Occupational Health and Safety Practitioner

Resource for BSBOHS403A

HAZARD, ENERGY AND DAMAGE

July 2005
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Overview

Objectives
This Resource is to help learners understand:

- hazards as sources of potentially damaging energy; and
- that the conditions resulting in the loss of control usually occur over time.

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INTRODUCTION

We still hear comments such as ‘safety is just common sense’. If it is common sense then why are so many people dying, being injured or suffering ill-health due to their work? History shows us that safety and prevention of injury and ill-health associated with work has been plagued by myths and misunderstandings.

Slate mining was a major industry in Wales from the 1850s to the 1950s but the slate miners suffered a very high incidence of tuberculosis. By the early 20th century the ‘science’ was that tuberculosis was caused by bacteria and that, in some way, exposure to slate dust increased the likelihood of contracting the disease.

However, this scientific evidence was completely ignored with regard to preventing tuberculosis among slate miners. Medical practitioners disagreed with the scientific evidence, actually claiming that slate dust was beneficial to health! The general view among medical practitioners at the time was that tuberculosis was a social disease and more related to poor hygiene and personal factors such as inadequate diet, insufficient sleep, lack of fresh air and exercise; which are exacerbated in the case of the Welsh slate workers by language, religion and intermarriage!

Quarry owners also disagreed, although for different reasons, saying that slate dust was no more harmful than road dust and warned that ‘...if all sort of fantastic rules and regulations are foisted upon employers.....the time will come when the business will not be worth continuing’ (D. Viner, 1991).

This may sound ridiculous but we still have many ‘hangovers’ of this person-centred approach today. Without an effective understanding of how injury, ill-health, damage or loss occur it is not possible to identify hazards and so act proactively to prevent injury, ill-health and other losses.

One of the approaches that has assisted in applying a scientific approach to safety is the ‘energy damage’ concept. This concept enables us to conceptualise the complete process leading to injury or damage for physical and chemical hazards. It requires some modification to use it to explain ergonomic hazards such as manual handling and problems associated with work posture, and it does not adequately explain psychosocial hazards. However, if the objective is to understand the nature of the hazard, then the discussion that the model generates is a vital tool in risk assessment and risk control.
HAZARDS
The term 'hazard' is commonly used when people think and talk about safety. It is usually defined in the following way:

A hazard is a source of potential harm in terms of human injury, ill-health, damage to property, the environment, or a combination of these.

Colloquially the term 'hazard' is often misused by using it to refer to any feature of the physical, organisational and/or behavioural environment, such as a spill on the floor, lack of training or poor work practices, which contributes to the incident or the severity of the outcome. Also, hazards are sometimes referred to as 'potential' hazards. Hazards are sources of 'potential harm' therefore they are either present or not present, the potential is in their 'risk' not in the hazardous nature.

Such misuse of the term 'hazard' often leads to poor or wrong analyses of OHS problems and therefore a failure to identify effective controls. Andrew Hopkins identified that confusion over the difference in meaning of 'hazard' and 'risk' hindered the investigation into the Longford explosion (Hopkins, 2002).

Factors such as inadequate work practices, lack of training, or fatigue, are NOT hazards but are failures in controls, or conditions, that may result in injury or damage occurring.

Where control failures are confused with hazards there is an assumption that the particular control should be implemented rather than identifying the best controls for the hazard.

Your first challenge is to always use the term 'hazard' in the correct context.

HAZARDS AND ENERGY
The energy damage concept was introduced in the 1960s and enables us to conceptualise physical and chemical hazards and the complete process leading to injury or damage.
Whenever injury or damage occur it is possible to identify the energy which produced it. These energies exist normally around us, or within us, and are an essential feature of both the natural and artificial environment. To proactively prevent injury and damage it is necessary to understand the relationship between energy and damage.

Energy makes things move, makes them hot, produces light and sound. Every process taking place in the world, even life itself, requires a supply of energy to keep it going. The following list shows the range of energies both external and internal to the body.

### Energies as Hazards

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Injuries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravitational</td>
<td>Found wherever objects could fall from a height onto a person or where a person could fall from a height, slip or trip on the same level or fall to a level below;</td>
<td>Injuries may range from lacerations to death.</td>
</tr>
<tr>
<td>Noise &amp; vibration</td>
<td>Found wherever people are exposed to noise or vibration;</td>
<td>Injuries may range from whole body vibration, 'white finger' to noise induced hearing loss.</td>
</tr>
<tr>
<td>Chemical</td>
<td>Found wherever people could inhale, ingest or absorb a range of liquids, dusts, fumes, gases or substances react to cause damage such as fire, explosion or corrosion;</td>
<td>Injuries range from acute to chronic, may have a long latency and could result in death.</td>
</tr>
<tr>
<td>Electrical</td>
<td>Found wherever electricity is used to operate equipment;</td>
<td>Injuries range from burns to death.</td>
</tr>
<tr>
<td>Mechanical</td>
<td>Found in machinery where there are moving parts that create trapping points or entanglement, or where there may be ejection of parts;</td>
<td>Injuries range from lacerations, amputations, to death.</td>
</tr>
<tr>
<td>Thermal</td>
<td>Found wherever there are hot or cold environments or objects eg furnaces/cool rooms, hot processes, welding, hot/cold objects;</td>
<td>Injuries range from burns, heat stress/heat exhaustion, hypothermia, hyperthermia, to death.</td>
</tr>
<tr>
<td>Pressure</td>
<td>Found wherever vessels/objects are under pressure including boilers, gas cylinders, compressed air;</td>
<td>Injuries range from laceration to death.</td>
</tr>
<tr>
<td>Radiation</td>
<td>Found wherever there are x rays, UV radiation, microwaves, lasers or welders;</td>
<td>Injuries range from burns to death.</td>
</tr>
<tr>
<td>Microbiological</td>
<td>Found wherever people could be exposed to bacteria, viruses or other pathogens such as in body substances, cooling towers;</td>
<td>Injuries may range from acute to chronic, may have long latency and could result in death eg. HIV, hepatitis, food poisoning.</td>
</tr>
</tbody>
</table>
There are two other sources of harm, ergonomic hazards and psychosocial hazards.

The energy damage concept requires some modification to be applied to ergonomic hazards such as manual handling and problems related to work posture. For the purposes of the energy damage model we may treat these types of hazards as ‘biomechanical’ or ‘self’ energy.

**Biomechanical**
- Found wherever muscles are used for doing work including lifting, pushing, pulling holding, restraining or where work involves repetitive use of muscles;
- Most common injury is muscle strain.

Psychosocial stress is not well explained by the energy damage model. However the energy damage concept does act as a useful stimulus for discussion on psychosocial hazards.

**Psychosocial hazards**
- Found where the way work is organised, the relationships or interactions which operate within the work environment create a potential for harm, or specific events occur that may lead to post-traumatic stress.

A simple hazard identification check list can be compiled using the energy damage concept.

- Can it move?
- Can it fall?
- Is it powered?
- Is it sharp?
- Does it make a noise?
- Is electricity supplied?
- Is it hot or cold?
- Is it a chemical?
- Is it a source of ignition?
- Does it give off radiations (X-ray UV etc.)?
- Are there ‘bugs’ (bacteria, viruses, other)?
- Are people walking, running, swinging limbs?
- Are people in awkward or fixed postures?
- Are people likely to overload muscles or work at high pace?
- Are people likely to be hit/attacked by another (purposely or inadvertently)?

- **What types of energies exist in your workplace?**
- **What are the normal barriers/controls that prevent these energies causing injury or damage?**
ENERGY AND DAMAGE

Injury and damage are caused by energy.

Energy can be controlled by a barrier
Energies do not normally create injury or damage. Their potential to cause damage is normally controlled by the physical, organisational and/or behavioural features of the design, environment or process.

(Derek Viner, 1998)

For energy to do damage it has to penetrate the barrier and transfer to the recipient. For example, sound transfers through the air to your ear, a person places their arm in the trapping space of a machine.

Whether there is damage and the extent of the damage depends on whether the amount of energy exceeds the damage threshold of the recipient. Fatalities usually result from occurrences involving high amounts of energy such as being struck by moving plant, entrapment in machinery or falls from heights. High severity injuries may also result from cumulative energy exchange.

- What types of energy transfer situations occur in your workplace?
- What factors may affect the injury threshold of the recipient?
Injury and damage are the result of a process that takes time. Experienced investigators will always be able to identify this process when investigating an incident and those who understand the energy damage concept will be able to identify the potential for such a process prior to an injury or damage occurring.

Injury and damage result from the loss of control of the damaging properties of energy that we work with or are present in the environment. The conditions that lead up to the loss of control usually occur over a period of time.

An event is the point in time at which control is lost over the potentially damaging properties of the energy source. (What happened?)

There are usually many reasons for this loss of control (How the accident happened?) and conditions that lead to these reasons for the loss of control over the energy (Why it happened?) develop over a period of time.

The reasons why it happened may come directly or through the interaction of one or more of 5 sources:

- the organisational and management environment;
- physical environment;
- equipment;
- procedures; and
- people and human error.

To be proactive, we must identify these conditions and reasons prior to an event occurring, i.e. identify the WHY and take corrective actions to remove the WHY and HOW.
The interaction of these sources to develop pre-conditions for an occurrence are illustrated in an article titled 'Fuel hoses unchecked, ship fire probe told,' reported in THE AGE newspaper (20th June 1998) and referring to a fatal fire on HMAS Westralia that started after two flexible fuel lines split, spraying diesel on to hot machinery in the engine room. In summary, the points covered in the article were:

- A private contractor who worked on HMAS Westralia’s engines just days before the fire admitted he failed to check the quality of fuel lines supplied by a sub-contractor because he believed that it was up to the sub-contractor to ensure the lines were approved by the international shipping watchdog Lloyds.

- In hind sight, the contractor agreed he had probably not given the sub-contractors ENZED adequate detail on the fuel-line specification. In addition, he had left it up to ENZED to check that the lines met with international standards.

- The contractor was unaware that ENZED fitted different hoses from that originally approved until well after the 5th May fire in Westralia’s engine room.

- The navy contract manager also did not believe it was his duty to check on the quality of the hoses.

<table>
<thead>
<tr>
<th>Why did it occur?</th>
<th>How did it occur?</th>
<th>What happened?</th>
<th>What was the outcome?</th>
<th>What was the damage?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-contractors not given adequate specification on fuel lines (contractor)</td>
<td>Flexible fuel line split</td>
<td>Leak of diesel</td>
<td>Fire</td>
<td>Death, injury, damage, loss to reputation</td>
</tr>
<tr>
<td>Assumption that sub contractors would check specification</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quality of fuel lines supplied by subcontractor not checked (contractor)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Hoses fitted not to specification</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No checks on hoses post fitting</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The reasons why this incident occurred may be listed as:

Organisational & management environment
- Responsibilities not clarified.

Physical environment
- Flammable liquid under pressure.

Equipment
- Fuel lines not to specification.

Procedures
Deficiencies in:
- contracting and purchasing specifications; and
- contract management procedures.

People and human error

A NEW SET OF DEFINITIONS

We can now see that we have a different definition of a ‘hazard’.

A hazard is a source of potentially damaging energy.

Also, we have seen that when there is a loss of control of energy there is the potential for injury. This process is termed an occurrence. The time frame for an occurrence may be anything from a fraction of a second to many years. Where the time frame is extended we refer to the hazards as having a ‘long latency’.

Occurrence is the process(es) which gives rise to damage, injury or ill-health.

‘Incident’ is a colloquial term often used to refer to the occurrence and is defined as ‘an event that has caused or has the potential for injury, ill-health or damage’. While this describes processes that give rise to injury or ill-health that arise suddenly and are of short duration it is not a useful term when the process of injury or ill-health occurs over time. Therefore ‘occurrence’ is the preferred term irrespective of the time period for the causation process.

Note that ‘accident’ is a term that is now considered out of date as it suggests inevitability, or an inability to prevent, or a lack of culpability on the part of those involved.
REFERENCES & FURTHER READING

References


Further reading
