A Pilot Assessment of Occupational Health Hazards in the U.S. Electronic Scrap Recycling Industry

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Contents

The employer is required to post a copy of this report for 30 days at or near the workplace(s) of affected employees. The employer must take steps to ensure that the posted report is not altered, defaced, or covered by other material.

The cover photo is a close-up image of sorbent tubes, which are used by the HHE Program to measure airborne exposures. This photo is an artistic representation that may not be related to this Health Hazard Evaluation. Photo by NIOSH.

Highlights of this Pilot Assessment

The Health Hazard Evaluation Program established an interagency agreement with the U.S. Environmental Protection Agency to learn more about the e-scrap recycling industry. As part of this interagency agreement, we surveyed a randomly selected sample of e-scrap recycling facilities nationwide.

What We Did

- We developed a survey to learn about work processes, exposures, controls, and health and safety programs at e-scrap recycling facilities across the United States.
- We contacted 278 e-scrap recycling facilities between September 2012 and April 2013.

What We Found

- Forty-seven facilities completed the survey. The response rate was 17%.
- Surveyed facilities averaged 58 employees.
- Most facilities had an industry certification.
- Surveyed facilities reported recycling a wide variety of electronics.
- The most common recycling processes were manual dismantling and sorting. Other processes included shredding, crushing, and automated separation.
- Most facilities reported having local exhaust or general ventilation. Some reported having environmental/ industrial hygiene monitoring and biomonitoring.
- Most facilities reported having a health and safety committee.
- Most facilities reported providing personal protective equipment for employees.
- Some facilities reported the use of compressed air for cleaning. This practice can lead to increased employee dust exposures.
- Some facilities allowed food and drinks in the production areas. This practice can lead to ingestion of contaminants.

We surveyed a randomly selected subset of e-scrap recycling facilities nationwide to characterize work processes, exposures, and controls. Despite multiple attempts to contact the facilities, of the 278 facilities contacted, only 47 responded. Many facilities reported that they had employee health and safety practices and controls in place.

What We Concluded

- E-scrap recycling has the potential for a wide variety of occupational exposures particularly because of the use of manual processes.
- On-site evaluations of e-scrap recyclers are needed to determine if reported work processes, practices, and controls are effective and meet current standards and guidelines.
- Educating the e-scrap recycling industry about adequate health and safety practices, specifically related to safe handling of metal dust, would help protect employee health.
- This survey may not represent the U.S. e-scrap recycling industry because of the low response rate.

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Abbreviations

CAER	Coalition for American Electronics Recycling
E-scrap	Electronic waste
HEPA	High-efficiency particulate air
ISO	International Organization for Standardization
LEV	Local exhaust ventilation
NAID	National Association for Information Destruction®
NIOSH	National Institute for Occupational Safety and Health
OHSAS	Occupational Health and Safety Advisory Services
OSHA	Occupational Safety and Health Administration
PPE	Personal protective equipment
R2	Responsible Recycling™
RIOS	Recycling Industry Operating Standard®

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Introduction

As of May 2014, 25 states had laws mandating electronic-scrap (e-scrap, also called e-waste) recycling. In 2012, the U.S. e-scrap recycling industry contributed approximately $20.6 billion to the U.S. economy, compared to less than $1 billion in 2002. In 2012, this industry sector employed more than 45,000 full-time employees, up from 6,000 employees in 2002 [ISRI 2014a].

Americans own almost 3 billion electronic products, including televisions, cell phones, computers, and peripherals (keyboards, scanners, faxes, etc.) [EPA 2007]. As new electronic products are developed and sold, obsolete or end-of-life products become e-scrap. This e-scrap amounted to about 2.3 million tons in 2007 with only 18% being recycled [EPA 2008]. In 2011, more than 4.4 million tons of used and end-of-life electronic devices were recycled [ISRI 2014a]. E-scrap contains more than 1,000 substances, many of which are hazardous [Wath et al. 2011], including heavy metals (lead, cadmium, mercury, beryllium, etc.), flame retardants, phthalates, and ozone depleting substances. The potential exists for worker exposure to these hazardous substances during recycling, but data are limited on the type and extent of exposures in developed countries [Tsydenova and Bengtsson 2011].

The rapid growth of the industry and the limited information about potential workplace health and safety hazards has revealed a need to learn more about the e-scrap recycling industry. To that end, the National Institute for Occupational Safety and Health (NIOSH) established an interagency agreement with the Environmental Protection Agency to characterize potential occupational exposures; evaluate work practices, programs, and policies; and provide recommendations to reduce worker exposures in e-scrap recycling facilities. The interagency agreement had two components: (1) to perform on-site health hazard evaluations at three e-scrap recycling facilities, and (2) to administer a survey to a randomly selected sample of e-scrap recycling facilities nationwide. This report discusses the results of the pilot survey. The results from the three workplace health hazard evaluations will be published separately.

Methods

Survey

We surveyed a randomly selected subset of e-scrap recycling facilities nationwide to characterize work processes, exposures, and controls. The survey developed by NIOSH and field tested by the contractor, Oak Ridge Associated Universities, is in Appendix A. The original survey included questions related to production quantities for each of the components processed but these questions were eliminated mid-way through the project due to the reluctance of respondents to provide this information. Additional changes included minor modifications to streamline the wording of some questions. The survey asked about:

- Certification(s)
- Number of employees
- Major components processed

- Processes performed
- Personal protective equipment (PPE) used
- Type of general ventilation, engineering, and administrative controls
- Medical surveillance and industrial hygiene monitoring

Facilities for the Survey

NIOSH contracted with Oak Ridge Associated Universities to contact e-scrap recycling companies, identify appropriate contact personnel at each facility to complete the survey, administer or provide the survey to that person(s), and provide data securely to NIOSH. The period of performance of this contract was September 14, 2012, to April 15, 2013.

NIOSH obtained a list of more than 1,300 e-scrap recycling companies that are subscribers to an industry magazine, and then selected 300 facilities using Research Randomizer (http://www.randomizer.org/) with a goal to obtain 100 responses. NIOSH personnel initially contacted these 300 facilities to see if they were still in operation. Of these, 178 facilities were still operating and the name and contact information was successfully used by the NIOSH contractor for followup. Eleven of these facilities with multiple locations referred 19 sister facilities to provide a response to the survey. Because of the low response rate from those 197 facilities, the NIOSH contractor asked NIOSH to provide contact information for an additional 100 facilities and these were also randomly selected from the list of magazine subscribers. NIOSH did not call these 100 additional facilities prior to giving their contact information to the contractor. Of these, 81 companies were still operating.

Following a script, the NIOSH contractor made 868 contacts (phone calls or e-mails) to 278 facilities in 43 states. The script contained information about the overall project, the survey, and NIOSH. After initial contact with the facility by the contractor, NIOSH sent a letter to the main facility contact to endorse the survey. Most of the facility contacts preferred to see the survey before agreeing to participate. They also preferred to complete the survey independently rather than during a scheduled phone call as initially planned. E-mail was the preferred method of correspondence for most representatives at the facilities contacted.

To promote the survey and increase visibility, information about the survey was posted on the NIOSH health hazard evaluation webpage, Facebook©, NIOSH monthly e-newsletter, Occupational Health & Safety magazine (http://ohsonline.com/articles/2013/01/11/niosh-program-evaluating-controls.aspx), and E-scrap News, a leading electronic waste recycling newsletter.

Data Management and Analysis

Password-protected electronic files were created to contain the survey information. Each facility was assigned a unique identifier, and a separate file containing all survey responses but without facility identifiers was created. All data were stored securely in Microsoft Excel® files, accessible only by NIOSH staff.

Results

Nineteen companies, representing 47 facilities in 28 states completed the survey for a response rate of 17%. Details of contacts and contact attempts made are summarized in Table 1.

Table 1. Survey outcomes

	Number of facilities
Survey responses received from original facilities contacted	30
Survey responses received from facilities referred within the same company	19
Facilities initially agreed to complete the survey but later refused	11
Made contact, determined qualified personnel, but no response	46
Refused survey	40
No response, and follow-up was unsuccessful*	132
Total	278

*Five repeated attempts were made to each facility.

Certification of E-scrap Recycling Facilities

Six different certifications were reported: e-Stewards®, Responsible Recycling™ (R2), Occupational Health and Safety Advisory Services (OHSAS) 18001, International Organization for Standardization (ISO) 14001, Recycling Industry Operating Standard® (RIOS), and National Association for Information Destruction® (NAID) (Table 2). Only two facilities had no certifications, 7 facilities had one certification, and 38 facilities had two or more certifications. E-Stewards and R2 are specific to the e-scrap recycling industry and address export, landfilling, and incineration; use of prison labor; data security; and employee safety and health, among other things. OHSAS 18001 is an international occupational health and safety management system, and ISO 14001 is an environmental management system. RIOS is the scrap recycling industry's (including e-scrap) integrated management system standard for quality, environment, and health and safety. It includes elements of ISO 9001, ISO 14001, and OHSAS 18001. NAID verifies the qualifications of certified information destruction providers through an audit program.

Table 2. Certifications of 47 surveyed facilities

Certifications	Number of facilities
R2	38
ISO 14000	38
e-Stewards®	32
OHSAS 18001	18
RIOS®	3
NAID®	3
None	2

Workforce Size

The size and composition of the workforce at the surveyed facilities is shown in Table 3. The surveyed facilities averaged 58 employees, with a median of 60 employees; most had between 70 and 79 employees.

Table 3. Number of employees at the 47 facilities by type

	Number of facilities		
Number of employees	All employees	Production employees	Office employees
1 to 9	2	4	20
10 to 19	5	4	22
20 to 29	5	7	0
30 to 39	4	4	2
40 to 49	2	3	1
50 to 59	1	8	0
60 to 69	6	14	0
70 to 79	15	0	0
80 to 89	0	1	1
90 to 99	3	1	1
≥ 100	4	1	0

Major Components Processed

All surveyed facilities accepted printed circuit boards, and most accepted switches, batteries, cell phones, fluorescent lamps and bulbs, cathode ray tubes, desktop bases and laptops, computer peripherals, liquid crystal displays, printers, fax machines, and audio/video equipment (Table 4). Other components accepted included computer hardware servers, power cords, kitchen appliances, electrical cords, chips, refrigeration equipment, integrated circuits, and silicon on tape. All companies had at least one type of component that they accepted but did not process or recycle onsite. The most common item sent out for further processing was fluorescent lamps and bulbs.

Table 4. Components accepted and processed at the 47 facilities

	Number of facilities			
	Not accepted	Accepted	Processed	Sent out for processing
Batteries	5	42	24	18
Cell phones	4	43	37	6
Cathode ray tubes	5	42	26	16
Desktop bases and laptops	1	46	40	6
Computer peripherals	1	46	39	7
Liquid crystal displays	2	45	39	6
Fluorescent lamps and bulbs	6	41	12	29
Printed circuit boards	0	47	42	5
Switches	6	41	40	1
Printers	1	46	41	5
FAX/video/radio/music players	1	46	40	6

Processes Performed

Disassembly was the main process performed at 45 of the 47 surveyed facilities, followed by 37 facilities that performed separation, 28 that performed refurbishing, 18 that performed plastic processing, and 2 that performed metallurgical processing. The types of disassembly are listed in Table 5; manual dismantling was the most common. The methods of separation performed are listed in Table 6; manual sorting and magnetic separation were the most common.

Table 5. Types of disassembly performed at the 47 facilities

	Number of facilities
Manual dismantling	40
Shredding	29
Automated crushing	20
Manual crushing	6

Table 6. Methods of separation performed

Method	Number of facilities/ total facilities responding
Manual sorting*	22/25
Magnetic separation	19/47
Eddy current separation	5/47
Gravity separation	1/47

*Only 25 facilities responded to this question because this question was added midway through the project.

Two surveyed facilities performed pyro-metallurgical processing that uses heat to extract metals from e-scrap. No facility performed hydro- or bio-metallurgical processing, techniques that use biotechnology (microorganisms) to extract metals from e-scrap. No surveyed facility performed depolymerization (i.e., the process of converting a polymer into a monomer or a mixture of monomers) or incinerated plastics. Some facilities reported baling plastics or collecting and separating plastics for subsequent recycling by downstream processors, although this question was not specifically asked. Some facilities reported reselling usable equipment, although this question was not specifically asked.

Exposure Controls

Ventilation

Most surveyed facilities had separate ventilation systems for office and production areas, but only 19 facilities had controlled supply and exhaust air flow into the production area, and seven facilities provided conditioned (heated and/or cooled) air in the processing areas (Table 7). This suggests that most facilities relied on natural ventilation in production areas.

Table 7. Types of general ventilation system in the 47 facilities

	Number of facilities
Conditioned air in the processing areas	7
Controlled supply and exhaust air flow into work areas	19
Separate ventilation for office areas	45

Types of Engineering Controls

Of the surveyed facilities, 33 used local exhaust ventilation (LEV) system(s) (Table 8). Some LEV systems recirculated this air back into the room after passing it through high efficiency particulate air (HEPA) filters, and some did not.

Table 8. Local exhaust ventilation systems in the 47 facilities

	Number of facilities
LEV ducted to the outside of the building	8
LEV filtered and ducted back into the room with a HEPA filter	16
LEV filtered and ducted back into the room with a non-HEPA filter	4
Chemical fume hoods	2
Ventilated enclosures – Other	3

Administrative Controls

Forty-four facilities reported having a safety and health committee with a non-management participant. Thirty-eight facilities had a dedicated safety and health employee(s). Forty-five facilities performed environmental/industrial hygiene sampling at least annually and performed housekeeping on a regular basis. No surveyed facilities allowed smoking in the production areas, but 13 allowed eating and drinking. All surveyed facilities reported having spill control and chemical storage policies and procedures, and formal safety and health training for employees. Thirty-nine surveyed facilities reported using HEPA-filtered vacuums for clean-up. Three facilities used compressed air during clean-up. Twenty of the surveyed facilities reported some medical surveillance. The type of medical surveillance varied (Table 9), with audiometry being reported most frequently. Some facilities noted that chest x-rays were only performed for some production employees at the discretion of the company physician.

Table 9. Medical surveillance performed at the 47 facilities

	Number of facilities	Frequency
Blood lead levels	22	22 Pre-placement 5 Annual 4 Bi annual
Blood cadmium levels	3	3 Pre-placement 3 Annual
Urine cadmium levels	5	5 Pre-placement 3 Annual 2 Bi annual
Urine mercury levels	4	4 Pre-placement 3 Annual 1 Bi annual
Beryllium lymphocyte proliferation testing	1	1 Pre-placement 1 Every 3 years
Examination by doctor or other licensed health care professional	24	24 Pre-placement 22 Annual
Spirometry	9	9 Pre-placement 5 Annual 4 Bi annual
Chest x-ray*	20	18 Pre-placement 5 Annual 13 Every 3 years
Audiometry	31	31 Annual

*Some facilities noted that x-rays were only done at the discretion of the physician.

Over half of surveyed facilities supplied production employees with coveralls or uniforms that were laundered by the company (Table 10). One facility had employees wash their uniforms at home. Over half of the surveyed facilities provided an area for employees to change clothes and shower. Although not specifically asked, some facilities commented that uniforms were only provided to certain production employees and 17 facilities commented that a third party laundered the uniforms.

Table 10. Uniforms provided by employer at the 47 facilities

Uniform administration	Number of facilities
Supply coveralls/uniforms at the worksite	28
Employees take coveralls/uniforms home to be laundered	1
Have facilities to change clothes and shower	27

Facilities with more than 50 employees appeared to be more likely to have administrative controls such as biomonitoring and environmental/industrial hygiene sampling, and provide coveralls/uniforms at the worksite (Table 11).

Table 11. Comparison of health and safety controls by facility size at the 47 facilities

Control	Number of employees (Number of facilities with that number of employees)		
	> 50 (28)	< 50 (19)	All sizes (47)
Controlled supply and exhaust air flow into the work area (%)	39	42	40
HEPA filtered vacuums used for clean-up (%)	89	74	83
Environmental/industrial hygiene sampling and monitoring performed on a regular basis (at least annually) (%)	100	89	96
Blood lead level monitoring (%)	57	32	47
Coveralls/uniforms supplied at the worksite (%)	71	42	60
Have facilities for employees to change clothes and shower (%)	64	47	57

Personal Protective Equipment

Personal protective equipment use is shown in Tables 12 and 13. Most surveyed facilities required the use of some PPE (gloves, eye protection, hearing protection, or steel-toed boots) during certain tasks. Gloves were required for most employees with the exception of those performing refurbishing (Table 13). Where respiratory protection was used, most respondents reported using filtering facepiece respirators, but some reported using half- or full face elastomeric respirators. Although not specifically asked, 13 facilities reported doing industrial hygiene sampling to determine if respirators and hearing protection was needed.

Table 12. Personal protective equipment use by dismantling process

Type of PPE		Manual dismantling n = 40	Shredding n = 29	Automated crushing n = 20	Manual crushing n = 6
Filtering facepiece*	Required	15	16	9	3
	Voluntary	16	9	11	2
Half- or full face elastomeric*	Required	1	12	0	1
	Voluntary	0	1	0	0
Gloves	Required	40	24	20	6
	Voluntary	0	4	0	0
Eye protection	Required	37	24	16	6
	Voluntary	1	0	0	0
Hearing protection	Required	29	28	17	4
	Voluntary	9	0	3	2
Steel-toed boots	Required	34	24	14	4
	Voluntary	4	0	2	2

*NIOSH-approved respirator

Table 13. Personal protective equipment use, by separation, plastic, and refurbishing processes

Type of PPE		Manual sorting n = 22	Magnetic separation n = 19	Eddy current separation n = 5	Plastic processing n = 18	Refurbish n = 28
Filtering facepiece*	Required	0	5	0	0	0
	Voluntary	8	3	2	2	8
Half- or full face elastomeric*	Required	0	1	1	0	0
	Voluntary	4	0	0	0	0
Gloves	Required	20	19	5	17	7
	Voluntary	1	0	0	0	7
Eye protection	Required	16	19	5	18	8
	Voluntary	1	0	0	0	0
Hearing protection	Required	5	19	5	18	1
	Voluntary	14	0	0	0	11
Steel-toed boots	Required	16	18	5	18	5
	Voluntary	1	1	0	0	2

*NIOSH approved respirator

Of the 31 facilities that reported using respirators in any process, all reported that they had written respiratory protection programs and provided respirator training to employees. However, 23 of the 31 facilities performed medical clearance and fit testing. Of the facilities that did not perform medical clearance and fit testing, four facilities required some employees to wear a respirator.

Discussion

We conducted a pilot survey to characterize occupational health and safety practices in the U.S. e-scrap recycling industry. Other surveys of the U.S. e-scrap recycling industry include one published in 2011 by the International Data Corporation [ISRI 2014b] and another published in 2013 by the Coalition for American Electronics Recycling (CAER) [American Recycling 2014]. The International Data Corporation survey documented company size and other business information from 103 facilities but did not include questions related to workplace health and safety. The CAER survey included 21 CAER member companies representing 89 facilities. The surveyed facilities averaged 205 employees (median of 100 employees). The CAER survey reported that 45% of employees were involved in demanufacturing, 21% in asset recovery and disposition functions, and 18% in shredding operations [American Recycling 2014]. Asset recovery and disposition functions were defined as certified data destruction and disposition of assets where the recycler has the capability to record make, model, and serial number, and in some cases engages in refurbishment of equipment for resale.

In our survey, several facilities reported having general ventilation and local exhaust ventilation; some reported filtering and then recirculating exhaust air back into the room. We do not have enough information to know if the LEV systems were used in processes that may be producing potentially contaminated air. If this was the case for some of the LEV systems, the Occupational Safety and Health Administration (OSHA) prohibits recirculation of air containing metals such as lead through non-HEPA filters (29 CFR 1910.1025). The recirculation of process air into the work environment of highly hazardous substances (as defined by the OSHA hazard communication standard) requires both an effective cleaning device (filtration) and a continuous monitoring device that is capable of detecting a concentration as low as 10% of the acceptable level in the discharge duct [ANSI/AIHA 2007].

The most common type of medical surveillance reported was audiometry, followed by measuring blood lead levels. Audiometry and blood lead level tests are good practices for an e-scrap recycling facility given that lead and noise are common hazards in this industry [NIOSH 2009]. It was encouraging to see that all 22 facilities that reported blood lead monitoring had a pre-placement assessment of the employees. However, it is unclear why only five facilities followed their employees annually and four bi-annually. We could not determine from this brief survey whether blood lead monitoring met current recommended practices and whether all potentially exposed employees were included or just those thought to have the greatest potential for exposure to lead (e.g., those who handled cathode ray tube glass). It is important to include all employees potentially exposed to lead in the medical surveillance program, even those employees not directly exposed to lead contaminated air [Kosnett 2007]. Lead contamination on surfaces outside of the production area and contamination of surfaces in common areas such as breakrooms can result in ingestion of lead which contributes to the overall exposure of all affected employees.

Many facilities provided uniforms and facilities to change clothes and shower before leaving work, but one facility commented that they allowed employees to launder their work uniforms at home. This practice may provide a route of take-home exposure to family members. OSHA requires uniforms and showers for employees exposed to metals like lead and cadmium above the occupational exposure limit. However, it is good practice to provide uniforms, laundering, and showers to all employees potentially exposed to these substances [Kosnett 2007]. Uniforms and showers are among the most effective workplace measures in preventing take-home exposures [NIOSH 1995]. Current OSHA occupational exposure limits for lead are outdated; more recent information suggests that health effects can be experienced by employees at much lower levels.

Current occupational exposures limits may prevent overt symptoms of lead poisoning, but do not protect workers from lead's contributions to conditions such as hypertension, renal dysfunction, reproductive, and cognitive effects [Schwartz and Hu 2007; Schwartz and Stewart 2007; Brown-Williams et al. 2009; IOM 2012]. Generally, acute lead poisoning with symptoms has been documented in persons having BLLs above 70 µg/dL. These blood lead levels are rare today in the United States, largely as a result of workplace controls put in place to comply with current occupational exposure limits. When present, acute lead poisoning can cause myriad adverse health effects including abdominal pain, hemolytic anemia, and neuropathy. In very rare cases lead poisoning has progressed to encephalopathy and coma [Moline and Landrigan 2005]. People with chronic lead poisoning, which is more likely at current occupational exposure levels, may not have symptoms or they may have nonspecific symptoms that may not be recognized as being associated with lead exposure. These symptoms include headache, joint and muscle aches, weakness, fatigue, irritability, depression, constipation, anorexia, and abdominal discomfort [Moline and Landrigan 2005].

Some facilities allowed food and drinks in the production area, a practice that can lead to ingestion of hazardous substances from contaminated hands and food and drink surfaces.

Some facilities reported using compressed air for cleaning. It was not clear from the survey responses if the compressed air was used for cleaning clothing, equipment, or both. Regardless, this practice can potentially result in contaminants entering the employees' breathing zone, as well as spreading contamination throughout the facility. Noise from compressors used to provide compressed air for cleaning can contribute to hearing loss if employees do not use appropriate hearing protection. Cleaning with compressed air can also dislodge particles that could enter eyes or abrade skin. Wet mopping and vacuuming with HEPA filters are recommended cleaning practices.

Although a high percentage of surveyed facilities used PPE and performed environmental/ industrial hygiene monitoring, this survey did not evaluate the effectiveness of these programs. We do not know to what extent PPE use was enforced and how many employees participated in any personal exposure monitoring for lead or other contaminants as prescribed by OSHA [OSHA 2014]. The four facilities that required the use of respirators but did not provide employees with medical clearance or fit testing were not following the OSHA respiratory protection standard [29 CFR 1910.134].

This survey had limitations. The main limitation was the low response rate. At the beginning of the pilot survey, we did not provide the targeted facilities with preliminary information about NIOSH, or information about the purpose of the survey prior to making the initial phone call. Because many facilities were not familiar with NIOSH, on the initial call, they misidentified our surveyor as being from a competitor or market research firm. Once we began sending an introductory letter to facilities prior to the initial call, informing them of the purpose of the survey and providing them information about NIOSH, our participation improved. Initial respondents were reluctant to share information about the quantities of materials processed; this line of inquiry was later dropped from the survey, which also improved the survey participation. Finally, smaller facilities who chose not to participate often reported that our survey questions did not match their own activities (e.g., most facilities with fewer than five employees did not dismantle electronics, but sorted items and shipped them to other facilities for processing).

Although our results may not be generalizable to all U.S. e-scrap recycling facilities, they are informative regarding existing health and safety programs in the industry. Focusing on processing of cathode ray tubes and liquid crystal displays (two major electronic items that are recycled) would be desirable in future surveys. Additionally, further information is needed on the specific demographics of the workforce (e.g., race and ethnicity), and the health and safety needs of the industry. Moreover, onsite workplace evaluations would help to determine if programs and controls reported by e-scrap managers are actually meeting current standards and guidelines.

Conclusions

This pilot survey of the U.S. e-scrap recycling industry provided information on health and safety programs and practices at 47 facilities among a rapidly increasing and changing industry. To expand our knowledge and to respond to the expectations of growing health and safety needs in this industry, resources need to be directed to this industry to capture more widely the occupational hazards, health consequences, specific processes, and exposures of concern. Efforts to evaluate, support, and promote good health and safety practices in the growing and dynamic e-scrap recycling industry are needed to prevent occupational illnesses and injuries.

Appendix A: Facility Questionnaire

Company Information **Date administered:** **Date confirmed:**

Company Name			
Street Address			
Address Line2			
City, State, Zip			
Phone Number			
Website Address			
Certified under	_____ E-stewards	_____ Responsible recycling practices (R2)	
	_____ Other (specify) _____		_____None

Company Technical Contact

Name	
Title	
Email Address	
Phone Number	
Background (IH, Safety, etc.)	

Workforce Numbers at this Facility

# Total workers in facility 2011 or 2012	
# Production workers	
# Office-only workers	

Major Components Processed

Type	**Y/N**	**Comments**
Batteries (please specify: Li-ion; Ni-Cd; NiMH, lead-acid, Silver oxide, etc.)		
Cell phones		
CRT (cathode ray tube)		
Desktop bases & laptops		
Computer peripherals (mice, keyboards, etc.)		
Liquid crystal displays (LCDs)		
Fluorescent lamps/bulbs		
Printed circuit boards		
Switches		
Printers		
Fax machines, radios, video/DVD/music players, etc.		
Other:		

Processes performed and PPE used

Processes	**Y/N**	**NIOSH-approved Respirator** **A = Filtering facepiece** **B = Half or full-face elastomeric** **C = Other (specify)** **N = Not used** **R/V = Required or Voluntary**		**Gloves**		**Eye/face**		**Hearing Protection**		**Steel-Toed Boots**	
		A/B/C/N	(R/V)	Y/N	R/V	Y/N	R/V	Y/N	R/V	Y/N	R/V
Disassembly	---										
- Manual dismantling											
- Manual crushing/pulverizing/etc.											
- Automated crushing/ pulverizing/etc.											
- Shredding											
- Other (please specify)											
Separation	---										
- Magnetic separation											
- Eddy current separation											
- Gravity separation											
- Manual sorting											
- Other (please specify)											
Metallurgical processing	---										
- Hydro-metallurgical											
- Pyro-metallurgical											
- Bio-metallurgical											
Plastic processing	---										
- Depolymerization											
- Incineration											
- Other (please specify)											
Refurbishing											
Other (Please specify)											

Types of General Ventilation and Administrative Controls (Check all that apply)

Y/N	
	General ventilation and administrative controls
	a. Is the air conditioned in the processing areas?
	b. Is there controlled supply and exhaust air flow into the work area?
	Is there separate ventilation for office areas?
	Are HEPA filtered vacuums used for clean-up?
	Is compressed air used during clean-up?
	Do you have documented spill control and storage policies and procedures?
	Is formal health and safety training provided to employees?
	Is environmental/industrial hygiene sampling and monitoring performed on a regular basis (at least annually)?
	Is medical monitoring performed on a regular basis (at least annually)?
	Are there dedicated health and safety employee(s)?
Any Comments:	

Types of Engineering Controls (Check all that apply and list process/areas)

Y/N		List for what processes/areas
	Local exhaust ventilation (LEV)	
	a. LEV ducted to the outside of the building	
	b. LEV filtered and ducted back into the room with a HEPA filter	
	c. LEV filtered and ducted back into the room with a non-HEPA filter	
	Chemical fume hoods	
	Ventilated enclosures – Other (Describe)	
Any Comments:		

Medical Surveillance (Check all that apply and write in frequency)

	Y/N		
Does your facility perform any of the following for employees who handle e-scrap?	----	Frequency – how often? Pre-placement	Periodic
Biological monitoring – if yes, please check all that apply	----	-------	-------
- Blood lead levels			
- Blood cadmium levels			
- Urine cadmium levels			
- Urine mercury levels			
- Beryllium LPT			
- Other: specify			
Physical examinations – if yes, please check all that apply	----	-------	-------
- Examination by doctor or other licensed health care professional			
- Spirometry (lung function testing)			
- Chest x-ray			
- Other (specify):			
Audiometry (hearing tests)			
Other (Please specify):			

Additional Administrative Controls (Check all that apply)

Y/N	
	If respirators are used, do you provide the following
	a. Medical clearance
	b. Training
	c. Fit testing
	d. Written respiratory protection program
	Are coveralls/uniforms supplied at the worksite?
	Are coveralls/uniforms taken home by the workers to be laundered?
	Do you have facilities for employees to change clothes and shower?
	Is housekeeping performed on a regular basis?
	Is food & drink allowed in process areas?
	Is smoking allowed in process areas?
	Do you have a safety and health committee at this facility?
	If yes, are non-management employees part of the committee?
	Would you be willing to participate in a possible future worksite evaluation with NIOSH?

Thank you so much for participating in this NIOSH evaluation. We will scan and email a copy of this questionnaire to you to review for accuracy. We will also send you via email a copy of the final report from this effort once it is completed. If you have further questions, please contact NIOSH project officers.

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The Health Hazard Evaluation Program investigates possible health hazards in the workplace under the authority of the Occupational Safety and Health Act of 1970 (29 U.S.C. § 669(a)(6)). The Health Hazard Evaluation Program also provides, upon request, technical assistance to federal, state, and local agencies to investigate occupational health hazards and to prevent occupational disease or injury. Regulations guiding the Program can be found in Title 42, Code of Federal Regulations, Part 85; Requests for Health Hazard Evaluations (42 CFR Part 85).

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