



Best Practices for Achieving Environmentally Sound Management (ESM)

At Facilities that
Refurbish and Recycle
Used and End-of-Life Electronic
Products in North America



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Risk Prevention and Minimization

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For more information:

Commission for Environmental Cooperation

393, rue St-Jacques Ouest

Bureau 200

Montréal (Québec)

H2Y 1N9

Canada

t 514.350.4300 f 514.350.4372

info@cec.org / www.cec.org





Commission for Environmental Cooperation

**Best Practices for Achieving Environmentally
Sound Management at Facilities that Refurbish
and Recycle Used and End-of-life Electronic
Products in North America**

Module 4a
Risk Prevention and Minimization for Managers

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4.2 Pre-questionnaire

1. Do you already know about risk prevention and minimization?

Yes

No

2. What additional aspects would you like to learn about risk prevention and minimization in this module?

3. Can you name a process that your facility has in place to prevent and minimize risks?

4. Are you involved in these risk prevention and minimization efforts? If so, what is your role?

5. What processes does your facility have in place to continuously improve its risk prevention and minimization practices?

6. Are there issues relating to risk prevention and minimization that you would like to hear examples of, and ideas or best practices about from other participants? For example, the best ways to protect workers from hazardous substances?

4.3 Check-in on Topics Previously Covered in Modules 1–3

Module 1 (Introduction to ESM)

In Module 1 you learned about:

- the importance and benefits of environmentally sound management (ESM), including elements deemed necessary to achieve ESM at the facility-level;
- potential environmental, health and safety issues associated with refurbishing and recycling electronic products;
- worker health and environmental benefits of implementing ESM at your facility;
- economic benefits of implementing ESM at your facility;
- the benefits of participating in ESM validation and certification programs and how this can increase your client base, inventory volumes, and potential profits; and
- the waste management hierarchy and how it applies to activities undertaken at electronics refurbishing and recycling facilities.

Module 2 (Top Management Commitment to ESM)

In Module 2 you learned about:

- specific best practices for how top management commitment to a systematic approach could be implemented, improved, and/or demonstrated at your facility;
- how to assess whether your facility follows best practices to demonstrate top management commitment to the environment, health and safety and how improvement can be made;
- important elements of an environmental, health and safety policy;
- important elements of an environmental, health and safety management system; and
- important procedures to document at your facility, including those relating to communications and training.

Module 3 (Risk Assessment)

In Module 3 you learned about:

- specific best practices to implement, improve, and demonstrate risk assessment at your facility;
- how to assess whether your facility follows best practices for risk assessment and how improvement can be made;
- hazards and risks to worker health and safety and the environment;
- how to apply the risk assessment process to your facility's operations; and
- how to determine if existing control measures to address identified risks at your facility are adequate or if more should be done.

4.4 Introduction and Overview of this Module

What is risk prevention and minimization and how can you apply it to your facility?

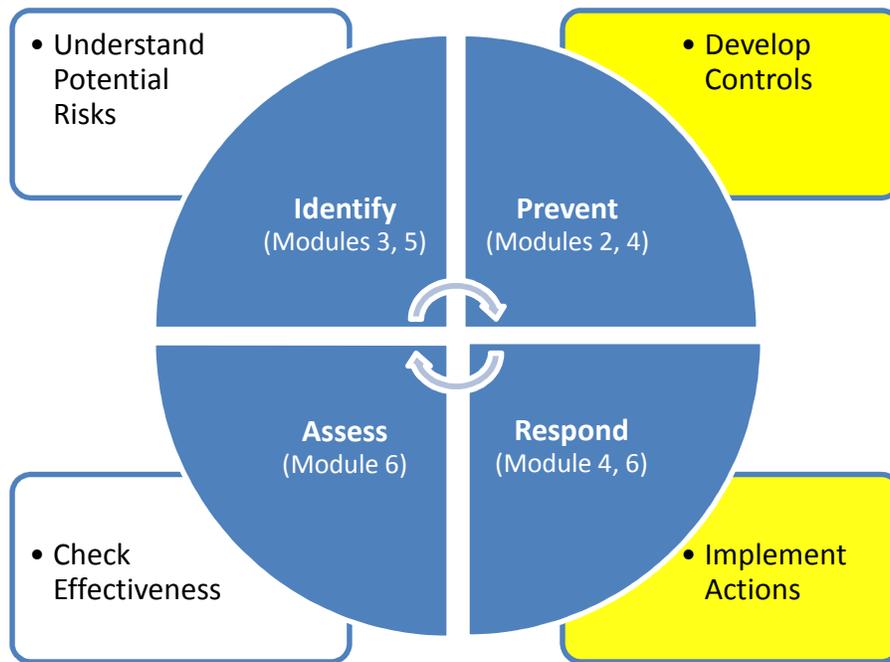
This module will answer this question and provide you with:

- an overview of the benefits of risk prevention and minimization in used, discarded and end-of-life electronics recycling and refurbishment operations;
- an understanding of various types of controls that are recommended as best practices to eliminate, prevent and minimize risks, including engineering controls, administrative controls, and personal protective equipment controls; and
- the tools, resources and knowledge to allow you—as a manager—to give assurance that your facility operates in a manner that supports ESM.

Exhibit 1 shows how the key responsibilities of operating a facility fit within the framework of ESM, and where these responsibilities will be covered in the training material.

Module 4 explains the important ways that facilities can put in place measures both to *prevent* risks and to *respond to* problems when they do happen (yellow boxes).

Exhibit 1: Key Responsibilities within the Framework of Environmentally Sound Management



4.5 What Is Risk Prevention and Minimization and Why Is It Important?

**REMINDER: ESM Criterion #3
Risk Prevention and Minimization:**
Eliminate where possible and in all cases strive to minimize actual and/or potential hazards and risks to public and worker health and safety and to the environment which are associated with activities, products and services.

As discussed in Module 3 (Risk Assessment), electronic components are made up of more than 1,000 different substances, some of which are hazardous. As a result, your facility’s activities can present a number of risks to the environment, worker health and safety, and the community. Your facility should identify these risks through a risk assessment process (Module 3). Risk prevention and minimization is the next stage where you manage these risks.

4.5.1 Why Is Risk Prevention and Minimization Important?

Answer:

Risk prevention and minimization is important for your facility because it allows you to:

- raise awareness among workers and supervisors about hazards and how to mitigate risks—this will contribute to safer work practices, reduce illnesses and accidents, and reduce lost time due to injuries;
- improve worker competency through regular risk management training programs. This will lead to more consistency in the implementation of safe, productive and efficient work practices;
- instill pride in the workforce—when workers are properly trained, they feel empowered to address a variety of work situations effectively;
- enhance the facility’s safety record and improve relations with the public and local community, as evidenced by healthy workers and community;
- reduce the likelihood of fines and penalties through a demonstrated commitment to best practices and ensuring legal compliance;
- improve your ability to demonstrate a safe work environment to government regulators, insurance agencies, financial institutions, and business partners by referring to documented risk management plans, procedures and other provisions;
- improve your ability to respond to emergencies, allowing for more timely and effective responses; and
- have the tools, resources and knowledge to allow you to give assurance that your facility operates in a manner that supports ESM.

Recall from Module 3:

Definition: Risk vs. Hazard

Risk: the chance, likelihood, or probability that a person or the environment will be harmed if exposed to a hazard.

Hazard: the potential source of harm.

4.5.2 What Does It Mean to Offer Assurance?

Answer:

Definition of Assurance: a positive declaration intended to give confidence; a promise or pledge; a guarantee.

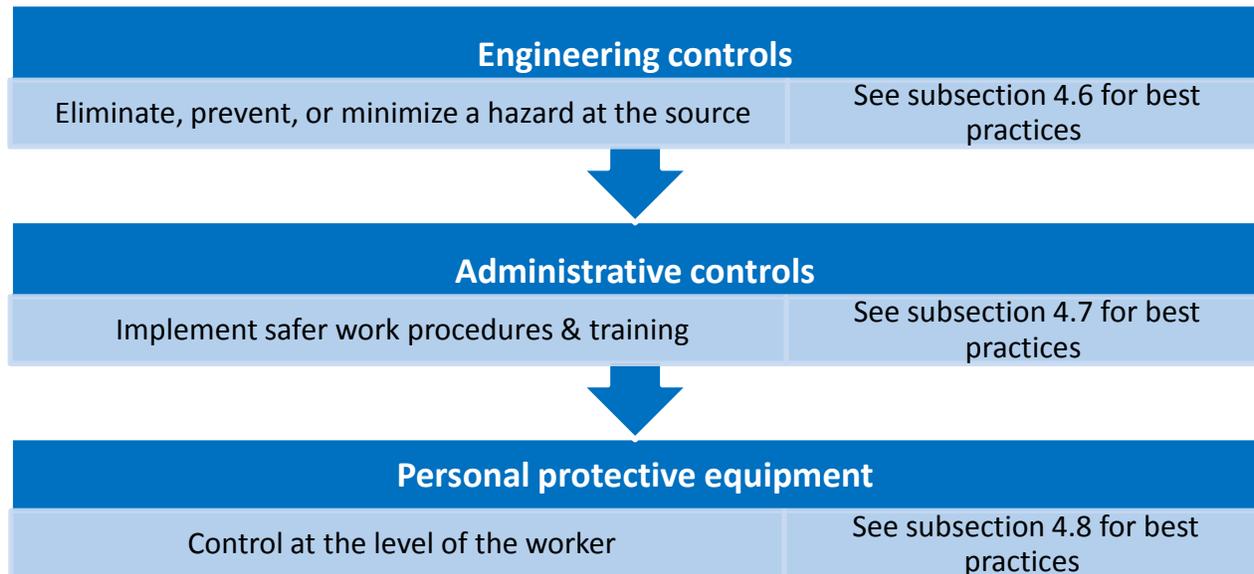
In Business: Businesses often use the term “guarantee” when a company attests to the quality of a product or service, as a way for them to provide assurance to stakeholders.

In the Refurbishment and Recycling Industry: A company can offer assurance that a service will be performed in a specified manner, such as assurance to undertake refurbishing or recycling services in an environmentally sound manner.

1. Verification and certification programs are a formal and clear indication of assurance to perform service in accordance with a defined standard of quality. Typically, verification and certification is performed by an independent third-party organization which is authorized or accredited to validate facility performance against the standard in question.
2. Companies may also consider following a path that does not involve certification, yet still adopt many of the best practices for ESM, including best practices for risk prevention and minimization that are identified in this training module.

4.5.3 Controls Used to Eliminate, Prevent and Minimize Risks—Overview

Once you have assessed (evaluated and prioritized) environment, health and safety (EHS) risks at your facility (as discussed in Module 3, Risk Assessment) you should *first* seek to *eliminate* the risk, and *then* seek to *prevent or minimize remaining risks*. EHS risks can be prevented and minimized by implementing the controls listed below^{1,2}:



What is included in each group of controls?

Answer:

1. **Engineering Controls:** These controls eliminate or reduce exposure to a chemical or physical hazard through substitution and use of engineered machinery or physical equipment. Examples include: non-hazardous or less hazardous substitutes to replace more-hazardous operations, activities and products; testing and calibration equipment; sound-dampening materials to reduce noise levels; ventilation and exhaust systems (e.g., fume hoods); safety guards, fences and interlock switches; filters, scrubbers, and bag houses to trap airborne particulates; ductwork equipped with fire suppression devices; and use of proper equipment for handling electronics safely.

¹ Electronics Product Stewardship Canada (EPSC). 2010. *Recycler Qualification Program for End-of-life Electronics Recycling*.

² US Centers for Disease Control and Prevention. Engineering Controls, <<http://www.cdc.gov/niosh/topics/engcontrols/>>.

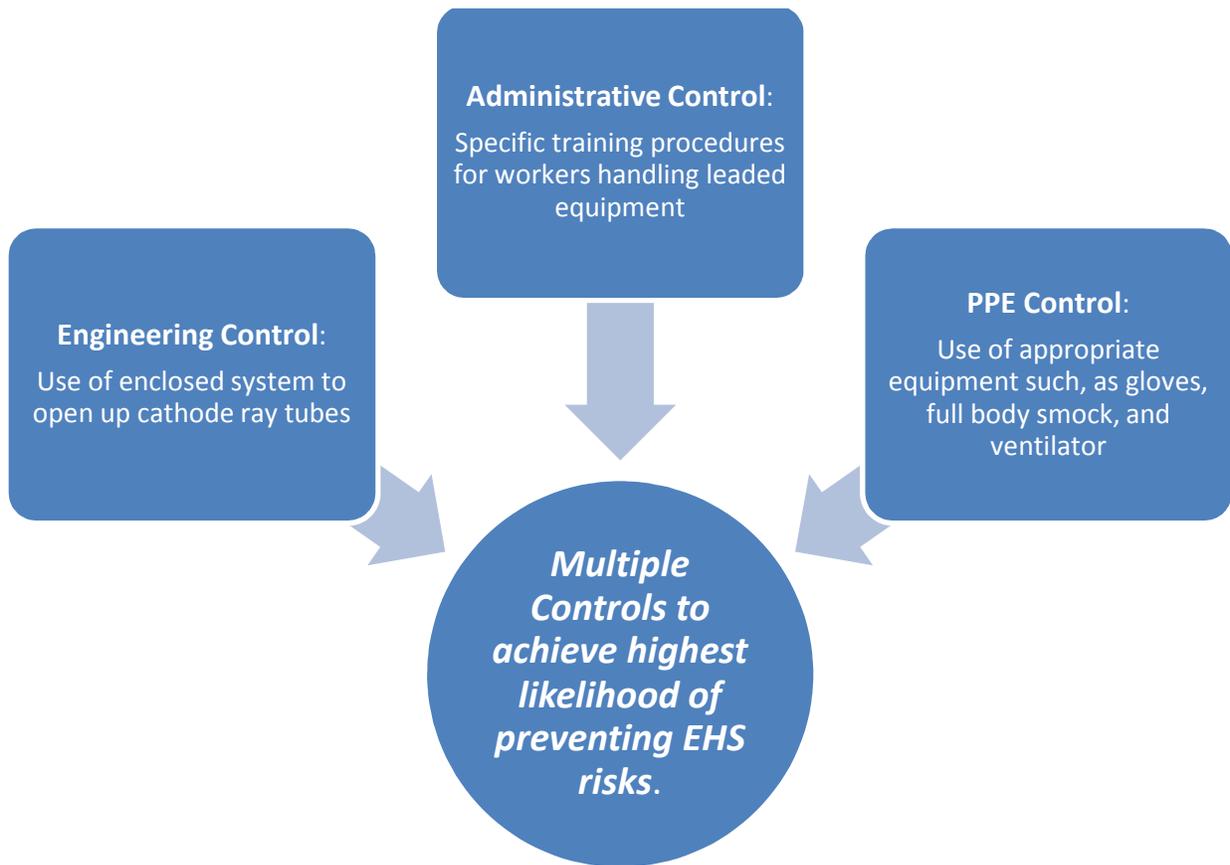
2. **Administrative Controls:** These controls refer to *work procedures* to reduce the duration, frequency, and severity of exposure to hazards by workers, or to *processes* to reduce potential impact to the environment from facility activities. Examples include: policies and procedures for pollution control and health and safety; emergency response plans and spill clean-up procedures; worker training; health and safety committees and regular supervision to ensure policies and procedures are followed; proper housekeeping, to minimize the likelihood of accidents or excessive exposure; incident reporting procedures; standard operating procedures for removing hazardous components from used and end-of-life electronic products; use of proper handling, storage and transportation protocols, and financial guarantees for site decommissioning and remediation.
3. **Personal protective equipment (PPE):** These controls include all clothing and other work accessories designed to create a barrier between an individual worker and workplace hazards. Examples include: safety glasses, visors and goggles; hearing protection; work gloves; disposable filtering face piece or respirator, half- or full-face respirators; air-fed helmets and breathing apparatus; conventional or disposable overalls, smocks, aprons, coveralls, specialist protective clothing (e.g., high-visibility clothing); safety boots and shoes; and hard hats. While PPE helps to protect an individual worker from hazards, engineering and administrative controls generally function to protect all employees by reducing or eliminating the hazard. Consequently, administrative or engineering controls should be considered to be the first line of defence whenever feasible.

Best Practice: Implement multiple and overlapping control schemes (i.e., engineering, administrative, and PPE) to heighten protection for the environment and worker health and safety.

Example of implementation of multiple controls

To control hazards effectively, it is important to consider and implement, where appropriate, a combination of engineering, administrative and personal protective equipment (PPE) controls to prevent environment, health and safety (EHS) risks, as outlined in the example below. This example demonstrates how multiple controls can be used to address a serious hazard, such as inhalation or ingestion of lead by workers, or potential release of lead to the environment.

Exhibit 2: Example of Using Multiple Controls for a Hazardous Substance such as Lead



4.5.4 Overview of Best Practices Identified under Each Type of Control

Exhibit 3: Controls and Their Associated Best Practices

Best Practice Identified	Type of Control Used, Number of Best Practices		
	Engineering Controls	Administrative Controls	Personal Protective Procedures/Equipment
<i>Engineering Controls</i> – manual processing at recycling or refurbishing facilities (disassembly or repair), mechanical processing at recycling facilities, management of processed and waste residuals.	17		
<i>Administrative Controls</i> – policies/procedures to be followed at recycling or refurbishing facilities, use of health and safety programs or committees, important environment, health and safety management system components that involve implementation of training.		21	
<i>Personal Protective Procedures/Equipment</i> – policies/procedures to be followed at recycling or refurbishing facilities, relating to worker protection, use of personal protective equipment to protect workers.			4

Best practices identified for each of these three types of controls are presented in the following sections of this module, in the same order as they are presented above.

**Best Practices to
Prevent and Minimize
Risks to EHS through
Engineering Controls**

4.6 Best Practices to Prevent and Minimize Risks to Environment, Health and Safety through Engineering Controls

Engineering Controls: These controls eliminate or reduce exposure to a chemical or physical hazard through use of engineered machinery or physical equipment.

Examples include: non-hazardous or less hazardous substitutes to replace more-hazardous operations, activities and products; testing and calibration equipment; sound-dampening materials to reduce noise levels; ventilation and exhaust systems (e.g., fumehoods); safety guards, fences and interlock switches; filters, scrubbers, and baghouses to trap airborne particulates; ductwork equipped with fire suppression devices; and use of proper equipment to handle electronics safely.

Exhibit 4: Best Practices at the Recycling/Refurbishment Stage

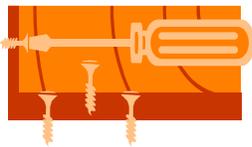
Best Practice Identified—Summary (details follow on next pages)	Recycling or Refurbishment Stage		
	Manual Processing: Disassembly and/or Repair	Mechanical Processing (Recycling)	Management of Processed and Waste Materials
Removal of hazardous components prior to mechanical processing, using specialized tools if authorized to do so.	✓		
Conduct all repair work indoors. Utilize ventilation and filtration equipment, where appropriate, for manual processing.	✓		
Use proper ventilation to collect solvent fumes during cleaning.	✓		
Technically capable to use the equipment they have, and should have an emissions management program for the specified equipment.		✓	
Perform all mechanical processing indoors. Put in place engineering controls in order of recommended priority: isolation, ventilation, control and capture, emergency shut-off, and fire suppression.		✓	
Perform regular maintenance on all emission control equipment. Develop preventive maintenance programs.		✓	
Conduct monitoring for hazardous substances on: indoor ambient air; surfaces. And monitor water discharges for hazardous substances.		✓	
Process all hazardous materials that have been generated, removed or recovered from primary processing at authorized facilities.			✓
Seal, label, and transport removed mercury-containing devices to licensed facilities.			✓
Printed circuit boards with lead-based solder should be smelted in an integrated copper smelter.			✓
When packaging for transport, make sure to seal containers holding CRTs, CRT cullet/glass, or equipment containing CRT glass.			✓
Manage toner and ink printer cartridges in a manner that minimizes dispersal of toner and inks.			✓
Ensure to bag dusts, residues, sweeps and slag from all facility air control cleaning and maintenance operations.			✓
Dispose of polychlorinated biphenyl (PCB)-containing components or PCB-contaminated material properly at a designated facility.			✓
Plastics and resin materials should be disposed of in a manner that is consistent with applicable Basel technical guidelines.			✓
Remove batteries prior to processing. Insulate, sort and store them to protect against short-circuiting; send to authorized recyclers.			✓
Apply the waste management hierarchy, in management decisions regarding final material disposition for end-of-life electronic products.			✓

4.6.1 Engineering Controls—Manual Processing at Recycling or Refurbishing Facilities

Disassembly and/or Repair

Removal of Hazardous Components Prior to Mechanical Processing

Best Practice: If your facility is well equipped and trained to do so, physically remove potentially hazardous components from electronic products prior to conducting mechanical processing, using proper physical equipment. Use appropriate tools and care to preserve the value of reusable components, the safety of workers, and protection of the environment. For example, use specialized enclosed cutting equipment for removal of cathode ray tube glass.



Manual removal of components that may contain hazardous substances (e.g., cathode ray tube glass/screens, mercury bulbs, batteries and printer cartridges) prior to mechanical processing will help to avoid dispersal of hazardous substances which can harm workers and the environment and contaminate processing equipment and processed material streams.

Workers should be properly trained to dismantle equipment and use the correct tools, to avoid personal injury and minimize accidental breakage of potentially hazardous components.

Manual removal of these types of substances should only be undertaken by workers with a high level of skill and training,³ and in accordance with local guidance if it exists in your jurisdiction. For example, the State of California has specific guidance related to handling cathode ray tubes.⁴

Box 1: Hazardous Components that Should be Removed or Redirected to Other Approved Processors Prior to Mechanical Processing

- mercury-containing components, including batteries, lamps, switches and subcomponents
- cathode ray tubes (CRTs)
- batteries, including nickel-cadmium, lead-acid, lithium-ion, alkaline, or any batteries containing lead, cadmium, or other hazardous substance
- toners, inks, ink cartridges
- photoreceptive drums containing selenium and/or arsenic in printers and copying devices
- components containing polychlorinated biphenyls (PCBs), such as older transformers
- radioactive materials found in some equipment, such as smoke detectors
- glycolant-based coolants (e.g., in rear-projection CRT display devices)

³ United Nations Environment Programme (UNEP). Basel Convention. 2011. *Guideline on Environmentally Sound Testing, Refurbishment & Repair of Used Computing Equipment*. Partnership for Action on Computing Equipment (PACE) Project 1.1.

⁴ State of California. Department of Toxic Substances. CRT disposal, online at: www.dtsc.ca.gov/LawsRegsPolicies/Regs/CRT_Glass_Disposal.cfm.

Engineering Controls – Manual Processing

Facility Enclosure Equipment, Filtration and Ventilation Systems

Some refurbishment operations contribute to air emissions (for example, soldering circuit boards) which could harm worker health or the environment if they are not contained.^{5,6} Similarly, during recycling operations, potential release of hazardous substances could occur if proper enclosures and ventilation systems are not in place (for example, specialized and enclosed cutting equipment is important for removal of cathode ray tube glass safely so that lead is not airborne or on worker table surfaces).

Best Practice: Conduct all repair and recycling work indoors. Utilize facility enclosure, ventilation and filtration equipment where appropriate, to ensure that airborne particulates are not simply redirected outside.

Cleaning undertaken at both refurbishment and recycling operations could contribute to hazardous indoor air emissions from solvent fumes.

Best Practice: Ensure proper ventilation is used to collect solvent fumes during equipment cleaning.

For further safety information on the dismantling and repair process, see the Microsoft Refurbishment Programs' online slide deck, available free at: <http://www.techsoup.org/learningcenter/hardware/7.Demanufacturing.pdf>



⁵ UNEP. Basel Convention. 2011. *Guideline on Environmentally Sound Testing, Refurbishment & Repair of Used Computing Equipment*. Partnership for Action on Computing Equipment (PACE) Project 1.1.

⁶ Electronic Products Recycling Association (EPRA). 2012. *Electronics Reuse and Refurbishing Program Guide*.

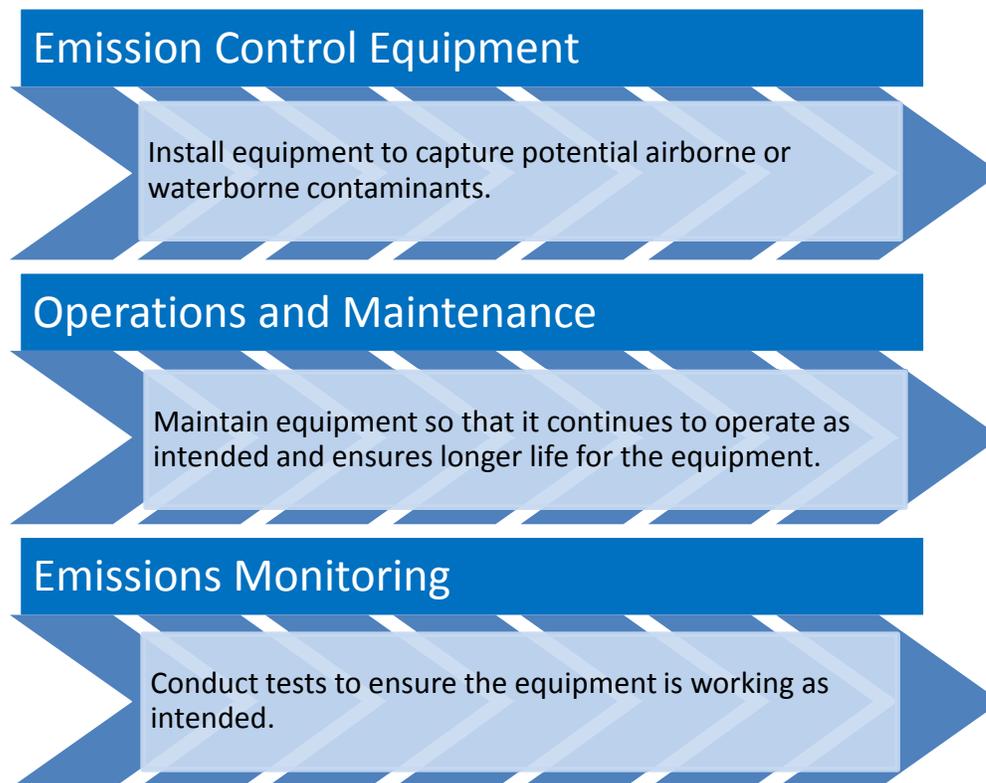
4.6.2 Engineering Controls—Mechanical Processing at Recycling or Refurbishing Facilities

Emissions Management for Equipment

Best Practice: Facilities that undertake mechanical processing should be technically capable to use the equipment they have installed, and should have an emissions management program for the specified equipment.

Electronics refurbishment and recycling facilities that undertake mechanical processing such as shredding, chipping, pulverizing, and smelting or melting, should be proficient in how to use equipment and the technology properly,⁷ and have in place an emissions management program that consists of the following elements^{7,8} (related best practices are on the following pages):

Exhibit 5: Elements for an Emissions Management Program



⁷ Basel Action Network. 2009. *Performance Requirements Excerpted from the e-Stewards Standard for Responsible Recycling and Reuse of Electronic Equipment*, and Appendix A: Guidance Document. UNEP.

⁸ Electronics Product Stewardship Canada (EPSC). 2010. *Recycler Qualification Program for End-of-life Electronics Recycling*.

Engineering Controls – Mechanical Processing – Emission Control Equipment

Emission Controls

Best Practice: Perform all mechanical processing indoors. Put in place engineering controls as listed below in order of recommended priority. Know what emission controls should be in place in each area of your facility.

It is important that all mechanical processing occur indoors, with suitable emission control equipment.⁹ The recommended priority for emission control equipment is:¹⁰

- ✓ substitution (e.g., replacing a toxic solvent with one less toxic during equipment cleaning),
- ✓ isolation (e.g., automating and isolating a process to avoid employee exposure),
- ✓ ventilation and capture (e.g., a negative pressure enclosure or fume hood),
- ✓ control and capture (e.g., via dust filters, or, if spills, via non-pervious flooring), and
- ✓ emergency shut-off systems and fire suppression systems.

Isolation

- Your facility should conduct all mechanical processing indoors, and some processes can be isolated to reduce employee exposure. For example, a hopper can be used to convey material for shredding into a mechanical separator, with screening and granulating machines to separate constituent metal and plastic fractions. Such recycling machinery is automated and isolated (enclosed) and usually employs a dust collection system.

Ventilation and Capture

- In areas where mechanical processing (e.g., shredding, chipping, pulverizing, and smelting or melting) occurs, your facility should have systems to collect airborne particulates and flue gases and remove contaminants (e.g, using filters, cyclones, scrubbers, and/or baghouses). Use of closed-loop ventilation systems is recommended.
- Air emission controls should reduce emissions to meet the most stringent regulatory exposure limits that apply to your facility. If legal limits on air emissions do not exist in your jurisdiction, use the precautionary principle, with a goal of preventing exposure. If established limits are exceeded, workers should be informed and removed from the hazard.

Precautionary Principle

“Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.” United Nations. 1992. Conference on Environment and Development. Rio de Janeiro.

In other words, the absence of complete scientific evidence to take precautions does not mean that precautions should not be taken—especially when there is a possibility of irreversible damage.

⁹ Electronics Product Stewardship Canada (EPSC). 2010. *Recycler Qualification Program for End-of-life Electronics Recycling*.

¹⁰ Basel Action Network. 2009. *Performance Requirements Excerpted From the e-Stewards Standard for Responsible Recycling and Reuse of Electronic Equipment*, and Appendix A: Guidance Document. UNEP.

Engineering Controls – Mechanical Processing – Emission Control Equipment

Control and Capture

- Air emission controls should always be implemented at the source of the contaminant, to minimize or eliminate potential uncontrolled releases of dust or air particulates. See Operations and Maintenance (below) for other clean-up controls.
- Other types of controls should be considered, to prevent or minimize releases to land and water, such as enclosed storage containers for out-of-doors storage, and wastewater collection and treatment systems in the event that material must be stored onsite until enough has been accumulated to justify processing and/or transport. Materials should be protected from atmospheric and weather effects (e.g., heat, cold, moisture, dust, etc.), and accidental spills and breakage. All materials and components should be stored in a way that:^{11,12} protects them from the atmospheric and weather effects (e.g., using weatherproof covering and a rain catchment system); and protects against accidental spills or breakage (e.g., using an impermeable surface with a sealed drainage system and sealed sump pump pits¹³).

Fire Suppression

Best Practice: Facilities that undertake mechanical processing should have adequate fire suppression equipment in place for the type and size of the facility, and workers should all know how to use this equipment.

- Adequate fire suppression equipment for the type and size of the facility should be maintained, particularly in areas where mechanical processing such as grinding and shredding is undertaken. Consideration should be given to the installation of sprinkler systems. At a minimum, the facility should be equipped with readily accessible and charged fire extinguishers suitable to the size and type of fire that might occur.¹⁴



¹¹ UNEP. Basel Convention. 2011. *Guideline on Environmentally Sound Testing, Refurbishment & Repair of Used Computing Equipment*. Partnership for Action on Computing Equipment (PACE) Project 1.1.

¹² Basel Action Network. 2009. *Performance Requirements Excerpted From the e-Stewards Standard for Responsible Recycling and Reuse of Electronic Equipment*, and Appendix A: Guidance Document. UNEP.

¹³ UNEP. 2007. *E-waste Volume II: E-Waste Management Manual*. International Environmental Technology Centre.

¹⁴ Electronics Product Stewardship Canada (EPSC). 2010. *Recycler Qualification Program for End-of-life Electronics Recycling*.

Engineering Controls – Mechanical Processing – Operations and Maintenance

Operations and Maintenance (O&M)

Best Practice: Perform regular maintenance on all emission control equipment. Develop preventive maintenance programs based on manufacturer and equipment instructions.

All mechanical controls should be tested, to ensure adequate protection from the hazard. For example, ventilation systems should be tested to ensure they remove the intended contaminants and maintain adequate air flow rates.¹⁵

Preventive maintenance programs should be implemented to monitor performance of the equipment and ensure proper functioning to the approved specifications. Maintenance involves actions regarding the control and upkeep of equipment. All emission control equipment will have operating manuals that specify the type of maintenance required, such as the following:

- Scheduling, procedures, and work/systems control and optimization.
- Routine, preventive, scheduled and unscheduled actions to prevent equipment failure, with the goal of increasing efficiency, reliability, and safety. For all ventilation systems, preventive maintenance tasks should include airflow testing, ductwork inspections and filter replacements. For example, flue dust should be removed from separators and redirected to recycle streams, off-site treatment and/or final disposal, where appropriate. Dust collection systems can be a significant source of exposure to hazardous and other contaminants if not properly cleaned, and maintained. You should safely inspect and replace air filters from building and processing equipment ventilation systems and personal protective equipment such as ventilators to prevent worker exposure to dusts and particulates.¹⁶
- Workers should be trained and competent in the use of emission control equipment, where appropriate.

¹⁵ *ibid.*

¹⁶ Basel Action Network. 2009. *Performance Requirements Excerpted From the e-Stewards Standard for Responsible Recycling and Reuse of Electronic Equipment*, and Appendix A: Guidance Document. UNEP.

An O&M program has important benefits, such as the following:

- The workplace is kept safe. Equipment is maintained, mitigating any hazard that may have come up from deferred maintenance.
- The designed life expectancy of equipment will be achieved, and in some cases exceeded. Conversely, the costs associated with early equipment failure are usually not budgeted for and often come at the expense of other planned O&M activities.
- It supports processing efficiency by minimizing the amount of operational downtime experienced due to equipment failure.

Engineering Controls – Mechanical Processing – Emissions Monitoring

Emissions Monitoring

Best Practice: Routinely conduct: (i) indoor ambient air monitoring for hazardous substances near receiving and processing areas; (ii) monitoring for potential surface contamination around work areas and common areas (e.g., lunchrooms, change rooms, washrooms); as well as (iii) monitoring for potential water discharge of hazardous substances.

The following identified best practices^{17,18} help to inform whether engineering controls are working as intended. Tests will either confirm the effectiveness of existing occupational health and safety practices, or suggest the need for additional control measures to increase safety.¹⁹

- If workers remove mercury-containing components (e.g., fluorescent lamps and liquid crystal display screens), air monitoring for mercury and mercury compounds should be performed routinely.
- If your facility is using thermal processes for operations that involve smelting, melting or combustion, then tests to measure atmospheric releases and airborne concentrations of hazardous substances such as hydrocarbons, bromated flame retardants, and mercury, lead, beryllium, and cadmium should be performed.
- If your facility uses acids or solvents for precious metals or plastics recovery, you should perform workplace exposure tests for any acid or solvent that is inhalable.
- If your facility conducts processing that involves breaking, cutting, crushing, shredding or pulverizing CRTs, it should perform semi-annual air testing for silica dust, lead, beryllium, and cadmium, as well as for compounds containing heavy metals.

¹⁷ Electronics Product Stewardship Canada (EPSC). 2010. *Recycler Qualification Program for End-of-life Electronics Recycling*.

¹⁸ Basel Action Network. 2009. *Performance Requirements Excerpted From the e-Stewards Standard for Responsible Recycling and Reuse of Electronic Equipment*, and Appendix A: Guidance Document. UNEP.

¹⁹ Electronics and the Environment. 2003. Institute of Electrical and Electronics Engineers (IEEE) International Symposium.

Further information, as well as the NIOSH guides below, available at **The National Institute for Occupational Safety and Health** website: <<http://www.cdc.gov/niosh/>>.

Pocket Guide to Chemical Hazards—a source of general industrial hygiene information on several hundred chemicals/classes.

Manual of Analytical Methods—a collection of methods for sampling and analysis of contaminants in workplace air, and in the blood and urine of workers.

4.6.3 Engineering Controls—Management of Processed and Waste Materials

Hazardous Materials

Best Practice: Process all hazardous materials that have been generated, removed or recovered from primary processing at authorized facilities that undertake environmentally sound management operations and activities.

Refurbishment and recycling facilities may receive used electronic products and components that cannot be reused or processed. These may include hazardous components, such as faulty mercury lamps, batteries, capacitors and printed circuit boards, and should be managed onsite in a manner that protects human health and the environment and preserves their value for subsequent material recovery and recycling, or proper treatment and/or final disposal.

- Refurbishment and recycling facilities should have provisions in place to arrange for processing, treatment and/or final disposal of processed waste streams at authorized facilities that possess the necessary infrastructure and capacity to manage these materials in an environmentally sound manner.
- Some substances, like lead, can be both hazardous and a valuable commodity. Some substances, such as cobalt, platinum, and rare earth metals, are becoming increasingly scarce, and their recovery is increasingly important for economic reasons. Conversely, some substances, such as mercury, should be recovered but should not be put back into commercial products.²⁰

Below are best practices related to specific materials management.

Mercury

Best Practice: Seal, label and transport removed mercury-containing devices to licensed facilities, in accordance with Basel Convention technical guidelines.

As a hazardous substance, mercury must be handled extremely carefully. It is very important to protect fragile mercury-containing components from breakage (e.g., liquid crystal display (LCD) backlighting, mercury lamps and tubes) and to properly seal and label containers of mercury-containing devices. Only authorized facilities can manage mercury. These facilities, called “retort operations,” can safely recover 99% of the mercury for further use in other applications, such as gold mining.²¹

Refer to the Basel Convention *Technical Guidelines for the Environmentally Sound Management of Wastes Consisting of Elemental Mercury and Wastes Containing or Contaminated with Mercury*, available free at:

www.basel.int/Implementation/TechnicalMatters/DevelopmentofTechnicalGuidelines/A_doptedTechnicalGuidelines/tabid/2376/Default.aspx.

²⁰ UNEP. Basel Convention. 2011. *Guideline on Environmentally Sound Material Recovery/Recycling of End-of-life Computing Equipment*. PACE.

²¹ Basel Action Network. 2009. *Performance Requirements Excerpted From the e-Stewards Standard for Responsible Recycling and Reuse of Electronic Equipment*, and Appendix A: Guidance Document. UNEP.

Engineering Controls – Management of Processed and Waste Materials

Lead

Best Practice: Printed circuit boards with lead-based solder should be smelted in an integrated copper smelter to recover as much of the metals as is possible.

- As a hazardous substance, lead must be handled extremely carefully. Components containing lead (e.g., circuit boards) should be removed only in an integrated smelter. During smelting, the process should control emissions of other hazardous substances such as tin, mercury, cadmium, arsenic, chromium, beryllium, and halogenated materials.²²



Best Practice: When packaging for transport, make sure to seal containers holding CRTs, CRT cullet/glass, or equipment containing CRT glass. Only process these materials at authorized facilities that are capable of managing lead in an environmentally sound manner.

- CRTs, CRT cullet/glass, and equipment containing CRT glass may be designated as hazardous waste or hazardous recyclable material in some jurisdictions. Ensure it is managed appropriately according to your jurisdiction. This may include sending lead to facilities such as a lead smelter or integrated copper smelter.
- Phosphorus and coatings or residues from CRTs should be managed as hazardous waste: sent only to facilities licensed and capable of managing hazardous waste.²³
- Processing of cleaned CRT, CRT cullet/glass, or equipment containing CRT glass should be undertaken in authorized facilities.

²² *ibid.*

²³ *ibid.*

Engineering Controls – Management of Processed and Waste Materials

Toner and Inks

Best Practice: Manage toner and ink printer cartridges in a manner that minimizes dispersal of toner and inks, minimizing worker exposure and avoiding contamination of processing equipment and processed materials.

Toner and ink printer cartridges should be managed in the following order of preference:²⁴



- 1) Refill or reuse cartridges, refurbishing or remanufacturing them where feasible.
- 2) Remove color inks and toners and dispose of these in hazardous waste landfills because they can contain hazardous substances. Black toners can remain in cartridges and be disposed of in a solid waste landfill. Emptied and fully cleaned cartridges can be remanufactured, recycled or reused.

- 3) Dispose of the remaining printer cartridges in authorized landfills or incinerators.

Components containing selenium, including printer drums, should be removed intact (not shredded) and sent to an authorized facility that is properly equipped to manage selenium.

Collections from Air Controls

Best Practice: Ensure bagging of dusts, residues, sweeps and slag from all facility air control cleaning and maintenance operations.

All collected dust and residues from routine maintenance on equipment (e.g., filters that were changed or cleaned) should be sealed, packaged and managed as hazardous wastes at authorized facilities, especially those collected from air control devices designed to control heavy metal and other hazardous airborne particulates.²⁵

Polychlorinated biphenyl (PCB)

Best Practice: Dispose of polychlorinated biphenyl (PCB)-containing components or PCB-contaminated material properly at a designated facility.

PCBs should be destroyed in accordance with the Stockholm Convention on Persistent Organic Pollutants, utilizing de-chlorination, OR high-temperature incineration equipped with pollution prevention.²⁶ Under no circumstances should PCB-containing devices be dismantled to expose their contents, be refurbished or be recycled.

²⁴ *ibid.*

²⁵ *ibid.*

²⁶ E-Stewards. 2012. *e-Stewards Standard for Responsible Recycling and Reuse of Electronic Equipment*. Appendix A: Guidance on the Interpretation and Application of the e-Stewards Standard.

Engineering Controls – Management of Processed and Waste Materials

Plastics and Resins

Best Practice: Plastics and resin materials containing bromated flame retardants (BFRs) or polyvinyl chlorides (PVCs) should be disposed of in a manner that prevents harmful releases, and in a manner that is consistent with applicable Basel Convention technical guidelines.

- Plastics can be smelted in a copper smelter or other metals smelter, or disposed of in a hazardous waste incinerator in a manner which prevents harmful emissions and manages residues, including slag, as hazardous waste.²⁷
- If plastics are smelted, it is recommended that the plastics are burned at a temperature of 850 °C (1600 °F) or higher, with a residence time of 2 seconds, and with excess oxygen. Complete thermal destruction of hydrocarbons will substantially reduce the possibility of formation of dibenzofurans and dioxins in the furnace emission stream. Halogens will be converted to acids, and then to salts in an acid gas scrubber.²⁸
- Plastics and resins should be managed in a manner that is consistent with applicable Basel technical guidelines:

Refer to the Basel Convention's *Technical Guidelines for the Identification and Environmentally Sound Management of Plastic Wastes and for Their Disposal*, available free at:

<<http://www.basel.int/Implementation/TechnicalMatters/DevelopmentofTechnicalGuidelines/AdoptedTechnicalGuidelines/tabid/2376/Default.aspx>>

Refer to the Basel Convention's *Technical Guidelines for the Environmentally Sound Management of Wastes Consisting of, Containing or Contaminated with Polychlorinated Biphenyls (Pcbs), Polychlorinated Terphenyls (PCTs) or Polybrominated Biphenyls (PBBs)*, available free at:

<<http://www.basel.int/Implementation/TechnicalMatters/DevelopmentofTechnicalGuidelines/AdoptedTechnicalGuidelines/tabid/2376/Default.aspx>>

²⁷ Basel Action Network. 2009. *Performance Requirements Excerpted from the e-Stewards Standard for Responsible Recycling and Reuse of Electronic Equipment*, and Appendix A: Guidance Document. UNEP.

²⁸ OECD. 2003. *Technical Guidance for the Environmentally Sound Management of Specific Waste Streams: Used and Scrap Personal Computers*. Working Group on Waste Prevention and Recycling. ENV/EPOC/WGWPR(2001)3/Final.

Engineering Controls – Management of Processed and Waste Materials

Batteries

Best Practice: Remove batteries prior to processing methods that use physical destruction methods (e.g., shredding, crushing, grinding). Insulate, sort and store them in a manner to protect against short-circuiting; and send them to authorized recycling facilities that are equipped to process the batteries in an environmentally sound manner.

- Batteries from electronic devices (such as rechargeable nickel cadmium, nickel metal hydride, lithium-ion batteries; or lead acid or mercury-containing batteries) should be removed manually and sorted by type.
- Management processes should be established to avoid inadvertent external short circuits and current flows (e.g., discharging capacitors prior to refurbishing or recycling). These processes may include, for example:²⁹ packing lithium-ion batteries in vermiculite; bagging corroding or leaking batteries; taping battery terminals to prevent short circuiting; and lining the inside of metal drums with plastic if used to collect batteries.
- Large inventories of batteries in storage should be avoided. They should be transported to authorized battery refurbishing or recycling facilities in accordance with local laws.

²⁹ Stewardship Ontario. Municipal Hazardous or Special Waste Program. Vendor [service provider] Standards, www.stewardshipontario.ca/service_providers/vendor_standards.

Exhibit 6: Recommended Best Practices for End-of-life Batteries³⁰

Type	Where Found	Toxic Content	Minimum Processing	Best Practice
Lithium-ion	Laptops, cell phones, personal digital assistant devices	Phosphate, cobalt (heavy metal)	Pyrometallurgical or hydrometallurgical processing	Electric arc furnace. Soft-chemical solvent-free process in the future.
Lithium metal / Lithium primary	Button cell, coin cell batteries	Lithium perchlorate, mercury	Hydrometallurgical processing	Hydrometallurgical processing. Soft-chemical solvent-free process in the future.
Lead acid	Universal power system, back-up.	Lead	Mechanical + smelt processing	Mechanical + smelt processing
Alkaline-cell	Digital cameras	Manganese, potassium hydroxide	Collection for decommissioning. Disposal in permitted, lined and leachate-controlled landfills or hazardous waste landfills.	Disposal in permitted, lined and leachate-controlled landfills or hazardous waste landfills. Soft-chemical solvent-free process in the future.
Nickel-metal hydride	Older cell phones, laptops	Nickel (heavy metal), potassium hydroxide	Recycling using stainless steel. Disposal of residuals in hazardous waste landfill.	Steel mill processing. Soft-chemical solvent-free process in the future.
Nickel-cadmium (Ni-cad)	Electric tools, shavers, cordless phones	Nickel, cadmium (heavy metals), potassium hydroxide	Recycling, cadmium recovery specialist. Retort furnace. Disposal residuals in hazardous waste landfill.	Cadmium retort furnace

The Waste Management Hierarchy in Final Material Disposition

Best Practice: Apply the waste management hierarchy in management decisions regarding final material disposition for end-of-life electronic products, and ensure that workers are aware of preferred practices.

³⁰ Source: E-Stewards. 2012. *e-Stewards Standard for Responsible Recycling and Reuse of Electronic Equipment*. Appendix A: Guidance on the Interpretation and Application of the e-Stewards Standard.

Exhibit 7: Material Disposition Hierarchy, and Acceptable Processes and Points of Final Disposition³¹

		Disposition Hierarchy			Acceptable Processes & Points of Final Disposition							
		Material recovery required	Energy recovery permitted	Other disposition permitted	Manual dismantling and material separation	Mechanical material separation	Extraction/purification/refinement	Smelting to reclaim metal	EFW incineration (use of material as an energy substitute)	Landfill	Hazardous waste landfill	Export to a non-OECD/EU country for processing
Electronic scrap	End-of-life electronics (EOLE)	★			✓	✓	✗	✗	✗	✗	✗	✗
	Components (hard drives, chips, etc.)	★			✓	✓	✓	✓	✗	✗	✗	✗
	Wires/Cables	★			✓	✓	✓	✓	✗	✗	✗	✗
	Copper yokes	★			✓	✓	✓	✓	✗	✗	✗	✗
	Circuit boards	★			✓	✓	✓	✓	✗	✗	✗	✗
	Metal/Plastic laminates	★			✓	✓	✓	✓	✗	✗	✗	✗
Non-hazardous	Metal	★							✗	✗	✗	✗
	Mixed metals	★							✗	✗	✗	✗
	Metal dusts (baghouse)	★							✗	✗	✗	✗
	Non-leaded glass	★						✗	✗	✗	✗	✗
	Plastic		★	★				✗			✗	✓
	Mixed plastics		★	★				✗			✗	✓
	Wood		★	★				✗			✗	✗
	Leather, cotton and other fibres		★	★				✗			✗	✗
Substances of concern	Insulation (fibreglass/composite)		★	★				✗			✗	✗
	Leaded glass	★			✓	✓	✓	✓	✗	✗	✗	✗
	Washed leaded glass cullet	★			✗	✓	✓	✓	✗	✗	✗	✗
	Mercury lamps	★			✗	✓	✓	✗	✗	✗	✗	✗
	Mercury	★			✗	✓	✓	✗	✗	✗	✗	✗
	Batteries	★			✗	✓	✓	✓	✗	✗	✗	✗
	Ink/Toner cartridges		★		✓	✓	✓	✓	✓	✗	✗	✗
	Ink/Toner		★		✗	✓	✓	✗	✓	✗	✗	✗
	Phosphorus powder			★	✗	✓	✓	✗	✗	✗		✗
Ethylene Glycol			★	✗	✓	✓	✗	✗	✗		✗	
Material recovery is always preferred over other disposition methods for all materials but only required where indicated with an '★'. Where the use of the material for energy recovery, or other disposition methods is permitted, they are indicated with an '★'.										Process/application not recommended		✗
										Process/application is permitted & subject to on-site audit		✓
										Process/application is permitted & subject to document review and verification		

³¹ Source: Electronics Product Stewardship Canada (EPSC). 2010. *Recycler Qualification Program for End-of-life Electronics Recycling*.

Notebook

Facility Check-In



- Goal:* My facility has the engineering controls it needs in place to prevent risks.

For each of the relevant areas of your facility, note the current situation; where improvement could be made; what challenges exist to implementing engineering controls; how these challenges can be overcome; and any steps you can take today / next week / next month to begin the change process.

Manual processing (disassembly or repair):

a) Current situation: _____

b) Where improvements could be made: _____

c) What challenges exist: _____

d) How these challenges can be overcome: _____

e) Steps to begin the change process: _____

Mechanical processing:

a) Current situation: _____

b) Where improvements could be made: _____

c) What challenges exist: _____

d) How these challenges can be overcome: _____

e) Steps to begin the change process: _____

Management of processed or waste material:

a) Current situation: _____

b) Where improvements could be made: _____

c) What challenges exist: _____

d) How these challenges can be overcome: _____

e) Steps to begin the change process: _____

**Best Practices to
Prevent and Minimize
Risks to EHS through
Administrative Controls**

4.7 Best Practices to Prevent and Minimize Environment, Health and Safety Risks through Administrative Controls

Administrative Controls: These controls refer to work procedures to reduce the duration, frequency, and severity of exposure to hazards. Examples include: policies and procedures for pollution control and health and safety; emergency response plans and spill clean-up procedures; worker training; health and safety committees and regular supervision to ensure policies and procedures are followed; proper housekeeping to eliminate clutter and minimize the likelihood of accidents; incident-reporting procedures; standard operating procedures for removing hazardous components from used and end-of-life electronic products; and financial guarantees for site decommissioning and remediation.

Facilities use many different types of management systems appropriate to their needs, size, and scale of operations. Some of the administrative controls identified as best practices by verification and certification bodies are presented in this section. Facilities may have these elements rolled up into an overarching environment, health and safety (EHS) management system, while others could opt to maintain separate programs.

The following page presents a summary table of the best practices identified and described in this section, relating to administrative controls. These include policies and procedures relevant to all areas of an electronics recycling or refurbishment facility (receiving, testing, manual processing, mechanical processing, packaging and holding), health and safety committees or programs in the facility, and management system components that include administrative controls. Following the summary table, details on the best practices are described on subsequent pages.

Exhibit 8: Summary Table of Administrative Control Best Practices

Best Practice Identified—Summary (details follow on next pages)	Type of Administrative Control		
	Policies / Procedures	Committees or Programs	Management System Components
<i>Receiving:</i> Have a documented process for dealing with “non-conforming” equipment that arrives (a “Do Not Accept” list). Redirect components with hazardous substances to authorized facilities.	✓		
<i>Receiving:</i> Have documented clean-up procedures for accidental breakage of hazardous equipment posted in the receiving area.	✓		
<i>Testing:</i> To determine the suitability of used equipment for reuse, test the functionality of key components and record results.	✓		
<i>Testing:</i> Always adhere to international electrical safety test guidelines when testing for electrical safety.	✓		
<i>Disassembly/Repair:</i> Have documented procedures in place for manual removal, storage and treatment of hazardous components.	✓		
<i>Disassembly/Repair:</i> All hazardous components removed should be packaged, stored and transported as hazardous, in compliance with all local, state/provincial, federal/national regulations.	✓		
<i>Holding:</i> Ensure all material is securely stored in a manner that meets all applicable legal requirements, including maximum allowable time periods for material retention and storage.	✓		
<i>Holding:</i> Keep inventories of stored hazardous substances, to ensure conformity with regulatory requirements and to support implementation of facility emergency response plans.	✓		
<i>Packaging:</i> Packaging must minimize potential breakage and risks to human health and the environment during movement. Basel Convention guidelines should be followed.	✓		
<i>Labelling:</i> Containers should be labelled in a clear, legible, visible and durable manner, and meet applicable legal requirements. Labels should convey essential information to facilitate proper handling.	✓		
<i>Downstream:</i> When selecting downstream processors, establish and maintain a documented process, to assess and evaluate their ability to handle products and materials from your facility in a safe and environmentally sound manner.	✓		
<i>Downstream:</i> Ensure that used products and components that are shipped for reuse will actually be directed for reuse (versus recycling or final disposal). Ship used products and components for reuse in separate packaging from non-reusable items, obtain verification of safe arrival, and maintain detailed documentation.	✓		
<i>Committees:</i> Develop an injury and illness prevention program (IIPP).		✓	
<i>Committees:</i> Develop a health and safety committee to ensure the elements of an IIPP are implemented and functioning properly.		✓	
<i>Management:</i> Document all important procedures.			✓
<i>Management:</i> Develop a site closure plan; and an emergency response plan, and maintain insurance.			✓
<i>Management:</i> Identify, plan, monitor and record training needs for all personnel. The company should have a protocol for training employees at each relevant function and level. The training should include awareness training and competence training.			✓
<i>Management:</i> Develop a training program that follows the principles of fairness, equity, and transparency.			✓
<i>Management:</i> Train workers on the health and safety program used by your facility. Include this in both the orientation and annual refresher training.			✓
<i>Management:</i> Design the training so that you can measure knowledge retention following it.			✓
<i>Management:</i> Provide training to workers whenever they will encounter anything new and train supervisors about the specific hazards that workers under their immediate supervision may be exposed to.			✓

4.7.1 Administrative Controls—Policies and Procedures at Recycling and Refurbishment Facilities

Receiving/Sorting at Refurbishment and Recycling Facilities

Best Practice: Ensure that you know what material is arriving at your facility, and that it is properly sorted and labelled in the receiving area so that suitable controls are in place for incoming hazardous components. Make sure you have a documented process for dealing with “non-conforming” equipment or materials that arrive (including a “Do Not Accept” list), and redirect equipment that your facility cannot handle to specialized facilities that are equipped to do so.

- A facility should avoid accepting materials and equipment that it does not have the capability to manage and process in an environmentally sound manner. Personnel should be trained to either reject unwanted materials or redirect them to an appropriate facility that can handle the materials in an environmentally sound manner.³²
- To ensure the safety of your organization’s employees and the environment, it is important for your facility to have a documented process for dealing with “non-conforming” equipment or materials. This could include how non-conforming equipment will be identified, redirected, or otherwise addressed at the receiving site. The procedures could include specific responsibilities for different levels of employees.³³
- Review incoming products and product label specifications that identify the hazards associated with the product or its composition, such as manufacturer and brandowner information (for example, incoming equipment might have material declaration sheets).
- Ensure that all workers in the receiving area know the policies for inspecting incoming products. This will assist them to document, label, and sort equipment as it arrives. For example, boxes labelled as peripheral components (computer mice, cords, casings, etc.) should not include cathode ray tube monitors, which require specific engineering controls for hazardous materials, such as safe handling practices to avoid breakage.

For further safety information in the receiving area, see Microsoft Refurbishment Programs’ online slide deck, available free at:
<http://www.techsoup.org/learningcenter/hardware/1.%20Warehouse%20Operations.pdf>



**Spill
Clean-up**



**Response and
Procedures at**



³² UNEP. Basel Convention. 2011. *Guideline on Environmentally Sound Material Recovery/Recycling of End-of-life Computing Equipment*. PACE.

³³ Electronic Products Recycling Association (EPRA). 2012. *Electronics Reuse and Refurbishing Program*. Part B: Implementation Guide.

Refurbishment and Recycling Facilities

Best Practice: Have specific, documented clean-up procedures for accidental breakage of hazardous equipment posted in the receiving area.

Spill response and clean-up procedures should be documented and posted for hazardous equipment such as mercury-containing components (fluorescent tubes, backlighting for liquid crystal display screens, thermostats, and mercury-containing batteries), lead-containing components (cathode ray tubes—CRTs, and tin-lead-based solders and connectors), leaking batteries or printer cartridges, as well as for any other hazardous materials that workers could come into contact with at your facility. For example, a recommended best practice for clean-up procedures for accidental CRT breakage during receiving or testing is outlined in Box 2 below.³⁴ This should be posted in convenient areas, and made a part of worker training.



Box 2: Recommended Best Practice Procedure for Spill Response and Clean-up after CRT Breakage

A CRT clean-up kit consists of a broom, small plastic liner bags, paper towels, dust pan, disposable dust mask, and disposable latex gloves. If a CRT breaks, the following steps should be taken:

- Inform the foreman and/or warehouse supervisor that there has been breakage.
- Put on personal protection equipment.
- Isolate the area prior to clean-up.
- Use hand-held broom and dustpan together and collect all glass particles from the breakage.
- Place the breakage into the plastic bag. NOTE: the bag should be in the plastic bucket when placing the CRT debris into it, just in case the bag has a hole.
- Spray the area with water and wipe up any residue with the paper towels in the clean-up kit.
- Throw the gloves, paper towels and mask into the garbage for disposal.
- Seal the bag, keeping it in the bucket.
- Bring the broken CRT glass in the bucket to a designated disposal area.
- Replace the clean-up kit if needed, or return the kit to the clean-up station.
- The warehouse supervisor should inform the manager when the collection container is full.
- Disposal should be in accordance with local legal requirements.

Cathode Ray Tube (CRT) Breakage Clean-up Procedures:

E-Stewards clean-up procedure #1, for accidental CRT breakage, available free at:

<http://e-stewards.org/standard-appendixes/appendix-c/clean-up-procedures/>

E-Stewards clean-up procedure #2, for accidental CRT breakage, available free at:

<http://e-stewards.org/standard-appendixes/appendix-c/clean-up-procedure-2/>

Fluorescent Lamps Breakage Clean-Up Procedures, available at:

Environment Canada. Mercury website. Link to Disposal and Clean up Guidelines:

<http://www.ec.gc.ca/mercure-mercury/>

³⁴ Basel Action Network. 2009. *Performance Requirements Excerpted from the e-Stewards Standard for Responsible Recycling and Reuse of Electronic Equipment*, and Appendix A: Guidance Document. UNEP.

Testing at Refurbishment Facilities

Functionality Testing

Best Practice: To determine the suitability of used equipment for reuse, workers should test the functionality of its key components. A visual inspection without testing functionality is unlikely to be sufficient. Results of testing should be recorded.

Workers should evaluate the potential suitability of used equipment for direct reuse and test the items.³⁵ The tests to be conducted depend on the kind of equipment.³⁶

Results of testing should be recorded. The record should contain:

- name of the item and the producer,
- identification number of the item,
- year of production (if available), and
- name and address of the company responsible for testing, along with date of testing, types of tests performed and results.

Electrical Safety

Best Practice: When testing for electrical safety, always adhere to international electrical safety test guidelines, such as the *Code of Practice for in-service inspection and testing of electrical equipment*, by the Institution of Engineering and Technology.

Used electronic products destined for refurbishment should be tested for electrical safety before they are connected to a power supply, as electrically unsafe equipment can cause death or serious injury from electric shocks and can also catch fire. The Institute of Engineering and Technology offers a useful Code of Practice for this purpose.³⁷



³⁵ Electronic Products Recycling Association (EPRA). 2012. *Electronics Reuse and Refurbishing Program*. Part B: Implementation Guide.

³⁶ UNEP. Basel Convention. 2012. Open-ended Working Group of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal. Eighth meeting, Geneva, 25–28 September 2012. Agenda item 3 (b) (ii) a.

³⁷ Institute of Engineering and Technology. 2012. *Code of Practice for In-service Inspection and Testing of Electrical Equipment, 4th Edition*. Available at: <http://electrical.theiet.org/books/e-books/cop-iitee.cfm>.

Disassembly at Refurbishment and Recycling Facilities

Disassembly Procedures

Best Practice: Have documented procedures in place for manual removal, storage and treatment of any hazardous components or substances that are removed prior to processing, repair, or recycling.



Documented procedures for the manual dismantling and removal, storage and treatment of any hazardous components and substances are important, including how to identify products and components that should be removed prior to subsequent processing activities. Procedures should outline the hazards associated with various types of used and end-of-life electronic products and the proper handling procedures to prevent unintended releases of hazardous constituents through handling, breakage, etc.³⁸

Legal Compliance for Removed Hazardous Components

Best Practice: All hazardous components removed during repair should be packaged, stored and transported as hazardous in compliance with all local, state/provincial, and federal/national regulations, as appropriate.



There are specific legal compliance requirements for handling hazardous materials, for both repair and recycling operations. These will depend upon your jurisdiction, so you will need to become familiar with the requirements that apply to your facility.³⁹



³⁸ Electronics Product Stewardship Canada (EPSC). 2010. *Recycler Qualification Program for End-of-life Electronics Recycling*.

³⁹ Ibid.

Packaging at Refurbishment and Recycling Facilities

Best Practice: Refurbishment and recycling operations should ensure that packaging minimizes potential risks to human health and the environment during movement, and risks for breakage are minimized. Reuse and refurbishment facilities should ensure that electronic products are properly packaged when destined for reuse. Recycling facilities should ensure that hazardous waste or residual materials are properly sealed in containers destined for further material recovery or disposal. Basel Convention guidelines for packaging should be followed.

Box 3: Packaging Guidelines for Refurbished Equipment

Where applicable, ensure that the following packaging guidelines⁴⁰ are met:

- Each piece of equipment should be protected with cushioning material appropriate to preserving asset value (e.g., bubble-wrap, packaging foam).
- Laptops and their chargers should be packed together in boxes (vertically).
- Cables, keyboards and mice should be packed in separate boxes.
- Stacked layers of equipment should be separated by appropriate intermediate packaging to preserve asset value (e.g., cardboard, bubble-wrap, and packaging foam) and shrink-wrap should be used to secure shipments to pallets.
- Stacking of equipment should be no more than as follows:
 - Display devices – 4 layers only, unless 17” (43.2 cm) or larger, in which case 2 layers; flat-panel displays should be stacked vertically.
 - Desktop PCs – 15 layers.
 - Laptops – 5 layers stacked vertically.
 - Printers – 5 layers.
 - Batteries – should be packaged in a way to avoid contact with their terminals, to avoid short circuits and fires.
- LCD backlights – Due to their fragile nature, where removed, LCD backlights should be individually packaged in a rigid container that prevents breakage during the transport and should also be sealed in a foil, laminated bag in case of any breakage during the transport. In general, removing and packaging LCD backlights for reuse is a specialist activity to be undertaken by professionals with detailed knowledge and experience in handling these hazardous components.
- Each load should be properly secured to the pallet (e.g., with plastic shrink-wrap).
- Small, individual items of equipment should be packed in a box, properly encased with cushioning material, and with sufficient fill to prevent movement. When multiple items are packed in the same box, each should be separated by appropriate packaging. Where pallets are used, boxes should be secured to pallets using shrink-wrap or other means.

⁴⁰ UNEP. Basel Convention. 2011. *Guideline on Environmentally Sound Testing, Refurbishment & Repair of Used Computing Equipment*. Partnership for Action on Computing Equipment (PACE) Project 1.1.

Labeling at Refurbishment and Recycling Facilities

A number of classification and labelling systems applicable to chemicals, products, materials and wastes exist at the national, regional and international levels. Furthermore, different regulatory agencies and different countries may have different requirements for hazard definitions and for information to be included on labels and/or material safety data sheets.



Best Practice: Packaging, storage and shipping containers should be labelled in a clear, legible, visible and durable manner, and meet applicable legal requirements. Labels should convey essential information, to facilitate proper handling, transport and storage, enable shipment tracking, and support safe and timely emergency and spill responding.

Labels should be clearly legible and visible, to facilitate identification by receiving facilities, regulatory authorities and inspectors, emergency responders, or the public. Labels must meet all applicable legal requirements, and include, for example, the following information, where appropriate:

- original generator information (e.g., name, address),
- physical state (e.g., solid, liquid, gas) and hazard properties,
- identification, shipment manifest and/or facility tracking numbers,
- accumulation or packaging start date,
- Workplace Hazardous Material Information System (WHMIS) symbols, if applicable,⁴¹
- for reusable equipment, proof of testing to confirm that used products are in good working condition and are fit for reuse, and
- description of container contents—for material destined for recycling or disposal, detailed description of contents and hazardous designation, if applicable.



⁴¹ Health Canada. WHMIS, www.hc-sc.gc.ca/ewh-semt/occup-travail/whmis-simdut/index-eng.php.

Holding at Refurbishment and Recycling Facilities

Best Practice: Ensure all material is securely stored in a manner that meets all applicable legal requirements, including maximum allowable time periods for material retention and storage. Materials also should be protected from atmospheric and weather effects (e.g. heat, cold, moisture, dust, etc.), and accidental spills and breakage.

Sometimes material must be stored onsite until enough has been accumulated to justify processing and/or transport. All materials and components should be stored in a way that:^{42,43}

- meets applicable requirements of regulatory agencies, including regulations, permits, standards, guidelines and codes of practice,
- is secure from unauthorized entrance or access,
- includes clearly labelled storage areas,
- includes labels on materials, with the date they were placed into storage, and
- safeguards workers.

Inventories should note the type, quantity and location of material, and should be accessible in the event of emergency, particularly where electronic files are used.⁴⁴

Best Practice: Keep inventories of stored hazardous substances, to ensure conformity with regulatory requirements (including maximum retention and storage times) and to support implementation of facility contingency and emergency response plans.



⁴² UNEP. Basel Convention. 2011. *Guideline on Environmentally Sound Testing, Refurbishment & Repair of Used Computing Equipment*. Partnership for Action on Computing Equipment (PACE) Project 1.1.

⁴³ Basel Action Network. 2009. *Performance Requirements Excerpted from the e-Stewards Standard for Responsible Recycling and Reuse of Electronic Equipment*, and Appendix A: Guidance Document. UNEP.

⁴⁴ Electronics Product Stewardship Canada (EPSC). 2010. *Recycler Qualification Program for End-of-life Electronics Recycling*.

Administrative Controls to Minimize Risks at Downstream Processors



A key component of ESM is to consider what could happen to products and materials after they leave your facility and to influence how they will be managed by your downstream processors, which may include contractors, vendors and service providers.

It is important for you to consider questions such as:

- Where does material that has left your facility go for further processing?
- Can you track that it actually is received by the intended facility(s)?
- Do they practice ESM or have worker health and safety protocols?
- Do you know whether the next level of downstream processors or final deposition facilities practice ESM or have worker health and safety protocols?

It is very important for refurbishers and recyclers to have provisions in place to validate whether or not potential downstream processors that you do business with are also able to achieve ESM. This is increasingly important as clients, investors, regulators and other interested stakeholders are looking for greater assurances that used and end-of-life products and materials are handled in a safe and environmentally sound manner regardless of who ultimately processes them.

Best Practice: When selecting downstream processors (including recyclers, vendors, contractors and other service providers), establish and maintain a documented process to assess and evaluate their ability to handle products and materials from your facility in a safe and environmentally sound manner.

Protect your business and demonstrate due diligence by ensuring that all downstream processors that accept products and materials from your facility also have provisions in place to ensure ESM, including any authorizations deemed necessary to conduct business in the jurisdiction in which they operate. For example, the concepts identified in Box 4 can be included in business contracts with downstream processors to help ensure that their activities and operations follow ESM:⁴⁵

⁴⁵ Basel Action Network. 2009. *Performance Requirements Excerpted from the e-Stewards Standard for Responsible Recycling and Reuse of Electronic Equipment*, and Appendix A: Guidance Document. UNEP.

Box 4: Tips for Preparing Business Contracts with Downstream Processors

Require downstream processors to:

- **fully disclose their arrangements for downstream processors**, which means they provide you with a list of the names and contact information of all the processors that they ship material to once they are done processing it, as well as any final destinations they use for non-recyclable material—you can then contact all of the companies and ask about their practices and processes;
- **provide you written notice if there are any changes to their list of downstream processors**;
- **maintain and keep current all permits and operating licenses** required by their jurisdiction—you should establish a system, or designate a timeframe, to regularly check in with downstream vendors to verify updated permits to ensure all records continue to be current;
- **maintain ongoing records of shipments to all downstream processors**, including volumes of each material—they should provide records of these shipments to you, as the primary processor;
- **allow both scheduled and unscheduled audits** of their premises by an authorized representative of your facility—these audits could both examine on-the-floor health-and-safety practices or protocols as well as verify invoices of shipments to and from downstream processors;
- **complete site evaluation forms** to document all of the processes they use—this will help you determine whether the processes are environmentally sound and whether they use protocols that ensure worker health and safety;
- **hold their downstream processors and intermediaries accountable** by:
 - requiring these downstream processors to provide documentation of final disposition of waste; and
 - requiring they allow scheduled and unscheduled audits at their facilities, both to examine on-the-floor health-and-safety practices or protocols as well to verify invoices of shipments to and from their downstream processors; and
- **provide you with any information relating to regulatory fines or orders** imposed upon these processors by regulatory authorities.

Administrative Controls – Downstream Processors

Best Practice: Ensure that used products and components that are shipped for reuse will actually be directed for reuse (versus recycling or final disposal). Ship used products and components for reuse in separate packaging from non-reusable items, obtain verification of safe arrival, and maintain detailed documentation.

- To maximize direct reuse of used products and components it is important to validate through testing that equipment is in good working condition prior to shipment to the customer. Used equipment that is found to be in good working condition should be labelled accordingly and packaged adequately to prevent damage during transit.
- Equipment and components that are being shipped for reuse should not be shipped in the same box, Gaylord, pallet, or other package as non-reusable items.
- The labelling scheme for the control of equipment that has been tested and designated for reuse should be distinctly different from the labelling used for non-tested equipment. This will ensure that equipment destined for reuse agencies or brokers is handled with extra care, to avoid breakage.
- Additional protection and additional packaging (possibly individual) is important for equipment destined for reuse.⁴⁶
- If the price paid for equipment at its final destination and the price received for reuse equipment sold by the refurbisher are in line with market conditions for similar equipment, then this is a good indication it was received by official reuse agencies. Keep in mind that reusable equipment is typically priced by unit, whereas recyclable material is priced by weight.
- A refurbisher should consider the use of a “Bill of Sale” to establish transfer of ownership for assets being reused.⁴⁷
- Documentation should include: who is receiving the shipment; the reason for the shipment; how the recipient of the shipment will test and qualify the equipment; how the material will be handled if further testing for reuse is to be done; and the timeframe for future shipments.⁴⁸ This type of tracking may also be requested by organizations that donate equipment for refurbishing or by clients that purchase equipment from your facility for direct reuse.
- For shipments intended for direct reuse, the invoice should specify that the used equipment was demonstrated to be in good working condition at the time of sale. For shipments intended for reuse, the invoice should specify that the used equipment is a good candidate for reuse subject to further testing and verification.

⁴⁶ R2 Solutions. 2012. *Guidance. R2 Standard: 2008*. Version 1.0. 16 June 2012.

⁴⁷ Ibid.

⁴⁸ Ibid.

Case Study: How do you know your downstream processors are meeting your requirements and legal obligations?

When the owners of a computer refurbishing company wanted to make sure the downstream processors that took their materials operated in a way that met their environmental, health and safety requirements, they visited each of the facilities and took pictures. They also asked their overseas vendors to send pictures of their operation and working conditions. This helped the owners assess how materials were, in fact, being dealt with and how the employees were being treated.

As a result of this due diligence, the owners stopped doing business with one vendor because its employees had obviously not been trained properly and were using heavy equipment dangerously. Another was dismissed because it could not adequately answer simple questions about what happened to batteries after they left its facility. At another printer refurbisher, spilled toner had been left on the floor, workers were exposed to extremely crowded conditions, and none of the containers or packages was labeled or dated. Poorly run facilities are often fairly easy to spot and reject. It takes time to find the good ones willing to disclose the final destination for their focus materials.

The following tips were offered for other managers:

- A simple, accessible and very helpful tool to assess the downstream vendor is to use Google Maps Satellite View. This aerial view can help you look for any obvious problem areas.
- If you need more information, ask the vendor for copies of Bills of Lading, to determine where the materials were sent to.
- You can visit the facility directly or request videos of the facility while in operation. Also ask to see the vendor's dumpsters to see if any inappropriate materials are being sent to landfill.
- You can also inquire about what types of administrative, engineering and personal protective equipment controls are in place at the facility. For greater assurances, you can request copies of administrative controls, including environmental health and safety (EHS) policies and plans, operating permits, accident records, emergency plans, and financial guarantees for facility closure and emergency response.
- You can have more confidence that materials are ending up in the right place if you use a downstream vendor that is verified or certified under a recognized recycling or refurbishing standard.

4.7.2 Administrative Controls—Injury and Illness Prevention Program

Best Practice: Develop an injury and illness prevention program (IIPP).

An injury and illness prevention program (IIPP):

- establishes a framework for identifying and mitigating workplace hazards within a facility;⁴⁹
- is a documented program to routinely identify and address hazards during normal business practices—the IIPP demonstrates management commitment to health and safety; it assigns responsibilities for hazard identification and correction, ensures regular workplace inspections, outlines required health and safety training, and encourages prompt employee reporting of environment, health and safety concerns;
- is typically administered by a *health and safety committee*;
- can be a 1-page policy outlining responsibilities, or a more comprehensive procedural document, depending on the preference, size, and needs of the organization; and
- can outline responsibilities of: *a health and safety committee, management, supervisors* (e.g., correcting identified hazards; investigating injuries and illnesses), and *employees*. Typical employee responsibilities which should be documented in an IIPP (or equivalent program) are outlined in the box below.

Box 5: Responsibilities for an Employee that Should Be Documented in an IIPP

- observe health and safety–related signs, posters, warning signals and directions,
- review the building emergency plan and assembly area,
- learn about the potential hazards of assigned tasks and work areas,
- take part in appropriate health and safety training,
- follow all safe operating procedures and precautions, read operating manuals for equipment,
- use proper personal protective equipment,
- warn co-workers about defective equipment or new hazards in the workplace not yet rectified,
- report unsafe conditions immediately to a supervisor, and stop work if an imminent hazard is presented,
- participate in workplace safety inspections, and
- regularly inspect PPE for correct fit and function.

For further information on developing an IIPP, see the California Department of Industrial Relations' *MODEL IIPP PROGRAM*, available free at:

<http://www.dir.ca.gov/dosh/dosh_publications/iiphizemp.pdf>.

⁴⁹ State of California. Department of Industrial Relations, www.dir.ca.gov/title8/3203.html. Since 1991, the State of California has required every employer to have an IIPP in place.

4.7.3 Administrative Controls—Health and Safety Committee

Best Practice: Establish and implement a health and safety committee, to ensure that the elements of an IIPP are implemented and functioning properly.

- A health and safety committee ensures that the elements of an IIPP are implemented and functioning properly. The committee can exist on its own, but more often exists within a broader EHS management system. If a facility has over a certain number of employees, sometimes there is a legal commitment to have an H&S committee.⁵⁰
- The committee can be as small as two individuals, or larger, depending on the preference, size, and needs of the organization. It should include representatives from both management and workers. Membership may rotate periodically. The committee should meet at least quarterly.
- The committee may have responsibility to: maintain and update the IIPP; assess compliance with applicable environment, health and safety regulations and policies; evaluate reports of unsafe conditions; and coordinate any necessary corrective actions.
- Unsafe conditions that cannot be immediately corrected by an employee or his/her supervisor should be reported to the safety coordinator or any safety committee member and documented, for example, using a form such as “Report of Unsafe Condition or Hazard.”
- Management retains authority to implement corrective actions; however, timely correction of workplace hazards should be tracked by the committee, which will receive and review reports of unsafe conditions, workplace inspection reports, or injury reports.

Box 6: Responsibilities of a Health and Safety Committee⁵¹

- Establish a formal process to investigate, resolve, and follow up on health and safety complaints filed by workers.
- Review the results of periodic, scheduled workplace inspections, to identify any needed safety procedures or programs and to track specific corrective actions.
- Review supervisors' investigations of accidents and injuries, to ensure that all causes have been identified and corrected.
- Where appropriate, submit suggestions to management for the prevention of future incidents.
- Review alleged unsafe and hazardous conditions brought to the attention of any committee member and assist management in determining necessary corrective actions, responsibilities and correction deadlines.
- Investigate accidents and/or alleged hazards, to assist in establishing corrective actions.
- Submit recommendations to assist management in the evaluation of employee safety suggestions.
- Encourage two-way communication among workers and supervisors or management, without fear of reprisal.
- Inspect emergency response kits and first-aid kits to ensure that they are readily accessible at all times and adequately stocked, especially following an incident.

⁵⁰ For example, the Canadian Labour Code requires one if a company has 20 or more employees, and some Canadian provinces require one if there are 10 or more employees.

⁵¹ Source: Basel Action Network. 2009. *Performance Requirements Excerpted from the e-Stewards Standard for Responsible Recycling and Reuse of Electronic Equipment*, and Appendix A: Guidance Document. UNEP

4.7.4 *Administrative Controls—Environment, Health and Safety Management System Components*

As you learned in Modules 1 and 2, an environment, health and safety (EHS) management system provides a set of administrative controls to ensure safe work practices. An EHS system weaves environmental and worker health decision-making into the identity of a business, facilitating compliance while improving overall performance. The systematic approach of an EHS management system focuses on environmental risk minimization and worker health and safety. Each facility's EHS system is unique, but follows a simple plan-do-check-act model. The components of this model are presented below, with further detail following.

1. **Policy.** An EHS policy includes objectives, targets, and programs. This policy should be established by top management, and should include commitments to compliance, prevention of pollution, and continual improvement of the EHS system (see Module 2, Top Management Commitment). The policy for managing used and end-of-life electronics equipment should be based on the waste management hierarchy of responsible management strategies (see Module 1), and cover materials managed onsite and throughout the recycling chain.
2. **Planning.** The organization should: i) identify the environmental aspects of its activities, products, and services, including those that could have a significant impact on the environment and can be controlled or influenced (see Module 3 for more information on hazard identification); ii) identify all applicable environmental regulations (see Module 5, Legal Compliance); and iii) develop objectives and targets for its EHS management system.
3. **Implementation and operation.** A company should implement and organize processes to control and improve the products and services that are critical for environmental and worker health and safety. Operational controls and procedures should be established that ensure that all employees are both aware of the environmental impacts of the company's activities and are properly trained to help implement the EHS management system.
4. **Checking and corrective action.** A facility should monitor, measure, and check to make sure that the EHS management system is being implemented and is achieving its objectives and targets. This includes regular internal audits as well as periodic reviews of the organization's compliance status.
5. **Management review.** Top management should review the EHS management system at least once per year to ensure that it remains suitable, adequate and effective. Management also needs to evaluate internal audits and regulatory developments and decide whether to modify the existing EHS management system. Management review should also be conducted in a timely manner following the implementation of corrective actions that are introduced to address ESM problems and deficiencies.

Administrative Controls—Environment, Health and Safety (EHS) Management System Components

This introduction outlines which components of the EHS management system have best practices that are profiled in the following pages of this module.

EMS Component #1: Policy

Details related to developing a policy were addressed in Module 2 (Top Management Commitment) and will not be included here.

EMS Component #2: Planning

As part of its planning activities, an organization’s EHS system should:

1. identify environmental and worker health/safety impacts or hazards (risk assessment—see Module 3 for more information), and legal and regulatory requirements (see Module 5, Legal Compliance);
2. establish environmental goals, objectives and targets (see Module 6, Performance Monitoring);
3. plan actions and document procedures that work toward achieving identified goals ([see best practice, on following pages](#));
4. plan for emergency preparedness and response ([see best practice, on following pages](#));
5. plan for site closure ([see best practice, on following pages](#)); and
6. plan for unanticipated events through insurance ([see best practice, on following pages](#)).

EMS Component #3: Implementation and Operation

Implementing and organizing processes to control and improve risk prevention and minimization activities is the crux of the EHS system. This consists of establishing operational controls and procedures (see Module 4, Risk Prevention and Minimization), ensuring that all employees are aware of the environmental impacts of the company’s activities and are properly trained to carry out their responsibilities for helping to implement the EHS management system ([see best practice, on following pages](#)).

EMS Component #4: Checking and Corrective Action

Details on this element are presented in Module 6 (Monitoring and Performance Measurement).

EMS Component #5: Management Review

Details on this element are presented in Module 6 (Monitoring and Performance Measurement).

Environment, Health and Safety Management System—Planning Components

Best Practice: Document all important procedures for the organization.

- A key way for your facility to plan actions toward achieving identified goals is to document expected procedures for both the company management systems as well as work instructions. Having detailed documented procedures allows management to have a way to achieve its objectives and targets.
- Procedures that should be documented to demonstrate management commitment were outlined in Module 2. They are included here briefly for review.

Box 7: Procedures that Should be Documented

1. Procedure to document the overall written EHS management system, including goals and objectives. Many of the following procedures could be documented within an overall EHS system.
2. Procedure to identify aspects of the company's activities that could affect the surrounding local environment (this could possibly be a documented requirement for a risk assessment).
3. Procedure to identify important worker health and safety aspects of the company's activities.
4. Procedure to identify applicable legal and other requirements.
5. Procedure to identify training and awareness goals and objectives, and a training plan for workers.
6. Procedure for internal and external communication across the various levels within the company.
7. Document control procedure for document approvals, reviewing and updating documents, and to ensure that the current versions of important documents are identified, available, and legible.
8. Procedure for operational controls, to outline control of situations where loss of control could lead to deviation from the policy, objectives and targets.
9. Procedure for emergency preparedness and response.
10. Procedure for control of records for the identification, storage, protection, retrieval, retention and disposal of records.
11. Procedure for monitoring and measurement, to monitor on a regular basis the key characteristics of the company's operations, including internal auditing procedures.
12. Procedure for evaluation of compliance with the applicable legal requirements.
13. Procedure to monitor regulatory change.
14. Procedure for nonconformity, corrective action and preventive action, for dealing with nonconformities and for taking corrective and preventive actions.
15. A plan and procedures for closing the facility and for its after-care.
16. Procedures for selecting a downstream processor.

An example of a documented procedure for emergency response is provided on the following page.⁵² Similar procedures should be documented for all items in Box 7. It is often inappropriate to simply copy procedures from another source; rather, procedures should be tailored to respond to the specific scope of operations and needs of your facility.

⁵² Adapted from: Bureau of International Recycling (BIR). 2006. *Tools for Environmentally Sound Management: All You Need for an ISO Compliant Environmental Management System that Includes OECD Core Performance Elements for the World's Recycling Industries.*

Administrative Controls—EHS—Planning

Exhibit 9: Documented Emergency Response Procedure

Purpose:

- to plan and prepare for a potential EHS emergency that may pose an immediate and significant threat to human health and/or the environment,
- to outline how workers should respond to such a situation if such an event is imminent or occurs, and
- to identify existing programs and provide guidance to support these activities.

Scope:

- This procedure encompasses all activities and processes at the company.
- The procedure applies to the actions of all employees at the plant, and to the services and products provided by vendors and subcontractors while operating at the facility.

Definitions:

- Emergency incident or emergency situation—Environmental releases which require an emergency response.
- Emergency response—Actions taken by personnel outside of the immediate work area, to address an EHS accident.

Responsibilities:

- Emergency response coordination shall be in accordance with the applicable emergency response plan.
- The emergency response plan should cover both short-term and long-term remedial activities.
- The management representative will in case of an emergency act as emergency coordinator.
- All plant employees are responsible for identifying potential conditions, practices or activities that could lead to an emergency situation and for communicating this observation to their operations manager or the management representative: Employees shall immediately notify the operation's controller of any emergency condition or pending emergency condition.
- All emergency response activities are to be conducted within boundaries of training levels, appropriate procedures and governmental regulations.

Emergency Planning Procedures:

- regularly updating the emergency response plan,
- adequately training employees regarding emergency response and practice drills,
- reviewing events and accidents at the company and other similar facilities within the industrial sector,
- conducting health and safety and environmental compliance audits to identify areas for corrective and preventive action or improvement,
- coordinating with local governmental agencies, and local communities,
- documenting procedures within the emergency response Plan,
- documenting procedures within the emergency spill response manual,
- documenting procedures within the chemical release emergency procedure,
- documenting procedures within the chemical hazard evaluation system,
- documenting procedures within the security and inspection program,
- documenting procedures within the malfunction & abatement plan, and
- documenting procedures for the continuous emissions monitoring system shutdown, breakdown or malfunction reporting.

Emergency Response Equipment:

- Emergency response equipment that may be required, in the event of a spill or potential release, is located within the facility. These locations are identified in the emergency spill response manuals.
- This equipment shall be periodically inspected to ensure that it is stocked, accessible, and appropriate to the response plans and needs.

Administrative Controls – EHS – Planning

Best Practice: Develop an emergency response plan, to anticipate and prepare for potential emergency scenarios, and provide guidance to employees during an emergency.

- Every industrial facility should develop and implement an emergency plan aimed at ensuring that facility management meets all legal requirements in developing, maintaining, exercising, and reporting emergency preparedness and resource activities.
- The planning process may bring to light deficiencies, such as the lack of resources (equipment, trained personnel, supplies), or items that can be rectified before an emergency occurs. In addition an emergency plan promotes safety awareness and shows the organization's commitment to the safety of workers.
- This plan should be consistent with a nationally recognized guideline such as the *Canadian Standards Association's Emergency Planning for Industry Major Industrial Emergencies* or the US Environmental Protection Agency's *Basic Awareness Factsheet for Small Business Prevention of Accidental Releases*.

Box 8: An Emergency Plan Should⁵³

- ensure the safety of workers, response personnel, and the public,
- reduce the potential for the destruction of property or for actual product losses,
- reduce the magnitude of environmental and other impacts,
- assist response personnel in determining and performing proper remedial actions quickly,
- reduce recovery times and costs,
- inspire confidence in response personnel, industry, and the public, and
- for particularly dangerous hazards that were identified in a risk assessment as high or medium priority, document and communicate to workers specific procedures to respond to each potential emergency. Procedures should also outline the types of personal protective equipment that should be worn in the event of the emergency, to minimize personal exposure.

The Emergency Response Procedures Should:

- include defined responsibilities and actions for responding to the incident,
- include a list of emergency contacts and telephone numbers,
- include a readily available stocklist of response resources, such as first aid supplies and spill clean-up materials, along with guidance on how to use these supplies,
- outline the requirements for reporting the incident internally and, where applicable, to a stewardship program and regulatory authorities,
- be tested on at least an annual basis and have records of the test and response maintained, and
- be reviewed following any test or actual response to an emergency, and revised as necessary, considering the effectiveness of the response in preventing or mitigating any environmental, health or safety hazards.

⁵³ Source: Adapted from Environment Canada. Codes of Practice website, www.ec.gc.ca/lcpe-cepa/default.asp?lang=En&n=71FE839D-1&offset=8&toc=show - s4_1.

Administrative Controls – EHS – Planning

Best Practice: Develop a site closure plan that outlines how your inventory and property will be managed in the event of sale, closure, abandonment, bankruptcy or any form of dissolution of the company.

A site closure plan should include the following elements:

Plan for testing and remediation: The plan should stipulate that facilities that have ever used potentially hazardous processing technologies indoors conduct dust sampling for bromated flame retardants (BFRs), heavy metals, and polycyclic aromatic hydrocarbons (PAHs), as part of the closure process. The plan should include remediation for any contaminated areas, especially those with dust levels above recommended exposure levels.⁵⁴ The plan should also state that any facility that has used potentially hazardous processing technologies and/or stored hazardous electronic components outside of fully contained impermeable buildings should conduct soil and groundwater testing. It is recommended that this testing be conducted by a third party.

Plan for decommissioning: Planning for decommissioning should begin in the design stage of the project life cycle, for new facilities, and as early as possible in the operating stage, for existing facilities. Decommissioning should be carried out in a way that ensures that limited adverse risk to the environment or human health will remain after closure. All site closures and associated decommissioning activities should be undertaken in accordance with a national guideline if applicable (e.g., Canadian Council of Ministers of the Environment's *National Guidelines for the Decommissioning of Industrial Sites*).

Management plan: Where soils have been contaminated or waste material has been disposed of (such as in an onsite repository), then a management plan should be prepared and implemented to ensure that the material is properly managed in the future. Arrangements should be set up to ensure that the plan is adhered to for as long as is necessary. Procedures or notification methods should be put in place to ensure that future operators or owners of the recovery site or disposal facility site are advised of the contamination and continue the required management activities. It may be a requirement for operators to have post-closure plans prior to being granted a permit to operate.⁵⁵

Proper financial provisioning: Such provisioning is crucial to ensuring that there are sufficient funds available to close an operation and that closure costs do not become a burden in later years when revenues could be diminishing. Closure provisions should reflect the real cost of closure.⁵⁶ Examples of types of financial guarantees that can be used to demonstrate financial surety include: letter of credit; surety bond or insurance policy.⁵⁷

⁵⁴ Recommended exposure levels will depend on your jurisdiction. If there is none set, check with the World Health Organization.

⁵⁵ UNEP. Basel Convention. 2004. *Technical Guidelines on the Environmentally Sound Recycling/Reclamation of Metals and Metal Compounds (R4)*.

⁵⁶ Ibid.

⁵⁷ Electronics Product Stewardship Canada (EPSC). 2010. *Recycler Qualification Program for End-of-life Electronics Recycling*.

Administrative Controls – EHS – Planning

Best Practice: Plan for unanticipated events through insurance.

It is considered to be a best practice for a facility to have adequate insurance to cover the potential risks of its operations, commensurate with the nature and size of its activities. Compensation should cover environmental and occupational risks, as well as future site closure risks.⁵⁸ The following types of insurance are representative of best practices in this area.

Pollution Liability:

- covers sudden and non-sudden release of pollutants resulting in damage to the environment or in bodily injury arising out of the operations,
- is recommended for facilities utilizing potentially hazardous processing technologies, and
- has minimum per occurrence limits of liability of at least USD \$2,500,000.⁵⁹

Professional Liability or Errors and Omissions:

- provides coverage for claims arising out of the performance of professional services, resulting from any error, omission or negligent act; and
- has a recommended USD \$5,000,000 per occurrence and aggregate.

Workers' Compensation:

- is insurance for statutory obligations imposed by law.

Employers Liability:

- has suggested limits of USD \$1,000,000 for bodily injury by accident and USD \$1,000,000 for bodily injury by disease.

Commercial General Liability:

- should include products and completed operations coverage, full fire legal liability, contractual liability, and coverage for bodily injury, property damage; and
- has a recommended per occurrence limit of US\$2,000,000 and US\$2,000,000 in the aggregate.⁶⁰

⁵⁸ Basel Action Network. 2009. *Performance Requirements Excerpted from the e-Stewards Standard for Responsible Recycling and Reuse of Electronic Equipment*, and Appendix A: Guidance Document. UNEP.

⁵⁹ In Canada, the minimum is \$5 million (EPSC Standard).

⁶⁰ Electronic Products Recycling Association (EPRA). 2012. *Electronics Reuse and Refurbishing Program*. Guide.

Administrative Controls—Environment, Health and Safety (EHS) System—Implementation

Implementing and organizing processes to control and improve risk prevention and minimization activities is the crux of the EHS system. This consists of establishing operational controls and procedures, and ensuring that all employees are aware of the environmental impacts of the company's activities and are properly trained to carry out their responsibilities for helping to implement the EHS management system.

Many best practices related to this component have already been addressed elsewhere in this training module (operational procedures; engineering controls). However, best practices related to implementing training and awareness programs to reduce risks to the environment and improve worker health and safety are presented in this section.

Employee Training and Awareness

**REMINDER: ESM Criterion #5
Awareness, Competency and Training:**
Ensure employees have an appropriate level of awareness, competency and training, with respect to the effective management of occupational risks.

Best Practice: Identify, plan, monitor and record training needs for all personnel. The company should have a protocol to train employees at each relevant function and level. The training should include awareness training and competence training.

Types of training include:

- **Awareness training:** Given to all employees and provides an overview of relevant environmental, health and safety aspects important to the facility's operations. The training covers the topics outlined in the EHS documentation. This type of training is typically part of the initial orientation.
- **Competence training:** Tailored to each position and provides specific training in designated operating processes of the facility that can cause significant environmental impacts to ensure competency on the basis of education, training and/or experience. This training includes handling of hazardous materials, proper use, care and maintenance of personal protective equipment, and accident and emergency response.



Administrative Controls – EHS – Implementation and Operation – Training

The training program should be comprehensive for new hires and should include periodic refresher courses for all workers (for example, annually). The training should be given to workers in a language and format they can understand. Training content should include:⁶¹

- awareness of hazards in the workplace, safe management and handling of hazards,
- spill prevention and spill response in an emergency, including spill reporting,
- engineering controls used by the facility and how they should be operated and maintained during normal use,
- equipment safety,
- use and care of personal protection equipment,
- fire safety—fire prevention techniques and fire extinguisher use,
- evacuation training,
- disaster response,
- medical response training and first aid, and
- requiring that workers need to pass this operational training *before* being allowed to work on the floor, so they are not a risk to themselves or their co-workers.

The need to deliver awareness-raising and training to contractors, vendors and other visitors should also be considered, on a case-by-case basis, especially if they enter work areas that are used for processing.

Best Practice: Develop a training program that follows the principles of fairness, equity, and transparency.

Important principles in designing an employee health and safety training program are presented in the following list.⁶² The training program should be:

- provided at no cost to the employee,
- conducted during the employee's normal working hours,
- presented by a knowledgeable supervisor or by contracted experts,
- documented (records of all completed training and assessments should be appropriately maintained), and
- offered in a language and format understandable by the employee.

⁶¹ Basel Action Network. 2009. *Performance Requirements Excerpted from the e-Stewards Standard for Responsible Recycling and Reuse of Electronic Equipment*, and Appendix A: Guidance Document. UNEP.

⁶² Ibid.

Administrative Controls – EHS – Implementation and Operation – Training

Best Practice: Train workers in the health and safety program used by your facility. Include this in both the orientation and annual refresher training.

If an IIPP is developed and implemented, all employees should receive specific training in this IIPP to ensure that they have a high level of competency regarding the program. Similarly, if the facility has an EHS system, management should develop specific training in the EHS program.

Management should consider the following when designing and scheduling any training:

- Content for worker and contractor training should be informed by the results of the annual risk assessment; any sampling, audits or inspections; worker accident/incident reports; fines or regulatory orders; and other pertinent activities. The effectiveness of previous training can also be assessed using these results.
- A training program should define the qualifications and specific training requirements needed for each job function, as well as how often workers and contractors need to receive any refresher training courses.
- Training should be scheduled and completed prior to undertaking the associated tasks.
- Worker training for core components is required at minimum on an annual basis.
- Contractor training should reflect the level of risk of the work, considering both what tasks are involved and how often these tasks are undertaken.

Best Practice: Design the training so that you can measure knowledge retention following it.

Training could be provided in a number of ways to allow for evaluation.⁶³

- Training may be provided on the job, through paper or electronic means, in classroom format, by external certification, or by any combination of means. Where necessary, training should be supplemented with suitable written procedures or work instructions.
- The training should be designed to allow the assessment of knowledge retention following the training. This will help management ensure that the training provided is effective and adequate. Training assessments may include written tests, task observation or worker performance reviews, and the results of these activities should be used to determine the refresher and upgrade training requirements and schedule.

⁶³ Electronics Product Stewardship Canada (EPSC). 2010. *Recycler Qualification Program for End-of-life Electronics Recycling*.

Administrative Controls – EHS – Implementation and Operation – Training

Best Practice: Provide training to workers whenever they will encounter anything new, and train supervisors about the specific hazards that workers under their immediate supervision may be exposed to.

This training will help a supervisor understand and enforce proper protective measures. As a best practice, all supervisors should also ensure that the personnel they supervise receive appropriate training on the specific hazards of work they perform, and how to protect against those hazards.

Training is particularly important for new workers and whenever a new hazard is introduced into the workplace. This may include new equipment, hazardous materials, or new procedures to deal with a hazardous material. Health and safety training is also required when workers are given new job assignments on which they have not yet been trained and whenever a supervisor is made aware of a new or previously unrecognized hazard.

Specific topics which may be appropriate to include in the training are:⁶⁴

- hazards relating to electronics recycling and refurbishing processes, such as hazardous materials present and released during each process,
- the use of important personal protective equipment (PPE), and
- back care, body mechanics, and proper lifting techniques.

The need to deliver awareness-raising and training to contractors, vendors and other visitors should also be considered on a case-by-case basis, especially if they enter work areas that are used for processing.

Notes

⁶⁴ Basel Action Network. 2009. *Performance Requirements Excerpted from the e-Stewards Standard for Responsible Recycling and Reuse of Electronic Equipment*, and Appendix A: Guidance Document. UNEP.

Notebook

Facility Check-in



Goal: My facility has the administrative controls it needs in place to prevent risks. For each of the following controls, note the current situation; where improvement could be made; what challenges exist to implementing them; how these challenges can be overcome; and what steps can you take today / next week / next month to begin the change process.

Relating to Policies and Procedures in Your Facility (Receiving, Processing, Packaging):

a) Current situation: _____

b) Where improvements could be made: _____

c) What challenges exist: _____

d) How these challenges can be overcome: _____

e) Steps to begin the change process: _____

Relating to Downstream Processors:

f) Current situation: _____

g) Where improvements could be made: _____

h) What challenges exist: _____

i) How these challenges can be overcome: _____

j) Steps to begin the change process: _____

Injury and Illness Prevention Program or Health and Safety Committee (choose 1 to think about):

a) Current situation: _____

b) Where improvements could be made: _____

c) What challenges exist: _____

d) How these challenges can be overcome: _____

e) Steps to begin the change process: _____

Emergency Response Plan or Site Closure Plan (choose 1 to think about):

a) Current situation: _____

b) Where improvements could be made: _____

c) What challenges exist: _____

d) How these challenges can be overcome: _____

e) Steps to begin the change process: _____

Training:

a) Current situation: _____

b) Where improvements could be made: _____

c) What challenges exist: _____

d) How these challenges can be overcome: _____

e) Steps to begin the change process: _____

**Best Practices to
Prevent and Minimize
Risks to EHS through
the use of PPE**

4.8 Best Practices to Prevent and Minimize Risks through the Use of Personal Protective Procedures and Equipment

Personal Protective Equipment (PPE): These controls include all clothing and other work accessories designed to create a barrier between an individual worker and workplace hazards.

Examples include: safety glasses, visors and goggles; hearing protection; work gloves; disposable filtering face-piece or respirator; half- or full-face respirators; air-fed helmets and breathing apparatus; conventional or disposable overalls, smocks, aprons, coveralls, specialist protective clothing (e.g., high-visibility clothing); safety boots and shoes; and helmets and bump caps. While PPE helps to protect an individual worker from hazards, engineering and administrative controls generally function to protect all employees by reducing or eliminating the hazard. Consequently, administrative or engineering controls should be considered to be the first line of defence, whenever feasible.

Exhibit 10: Summary of Best Practices and Their Controls

Best Practice Identified—Summary (Details Follow on Next Pages)	Type of Control	
	Personal Protective Procedures	Personal Protective Equipment
Ensure that good housekeeping and hygiene practices are documented and practiced by all staff in all areas of your facility.	✓	
Work clothing and PPE can become contaminated with hazardous substances. Therefore they should be cleaned and laundered at or by the facility. Workers should not be allowed to take them home.	✓	
It is management's responsibility to implement a program for the proper provision, use and care of PPE. Management must require workers to use PPE during all applicable activities at both recycling and refurbishment functions. Protection is important for eyes, head, hands, skin, feet, hearing, and respiratory tract, and the level of protection required will depend on the activity undertaken.		✓
Monitor worker exposure to hazardous substances on a semi-annual basis as an indicator of both equipment performance and implementation of health and safety practices by workers.		✓

4.8.1 Personal Protective Procedures

Best Practice: Ensure that good housekeeping and hygiene practices are documented and practiced by all employees at your facility.

The following personal protective procedures should be followed:⁶⁵

- Clean chemical and other spills using procedures and PPE in accordance with material safety data sheets, facility emergency response protocols, and applicable legal requirements (including spill reporting). Dust and particulate matter should be regularly removed from surfaces, using wet cleaning methods as opposed to dry cleaning methods, to maintain a clean working environment and avoid further distribution of contaminants;
- Prohibit eating, drinking and smoking at work stations.
- Require employees in the CRT processing area to remove contaminated clothing and wash their face and hands before they enter the common break room or eating area. Employees should wash their face and hands before they eat, drink, smoke or apply cosmetics.
- Require employees in processing areas to wear smocks, coveralls or other suitable protective work clothing over their personal clothing to prevent them from becoming contaminated. Protective clothing should be professionally laundered by an industrial laundering service.
- Implement a regular cleaning schedule.



⁶⁵ Katers, J., Jim Barry, and Neil Peters-Michaud. 2003. Occupational Risks Associated with Electronics Demanufacturing and CRT Glass Processing Operations and the Impact of Mitigation Activities on Employee Safety and Health. Presentation at the Institute of Electrical and Electronics Engineers (IEEE) International Symposium: Electronics and the Environment.

Administrative Controls – Personal Protective Procedures

Best Practice: Work clothing and personal protective equipment can become contaminated with hazardous substances at electronic product processing facilities. Therefore they should be cleaned and laundered at or by the facility. Workers should not be allowed to take them home.

- Ensure that workers remove contaminated clothing promptly after they have completed their work and before break time and departure.
- Keep contaminated clothing in closed containers.
- Launder clothing before it is re-worn. In industrial facilities this often means having workers place used protective work clothing into a designated laundry bin, from which it is collected and appropriately laundered by the company prior to reuse.
- Wash before eating or drinking. Similarly, no food or drinks should be allowed in a work area where hazardous products are present.
- Do not allow workers to wear work clothing or other PPE home.
- Use of a double locker-shower setup is ideal, to prevent migration of surface contamination from clothing (i.e., work clothes are left in one locker room, the worker takes a shower and then goes to the locker on the other side where his/her street clothes are).⁶⁶

Notes

⁶⁶ Canadian Centre for Occupational Health and Safety. Website, http://www.ccohs.ca/oshanswers/chemicals/chem_profiles/lead/personal_lead.html.

4.8.2 Personal Protective Equipment (PPE)

Best Practice: It is management's responsibility to implement a program for the proper provision, use and care of personal protective equipment (PPE). Management must require workers to use PPE during all applicable activities at both recycling and refurbishment functions. Protection is important for eyes, head, hands, skin, feet, hearing, and respiratory tract, and the level of protection required will depend on the activity undertaken.

Personal Protective Equipment (PPE) includes:^{67,68}

- approved eye protection* (e.g., safety glasses, visors and goggles): face shields or protective glasses may be needed to protect workers from pieces of metal and plastic ejected from shredders or other processes;
- chemical protective clothing* (e.g., coveralls or smock): to protect workers from lacerations, thermal or chemical burns, or hazardous substance contamination on skin;
- approved hand protection* (e.g., chemical gloves or work gloves): if workers are at risk for lacerations, thermal or chemical burns, or hazardous substance contamination;
- approved foot protection* (e.g., safety work boots and shoes): clip-on steel toe protectors or steel-toe shoes with puncture-resistant soles may be needed to protect workers' feet; in smelting operations, more-specialized footwear may be needed, due to the possibility of molten metal spill;
- approved respirator protection* (e.g., disposable filtering face-piece or respirator; face respirators; air-fed helmets and breathing apparatus): workers should use appropriate respiratory protective equipment to avoid being exposed to unexpected releases;
- approved hearing protection* (e.g., ear plugs, ear muffs): high noise levels such as in shredding operations should be controlled by engineered enclosures but workers may also need personal hearing protection;⁶⁹ and
- approved head protection* (e.g., hard hats, helmets and bump caps): hard hats will protect workers from overhead hazards such as those from material handling and storage, and transportation of equipment on skids.



⁶⁷ *ibid.*

⁶⁸ International Precious Metals Institute (IPMI). 2003. *Environmentally Sound Management for Used Mobile Telephones*. IPMI guidance paper. Online at: http://ipmi.org/pdf/IPMI_Guidance_Used_Mobile_Phones.pdf.

⁶⁹ The US OSHA-permitted exposure limit for workplace noise is 90 db (decibels) for an eight-hour workday, with additional surveillance required at 85 db. Similar limits exist in Canada and Mexico.

Administrative Controls – Personal Protective Equipment

Managers are responsible for:⁷⁰

- providing the necessary PPE to all employees,
- ensuring that PPE is appropriate, properly rated, and fitted to individual needs,
- posting notices in areas requiring the use of PPE, to ensure awareness by all employees, and
- enforcing the use of necessary PPE.

Management could ensure the use of PPE through routine communication and training, the use of posters in designated areas, the use of peer pressure from supervisors and other workers, key messaging activity from the H&S committee, an inspection program, or possibly a rewards program.

Best Practice: Monitor worker exposure to hazardous substances on a semi-annual basis, to supply an indicator of both equipment performance and implementation of health and safety practices by workers.

- If your facility uses power machinery to shred, cut, grind or shear electronics, then you should perform semi-annual exposure monitoring of workers for mercury, lead, beryllium, cadmium, and bromated flame retardants.⁷¹
- The value of medical surveillance testing is high: an organization should have a medical surveillance program in place (e.g., biomonitoring through the use of routine blood work or other tests), offering to all workers a confidential service to monitor levels of contaminants in their bodies.
- Baseline information could be collected upon employment start, and supplemented by regular intervals of testing (e.g., semi-annual).
- Workers should be entitled to a second medical opinion, at the expense of the organization, for a reasonable and comparable cost. This will allow for identification of key hazard areas and implementation of new occupational safety procedures.⁷²



⁷⁰ Electronics Product Stewardship Canada (EPSC). 2010. *Recycler Qualification Program for End-of-life Electronics Recycling*.

⁷¹ E-Stewards. 2012. *e-Stewards Standard for Responsible Recycling and Reuse of Electronic Equipment*. Appendix A: Guidance on the Interpretation and Application of the e-Stewards Standard.

⁷² Basel Action Network. 2009. *Performance Requirements Excerpted from the e-Stewards Standard for Responsible Recycling and Reuse of Electronic Equipment*, and Appendix A: Guidance Document. UNEP.

Notebook

Facility Check-in:



- Goal:* My facility provides appropriate personal protective equipment to workers, trains workers on how to use this equipment, and ensures workers use the equipment.

Note the current situation: _____

Note where improvement could be made: _____

What challenges exist and how might they be overcome? _____

Note what steps you can take today / next week / next month to begin the change process:

4.9 Summary—Key Take-away Messages

Why Implement Risk Prevention and Minimization?

Efforts to minimize risks to the environment and to worker health and safety are important to:

- ✓ reduce worker and community illnesses,
- ✓ reduce worker accidents,
- ✓ raise awareness in the facility about hazards and how to prevent risks—this will contribute to safer work practices, and
- ✓ improve worker’s skills through regular training.



How to Implement Risk Prevention and Minimization?

Companies could adopt many of the ESM practices outlined in this module, such as a commitment to:

- ✓ control a hazard at the source (including controls during manual processing, emission controls during mechanical processing, and emission monitoring in processing areas);
- ✓ use of procedures and training to increase awareness and understanding of and competency in how to minimize hazards from company operations to the environment and worker health and safety; and
- ✓ use of personal protective equipment to ensure worker health and safety in all designated areas of electronic product refurbishment and recycling facilities. Personal protective equipment might include eye and ear protection, hand and body protection, respiratory protection, and head protection. If this equipment is not worn properly and consistently, workers and their families could become very ill.



Using the best practices, all combined, presented in Module 4 will allow your company to be in a better position to offer assurance that you have taken all reasonable care to prevent, minimize or otherwise address risks to worker health and safety, the environment and the local community.

Notebook	
<p>Please check off which of the following risk prevention and minimization measures your facility has in place.⁷³</p> <div style="text-align: right; margin-top: 10px;">  </div>	
Risk Prevention and Minimization Checklist for Continual Improvement	
Has Your Facility Implemented the Following to Prevent and Minimize Risks?	Priorities for Action
<p>Engineering Controls:</p> <p>Does your facility have engineering controls in place to prevent risks during:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Manual processing <input type="checkbox"/> Mechanical processing <input type="checkbox"/> Packaging, labelling, holding <input type="checkbox"/> Hazardous materials management <input type="checkbox"/> At downstream processors or final disposition facilities 	<ul style="list-style-type: none"> • • •
<p>Administrative Controls:</p> <p>Does your facility have the administrative controls needed to prevent risks?</p> <ul style="list-style-type: none"> <input type="checkbox"/> Injury and illness prevention program or an equivalent type program <input type="checkbox"/> Health and safety committee <input type="checkbox"/> Documentation of important procedures <input type="checkbox"/> Emergency response plan <input type="checkbox"/> Site closure plan <input type="checkbox"/> Insurance <input type="checkbox"/> Employee training <input type="checkbox"/> Controls at downstream processors or final disposition facilities 	<ul style="list-style-type: none"> • • •

⁷³ UNEP. Basel Convention. 2011 (Revised). *Environmentally Sound Management (ESM) Criteria Recommendations*. Partnership for Action on Computing Equipment (PACE).

<p>Personal Protective Equipment:</p> <p>Does your facility have the personal protective equipment and related practices it needs in place to prevent risks?</p> <p><input type="checkbox"/> Good hygiene practices are documented and practiced</p> <p><input type="checkbox"/> Management has implemented a program for the provision, use and care of PPE</p> <p><input type="checkbox"/> Contaminated clothing is segregated</p> <p><input type="checkbox"/> Worker exposure to hazardous substances is monitored on a semi-annual basis</p> <p><input type="checkbox"/> Appropriate health and safety precautions and equipment are used during shredding</p>	<ul style="list-style-type: none">••••
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4.10 Post-questionnaire



1. Were your learning objectives from the Pre-questionnaire, Question #1, met? If not, what questions do you still have that have not been answered?

2. What best practices, ideas or suggestions that came out of this module and from other participants would you like to implement at your facility?

3. Do you and your facility have the tools, processes and knowledge needed to ensure that downstream processors handle material in accordance with ESM principles? If not, what needs to be put in place to make sure that material that leaves your possession is handled responsibly?

4. Do you feel that you and your facility have the *tools, resources and knowledge* (forms, skills, personnel, etc.) to implement the best practices in this module?

Note the current situation: _____

Note what is still needed: _____

What challenges exist and how might they be overcome? _____

Note one step you can take today / next week / next month to begin the change process: ____

4.11 Additional Resources

Environment, Health and Safety Management

- **Canadian Centre for Occupational Health and Safety** website: <<http://www.ccohs.ca/>>. Available online: downloadable posters on health and safety, and WHMIS fact sheets.
- **US Department of Labor. Occupational Safety and Health Administration** website: <<http://www.osha.gov/>>. Available online: written programs and examples to meet the state regulations; hazardous materials training and other training materials; resources for small businesses, etc.
- **US Department of Labor. Occupational Safety and Health Administration. Forms for Recording Work-Related Injuries and Illnesses**, at: <<http://www.osha.gov/recordkeeping/new-osha300form1-1-04.pdf>>.
- **US Department of Labor. Occupational Safety and Health Administration. Chemical Hazard Communication Plan**, OSHA 3084 (1998), at: <<http://www.osha.gov/Publications/osha3084.pdf>>.
- **US Centers for Disease Control and Prevention. Engineering Controls**, website: <<http://www.cdc.gov/niosh/topics/engcontrols/>>.
- **Bureau of International Recycling (BIR). 2006. Tools for Environmentally Sound Management: All You Need for an ISO Compliant Environmental Management System that Includes OECD Core Performance Elements for the World's Recycling Industries.** Available free at: <<http://www.epa.gov/osw/consERVE/materials/recycling/conference/resource/guide-esm.pdf>>.
- **OECD. 2003. How to Apply Environmentally Sound Management to Small and Medium Size Enterprises in the Waste Recovery Sector.** Available free at: <[http://search.oecd.org/officialdocuments/displaydocumentpdf/?doclanguage=en&co te=env/epoc/WGWPR/RD\(2002\)5/FINAL](http://search.oecd.org/officialdocuments/displaydocumentpdf/?doclanguage=en&co te=env/epoc/WGWPR/RD(2002)5/FINAL)>.
- **OECD. 2004. Guidance Manual for the Implementation of the OECD Recommendation C(2004)100 on Environmentally Sound Management (ESM) of Waste.** Available free at: <<http://www.oecd.org/env/resourceproductivityandwaste/39559085.pdf>>.
- **OECD. 2003. Technical Guidance For The Environmentally Sound Management of Specific Waste Streams: Used and Scrap Personal Computers** (ENV/EPOC/WGWPR(2001)3/FINAL), at: <<http://ban.org/library/OECDGuidelineWEEE.pdf>>.
- **Canadian Standards Association. 2011. Occupational Health and Safety Management.** CAN/CSA-Z1000-06 SMART CD-ROM (R2011). Available for a fee at the CSA website, <http://shop.csa.ca/?gclid=CLe1o6_u0bUCFckx4AodKzwaIw>. The CSA Z1000-06 Smart CD-ROM is an electronic version of the Occupational Health and Safety Management Standard. It is organized according to a popular management system of “plan-do-check-

act” methodology which easily guides the user through each phase for easy implementation of the CSA Z1000-06 Standard.

- **UNEP. Basel Convention. 2004. *Technical Guidelines on the Environmentally Sound Recycling/Reclamation of Metals and Metal Compounds (R4)***, at: <<http://www.basel.int/DNNAdmin/AllNews/tabid/2290/ctl/ArticleView/mid/7518/articleId/189/Technical-guidelines-on-the-environmentally-sound-recyclingreclamation-of-metals-and-metal-compounds-R4.aspx>>.
- **US Department of Labor. Occupational Safety and Health Administration (OSHA). Safety and Health Management Systems etool.** Website: <<http://www.osha.gov/SLTC/etools/safetyhealth/index.html>>.
- **Five Winds International, LP. *Toxic and Hazardous Materials in Electronics***, at: <http://www.fivewinds.com/_uploads/documents/g60vcj6y.pdf>.
- **Microsoft Refurbishment Programs. Safety in the receiving area.** In online slide deck, available free at: <<http://www.techsoup.org/learningcenter/hardware/1.%20Warehouse%20Operations.pdf>>.
- **Microsoft Refurbishment Programs. Dismantling and repair process.** In online slide deck, available free at: <<http://www.techsoup.org/learningcenter/hardware/7.%20Demanufacturing.pdf>>.

Emergency Planning

- **Canadian Standards Association. 2009. *Emergency Planning for Industry Major Industrial Emergencies*. CAN/CSA-Z731-03 (R2009). *Emergency Preparedness and Response*.** Available for a fee at: <<http://shop.csa.ca/en/canada/injury-prevention/canca-z731-03-r2009/inv/27019912003/>>.
- **Transport Canada (TC), the US Department of Transportation (DOT), the Secretariat of Transport and Communications of Mexico (SCT). 2012. *2012 Emergency Response Guidebook*.** This guidebook will assist responders in making initial decisions upon arriving at the scene of a dangerous goods incident. It should not be considered as a substitute for emergency response training, knowledge or sound judgment. The 2012 Emergency Response Guidebook (ERG2012) does not address all possible circumstances that may be associated with a dangerous goods incident. It is primarily designed for use at a dangerous goods incident occurring on a highway or railroad. The ERG2012 was developed jointly by Transport Canada (TC), the US Department of Transportation (DOT), the Secretariat of Transport and Communications of Mexico (SCT) and with the collaboration of Ciquime (*Centro de Información Química para Emergencias*) of Argentina, for use by fire fighters, police, and other emergency services personnel who may be the first to arrive at the scene of a transportation incident involving dangerous goods. The ERG2012 is primarily a guide to aid first responders in quickly identifying the

specific or generic hazards of the material(s) involved in the incident, and protecting themselves and the general public during the initial response phase of the incident. Available documentation and videos free at: <<http://www.tc.gc.ca/eng/canutec/guide-menu-227.htm>>.

- **United States Environmental Protection Agency (EPA). *Basic Awareness Factsheet for Small Business—Clean Air Act Section 112(r): Prevention of Accidental Releases*.** Online at: <<http://www.epa.gov/oem/docs/chem/sb-final.pdf>>.

Risk Prevention and Minimization Guidelines and Practices

- **E-Stewards. Basel Action Network. E-Stewards Guidance Document.** Available free at: <<http://e-stewards.org/wp-content/uploads/2009/10/e-StewardsStandardGuidanceDocument.pdf>>. Appendix A: The Guidance Document is provided to aid in interpretation of the e-Stewards certification requirements as well as to provide guidance in how to meet the requirements in the Standard, including many leading practices provided by industry.
- **E-Stewards. Basel Action Network. Identification, Reporting, and Disposal of Potentially Non-Conforming Equipment.** Available free at: <<http://e-stewards.org/standard-appendixes/appendix-c/identification-reporting-and-disposal-of-potentially-non-conforming-equipment/>>.
- **US Department of Labor. Occupational Safety and Health Administration. Lead Smelting.** Available free at: <<http://www.osha.gov/SLTC/etools/leadsmelter/index.html>>.
- **E-Stewards. Basel Action Network. Toners and Inks.** Available free at: <<http://e-stewards.org/standard-appendixes/appendix-c/toners-and-inks/>>.
- **E-Stewards. Basel Action Network. Cathode Ray Tube (CRT) Breakage Clean-Up. Sample #1: Clean up procedure for accidental CRT breakage.** Available free at: <<http://e-stewards.org/standard-appendixes/appendix-c/clean-up-procedures/>>.
- **E-Stewards. Basel Action Network. Cathode Ray Tube (CRT) Breakage Clean-Up. Sample #2: Clean-up procedure for accidental CRT breakage.** Available free at: <<http://e-stewards.org/standard-appendixes/appendix-c/clean-up-procedure-2/>>.
- **Environment Canada. Mercury. Disposal and Clean-up Guidelines.** Available at: <http://www.ec.gc.ca/mercure-mercury/>.
- **California Department of Industrial Relations. Injury and Illness Protection Program E-Tool.** Available at: <<http://www.dir.ca.gov/dosh/etools/09-031/index.htm>>.

Site Closure

Canadian Council of Ministers of the Environment. 1991. National Guidelines for the Decommissioning of Industrial Sites. Available at: <http://www.ccme.ca/assets/pdf/pn_1074_e.pdf>.