constrained by supervision, the tools and equipment provided, choices already made about the process of production and workplace design, the actions of co-workers and supervisors, operating instructions and procedures, etc. Remedies must therefore focus on the organization, not the individual.

For example, "forced" operator error often occurs as result of production demands imposed by the owners of the enterprise. On the other hand, design of the workplace is a result of decisions made by management. If a system requires 100% vigilance

100% of the time to avoid a catastrophe, a catastrophe is guaranteed and it makes no sense to blame the worker when it finally occurs.

Workplace and process design do not happen by chance. Someone decided to design and operate the plant a certain way. Management has the ultimate authority to make choices about chemicals, technology, instruments, alarm systems, maintenance frequency and procedures, and even training — and they retain the responsibility that goes with that power. These choices can be good, or they can be bad. If good, systems are put in place so that accidents, injuries, and illnesses will be prevented. Systems, therefore, should be proactive in controlling hazards.

If human error or behaviour is to be considered, then some human factors that are often overlooked, can include fatigue, stress, shiftwork, and the ergonomics of workstation, tool, and equipment design. Even something as simple as a dial or a knob must be perceived and understood by the human operator to be useful, and that is largely a function of how well the control or instrument is designed.

Corrective measures should generally be chosen from the available range of alternatives according to the following order of preference:

1. **Control at or very near the source (if the hazard can be eliminated or completely isolated through substitution or effective engineering controls).**
2. **Control along the exposure pathway.**
3. **Control at the worker.**

A FEW WORDS ABOUT BEHAVIOUR BASED PROGRAMMES

A theory promoted by some behavioural consultants is that all hazards relate to behaviour. Even defective equipment or hazardous chemicals, for example, involve choices made by engineers and purchasers. Therefore, according to the behaviourists, human behaviour is the key to improved health and safety performance.

Typically, behavioural safety programmes involve:

1. **Observation of tasks;**
2. **Job analysis to identify potential safety problems with tasks;**
3. **Implementation of measures based on job observation and job analysis to improve safety performance; and**
4. **Re-observations and re-analysis on a periodic basis**

IndustriALL does not recommend behavioural programmes because of:

- **Their tendency to ignore or minimize the importance of non-behavioural hazards (e.g. physical hazards, occupational hygiene measures, ergonomics, and toxic chemicals).**
- **Their tendency to ignore the behaviour of management and engineering staff, especially those involved in the plant design state who may no longer be on-site.**
- **Their tendency to become fault-finding and punitive.**

It is difficult to guarantee that a behavioural programme would be implemented with a commitment to maintain strict confidentiality and avoid blame resulting from observations, and thus develop and maintain trust. Nevertheless, some believe behavioural programmes can be successful in using the knowledge of workers to identify “worker solutions” to safety hazards, while maintaining a high level of employee involvement and positive feedback on hazard control.

Our criticism of behaviour based programmes is that “human behaviour” is interpreted most often as “worker behaviour”. Rarely are the decisions and actions of supervisors and managers scrutinized. Even more difficult to observe is the key behaviour leading to an ergonomic or chemical hazard, which may have been on the part of an engineer, doctor, or toxicologist at the time the plant was designed. Workplace observer/ auditors do not have access to these people — especially if it is the only visible part of a behaviour based programme.

Unfortunately, some management have shown a determination to implement a behaviour based programme in spite of these concerns.

If so, avoid blame and punitive measures at all costs. Treat observations with a “what can we learn” attitude. Make sure that participation on the part of observers and observed is voluntary.

If the programme shows signs of becoming punitive, or of distracting attention from health and safety concerns important to the workers, then worker support for and cooperation with the programme must be withdrawn.

CONCLUSION

To IndustriALL Global Union, health and safety is not merely an administrative or service function. It is more than just complying with the letter of the law. It is something fundamental that we believe in, and demand to have. The centrepiece of occupational health and safety is the joint health and safety committee. Safety audits are a tool that can be used by the joint health and safety committee to evaluate and improve the safety systems in a workplace.

SOME DEFINITIONS

Note: The following definitions may not be identical to dictionary definitions, but reflect how the term is typically

ABSORPTION

The process by which chemicals enter the body directly through the skin. Some chemicals are able to enter the body in significant quantities by this route. Examples include benzidine, carbon disulphide, cyanide, phenol, and many others. Other routes of entry include INGESTION and INHALATION.

ACUTE

A condition that arises instantly or quickly upon exposure to the hazard. For example, poisoning from carbon monoxide, hydrogen sulphide, or cyanide is an acute effect. Full recovery from a non-fatal acute effect is often possible. Compare the definitions of CHRONIC and LATENT.

ALONG PATH

In a discussion of where best to control a hazard, the phrase "along the path" or "along the exposure path" is used to describe a strategy of controlling a hazard somewhere between its origin, and the point of interaction with a worker. Compare the definitions of AT THE SOURCE and AT THE WORKER. Examples would be machine guards and barriers, noise absorbing machine enclosures, local and area ventilation.

ASPHYXIANT

A gaseous substance that, while not a poison, does not support life. Examples are nitrogen, and carbon dioxide. We breathe both, all the time. However, if they displace the oxygen in the air we will die because they do not support life, as oxygen does.

AT THE SOURCE

In a discussion of where best to control a hazard, the phrase "at the source" is used to describe a strategy of eliminating the hazard completely, for example by engineering it out of existence, or substituting a less hazardous chemical. This is the best possible control strategy because no further monitoring, maintenance, control programme, or training is required — the hazard is simply gone. Compare the definitions of ALONG PATH and AT THE WORKER.

AT THE WORKER

In a discussion of where best to control a hazard, the term "at the worker" is used to describe a strategy of controlling a hazard at the worker. Examples would include work procedures, personal protective equipment (PPE), and administrative controls such as job rotation. This is the least effective point at which to control a hazard because it requires the development of a control programme and constant monitoring for compliance, PPE suitability, PPE fit, PPE maintenance, PPE availability, training, enforcement, etc. As a result, control at the worker is rarely 100% effective.

BIOHAZARDOUS

This general term refers to infectious agents such as bacteria, viruses, and prions but includes other biological hazards. These could be moulds and fungi and their spores, pollens or animal dander that can cause allergic reactions, microscopic insects, and sometimes other biomolecules such as proteins, enzymes, hormones, or DNA.

BURN

Tissue damage caused directly by heat. Sometimes the phrase "chemical burn" is used to refer to the tissue damage caused by a corrosive chemical.

CARCINOGEN

A substance or agent that can cause cancer. A carcinogen can be a cancer initiator (implies an ability to damage or cause changes to the DNA of a cell, creating or unblocking a DNA sequence that codes for cancer — a "cancer gene") or a cancer promoter (able to cause or signal one or more biochemical events that being the expression of the "cancer gene"). Some carcinogens are both initiators, and promoters.

CHRONIC

Refers to a disease process that is long-term and resistant to treatment, if not permanent. Full recovery from a chronic disease is often impossible because the damage has (usually) taken place over a period of years, and has resulted in irreversible damage to an organ or system. For example, many people do not notice lung disease until 85% of lung capacity has been permanently destroyed, and will not be recovered. This is because normal activities often require no more than about 15% of the capacity of a healthy pair of lungs.

CONTROL MEASURE

The strategy used to prevent a hazard from causing injury or disease. Good industrial hygiene practice recognizes that the best place to control a hazard is at the source; and that the lease effective point at which to control a hazard is at the worker. Control measures taken at some point between the source of the hazard and the worker are referred to as controls "along the path" referring to the exposure path.

CORROSIVE

Chemicals that can directly attack and physically damage living tissue. Examples include strong acids (e.g. sulphuric acid, hydrochloric acid) and strong bases (e.g. caustic soda).

CUMULATIVE

Toxic substances or poisons that are eliminated from the body more slowly than they are being inhaled, ingested, or absorbed. Such substances will increase in concentration in the body until a health effect is noticed.

DNA

Deoxyribonucleic acid. A large molecule found in the nucleus of cells, DNA contains the instructions for cellular activity. The instructions are coded by the sequence of four different nucleic acids that are linked in pairs between the long double helix backbone of the molecule.

DOSE-RESPONSE RELATIONSHIP

The relationship between the level of exposure (dose) to a chemical, biological or physical agent and the severity and frequency of associated adverse health effects (response).

DUST

Small particles of solid material suspended in the air. Particle size is important, and industrial hygienists often look for "respirable dust". Large dust particles tend to become trapped in the nose, throat, and upper respiratory tract. Particles below a certain size, that are much more likely to penetrate deeply into the lung, are referred to as "respirable".

ELECTROMAGNETIC FIELD (EMF)

Electricity always produces electric fields and magnetic fields. Although the electric and magnetic fields have different properties and can be measured separately, they are often grouped together and referred to as electromagnetic fields or EMFs. All of us are continually surrounded by EMFs, at work and at home. If there is the slightest possibility that electromagnetic fields could be affecting human health, then it should be taken extremely seriously because of the huge number of people who are exposed.

ENERGY

In occupational health and safety, energy can be thought of as anything that has the ability to create motion or cause injuries. When locking out equipment for maintenance, all potential sources of energy must be considered. These can include kinetic energy (parts that are still moving); potential energy due to gravity; stored energy in pressurized systems or compressed springs; electrical energy; chemical energy; light energy; heat energy; and ionizing radiation.

ERGONOMICS

The principle by which work is designed to match the real characteristics of workers. Ergonomists consider the size and strength of workers compared to the demands of their work, postures and movements required of them, frequency of repetitive movements, as well as other aspects of the human/work systems.

EXPLOSIVE

Chemicals that burn or react so rapidly and violently that a shock wave is produced. Explosives are unstable materials that can often be detonated by shock or elevated temperatures, even without an open source of ignition.

EXPOSURE

The way in which the hazard interacts with or enters the body; whether by e.g. absorption, contact, ingestion, inhalation, or infection. Quantitative estimates of exposure to a toxic substance measure the quantity and concentration substance, the nature of the work being done and the extent of contact between the worker and the substance, the number of people exposed to the hazard, and the length of time of exposure.

EXPOSURE ASSESSMENT

An evaluation of the potential for, and level of, exposure to identified hazards. This includes an evaluation of the frequencies of exposure, the number of workers exposed, and the intensities of exposure. See Hazard Identification.

FUME

Small particles suspended in air that have been released as a liquid but condense rapidly to a solid. For example, welding fumes are released from the point of welding as minute droplets of molten metal, but almost instantly change state to small solid particles.

GLOBALLY HARMONIZED SYSTEM OF CLASSIFICATION AND LABELLING OF CHEMICALS (GHS)

The international successor to various national workplace hazardous materials information systems. Concerned that the proliferation of national “right-to-know” laws was becoming a trade barrier, several agencies of the United Nations were mandated to work out an international harmonized system of classification and disclosure of information about hazardous chemicals.

HAZARD

Having the potential to cause harm, based on inherent characteristics. Compare the definition of RISK. A toxic substance, for example, is a hazard even if no one is exposed to it. However, if the chance of exposure is low, it may not be a significant risk.

HAZARD CHARACTERIZATION

An evaluation of the types of potential injuries and adverse health effects that are associated with identified hazards. See Hazard Identification.

HAZARD IDENTIFICATION

The identification of materials, tools, equipment, biological agents, chemicals, physical agents, and job demands capable of causing injury or adverse health effects.

INGESTION

The process by which anything enters the body by way of the digestive system. Although ingestion is not normally thought of as a workplace issue, significant quantities of workplace chemicals can be ingested by swallowing saliva, licking one’s lips.

INHALATION

The process by which anything enters the body by way of the respiratory system. Inhalation is generally considered to be the most serious potential route of entry for toxic substances in the workplace, even though ingestion and absorption can also be important in some instances.

LATENT

The period of time between exposure to a hazardous material and the appearance of health effects. Latency is most commonly discussed in connection with occupational cancer. For example, two or three decades may elapse between a worker’s first exposure to asbestos and the appearance of asbestos-related disease.

LIGHT

Visible electromagnetic radiation.

MATERIAL SAFETY DATA SHEET (MSDS): see SAFETY DATA SHEETS (SDS)

A legally prescribed form for the disclosure of information about hazardous materials.

MECHANICAL HAZARD

The typical hazards associated with vehicles, moving equipment, industrial machinery that have the potential to cut, sever, or crush body parts.

MIST

Small droplets of a liquid suspended in air.

MUTAGEN

Capable of causing genetic (DNA) changes in the germ cells (sperm in men, ova in women) that can be passed on to one’s descendants. Mutations can result in stillbirths, or inheritable birth defects, predisposition towards cancer, and other changes. Compare with the definition of TERATOGEN.

NOISE

Energy in the form of vibrations in the air, that can be detected by the ears.

ORGAN(S)

An identifiable structural part of the body that has a specific function. In discussing the effects of a toxic chemical it is often important to note its effect on a specific organ or organs.

OXIDIZER

While not flammable or explosive in itself, an oxidizing material promotes combustion or dangerous reactions. Oxygen is of course a member of this group, and other examples include organic peroxides, permanganates, and any material that contributes to the combustion of another material.

PINCH POINT

A common mechanical hazard describing a point where two moving parts, or one moving and one stationary part, can potentially catch a worker or a body part. Pinch points have the potential to cut, sever, or crush body parts.

POISON

A hazardous material that interferes directly with the biochemical process of the body's cells. For example, carbon monoxide interferes with the ability of haemoglobin in the blood cells to transport oxygen through the body, by binding to the haemoglobin molecule more strongly than oxygen itself. Hydrogen sulphide is a neurotoxin, (the first part of compound words that end in "toxin" generally refers to the organ or system that the toxic substance attacks) that interferes with the biochemical processes that allow brain and nerve cells to transmit signals. Hydrogen sulphide tends to kill by stopping the nervous signals that control breathing. The lungs stop working and death by asphyxiation results. TOXIC is a synonym for poison.

PRECAUTIONARY PRINCIPLE

A decision making process that assumes that the data available about a hazard is rarely accurate and never complete. When an activity raises concerns that worker or environmental health may be threatened, precautionary measures should be taken even if some causes and effect relationships are not fully established scientifically. The process of applying the precautionary principle must be open, informed and done with the participation of potentially affected parties. It must also involve an examination of the full range of alternatives, including no action.

PROPERTIES

The inherent characteristics of something. The properties of a hazardous material are unchanging and do not depend on quantity or concentration, manner of use, number of workers exposed or extent of worker exposure.

RADIATION

Refers to electromagnetic energy that can travel through space. Heat, radio and television signals, microwaves, and light are all forms of radiation but the term is usually associated in occupational health and safety with the higher-energy and higher-frequency end of the electromagnetic spectrum. High-energy radiation (for example x-rays and gamma radiation) can dislodge electrons from atoms to produce ions and for that reason is often referred to as "ionizing radiation". Ionizing radiation is particularly dangerous in that it penetrates deeply into the body where it can invisibly destroy cells and damage DNA (resulting in tumours or cancers).

RADIOACTIVE

Materials that emit ionizing radiation through a natural process of atomic decay.

REACTIVE

Materials that are unstable alone or in combination with other specific materials. Usually refers to materials that may undergo rapid decomposition, polymerization, or that react vigorously with common materials like water.

RISK

The chance that exposure to a hazard will occur and result in an undesirable outcome. For example, hydrogen sulphide is a hazard because it has the property of being a poisonous gas. However, the risk of hydrogen sulphide poisoning arises when there is a chance that workers may be exposed to it. If more workers could potentially be exposed to higher concentration of hydrogen sulphide, the risk is greater even though the properties of hydrogen sulphide are unchanging. Compare definition of HAZARD.

RISK ASSESSMENT

A process consisting of the following steps: (i) hazard identification, (ii) hazard characterization, (iii) exposure assessment, and (iv) risk characterization.

RISK CHARACTERIZATION

An estimate of the probability of, and potential severity of, workplace injury or disease occurring as the result of exposure to identified hazards.

RISK MANAGEMENT

A process of using Risk Assessment (q.v.) to make policy decisions about the protection of the health and safety of workers, and for selecting appropriate prevention and control options. Risk Assessment/Risk Management is generally presented as scientific, unbiased decision-making system, best performed in secret by "professionals". However, risk-based decision-making systems usually depends heavily on assumptions – especially on the assumption that the data used in the various steps is complete and accurate. Compare with the definition of "Precautionary Principle".

SAFETY DATA SHEET (SDS)

A legally prescribed form for the disclosure of information about hazardous materials; a requirement of the Globally Harmonized System of Classification and Labelling of Chemicals (GHS).

SENSITIZER

The usual definition of sensitizer is a material that is capable of interacting with the body's immune system to produce a serious allergic response. However, this definition is not completely adequate in an occupational health and safety sense.

For example, isocyanates are well-known industrial sensitizers, because workers can develop severe asthma-like-reactions to minute quantities of isocyanates after working with them. However, the mechanism by which isocyanates produce sensitization does not seem to follow the normal process by which people become allergic to e.g. pollens, and is not fully understood. Furthermore, classification of materials as sensitizers is difficult because the response is more dependent upon individual differences than the response to a typical toxic substance.

STANDARDS

Established specification or level of performance expected in occupational health and safety.

SYNERGISTIC

Two hazards that interact with each other in such a way that each multiplies the risk produced by the other. Well known examples are: smoking and asbestos exposure; exposure to chlorinated solvents and drinking of alcoholic beverages. There are probably many more synergistic interactions than are known because they are difficult to research.

SYSTEM(S)

A group of organs and structures in the body that have related functions. Examples: digestive system; nervous system; reproductive system; circulatory system.

TERATOGEN

An agent that is capable of causing birth defects without necessarily damaging the DNA of germ cells (Compare the definition of MUTAGEN). For example, thalidomide, a drug that was once administered to some pregnant mothers with disastrous results, is believed to have caused birth defects by interfering with the biochemical signals that guide the development of the foetus in the mother's womb. However, thalidomide is not believed to have the capacity to damage DNA. Therefore, persons born with birth defects caused by thalidomide might be expected to have the same chance of having normal children themselves as the general population, since a mutation was not involved.

TOXIC

A hazardous material that interferes directly with the biochemical processes of the body's cells. For example, carbon monoxide interferes with the ability of haemoglobin in the blood cells to transport oxygen through the body, by binding to the haemoglobin molecule more strongly than oxygen itself. Hydrogen sulphide is a neurotoxin, (the first part of compound words that end in "toxin" generally refers to the organ or system that the toxic substance affects) that interferes with the biochemical processes that allow brain and nerve cells to transmit signals. Hydrogen sulphide tends to kill by stopping the nervous signals that control breathing. The lungs stop working and death by asphyxiation results. POISON is a synonym for toxic.

TOXICOLOGY

The science of toxic, or poisonous, materials. Toxicology seeks to identify which materials are poisonous, at what levels or quantities they present a danger, and the mechanisms by which they affect the body. Typical toxicology studies aim to relate dose, or concentration, of a hazardous material with observed health effects. In studies using laboratory animals, the observed health effect is commonly fatality, and the result of the study is expressed as a LC50 (the concentration of a substance that killed 50% of the test animals) or LD50 (the dose of a substance that, when administered to test animals, killed 50% of them). Toxicologists also use cell cultures, computer models, and other methods to predict toxicity.

Head office

IndustriALL Global Union

54 bis, route des Acacias
1227 Geneva Switzerland
Tel: +41 22 308 5050
Email: info@industriall-union.org

Regional offices

Africa office

Physical address:
North City House
Office S0808 (8th Floor)
28 Melle Street, Braamfontein
Johannesburg 2001 South Africa
Tel: +27 11 242 8680
Email: africa@industriall-union.org

Postal address:
P O Box 31016
Braamfontein 2017 South Africa

South Asia office

16-D, 16th Floor
Atma Ram House
No.1, Tolstoy Marg
New Delhi - 110 001 India
Tel: +91 11 4156 2566
Email: sao@industriall-union.org

South East Asia office

809 Block B, Phileo Damansara II
No 15, Jalan 16/11
46350 Petaling Jaya Selangor Darul
Ehsan, Malaysia
Email: seao@industriall-union.org

CIS office

Str. 2, d.13, Grokholsky per., Room 203
12090 Moscow Russia
Tel: +7 495 974 6111
Email: cis@industriall-union.org

Latin America & the Caribbean office

Avenida 18 de Julio No 1528
Piso 12 unidad 1202
Montevideo Uruguay
Tel: +59 82 408 0813
Email: alc@industriall-union.org

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