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Technical Guidelines on

Environmentally Sound E-Waste Management

for

Collectors, Collection Centers, Transporters, Treatment Facilities and Final Disposal

in Ghana

February 2018

Preamble

The Technical Guidelines on Environmentally Sound E-Waste Management for Collectors, Collection Centers, Transporters, Treatment Facilities and Final Disposal in Ghana have been developed by the Environmental Protection Agency (EPA) with the support of the project "Sustainable Recycling Industries" (SRI) funded by the Swiss State Secretariat for Economic Affairs (SECO) between 2015-2018.

In developing these guidelines, reference was made to ISO/IWA 19, Guidance Principles for the Sustainable Management of Secondary Metals, and the European Standards on Collection, Logistics and Treatment Requirements for WEEE – Part 1 General Treatment Requirements (EN 50625-1).

Based on a detailed analysis of existing voluntary guidelines and standards in other jurisdictions the project team presented a first draft of the guidelines tailored to the specific needs and challenges of the national e-waste sector to public and private sector stakeholders in Ghana in August 2016. Subsequently, comprehensive feedback was included. In particular, the guidelines were extended towards an approach to differently address the various target groups of the reverse supply chain of electronic and electric equipment becoming e-waste. By this, the guidelines at hand specifically address the following five target groups:

(1) Collectors,

(2) Collection Centers,

(3) Transporters,

(4) Treatment Facilities,

(5) Final Disposal

In May 2017, the second draft of the guidelines was tested in five private sector recycling facilities by possible future public and private sector auditors. Especially, the active participation of the Ministry of Environment, Science, Technology and Innovation (MESTI), Manufacturing Industries Division as well as the Standards Compliance and Enforcement Division, both EPA Ghana, are to be highlighted here. In the same context, special thanks of the project team go to Blancomet Recycling Ltd., City Waste Recycling Ltd., Fidev Recycling Ltd., Presank Enterprise Ltd and Agbogbloshie Recycling Centre that all actively participated in the field tests of the recycling guidelines at hand.

In January 2018, the final draft of the guidelines was carefully reviewed by stakeholders such as EPA, Ghana Standards Authority, Ministry of Environment Science, Technology and Innovation, Department of Factory Inspections, GIZ, Ghana Atomic Energy Commission and other independent private institutions within a stakeholder workshop at Aburi from 24th to 26th January 2018. Final changes and reviews were included resulting in the present final version.

Last but not least, the project team would like to thank everybody for reviewing and contributing to this framework.

The SRI Ghana Team

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For the benefit of the environment, this document has been optimized for **double-sided printing**.

Guidelines on Environmentally Sound E-Waste Management for Collectors, Collection Centers, Transporters, Treatment Facilities and Final Disposal in Ghana

1. General Principles

(1) The following guidelines are mandatory in compliance with Act 917, Act 328 and LI 2250 with respect to every undertaking operating in the field of collection, storage, transport, treatment and final disposal of e-waste in Ghana.

(2) The Guidelines are non-exhaustive for treatment processes where emissions of the following substances occur:

a. Mercury (Hg), for example by recycling of fluorescent lamps (FLs),[1]

b. Lead (Pb), for example by recycling of used lead-acid batteries (ULABs),[2]

c. Ozone depleting Chlorofluorocarbons (CFCs) and Hydrochlorofluorocarbons (HCFCs)[3] and highly climate relevant Perfluorocarbons (PFCs) and Hydrofluorocarbons (HFCs), for example within the recycling process of refrigerators and air-conditioners.[4, 5]

For such treatment processes, additional substance specific process and management standards shall be applied.

NOTE: The special guidelines are to be developed in the future.

(3) Compliance with the regulatory requirements is verified by annual audits executed by the Environmental Protection Agency (EPA), or by a competent third party. Compliant undertakings will be issued with an audit certificate by EPA.

(4) The treatment facility shall ensure that there is insurance cover according to the Act 917, Part I, Section 15.

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1 Such as EN 50625-2-1

2 Basel Convention/UNEP 2003: Technical Guidelines for the Environmentally Sound Management of Waste Lead-acid Batteries, http://archive.basel.int/pub/techguid/tech-wasteacid.pdf

3 According to L.I. 1812: MANAGEMENT OF OZONE DEPLETING SUBSTANCES AND PRODUCTS REGULATIONS, 2005

4 Such as EN 50474; EN 50625-2-3, forthcoming

5 More information can be found at GIZ 2017: Guideline on the Manual Dismantling of Refrigerators and Air Conditioners. https://www.giz.de/expertise/downloads/giz2017-en-weee.pdf

(5) The treatment facility shall take necessary steps to optimize re-use of incoming e-waste.

(6) Collection centers (Tier 2), transporters of e-waste (Tier 3), treatment facilities (Tier 4) and final disposers (Tier 5) shall undertake Environmental Assessment as required by LI 1652.

(7) The requirements described in the following guidelines must hold for every e-waste operator, except for tier 1 operators.

2. Guiding Principles for Collectors (Tier 1)

(1) Applicability. The guidelines apply to any person that collects, sorts or consolidates e-waste.

(2) Registration.

a. A collector shall be registered with the relevant MMDAs and, where in an association, with the EPA.

b. A collector shall complete and submit the relevant form.

(3) Prohibited activities. A collector shall not:

a. Engage in any disposal activities outside the collection centers (Tier 2);

b. Engage in any treatment activities of e-waste (such as dismantling);

c. Burn whole or components of e-waste;

d. Deliver whole or components of e-waste to a collection center that is not permitted by EPA;

e. Export whole or components of e-waste; however a collector shall export e-waste in accordance with section 20, subsection 1 and 3 of Act 917, and LI 2250 regulation.

(4) Collection management standards. A collector shall manage all of its collection activities in the following manner:

a. The collection location must have a Ghana Post GPS address.

b. The collection and storage location should be adequately protected against unauthorized entry and theft.

c. All staff shall receive appropriate training provided by EPA, Factories Inspectorate Department, and other competent bodies.

d. The collector shall follow minimum requirements as regards health and safety by the use of appropriate personal protective equipment (PPE).

(5) Materials management standards. A collector shall manage e-waste in a way that prevents releases of gases, liquids or solid particles from any e-waste, or component, to the environment.

The Collector shall:

a. Store e-waste on an impervious surface within a structure or a transportation unit such that it is protected from precipitation. E-waste must be stored in such a way that it is not exposed to direct sunlight and rainfall.

b. Ensure that whole or fractions containing hazardous substances shall be stored in a manner that prevents dispersal of hazardous materials to the environment.

c. Maintain adequate storage space and good housekeeping.

d. Transport, store and handle e-waste in a manner adequate to minimize damage.

e. Not mix e-waste with any other type of waste.

3. Guiding Principles for Collection Centers (Buy Back Centers) (Tier 2)

(1) Applicability. These guidelines apply to collection centers where e-waste is temporarily stored before transported (Tier 3) to treatment facilities (Tier 4) or for final disposal (Tier 5)-according to section 47 of LI 2250.

(2) Registration. A collection center shall be registered with EPA and other relevant body (such as district assemblies) by completing and submitting the required forms in line with LI 1652 and LI 2250. Also the number and Ghana Post GPS location of collection points shall be documented at the registration.

(3) Collection centers shall register and keep records of collectors within their catchment areas.

(4) Prohibited activities. A collection center shall not:

a. Dispose any negative value fractions of e-waste. All unusable fractions shall be sent to a tier 5 facility.

b. Engage in any treatment activities of e-waste (such as dismantling) unless permitted by EPA.

c. Burn/incinerate whole or components of e-waste.

d. Deliver e-waste or components to a facility that is not registered under LI 2250.

e. Export or import e-waste unless done in accordance with section 20, subsection 1 and 3 of Act 917 and LI 2250.

(5) Facility management standards. A registered collection center shall manage all of their facility(ies) in the following manner:

a. The collection and storage location shall be adequately secured and protected against unauthorized entry and theft until transported to the registered tier 4 facility.

b. Infrastructure requirements for collection centers shall meet the minimum requirements as specified by the EPA.

c. All staff shall receive appropriate training provided by EPA, Factories Inspectorate Department and other competent institutions.

d. Manage and operate the facility in accordance with documented Standard Operating Procedures that identifies and minimizes risks of pollution.

e. The facility shall have minimum procedures in place as required by Act 328, Act 490, LI 1652 and LI 2250.

(6) Materials management standards. A registered collection center shall manage e-waste in a way that prevents releases of gases, liquids or solid particles from whole or components of e-waste to the environment.

(7) The facility shall:

a. Erase data from all storage devices at the point of collection;

b. Store e-waste on an impervious surface within a structure or transportation unit such that it is protected from precipitation. E-waste must be stored in such a way that it is not exposed to direct sunlight and rainfall;

c. Store whole or components of e-waste containing hazardous substances in a manner that dispersal of hazardous materials to the environment are prevented.

d. Maintain adequate storage space, ensure access for free movement to all sections of the facility and good housekeeping;

e. Transport, store and handle e-waste in a manner adequate to minimize damage.

f. Containers, pallets, or packages containing e-waste shall be clearly marked appropriately (e.g. “E-WASTE”).

g. E-waste shall not be mixed with any other types of waste.

(8) Recordkeeping. The following shall be recorded:

a. The types of e-waste collected from covered entities (e.g. Cathode Ray Tube Television, Desktop Computer etc.);

b. The quantities of incoming and outgoing e-waste according to Annex C of LI 2250.

(9) Annual audits shall be conducted on the facility by EPA or a third party.

(10) In case treatment activities (e.g. depollution) are allowed by EPA under (4)b, provision should be made to capture the depollution status of the e-waste according to Annex C at the collection center before packaging and transportation.

4. Guiding Principles for Transporters (Tier 3)

(1) Applicability. These guidelines apply to an entity that transports e-waste (in accordance with Regulation 56 of LI2250) from a collection point to a recycler, between collection centers (from a collector to collector), or from a recycler to a recycler (between treatment facilities). Transporters of Tier 1 are exempted from the following requirements; however requirements of Tier 1 apply.

(2) Registration. A transporter shall register with EPA or other relevant bodies (such as district assemblies).

(3) Prohibited activities. A transporter shall not:

a. Dispose of any e-waste; whole or components;

b. Engage in any treatment activities of e-waste (such as dismantling);

c. Burn/incinerate whole or components of e-waste;

d. Deliver e-waste or components to a facility that is not registered under this guideline;

e. Transfer e-waste whole or components in case of malfunctioning of vehicle to unregistered vehicles without notifying EPA.

(4) Transboundary movement: The transporter shall comply with relevant international conventions.

(5) Re-use. The transporter shall ensure that collected e-waste is transported in a way that does not limit the potential for re-use purposes.

Example: In case e-waste seems to be suitable for re-use, they shall not be transported in a manner that they are likely to be damaged.

(6) Transport Capacities.

a. The transporter shall ensure that the transport capacities comply with the road traffic regulation of Ghana.

b. All transporters shall receive appropriate training approved by EPA and FID.

(7) Materials management standards. A registered transporter shall manage e-waste in a way that prevents releases of gases, liquids or solid particles from it or components of e-waste to the environment.

(8) Registered transporters shall:

a. Ensure that all fractions containing hazardous substances are stored in a manner that prevents dispersal of hazardous materials to the environment.

b. Develop Standard Operating Procedures (SOP) for transport and handling of e-waste including remedies for emergencies.

c. Transport e-waste in a transportation unit that that is purposely prescribed.

d. Transport reusable electric and electronic devices in a transportation unit that is purposely prescribed.

e. Alert other road users and notify appropriate authorities for clean-up in case of an accident.

f. E-waste shall not be mixed with any other materials.

(9) Recordkeeping requirements.

a. The transporter shall retain a copy of the way bill at all times.

b. The transporter shall keep records in accordance with LI 2250.

Note: If e-waste is transported, the Ghana Waybill also requires records on the types and quantities of e-waste transported (e.g. Cathode Ray Tube Television, Desktop Computer etc.) in accordance with the template in Annex C.

5. Guiding Principles for Treatment Facilities (Recyclers) (Tier 4)

(1) Applicability. These guidelines apply to treatment facilities (section 57) that dismantle (section 49), recycle (section 50), prepare for re-use or repair/refurbish (section 46) and recover (section 58) electrical and electronic waste (e-waste) operating under LI 2250.

(2) Registration. A treatment facility shall register with EPA by completing the relevant from and with other relevant bodies.

(3) Prohibited activities. A treatment facility shall not:

a. Accept any e-waste it cannot treat.

b. Dispose any e-waste inappropriately. A treatment facility shall initiate a shipment of parts to a facility that is permitted or certified to accept those materials and that is registered under Act 917 or internationally.

(4) Facility management standards.

a. Management Principles

i. The treatment facility shall ensure that a management system is in place for all activities in the fields of health, safety, environment and quality.

ii. The treatment operator shall demonstrate continuous improvement of their activities by a review and management process. This management process shall be updated or revised as changes occur to the activities of the operator and evaluated in order to monitor its effectiveness.

iii. The treatment operator shall establish and maintain a procedure in order to identify legal requirements that are applicable to the environmental, health and safety aspects of all activities, services and processes undertaken at the facility.

Note: Within a conformity assessment audit it could be checked if all relevant laws and further legal requirements are available on-site and that all relevant persons are familiar with them.

iv. The treatment operator shall demonstrate that confidential and personal data stored in the permanent memory of received IT-Equipment is destroyed e.g. by physical destruction of the memory or through secure data.

> Example: To fully ensure that the data will not be accessible anymore, it would be necessary to physically destroy a magnetic hard disc drive by drilling a hole in it.

b. Technical and Infrastructural Pre-Conditions

i. The treatment operator shall possess infrastructure, in terms of size, technologies installed, and characteristics of the operations, that is suitable for the activities performed on site. Suitability of the site shall be assessed by a risk management process for all tasks performed on site and include the identification of hazards, the assessment of risk and, where appropriate, the elimination or reduction of the risk, and documentation of the process.

> Example: The treatment operator must know the relevant health & safety and environmental risks and shall demonstrate appropriate risk mitigation measures. For example, the risk of being injured by falling e-waste components from high piles can be reduced by sufficient storage space, as well as structures (e.g. shelves, walls) to prevent such hazards.

ii. This risk assessment shall include the identification of those locations and activities that require the use of personal protective equipment and procedures to be followed.

iii. Treatment facilities including storage areas shall be designed, organized and maintained to provide safe access to and egress from the site.

iv. Treatment facilities should be adequately protected against unauthorized entry and theft.

v. Weatherproof covering shall be required for the areas where:

- whole equipment and/or components are intended for preparation for re-use are stored and/or prepared for re-use, or;
- e-waste and fractions thereof that can cause emissions that are hazardous to human health and the environment is stored and/or treated. These fractions are further specified in ANNEX B.

- the following components are stored or pre-treated: plastic components, mercury containing components, batteries, printed circuit boards, toner cartridges, asbestos and components which contain asbestos, cathode ray tubes, gas discharge lamps, components containing refractory ceramic fibers and components containing radioactive substances, insulation foam from dismantled refrigerators (see also section I.ii, p. 21).

> Note: Especially gas discharge lamps shall not be exposed to direct sunlight.

vi. The operator shall ensure that the treatment facility where the e-waste is treated shall have the following properties:

- impervious floor,
- appropriate fire precautions.

> Example: Weatherproof cover can be a roof and surrounding walls to prevent e-waste from sunlight and rainfall. Also important is a concrete floor that can be properly cleaned and that is protected against the entry of floodwater in the event of heavy rainfalls.

c. Training

i. All persons at the treatment facility shall be made familiar with the environmental, health and safety policy of the facility.

ii. All training staff shall receive appropriate training provided by EPA, Factories Inspectorate Division, or by an institution approved by EPA.

iii. Additionally, employees shall be made familiar with the environmental, health and safety policy of the facility by in-house trainings.

iv. In-house as well as EPA certified training shall include emergency response planning, occupational health and safety measures, and training for the relevant operations performed on site. The effectiveness and suitability of training shall be checked regularly. Training programs shall be delivered at a level suitable to the trainee in form, manner and language.

v. Where the risk assessment has identified the need for personal protective equipment (PPE) training in the proper use of that PPE shall be provided.

Examples: For e-waste dismantling safety boots, safety glasses and work gloves are essential.

vi. Accordingly, training personal shall have a certificate by EPA or other approved institution.

d. Monitoring

i. The treatment operator shall record the origin of each consignment of e-waste accepted at the treatment facility if e-waste is received from companies or other institutions (B2B collection).

ii. The treatment operator shall record the downstream treatment of e-waste and fractions thereof until end-of-waste status is reached or until the e-waste is prepared for re-use, recycled, recovered, or disposed of.

iii. The treatment operator shall maintain the following records from the output fractions resulting from the treatment process according to the template in Annex C.

iv. Furthermore, the treatment operator shall collect and file the disposal certificates of the e-waste receiving companies that treat the negative value fractions.

e. Storage and Handling

i. E-waste should be stored according to categories and made upright.

ii. Locations that store e-waste prior to treatment shall have:

- Effective and efficient impermeable surfaces to prevent ground water and soil contamination;
- The provision of spillage collection facilities relevant to the type of e-waste stored
- Where appropriate, decanters and cleanser-degreasers, and weatherproof covering for appropriate areas, so there are no emissions which give rise to an adverse environmental impact.

- Where containers are used for storage of equipment and fractions, and these have led to pollutant dispersion, the affected containers shall be cleaned and decontaminated prior to their re-use, recycling or disposal.

iii. The treatment operator shall possess infrastructure, in terms of size, technologies installed, and characteristics of the operations, that is suitable for the activities performed on site. This holds particularly with regards to:

- Overall sheltered storage space of the facility,
- Appropriate working space for workers for dismantling,
- Appropriate possibilities to sort and store fractions.
- Appropriate changing rooms fitted with lockers.
- Suitable sanitary facilities and washrooms.
- Technical Requirements

iv. General. E-waste shall be handled and stored with due care in order to avoid release of hazardous substances into air, water, or soil, as a result of damage and/or leakage.

Example: Gas discharge lamps shall be handled with due care to prevent breakage resulting in the emission of mercury.

v. During handling and storage attention shall be given but not limited to:

- Temperature exchange equipment (to avoid damage to the temperature exchange system), as well as unnecessary damage to the insulation material of such equipment)

Example: The compressor and cooling circuit of a refrigerator or air conditioner is a temperature exchange system that shall not be destroyed in an uncontrolled manner. Fridge foams should be stored appropriately to avoid inflammation.

- CRT equipment (to avoid implosion and/or emissions of fluorescent coatings);
- Gas discharge lamps, appliances containing gas discharge lamps;

- Appliances containing mercury switches (to avoid breakage resulting in the release of mercury);
- Smoke detectors (as they may contain radioactive components);
- Appliances containing oil and other fluids within an internal circuit, or capacitors containing mineral or synthetic oil (to avoid spillages and other emissions);
- Appliances containing asbestos or ceramic fibers (to avoid release of asbestos or ceramic fibers); and
- Photovoltaic panels (to prevent injury from broken glass and electrocution caused through contact with hazardous voltages generated when the panels are exposed to light).
- Lead-acid batteries or devices containing lead-acid batteries (to prevent emissions of acid and lead particles)
- Lithium-Ion batteries (to prevent that overheating and ignition can cause the outbreak of fires)

f. Receiving of e-waste at treatment facility

   i. The treatment operator shall weigh and record each delivery that is received at the facility;

   ii. Incoming and outgoing e-waste volumes shall be classified and recorded according to Annex C.

g. Handling of e-waste

   i. All handling of e-waste, including the loading, unloading and transport, shall be carried out using appropriate tools, containers and fixings to avoid damage where there is the potential for preparation for re-use or the risk of hazardous substances being emitted.

   ii. Uncontrolled tipping of containers with CRT equipment, flat panel display equipment, temperature exchange equipment, and gas discharge lamps and equipment containing gas discharge lamps shall not be permitted.

Example: If the cooling circuit of a refrigerator is destroyed by uncontrolled tipping, refrigerants can leak in an uncontrolled manner. This shall be avoided.

iii. E-waste shall not be handled in a way that subsequent preparation for re-use, depollution or recovery is adversely affected.

> Example: If a Flat-Panel TV could be suitable for re-use it is important not to damage the screen, cables or plugs.

iv. CRT equipment, flat panel display equipment, temperature exchange equipment, and gas discharge lamps shall be placed in containers or stacked in a stable manner to prevent damage or breakage.

v. The treatment process to separate material streams shall be documented. Removed substances, mixtures and components (and fractions containing those substances, mixtures and components) shall be kept separate and shall be clearly and identifiable labelled (as stated in Act 917, section 13, subsection 3(a)).

h. Storage of e-waste prior to treatment

i. The maximum volume of e-waste stored by the treatment facility shall not exceed the storage capacity of the storage facility at the plant. E-waste shall not be stored at the vagaries of the weather.

ii. Where the storage capacity at the treatment is exceeded, an alternative suitable warehouse shall be acquired for storage.

iii. Additional temporary storage can be granted for e-waste fractions that cannot be managed in an environmentally sound manner in Ghana and which require large-volume shipments to environmentally sound facilities in other countries. Such exemptions can only be granted by EPA and require a written application, including the corresponding justification.

i. Depollution

i. The treatment operator shall have procedures to identify e-waste which are known to contain substances, mixtures and/or components listed in Annex B.

ii. The treatment processes identified in the above procedures shall result in the removal of substances, mixtures and components, as listed in Annex B, from e-waste in accordance with Annex A.

> Example: Incoming e-waste is thoroughly screened for substances, mixtures and/or components listed in Annex B. Accordingly, the identified devices shall be sorted out and treated in a separate waste stream.
> This includes CRT-TVs, gas discharge lamps and batteries (see Annex B).

iii. Depollution shall not damage or destroy components in a way that hazardous substances are released to the environment or distributed to fractions, unless subsequent treatment to remove or render harmless the hazardous substances is carried out. Where release to the environment is possible the fraction containing the hazardous substances shall be contained and/or sealed prior to treatment. The subsequent treatment mentioned above may be performed at the treatment operator's location or another location. Where the subsequent treatment is not performed at the treatment operator's location, the e-waste thus transferred shall be accompanied by information on depollution already undertaken.

Example: Gas discharge lamps commonly contain mercury and need to be de-gassed appropriately. They shall not be damaged so that mercury is emitted to the environment.

iv. If it is uncertain whether e-waste contains substances, mixtures or components as listed in Annex B, it shall be treated as though it does contain those substances, mixtures or components.

j. Depollution monitoring

i. Monitoring of depollution performance is an important criterion to facilitate continuous improvement of the treatment process.

ii. Where appropriate (see ANNEX B) treatment operators shall carry out monitoring of depollution performance in accordance with the mass-balance methodology that establishes a mass balance between incoming and outgoing streams.

iii. Provision should be made to capture the depollution status of the e-waste according to Annex C at the collection center before packaging and transportation (pelleting, shrink wrapping and labelling).

k. Treatment of non-depolluted e-waste and fractions

i. Except as specified below, e-waste and fractions containing hazardous substances, hazardous mixtures, or hazardous components shall be treated separately from other waste. It is permitted to treat e-waste and fractions containing hazardous substances, hazardous mixtures, or hazardous components with other hazardous waste if:

- the mixing operation is carried out by a treatment operator which has obtained a permit from the relevant authorities for this activity; and

- the mixing operation does not adversely affect human health, safety, or the environment as determined by review of the relevant risk assessment; and
- the mixing process does not create an additional hazardous waste stream.

ii. If non depolluted e-waste and fractions are treated by a downstream treatment operator, this treatment operator shall be informed in accompanying documents of the potential presence of hazardous material.

iii. The downstream treatment operator shall be informed of the need for the non-depolluted e-waste or fractions to be depolluted in compliance with the objectives of this standard regardless of the hazardous or non-hazardous nature.

l. Storage of fractions

i. All fractions containing hazardous substances shall be stored in a manner that prevents dispersal of hazardous materials to the environment.

ii. Weatherproof covering shall be provided for storage locations for all e-waste fractions (especially hazardous fractions according to Act 917).

iii. Containers used for the storage of fractions containing hazardous substances shall be cleaned and decontaminated prior to their re-use, recycling or disposal.

(5) Releases. The treatment facility shall put in place and operationalize an Emergency Response Plan in accordance with Act 328 and Act 490.

(6) Decommissioning plan. A treatment facility shall develop a written decommissioning plan for the proper closure of the facility. A decommissioning plan shall be based upon the following requirements:

a. A description of a decommissioning plan the facility shall be provided ;

b. An estimate of the maximum inventory of e-waste ever on-site over the active life of the facility and a detailed description of the methods to be used during closure, including, but not limited to methods for removing, transporting, treating, storing or disposing of e-waste and

c. A detailed description of the steps needed to remove or decontaminate all harmful residues and contaminated containment system components, equipment, structures, and soils during closure including, but not limited to, procedures for cleaning equipment and removing contaminated soils, methods for sampling and testing surrounding soils, and criteria for determining the extent of decontamination.

d. The decommissioning plan shall comply with the requirements of the LI 1652.

(7) Recordkeeping and reporting requirements. The following shall be reported to EPA annually:

a. The types of e-waste managed;

b. The quantities of incoming and outgoing e-waste according to Annex C of this regulation.

6. Guiding Principles for Final Disposal of certain hazardous fractions (Tier 5)

(1) Applicability. The following requirements apply to disposal at landfills, incineration and other technologies approved by EPA.

(2) Registration. Owners and operators of disposal sites shall be licensed by Ghana EPA and the MMDA (Local Authorities).

(3) Prohibitions.

a. E-waste shall not be landfilled with other waste;

b. Burying and open burning is strictly prohibited as contaminants may easily leach into the soil and pollute both soil and groundwater resources and lead to considerable air pollution.

c. The disposal is strictly out of bound to all unauthorized persons especially for children.

(4) Facility management.

a. Owners and operators should be trained by competent institutions in collaboration with EPA with regards to technical knowledge and understanding of the hazardous nature of e-waste.

b. The disposal site shall be managed in accordance with the guideline for Landfill Management and other relevant laws.

c. Disposal should be done in specialized cells or sections in a licensed landfill site.

d. Incineration facilities shall be registered and permit obtained in accordance with LI 1652.

e. Annual audits of the facility shall be conducted by EPA or any independent auditor.

f. The disposer shall issue a certificate to the owner of the waste.

g. The facility shall put in place appropriate pollution control measures/systems.

(5) Record keeping. Disposers shall keep a record of the amounts and categories of e-waste according to Annex C, which EPA may access upon request or during inspection of e-waste handling facilities.

A.1. ANNEX A: DEPOLLUTION

Introduction

This annex refers to Chapter 5 i, i, **depollution** (p. 19), and gives additional information about substances, mixtures, and components to be removed from e-waste according to Annex B (Materials and components of e-waste requiring selective treatment).

Substances, mixtures and components shall be removed such that they are contained as an identifiable stream or identifiable part of a stream by the end of the treatment process. A substance, mixture or component is identifiable if it can be monitored to prove environmentally safe treatment. As a consequence of this interpretation of the phrase “have to be removed” two different categories are distinguished in this annex:

(1) The following shall be removed as a distinct step during the treatment process and prior to size reduction and separation unless the treatment technology captures the materials and components identified in Annex B in an identifiable stream such that it is not released to the environment:

1. capacitors containing polychlorinated biphenyls (PCB),
2. cathode ray tubes, gas discharge lamps,
3. volatile fluorocarbons and
4. volatile hydrocarbons contained in a refrigeration system,
5. batteries which are accessible in the equipment without using tools,
6. toner cartridges;
7. and components containing asbestos, mercury, refractory ceramic fibers, and radioactive substances (see Annex B).

(2) The following shall be removed as an identifiable (part of a) stream during the treatment process:

a. batteries which are not accessible in the equipment without using tools,
b. printed circuit boards,
c. plastics containing brominated flame retardants,
d. volatile fluorocarbons and volatile hydrocarbons other than those contained in a refrigeration system,
e. liquid crystal displays, external electric cables and electrolyte capacitors (> 25 mm or proportionately similar volume) containing substances of concern.

A.1.1. Capacitors

The following capacitors shall be removed from separately collected e-waste:

a. polychlorinated biphenyls (PCB) containing capacitors;

b. electrolytic capacitors containing substances of concern (height > 25 mm, diameter > 25 mm or proportionately similar volume).

If the treatment operator is not capable of identifying the capacitors described above then they shall remove and consider all such capacitors as though they contained PCBs and/or are electrolytic capacitors containing substances of concern.

NOTE: As it can be difficult to tell whether capacitors contain PCBs it is suggested to screen all capacitors with a diameter > 25mm as below. Capacitors meeting one of the criteria below do not need to undergo separate treatment as they are presumed to be free of PCBs:

(1) if it is evident that the capacitor was manufactured after 1986 or they come from appliances produced after 1987;

(2) if they are declared and/or labelled as being free of PCBs.

Capacitors do not need to be removed from e-waste if there is evidence to show that the presence of PCBs or substances of concern contained in electrolytic capacitors can be discounted where certain identifiable conditions apply. The evidence is only considered acceptable if it is contained in a report that utilizes statistically and scientifically accepted methods and has been issued by an independent body accepted by the relevant national competent authority.

A.1.2. Printed circuit boards

Printed circuit boards with an area greater than 10 cm^2 shall be removed from separately collected e-waste.

Consideration should be given to potential hazards from printed circuit boards.

NOTE 1: During mechanical processing of printed circuit boards there can be a risk of diffuse emission to the environment and contamination of workplaces with dust and heavy metals. In addition, mechanical processing (e.g. shredding) of printed circuit boards often leads to losses of valuable materials. Therefore, it is recommended to reduce mechanical processing as far as possible.

NOTE 2: Printed circuit boards can contain lead, tin, antimony, chromium, beryllium oxide and cadmium. Plastic parts mounted on the printed circuit board can contain restricted brominated flame retardants.

NOTE 3: Printed circuit boards occur in a wide range of electronic appliances and also in the electronic parts of large and small household appliances, tools, toys, sport equipment, and medical devices.

A.1.3. Gas discharge lamps and components containing mercury

Gas discharge lamps and components containing mercury shall be removed before any treatment process that can cause damage to the item, or shall be treated in such a way that the mercury can be removed and monitored to prove environmentally safe treatment.

NOTE 1: Mercury tilt switches or vapor pressure switches can be found in boilers, washing machines, chest freezers, irons, coffee machines and old telephone installations. Mercury containing relay switches were used in old high quality electronic and sophisticated monitoring equipment.

NOTE 2: Straight fluorescent lamps, compact fluorescent lamps, fluorescent lamps, high intensity discharge lamps - including pressure sodium lamps and metal halide lamps, and low pressure sodium lamps contain mercury.

A.1.4. Batteries and accumulators

Batteries shall be removed from e-waste before any treatment process that can cause damage to them.

Special precautions and safety measures shall be in place for the treatment of e-waste, which may contain lithium batteries and for operations involving used lithium batteries, and for fractions containing lithium batteries.

Lithium batteries shall be protected to prevent exposure to excessive heat, water, or any crushing or physical damage during handling, sorting, and storage.

A.1.5. Plastics

(1) Plastics fractions without brominated flame retardants (BFRs)

Plastic fractions extracted from waste streams consisting of temperature exchange equipment which contains volatile fluorocarbons or volatile hydrocarbons (e.g. refrigerators and freezers) and large household appliances shall be deemed free of BFRs and may be recycled.

(2) Plastic streams containing brominated flame retardants

a. General

Plastic fractions from other appliances than those detailed in this Annex A, section 6 (1) shall be deemed to contain brominated flame retardants except if there is evidence to the contrary i.e. if it is contained in a report that utilizes statistically and scientifically accepted methods and has been issued by an independent body.

The evidence of absence of restricted BFRs shall also be considered acceptable if it is contained in a report that utilizes statistically and scientifically accepted methods and has been issued by an independent body.

b. Treatment requirements for plastics containing brominated flame retardants

Plastic fractions containing any BFRs shall be segregated from plastic fractions that do not contain BFRs and the resulting fractions shall be treated according to the appropriate legislation. Any plastic fraction that is not separated as above shall be considered as a BFR fraction and shall be managed accordingly.

A.1.6. Volatile fluorocarbons and volatile hydrocarbons

E-waste containing either volatile fluorocarbons or volatile hydrocarbons shall be sorted to a separate e-waste stream and treated.

The substance in the refrigeration system is identified on the compressor. Substances shall be recovered using specialist equipment that can also guarantee the extraction of the gas from oil. Recovered substances shall be stored according to type until they are handed over to EPA for final destruction/export for final destruction. Special pre-cautions and training shall be in place regarding flammable substances.

Note 1: If the refrigeration circuit has been tampered with, the refrigerant might be different than indicated and could be flammable.

Note 2: Volatile fluorocarbons or volatile hydrocarbons are also contained in the circulation system of heat pump tumble driers.

Volatile fluorocarbons or volatile hydrocarbons can also be found in insulating foam of refrigerators and freezers or water boilers. During manual dismantling, foam shall be dismantled carefully and stored in the dry, preferably in bags. It has to be treated in a specialist treatment plant where the substances can be recovered.

A.1.7. Asbestos

Waste and components that contain asbestos shall be removed as an identifiable stream from the remaining e-waste stream. This shall occur before any treatment process that can cause damage to such waste and components.

Handling shall avoid any emissions of asbestos fibers. Waste and components that contains asbestos shall be sealed with an impermeable covering and clearly marked with the related asbestos danger label.

NOTE: Asbestos is not commonly found in e-waste and is mostly present in a limited number of quite old appliances such as old radiators.

A.1.8. Components containing radioactive substances

Treatment facilities shall have a procedure in place to monitor for the presence of radioactive materials in waste and components.

Waste and components that contain radioactive substances (see Annex B) shall be removed as an identifiable stream from the remaining e-waste stream. This shall occur before any treatment process that can cause damage to such waste and components.

NOTE: Radioactive substances are not commonly found in e-waste. Exemptions: Some smoke detectors and medical equipment (x-ray machines).

A.2. ANNEX B: MATERIALS AND COMPONENTS OF E-WASTE REQUIRING SELECTIVE TREATMENT

A.2.1. Removal and collection

As a minimum the following substances, mixtures and components have to be removed from any separately collected e-waste:

- polychlorinated biphenyls (PCB) containing capacitors
- mercury containing components, such as switches or backlighting lamps,
- batteries,
- printed circuit boards of mobile phones generally, and of other devices if the surface of the printed circuit board is greater than 10 square centimeters,
- toner cartridges, liquid and pasty, as well as color toner,
- plastic containing brominated flame retardants,
- asbestos waste and components which contain asbestos,
- cathode ray tubes,
- chlorofluorocarbons (CFC), hydrochlorofluorocarbons (HCFC) or hydrofluorocarbons (HFC), hydrocarbons (HC),
- gas discharge lamps,
- liquid crystal displays (together with their casing where appropriate) of a surface greater than 100 square centimeters and all those back-lighted with gas discharge lamps,
- external electric cables,
- components containing refractory ceramic fibers,
- components containing radioactive substances,
- electrolyte capacitors containing substances of concern (height > 25 mm, diameter > 25 mm or proportionately similar volume)

A.2.2. Treatment

The following components of e-waste that is separately collected have to be treated as indicated:

- cathode ray tubes: the fluorescent coating has to be removed,
- equipment containing gases (CFCs, HCFCs, HFCs or HCs or volatile fluorocarbons/hydrocarbons) that are ozone-depleting or have a global warming potential (GWP) above 15, such as those contained in foams and refrigeration circuits: the gases must be properly extracted and properly treated,
- gas discharge lamps: the mercury shall be removed,
- lead-acid batteries: Acid shall be removed and captured. The acid has to be filtered to remove lead particles, and either neutralized or converted into a non-hazardous commodity such as gypsum.

A.2.3. Re-use and recycling of components

Taking into account environmental considerations and the desirability of preparation for re-use and recycling, points 1 and 2 shall be applied in such a way that environmentally sound preparation for re-use and recycling of components or whole appliances is not hindered.

A.3. ANNEX C: RECORD OF INPUTS AND OUTPUTS FOR COLLECTION POINTS PER MONTH

The Type of Equipment shall be recorded according to the following categories:

1. Temperature exchange equipment

Refrigerators, Freezers, Equipment which automatically delivers cold products, Air conditioning equipment, Dehumidifying equipment, Heat pumps, Radiators containing oil and other temperature exchange equipment using fluids other than water for the temperature exchange.

2. Screens, monitors, and equipment containing screens having a surface greater than 100 cm2

Screens, Televisions, LCD photo frames, Monitors, Laptops, Notebooks.

3. Lamps

Straight fluorescent lamps, Compact fluorescent lamps, Fluorescent lamps, High inten sity discharge lamps – including pressure sodium lamps and metal halide lamps, low pressure sodium lamps, LED.

4. Large equipment

Washing machines, Clothes dryers, Dish washing machines, Cookers, Electric stoves, Electric hot plates, Luminaires, Equipment reproducing sound or images, Musical equipment (excluding pipe organs installed in churches), Appliances for knitting and weaving, Large computer-mainframes, Large printing machines, Copying equipment, Large coin slot machines, Large medical devices, Large monitoring and control instruments, Large appliances which automatically deliver products and money, Photovoltaic panels.

5. Small equipment

Vacuum cleaners, Carpet sweepers, Appliances for sewing, Luminaires, Microwaves, Ventilation equipment, Irons, Toasters, Electric knives, Electric kettles, Clocks and Watches, Electric shavers, Scales, Appliances for hair and body care, Calculators, Radio sets, Video cameras, Video recorders, Hi-fi equipment, Musical instruments, Equipment reproducing sound or images, Electrical and electronic toys, Sports equipment, Computers for biking, diving, running, rowing, etc., Smoke detectors, Heating regulators, Thermostats, Small Electrical and electronic tools, Small medical devices, Small Monitoring and control instruments, Small Appliances which automatically deliver products, Small equipment with integrated photovoltaic panels.

6. Small IT and telecommunication equipment (no external dimension more than 50 cm)

Mobile phones, GPS, Pocket calculators, Routers, Personal computers, Printers, Telephones.

Incoming E-Waste per Category			
E-Waste Category	**Mass in [kg] / month**	**Origin**	**Date**
…	…	…	…
Outgoing E-Waste per Category			
E-Waste Category	**Mass in [kg] / month**	**Destination**	**Date**
…	…	…	…

Record of Inputs and Output of Hazardous Fractions of the Treatment Facility per year

The Type of Equipment shall be recorded according to the following categories:

1. CRT-tubes
2. Batteries (Mixed Batteries, Lead-Acid Batteries, Lithium-Ion Batteries)
3. Capacitors
4. Printer Cartridges
5. LCD-Displays
6. Hg-Containing Lamps
7. Flame-Retardant Plastics
8. Volatile Fluorocarbons

Input Fractions			
Hazardous Fraction	**Mass in [t]/year**	**Origin**	**Date**
…	…	…	…
Output Fractions			
Hazardous Fraction	**Mass in [t]/year**	**Destination**	**Date**
…	…	…	…

A.4. ANNEX D: DEFINITIONS[6]

"Agency" means the Environmental Protection Agency established under the Environmental Protection Agency Act, 1994 (Act 490);

"analysis" means the extraction, purification, separation, identification, quantification, and reporting of polychlorinated biphenyls concentrations in the matrix of interest;

"approved site or facility" means a site or facility authorized or permitted by the Agency for the disposal of hazardous wastes or other wastes;

"after-care of disposal site" means the after-care of a site which is still in operation as well as of a site which is no longer in operation;

"area" means any land, marine area or air space within which the Republic exercises administrative and regulatory responsibility, as regards the protection of human health or the environment;

"Basel Convention" means the Basal Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal adopted on March 22, 1989 and entered into force on 1992;

"carrier" means a person who transports hazardous wastes and other wastes by means of conveyance such as trucks, taxi auto, bus, airplane, train, or ship;

"child" refers to the Act of the Parliament of the Republic of Ghana entitled "The Children's Act, 1998" (Section 1) and describes a person below the age of eighteen years.

"collection" includes the environmentally sound mixing, bulking and sorting of wastes and interim storage at an approved site or facility for hazardous wastes and other wastes as well as waste generated in small quantities within the Republic;

"collection center", also called "Buy Back Centre", refers to any facility where e-waste is handed over by collectors and that temporarily stores e-waste before it is transported to treatment facilities or for final disposal;

[6] In accordance to the Ghana E-Waste Act 917.

"commercial building" means an enclosed structure that is used for the selling of goods and the provision of services and is open to the public and includes, but is not limited to malls, restaurants, schools, hotels, offices, including government buildings and the like;

"Court" means a Court of competent jurisdiction;

"disposer" means a person to whom hazardous wastes or other wastes are shipped and who carries out the disposal of the wastes;

"distributor" means any person who is a wholesaler or retailer of electronic goods with an annual turnover of ten thousand Ghana Cedis; "electrical and electronic waste (e-waste)" means discarded electronic equipment inclusive of all components, subassemblies and consumables which are part of the product at the time of discarding;

"energy recovery" means the use of combustible waste as a means of generating energy through direct incineration with or without other waste but with recovery of the heat;

"environmentally sound disposal" means disposal in a manner which will project human health and the environment against the adverse effects of the hazardous wastes and other wastes;

"environmentally sound management" means taking practicable steps to ensure that hazardous wastes or other wastes are managed in a manner which will protect human health and the environment against the adverse effects which may result from the wastes;

"environmentally sound manner" means in a manner which will protect human health and the environment against the adverse effects which may result from hazardous wastes and other wastes;

"equipment" means electrical and electronic equipment that is dependent on electric currents or electromagnetic fields in order to work properly, including components that can be removed from equipment and can be tested for functionality and either be subsequently directly reused or reused after repair or refurbishment;

"exporter" means a person under the jurisdiction of the State of export who arranges for hazardous wastes or other wastes to be exported;

"facility" means a site, building, structure, installation equipment, pipe or pipeline, well, pit, pond, lagoon, ditch, landfill, storage container, motor, vehicle, rolling stock or aircraft in which an act prohibited by this Act occurs but does not include a vessel;

"generator" means a person whose activity produces hazardous wastes or other wastes or a person who is in possession or control of those wastes;

"hazardous wastes" means wastes that belong to any category contained in the schedule (categories of wastes to be controlled), unless they do not possess any of the characteristics contained in the schedule (list of hazardous characteristics) and wastes that do not belong to any category contained in the schedule (categories of wastes to be controlled) but are defined as, or considered to be, hazardous wastes by the domestic legislation of the party of export, import or transit under the Basel Convention and material regarded as a hazardous waste in one country may not in another country be regarded as hazardous;

"industrial facility" means a facility including factories, power generation or distribution stations or sub-stations, assembly plants, feed mills and other buildings and structures used in general industrial assembly;

"illegal traffic" means any unauthorized transboundary movement of hazardous wastes or other wastes;

"import" means any entry into the national territory other than entry for transit;

"importer" means a person who, in the ordinary course of business imports electronic equipment into the Republic or arranges for hazardous waste or other wastes to be imported into the Republic;

"law enforcement officer" includes a nominated Customs Officer, a member of the Ghana Armed Forces, a designated officer or an inspector of the Environmental Protection Agency, the Port Health Authority, the Ghana Atomic Energy Commission and personnel of other institutions authorized in writing by the Minister who shall have the same powers, authority and privileges of a police officer;

"management" means the collection, transport and disposal of hazardous wastes and other wastes and the after-care of disposal sites;

"manufacturer" means any person who assembles or produces an electronic equipment in the Republic;

"Minister" means the Minister responsible for the Environment;

"other wastes" means wastes collected from households or residues arising from the incineration of household wastes and classified under the first schedule as categories of wastes requiring special consideration or waste that possess any of the characteristics contained in the list of hazardous characteristics specified in the first schedule;

"person" for purposes of liability includes (a) an owner or operator of a vessel or facility used to perform acts identified in this Act as prohibited acts; (b) persons who by contract, agreement or other means indulges in acts identified in this Act as prohibited acts;

"polluter-pays principle" means the principle by which the polluter bears the cost of measures to reduce pollution according to the extent of either the damage done to society or the exceeding of an acceptance level or standard of pollution;

"polychlorinated biphenyls" means discarded materials that contain polychlorinated biphenyls or have been contaminated with polychlorinated biphenyls, that are without any safe commercial, industrial, agricultural or economic usage;

"polychlorinated biphenyls equipment" means any equipment that contains 50ppm polychlorinated biphenyls; "polychlorinated biphenyls waste" means contaminated solvent or water, used oil and waste oil, sludges and slurries, dredged spoils, contaminated soils or sediments, by products, scraps, ballasts and capacitors, other materials contaminated with polychlorinated biphenyls as a result of spills, decommissioning and other demolition activities;

"collector" refers to any person that collects, sorts or consolidates e-waste (as stated in Tier 1 of these guidelines);

"used equipment" means electrical and electronic equipment that is directly reused for the purpose for which it was originally intended or presented for sale, or transported across borders for the purpose of being put back to direct reuse or sold to end consumers for such reuse and is considered waste if:

a. the equipment is destined for disposal or recycling instead of being transported with the intent of reuse or its fate is uncertain;

b. the equipment is not complete - essential parts are missing and the equipment cannot perform its essential key functions;

c. it shows a defect that materially affects its functionality and fails relevant functionality tests;

d. it shows physical damage that impairs its functionality or safety, as defined in relevant standards, and cannot be repaired at reasonable cost;

e. the protection against damage during transport, loading and unloading operations is inappropriate, for example the packaging or stacking of the load is insufficient;

f. the appearance is particularly worn or damaged, thus reducing the marketability of the item;

g. the item has among its constituent parts hazardous components that are required to be disposed of or are prohibited to be exported or prohibited for use;

h. the equipment is destined for disposal or recycling instead of reuse or its fate is uncertain;

i. there is no regular market for the equipment;

j. it is destined for disassembly to gain spare parts; or

k. the price paid for the items is significantly lower that is a value approaching $0 than would be expected from a fully functional equipment intended for reuse;

“vessel” means a watercraft or other artificial contrivance which is used or is capable of being used as a means of transportation on water;

“wastes” means substances or objects, which are disposed of or are intended to be disposed of or are required to be disposed of; and

“waste electrical and electronic equipment (e-waste)” means electrical or electronic equipment that is waste, including all components, sub-assemblies and consumables which are part of the equipment at the time the equipment becomes waste.

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