Utility Approaches to PCB Ballast and Mercury Lamp Disposal

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The subject of polychlorinated biphenyl-(PCB) containing light ballast and mercury-containing fluorescent lamp disposal has generated significant comment/attention among energy and environmental professionals, A renewed interest in this issue has been spurred by the growing popularity of the Environmental Protection Agency's (EPA) Green Lights Program, the growth and change of state regulations, and utility Demand-Side Management (DSM) programs. Utilities that encourage commercial and industrial customers to replace older lighting with more efficient alternatives should also advocate review of local regulations for disposal of lamps and ballasts as well as options for disposal. In an effort to identify disposal practices and regulations regarding these, as well as current trends, we compiled literature and conducted interviews with representatives from 11 utilities, the EPA, and a leading hazardous waste and PCB incinerator.

This paper[1] provides an overview of federal and state regulations surrounding PCB-containing ballast and mercury-containing fluorescent lamp disposal, a summary of equipment disposal options, and presents, in case study format, a review of how several utilities across the country manage PCB and mercury disposal and implications for operation of the utility. Findings suggest that utility response to and level of involvement with the disposal issue have run the gamut-from simply providing information (e.g., Rochester Gas & Electric) to actually managing the entire process (e.g., New England Electric). The level of involvement is variable both within and between different states. Some utilities allocate budgets specifically for ballast disposal, some include funding in the rebate amount, while others provide equipment rebates but leave the entire cost of disposal to the customer. The paper concludes that the incorporation of a ballast and lamp recycling/disposal service to a lighting efficiency program does not significantly reduce its cost effectiveness, and it eliminates utility liability associated with the hazardous waste disposal.

Introduction

Federal and State Laws Governing PCB Ballast Disposal

Prior to 1979, fluorescent light ballasts were manufactured with capacitors that contained PCBs. The Toxic Substance Control Act (TSCA) of 1976 established a series of prohibitions on the manufacture, processing, use or distribution of PCBs and, as a result, the use of PCBs in lighting ballasts ceased in 1979. TSCA, however, did not require immediate removal of equipment containing PCBs; thus, much of this equipment is still in use. In addition, some manufacturers' stock was still being sold as late as 1986. The life of a ballast is typically 15 to 20 years; the implication being that the majority of PCB-containing ballasts[2] in use are nearing the end of their useful lives and will require disposal.

TSCA did establish PCB disposal requirements, which ensured either destruction via incinerator or placement in a PCB chemical waste landfill. Non-leaking small capacitors—defined as capacitors containing less than three pounds of dielectric fluid-are exempt from TSCA disposal requirements (a ballast contains 0.5 to 2.0 ounces of PCB fluid). Leaking ballasts do not qualify for this exemption; TSCA requires these to be incinerated or placed in a chemical waste landfill.

When the EPA granted the original disposal exemption, it was assumed that a small number of ballasts dispersed randomly throughout a municipal landfill would not present a significant risk to the environment. Congress did not believe the EPA could effectively regulate disposal of small capacitors because, typically, these are removed one-by-one. However, with major lighting retrofit projects resulting from utility DSM programs and Green Lights, a

significant increase in the magnitude of ballast disposal has been the result. What the EPA assumed would be an occasional faulty ballast has, in many cases, become entire truckloads. Because these major retrofit projects resulted in a greater accumulation of ballasts, the EPA's original exemption is in question. In fact, it is reasonable to assume that when thousands of ballasts are compacted in a municipal landfill, some will leak.

The disposal of PCB-containing ballasts is also regulated by a second Federal law, the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). CERCLA and its subsequent reauthorizations are commonly referred to as "Superfund." Under Superfund, the "release of a reportable quantity of hazardous substances to the environment establishes liability if, in the future, remediation of the release is required. " The "reportable quantity" for PCBs is one pound, or the equivalent of about 16 ballasts. With Superfund, the EPA initiates clean-up of hazardous sites that threaten the environment, and then sues "potentially responsible parties (PRPs) to recover the cost of the clean-up. " Anyone with a known reportable quantity of a hazardous substance in a given site can be labeled a PRP. As such, it is difficult to identify and establish levels of responsibility for contamination in municipal landfills. In theory, utilities, DSM contractors, and building managers could be named as PRPs even though they never owned the ballasts, but because they were involved with financing, engineering, replacing, or improperly disposing of old PCB ballasts in disposal sites that become Superfund sites.

Due to liabilities associated with Superfund, the disposal of PCB-containing ballasts in municipal landfills is not a recommended practice. This view appears to be shared by many municipal landfills and states which have now restricted the disposal of PCB ballasts. Although many states do not regulate the disposal of non-leaking PCB ballasts, the disposal standards for these ballasts are far more stringent in some states than Federal TSCA or CERCLA guidelines. While many states rely on TSCA for regulation of PCBs, state standards can take many forms (e.g., written regulations, regional policies, written and verbal recommendations, transportation documentation only). Some states do not regulate PCB-containing ballasts as a hazardous waste, but prohibit their disposal in municipal landfills. Table 1 provides a listing of regulations and recommendations for each state.

PCB Ballast Disposal Options

There are five options for customers who must dispose of PCB ballasts. A discussion of each option follows:

- Leave disconnected PCB ballasts in fixtures-When installing a new ballast, the customer has the option of leaving the disconnected ballast in the light fixture. Although this option is convenient and inexpensive, it is very dangerous in the event of a fire.

- Dispose of PCBs in sanitary landfills-Municipal landfills were not designed to handle PCBs, and many will not take any electrical equipment with PCBs due to the risk of potential Superfund cleanup liability. The disposal of PCB-containing ballasts in sanitary landfills is often prohibited by state and local regulations although it is allowed under Federal TSCA regulations.

- Dispose of PCBs in chemical waste landfills-Although chemical waste landfills are cheaper than PCB incineration and are designed for maximum security, there is the potential for leaks. TSCA stipulates that PCB liquids must be drained from electrical equipment and leaking capacitors before they enter a chemical waste landfill, However, this is a difficult procedure for ballasts and, given their potential for leaks, chemical waste landfills are only viable as temporary storage facilities. Environmentally, however, they are far superior to municipal landfills for PCB ballasts. Chemical waste landfill costs are calculated by the drum. Costs range from $65/drum to $385/drum; the average cost is $150/drum, which equals approximately $1/ballast. Estimated costs do not include packaging, transportation, or documentation fees.

- Incinerate the entire ballast-This often involves shipping the entire ballast to one of four TSCA-permitted incinerators in the United States, Incineration is the safest and only proven method that guarantees complete PCB destruction. Whole-ballast incineration costs $6 to $10 per unit compared to $0.50 to $2 per ballast for disposal in a chemical waste landfill. Incineration costs are calculated by weight.

- Incinerate the capacitor and recycle the rest of the ballast-Another option is to remove the PCB capacitor from the ballast and send only the capacitor to be incinerated. The cost of capacitor incineration ranges from $4 to $5 per ballast. The remaining materials can be tested for contamination and, if clean, recycled for usable copper, steel, and asphalt.

Utility Approaches to PCB Ballast Disposal

Utility approaches to handling PCB ballast disposal as part of their high efficiency lighting programs are varied. Some simply provide information (e.g., Rochester Gas & Electric), while others elect to manage the entire process

Table 1. State Requirements for Non-Leaking PCB Ballast Disposal

State	Regulation or Recommendation
AL	In-state landfill requires prior approval from TSCA
AR	Regulates transportation of PCBs >50 ppm
AZ	Can be sent to municipal landfill if packed in approved drums
CA	PCBs >50 ppm are hazardous waste and must either be placed in lab packs and disposed of in hazardous waste landfill or incinerated
CT	PCB ballasts must be incinerated or sent to chemical waste landfill
FL	Follow EPA Region 4 Policy, which recommends chemical waste landfill
GA	Must check with local landfill and see if it will accept the waste
ID	Follow EPA Region 10 policy (>5 ballasts/yr. must be incinerated or sent to a chemical waste landfill)
IL	All PCB-containing ballasts meet definition of special waste (35 IAC)
IN	Need approval from TSCA to dispose of >25 small capacitors of ballasts/day
KY	Solid waste PCB greater than or equal to 1 ppm cannot be placed on the land, waste containing less than 50 ppm can be placed in a contained landfill, Residual landfills may dispose of PCBs according to their permit
LA	PCBs >50 ppm considered hazardous waste
MA	Policy on disposal and handling more stringent than Federal legislation
MD	Based on entire weight of ballast. Avg. 1-2 ballasts limit.
ME	All PCBs >50 ppm regulated as hazardous waste
MI	PCB disposal prohibited in Michigan landfills with no small quantity exemptions
MN	All PCBs >50 ppm regulated as hazardous waste
MS	PCBs >25 ppm must be disposed of in hazardous waste landfill
NJ	PCBs >50 ppm is hazardous waste, unless meets certain conditions
NM	Follow EPA Region 8 policy
NV	Recommends incineration or chemical waste landfill)
OR	Follow EPA Region 10 policy (>5 ballasts/yr. must be incinerated or sent to a chemical waste landfill
PA	If PCBs >50 ppm, then waste is regulated by DER
RI	All PCBs >50 ppm regulated as hazardous waste.
SC	In-state disposal requires prior approval from TSCA
TN	In-state disposal requires prior approval from TSCA
TX	3 lbs. or over per item or more than 20 items per 10 day period from a specific project, location or generator must be incinerated or sent to a chemical waste landfill. All wastes generated from a renovation project over 200 square feet in size must be incinerated.
VA	PCB-containing materials are regulated as Special Solid Waste. PCBs >50 ppm may not be disposed or stored without EPA approval. PCBs between 1 and 50 ppm restricted to disposal in sanitary landfills or industrial waste landfills
VT	All PCBs >50 ppm regulated as hazardous waste
Wash. DC	Recommends incineration or chemical waste landfill
WA	Follow EPA Region 10 policy (>5 ballasts/yr. must be incinerated or sent to chemical waste landfill)
WV	Follow EPA Region 3 policy
WI	All PCBs >50 ppm regulated as PCB waste

NOTE: States not listed follow Federal TSCA and CERCLA guidelines.

(e.g., New England Electric). The level of involvement with waste management is variable from state to state, and within states, Some utilities allocate budgets specifically for ballast disposal, some include funding in the rebate amount, and others provide equipment rebates but leave the entire cost of disposal to the customer. Utility positions tend to be grounded on federal, state, and local regulations, corporate objectives, legal counsel recommendations, budgetary constraints, program cost-effectiveness, and other factors.

A total of eleven utilities across the country were contacted in an effort to identify current approaches to ballast disposal associated with commercial and industrial customer lighting efficiency programs. The selection of the case study utilities was based on identifying those companies known to offer efficient lighting rebate programs; additional effort focused on targeting multiple utilities within states, where possible, in order to discern similarities and differences. What follows is a review of each utility's position and activities in this regard.

- *Arizona Public Service*— APS requires that program participants properly dispose of all lamps and ballasts and provides funding for disposal, in addition to equipment rebates. APS provides customers with information regarding its position on ballast disposal, available incentives, and contacts for disposal or recycling. APS also provides a list of environmental consultants available to assess disposal options; this analysis is also funded by the utility. In an effort to maintain environmental consciousness, APS provides incentives but distances itself from "hands-on" disposal responsibility by not taking physical possession of ballasts. APS contributes $140/55-gallon barrel for ballasts and associated fees. According to APS, many customers are recycling ballasts; a leading ballast disposer/recycler is located in Phoenix. It was also estimated that APS contributes an equivalent amount to disposal costs as it does for incentives. Note that while APS currently enjoys excess capacity, its Commission is very conservation-oriented; APS receives full cost-recovery on its DSM initiatives.

- *Central Maine Power*— CMP has a department that handles internal hazardous waste disposal. CMP provides customers, who change out their lighting systems, with information on disposal options and a listing of locations for disposal. CMP believes that there is a substantial cost associated with ballast disposal, and therefore does not assume direct responsibility. In 1988 and 1989, CMP estimated a cost of $60/ballast for recycling/disposal.

- New *England Electric System*— NEES requires commercial customer co-payment for direct installation of efficient lighting, but the utility funds the entire PCB ballast recycling and disposal cost. For large C/I program participants, NEES will fund recycling/disposal of non-PCB ballasts as well. NEES' involvement was spurred by environmental concerns and civic responsibility, and was not commission-initiated. NEES believes that customer confusion regarding ballast disposal has resulted in many ballasts being placed in municipal landfills.

- *Pacific Gas & Electric*— PG&E has prepared a brochure to inform customers of local California laws and common practices for PCB disposal. PG&E provides customers with access to an information line where they can have their questions answered.

- *Rochester Gas & Electric*— Similar to PG&E, RG&E provides information on proper ballast disposal procedures. RG&E maintains that ballast disposal is the customer's responsibility as it would have been in the absence of a rebate program. RG&E maintains that "if we start [providing funding for] PCBs, then we'd also have to worry about CFCs, mercury, asbestos, etc. "

- *Salt River Project*— SRP does not have a ballast disposal program; however, the utility has developed literature on disposal options and local regulations. This approach was adopted and is based on the position of other utilities, advice from legal counsel, and the impact of a disposal service on equipment incentives.

- *Seattle City Light*— SCL requires that lighting rebate recipients must comply with EPA regulations for PCB ballast disposal. A compliance clause is included in each customer contract, and SCL requires documentation to verify compliance. SCL informs customers of EPA regulations, disposal issues and contacts, and requires follow-up action on the part of the customer.

- *Snohomish County Public Utility District*— The utility has managed DSM programs since 1984, and few current lighting participants have PCB ballasts in place. The utility requires customer compliance with EPA guidelines for PCB disposal. In the presence of PCBs, the utility requires that the customer submit an invoice outlining disposal procedures which have been followed. The utility provides a customer referral service. An average job (e.g., 100 ballasts) would cost approximately $1,000 to $2,000 for disposal. Disposal costs are absorbed in customer rebates if cost-effectiveness to the utility is maintained and the customer can provide the disposal estimate in the bid.

- *Turlock Irrigation District*— PCB ballasts are considered a hazardous waste in California. Turlock

provides customer referrals for deposit or recycling of ballasts.

- *Tucson Electric Power Company*— TEPCO contracts with a local ballast recycler/disposer to process all PCB and non-PCB ballasts. The utility estimates a cost for recycling and disposal of $5/ballast. This translates to a cost of $100,000 to $150,000, approximately 10% of the initial pilot phase of the program. In 1993, eligibility for the recycling/disposal service was restricted to a maximum of 2,000 ballasts, after which, a charge to the customer is assessed. A pre- and post-inspection is conducted by the utility for each participant. Large customers (e.g., IBM, Universities) are considered to be free-riders of the disposal service (i.e., these customers would have taken care of the PCBs anyway via in-house disposal plans).

- *Wisconsin Electric Power Company*— WEPCO will rebate 50% of total project costs that include lighting efficiency upgrades and disposal costs. WEPCO estimates a cost of $4 to $5/ballast for recycling/disposal. WEPCO has not developed a statement of "proper disposal techniques;" however, the utility is investigating adaptation of an existing document. WEPCO will also provide customers a referral for ballast disposal.

Federal and State Laws Governing Fluorescent Lamp Disposal

According to current federal law, fluorescent lamps may constitute a hazardous waste. Under the Resource Conservation and Recovery Act (RCRA), used fluorescent lamps, like other wastes, are subject to evaluation against the RCRA hazardous waste characteristics. RCRA is subject to interpretation associated with the following statement maintaining that "the generator of the waste is responsible for making this determination." According to the EPA, "Wastes found to exhibit toxicity characteristics are defined as hazardous wastes and must be managed according to hazardous waste storage, treatment and disposal regulations, unless otherwise excluded." Under this regulation, the mercury content of fluorescent lamps can be classified as hazardous, thus requiring hazardous waste management. Similar to PCB ballast disposal, there is subjectivity in each state's interpretation of federal rules pertaining to lamp disposal. Some states do not permit the disposal of mercury and few firms in the United States provide mercury recycling services.

Currently, several states are considering bills that require recycling of fluorescent lamps. California has such a bill in place. The Vermont bill, which is currently being reviewed in the state Senate/Legislature, would prohibit placement of fluorescent lamps into landfills; require that lamps be returned to a collection point or the original manufacturer; require the manufacturer or wholesaler to ensure that a collection system is in place and inform customers of disposal restrictions; and require the manufacturer or wholesaler to include the cost of collection in the original purchase price. EPA's Office of Solid Waste is currently determining the waste classification of fluorescent and high intensity discharge lamps. Table 2 presents a listing of the current mercury-containing lamp disposal requirements for each state:

Utility Approaches to Fluorescent Lamp Disposal

Utility representatives were interviewed to identify their position on and approach to fluorescent lamp/mercury disposal as it relates to lighting efficiency programs. A review of each follows.

- *Arizona Public Service*— APS distributes literature and provides a disposal/recycling incentive of $260/barrel. Currently, no companies in Arizona provide this service; the closest service is available in California. An inadequacy in the availability of service is realized as mercury in fluorescent lamps must be manifest as hazardous waste for shipping; however, California will not accept hazardous materials from out of the state. California companies have established warehouses in Arizona to hold materials until recycling operations are in place. Currently, firms in Arizona will dispose of lamps; however, none can recycle them.

- *New England Electric System*— NEES instituted a mercury recycling/disposal program in early 1994 for its small C/I program participants. Although the service is free-of-charge, program participants must make co-payments for the project installation. After the program becomes established, NEES may offer the recycling/disposal services to its larger C/I program participants. Currently, a local contractor facilitates recycling/disposal of the spent fluorescent tubes,

- *Rochester Gas & Electric*— RG&E does not currently address the mercury disposal issue.

- *Seattle City Light*— Currently, SCL is not involved in mercury disposal/recycling.

- *Snohomish County Public Utility District— The* utility has not addressed mercury disposal/recycling because it has not seen a direction from BPA. Often on lighting efficiency projects, there is no requirement for lamp disposal (e.g., lamps may be re-used at a non-profit organization).

Table 2. State Requirements for Mercury-Containing Lamp Disposal

State	Regulation or Recommendation
CA	Over 25 lamps per 24 hour period must be disposed of as hazardous waste
FL	After July 1, 1994, lamps may not be burned in any municipal waste incinerator. Generators of >10 lamps/month must arrange disposal in permitted lined landfills (unless prohibited by Department rule after 7/1/94)
IL	Subject to RCRA through TCLP testing and may be regulated as hazardous waste under 399 IAC 3.1
KS	Determined on a case-by-case basis
MA	Can be shipped to a recycler without manifest
ME	Lamps failing TCLP are handled as hazardous waste, including hazardous waste licensed transporter requirements
MN	Mercury containing lamps must be stored according to Minnesota Pollution Control Agency (MPCA) guidelines and shipped to an existing recycling facility in accordance with MPCA requirements.
PA	Landfill only when certification shows that waste has passed to TCLP
RI	Treat as hazardous waste. Log system is used for transporters and generators
SC	Some landfills ban disposal
TX	Must be disposed or recycled at a permitted hazardous waste facility
WI	Hazardous waste lamps and bulbs (including bulbs with high lead concentrations) may not be placed in a solid waste landfill. Lamps and bulbs that are recycled are subject to reduced hazardous waste management requirements

NOTE: States not listed follow RCRA standards

Pending Lighting Regulation

According to the Technical Marketing Manager from the largest hazardous waste and PCB incinerator in the United States, within the next five years, National Environmental Policy Act (NEPA) regulations will prohibit the manufacture of less efficient lightbulbs (i.e., everything will be high efficiency).[3] A significant number of fixture change-outs is likely to result from this ruling which may also exacerbate the ballast and lamp disposal/recycling issue. In addition, EPA will be reviewing the small capacitor exemption noted above.

Liability and Cost Effectiveness of a Recycling/Disposal Service

The inclusion of a recycling/disposal service with a utility's commercial and industrial lighting efficiency program hinges on a number of factors. It is the author's opinion that recycling/disposal is the most environmentally-friendly option, and one that eliminates all utility and customer liability since the PCB-containing capacitor is destroyed. In addition, the rest of the ballast's materials, including steel, aluminum, copper, and asphalt, can be recycled. The next best choice, which also eliminates liability, is to incinerate the entire ballast. The liability to the utility and customer associated with landfilling can be quite high, given the potential financial responsibility for hazardous waste clean-up should a disposal site become a Superfund site.

In addition to liability, the possibility of including a recycling/disposal service depends on its cost-effectiveness. The cost of ballast disposal varies considerably; however, recycling some components reduces the amount of material to be landfilled or incinerated, conserves metal resources, and generally reduces disposal costs. Based on the following analysis, a lighting efficiency program is likely to remain financially attractive with the inclusion of a recycling/disposal service. Tables 3 through 5 present the assumptions and calculations used to assess a hypothetical program's economics.

Table 3. Program Assumptions

Base Case: 4, 34W lamps and 2 standard ballasts w/PCBs = 159W

DSM Case: 4, T8 lamps and 2 electronic ballasts w/o PCBs = 110W

Measure costs: $25/ballast, $2.25/T8 lamp

Useful life: 15 years (ignores periodic lamp replacements)

5,000 hours of operation per year

8% discount rate

Avoided costs: $100/kW, 3¢/kWh

Cost of recycling/disposal: $5/ballast, 40¢/lamp

Table 4. Calculated Benefits

NPV Energy Saved =	$ 63.00
NPV Demand Saved =	$ 42.00
Total Benefit	$105.00

Table 5. Calculated Costs

Equipment =	$ 59.00
Labor (@ 20%) =	$ 11.80
Total Equipment and Labor	$ 70.80
Program Administration (@ 15%)	$ 8.85
Total Cost	$ 91.25
Recycling/disposal cost	$ 11.60
Total Cost	$102.85

As shown, from the Total Resource Cost perspective, the benefits of this hypothetical efficient lighting program-including recycling and disposal-outweigh the costs. Without the recycling component, the program's benefit/cost ratio is 1.15; inclusion of the recycling/disposal service only reduces the benefit-cost ratio to 1.0. In addition, recognizing that some utilities are experiencing excess capacity, avoided capacity costs may be significantly lower than the assumption used above.

However, even if we assume $0/kW avoided capacity cost, the program remains cost effective at 4¢/kWh avoided energy cost or higher,

Conclusions

As utilities design and implement high efficiency lighting programs, important policy decisions must be made regarding the utility's role in PCB ballast and mercury lamp disposal. A number of factors impact such policy decisions, including federal, state, and local regulations, utility budgetary constraints, program cost effectiveness, utility corporate objectives, recycling/disposal logistics, liability concerns, and a myriad of other issues. At a minimum, utilities should provide their lighting program participants with information regarding federal/state/local disposal regulations (including potential Superfund liability) and recycling/disposal options and procedures. Additional services may include seminars, technical assistance, and listings of approved recycling and disposal companies. All utilities should require documentation of proper disposal. At the other end of the spectrum, utilities can completely fund a participant's PCB ballast and fluorescent lamp recycling and disposal costs, and arrange for the contractor to provide the service. It is the author's opinion that this last option—the most comprehensive and environmentally sound—ensures proper hazardous waste disposal (and eliminates utility liability), increases program participation, and provides excellent customer service and public relations. This ultimately contributes to customer loyalty or attrition. Providing "free" PCB ballast/fluorescent lamp recycling and disposal services may also have economic development implications, particularly if the contractors and recycling firms are located within the utility's service area. If the inclusion of such services can maintain program cost-effectiveness, utilities should consider offering PCB ballast and fluorescent lamp disposal as an added-value component of their commercial and industrial lighting efficiency programs.

Acknowledgments

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Endnotes

1. This paper was adapted from an article by the author that appeared in Strategic Planning for Energy and the Environment, Vol. 13, No. 2, 1993. Substantive changes, including the discussion pertaining to liability and cost effectiveness as well as conclusions, have since been incorporated.

2. The Lighting Research Institute estimates that there are at least 400 million existing ballasts installed in buildings in the U.S. Several of the large ballast manufacturers have estimated much larger quantities—up to 1 to 1.6 billion ballasts.

3. Personal communications with Jeff Karnes, technical marketing manager, Rollins Environmental Services (Sales) Inc., April 1993.

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