Analysis of Battery Industry Sponsored

Button Cell Collection Programs

Presented to the

Dry Battery Section
National Electrical Manufacturers Association

December 19, 2003

Prepared by

Richard F. Tozer
Consultant to Management
2911 Turtle Creek Blvd., Suite 300
Dallas, Texas 75219

Phone 214-521-3440
rftozer@hotmail.com

Member, The Institute of Management Consultants

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY

The General Assembly of the State of Connecticut has determined that

> "mercury is a persistent and toxic pollutant . . .[and] . . . the virtual elimination of the discharge of anthropogenic mercury should be pursued."

Public Act 02-90 effective July 1, 2002 requires that battery manufacturers create a program to collect used button cell batteries containing mercury. The Department of Environmental Protection is enforcing this legislation, which also permits the Commissioner to grant exemptions for products for which collection is deemed not feasible.

The Dry Battery Section of the National Electrical Manufacturers Association (NEMA) has asked me to assemble and analyze available information regarding the feasibility of collection programs for button cell batteries. This document is my report.

Button cells are tiny electrical batteries packaged in tiny metal containers approximately the size and shape of shirt buttons. They are used to power an almost endless array of electronic devices: watches, cameras, calculators, hearing aids, toys, games, medical devices, small flashlights, etc. Button cells that use silver oxide, manganese alkaline, and zinc-air electro-chemical systems contain trace amounts of mercury.

Button cell batteries have no value independent of the devices in which they are used. Most of the value realized by consumers is in the cost of the devices; most of the remaining value is in the retail distribution of the button cells, not in their manufacture. Button cells that sell at retail for a few dollars are advertised at the manufacturer's level for about thirty cents. Devices such as watches and hearing aids may cost as much as hundreds or thousands of dollars.

Total button cell battery manufacturers' profits on the sale of batteries purchased by Connecticut consumers are estimated to be about a quarter of a million dollars per year. This figure is something of an upper bound on the cost of a manufacturer-financed collection program, since manufacturers are free to stop selling batteries in Connecticut if the costs of the program exceed their profits in the state.

Seventeen other states and the Federal government have passed some type of battery law and none of these requires collection of button cells by anyone. Without a legislative mandate on retailers or device manufacturers there is no way battery manufacturers can recover the costs of a collection program from consumers.

Virtually every consumer in Connecticut uses one or more devices powered by one or more button cells. No one knows how many such devices are sold to consumers in Connecticut each year, but manufacturers estimate that each year several million button cells are sold in the replacement market in the state.

Programs already exist to collect silver oxide button cells. These programs are driven by the financial value of the silver that can be recovered from these cells. Unfortunately, the materials that can be recovered from manganese alkaline or zinc-air button cells are worth less than the cost of recovery.

No one knows exactly how button cells are distributed. Button cell manufacturers do not sell directly to consumers in Connecticut, but through a maze of intermediate distribution channels to several thousand retail points in Connecticut: mass-market retailers, specialty stores, jewelers, watchmakers, audiologists, hearing aid specialists, internet vendors, and by mail order from vendors inside and outside the state. Each of these retailers is an independently owned business.

There do not appear to be any obvious high volume retail outlets at which manufacturers could collect a significant portion of used button cells or capture a significant amount of mercury. Since retailers in Connecticut are not required by law to participate, they have minimal incentive to cooperate.

We have identified seven related battery collection programs: the silver oxide button cell collection programs organized by the American Watchmakers Association and the silver recovery industry, various battery collection programs operating in Europe, two community-based battery collection programs and one mercury collection program operating in the United States, the Rechargeable Battery Recycling Corporation program for rechargeable batteries, and the Thermostat Recycling Corporation program for recovery of mercury in thermostats.

The silver oxide collection programs (which currently operate in Connecticut) are the only battery collection programs we can identify that have been financed without financial assistance from another party. Financing by state and local governments, or by retailers and device manufacturers operating under a legislative mandate has been required for every other program. These financial sources are not available to support the collection of other button cells in Connecticut.

All button cell collection programs in Connecticut (or elsewhere) are limited by nine significant constraints: the risk of fire safety, U.S. Department of Transportation regulations regarding shipping, the risk of ingestion by consumers, contamination of the waste stream by lithium batteries and other contaminants, the need and cost of educating consumers, the cost and limited availability of insurance, uncertain access to recycling, contingent Superfund liability, and environmental costs.

Used button cells may contain small amounts of energy when disposed of. If multiple batteries are placed in contact, there is a risk of sparking, short circuits, high temperatures, leakage, and fire. Consequently, U.S. Department of Transportation regulations require that battery terminals be separated during shipment. This regulation implies that used button cells would have to be taped or placed in individual plastic bags for shipment, a time consuming and expensive process.

More than eighteen hundred button battery exposure cases are reported to U.S. poison control centers each year. Most of these are ingestions by young children or the elderly. The effects can be serious. Button cell collection programs will encourage consumers to stockpile used batteries for collection and recycling and thus exacerbate this problem.

Lithium cells or other contaminants may contaminate the waste stream of used button cells when collected. Lithium cells are similar in appearance but larger than button cells; they do not contain mercury, but the lithium electrolyte is flammable. These batteries also contain metallic lithium, a highly reactive metal, that when exposed to water liberates hydrogen, a very flammable gas. If these batteries are opened at a mercury recycling facility they will ignite. Lithium battery contamination of the waste stream would result in a recycling facility receiving material it is not permitted to handle, placing its permits in jeopardy and exposing it to potential fines.

Individual consumers and retail employees throughout Connecticut have assumed, learned or been taught that it is legal and appropriate to dispose of used button cells one by one in the household waste stream. The success of any additional button cell collection program depends on the industry's ability to change this attitude. It is unlikely that consumer or employee attitudes can be changed with a budget of less than the button cell manufacturers' annual profits in Connecticut.

Any new button cell collection program can be expected to be held liable for damages that may be caused by the collection, sorting, packing, transportation, and recycling of the used button cells. Insurance will be required. Whether such insurance is available, and if so, at what cost, is unknown. Such insurance costs tend to be fixed, rather than dependent on the volume of material collected.

NEMA has identified only one company capable and interested in recovering mercury from mixed used button cells. Should this company be unable to perform, and if NEMA cannot identify an alternative company interested in taking mixed used button cells, then any new button cell collection program would be unable to recover mercury and collected batteries would be disposed of in landfills, essentially returning them to the waste stream from which they had been collected at great effort and expense.

This one company is a Superfund site. Persons that dispose of waste material at Superfund sites become jointly and severally liable for all past and future costs of cleanup. It seems doubtful that the continued profits on the sale of button cells in Connecticut alone are sufficient to justify a manufacturer taking on this contingent liability.

Collection, sorting, packing, transportation, and recycling of used button cells in a newly developed collection program will create additional environmental impacts. The nature and magnitude of these impacts is difficult to calculate and will depend on the design of the program and its relative success.

An additional button cell collection program in Connecticut may require significant startup costs plus annual expenditures for education, marketing, and promotion of the program; for containers, shipping, and processing of the button cells; and for management, general, and administrative expense, including insurance, and the cost of a web site and 1-800 phone system if needed. These costs are largely fixed, rather than dependent on the volume of material collected.

The vast majority of mercury being deposited in Connecticut is coming from outside the region. Even within the region, Connecticut emissions would make up a small portion of emissions in the region. Button cells make up a tiny portion of mercury entering the state's municipal solid waste incinerators. Any effort to collect button cells in Connecticut will result in virtually no change in mercury deposition in Connecticut.

No state requires the labeling of button cells. No other state requires manufacturers to collect button cells. No state bans the disposal of button cells.

NEMA members would operate any new button cell collection program in Connecticut by setting up a new corporation to collect and recycle used button cells. The owners of the new corporation would then contract with NEMA or another entity to manage it. Legal fees, insurance, and other setup costs for the new corporation alone could easily exceed the industry's annual profits on batteries sold to consumers in Connecticut.

Once established, the new corporation would select one or more of five collection programs: retail take back, partnership with audiologists/hearing instrument specialists, mail back, partnership with household hazardous waste collection, or partnership with municipal transfer stations.

Each of these alternatives has a different set of appropriate partners who would operate the points at which citizens would offer used button cells for collection. Each potential program is either cost prohibitive, or would require partners with little or no incentive (and no legal mandate) to participate, or would require complex arrangements which appear to be inefficient and/or cost prohibitive. Each alternative would increase the risk of fire and ingestion.

The House sponsor of Public Act 02-90 assumed that the Department would decide that it was unfeasible to establish a program to collect button cell batteries.

2. **LEGISLATIVE HISTORY**

In Section 1 of Public Act 02-90 effective July 1, 2002, the General Assembly of the State of Connecticut determined that . . .

> "mercury is a persistent and toxic pollutant that bioaccumulates in the environment, and that in order to create and maintain a healthful environment and protect public health, the virtual elimination of the discharge of anthropogenic mercury should be pursued."

When originally introduced in the legislature, the bill creating this act banned the disposal of all mercury containing products, including button cells, or products containing button cells in Connecticut. When the Act was passed, this ban had been deleted, and replaced by provisions calling for the creation of collection programs for mercury containing products.

Specifically, among other provisions, Section 9 of the Act specified that . . .

> (a) On and after July 1, 2003, no person shall offer any mercury-added product for sale or distribute any such product for promotional purposes unless the manufacturer either on its own or in concert with other persons has submitted a plan to the commissioner [of the Department of Environmental Protection] for a system that reasonably enables the collection of such products. If a mercury-added product is a component of another product, the collection system shall provide for removal and collection of the mercury-added component or collection of both the mercury-added component and the product containing it.
>
> (b) The collection system shall include (1) a public education program to inform the public about the purpose of the collection program and how to participate in it; (2) a targeted capture rate for the mercury-added product or component; (3) a plan for implementing and financing the collection system; (4) documentation of the willingness of all parties to the system to implement the proposed collection system; (5) a description of the performance measures to be utilized and reported by the manufacturer to demonstrate that the collection system is meeting capture rate targets; (6) a description of additional or alternative actions that will be implemented to improve the collection system and its operations in the event that the program targets are not met; and (7) a recycling or disposal plan.
>
> And . . .
>
> (d) The cost for the collection system shall not be borne by state or local government.

It further specified that . . .

> (f) The following are exempt from the provisions of this section . . . (5) any other product for which the commissioner determines a collection plan is not feasible.

Thus it remains legal for anyone to dispose of virtually all button cells or products containing button cells in the state.

The House sponsor of the bill creating this Act was Representative Jessie Stratton, House Chair of the Joint Environment Committee. During floor debate, she engaged in the following interchange with Representative Lou Wallace:

Representative Wallace:

> "Section 9 allows the Commissioner to waive certain items from a collection plan due to its small size and traced amounts of mercury. Would button cell batteries likely be exempt from collection?"

Representative Stratton:

> "Yes, it would be my assumption that the Department would decide that it was unfeasible to particularly establish a specified collection program for button cell batteries."

You have asked me to assemble and analyze available information regarding the feasibility of various industry sponsored button cell collection programs that could be implemented in response to the Act. This document is my report.

3. BACKGROUND

a. The Product

"Button cells" are miniature electric batteries packaged in tiny cylindrical metal containers approximately the size and shape of commonly used buttons. Some are smaller than the tiny buttons used on dress shirt collars.

Each button cell is constructed from six major components: an anode (zinc), a cathode (silver oxide, manganese dioxide, oxygen), a tiny cylindrical metal can, a potassium hydroxide electrolyte, a round metal plate forming the top of the can, and a rubberized or plastic insulating seal that bonds the top to the can, preventing leakage. The can and the flat plate top are the electrical terminals of the battery.

Button cells that contain added mercury commonly fall into three electro-chemical systems: manganese-alkaline, silver oxide, and zinc-air. Each of these electro-chemical systems delivers a trickle of direct current at approximately one and one half volts. Each has a unique energy density, useful life, and capacity for delivering power over time. Each system is manufactured in various sizes.

Button cell manufacturers also produce a few models in which button cells are stacked to create a six-volt or twelve-volt unit. These models may be confused in appearance with round cells used in flashlights.

b. Applications

Button cells are used to power an almost endless array of electronic devices: watches, cameras, calculators, hearing aids, toys, games, medical devices, small flashlights, etc.

Each chemical system is associated with specific product applications, is used in a specific manner, and is packaged, distributed, and sold somewhat differently.
In a recent survey, NEMA member button cell manufacturers reported that approximately three quarters of all silver oxide batteries are used in watches. Most of the remaining silver oxide batteries are used in cameras. Only a very small percentage of the silver oxide batteries manufactured are used in toys, games, medical devices, etc.

About ninety percent of manganese alkaline button cells are used in cameras. Less than one percent each are used in toys, games, and watches; the balance are used in a wide variety of other devices.

Silver oxide and manganese alkaline button cells used in watches, cameras, calculators, toys, games, and medical devices come in more than forty-five sizes and shapes and have a useful life measured in years. Consumers buying replacements typically buy one unit at a time, infrequently, to replace a battery that has been depleted in service. Replacement silver oxide button cells are typically packaged in individual packages. Consumers usually buy them only as needed and almost never maintain an inventory of fresh silver oxide or alkaline button cells.

One hundred percent of zinc air button cells are used in hearing aids. These devices have a much higher power drain than watches, etc. As a result, zinc-air button cells have a useful life measured in days; they are produced in just five sizes. Replacement zinc-air button cells are typically packaged in multiples: six packs, eight packs, and twelve packs. Hearing aid users typically buy multiple units at a time, frequently, in anticipation of need, and often maintain an inventory of fresh zinc-air button cells.

c. Attributes of The Button Cell Value Chain

A button cell battery has no intrinsic value in and of itself until it goes into some other device and retailers sell that other device. The cost of button cells to consumers is tiny compared to the value of the devices in which they are used. Button cells costing no more than one to three dollars at retail are commonly used to power hearing aids costing more than a thousand dollars, watches costing more than a hundred dollars, andcostly cameras and medical devices. Most of the value realized by consumers is in the costof the device; most of the value that remains is in the retail distribution of the button cell, not in its manufacture. Button cells that sell in retail stores for a few dollars are advertised at the manufacturer or master distributor level for sale at about $0.30.

The market for button cells is mature and growing slowly. Although manufacturers work diligently to differentiate their brand names and their products, button cells are often regarded by consumers as commodities and are often sold and promoted on price. Price competition is fierce.

In a survey completed in September 2003, NEMA member button cell manufacturers estimated that their estimated profits from the sale of button cells in Connecticut in 2002 were $267,848, of which $37,671 was from the sale of manganese alkaline cells, $102,024 was from the sale of silver oxide cells, and $128,153 was from the sale of zinc-air cells.

The manufacturer's profit represents something of an upper bound on the costs of any reasonable collection program in Connecticut. Button cell manufacturers will have no way of imposing the costs of such a program on to consumers in Connecticut so the costs of the collection program will have to be paid by consumers throughout the country. It makes little sense for the button cell manufacturers to pay more for a program in Connecticut than their profits in Connecticut, since they have the option of labeling their battery packaging "Illegal for sale in Connecticut" and essentially leaving the state.

d. Mercury Content

The battery industry has taken the initiative in reducing the mercury content of its products. All mercury has been eliminated from round cells. In button cells, manufacturers significantly reduced the mercury content of hearing aid batteries by replacing the mercuric oxide electro-chemical system with the zinc-air system. This change reduced the amount of mercury per cell by 98%. Battery manufacturers continue to research alternatives to the use of mercury in button cells.

Each of the current button cell electro-chemical systems uses very small amounts of mercury as an amalgamated component on the anode to prevent internal discharge and gassing, both of which present serious leakage issues. Use of mercury also allows a high rate of discharge, necessary in some small applications. Leakage would shorten battery life and cause damage to the device in which the battery was installed, and in certain hearing aids, wristwatches, and medical devices, could potentially expose the user to serious, immediate and acute adverse health effects.

The amount of mercury in each button cell varies by electro-chemical system, cell size, and manufacturer but each cell contains less than 25 mg of mercury. During the past decade, battery manufacturers have consistently reduced the average amount of mercury per cell.

In its September 2002 submission to the Interstate Mercury Education and Reduction Clearinghouse of the Northeast Waste Management Officials' Association, NEMA reported that in 2000 the amount of mercury in each silver oxide button cell ranged from a low of 0.74 milligrams (mg) to a high of 16.27 mg, with an average of 3.1 mg. The amount of mercury in each zinc-air button cell was reported to range from a low of 1.3 mg to a high of 24.8 mg, with an average of 7.9 mg. The amount of mercury in each manganese alkaline button cell was reported to range from a low of 0.006 mg to a high of 17 mg, with an average of 11.4 mg. There were no significant changes in 2001.

A new survey of NEMA members was completed in September 2003. Based on the weighted average of the sizes of cells actually sold by each manufacturer, this survey determined that the average silver oxide button cell currently contains 2.5 mg. of mercury, the average zinc-air button cell currently contains 8.5 mg. of mercury, and the average manganese alkaline button cell contains 10.8 mg. of mercury. The more recent survey included data from one additional NEMA member who had joined since the 2000 survey was completed.

A fourth electro-chemical system, based on the element lithium, is also used, primarily in somewhat larger batteries, called "coin cells" because many of them are approximately the size and shape of common coins. Lithium cells come in a variety of sizes and shapes and deliver electrical direct current at approximately three volts. Lithium cells do not contain mercury. A complicating factor is that lithium cells are used in watches, cameras, and many of the other applications that use button cells.

Lithium cells are a concern for any button cell collection program because they are often confused with button cells and can be expected to contaminate the button cell waste stream. Unlike the other systems, lithium battery electrolyte is flammable.

In the September 2003 survey, NEMA members estimated that the button cells they shipped in the United States in 2002 contained 5,283.5 pounds of mercury, of which 269.6 pounds were in manganese alkaline cells, 473.6 pounds were in silver oxide cells, and 4,540.3 pounds were in zinc-air cells. NEMA members believe they supply the overwhelming majority of button cells sold in the United States.

No comparable data is available for the state of Connecticut. However, according to the Statistical Abstract of the United States, the 1997 Census of Retailers, and Hearing Journal magazine respectively, Connecticut has about 1.2% of the population of the United States, about 1.4% of the retail sales, and about 1.0% of hearing aid sales.

These factors indicate that in 2002 Connecticut consumers purchased about 3,785,000 button cells manufactured by NEMA members. These cells contained about 55.8 pounds of mercury. Of these totals, about 160,000 (containing about 3.8 pounds of mercury) were manganese alkaline cells, about 1,200,000 (containing about 6.6 pounds of mercury) were silver oxide cells, and about 2,425,000 (containing 45.4 pounds of mercury) were zinc-air cells.

Collection programs already in place for silver oxide cells have been reported to achieve a 95% collection rate. (See below).

e. Distribution Channels

Button cells are ubiquitous. Virtually every consumer in Connecticut uses one or more devices powered by a button cell.

Button cells reach consumers through a maze of diverse, complex distribution channels which are somewhat different for each application and therefore, for each chemical system. Manufacturers do not sell button cells directly to consumers. Few button cell manufacturers have a physical presence in Connecticut; some foreign manufacturers have no physical presence in the United States.

Button cells are not taxed separately from other products. No statistical reporting of button cell shipments is required by any government agency. Valid, universally recognized, published market research data regarding the sale of button cells is not available.

Button cells are sold through the original equipment market and the replacement market.

In the original equipment market, button cell manufacturers sell directly and indirectly through distributors to manufacturers, wholesalers, and retailers of electronic devices (watches, cameras, calculators, hearing aids, toys, games, etc.) who provide button cells as original equipment when the devices are sold to consumers. Some of these device manufacturers, wholesalers, and retailers also use their channels of distribution to offer button cells to consumers for replacement purposes.

In the replacement market, button cell manufacturers sell directly to some retail accounts, and indirectly through distributors to a large number of other retailers, traditional mail-order houses, and internet based vendors.

An individual button cell may pass through multiple levels of distribution between the manufacturer and the consumer. Each participant in these replacement market distribution channels is an independent business that fiercely guards its customer list. The button cell manufacturer has no control and little influence over its customers. Because of the complexity of the distribution channels, manufacturers generally do not know the identity of the retail outlets that sell their button cell batteries directly to consumers, and do not know the ultimate destination of the button cells they ship.

Button cells shipped into Connecticut may be re-exported to other states; conversely, button cells shipped into other states may be reshipped to retailers and mail order houses that sell to consumers in Connecticut. Also, Connecticut residents may buy button cells out of state personally, by mail order, or on the internet.

A manufacturer may sell button cells to a distributor in Connecticut who resells those batteries to a distributor or retailer in another state; or, the manufacturer may sell button cells to a distributor in another state who resells those batteries into the state of Connecticut.

Connecticut consumers acquire replacement button cells from mass-market retailers, specialized retailers, and mail order and internet vendors, both in-state and out-of state.

f. Mass-Market Retail Channels

NEMA member button cell manufacturers believe that the majority of button cells of all three chemistries reach consumers through mass market retail channels: food and drug stores, department stores, warehouse clubs, hardware stores, office supply stores, and electronics stores.

According to the 1997 Census of Retailers (the latest available) Connecticut was home to 783 supermarkets, 549 pharmacy and drug stores, 130 department stores, 14 warehouse clubs and superstores, 109 variety stores, 199 hardware stores, 586 electronics and appliance stores, 101 office supply stores, and 350 convenience stores, a total of 2,821 mass-market retail outlets, each of which was a potential (and likely) retail outlet for button cells. These numbers have probably not changed appreciably, and are consistent with current data on the number of retail taxpayers supplied by the Department of Revenue Services.

Mass-market retailers typically display button cells in more than one location in each store. There are multiple points of contact in each store at which each button cell purchase transactions may occur. Many of these points of contact are self-serve, and are not staffed.

Button cells that are regarded as impulse purchases are displayed at checkout counters; hearing aid (zinc-air) batteries are displayed at the pharmacy window; a wide selection of button cells is displayed along with all other batteries, flashlights, etc.; and a few button cells may be displayed along with the devices they power (watches, cameras, etc.). Mass-market retailers of size have multiple checkout counters.

If mass-market retailers handled 60% of the button cells sold in Connecticut in 2002, and if the calculations made above are correct, then in 2002 mass-market retailers in Connecticut sold about 2,271,000 button cells containing a total of about 33.5 pounds of mercury. Of these totals, about 96,000 (containing about 2.3 pounds of mercury) were in manganese alkaline cells, about 720,000 (containing about 4.0 pounds of mercury) were in silver oxide cells, and about 1,455,000 (containing about 27.2 pounds of mercury) were in zinc-air cells.

If each of the 2,821 potential retail outlets in Connecticut did in fact carry button cells, and if the above calculations are correct, then on the average each retail outlet in Connecticut sold 805 button cells containing a total of 0.0119 pounds (about 0.19 ounce) of mercury in 2002.

It would be more conservative to assume that all of the 783 supermarkets and 549 pharmacy and drug stores did sell button cells in 2002, but that none of the department stores, warehouse clubs, superstores, variety stores, hardware stores, electronics and appliance stores, office supply stores, or convenience stores did. Under this conservative assumption, the average mass-market retail outlet in Connecticut sold about 2042 button cells containing 0.0252 pounds (about 0.40 ounces) of mercury in 2002.

If we assume the average mass-market retailer has three points of contact with button cell consumers, and if the calculations above are correct, then the average mass-market retail point of contact with button cell consumers in Connecticut delivered from 268 to 681 button cells containing from 0.0040 to 0.0084 pounds of mercury (0.063 to 0.133 ounces) of mercury in 2002.

There is no apparent concentration among mass-market retailers, and thus there are no logical mass-market retail partners with whom to form a collection program. The largest supermarket operator in New England (Stop & Shop, Inc.) has just 78 stores in Connecticut. A major pharmacy chain (Rite-Aid) has just 26 stores. The likely largest chain of electronics stores, Radio Shack appears (from the map on their website) to have just 67.

Mass-market retailers choose to carry button cells primarily as a convenience to their customers, because the gross profit margin on button cells is higher than on other products, and because they occupy very little space. It is very difficult to construct any reasonable scenario in which button cells represent more than one to two tenths of one percent of sales for any mass-market retailer. For example, in a supermarket, button cells may account for no more than twenty-five out of twenty five thousand stock keeping units.

Since mass-market retailers have no motivation to devote management time to button cells, button cell manufacturers have limited influence on how mass-market retailers merchandise the product. Individual manufacturers complain they are unable to convince even the most professionally run mass-market retailers to properly display and promote button cells, even when they can demonstrate that proper merchandising will have a significant positive impact on the retailer's total profit.

Under these conditions, it seems unlikely that any significant number of mass-market retailers would be willing to implement a button cell collection program, even if paid a nominal fee per battery collected.

g. Specialized Retail Channels

Button cells also reach consumers through specialized channels of distribution:

- For silver oxide cells: jewelers, watch-makers and watch repair facilities, and camera and photo stores
- For zinc-air cells: audiologists, hearing instrument specialists, hearing instrument manufacturers and service centers, and mail order/internet vendors.
- For manganese alkaline cells: camera and photo stores, toy and game stores, device manufacturers, etc.

According to the 1997 Census of Retailers, Connecticut was home to 350 jewelry stores, 175 hobby and game stores, and 60 camera and photography supply stores.

These numbers have probably not changed appreciably. Each of these was a potential (and likely) retail outlet for button cells.

The American Watch Association estimates that 95% of silver oxide button cells are captured in existing collection programs that focus on, but are not limited to jewelers and watchmakers. (See below).

If the remaining 40% of manganese alkaline button cells are distributed by hobby, game, camera, and photography stores, and if our previous calculations are correct, then in 2002 these outlets delivered button cells containing 1.52 pounds of mercury. If each of these specialty stores carried manganese alkaline button cells, then in 2002 the average specialty store delivered manganese alkaline button cells containing 0.00647 pounds, or 0.10 ounces of mercury.

According to the Connecticut Department of Public Health, as of October 16, 2003, there were 231 licensed audiologists and 127 licensed hearing instrument specialists in the state, a total of 358 licensed professionals. While it is true that some of these licensed professionals are inactive, and others practice in small groups, each is in some sense a separate retailer, and a potential (and likely) retail outlet for button cells. It is impossible to identify the number of retail outlets that distribute hearing aids that do not require the services of a licensed professional for fitting.

If licensed audiologists and hearing instrument specialists account for 30% of zinc-air hearing aid battery sales in Connecticut, and if our previous calculations are correct, then in 2002, these professionals delivered about 808,000 button cells containing 13.62 pounds of mercury, an average of about 2258 button cells containing about 0.038 pounds (0.61 ounces) of mercury per professional.

According to the 1997 Census of Business, Connecticut was also home to 188 electronic shopping and mail order houses. Presumably this number has increased as a result of the increased popularity of the Internet. It is impossible to determine how many of these sell button cells to consumers, how many customers they have in Connecticut, nor how many such establishments located outside Connecticut sell button cells to Connecticut residents.

A Google search of the Internet for Hearing Aid Batteries produced approximately 125,000 hits. I checked the first 19 pages (181 entries) and found each advertising zinc-air button cells for sale to individuals. A Google search of the Internet for Watch Batteries produced approximately 770,000 hits. Most of these appeared to offer button cells in association with other products.

It is difficult to make a clear distinction between mail order distribution of zinc-air hearing aid batteries and professional distribution through audiologists and hearing instrument specialists, because many licensed professionals offer batteries to their patients both on a walk-in basis and by mail as a convenience, as a means of building a lasting relationship with their patients, and as a source of additional income.

Mail order (and Internet) vending of button cells is a business with low barriers to entry and low barriers to exit. Mail order vendors compete on price and maintain tiny profit margins. Suppliers come and go, and are impossible to identify geographically. Increasingly, they represent Chinese and other foreign button cell manufacturers who maintain no physical presence in the United States

Some mail order vendors, like the audiologists and hearing instrument specialists, provide button cells by mail as an add-on to their primary business in a related product line; others are highly specialized and offer no other products and services. Mail order vendor advertising for button cells is everywhere button cell users congregate on the Internet and in print. Magazines like the American Association of Retired Persons (AARP) Modern Maturity that cater to older people more likely to use hearing aids are full of tiny ads from mail order vendors, some of whom are very sophisticated, significant businesses.

There is no apparent concentration among mail order vendors. AARP itself does not sell button cells; it does contract with a Minneapolis mail order house, United Health, as its official vendor. United Health has much less than 5% of the market.

Because of the cost and administrative burden it is unlikely that mail order vendors would be willing to volunteer to implement a button cell collection program for a single state.

If mail order vendors account for the remaining 10% of zinc-air hearing aid battery sales in Connecticut, and if our previous calculations are correct, then, in 2002, these vendors delivered button cells containing 4.54 pounds of mercury. The amount delivered per mail order vendor is much smaller, and cannot be calculated.

4. RELATED BATTERY COLLECTION EXPERIENCE

We have identified seven related battery collection programs: the silver oxide button cell collection programs organized by the AWA and the silver recovery industry, various battery collection programs operating in Europe, two community-based battery collection programs and one mercury collection program operating in the United States, the Rechargeable Battery Recycling Corporation program for rechargeable batteries, and the Thermostat Recycling Corporation program for recovery of mercury in thermostats.

The silver oxide collection programs (which currently operate in Connecticut) are the only battery collection programs we can identify that have been financed without financial assistance from another party. Financing by state and local governments, or by retailers and device manufacturers operating under a legislative mandate has been required for every other program. These financial sources are not available to support the collection of manganese alkaline or zinc-air button cells in Connecticut.

a. Silver Oxide Button Cell Collection Program

According to the AWA, 95% of watch batteries are currently recycled.

The collection of silver oxide button cells is driven by the monetary value of the silver that can be recovered from used silver-oxide cells. At early December 2003 prices, silver is being sold at $87 per pound. Zinc sells at $0.45 per pound or roughly 1/200th the price of silver.

The American Watchmakers and Clockmakers Institute Education Trust ("AWI") accepts donations of used batteries nationwide and enables retailers and watch manufacturers to write off the value of the silver content for tax purposes. AWI promotes the program through its state chapters and conducts an annual competition rewarding the chapter whose members accept the most. There is also a robust silver recovery industry: waste management companies routinely approach all industrial sources of used silver, including retailers, and purchase silver-oxide batteries directly.

b. European Collection Programs

Twelve countries that comprise 67% of the European market currently require the collection of all batteries sold within their borders. In the chronological order in which their requirements were imposed, they are: Austria, Belgium, Netherlands, Switzerland, Sweden, Germany, France, Czech Republic, Hungary, Poland, Portugal, and Spain. In each country, the retailer takes back batteries, including button cells, at the point of sale.

Collection and recycling is funded by levies based on the sales of battery manufacturers that are then passed on through the distribution channel. Retailers are required to participate. Each country's program operates independently. Collection and recycling organization (CRO) cost structures vary widely. Since button cells are not collected separately, many costs are bundled together with the costs of collecting other batteries and cannot be identified separately.

In 2002, the average cost in Europe was 773 euros per ton of batteries collected; however, the costs and the cost structures of the various country collection and recycling organizations vary widely. Costs per button cell collected have been estimated to range from 0.4 cents U.S. in Germany to 13 cents U.S. in Belgium.

The Belgian program is the most successful, yielding a collection rate of about 50% of new battery shipments. To achieve this success, the Belgian CRO paid about 4.6 million euros for promotion and advertising in 2002 (about 2,087 euros per ton of batteries collected), far more than the cost of collection, 0.8 million euros (about 363 euros per ton) or the cost of sorting and recycling, 1.8 million euros (about 817 euros per ton). Total costs of 11.1 million euros are 6.16 times the cost of sorting and recycling.

The total cost of this program clearly includes costs associated with collecting and recycling other types of batteries. Therefore, the *total cost* cited above is not representative of the total costs of collecting and recycling button cells alone.

But Connecticut does not require collection of other types of batteries. Therefore, in Connecticut, all the cost of education (promotion and advertising) reported in Belgium would likely be required to support a button cell collection program.

As of July 2000, the population of Belgium was estimated to be 10,241,506 (www.yahooligans.com/reference/factbook/be/popula.html). Currently, $1 equals about 0.85 euros (www.exchangerate.com). Thus, a comparable program in Connecticut would need to spend $1,809,820.60 for promotion and advertising. This figure is more than 6.75 times the industry's profit from selling button cells that reach Connecticut consumers.

c. Community Based Programs

Hennepin County, Minnesota

Hennepin County, Minnesota has a land area of 611 square miles and a population of about 1.1 million people living in and around the city of Minneapolis. According to Amy Roering of the Hennepin County Environmental Services Department, the county collects button cells as part of a comprehensive system, which currently collects all types of batteries, fluorescent lamps, mercury-containing items, consumer electronics and household hazardous waste.

Mixed button cells are collected in small cardboard boxes provided by the county at 176 locations throughout the county. When the box becomes full, the location calls the county for a pickup and a replacement box.

The county also collects button cells along with other types of dry cell batteries in larger, 30-gallon containers at an additional 71 locations (no duplicates with the button boxes). The City of Minneapolis also provides curbside pickup of all types of batteries (button and dry cell).

Battery boxes and containers are located in certain city halls, county buildings, drug stores, health care facilities, hardware stores, jewelers, libraries, photo stores, retail stores, senior apartment complexes, and senior citizens' organizations. The county contracts with PPL Industries to service the 30 gallon containers; the City of Minneapolis sorts and consolidates the batteries by type, and stores them in drums until a shipment is warranted. Button cells are consolidated at PPL, but they are not sorted by type. The county's hazardous waste vendor sorts the button cells and recycles/disposes of them.

Hennepin County has followed the practice of accumulating used button cells over time and shipping them to reclamation/recycling facilities at irregular intervals. One drum, containing 803 pounds of button cells was shipped in 1991, eleven drums containing 7,676 pounds of button cells were shipped in 1998, two drums containing 1,822 pounds of button cells were shipped in 2001, and one drum containing 798 pounds of button cells was shipped in 2002. Assuming that all the cells shipped in 1991 were accumulated in 1991, the county shipped a total of 15 drums containing 11,099 pounds of button cells in twelve years, an average of about 925 pounds per year.

This program presents certain safety risks (as discussed below); it does not appear to comply with U.S. Department of Transportation regulations regarding the shipment of batteries in separated compartments or containers.

In this program, button cells are collected and processed as part of larger waste stream; therefore no cost breakout is available. An unknown percentage of the button cells collected are lithium cells.

Local governments finance this program, a practice prohibited in Connecticut.

Burlington, Vermont

Chittenden County, Vermont has a population of about 150,000 people living in and around the city of Burlington. According to Jen Holliday of the Chittenden County Solid Waste District, the county receives button cells at seven recycling centers. Over a three year period, from fiscal year 2001 to fiscal year 2004, the District has received 174 pounds of mixed button cells and 9 pounds of lithium coin cells (about 5% of the total), an average of 58 pounds of mixed button cells per year.

Operational details are unknown. A local government finances this program, a practice prohibited in Connecticut.

Miscellaneous Community Programs

Wheelabrator Technologies Inc., of Hampton, New Hampshire has mercury collection programs in sixty-nine communities, and has offered to collect button cells in each one. Only six communities with a total population of 183,000 have agreed to participate. Each has a collection box in the town hall. In 2002, these programs collected 53,120 button cells. An unknown number were lithium cells. Without further knowledge of the sixty-three communities that have chosen not to participate it is not possible to use this information to predict the success of a community collection program in Connecticut.

d. Rechargeable Battery Recycling Corporation (RBRC)

The Rechargeable Battery Recycling Corporation (RBRC) is a 501(c)(4) not-for-profit corporation engaged in the business of collecting and recycling nickel-cadmium, nickel-metal hydride, lithium-ion and valve regulated lead acid (small sealed lead acid)

rechargeable batteries (< 2.0 lbs) in the United States and Canada. The company is operated by a board of directors represented by battery manufacturers and outside directors, but is financed by the manufacturers and marketers of the devices in which those batteries are used.

This program began as a response by the Portable Rechargeable Battery Association (PRBA) (a trade association of manufacturers of batteries and battery-operated products) to a series of laws in seven states mandating the collection of nickel cadmium batteries. Product manufacturers have been required by law to participate.

The RBRC supplies participating retailers and community collection sites with collection boxes and pre-paid shipping materials. When a retailer sells a rechargeable battery, they take back the spent battery, put it in a plastic bag supplied by RBRC, and drop it in a pre-addressed, pre-paid shipping box supplied by RBRC. When the shipping box is full, the retailer ships it postage-paid to RBRC via United Parcel Service. Communities are similarly supplied collection boxes and incur no cost in shipping batteries to recycling facilities. Business collection sites follow a similar procedure, however, they must pay their own freight costs. RBRC pays actual the cost to recycle batteries from all sources. The RBRC program sends all batteries to INMETCO, an EPA certified recycler in Ellwood City, PA where they are sorted by chemistry and any contamination is removed and the batteries are recycled. Recovered materials, including cadmium and nickel are recovered, and can be used to make new products, including batteries and stainless steel.

RBRC believes that retailers are willing to participate because they make money on the sale of the devices powered by the batteries. Rechargeable batteries are typically much more expensive than button cells; it is not unusual for a laptop computer or cell phone battery to retail for more than $100. Only laws in Iowa, Maryland, and New Jersey require retailer participation.

RBRC currently serves about 35,000 large and small participating retailers nationwide, but none are supermarkets or drugstores who normally don't sell a lot of rechargeable products. The focus is changing away from smaller, single unit retailers toward large chain stores and service and repair centers, where volumes are higher.

RBRC drives participation in the program with an extensive public service media and advertising campaign, a website, and a toll free consumer help line (1-800-8BATTERY). The website gets about 31,000 hits per month, and the phone system over 12,000 calls per month.

License fees paid by product manufacturers finance the RBRC program. In return for the fees, product manufacturers receive the right to display the RBRC battery recycling seal, label their battery packs, and inform consumers and state and federal officials that the RBRC program covers their batteries. In 2002, RBRC revenue was $9.63 million. Total program and management expenses were $7.74 million. The balance of funds is held in reserve to cover future collection costs.

In 2002, RBRC collected 3.7 million pounds of nickel cadmium batteries, 250 thousand pounds of nickel metal hydride batteries, and 150 thousand pounds of lithium ion batteries. RBRC also collected 25 thousand pounds of non-rechargeable batteries. At the end of the year, additional spent batteries were in the system, at the collection sites or in transit. Because these batteries last several years in service, and are often retained or hoarded after end of life, it is impossible to determine what percentage of the annual sales of these batteries were collected.

RBRC believes that the process has to be totally cost free and convenient for the retailer, must be designed to minimize contamination, and works because it is focused on large volume collection sites. Unfortunately, there do not appear to be any obvious high volume collection sites for button cells in Connecticut.

RBRC automatically replenishes stores with collection containers and bags and encourages the stores to locate the collection box behind the counter so the batteries can be packed properly. The clerk serves as a last line of defense against contamination.

Of the $7.74 million spent in 2002, recycling expenses were $3.59 million, marketing expenses were $3.35 million, and management, general, and administrative expenses were $0.8 million.

Major items included in marketing expenses were: paid TV, radio and print advertising, $2.1 million, public relations, $0.3 million, a professional spokesperson, $0.25 million, trade shows, $0.15 million, and maintaining the web site and 1-800 phone system, $0.1 million. In addition to the paid advertising, RBRC benefits from numerous public service announcements due to its not-for-profit status. More than 366 million media impressions were generated by RBRC's media education campaign in 2002 RBRC qualifies for not-for-profit status because of its largely educational purpose. RBRC expects to increase marketing expenses in 2004.

Recycling expenses were about equally split, about $1.2 million each for purchasing and distribution of the collection boxes, freight to collect the batteries, and actual processing at the INMETCO facility.

Total RBRC expenses of $7.74 million were 6.45 times the actual processing cost at the INMETCO facility.

Management, general, and administrative expenses included approximately $100,000 for liability insurance.

Significant costs were required to setup RBRC and significant assets have been required to maintain its program. Since its founding in 1994, RBRC has invested more than $1 million in software development alone. At the end of 2002, RBRC had total assets of almost $20 million, and net assets of $12.6 million. The RBRC has set aside the bulk of these net assets for the future collection of unfunded batteries.

RBRC experience cannot be used to predict results for a button cell collection program in Connecticut because the industry has no means to compel device manufacturers (or retailers) to participate.

e. Thermostat Recycling Corporation (TRC)

The Thermostat Recycling Corporation (TRC) is a not-for-profit corporation owned by three NEMA member companies. It facilitates collection of all brands of used, wall-mounted mercury-switch thermostats by heating, ventilation, and air-conditioning (HVAC) wholesalers from HVAC contractors so the mercury can be purified for reuse.

The TRC began operation in eight Midwest states and Florida in early 1998, expanded the program to include fourteen eastern jurisdictions in 2000, and to remaining lower 48 states in 2001.

In a process similar to that of the RBRC, TRC places shipping containers in HVAC stores nationwide; store personnel encourage contractors to leave used thermostats in the containers when they purchase new ones. When the container is full, it is shipped to TRC, where the contents are accumulated in larger batches and shipped to a recycling facility. TRC also processes thermostats returned to the three manufacturers.

As of August 20, 2003, there were 1,676 TRC containers in nearly 1,000 HVAC wholesale stores in the lower 48 states; 21 containers were in 12 stores in Connecticut. In 1997, according to the Census of Wholesalers, there were 5,524 HVAC wholesalers in the United States, 58 in Connecticut. TRC's voluntary approach has achieved participation by about 18% of the eligible locations.

TRC believes that participation is stimulated because HVAC wholesalers who participate have a competitive advantage—they can advertise that they offer collection to HVAC contractors who may have no other legal means of disposing of used thermostats containing mercury. HVAC contractors who come in to a store to dispose of used thermostats presumably are more likely to buy larger, more expensive HVAC systems at the same store.

These incentives to participate do not apply to retailers who might be involved in the collection of button cells in Connecticut.

During the first half of 2003, the TRC collected 37,014 thermostats and processed 358.04 pounds of mercury in the United States; 512 thermostats and 3.72 pounds of mercury in Connecticut. Additional thermostats were collected but remained in participating wholesalers inventory pending shipment. Because thermostats are typically in service for many years, it is impossible to calculate a meaningful capture rate.

Each thermostat evidently contains about 500 times the amount of mercury as a typical button cell.

Data on start-up expenses and costs of operation are not available.

Thermostat manufacturers finance the TRC program.

TRC experience is not directly applicable to a button cell collection program in Connecticut because the industry has no means to compel device manufacturers (or retailers) to participate and button cell retailers would not have the benefit of participation that would accrue to an HVAC wholesaler.

5. BUTTON CELL COLLECTION CONSTRAINTS

The design of any button cell collection program in Connecticut is constrained by nine significant constraints: the risk of fire safety, U.S. Department of Transportation regulations regarding shipping, the risk of ingestion by consumers, contamination of the waste stream by lithium batteries and other contaminants, the need and cost of educating consumers, the cost and limited availability of insurance, uncertain access to recycling, contingent Superfund liability, and environmental costs.

a. Fire Safety

Used batteries may contain small amounts of energy when disposed. Even if consumers only disposed of batteries that they believed to be dead, they may dispose of a battery with remaining energy because consumers cannot readily determine whether a battery is dead. For example, a piece of equipment may stop working because the battery does not have adequate power for the equipment but may still have some remaining power. Consumers also may simply dispose of batteries with remaining power by mistaking them for a dead battery. If terminals of batteries with remaining energy are in contact, that energy will short-circuit creating heat, potential leakage, and possibly a fire.

This is a relatively small problem if there is a 100% pure collection of only spent button cells containing mercury and the container is made of non-conductive and non-combustible material so that there is no fuel for any heat generated by short circuiting batteries. This problem becomes much more serious with lithium coin cells because of the larger surface area of the lithium battery terminals than button cells and their ability to rapidly discharge leading to higher energy output and greater chances of heat generation. It also becomes a problem if other types of batteries are placed in a collection container because button cells can serve as a bridge between terminals of larger batteries to create a short circuit with batteries having greater energy than the button cell itself.

Lithium electrolyte is flammable. These batteries also contain metallic lithium, a highly reactive metal, that, when exposed to water, liberates hydrogen, a very flammable gas. At a mercury recycling facility, batteries will be shredded or hammered. If the recycler shreds or hammers lithium batteries, they will ignite as they are opened. Ultimately the lithium metal may ignite.

It is hardly unreasonable to expect that there will be some level of contamination from any collection program. We see contamination in both the RBRC and TRC collection efforts despite education of stores with collection containers. The RBRC containers explicitly say that consumers should not place alkaline batteries in the containers. Yet the RBRC, now in its tenth year of operation, still collects 25,000 pounds of nonconforming (non rechargeable) batteries a year. Some communities that collect rechargeable batteries also collect non-rechargeable batteries because they believe consumers do not distinguish one battery type from another. The TRC makes clear that it accepts only whole containers but it still receives cans that contain clipped mercury ampoules. Based on this experience we would expect a similar level of contamination any button cell collection effort despite education efforts.

The DEP appears to agree with these concerns. Its publication, "Managing Household Batteries: A DEP Recycling Program Fact Sheet," states (in relation to collecting silver oxide batteries) that "Sorting batteries is labor intensive, potentially dangerous, and requires familiarity with the various types of batteries." Regarding lithium batteries, the DEP Fact Sheet says "Lithium is a highly reactive metal and, when collected with other button cells, may present a hazard if not fully discharged." www.dep.state.ct.us/wst/recycle/batthaz.htm.

Lithium batteries flat-line discharge; that is, they produce current at full voltage until the energy in the electrolyte is completely exhausted, at which point they produce no current. Other types do not flat-line discharge. There is no way to insure that batteries will be fully discharged when collected.

Currently, the vast majority of used button cells are individually disposed of as they are replaced, with minimal risk of short-circuiting and fire.

An industry sponsored collection program will inevitably lead to the accumulation of inventories of used button cells in the hands of both consumers and collectors, increasing that risk and leading to increased insurance costs for the operators of the program.

On August 21, 2003, Onyx Electronics Recycling, a firm that reprocesses lithium batteries has warned its clients by letter that

> "If lithium batteries are improperly packaged they can pose a serious fire hazard. Batteries that are loosely packed can short circuit and release a significant amount of heat. The heat can cause more batteries to burst, releasing the lithium, and when the lithium is exposed to a sufficient amount of heat or moisture it will begin to burn. The fire will burst more batteries and the reaction will quickly get out-of-control . . .
>
> Over the past two years, three significant fires have occurred due to improperly packaged lithium batteries, Fortunately, none of these incidents have occurred at Onyx facilities."

In an incident of this type during the night of August 14-15, 2002, an 85-gallon drum of lithium batteries sent for recycling burst into flames at a Safety Kleen facility in Clarence, New York. The fire engulfed the facility, caused $2 million in damages, forced safety officials to consider evacuating the community, and took two hundred town firefighters and a "jet-fuel-fire-fighting apparatus" from the Buffalo-Niagara International Airport seven hours to control.

According to U.S. Chemical Safety and Hazard Investigation Board Incident report number 2002-5199,

> "Van Domelen (the facility's manager) said the likely cause was either an internal or external short circuit inside one of the lithium battery casings being stored in a treatment room at the facility. The short sparked a fire, which led to a series of explosions at the plant, where spent lithium and alkaline batteries are stored, treated and shipped for disposal."

This report can be found at www.chemsafety.gov/circ/post.cfm?type=basic&b01=10&rf=full&incident_id=5899#disclaimer.

The event was covered by WIVB, the CBS television affiliate in Buffalo, NY, which subsequently honored the Clarence Fire Company as being the Bravest of Western New York for their efforts at the scene.

In another incident of this type, a fire that evidently started in a battery collection container burned a Radio Shack store in Pennsylvania to the ground.

b. USDOT Regulations

US Department of Transportation Research and Special Programs Administration (RSPA) regulations require that batteries be shipped only when they are protected from short-circuiting. Special Provision 130 exempts dry batteries (other than lithium batteries) from the RSPA Hazardous Material Rule provided that dry batteries "are securely packed and protected against short circuits." (49 CFR 172.102 (c) found in 68 FR 44991 (July 31, 2003). 49 CFR 173.185 (e)(4) contains a requirement that shippers must prevent short circuiting of lithium batteries and that batteries be packed in strong packaging for conditions normally encountered in transportation. RSPA regulations (49 CFR 173.21) prohibit the shipping of any product unless the product is protected from short-circuiting. That would mean that extra care would have to be taken for batteries by taping the terminals or placing individual batteries in plastic bags as is done with rechargeable batteries (See RBRC Safety Guidelines http://www.rbrc.org/community/disposal.html#storage).

Taping or repackaging button cells at the collection point will add significantly to the cost and complexity of any industry sponsored collection program, and may dissuade some parties (particularly retailers) of their willingness to implement the program.

To comply with existing transportation requirements and to minimize the danger of shipping used button cells, there would need to be an extensive education program for every employee at a collection outlet and every consumer. This would require both consumers and collection points to distinguish lithium coin cells and other batteries from other button batteries and for consumers or collectors to place each battery in a plastic bag or tape its terminals. Given the number of users of button cells, the greater degree of infirmity of the largest users of button cells, older people with hearing aides, and the number of distribution channels, this task would present a very significant challenge.

c. Ingestion Risk

According to the National Capital Poison Center (NCPC), there are thousands of incidents each year in which people swallow button cell batteries. Most of these people are young children or elderly. Hearing aids and games and toys are the most common intended use of the batteries involved.

In most cases, ingested batteries will travel through the body without a problem. In some cases, however, batteries can become lodged in the esophagus, the ear, or the nose canal, which can result in tissue damage. Damage can result either from leaking alkaline electrolyte or generation of an external current.

Esophageal burns can lead to a number of adverse effects. Lodging of button batteries in ear and nose canals can result in tissue damage, hearing impairment, and facial paralysis. Lithium coin cells present a greater ingestion risk because of their larger voltage. Their larger size leads to a greater chance of lodging.

A collection program would encourage people to retain inventories of spent batteries rather than disposing of them promptly. This added retention time would increase the time available for battery ingestion. People currently dispose of most button batteries individually, so there is less opportunity for mischief with the batteries.

Individuals most at risk would be hearing aid users, who tend to be older and more infirm than the general population, take more medicines orally, have poorer eyesight, and are more forgetful.

In response to a written request from the Connecticut Department of Environmental Protection, Dr. Toby Litovitz, Executive and Medical Director of the National Capital Poison Control Center said the following:

> "More than 1,800 button battery exposure cases are reported to US poison centers each year. Most of these cases are ingestions; some involve batteries placed in the ear or nose. In most cases the batteries pass entirely through the digestive system without causing problems for the patients, but a few ingestions lead to serious medical complications. The complications can be esophageal burns, perforation, stricture, or infrequently death. Batteries in the ear and nose can cause serious problems such as nasal septal perforation or destruction of parts of the inner ear.

> In my opinion, the potential for harm caused by ingestion of a battery, or its placement in the ear or nose, overrides any need to recycle this extremely small amount of material. A safe recycling program would incorporate a mechanism to prevent unintentional ingestion of batteries . . . both at the site of the final repository as well as in the home. In reality, assuring safe collection in the home is problematic. It would require significant investment in designing and providing secure collection devices as well as a fundamental change in the behavior of the user. Neither is a practical concept. We have spoken out repeatedly against battery recycling programs because they fail to address these practical considerations that impact individual consumers collecting these miniature batteries at home, ultimately leaving the batteries accessible to small children and other susceptible individuals. We have not envisioned, nor have we seen a recycling program proposed that would prevent retrieval of the battery from the recycling container AND address the issues of battery accessibility prior to the battery being deposited in the recycling container. For example, recycling containers placed in stores merely encourage consumers to collect batteries at home, ultimately resulting in inadequate storage protection.
>
> We have worked with the toy and hearing aid industries for years to promote secure closures on products using button batteries. In addition, most manufacturer's battery packages are relatively child resistant. We urge you not to undermine these safety gains and to exercise caution before instituting a recycling program that leaves batteries loose and exposed in the home."

The Connecticut DEP made no reference to Dr. Litovitz's comments in its letter to NEMA of July 10, 2003. Ingestion is a concern even without a collection system in place, but the DEP has ignored Dr. Litovitz's observation that requiring collection will increase ingestion risk because it will motivate people to maintain larger inventories of batteries for much longer periods of time.

NEMA agrees that the problem requires attention. For more than twenty years, the battery industry has provided funding to the National Capital Poison Control Center to provide medical response for these situations. Battery packaging warns consumers not to swallow batteries and to call the National Capital Poison Control Center hotline in the event that someone does ingest a battery. The DEP suggestion that ingestion may be more effectively addressed through a collection plan ignores the comments that the DEP solicited from Dr. Litovitz, who believes that collection will result in a greater frequency of ingestion.

d. Contamination

Any collection program for used button cells will attract contaminants: lithium cells, coins, and other items that do not contain mercury and cannot be recycled. Some may be dangerous (the European programs report having received munitions in unsupervised curbside collection boxes). The safety hazards and the costs of removing and

transporting these contaminants place significant constraints on the design and operation of a button cell collection program.

Contamination is a concern both in collection and at recycling facility. Contamination may result in a recycling facility receiving materials and products the facility is not permitted to handle, placing their permits in jeopardy. Recycling permits and technology are material specific.

As the RBRC has observed, involving trained personnel at the point of collection can reduce contamination. Collection boxes should be supervised wherever possible; the program should require citizens to interact with a trained person at the point of collection.

e. Education

Individual consumers throughout Connecticut have assumed, learned or been taught that it is legal and appropriate to dispose of used button cells one by one in the household waste stream and that collection and recycling is *optional*. Absent some reason to collect and recycle, the typical consumer will not be a willing participant.

The success of any additional button cell collection program depends on the industry's ability to change this attitude. That will require a significant educational campaign of public relations and advertising that may be cost prohibitive. It is unlikely that the attitude of every consumer (or any significant percentage of consumers) can be changed with an industry budget of less than $300,000 per year.

Success with a button cell collection program also requires that we educate and train the individual employees in the distribution channels who contact consumers who use (and might return) button cells. We would also have to train individuals to properly sort, pack, and ship collected cells. Since retail service personnel have high turnover rates, the employee education program will need to be repeated frequently.

f. Insurance

Any new button cell collection program can be expected to be held liable for damages that may be caused by the collection, sorting, packing, transportation, and recycling of the used button cells. Insurance will be required. Whether such insurance is available, and if so, at what cost, is unknown.

Insurance costs for such a collection program are specific to the material, collection methods, and recycling facilities employed. Such policies are unique. There is a very limited market. Both RBRC and TRC report that their insurance is essentially a fixed cost determined by what they do, *not* a variable cost based on the volume of material they collect.

g. Uncertain Access to Recycling

NEMA has identified only one company capable and interested in recovering mercury from mixed used button cells: Mercury Refining Company, Inc., (MERECO) in Albany, New York. INMETCO, used by RBRC, does not accept button cells.

Should MERECO be unable to perform, and if NEMA cannot identify an alternative company interested in taking mixed used button cells, then any new button cell collection program would be unable to recover mercury and collected batteries would be disposed in landfills, essentially returning them to the waste stream from which they had been collected at great effort and expense.

Presumably, sorting out the contaminants would be required to make a mixed used button cell waste stream acceptable to additional recovery companies. As the DEP publication cited above "Managing Household Batteries: A DEP Recycling Program Fact Sheet," states (in relation to collecting silver oxide batteries) "Sorting batteries is labor intensive, potentially dangerous, and requires familiarity with the various types of batteries."

h. Contingent Superfund Liability

MERECO Is a Superfund site.

In the Federal Register, October 2, 2003, pages 56835-56836, the U.S. Environmental Protection Agency gave notice of an administrative settlement agreement with Mercury Refining Company, Inc. and Leo Cohen, its founder, sole shareholder, and former president, for the payment of past and future response costs for this site. The settlement requires that the EPA be paid a total of approximately $524,000.

Persons that dispose of waste material at Superfund sites become jointly and severally liable for all past and future costs of cleanup if the facility is unable to meet its obligations, or if new obligations are discovered. Thus, any single manufacturer who chooses to participate in a new button cell collection program in Connecticut could become exposed to liability for the entire cleanup cost of the MERECO site. It seems doubtful that the continued profits on the sale of button cells in Connecticut alone are sufficient to justify a manufacturer taking on this contingent liability.

i. Environmental Costs

Collection, sorting, packing, transportation, and recycling of used button cells in a newly developed collection program will create additional environmental impacts. The nature and magnitude of these impacts is difficult to calculate and will depend on the design of the program and its relative success.

Collection of button cells will involve transportation from the consumer's home to a collection point, from the collection point to a central aggregation facility, and from that facility to a recycling facility. This transportation will impact the environment.

Sorting and packaging cells at the initial collection point will require collection boxes and packaging materials (probably plastic bags) to keep the cells separated. The manufacture and distribution of these supplies would impact the environment as would commuting trips to and from home to the collection points for the people sorting and packing the batteries.

Additional materials, supplies, and labor would be required at the aggregation point, and additional transportation would be required from the aggregation point to the recycling (or resource recovery) facility. Each of these would also impact the environment.

The magnitude of the environmental impact will depend on how the program operates, on the number of batteries collected, and on the extent of contamination.

In an August 2001 study entitled "Assessment of the Environmental Impacts Associated with the Transport of Waste Batteries in Europe," the European Portable Battery Association determined that significant environmental impacts were associated with the transportation of used batteries in each of three scenarios: curbside collection, collection at civic amenity sites, and retail take-back collection. Button cells were considered as part of the total waste battery stream. The authors assumed that 75% of batteries sold would be collected. An analysis was made for the UK and extrapolated to Europe for each of two transportation plans of 200 km and 500 km.

For each scenario, for each measure of pollution, using the most comparable (200 km) transportation plan, the annual environmental impact of transporting collected button cells in the UK was determined to be equivalent to that of the environmental pollution of one to four typical passenger cars. This analysis probably understated the environmental cost of a button cell specific collection program because the fixed environmental costs of the infrastructure were shared with the other battery types.

It is tempting to say that the environmental impact of an additional button cell collection plan in Connecticut would be very small. After all, if 300 to 400 million button cells are sold in the replacement market in the U.S. each year, if 1.2% of them are sold in Connecticut, and if there are, on the average, 600 cells per pound, then all the button cells sold in Connecticut in a year weigh just 7000 pounds, and the environmental impact of the program would appear to be equivalent to shipping one truck load with 7000 pounds of button cells and 4.2 million small plastic bags (a few pounds) from Connecticut to the recycling facility.

But in reality, any new program will not collect 100% of the button cells sold, they will be collected in small quantities from numerous locations, extra supplies will be necessary, many vehicles will travel with light loads, and depending on the specific plan adopted, many people may have to commute to sort and pack batteries at scattered collection points.

6. BUTTON CELL COLLECTION COSTS

An additional button cell collection program in Connecticut may require significant startup costs plus annual expenditures for education, marketing, and promotion of the program; for containers, shipping, and processing of the button cells; and for management, general, and administrative expense, including insurance, and the cost of a web site and 1-800 phone system if needed.

Annual education, marketing, and promotion expenses will include costs of public relations, advertising, and trade shows designed to reach the general public and any partnering organizations.

Costs of shipping and recovery of the mercury should be directly proportional to the number of batteries collected. MERECO has quoted a price of $4.25 per pound for recovering the mercury from zinc-air button cells.

Other costs are not predictable. Containers and processing costs will depend on the program design, especially on how the batteries will be separated and packed in individual plastic bags for shipment. Costs of marketing, education, and promotion will be arbitrary and will depend on the type of program. It seems almost impossible to predict the relationship between marketing, promotion, and education costs and the number of batteries collected.

A button cell battery collection program implemented in a single state would have many fixed costs comparable to those in a national program.

7. ENVIRONMENTAL BENEFITS OF BUTTON BATTERY COLLECTION

Sources of Mercury in Connecticut – We are aware of no comprehensive data on sources of mercury in Connecticut. There are data available, however, from federal, regional, state and industry sources.

i. **Out of State Sources** – The NESCAUM 1998 report, "Mercury Study, A Framework for Action," using 1995 data, estimated that 53% of mercury emissions in the northeast (New York, New Jersey and the six New England states), came from outside the region (Page VI-16). In 1995 the largest source of mercury emissions in the region came from municipal solid waste incinerators. The report estimates that 42% of all mercury deposition in the Northeast came from municipal solid waste and sewage sludge incinerators in the northeast (Page VI-24). Sewage sludge incinerators emitted 1/8 the mercury of municipal solid waste incinerators so the overwhelming amount of mercury in this category comes from municipal solid waste incinerators.

Since then municipal solid waste incinerator emissions have dropped sharply (see below) without declines in other larger sources such as power plant emissions and fuel oil burning. An EPA Region V estimate of mercury emissions in the US shows that US emissions have declined from 149 to 115 tons of mercury. This decline came from emission reductions from municipal solid waste and medical waste incinerators. In addition, newer information has shown that a greater percentage of mercury deposition in the US is coming from outside the US. (See for example the 2003 UNEP Global Mercury Assessment citing modeling studies showing up to 50% of anthropogenic mercury deposition in the US comes from outside the US.)

We understand that NESCAUM currently is updating its estimate of sources of mercury. This update will undoubtedly show that a far greater percentage of mercury is coming from outside the region than shown in the earlier report because of the very large reduction of emissions from municipal solid waste incinerators and the large historic contribution of mercury in the northeast from this source.

ii. **Incinerators** – The Connecticut draft solid waste plan says that 82% of the state's solid waste is disposed in municipal solid waste incinerators. www.dep.state.ct.us/wst/solidw/swplan.htm. According to EPA Region V data and newer information from a survey conducted by EPA, municipal solid waste incinerator emissions have declined from 42 tons in 1990 to 24 tons in 1995 to 2 tons in 2001 (See http://www.epa.gov/region5/air/mercury/progress.html and June 20, 2002 memo from Walt Stevenson of EPA showing actual national mercury emissions from Municipal solid waste incinerators at 2 tons in 2001.

The 1998 NESCAUM report estimated that the region's municipal solid waste incinerators emitted 15,874 pounds of mercury in 1995. According to the EPA Status of State Plans for Large Municipal Solid Waste Incinerators, Connecticut has 17.7% of the region's incinerator capacity. That suggests 1995 mercury emissions from Connecticut MSW facilities were 1,276 pounds.

A survey conducted by the Integrated Waste Services Association (IWSA), which represents the municipal solid waste incinerator industry, shows that emissions from five of six Connecticut incinerators (only the smallest incinerator not surveyed) emitted 288 pounds of mercury in 2001.

According to IWSA, municipal solid waste incinerators currently remove 95% of mercury emissions. With a current emission level of 288 pounds of mercury, the amount of mercury entering Connecticut's municipal solid waste incinerators would equal 5,760 pounds of mercury.

iii. **Landfills** – The EPA Mercury Report to Congress concluded that total mercury emissions from municipal solid waste landfills was only .05 percent of total manmade sources of mercury emissions or 162 pounds out

of 154 tons. In making this estimate, EPA used a range of 5.8ng/m^3 to 20.8ug/m^3 of mercury emissions from landfills. A more recent study funded in part by the Florida DEP found that the mean concentration of total gaseous mercury emissions measured at the Brevard County landfill was 7.2 ug/m^3, well within the range that EPA used in its report. A recent analysis of mercury emissions for the New York – New Jersey Harbor prepared for the New York Academy of Sciences, after reviewing the Florida data and applying it to the Fresh Kills landfill in Staten Island, concluded, "…landfills are not a major source of gaseous emissions of mercury." "Sources and Material Balance of Mercury in the New York – New Jersey Harbor, by Nickolas J. Themelis and Alexander F. Gregory, Report to the New York Academy of Sciences, November 31, 2001, P. 23. And the 2002 New Jersey Mercury Report (p. 157) concludes, "Low concentration of mercury in landfill gas…argues that no efforts to control this source are necessary at this time." The Vermont Agency of Natural Resources estimated that in 2000, 0.1 % of mercury emissions in the state came from landfills even though the vast majority of garbage in Vermont is disposed in landfills.

iv. **Other New England State Data** – Other recent New England state data shows that mercury emissions from products are small sources of instate emissions. Button cells would be a very small source of the emissions from products.

a. Vermont – According to the Vermont Air Pollution Control Division, the 2000 Source Contribution of Mercury Emissions in the state were as follows:

Residential Fuel Combustion	- 36.4%
Automobile Switches	- 22.2%
Mobile Sources	- 15.3%
Industrial Fuel Combustion	- 11.7%
Residential Open Burning	- 4.1%
Lamp Breakage	- 3.9%
Crematoria	- 3.8%
Dental Applications	- 1.5%
Lab Use	- 1.0%
Landfills`	- 0.1%

Vermont has no in state municipal solid waste incinerators.

b. New Hampshire – The New Hampshire Department of Environmental Services released state emissions data from 2000. Of the 1,000 pounds of emissions, 37.6% came from burning fuel oil and 28.6% came from coal combustion. Large municipal solid waste incinerators were responsible for 16.6 %. The emissions from this source, however, exclusively came

from one incinerator that has installed emission controls since the DES released the study. As a result, municipal solid waste incineration now accounts for less than 2% of emissions in the state.

c. Maine – The Maine Department of Environmental Protection has published a report, "Mercury in Maine: A Status Report" in February 2002. The report estimates that of the 1,467.21 pounds of mercury emitted in 2001 in Maine, 845 came from commercial and industrial boilers. Municipal solid waste incinerators emitted 43.6 pounds or less than 3% of mercury emissions. Landfills emitted 6 pounds or 0.41% of emissions. Volatilization of mercury from breakage of all products emitted 93 pounds or 6.34% of emissions.

v. **Contribution of Button Cells** – Based on existing information, button cells disposed in landfills would not result in emissions of mercury. While Hennepin County encourages its citizens to take button cells to collection sites, the County website says that it is "OK to place in trash." www.co.hennepin.mn.us/environmental/learning/HHW.html.

According to the NEMA survey data, button cells sold by NEMA members in Connecticut in 2002 contained roughly 56 pounds of mercury. Silver oxide batteries, 95% recovered by existing collection programs, contained about 7 pounds. This means that button cells containing approximately 50 pounds are going into the solid waste stream. That is roughly one percent of the mercury currently entering municipal solid waste incinerators in the state.

With municipal solid waste incinerators having a 95% control rate, even assuming that all disposed cells are going into MSW incinerators except for collected silver oxide cells, button cells disposed in the MSW stream result in about than 2.5 pounds of emissions in the state.

vi. Summary

The vast majority of mercury being deposited in Connecticut is coming from outside the region. Even within the region, Connecticut emissions would make up a small portion of emissions in the region. Button cells make up a tiny portion of mercury entering the state's municipal solid waste incinerators. Any effort to collect button cells in Connecticut will result in virtually no change in mercury deposition in Connecticut.

8. EXISTING REGULATIONS

i. Federal – Almost all button cells are non-hazardous waste under the Resource Conservation and Recovery Act (RCRA). Button cells are not ignitable, corrosive, or reactive. Only the largest size button cells may fail the Toxicity Characteristic Leaching Procedure (TCLP). Under RCRA, even for the few

button cells that might fail the TCLP test, homeowners, who use the overwhelming percentage of button cells, can dispose of their button cells in the trash. Button cells are not regulated as hazardous materials under the US Department of Transportation hazardous materials requirements as long as they are packed to avoid short-circuiting.

Commingled batteries managed outside of the household and municipal collection schemes should be managed as "universal waste." EPA's Universal Waste Rule provides regulatory flexibility for generators and handlers of the commingled batteries, provided the materials are destined for viable treatment and/or recycling. Destination facilities that store the commingled batteries prior to recycling, however, invoke full RCRA Subtitle C jurisdiction, which includes satisfying all applicable BDATs (Best Demonstrated Available Technologies) under the LDR (Land Disposal Restriction) program as well as mercury NESHAP provisions of the Clean Air Act. Such regulatory burdens will result in higher costs to employ expensive thermal recovery techniques, or unnecessary sorting by handlers or destination facilities prior to recycling.

ii. Connecticut – Connecticut follows the RCRA hazardous waste rules. Public Law 02-90 does not ban the disposal of button cells in the trash.

iii. Collection/Labeling/Disposal/Use Requirements in Other States

Maine – Maine's mercury products labeling and disposal ban law does not apply to button cells. Maine bans the use of mercury in thermometers except for button cells.
New Hampshire – New Hampshire bans the use of mercury in thermometers and novelties.
Vermont – Vermont's labeling law specifically excludes button cells from the labeling requirement. The disposal ban only applies to labeled products.
Massachusetts – Massachusetts bans the sale of thermometers with mercury except for thermometers with button cells.
Rhode Island – Rhode Island's mercury law, which is not yet effective, exempts button cells from labeling, collection and the disposal ban. The bill bans the sale of thermometers and novelties with mercury except for those products with button cells.
Maryland – Maryland's law bans the use of mercury in thermometers except if they contain a button cell.
Florida – Florida's disposal ban does not apply to button cells.
Illinois – Illinois's law bans the sale of thermometers and novelties with mercury but exempts products with button batteries.
Indiana – Indiana law bans the sale of thermometers and novelties with mercury but exempts products with button batteries.
Minnesota – Minnesota's law bans the disposal and requires the labeling of many products containing mercury except button cells.

California – California law bans the sale of thermometers and novelties with mercury but exempts those products containing button batteries.
Oregon – Bans the sale of fever thermometers and novelties with encapsulated mercury.
Washington – Washington's law bans the sale of thermometers and novelties with mercury except those containing a button cell.

Summary – No state requires the labeling of button cells. No state requires manufacturers to collect button cells. No state bans the disposal of button cells.

9. ALTERNATIVE BATTERY INDUSTRY SPONSORED BUTTON CELL COLLECTION PROGRAMS

NEMA members would operate any new button cell collection program in Connecticut by setting up a new corporation to collect and recycle used button cells. The owners of the new corporation would then contract with NEMA or some other entity to manage it. NEMA would require the manufacturers (owners of the new corporation) to indemnify NEMA from all liabilities that might be associated with its operation.

Legal fees, insurance, and other setup costs for the new corporation alone could easily exceed the industry's annual profits on batteries sold to consumers in Connecticut; NEMA's current rates for management services are $135 per hour.

Once established, the new corporation would select one or more of the five collection programs described below. Each has a different set of appropriate partners who would operate the points at which citizens would offer used button cells for collection.

Each of these programs would require the new corporation to pay the setup costs of recruiting appropriate partners, arranging for insurance, writing software, buying initial supplies, and establishing systems to collect and sort the batteries at the partners' collection points, transport them to a central facility, sort them again to eliminate contamination, and ship them to MERECO. The new corporation would also have to pay the cost of marketing, promotion, and education of consumers, and the annual operating costs of the systems described above. Most of these costs would be fixed, and not dependent on the volume of button cells collected.

Based on the limited data on comparable programs we have cited above, both the setup and the annual operating costs for such a new program would far exceed the button cell manufacturers' annual profits on batteries sold to Connecticut consumers.

The five collection programs are: retail take back, partnership with audiologists/hearing instrument specialists, mail back, partnership with household hazardous waste collection, and partnership with municipal transfer stations,

a. Retail Take Back

NEMA members could attempt to form a partnership with one or more mass-market retailers similar to the RBRC partnership. Button cell collection is incompatible with the RBRC program because it would contaminate the RBRC waste stream with mercury. NEMA members could supply button cell collection packaging, retail personnel could be trained to ask to take back a battery for each battery sold, the batteries could be collected in the store, packed in individual plastic bags, and shipped UPS collect to a central facility where they could be consolidated into larger shipments to MERECO. The retailer and NEMA members could undertake an educational and advertising campaign to encourage public participation.

It is unlikely that a mass-market retailer would willingly participate, even if compensated by NEMA members. Unlike the bottle bill, which requires retail participation by law, there are no incentives to the retailer to participate in this plan other than a general civic duty to protect the environment. In my opinion, most mass-market retailers would opt out.

Even a successful retail take back program focused on mass-market retailers would yield very small amounts of mercury per store. Partnership with just one chain might be possible, but yield small returns. The Federal Robinson-Patman Act prohibits discrimination by manufacturers in providing advertising or other services to retailers; what was offered to one would have to be offered to all others.

Set up costs for a program that reached all mass-market retailers in Connecticut would be prohibitive. RBRC's program reaches the entire country for its products through 35,000 stores; A Connecticut button cell program would reach about 1.2% of the country's population through about 2,800 stores, about 8% of the RBRC total.

It is not feasible for NEMA members to change the consumer attitudes and behavior of the entire population of Connecticut with an annual promotional budget equal to total profits earned on button cells sold in the state.

Adequate employee education for this approach is equally infeasible. The 2,821 mass-market retailers identified above reported to the 1997 Census of Business that they employed more than 80,345 employees in Connecticut; at least half must be customer contact personnel who would require training. The stores represented in the more conservative estimate of 1,332 mass-market outlets reported they employed 48,953 people. According to the National Retail Foundation, average turnover in retail employment is 64% per year, so the training would have to be repeated frequently.

Since the mass-market retailers have more employees per store than the more focused retailers favored by RBRC, employee education costs per store for this approach would be much higher than RBRC's costs. Per store yield in pounds of mercury per year would be much less.

This approach would encourage mass-market retailers to accumulate used button cells until they had enough to send back, which invites all kinds of mischief.

Any successful effort to change the consumer attitudes and behavior towards collection of button cells will encourage consumers to collect inventories of spent batteries, which may present fire hazards in the home and will increase the number of reported ingestions. This applies to all possible collection programs.

b. Partnership with Audiologists/Hearing Instrument Specialists

NEMA members might seek a partnership with audiologists and hearing instrument specialists, who might them educate them and their patients about the need for recycling zinc-air batteries. NEMA members could supply educational materials, attend and make speeches to hearing industry conventions and trade shows, offer prizes for participation, and distribute mail back packaging and instructions so that patients could inventory their spent batteries and return them either to NEMA members or to the audiologists and hearing instrument specialists. NEMA members could then aggregate the batteries and ship them to MERECO for recycling.

Audiologists and hearing instrument specialists would have no incentive to participate other than a general feeling of responsibility toward the environment. There might be a limited positive benefit for a few who deal with environmentally conscious consumers. The time and trouble of participation would put them at a competitive disadvantage against mass-market retailers, mail-order vendors, and audiologists and hearing instrument specialists who were not willing to participate. It is impossible to identify the capture rate or the number of audiologists and hearing instrument specialists who would be willing to participate.

This approach would encourage consumers to collect inventories of spent batteries, which would present fire hazards in the home and would increase the number of reported ingestions.

c. Mail Back

Mail order vendors could be approached and asked to include mail back packaging and instructions with shipments of new batteries to consumers in Connecticut. Under this program, consumers would be encouraged to inventory spent batteries and mail them to NEMA members, who would aggregate them and ship them to MERECO for recovery of the mercury. Unfortunately, there is little concentration among mail order vendors serving Connecticut; in many cases, battery manufacturers do not know who the mail order vendors are.

Mail order vendors, if they could be located, would have no incentive to segregate their Connecticut business from their other business. Consumers would have little incentive to comply. Capture rate cannot be predicted. Ingestion and fire safety risks would exist.

d. Household Hazardous Waste Collection

Residents might be educated to bring spent button cells to a household hazardous waste collection program. There is a fairly well established household hazardous waste program in Connecticut. Residents participate routinely and some button cells are undoubtedly collected in this fashion already.

However, spent button cells would have to be separated from the hazardous waste stream, bagged or taped, accumulated for transportation, and transported to a central site for shipment to a recovery site, at some expense. Section 9(d) of the Act states "The cost of collection shall not be borne by state or local government."Local government currently pays for household hazardous waste collections. Therefore under this approach, the battery manufacturers would have to reimburse local governments for these costs. It is not clear that it is either possible or efficient for local governments to keep track of the volume of cells that would come in or the separable costs of processing those cells at the hazardous waste collection points,

There are currently only three permanent household hazardous waste collection facilities in Connecticut with one more planned. There are only eight Regional Shared One Day Collection programs, which typically collect in the spring or fall. (See www.dep.state.ct.us/wst/recycle/househaz.htm.) Because there are so few sites, and because of the Regional One Day Collection programs, this approach would encourage consumers to build inventories of spent button cells, increasing the risks of fire and ingestion.

Based on the capture rates of other community collection programs, this number of hazardous waste collection facilities is not adequate to capture a meaningful quantity of button cells. If a system of cost calculation and reimbursement could be set up, the cost would be prohibitive.

e. Municipal Transfer Stations

Residents might drop off spent button cells at a municipal transfer station. As mentioned, the cost cannot be borne by state or local government; a system would need to be established to either pack them and mail them to a recycling or aggregation facility through a prepaid mailer or by reimbursing the municipality. Any cost reimbursement system would face the same challenges as noted under Household Hazardous Waste Collection above. If the consumer picked up packing and mailing supplies at the Household Hazardous Waste Collection facility, packed them with spent cells, and either mailed them or returned the packages to the facility for mailing, there would be the added safety risks of improper packaging.

On the surface, it appears that a system like the one in Hennepin County installed in Connecticut, could be expected to collect about three drums (2400 pounds) of batteries per year. Assuming 582 batteries per pound and that each cell contains 8.5 mg. Of

mercury, a comparable program in Connecticut could be expected to recover about 26.2 pounds of mercury per year.

In practice, however, this number would be reduced, since the Hennepin County collection included an unknown number of lithium cells, and because zinc-air cells gain about 5% in weight as they are discharged.

Furthermore, Hennepin County's results were achieved using 247 collection stations in 611 square miles serving 1.6 million people. To achieve a comparable density in Connecticut would require 529 collection stations for Connecticut's 3.425 million people, or 1953 collection stations for Connecticut's 4,832 square miles.

If a system like the one in Chittenden County were installed in Connecticut, we could expect to collect about 1,324.3 pounds of button cells per year, yielding about 14.4 pounds of mercury, assuming no lithium cells were collected, without correcting for the increase in weight of the zinc-air batteries. To match the density of Chittenden County's collection stations in Connecticut's population would require about 160 collection stations.

There are not enough municipal transfer stations in Connecticut to achieve results comparable to those in Hennepin or Chittenden Counties. The costs of additional facilities would be prohibitive for button cell manufacturers, much larger than industry profits on batteries that are purchased by Connecticut consumers.

10. ABOUT THE AUTHOR

Richard F. Tozer is a consultant in Dallas, Texas, who uses analytical methods to counsel owners of emerging companies; help them make better strategic decisions, and accomplish their objectives. He also helps attorneys as an expert witness in legal cases involving complex business issues, and develops and presents financial and strategic management training programs.

A former member of management in a New York Stock Exchange listed company, Dick has been an adjunct professor in the Cox School of Business at Southern Methodist University, and is a lecturer in the School of Management of the University of Texas at Dallas, where he developed and presents the Entrepreneurial Ventures course in the Executive MBA program.

Mr. Tozer is a graduate of Case Institute of Technology, Cleveland, and of the doctoral program of the Harvard Business School. He is a member of the Institute of Management Consultants (former board member of the Dallas-Fort Worth Chapter), the Dallas Economists Club, and the National Association for Business Economics.

Dick has conducted several hundred financial and management training programs for various corporations and organizations. He has served consulting clients in the banking, information services, industrial distribution, manufacturing, training and professional

engineering industries, and has been conducting market research in the button cell battery industry since the early 1980s.