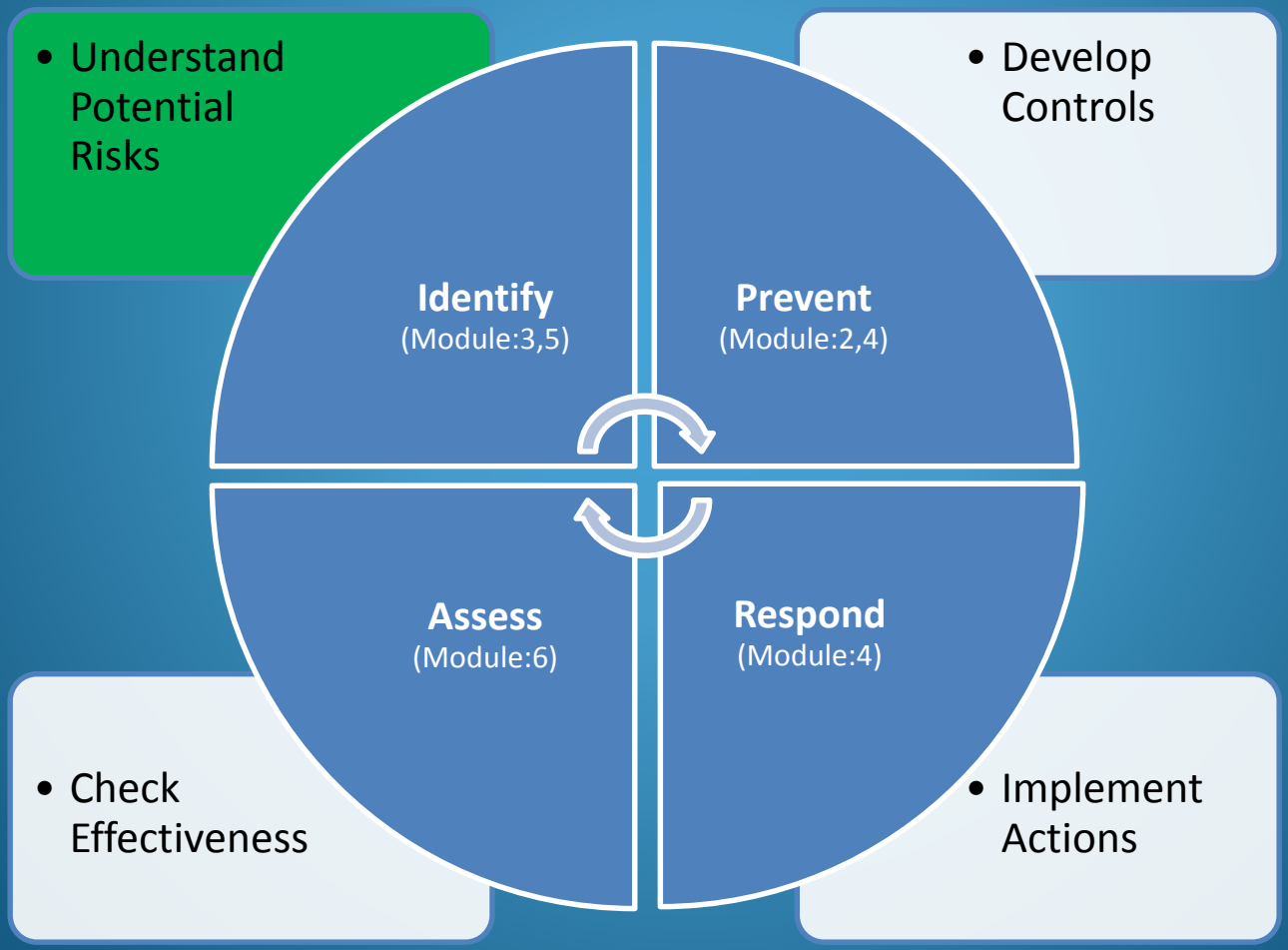
Module 3
Risk Assessment

Best Practices for Achieving Environmental Sound Management

at Facilities that Refurbish and Recycle Used and End of Life Electronic Products

ESM Framework

Where Module 3: Risk Assessment fits within the framework of ESM.



What is Risk Assessment?

Identify actual and/or potential hazards and risks to public and worker health and safety, and the environment that are associated with activities, products and services.

- **Risk:** the chance or probability that a person or the environment will be harmed if exposed to a **hazard**.
- **Hazard:** the potential source of harm.
  - An **environmental hazard:** the source of potential damage or harm to the environment (e.g. industrial releases; use of chemicals).
  - An **occupational hazard:** any source of potential damage, harm or adverse health effects to someone at work.

What is Risk Assessment?

- **Risk Assessment** is the process where you:
  - Identify **occupational** and **environmental** hazards
  - Analyze or **evaluate risks** associated with the hazards
  - Determine how to eliminate or **control the hazards** (Module 4).

Best Practice:

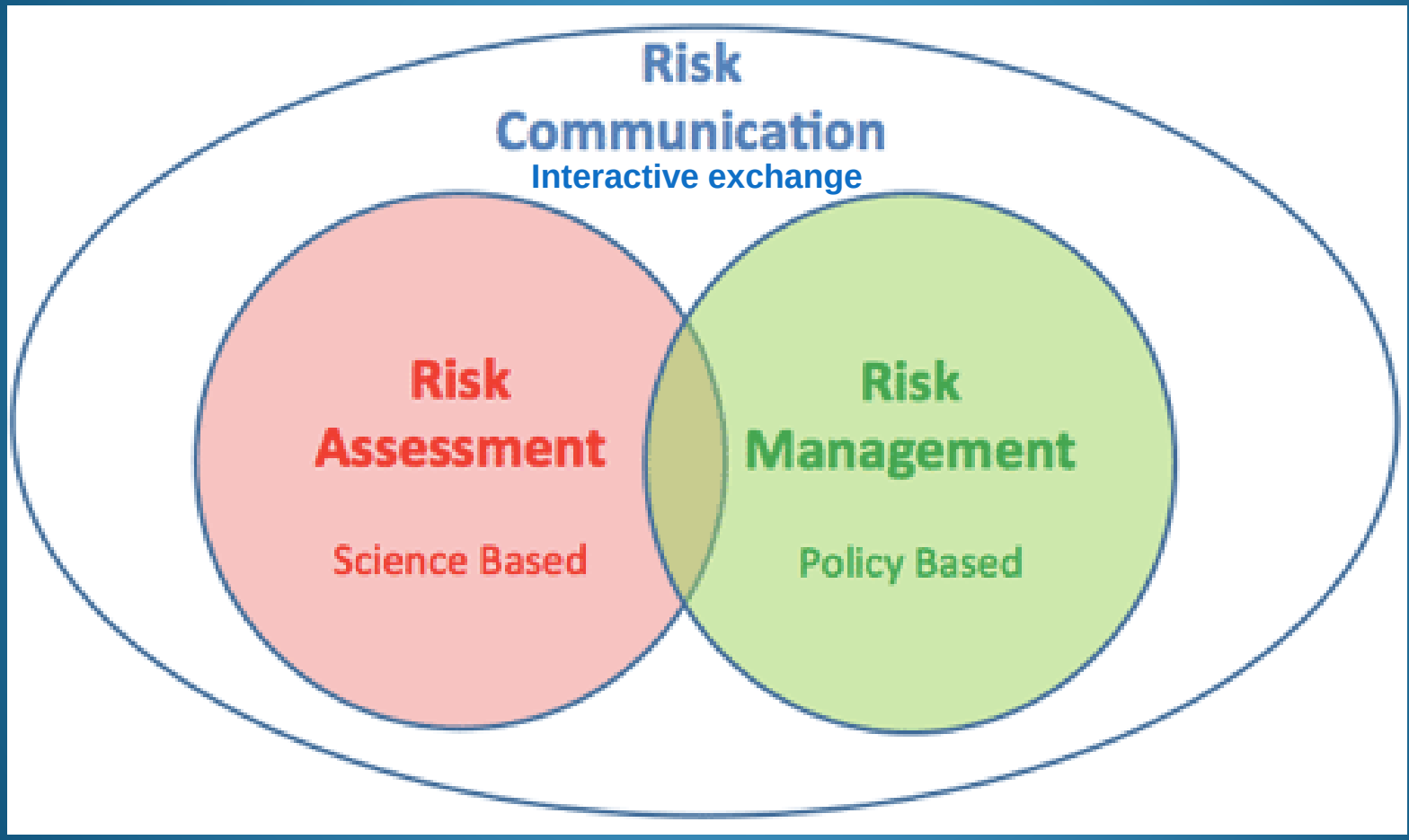
- Facilities should conduct risk assessment at a minimum on an annual basis.
  - Identify situations or activities that may harm workers or the environment.
  - Assess when any changes are made to the facility's operations (e.g. a new process), regulatory requirements (e.g. new waste handling standard), or following an EHS incident (e.g. occupational exposure or accident).
  - Risk assessment information is useful for decision making (policies, regulations, etc.)

Why is Risk Assessment Important?

- Risk assessment provides a step-by-step process that helps a facility identify, prioritize, and mitigate actual and potential **risks to the population,** to **worker health and safety**, and to the **environment**.
- Risk assessment forms an integral part of a good health and safety management plan as it helps to:

  - ✓ Create awareness of hazards in the workplace
  - ✓ Identify who may be at risk (employees, cleaners, visitors, etc.)
  - ✓ Determine if existing control measures are adequate
  - ✓ Prevent injuries or illnesses when done at the design or planning stage
  - ✓ Prioritize hazards and control measures

Why is Risk Assessment Important?



Different risk assessment studies could be done, depending on the scope (health, environmental, for a chemical substance.)

Why is Risk Assessment Important?

RISK

Normal operating conditions (material handling, shredding, routine maintenance)

Exceptional operating conditions (preventive maintenance, major equipment repair, accidents, start-up, shut-down)

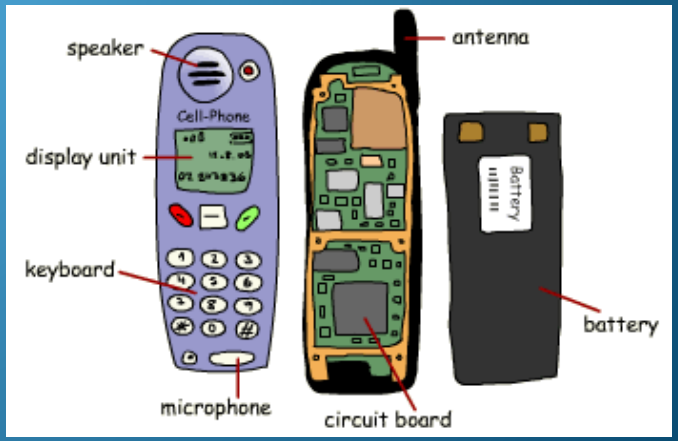
Used electronics contain different chemical substances, some of which are hazardous. These can be released when used electronics are harvested for parts or processed for material reclamation.

Best Practice:

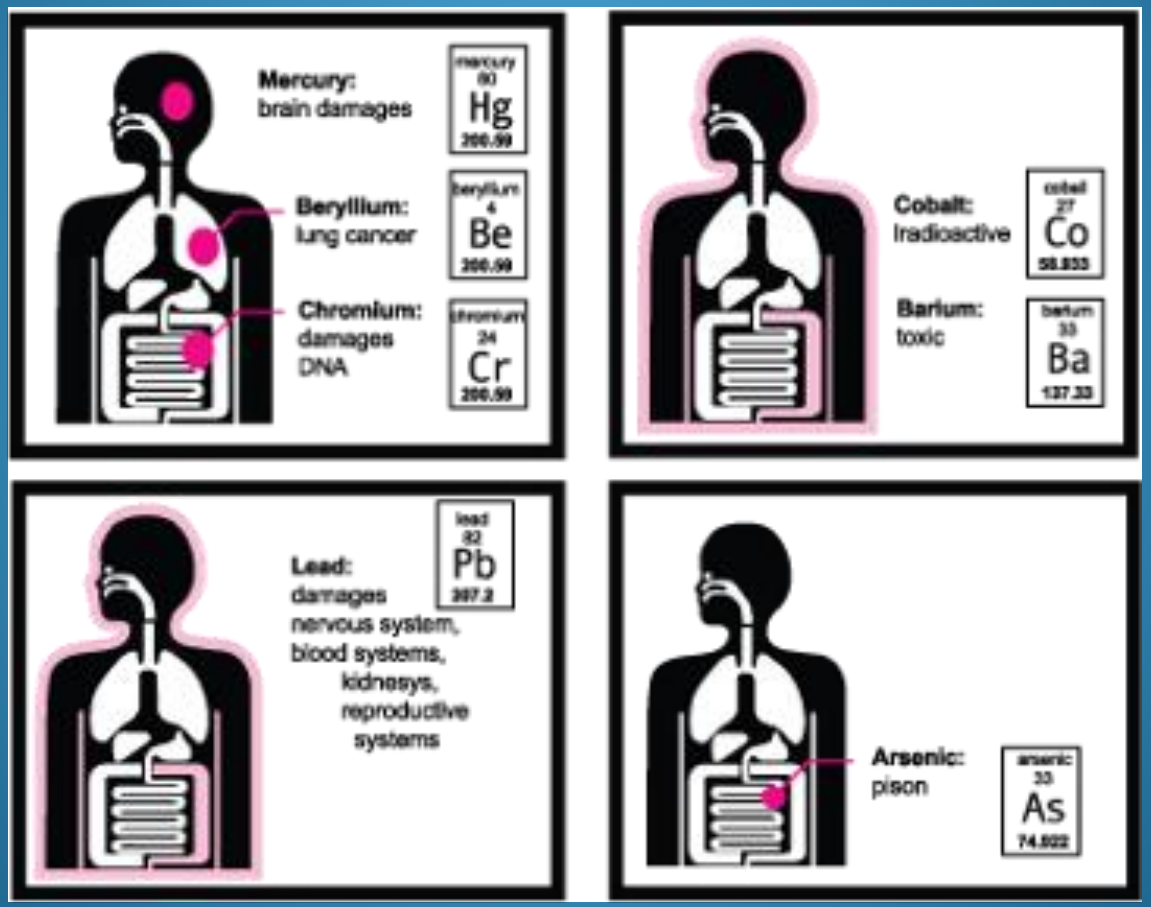
- Maintain a documented process to conduct an annual EHS Risk Assessment for both normal and exceptional operating conditions.
- Note that normal operation conditions doesn't mean they follow ESM.

Examples of hazardous substances in electronics

- **Mercury**: in backlighting of liquid crystal display screens, some batteries. Risk occurs when replacing lights, or shredding for recycling.
- **Lead**: in cathode ray tubes as radiation shielding, tin-lead solders, and plastic stabilizers. Risk occurs when shredding circuit boards.
- **Cadmium**: in cathode ray tubes, some batteries, colour pigments and plastic stabilizers. Risk occurs from broken cathode ray tubes.
- **Hexavalent chromium**: used in colour pigments, plastic stabilizers, and anti-corrosion treatments. Risk occurs from smelting.
- **Brominated flame retardants**: used in plastic housings, circuit boards, cables, keyboards. Risk occurs during smelting.
- **Beryllium**: used in contact clips and springs, and rotating mirrors in laser printers. Risk occurs during smelting



Examples of hazardous substances and potential effects



Can these activities release chemical substances?

Handout example of Risk Asessment EPSC

Example of Risk Assessment Requirements in the Electronics Product Stewardship Canada (EPSC) Recycler Qualification Program for End-of-life Electronics *and* the Electronics Reuse and Refurbishing Program

Environment, Health and Safety (EHS) Risk Assessment Requirements
Included in the EPSC 2010 *Recycler Qualification Program for End-of-life Electronics Recycling* manual and EPSC 2012 *Electronics Reuse and Refurbishing Program* manual

E-recyclers and e-refurbishers shall maintain a documented process to conduct an annual EHS risk assessment. The risk assessment shall be planned and conducted in a manner to identify and assess the potential environmental impacts of the operations, and any workplace hazards under both normal and abnormal conditions. The risk assessment shall cover all aspects of the operations and include at a minimum:

1) a process to identify and record physical, chemical and ergonomic hazards;
2) a process to assess risk of identified hazards, considering the potential probability and severity of the hazard;
3) a process to determine the appropriate level of control necessary to eliminate or effectively control the hazards;
4) a process to assess the need and frequency for EHS monitoring and sampling, including:
    a. monitoring and tracking of facility emissions, effluent or wastes;
    b. facility-wide air sampling and analysis for airborne contaminants such as metal content and dusts;
    c. surface sampling for contaminants that may not be released under normal operating conditions, or may be released in quantities below detectable air sampling limits but over time may accumulate to hazardous levels or pose other risk of worker exposure;
    d. analysis of noise levels in processing areas; and
    e. medical examinations, including hearing assessments and blood testing, where required by regulations or if sampling reveals elevated exposure levels.
5) a process to record and track the results of the risk assessment, to facilitate the identification of recurring issues or trends,
6) a process to communicate risks and their associated controls to applicable workers and make the overall results of the risk assessment available to all workers, and
7) a process to conduct subsequent risk assessments, either facility-wide or task-specific, as a result of any changes in operations that may affect exposure levels.

Steps to Conduct a Risk Assessment

- **Step 1. Identify the Stages of Operations:** What needs to be assessed? Identify at each stage of operations.
- **Step 2. Identify the Hazards:** What can go wrong? Identify real or potential hazards by thinking of possible problems at each stage of operations.
- **Step 3. Assess the Hazard and Exposure to the Hazard (Level of Risk):** How often is the hazard likely to happen? How could this hazard impact workers, the community or the environment?
- **Step 4. Identify the Consequence of the Hazard / Characterize the Risk:** What is the consequence if something goes wrong? Is the risk large? Will the impact be major? Are there long term implications?
- **Step 5. Evaluate and Prioritize the Risk:** Which risks are the most important to direct resources to risk management?

DOCUMENT

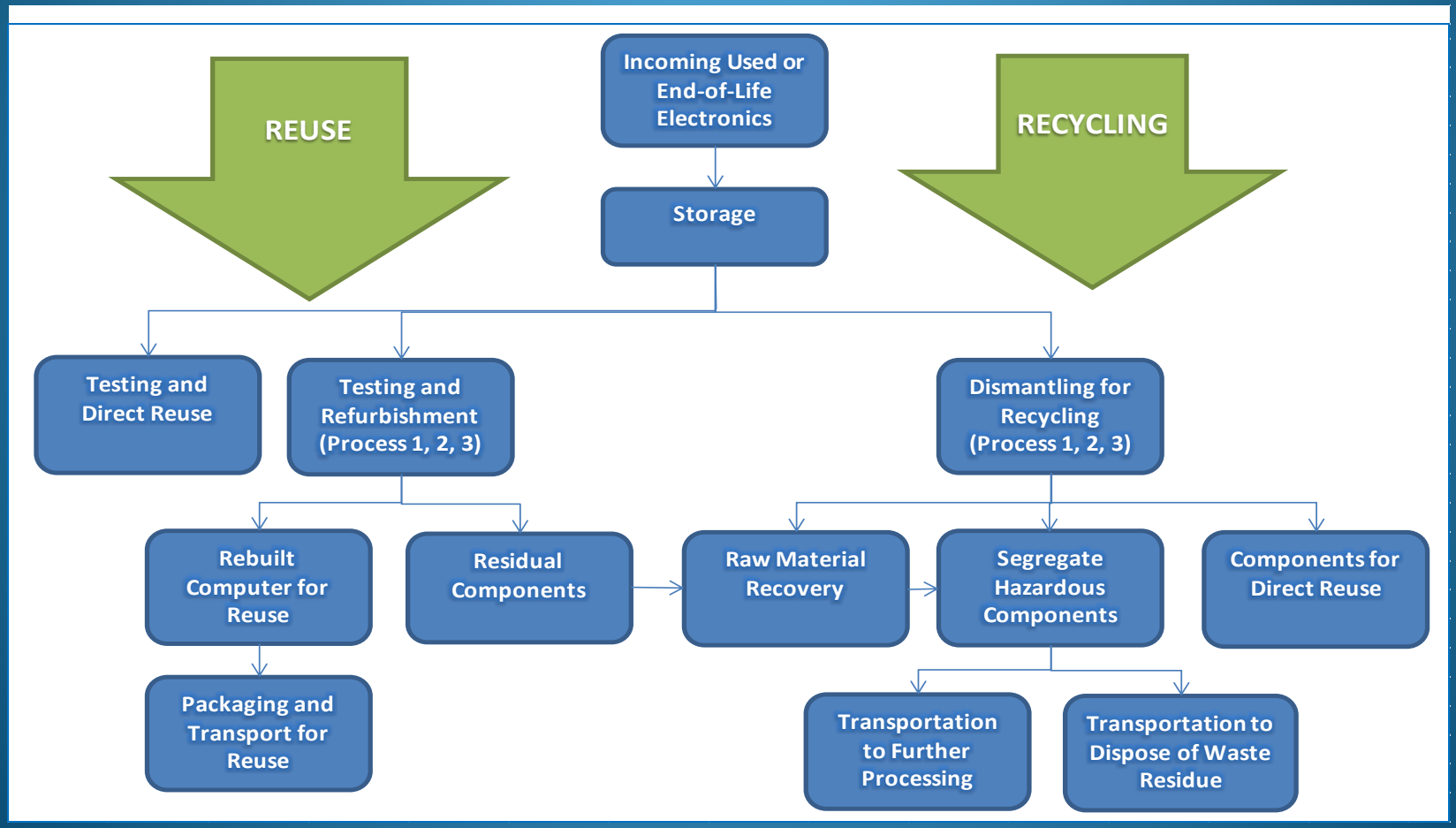
Best Practice:

Include in the Risk Assessment Process:

- Documenting, implementing, communicating and maintaining the:
  - ✓ Roles and responsibilities for risk assessments.
  - ✓ Procedures to identify, prioritize and assess environment, health and safety hazards associated with new, existing and planned activities.
  - ✓ Environment, health and safety risk and hazard information to reflect changes in operational, environmental or regulatory requirements.

Step 1: Identify Stages of Operations

- Map all the process. (Could be different if is refurbishment, reuse or recycling)
- Identify the potential hazards.



Step 2: Identify the Hazards

Identify potential hazards:

Hazardous substances

Workplace machinery

Ergonomic injury

Environmental releases

- Use professionals with working knowledge of hazardous substances.
- Supervisors and workers should be involved
- Document the hazards:
  - Name of person doing assessment, and date
  - Activity / Procedure being assessed
  - Known or expected hazards associated
  - The risk of injury and its severity as well as who is at risk

Does your organization / office / ministry has risk assessment professionals?

Step 2: Identify the hazards

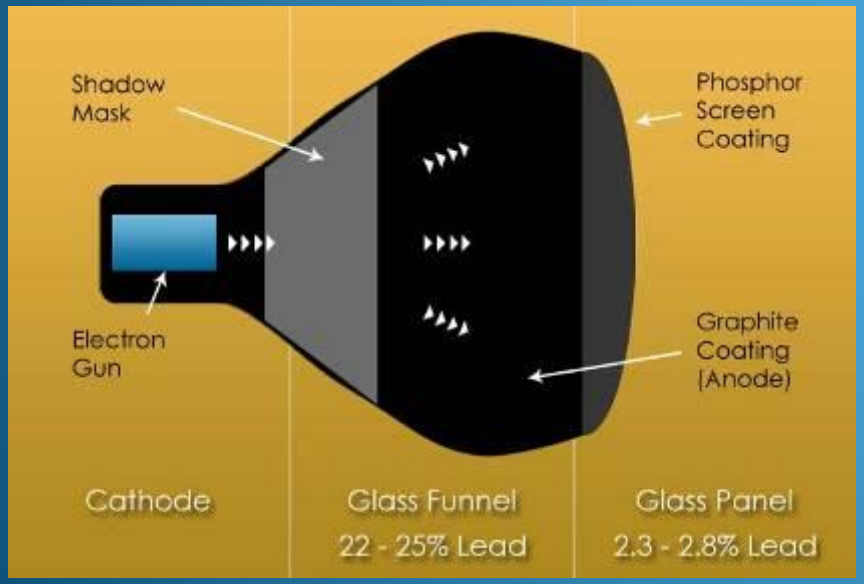
- Hazard identification must take into account:
  1. Routine and non-routine activities
  2. Procedures to control exposure (engineering controls, work and hygiene practices)
  3. Hazardous substances main pathways to the environment (dust, water) and workers exposure routes (inhalation, ingestion skin absorption)
  4. Accident records
  5. Risks to visitors, and special groups (trainees, pregnant women)

Example of Step 2: Hazard identification in a routine activity

- There are hazardous substances in specific components that should be removed prior to shredding such as Cathode Ray Tubes, batteries, printer cartridges, and bulbs.
- **Example:** The lithium battery (coin cell) must be removed from the motherboard before shredding. If the cell opens, exposing the lithium anode, unreacted lithium may then react with oxygen in the air or with moisture, generating heat and potentially, hydrogen gas.
  - A fire may start!

Example of Step 2: Hazard Identification in lead emissions

For workers, inhalation is a route of exposure to lead, it can also be transported in clothes to common areas



Lead can be leached if CRTs are disposed in landfills

Example of Step 2:
Hazard Identification in accident records

Example of Step 2:
Hazard Identification for visitors

Without safety glasses

With safety glasses

Examples of Hazards

At Electronics Refurbishing or Recycling Facilities

Area	Hazard to Workers	Hazard to the Environment
Receiving, Testing	Hazardous substances (lead, mercury) from broken equipment; sharps	Chemical substances (lead, mercury) to air or soil from broken equipment
Manual and Mechanical Operations	Refurbishing: exploding capacitors Shredding: hazardous dusts, caustic substances, injuries Smelting: metal fumes and metal oxide particulates; exposure to dioxins and furans	Shredding: hazardous dusts Smelting: air emissions (metal fumes, metal oxide particulates, particles of incomplete combustion (PAH's), dioxins and furans). Leachates with chemicals.
Storage / Holding	Hazardous substances that are not packaged and stored properly (probability of inhalation, ingestion)	Chemical substances in leachate to soil, groundwater or surface water (outdoor storage). Chemical substances (mercury) into air from breaking lamps.

Identifying Downstream Hazards

- Responsability for how material accepted by facilities is managed by downstream vendors.
- Risks associated with selecting downstream processors include that the processor might not practice ESM.
- Downstream vendor control:
  - Requested upon certification
  - Helps to maintain public opinion and integrity of business operations
  - Helps to minimize potential legal issues

Handout – Downstream Considerations

Requirements	Y/N/NA	Action?
Does the processor have the technical capability to process hazardous waste as confirmed through permits / licences etc.?		
Does the processor practice occupational health and safety as evidenced through inspection of documentation and on site audits?		
Does the processor have appropriate environmental permits in place for their jurisdiction to protect the local environment and community from air or water discharges?		
Does the processor appropriately track quantities of waste shipments to ensure transparency and allow for proper documentation?		
Does the processor properly label hazardous waste and ensure it is processed and transported as such?		
Does the processor ensure hazardous waste is recycled as much as possible and when disposed use licensed incineration facilities?		
Does the processing facility have emergency plans in place that include financial guarantees to ensure re-sourcing is available to accommodate emergency response, site decontamination and facility closure?		
Does the processor conduct scheduled or unscheduled audits of their downstream processors?		
Does the processor require transparency with *their* downstream processors regarding verifiable and traceable material shipments (i.e. do they require their processors to track quantities, verify shipments via documentation, or have other ESM requirements of their downstream processors)?		
Does the processor have means to ensure that the downstream processors they select are not engaged in illegal hazardous waste shipments to non-Basel countries? (e.g. unscheduled auditing, evidence through documentation trails such as shipment manifests).		

Step 3: Assess the hazard

- Assess each hazard.
- Identify level of risk (severity of harm) from:
  - Past experience (workers observations of hazards, etc.)
  - Potential for hazard transport (substances may accumulate in work areas or be transported to the lunchroom, washrooms, home)
  - Legislated environmental and health and safety requirements
  - Industry codes of practice / best practices / certification guidelines
  - Results of testing (air sampling of workplace, biological, etc.)
  - The expertise of an occupational health and safety professional
  - Previous injuries, illnesses or accident reports.
- Consider factors such as: work environment (layout, condition, etc.); capability, skill, experience of workers; systems of work being used; and range of foreseeable conditions.

Step 3: Assess the Hazard

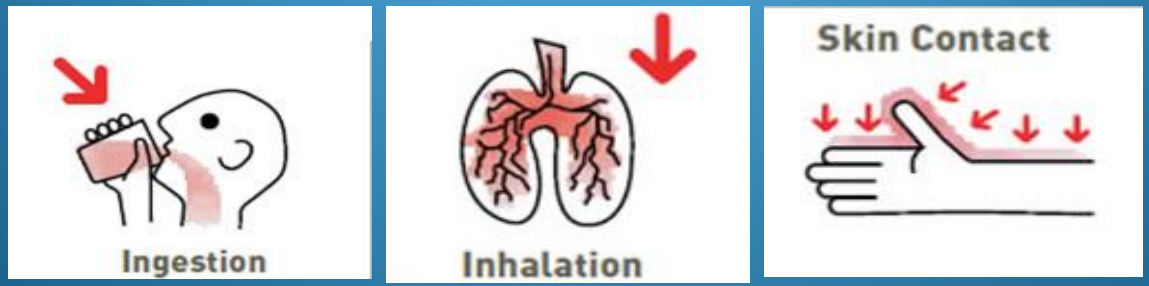
- One example of how you can document the Level of Risk:

Hazard	Level of Risk / Severity of Harm		
	Slight Harm	Moderate Harm	Extreme Harm
Hazard 1: When equipment arrives at the facility, workers in the receiving area are sorting equipment so fast that often equipment is not secured properly and breakage happens. Often, the breakage includes Cathode Ray tube monitors.			✓
Hazard 2 (Describe)			
Hazard 3 (Describe)			
Hazard 4 (Describe)			

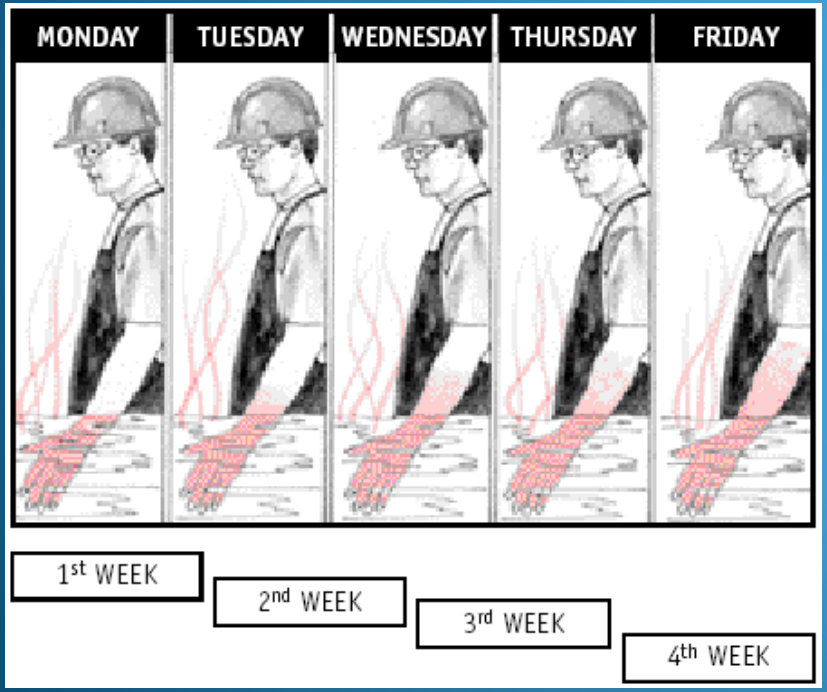
What other hazards you can find in a facility that refurbishes and recycles e-waste?

Example of Step 3:
Hazard Assessment - Tips for Risk Assessors

- When assessing potential hazards or exposure:
  - Consider low-level or infrequent releases, cumulative amounts could pose a risk.
- Consider and evaluate all potential routes of entry and associated hazards from airborne particles, not just inhalable dusts.



Remember chronic and acute exposure



Step 4: Identify Consequences of the Hazard / Characterize the Risk

- Characterize the risk by thinking about the consequence or effect of the hazards that you identified (**Level of Risk**) in combination with the **Potential Occurrence**.
- There is no one way to characterize risk
- Potential occurrence scale example:
  - **Very Likely** - Typically experienced at least once every six months;
  - **Likely** - Typically experienced once every five years;
  - **Unlikely** - Typically experienced once in 5-10 years
  - **Very unlikely** - Less than 1% chance of being experienced

Step 4: Identify Consequences of the Hazard / Characterize the Risk

- Example of characterizing risk:

Hazard	Likelihood of Harm / Potential Occurrence	Level of Risk / Severity of Harm		
		Slight Harm	Moderate Harm	Extreme Harm
Hazard 1 (Describe)	Very unlikely	✓		
Hazard 2 (Describe)	Unlikely		✓	
Hazard 3 (Describe)	Likely			✓
Hazard 4 (Describe)	Very likely	✓		

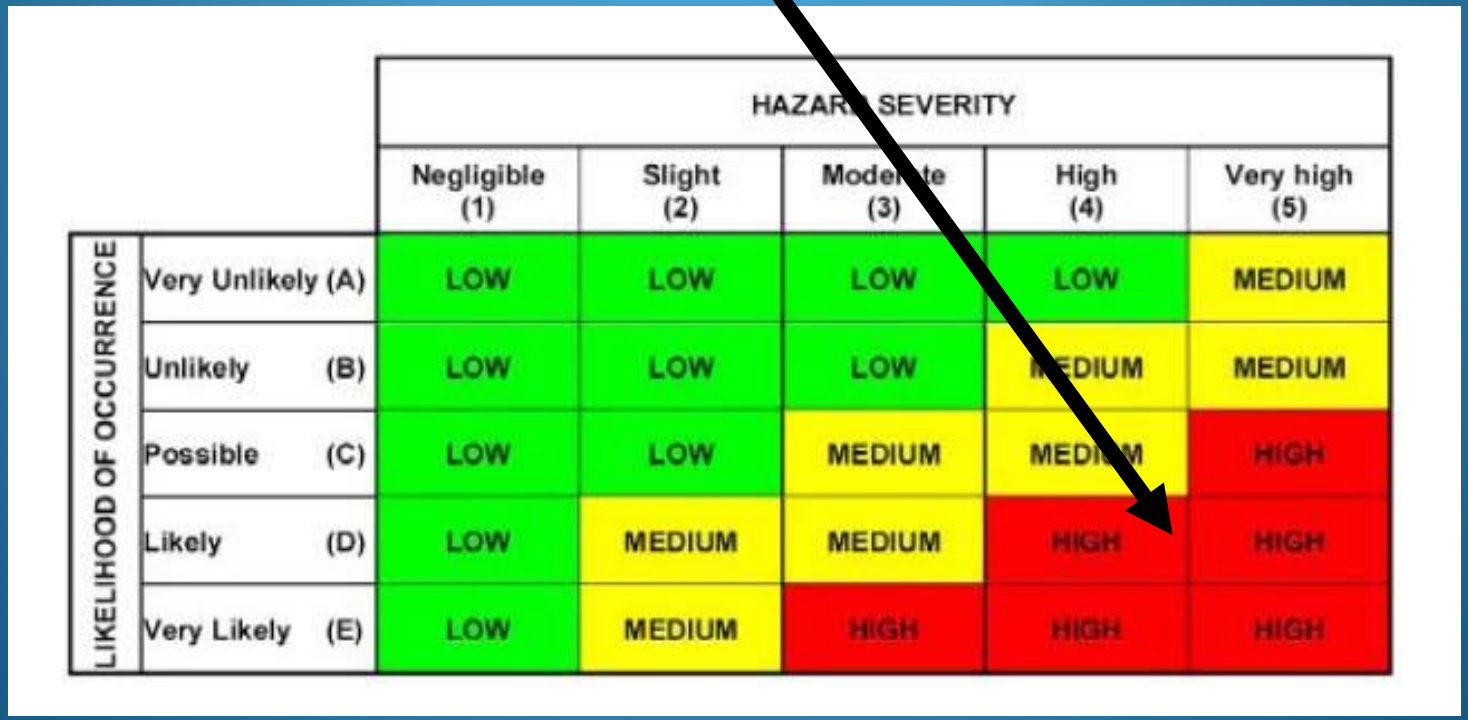
Step 5: Evaluate and Prioritize the Risk

- There is no single way to prioritize hazards. Ranking hazards requires knowing about the workplace and showing objective judgement.
- Identify which cells in the table show extreme harm and likely / very likely in potential occurrence.

Hazard	Likelihood of Harm / Potential Occurrence	Level of Risk / Severity of Harm		
		Slight Harm	Moderate Harm	Extreme Harm
Hazard (Describe) 1	Very unlikely	✓		
Hazard (Describe) 2	Unlikely		✓	
Hazard (Describe) 3	Likely			✓
Hazard (Describe) 4	Very likely	✓		

Step 5: Evaluate and Prioritize the Risk

- Plot the individual risks on a grid (*probability or frequency* vs. *severity of harm)*. Look out for priorities:



LIKELIHOOD OF OCCURRENCE	HAZARD SEVERITY				
	Negligible (1)	Slight (2)	Moderate (3)	High (4)	Very high (5)
Very Unlikely (A)	LOW	LOW	LOW	LOW	MEDIUM
Unlikely (B)	LOW	LOW	LOW	MEDIUM	MEDIUM
Possible (C)	LOW	LOW	MEDIUM	MEDIUM	HIGH
Likely (D)	LOW	MEDIUM	MEDIUM	HIGH	HIGH
Very Likely (E)	LOW	MEDIUM	HIGH	HIGH	HIGH

Step 5: Evaluate and Prioritize the Risk

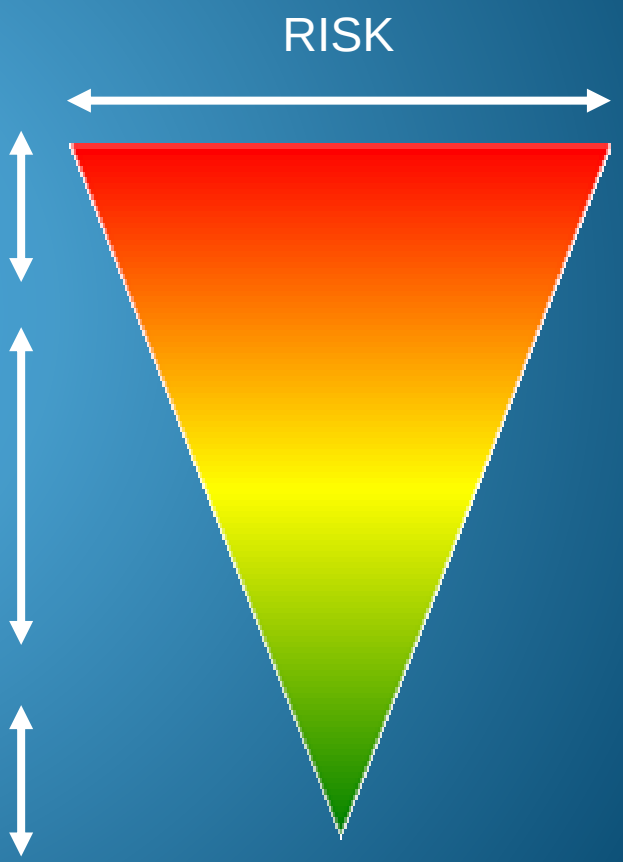
- Inform an opinion of **tolerable risk level**.
- Tolerability guidance:

Unacceptable – Risks are very high. Substantial improvements in risk control measures are needed.

Tolerable – Make substantial effort to reduce the risk urgently within a defined time period. Ensure that controls are maintained.

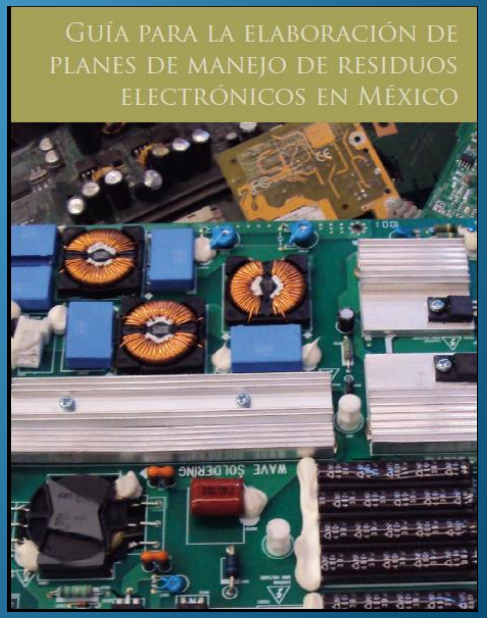
Acceptable – No need for additional controls (only at very low cost). Ensure that the controls are maintained.

Very low - These risks don't need control actions



Gap analysis of policy and procedures associated with risks

- The risk assessment includes analysis in policies and procedures for risks to worker health and safety and environmental protection.
  - Do my policies cover all the hazards?
  - Is my policy adequate?
- Identify the gap between your current situation and the future state that you want to reach.
- For Module 4: Tasks that you can use to close the gaps.
- Policies and procedures that minimize risks include:
  - Management systems
  - Plans to protect worker health and safety and the environment.



Handout – Operations / Internal Controls Checklist for procedure assessment

Requirements	Y/N/NA	Action?
Using results from a Risk Assessment, does the facility establish, implement and maintain documented procedures to control activities that are associated with potential environmental or health risks?	Y	None needed; EHS system is reviewed annually
Are these procedures communicated to suppliers and onsite contractors?		
Is onsite recovery or disposal of waste generated by the process carried out in compliance with the applicable laws?		
Is onsite recovery or disposal of waste generated by the process tracked internally and recorded appropriately?		
Is outgoing waste destined for recovery or disposal appropriately recorded and handed over only to environmentally sound recover and/or disposal operations?		
Does the facility have an adequate plan for closure and aftercare?		
Is the closure plan periodically updated?		
Are there financial guarantees to ensure that the necessary measures are undertaken upon definite cessation of activities to prevent any environmental or public health damage and to ensure that the return of the site of operation is to a satisfactory state as required by applicable laws?		

Handout - Monitoring and Measurement Checklist for procedure assessment

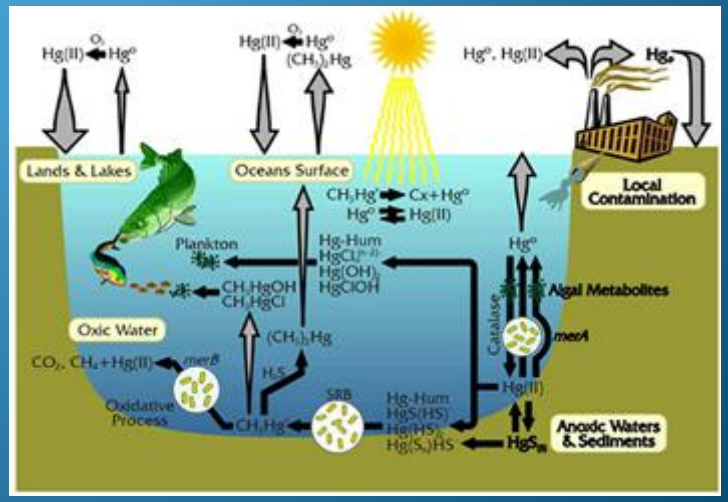
Requirements	Y/N/NA	Action?
Has the facility established, implemented and maintained procedures to monitor and measure on a regular basis the key characteristics of its operations and activities that can have a significant impact on the environment or worker health?		
Does the facility have a reporting program?		
Does the reporting program cover relevant legal requirements, including key process parameters?		
Does the reporting program cover compliance with applicable health and safety requirements?		
Does the reporting program cover effluents and emissions, incoming, stored and outgoing waste, in particular hazardous waste?		
Do the procedures of monitoring and measuring include requirements for information to monitor performance? Applicable operational controls? Conformance with objectives?		
Does the facility ensure that calibrated or verified monitoring and measuring equipment is used and maintained?		
Does the facility ensure that associated monitoring records are retained?		
Does the facility maintain records on the generation, recovery or disposal of waste, its types and amounts, and are these available to authorities upon request?		

Environmental or health risk assessment

- Process for evaluating how likely it is that the environment may be impacted as a result of exposure to one or more environmental stressors such as chemicals.
- Uses exposure profiles and exposure-effects
- Ecological risk assessments are used to support many types of actions, including the regulation of hazardous waste sites, industrial chemicals, or compliance with norms.

MINAMATA CONVENTION ON MERCURY
UNEP

Mercury cycle



Summary – Key Take Away Messages

- **Risk Assessment**:
  - ✓ Hazard vs. Risk
  - ✓ Identify and assess risks related to direct facility operations as well as risks that might exist from gaps in policies and procedures.
  - ✓ Risks can exist at facilities and downstream (think about informal recycling).
  - ✓ There are serious hazardous substances in used and end-of-life electronics such as lead, mercury, and cadmium.
  - ✓ The Risk Assessment process includes five steps:
    - ✓ Step 1. Identify the Stages of Operations;
    - ✓ Step 2. Identify the Hazards;
    - ✓ Step 3. Assess the Hazard and Exposure to the Hazard (Level of Risk);
    - ✓ Step 4. Identify the Consequence or Effect of the Hazard / Characterize the Risk;
    - ✓ Step 5. Evaluate and Prioritize the Risk.

Thank you