The information provided in this section comprises the Operations Plan for primary recycling activities throughout AERC Recycling Solutions facilities nationwide.

## D.5.1 Fluorescent and Mercury Lamp Processing and Recovery

This section describes how fluorescent and other mercury containing lighting devices are disassembled, treated and separated in the AERC systems. These systems include an integrated set of components, the technology, and a set of process control and operating procedures, the process, which, together, are considered the lamp recycling and recovery system. For purposes of this discussion, the machinery, equipment, vacuum system, crushers, separators, etc. can all be considered containers, in that the components of the lamps remain inside them as they are being processed.

We have included process descriptions, and have excerpted non-confidential portions of more comprehensive technical documents developed by the company or provided by equipment manufacturers on the installation, operation and maintenance of some of the recycling systems, along with confidential process schematic drawings of equipment components. AERC maintains the detailed confidential documents at its facility and will make this information available to state officials upon request.

This section also includes summary information on HID Recovery Systems currently being used by AERC. This equipment integrates into the existing Vacuum and Air Handling, Vapor Control, Materials Control and other processing systems. The procedures, methods, monitoring and testing requirements in any of the systems are essentially the same as those used for standard fluorescent lamps.

An integral part of all systems operations are process control and monitoring plans and procedures, along with a discussion of the use of personal protective equipment, standard health and safety practices, air monitoring, medical surveillance, hazardous communications, employee training requirements, as well as the company's monitoring and record keeping requirements, which are part of an extensive QA/QC Program. These are summarized in the Training Plan (Item D.7 | Attachment 9) and the Quality Control Plan (Item D.8 | Attachment 10).

### D.5.1a Fluorescent Lamp Recovery Process and Operations Descriptions

This operation involves processing and physical separation of fluorescent lamps containing mercury. The lamps are separated into the co-product streams of lamps end-caps, clean glass, and phosphor powder. The sources of these spent fluorescent lamps include households, schools, commercial and industrial sites, and the manufacturers of these lighting components.

Fluorescent lamps are transported to the facility in accordance with local, state and federal regulations. The containers are then off-loaded from the vehicles and staged prior to processing.

After temporary storage, the lamps are processed in the equipment and physically separated into the components mentioned above. The recovery equipment components are designed for lamp crushing, co-product segregation, and include air filtration systems. The resulting materials generated from this activity (end caps, glass, and phosphor powder) are transported off site for further processing, recycling, or reuse.

## D.5.1b Operations Procedures for Loading/Unloading, Handling and Storage of Mercury Lamps at AERC.

*Loading/Unloading Procedures:*

Lamps are delivered to the plant in small trucks, bobtails, 27' and 48' semi trailers. Plant workers unload the boxes or other lamp containers onto pallets. Work gloves and eye protection must be worn, as there may be pieces of glass from breakage in shipment. Depending on how customers pack lamps and how the trucks are loaded there may be as much as 5% breakage in a load. If breakage exceeds this amount the customer and/or transporter will be notified so steps can be taken to minimize breakage. Most of the time, the breakage is contained within the lamp boxes and can be taken directly into the process. Culls (broken pieces of lamps still large enough for processing) are separated from the rest and brought to the processing area as soon as possible.

During the loading/unloading, most breakage or spillage of lamps is contained on the truck deck, the loading dock, or floor. Any breakage that may fall to the ground is cleaned in accordance with the procedures established, including use of brooms, mops, buckets, dustpans, vacuum systems, etc. If breakage is excessive, the work area is monitored and cleanup continues with appropriate respirators and personal protective equipment.

*Broken Lamp Clean-up Procedure:*

Within 5-minutes from the time when lamps are discovered broken, clean-up shall be undertaken by plant operators as follows:

The operator shall collect any breakage, using a broom or dust mop and dustpan, or vacuum system, removing large pieces carefully. Large pieces of lamps should be collected and processed as soon as possible. Very small size breakage and powder residues are swept or vacuumed with the HEPA/Carbon filtered system in the plant. The area vacuumed includes

approximately 25 square feet around the area where the breakage occurred. This will vary with the type and location of the breakage.

*Handling and Storage Procedures:*

Once the culls are handled, the remainder of the lamps are secured in boxes, bins and pallets and staged inside the plant prior to processing. There are occasions when AERC cannot off load all materials by the receiving department due to time constraints during an operating shift or because of inventory staging activities. Lamps will stay on the box truck or enclosed trailer within which the material arrived in – either that they were picked up in or when a customer has delivered the trailer to be off loaded by AERC at a later date,. The box trucks and trailers are secured, enclosed vehicles with doors locked and free of damage. Materials are unloaded into the facility as soon as operating schedule allows - which is typically within a few days. At no time are lamps stored outside in the open elements or left unsecured.

Once inside the building, the lamps are placed on the floor with the existing inventory. Depending on how customers will palletize their lamps some pallets could be taller than 4 feet high. In agreement with the permit, and to make the most of space, AERC will double stack such pallets, thus there will be on occasion that some double stacked pallets could range from 6 feet to 10 feet high but will not exceed 12 feet in overall height. From this staging location the lamps are moved by hand, pallet jack and forklift directly to the process area. Sometimes they are removed from the boxes and placed into satellite accumulation lamp racks for subsequent processing.

Cardboard boxes which have been emptied of lamps are visually checked for remnants of broken pieces and powder. Remaining contamination is vacuumed as necessary in agreement with established broken lamp clean-up procedures. When appropriate, containers holding larger volumes of glass pieces and/or powder, i.e., evidence beyond “incidental breakage”, are thoroughly cleaned and examined using established air monitoring procedures (Ref: A*ttachment 9, Exhibit D.7.4*). On such occasions, the air within the empty container is tested using a Jerome meter. Any boxes that still appear to be visually contaminated after emptying would be segregated for management as solid, and possibly, hazardous waste. Empty, clean boxes are placed in a compactor, bailed and sold as recyclable cardboard.

For fire safety and health reasons, there is a no smoking policy in the building. The plant is equipped with a sprinkler system. No open flames are allowed, except in a controlled manner, such as for maintenance.

### D.5.1.c Crush and Separation

The process flows are summarized here:

Whole lamps enter the recycling process and end-caps are separated from the glass and collected from the system, sampled, analyzed for mercury content, and shipped to an off-site metals recycling facility for their aluminum, brass and tungsten content.

The glass is further processed to remove the residual phosphor powder coating. The processed glass is placed into a collection container and is sampled, analyzed for mercury content, and subsequently sent off-site for disposal/recycling.

The powder containing mercury and non-condensed mercury vapors are conveyed and filtered inside the system, separated in the LSS1 lamp recycling equipment, and accumulated in containers for further retort processing offsite.

The excess air from the LSS1 lamp equipment is cleaned of all remaining dust in the baghouse air filter system. Dust-free air then passes through the carbon filtration system prior to discharge.

*Equipment*

In order to reduce the hazards of land-filling fluorescent lamps, AERC uses a lamp recycling process which consists of eleven separate but integral components:

(a) The Feed Conveyors
(b) Breaking Bar
(c) Primary Crushing Drums
(d) Elevating Conveyor
(e) Primary Trommel
(f) Vibrating Screen Conveyor
(g) Secondary Trommel
(h) Magnetic Conveyor
(i) Vapor Collection System
(j) Vacuum System
(k) Process Control System

Each component has a special purpose which is discussed in detail in a confidential technical operations manual kept at the facility. This document can be made available to FDEP staff upon request. The Model LSS1 Lamp Recycling System operating manual is presented in **Exhibit D.5.1.**

## D.5.2 High Intensity Discharge (HID) Lamps

As discussed in the introduction to this section, the HID lamp recycling technology depicted here is being operated at the companies facilities throughout the U.S. The West Melbourne

facility will use the same methods, procedures, QA/QC measures, testing and monitoring as used throughout the company. Currently, HIDs are processed as follows:

## D.5.2.a HID Lamp Process Description and Operating Procedures

HID lamps are processed one-at-a-time to remove the inner capsule containing mercury and separate the non-hazardous metals and glass. During this process an air current is passed over the process area to remove and filter potential mercury emissions.

*Air Filtration System*

An air cleaning/filtration unit is fitted with a manometer to insure that the filters are not clogged and to determine when filters must be changed. Pressure differentials are measure across the filters. Filters are changed based on manufacturer specified pressure differentials.
As lamps are being processed any processed materials which collect in the unit's tray are emptied into the proper container. The top of the system is checked for items on top of the metal grating, which could restrict the proper down draft air flow while the unit is operating. A continuous check for physical damage and proper operating conditions is performed while the system is operating

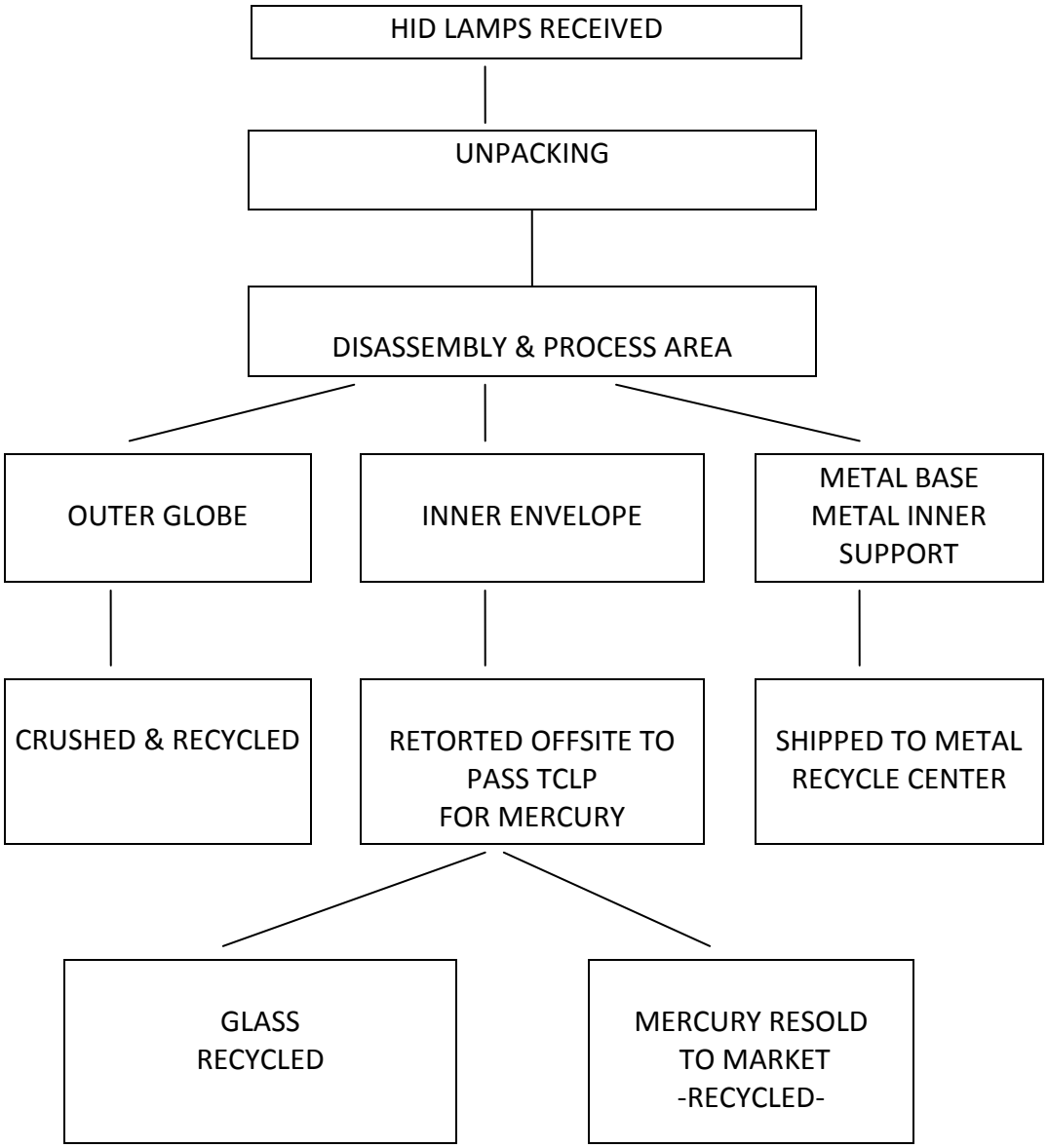
*Materials Separation | HID Lamp Disassembling Procedure*

The process flow for the HID lamps, which is a manual process activity, is presented in Figure D.5: *Process Flow Summary for HID Lamp Recovery*.

Work is performed on top of metal grating on the air flow unit. The outer globe of the H.I.D. is separated from the base and placed into the glass recovery drum. The inner envelope, still be attached to the base is removed by cutting the wires and metal frame that holds the inner envelope. The inner envelope is placed into a collection container. The lamp base and other metal components are placed into appropriate containers.

The capsules containing mercury are sent off-site for further processing. The remainder of the lamp components are sampled, tested and shipped to metal or glass recyclers.

## Figure D.5: Process Flow Summary for HID Lamp Recovery



The main objective of the HID lamp processing system is to separate the lamp components without releasing mercury emissions into the air. The system is operated in conjunction with the Health and Safety and Quality Assurance/Quality Control measures discussed in reference to Item D.8 | Attachment 10.

## D.5.3 Mercury Containing Device Processing

The offsite mercury retort systems which AERC utilizes are designed to thermally recover and purify, through a heating and distillation process, mercury from various devices, process materials and manufactured items, debris, equipment or other materials that contain or have become contaminated with mercury.

The permitted AERC TSD in Allentown, PA uses two retort units to heat devices, such as thermometers, switches, regulators, and other materials, such as precipitates, filter media, powders, soils, and the like, which contain mercury. The product from these systems is commodity grade mercury which is resold back to market. The cleaned glass and metal is shipped off-site for recycling.

*Receipt of materials*

Materials are received at the West Melbourne facility from generators in drums or other shipping containers. Upon receipt these materials are separated into similar components (e.g. switches, regulators, thermometers, etc.), some of which need to be disassembled before they can be processed. Some of the items contain materials which cannot be placed in the retort unit. These include rubber gaskets, plastic parts or other organic materials. Thus, in some cases, there is a significant reduction (approximately 50-80%) in volume by removing the non-hazardous components <u>before</u> retort. Other items may be placed in the retort whole and when the mercury is removed they come out intact.

Once separated, materials are containerized for future shipment to the AERC, PA facility or an alternate approved facility for retorting.

## D.5.4 Lighting Ballasts

In addition to lamp recycling processing AERC.com, Inc. offers service to its customers for the effective handling of non-leaking PCB and non-PCB ballasts.

Wastes are received in containers ranging from fiber cartons and poly pails to 55-gallon steel drums. AERC.com, Inc. conducts visual QC of these waste containers, repackages and consolidates these items as needed for shipping purposes. Only intact, non-leaking ballasts are received. Once accumulated, wastes are shipped to an approved offsite ballast recycler.

Ballasts are shipped using standard shipping documents as "Non-Leaking PCB Ballast" or "Non-PCB Ballast" a Certificate of Recycling can be provided for customer records.

## D.5.5 Used Electronic Scrap

AERC.com, Inc (AERC) has developed an used electronic equipment, i.e., e-waste, management program as a service to its customers. These customers include a wide variety of generators, including, but not limited to retailers, manufacturers, as well as non-profit organizations and government institutions.

AERC's program has been designed to transport and collect whole, intact, electronic equipment. Electronic components are evaluated for reuse, rebuilt for reuse or disassembled or demanufactured by AERC for component resale and recycling. The computers and CRT's collected and shipped by AERC are identical to new computers being offered by establishments for sale or resale.

Although some disassembly may take place at the facility, the AERC West Melbourne facility primarily accumulates the used electronic equipment for shipment offsite to an AERC electronic scrap processing facility or to alternate approved electronic equipment recycling facilities.

AERC does not allow, authorize or approve of land disposal of any hazardous components generated through the electronic equipment demanufacturing processes.

AERC manages all used electronic equipment, whole and intact, and is not the ultimate recycling facility. AERC sends equipment to recycling facilities, which may, in-turn offer it for direct consumer resale.

AERC has interpreted that the products it collects are not waste. The decision-making for determining which components are offered for resale and which are demanufactured is not made by AERC, buy made rather, by the recycling/resale facilities using technical evaluation methods.

Components are shipped using standard Bill-of-Lading shipping documents are "Used Electronic Equipment for Recycling, Reuse or Resale". A Certificate of Recycling can be provided for customer records.

## D.5.6 Battery Program

AERC.com, Inc. (AERC) in its continuing Universal Waste Program development provides a necessary service for battery recycling. Small quantity generators do not have the logistical capability of getting the batteries to the ultimate battery recycling facilities. Therefore, AERC created a service that includes but is not limited to various types of batteries such as lead acid, nickel-cadmium, alkaline, lithium and mercury batteries. AERC has established shipping and packaging guidelines for its customers to ensure that batteries are packaged and transported according to chemical compatibility and USDOT standards.

Once received at AERC, all batteries are inspected, unpacked and sorted into categories according to the final TSD or recycling facility requirements. These materials are repackaged and sent to the ultimate recycling facility. Attached are the specifics of this program.

### D.5.6a Battery Processing Descriptions

AERC.com, INC. ("AERC") has developed a comprehensive battery recycling program. AERC provides onsite sorting and repackaging for all battery types. All containers of batteries are weighed, unpacked and sorted by recycling technicians at the Allentown facility. If necessary, the recycling technicians utilize a computerized database to properly identify individual batteries. All sorted, repackaged batteries are then shipped to offsite, secondary facilities for final recycling. Each permitted recovery/treatment facility is audited and pre-approved by AERC prior to the recycling of any batteries at the facilities.

### D.5.6b Battery Categories

AERC accepts the following types of batteries, i.e., categories, for processing at our approved facilities. These categories of universal waste have been designated as such for billing and packaging purposes. As a general rule, batteries can be commingled within a category - however, categories should not be mixed.

| Battery Category | General Description (common types included there-in) |
|---|---|
| CATEGORY 1 | **Lead Acid** – includes: Sealed Lead Acid, i.e., gel-cell such as found in uninterrupted power supply (UPS) batteries \| Common starting, lighting and ignition (SLI) Wet-Cell batteries ; large/multi-cell powered industrial truck batteries; |
| CATEGORY 2 | **Corrosive Metal** - includes: Alkaline and NiCad (wet and dry), Carbon Zinc (non mercury), Nickel Iron, Nickel Hydride and Lithium Ion, Zinc Air |
| CATEGORY 3 | **Mercury Bearing** - includes: Carbon Zinc, Button Cell, Silver Oxide, Mercuric Oxide |
| CATEGORY 4 | **Reactive Metal** – includes: Lithium Primary Metal and Lithium-Ion; Magnesium |

A more detailed summary of battery types and general characteristics is presented in **Exhibit D.5.2**. Additionally, guidance on the regulatory requirements for proper packaging and shipment of batteries is presented in **Exhibit D.5.3**.

## D.5.7 Ten-Day Transfer Operations

The AERC, West Melbourne facility is set up as a ten-day transfer facility for hazardous wastes under the existing Florida DEP hazardous waste transporter approval. Wastes that are ultimately destined to the AERC, PA TSD facility may be transported through the AERC, FL facility on an as needed basis. This transfer operation is designed to help manage and provide cost effective logistical operations to clients for those wastes generated in the southeastern portion of the United States that ultimately must be shipped to the AERC, PA facility for acceptance and processing. AERC will not be consolidating any materials from clients that come through the ten-day transfer area. All materials that come through will stay in original containers and be sent out in the same containers.

A summary of materials that AERC can manage via ten-day operations is presented in **Exhibit D.5.4**.