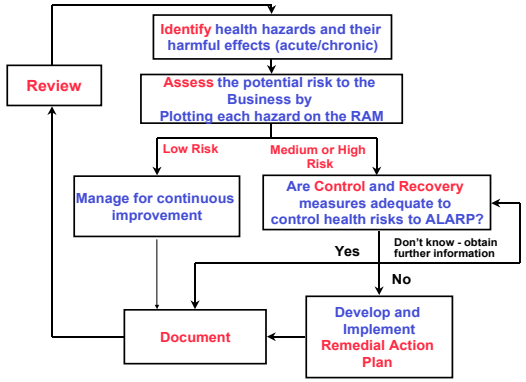
Controlling Exposures and Health Risks at work

How do you know you have a problem?

- Topic outline
  - Hazard assessment strategies
  - Hierarchy of control strategies
  - Review of error and uncertainty analysis
  - Statistical measures of process control

Hazard Risk Assessment Paradigm



Identifying and Assessing Health Hazards

- Selection of assessment team
- Identify and assess hazards
- Identify nature and degree of exposures
- Identify control standards
- Evaluate health risks
- Deciding on remedial action / monitoring

Selection of team

To gather necessary information team members must be able to:

- Observe the activity being performed
- Predict any potential departure from observed practice
- Ask supervisors, staff etc. the relevant questions
- Undertake simple diagnostic tests
- Identify and review relevant technical literature
- Gather the information systematically
- Form valid, justifiable conclusions about exposures

Identify Health Hazards and their harmful Effects

Agent	Source	Route	Harmful Effect
Silica dust (crystalline)	Refractory bricks	Inhalation	Lung disease (silicosis)
Used mineral oils	Engine oil	Skin	Dermatitis, cancer
Noise	Process noise above 85dB(A)	Hearing	Hearing Loss
Heat	Plant heat	Whole body	Heat stress, heat stroke
Legionella bacteria	Spray cooling towers	Inhalation	Legionnaire's Disease
Repetitive movements	Workplace design	Whole or part of body	Musculo-skeletal disorders

Factors influencing the Relationship between Hazard and Risk

- ❑Cumulative exposure
- ❑Individual susceptibility
- ❑Threshold levels
- ❑Knowledge gaps
- ❑Workstyle changes
- ❑Real world practices

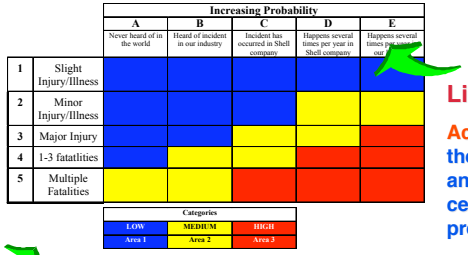
Assigning Hazard Ratings

Hazard Rating	Definition Consequence Category (harm to people)
1	**Slight health effects:** Not affecting work performance or causing disability, e.g. non toxic dusts (as an acute hazard)
2	**Minor health effects:** Agents capable of minor health effects which are reversible, e.g. irritant and defatting agents, many food poisoning bacteria
3	**Major health effects:** Agents capable of irreversible health damage without loss of life, e.g. noise, poor manual handling tasks, hand/arm vibration, chemicals causing systemic effects, sensitisers
4	**1 to 3 fatalities or Permanent Total Disability:** Agents capable of irreversible damage with serious disability or death, e.g. corrosives, known human carcinogens (small exposed population), heat, cold, psychological stress
5	**Multiple fatalities:** Agents with the potential to cause multiple fatalities, e.g. chemicals with acute toxic effects (hydrogen sulphide, carbon monoxide), known human carcinogens (large exposed population)

Risk Assessment Matrix

- A Risk Assessment Matrix (RAM) allows assessment of the risk from each identified health hazard
- It helps you prioritize potential health risks and determine which risks need documented controls
- Ensure that health risks are assessed properly by taking into account acute and chronic harmful effects

Health Risk = Consequences X Probability (Likelihood)



Likelihood

Acute - Estimated on the basis of experience and or evidence that a certain outcome has previously occurred

Chronic - Estimated based on the historical evidence that excess exposure has occurred

Consequence

Estimate of what could happen (acute and chronic)

Risk Assessment Matrix

CONSEQUENCE ?				Increasing Probability ?				
				A	B	C	D	E
HAZARD RATING	People	Assets	Reputation	Never heard of in the world	Heard of incident in our Industry	Incident has occurred	Happens several times per year	Happens several times per year in our location.
1	Slight health effect	Slight damage	Slight impact	LOW RISK				
2	Minor health effect	Minor damage	Limited impact					
3	Major health effect	Localised damage	Considerable impact			MED. RISK		
4	PTD* or 1 to 3 fatalities	Major damage	Major national				HIGH RISK	
5	Multiple fatalities	Extensive damage	Major int'national					

Manage for continuous improvement

Incorporate risk reduction measures

Intolerable – investigate alternatives

* PTD = Permanent Total Disability

Note: Environment consequence column omitted

Low RAM Ratings

- **Manage for continuous improvement**
  - **via standard procedures (ensure these are adequate)**
  - **ensure Exposure Limits and other control standards are met**

Medium and High RAM Ratings

- Detailed review of controls
  - Standards of control
  - Who is exposed and when
  - Estimate or measure exposure
  - Compare existing controls against standards (are OELs met and risks As Low As Reasonably Practicable - ALARP?)
  - Consider need for routine exposure monitoring and/or health surveillance
- For risks assessed as High
  - give serious consideration to alternative ways of carrying out the operation

Control and Recovery

- Identify exposure
- Hierarchy of controls
- Control standards
- Use of control chart for individual risk
- Apply ALARP principle
- Exposure measurements
- Health Surveillance

Hierarchy of controls

- The hierarchy of controls is a list in preferential order of the means by which exposure to health hazards can be controlled
  - Elimination
  - Substitution (alternatives)
  - Engineering (plant and equipment)
  - Administrative/procedural
  - Personal protective equipment

Types of controls

- Elimination and substitution
- Engineering (plant and equipment):
  - Equipment/processes designed to prevent or minimize release of the hazard
    - Examples: containment (enclosure), exhaust ventilation, remote venting/vapor recovery systems

Types of controls

- **Procedural:**
  - Safe systems of work / Permit to work system
  - Record systems
  - Staff Instruction, Information & training
  - Supervision, Emergency arrangements
- **Personal Protective Equipment (PPE):**
  - Respiratory & Skin Protection as a secondary line of defence or as the only option

Effectiveness of Controls

The types of control vary in their effectiveness according to the control hierarchy:

Elimination — Most Effective

Substitution

Engineering

Procedural

PPE — Least Effective

Control selection

Control selection to achieve ALARP must consider the control effectiveness and cost:

- consider the most effective controls first
- limit PPE to:
  - -infrequent tasks
  - -temporary use until more effective controls are in place
  - -as a precaution should other controls fail

Maintenance of controls

- **Controls are only effective if they work**
  - **Engineering controls**
    - **Preventive maintenance, inspections and tests**
  - **Procedural controls**
    - **Record systems, information and training**
    - **Effective supervision**
  - **PPE**
    - **Routine maintenance, inspection and training**
  - **Emergency measures**
    - **Inspections and realistic exercises**

Control standards

- ❑Occupational Exposure Limits (OELs)
- ❑Specifications for control:
  - ❑Engineering Control Standards (SES, DEP)
  - ❑Procedural (supplier' s info / industry good practice)
  - ❑Personal Protective Equipment
- ❑ National, Company, Group, Industry and International Standards

Engineering control standards

- ❑Face velocities of Lab Hoods should meet recognized design standards
- ❑Rotating equipment mechanical seals that do not leak
- ❑Transfer lines/hoses with disconnect fittings that do not leak
- ❑Capture velocities for welding hoods meet recognized ventilation standards
- ❑Engineering controls are inspected regularly
- ❑Engineering controls are on a PM (preventive maintenance) schedule

Procedural standards

- ❑written procedures for tasks involving exposure (permit to work system)
- ❑procedures include work practices that minimize exposure
- ❑work practices are understood (e.g. training & validated by testing) and followed by employees (supervision, validated by auditing)

Personal Protective Equipment

- ❑ respirators
- ❑ gauntlets (gloves)
- ❑ goggles
- ❑ protective clothing
- ❑ foot protection

Personal protective equipment

Adequate use of PPE includes an assessment of:

- PPE requirement for each task
- PPE selection to match the hazard
- PPE is practical & functional for the task
- PPE requirements are understood by employees (e.g. training & validated by testing)
- PPE is used correctly (e.g. training & validated by audit))
- PPE is used when required (validated by audit)
- PPE is inspected and maintained regularly (validated by audit)

Use of Banding / Control Chart

- ❑Are controls meeting the control standards?
- ❑Control chart: tool for decisions
- ❑Use of information on exposures and controls
- ❑Combining 'hazard rating' and 'exposure rating'

Hazard rating categories

HAZARD RATING	DEFINITION (Consequence Category: Harm to People)
1	Slight health effects: Not affecting work performance or causing disability, e.g. non toxic dusts (as an acute hazard)
2	Minor health effects: Agents capable of minor health effects which are reversible, e.g. irritant agents, defatting agents, many food poisoning bacteria
3	Major health effects: Agents capable of irreversible health damage without loss of life, e.g. noise, poor manual handling tasks, hand/arm vibration, chemicals causing systemic effects, sensitisers
4	One to three fatalities or Permanent Total Disability: Agents capable of irreversible damage with serious disability or death, e.g. corrosives, known human carcinogens (small exposed population), sensitisers where the onset of sensitisation threatens continuing employment, heat, cold, psychological stress
5	Multiple fatalities: Agents with the potential to cause multiple fatalities, e.g. chemicals with acute toxic effects (hydrogen sulphide, carbon monoxide), known human carcinogens (large exposed population)

Exposure Rating

Exposure Rating	Exposure Band	Definition
a) Very Low	< 0.1 x OEL	Exposures are negligible
b) Low	> 0.1 - <0.5 x OEL	Exposure are controlled well below OEL and are likely to remain so in accordance with standards
c) Medium	> 0.5 – 1 x OEL	Exposures are currently controlled below OEL to meet standards but control may be reliant on less robust measures such as personal protective equipment
d) High	> OEL	Exposure are not adequately controlled to meet standards and continuously/regularly exceed OEL
e) Very High	>> OEL	Exposures are excessive and will almost certainly result in health damage to persons exposed

Control Chart

Hazard Rating ↓	Exposure Rating → Very Low (a)	Low (b)	Medium (c)	High (d)	Very High (e)
1	No	immediate	Third	Second	Priority
2	action	required	priority		
3				First Priority	
4				for	
5					Action
Exposure Band (1) →	<0.1*OEL (2)	0.1*OEL - 0.5*OEL	0.5*OEL - 1*OEL	> OEL	>> OEL

1. reference to exposure bands is a qualitative estimate only where no exposure data are available
2. OEL: Occupational Exposure Limit

Evaluate the Adequacy of Controls

- What is the nature of the hazard to health ?
  - Use Hazard Rating
- What is the nature and degree of exposure for the task ?
  - Assign Exposure Rating
- Combine in Control Chart

Remedial Action Plan

- The Remedial Action Plan must cover:
  - Recommendations divided into four levels of action (first, second, third priority and no immediate action required)
  - Is recommendation agreed or not?
  - Responsible person
  - Due date

Actions Control Chart (1) To aid priority setting

- Action 1st priority
  - Stop the exposure; notify management immediately
  - Identify all sources
  - Implement immediate control improvements e.g. PPE
  - Consider need for exposure measurement
  - Identify and implement work practice and control improvements
  - Review HRA, including measurements

Actions Control Chart (2) To aid priority setting

- Action 2nd priority
  - Reduce exposure to below OEL (Hazard Ratings 1-2)
  - Consider reducing to below 0.5 x OEL (Hazard Ratings 3-5)
  - Identify and implement work practice and control improvements (*)
  - Consider need for exposure measurement (*)
  - Review HRA, including measurements (*)
- Action 3rd priority
  - Actions with asterisk under 2nd priority
- Action – No Immediate Action Required
  - Normally no need for immediate action to improve controls. Manage for continuous improvement

ALARP Definition

Definitions of ALARP
" balancing the reduction in risk against the time, difficulty and cost of achieving it"

This level represents the point, objectively assessed, at which the time, difficulty and cost of further reduction measures become unreasonably disproportional to the additional risk reduction obtained.

ALARP- rule of thumb

- List the measures that have been taken to reduce the risk
- Go on to identify an additional option which might be introduced to reduce the risk further
- Give reasons why this additional control is not adopted

Exposure measurements

- Identify who may be exposed to health risks
- Identify the relevant exposures to individuals in the workplace
- Assess your work environment to determine when you need to do exposure monitoring/measurements

Document & Review HRA

- Appropriate Depth of Records
- Linked with Medical Records
- Informing Staff
- Archiving of Records
- Reviewing Records

Appropriate Documentation

- Records should:
  - be retrievable
    - Internal/external audits, authorities and review
  - meet legal requirements
  - be detailed enough to ensure audit trail on how conclusions were reached
  - allow traceability from individual name via Job Type to tasks
  - include exposure monitoring and health surveillance

STOP HERE