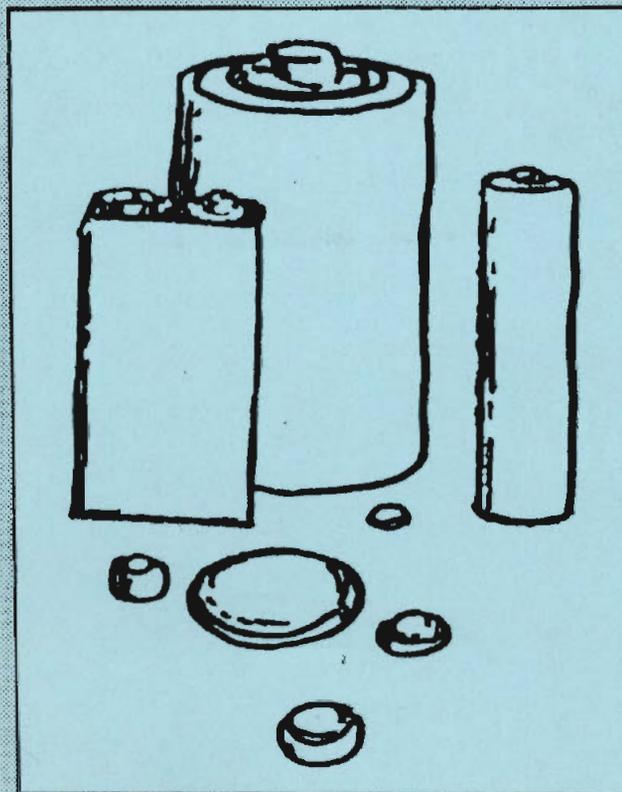


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# VERMONT HOUSEHOLD BATTERY REPORT



*State of Vermont  
Agency of Natural Resources  
January 1992*





# State of Vermont

AGENCY OF NATURAL RESOURCES  
Department of Environmental Conservation

Department of Fish and Wildlife  
Department of Forests, Parks and Recreation  
Department of Environmental Conservation  
State Geologist  
Natural Resources Conservation Council

## VERMONT DRY CELL BATTERY PLAN JANUARY 1992

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Plan prepared by Vermont Solid Waste Management Division  
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## SECTION I

### STATEMENT OF PURPOSE

Under No. 95, of the 1991 Public Acts, Sec. 2, the Agency of Natural Resources is to develop a Battery Report.

" a) By January 1, 1992, the secretary of natural resources, in cooperation with manufacturers and wholesalers of batteries sold at retail in the state, and in consultation with the technical advisory committee on solid waste, shall develop and adopt a used battery management plan. The plan shall review and report on the environmental harm and public health risk of mercuric oxide, silver oxide, nickel cadmium, small lead acid, zinc air, lithium, carbon zinc, nickel hydride, and alkaline batteries, and such other type of batteries or reformulated batteries as the Secretary may identify. The plan also shall consider alternate battery collection systems giving preference to a returnable battery deposit system for the state and shall contain a comprehensive system for the collection, recovery, recycling, reuse, treatment or disposal of all those batteries determined to be harmful to humans or the environment. Implementation of plans shall emphasize the responsibility of manufacturers and wholesalers, shall contain incentives to encourage consumers to return used batteries to the collection system, and shall be adequate to ensure that these batteries, determined to be harmful, are separated and removed from the waste stream by no later than January 1, 1993.

" b) Any system developed under this section shall include an educational and publicity component that seeks to maximize consumer participation in the system.

" c) Unless the plan established under subsection (a) of this section provides that it is not feasible to ban placement into mixed municipal solid waste of all dry cell batteries that contain mercuric oxide electrode, silver oxide electrode, nickel-cadmium, or sealed lead acid, regardless of the identity of the purchaser or user, batteries with those contents shall not be placed into mixed municipal solid waste as of January 1, 1993. A violation of this prohibition shall be a violation of 10 V.S.A. chapter 159".

The Agency of Natural Resources (ANR) has met with battery manufacturers, distributors, retailers, and a "Waste Battery" subcommittee of the Technical Advisory Committee on Solid Waste (TAC), from June 1991 through January 1992 in the development of this plan. Appendix C includes a list of Subcommittee participants.

## SECTION II

### REPORT SUMMARY

The major conclusions of the Vermont Waste Battery report are:

1) **Mercuric oxide button cells, small sealed lead acid (SLA), and nickel cadmium (Ni-Cads) batteries** are the battery types that have been determined to have the potential to cause harm to human health or the environment, regardless of the particular method of disposal (landfill, incineration, MSW composting). This Plan arranges for these batteries to be separated and removed from the waste stream by no later than January 1, 1993.

It is recommended that mercuric oxide button batteries be diverted from the waste stream by prohibiting their sale at retail by July 1992, instead of by January 1993 as now written in law. There are comparable less-toxic battery chemistries readily available for substitute use (zinc air). [Under Minnesota law, sale of mercuric oxides is prohibited after Jan. 1992]. Ni-cads and small sealed acid batteries will need to be diverted from disposal through targeted retail collection, manufacturer mail-back programs (only for ni-cads), and integration with other waste collection systems. These batteries will be diverted for recycling.

2) **Alkaline Manganese batteries, under current mercury levels**, have also been determined to have the potential to cause harm if disposed of through incineration or MSW composting. The Plan requires that these batteries be removed from waste streams destined for waste-to-energy incineration and MSW composting by no later than January 1, 1993.

The collection system for alkaline batteries will only consist of existing and/or already planned separation programs due to the short term nature of the collection program, and the expected small benefit derived from instituting a new short-term program. Battery diversion is already being planned at the front-end of proposed Vermont waste-to-energy incineration and MSW composting facilities. Existing collection systems in towns under contract with-out-of state waste-to-energy incineration facilities will also continue to be utilized, because any amount of mercury diversion from waste-to-energy incineration facilities is desirable. The disposal costs for the collected alkalines will be the responsibility of those battery manufacturers.

When an alkaline manganese manufacturer demonstrates that all of the alkaline manganese batteries sold at retail in Vermont, (from that manufacturer) are at zero mercury added, the harm determination for that manufacturer's alkaline batteries will be withdrawn, and the manufacturer will no longer be responsible for any disposal costs.

3) The Plan calls for the development and expansion of existing voluntary collection systems for silver oxide batteries. These batteries were not determined to pose harm to human health or the environment, but were targeted because of the resource recovery

value of their silver and the existence of readily available markets.

4) The deposit system was not chosen as the preferred battery collection system for those batteries that were determined to be harmful. The bottle bill model is not easily transferable to batteries because of the long turn around time, the difficult labeling requirements, and the heterogenous nature of batteries. Appendix E contains a discussion of why this system was not preferred.

5) Some legislative changes will be necessary to facilitate implementation of the State Waste Battery Management Plan:

A) Amend language so that a manufacturer may not sell, distribute, or offer for sale at retail in Vermont a button battery containing a mercuric oxide electrode which was manufactured on or after July 1, 1992. [ Current language bans sale effective January 1, 1993 ].

B) Add language that if manufacturers of batteries subject to the harm determination (Ni-cads, sealed lead-acid, alkalines destined for incineration and MSW composting) do not pay the costs of final disposition, their products may be prohibited from sale.

C) Delete all prohibitions and requirements relating to "silver oxide electrode."

D) Add language to require that manufacturers submit full TCLP test data (or tests of the current EPA standard) to the Agency of Natural Resources for each battery type, (existing as well as newly introduced), sold at retail within the state.

E) Add language to require that the Agency must give approval to a manufacturer before any new battery chemistry can be sold at retail within the State. (This is so that any new batteries that have been determined to cause harm can be managed similarly to existing products that have been determined to cause harm).

F) Amend language relating to alkalines to read "zero mercury added" instead of "any mercury".

G) Add language to require that manufacturers who are subject to non-consumer program provide a 1-800 information number to purchasers. Include a sunset clause that the requirement shall be dropped after 5 years.

6) Finally, it has been determined that to adequately carry out the responsibilities associated with the waste battery management program, at least 1/2 of the time of one Agency staff person will be necessary (see Section 4 for discussion). This would include oversight of this consumer program as well as the nonconsumer program, and the labeling and accessibility requirements as established under 10 VSA 6621b. If the Agency is charged with implementing this consumer plan, the current responsibilities of a staff person must be redescribed and reduced to accommodate this task.

## SECTION III

### ENVIRONMENTAL HARM AND PUBLIC HEALTH RISK ASSESSMENT

ANR has been asked by the legislature to:

Review and report on the environmental harm and public health risk of mercuric oxide, silver oxide, nickel cadmium, small lead acid, zinc air, lithium, carbon zinc, nickel hydride, alkaline batteries and such other type of batteries or reformulated batteries as the Secretary may identify, and create a comprehensive system for the collection of all those batteries determined to be harmful to humans or the environment which ensures that those batteries determined to be harmful, are separated and removed by the waste stream by no later than January 1, 1993.

ANR has interpreted the legislative language in its strictest sense. Without further directive from the Vermont Legislature, ANR has interpreted this language to mean that a particular battery type will pose harm to humans or the environment if it contributes to exceedences of environmental standards. Environmental harm (environmental injury, damage, or deterioration of environmental quality), is posed if a battery type contains a constituent of concern (e.g. mercury, cadmium, lead), and this constituent is released into the environment in exceedences of environmental standards through various disposal practices (landfill, incineration, composting). Further, ANR used Toxicity Characteristic Leaching Procedure (TCLP) test data as an additional measure of the potential harm to humans and the environment resulting from disposal of particular battery types.

ANR acknowledges that the context in which the determinations of environmental harm and public health risk have been made may be limited. First, ANR has not attempted to quantify the risk associated with the releases of a constituent from battery sources. This was beyond the means available for this Report. However, batteries are currently the second largest contributor of mercury into the municipal solid waste stream, and in the future, batteries will contain 76% of the total cadmium entering the municipal solid waste stream.

Second, ANR did not base its determination of harm on the relative contribution from particular batteries versus other human-made, or natural releases, of potentially dangerous constituents into the environment. For example, it has been estimated that coal-fired electric power plants contribute more mercury to the environment than any other human-made source, and that natural emissions of mercury may exceed human-made contributions. However, we still believe that due to the high toxicity of mercury, and the amount of mercury still available in alkaline batteries, it is beneficial to have them diverted from incineration and composting facilities.

Finally, ANR did not undertake a cost-benefit analysis in its determination of environmental harm and public health risk. The legislature did not direct this type of analysis, and a cost-benefit assessment on the dollar value of diverting one pound, or 50 pounds, of mercury into the environment was beyond the scope of this report.

Although relative contribution analysis and cost-benefit balancing were not used in making harm determinations, they were taken into account when decisions were made regarding collection systems. As outlined in Section 4, the Agency has decided to not institute new collection programs for alkaline manganese batteries because the costs of such a program are expected to outweigh the benefits.

This Section examines the following information necessary to make harm determinations:

A) **What are the metals of concern in household batteries?**

For this question we explored the potential impact on human health and the environment from exposure to metals found in dry cell batteries, and the relative toxicity of metal components.

B) **What are the means through which these metals may be released into the environment and is there any data indicating that releases from these means exceed environmental standards?**

For this investigation, we looked at unlined and lined landfill leachate data, air emissions from incineration, and the impact of metals on MSW composting. We looked at Vermont data as well as information from other regions to see if there were excessive environmental releases of the metals of concern from different disposal options. The environmental standards used included air emission standards for municipal solid waste incineration facilities, groundwater quality standards for lined and unlined landfills, and compost quality standards for municipal solid waste compost.

C) **What is the total amount of those metals available from a battery source?**

We looked at the gross and relative contribution of these constituents from the different battery types. We also included information on the contributions of metals from other sources.

D) **Is there other information available that points to potential risk of a release of metals from the battery source?**

We used industry supplied test results from the Toxicity Characteristic Leaching Procedure (TCLP) for particular batteries, in order to incorporate risk potential into our analysis. TCLP tests the potential of a waste to leach to the environment significant concentrations of toxic constituents.

E) **Subsection E includes the Agency's determination of environmental harm and public health risk for the different battery types.**

**III A: What Are The Metals of Concern in Household Batteries ?**

The constituents of concern within batteries may include mercury, cadmium, lead, nickel, and silver. The metals of primary concern are mercury, lead, and cadmium. These metals have threshold levels, (limitations on their release into the environment), under both federal water<sup>1</sup> and hazardous waste standards<sup>2</sup>. Silver and nickel are of secondary concern. Silver has recently been delisted from federal water standards but still has a threshold under TCLP. Nickel has a groundwater threshold but is not a TCLP constituent of concern.

Potential risk to humans or the environment may also result from exposure to lithium, manganese, and zinc but they are not of priority concern for this study. Toxicity via ingestion is rare for manganese and zinc<sup>3</sup> and lithium is not considered to be a toxicity problem in the environment since it is tolerated in reasonable concentrations in both plants and animals<sup>4</sup>.

**Mercury-** Mercury is considered to be a highly toxic substance. The toxicity of mercury depends on its form and the route of entry. Both organic mercury (e.g. methyl mercury) and inorganic mercury (mercuric chloride, mercuric oxide) may cause brain and kidney damage with long term exposure<sup>5</sup>.

When vaporized in a waste-to-energy incinerator, mercury becomes more bioavailable and may be emitted as metallic mercury or as mercuric chloride. The relative amount that becomes mercuric chloride depends on the amount of chloride in the waste stream. It has been estimated that 85% of the mercury emitted from incinerators may be mercuric chloride<sup>6</sup>. Mercuric chloride is most soluble in water and travels via rain. Elemental mercury will remain aloft for longer periods although acidic air moisture conditions will make it more soluble<sup>7</sup>.

Methyl mercury has a greater toxicity than either metallic mercury or mercuric chloride. Methyl mercury lasts longest in the environment and when it enters the food chain it may bioaccumulate. Metallic mercury and mercuric chloride can be converted to methyl mercury by microorganisms in sediments or by bacteria in water. Conversion to methyl mercury is sped up by acidic conditions like acid rain<sup>8</sup>. Most of the mercury in the air is in a gaseous state. Soluble mercury in precipitation is mainly of the inorganic type, with 2% to 10% being methyl mercury.

**Cadmium-** Cadmium is highly toxic to aquatic organisms and highly bioaccumulative<sup>9</sup>. Air exposure to cadmium may cause kidney and lung damage. Through inhalation, cadmium is also suspected to be a human carcinogen<sup>10</sup>.

**Lead-** Lead accumulates in soils and in aquatic organisms. Chronic exposure to even small amounts of lead can cause permanent damage to the developing central nervous system<sup>11</sup>.

**Silver-** In animals, silver exposure has been shown to cause liver damage, anemia, growth retardation and cardiac enlargement, while exposure in humans has only been poorly studied. Although, in the Handbook on the Toxicity of Inorganic Compounds it states that "according to present knowledge, silver is a minor problem in the general environment"<sup>12</sup>.

**Nickel-** Nickel compounds are very toxic in aquatic organisms and can accumulate<sup>13</sup>. Ingestion of nickel can cause hyperglycemia, capillary depression, and kidney damage. Inhalation may possibly cause cancer<sup>14</sup>.

**III B: What Are the Means Through Which These Metals May be Released Into the Environment and Is There Any Data Indicating That Releases From These Means Exceed Environmental Standards?**

The potential harm posed by a particular battery type will be effected by the means in which it is disposed. Certain battery constituents will be released more readily to the environment if burned, and others may contribute to environmental exceedences if buried in the ground. By investigating this question, constituents of concern were identified dependent on the means of disposal.

We conclude in sum:

**MSW Incineration-** Available air emissions information about mercury controls shows that **mercury** is a constituent of concern in MSW incinerator air emissions. Ash leachate information shows that **cadmium** is a constituent of concern in MSW incinerator ash leachate. Batteries that contain high levels of mercury and cadmium should be diverted from MSW incinerators.

**Landfills-** Leachate data show that **cadmium** and **lead** are constituents of concern in lined landfills because leachate levels do exceed groundwater quality levels. Studies also show that cadmium releases will be detected in unlined landfills over time. Batteries that contain high concentrations of cadmium or lead (as indicated by TCLP) should be diverted from landfill disposal. Information from unlined landfills also show that nickel and zinc are constituents of concern in unlined landfills.

**MSW Composting-** The end use of MSW compost will be affected by the concentration of certain metals. Batteries that contain **mercury**, **cadmium**, **lead**, or **nickel** are of concern if they are not diverted from the compost process.

## INCINERATION

Incineration of dry cell batteries will cause metals to become concentrated in the bottom ash, in the fly ash, or emitted to the environment through stack vapors. The amount of mercury that is captured, and the relative amount of fly and bottom ash, varies with the air pollution control system utilized.

In the presence of chlorine, mercury may form 2 types of compounds which condense at higher temperatures and are more easily captured as particulate. The addition of ammonia to reduce nitrogen oxides at some state-of-the-art incinerators may actually interfere with mercury control. (The ammonia may scavenge the chloride from the mercury, leaving the mercury more volatile).

### **Emissions Control**

In Minnesota, they have found that existing air pollution control equipment can be very effective at removing particulate and gases that contain metals found in household batteries. They report that current dry and semi dry air pollution control systems can collect 95% or more of metals in MSW, except for mercury. They report that a dry scrubber and baghouse achieves 75% to 85% mercury control and that a dry scrubber with an electrostatic precipitator (ESP) achieves 35%-45% mercury control. A wet scrubber or wet/dry scrubber may achieve higher collection efficiencies of mercury than other pollution control devices because the lower temperatures of wet systems aid in capture by condensing mercury. However, as a trade-off, wet systems create a sludge which then requires management<sup>15</sup>.

However, the capabilities of dry scrubbers and baghouses varies, and other studies have shown that they are ineffective in capturing gaseous mercury. Tests on two incinerators in California (both equipped with dry scrubbers and baghouses) showed that little, if any, mercury was captured from air emissions. Tests on the Millbury Ma. Wheelabrator facility (also fitted with dry scrubbers and baghouses) also did not show that mercury was captured by those pollution controls<sup>16</sup>. The Claremont NH, Wheelabrator facility that is utilized by some Vermont towns, has an acid/gas control with a baghouse<sup>17</sup>. The State of New Hampshire does not require emissions tests for metals, so it is not known whether mercury emissions exceed acceptable standards.

Exceedences of mercury air emissions standards at solid waste incineration facilities have been reported in Detroit, California, Oregon, New Jersey, and Minnesota<sup>18</sup>. Some of the facilities met standards with the addition of activated carbon and other materials. A resource recovery industry association disputes this claim, and reports that emissions from municipal combustors fall below emissions standards<sup>19</sup>.

When compared to mercury, cadmium is more readily captured with pollution control technology. One study found that 30% of the

cadmium in the waste stream remained in bottom ash, 65% went into fly ash, and 5% as flue gas vapor<sup>20</sup>.

#### **Incinerator Ash**

Although incineration reduces the total volume of trash, metals that do not escape through the stack are concentrated in the incinerator ash. Incinerator ash will either be bottom ash, or fly ash. Bottom ash is generally more benign than fly ash. A common ash management practice involves the mixing of bottom and fly ash into a combined ash.

Metals content in ash is much greater than background levels in soils. National results from 92 different facilities show that cadmium is of particular concern when it comes to incinerator ash. In this sampling, fly ash cadmium exceeded hazardous levels 97% of the time, mixed ash exceeded cadmium levels 14% of the time, and bottom ash cadmium exceeded hazardous levels 2% of the time<sup>21</sup>. A resource recovery industry association reports that The that TCLP tests on incinerator ash are consistently below the threshold of regulatory concern but had only used data from three facilities<sup>22</sup>.

Ash is often disposed of in special lined ash landfills. A sampling of MSW incinerator ash monofill leachate data shows that cadmium, nickel, and lead levels in ash monofill leachate do exceed groundwater standards<sup>23</sup>. The Institute of Resource Recovery reports that leachate from municipal waste combustor ash landfills poses no significant risk to human health and the environment, and that the leachate characteristics closely resemble sea water<sup>24</sup>. A review of the ash monofill leachate data from the Claremont NH Wheelabrator facility shows that cadmium levels are of concern in ash leachate. In 20 out of 44 samples, taken at least monthly from October 1988 to January 1991, cadmium was at, or exceeded, the primary groundwater enforcement standard. Lead had 7 exceedences out of 39 samples taken from October 1989 to January 1991. Mercury was only detected at the groundwater enforcement standard 1 time out of 45 samples from October 1988 to January 1991<sup>25</sup>.

#### LANDFILLS

##### **Unlined Landfills**

Metals migration in landfills will be affected by the soil type surrounding unlined landfills and the hydrology of the area. An acidic environment is likely to produce a higher concentration of metals in leachate. A high rate of flushing may dilute the metal concentrations and/or increase the flow of metals into leachate.

In Vermont's landfill assessment program, approximately 160 monitor wells at 25 landfills were sampled. Dissolved mercury was detected in a total of six monitor wells at three landfills. Only one of the detections exceeded the 2 part/billion (ppb) standard. No detections occurred on the second sampling date<sup>26</sup>.

An English study reported in 1977/78 found that "there is no evidence to suggest that mercury is leached from landfilled material to any significant extent or that organo-mercury compounds are formed". That study concludes that dry cell batteries do not pose a special threat to groundwater quality, provided they are well mixed with household wastes<sup>27</sup>.

In the Vermont landfill assessment data, cadmium was detected in a total of sixteen monitor wells at nine landfills. Four of the detections were above the 5 part per billion groundwater quality enforcement standard, but only 1 monitoring well had cadmium above the detection limit on both sampling dates.

A study conducted by the Japanese Storage Battery Association in 1989 looked at the leachability of cadmium in various simulated landfill conditions<sup>28</sup>. The finding was that cadmium from batteries should not be detected in leachate for approximately 25 years.

Nickel was more commonly detected in the Vermont landfill assessment data, it was detected in a total of sixty-two monitor wells at 22 landfills. Many of the wells had detectable levels on both testing dates. Zinc was also detected in many monitoring wells. It was found in a total of thirty-six wells at 22 landfills and many of the wells had detectable concentration on both sample dates. Zinc was detected in six residential water supplies.

Recent investigations and reports are inconclusive about the environmental impact of disposing of batteries in landfills. It is generally believed that certain metals, like mercury, are bound-up in soil and are not released from landfills, although long term impacts are difficult to predict. Given the inconclusive nature of much of this data, we relied on information from TCLP tests to give us information about the potential for future releases in unlined landfills of metals from battery sources.

#### **Lined Landfills**

As Vermont moves towards lined landfills, the focus moves away from groundwater data and toward leachate data collected from lined landfills. Metals in lined landfills will not have the opportunity to bind with soils, but rather are likely to remain intact in the leachate. Metals levels in lined landfill leachate are a concern because the leachate is sent to waste water treatment plants.

Short-term leachate data collected from the lined landfill in Colchester, Vermont does not indicate that mercury has ever shown up at any level of concern. Cadmium exceeded the 5 ppb level 4 times over 15 test months. Nickel exceeded groundwater enforcement standards on 2 consecutive months and 1 other month out of 15 testing months. The silver standard was exceeded 1 time in the 15 test months<sup>29</sup>.

A review of leachate quality references from 5 clay lined landfills was undertaken by the Solid Waste Division in 1989 to try to derive characteristics transferable to Vermont conditions. The report cautions that all the references reviewed indicate that leachate quality is variable. The derived leachate characteristics show mercury and nickel concentrations at 50% below the primary groundwater enforcement standards. Cadmium concentrations at eight times above, and lead at twenty times above the enforcement standard<sup>30</sup>.

**MSW COMPOSTING**

Metals composition in final compost product will effect allowable end-use of the product. In Vermont's proposed compost rules, neither MSW compost or sludge can be applied on land used for food for direct human consumption. It may be applied on fodder crops or for other agricultural uses if it meets certain requirements including metals limitations. If the compost product does not meet those standards, the Secretary of the Agency of Natural Resources may grant permission to use product for a particular use.

**Proposed Standards for Metal Concentrations in Compost  
Draft Vermont Solid Waste Rules  
(For those metals associated with household batteries)**

<u>Contaminant</u>	<u>Concentration</u>
(Milligrams per kilogram dry-weight)	
Cadmium	10 ppm
Mercury	10 ppm
Nickel	200 ppm
Lead	250 ppm

Under the proposed Solid Waste Management Division Rules, composting operations will be required to presort and separate out unregulated hazardous waste from exempt small quantity generators and households prior to treatment. The level of presorting must be equivalent to a system that includes bag opening, magnetic separation, handpicking, and mechanical screening.

This type of operation should be adequate to capture both the larger batteries (handsorting) and the small button batteries (magnetic separation). In Minnesota, where they have five municipal solid waste composting operations, they have found most of the large batteries (9 volt, A, B, C, and D cells) are removed by handsorting and that button batteries will get captured through mechanical separation (usually a magnetic system). Any future operation that uses hammermills will need to be the most thorough about separation<sup>31</sup>.

III C:      What Is The Total Amount of Those Metals Available  
From A Battery Source?

After determining constituents of concern for particular disposal options, we evaluated the contribution of the metals for each battery type. The environmental harm and public health risk of a particular battery type depends not only on the constituents within the battery, but on the concentration of that constituent in a battery, and the total number of batteries entering the waste stream.

TOTAL NUMBER OF BATTERIES SOLD

If we assume that Vermont's use and battery consumption patterns are similar to the rest of the country, the amount of batteries sold at retail in Vermont (1985 and 1990) was<sup>32</sup>:

	<u>1985</u>	<u>1990</u>
Button Batteries:	392,288	207,296
Alkaline Batteries:	2,768,320	4,460,800
Carbon Zinc:	1,443,200	642,880
Heavy Duty:	1,154,560	970,000
Nickel Cadmium:	26,240	401,472
Total:	5,392,320*	6,475,152*

\* (Total does not include button battery sales since the 1985 and 1990 figures were of different chemistries).

TOTAL AMOUNT OF MERCURY AND CADMIUM ENTERING  
THE VERMONT WASTE STREAM FROM HOUSEHOLD BATTERIES

The total amount of mercury and cadmium entering the waste stream can be derived from the number of waste batteries, the average battery weight, and average percent by weight of the metals constituents. Listed below are 2 columns of metals contribution estimates; 1 estimate for 1985 and 1 estimate for 1991. The 1985 mercury and cadmium estimates, and the 1991 cadmium estimates were derived from a June 1991 report from Minnesota, while the 1991 mercury estimate was derived from a May 1991 report from the Northeast Waste Management Officials Association (NEWMOA).

Assumptions for 1985 (mercury and cadmium) and 1991 (cadmium) estimates:

We derived these figures from Minnesota data which took into account how metals contribution will be affected by changes in market share of certain batteries, changes in overall sales, and mandated and voluntary action by industry<sup>33</sup>. By using some of the same assumptions, we can derive information specific to Vermont. The assumptions made for the 1991 cadmium figures include:

- 1) Each nonrechargeable battery is discarded in the year it is bought. (This is the generally agreed upon turnover time).
- 2) Sales figures at 1990 sales level.

1991 estimates for mercury were not used from this source since button battery data were not available

Assumptions for 1991 mercury estimates:

These figures were derived from a report written by the Northeast Waste Management Officials Association (NEWMOA) in which it was estimated that 252 short tons of mercury would enter the U.S. waste stream from household alkaline batteries in 1991<sup>34</sup>. Industry officials have disputed the NEWMOA numbers because they believe that the calculations should not use .2625% as the amount of mercury in household alkalines but rather .025% because conversion to this lower mercury level was mostly completed by the top four alkaline battery manufacturers<sup>35</sup>. Industry officials estimate that mercury in household alkaline manganese batteries sold in Vermont total 96 lbs. a year in 1990<sup>36</sup>. This 96 lbs. is indicated by the "\*" on the chart below.

MERCURY (Hg) AND CADMIUM (Cd) ENTERING THE VERMONT WASTE STREAM FROM HOUSEHOLD BATTERY SOURCES

	<u>1985</u>		<u>1991</u>	
<b>MERCURY</b>				
Button batteries:	341- 485	lbs. mercury	132	lbs. mercury
mercuric oxide	-		118	
silver oxide	-		3	
zinc air	-		11	
Carbon Zinc:	3- 157		13	
Alkalines:	6088		1000 ( 96)*	
	<b>6432-6730</b>	<b>lbs. mercury</b>	<b>1145 (241)*</b>	<b>lbs. mercury</b>
<hr/>				
<b>CADMIUM</b>				
Alkalines:	60	lbs. cadmium	97	lbs. cadmium
Ni - Cad:	102		1811	
	<b>162</b>	<b>lbs. cadmium</b>	<b>1908</b>	<b>lbs. cadmium</b>

As these estimates reveal, the amount of mercury entering the waste stream from household batteries has been reduced significantly due to source reduction efforts from the industry. Unfortunately, mercury reduction will continue to be somewhat offset by increasing future battery sales. Until all alkaline batteries have "zero mercury added", alkaline batteries will contribute to the loading of mercury into the municipal solid waste stream. The amount of cadmium will continue to rise as nickel cadmium batteries assume a greater market share in the coming years.

It is worthwhile noting that the bulk of mercuric oxide batteries is not for the consumer market (27%), but for medical (14%), industrial (10%), and military uses (48%)<sup>37</sup>. Figures from the National Electrical Manufacturers Association show that 172.6 tons of mercury was used for mercuric oxide batteries in 1989. Management of these nonconsumer mercuric oxide batteries is currently regulated under Vermont law, 10 V.S.A. 6621b

The amount of nickel and cadmium entering the waste stream will continue to increase as the market share of nickel cadmium batteries increases. Nickel is 15-25% by weight, and cadmium is 10-15% by weight, of household nickel cadmium batteries<sup>38</sup>.

#### Other Sources of Mercury

##### **Municipal Solid Waste Stream**

The U.S. Bureau of Mines data shows that in 1990, batteries were the third greatest user of mercury (3,075 flasks (116 tons)) in the U.S., and the second greatest user of mercury that was likely to enter the municipal solid waste stream. Batteries used almost 15% of all mercury consumed in that year, and use has been steadily decreasing since 1980. The first and second users are chlorine and caustic soda manufacture (7,164 flasks), and measuring and control instruments (3,133 flasks)<sup>39</sup>. Mercury used in chlorine and caustic soda manufacturing goes into the hazardous waste stream.

##### **In the Environment**

There are other mercury sources in the environment that are not included in Bureau of Mines consumption data. Mercury continually circulates through the environment and is produced from both "natural" and "human-made" sources.

-The atmosphere contains up to 930 tons of mercury at any one time. In the upper atmosphere, mercury compounds can remain suspended for up to two years.

-Lakes and rivers contain up to 2,200 tons, and the oceans contain more than 45 million tons of mercury at any one time.

-Emissions from natural sources range from 3,000 to 20,000 tons a year. Volcanoes are major sources and mineral ores in the earth's crust.

-Emissions from industrial sources can be up to 21,000 tons a year. Mining is the greatest source. Other sources include burning of oil and coal, metal smelting, steel and cement making, incineration of batteries, paint, and other products made with mercury<sup>40</sup>.

**III D: Is There Other Information that Points To Potential Releases of Metals From Dry Cell Batteries into The Environment?**

ANR investigated potential long term risk from landfill disposal by looking at available Toxicity Characteristic Leaching Procedure (TCLP) data for dry cell batteries of particular concern. TCLP was developed by the EPA to make determinations under the Resource Conservation and Recovery Act (RCRA) for hazardous waste. RCRA defines hazardous waste as "solid waste that may"... pose a substantial present or potential hazard to human health and the environment when improperly treated, stored, transported, disposed or otherwise managed<sup>41</sup>. If a battery type fails TCLP for a constituent of concern, that battery is considered harmful if disposed of in a landfill. In our analysis, the only exception to this rule is for silver oxide batteries. Silver oxide batteries fail TCLP for silver, however, since silver is expected to be delisted from the TCLP constituent list when the EPA revisits TCLP, we decided to not incorporate a standard which is expected to change<sup>42</sup>. Silver has also recently been delisted from federal water standards. Other TCLP elements of concern include cadmium, lead, and mercury. Nickel and zinc were not included in final rule.

**III E: Determinations of Environmental Harm and Public Health Risk For Particular Battery Types**

The criteria used to make determinations are discussed in the introductory paragraphs to Section 3. Determinations have been categorized according to disposal method.

\* A battery type is considered harmful if landfilled, if information suggests it may contribute to environmental exceedences and/or if it fails TCLP for the constituents of concern.

\* A battery type is considered harmful if incinerated or composted, if information suggests that its constituents may contribute to environmental exceedences.

**Mercuric Oxide**

Mercuric oxide batteries contributed approximately 118 lbs. of mercury into the Vermont solid waste stream in 1991<sup>43</sup>. Mercuric oxide batteries can contribute to environmental harm and public health risk if incinerated because of mercury's high toxicity. Mercuric oxide batteries fail TCLP tests for mercury which indicate that they may also pose a potential threat if disposed of in a landfill.

**The Agency must plan for comprehensive management of mercuric oxide batteries, which will be a sales prohibition.**

**Nickel Cadmium**

By 1995, it is estimated that Ni-Cd batteries will contain 76% of the total cadmium in products entering the municipal solid waste stream<sup>44</sup>. These batteries contribute to environmental harm and public health risk if incinerated because of cadmium's high toxicity. Ni-Cd batteries fail TCLP tests for cadmium which indicate that they may also pose a potential threat if disposed of in a landfill.

**The Agency must plan for comprehensive management of Nickel Cadmium batteries.**

**Alkalines**

Assuming all alkaline batteries contained .025% mercury, approximately 96-142 lbs of mercury entered the solid waste stream from alkaline batteries in 1991. This is a very conservative estimate because the conversion to .025% batteries was variable amongst manufacturers (November 1989-January 1991)<sup>45</sup>, and it may be at least 2 years from the date of manufacture to the time when the battery enters the waste stream. Alkaline batteries contribute to environmental harm and public health risk if incinerated because of mercury's extremely high toxicity. Alkaline batteries do not fail TCLP for mercury, cadmium or lead<sup>45</sup>.

**The Agency must plan for a comprehensive system to divert alkaline batteries from incineration until there are only zero-mercury batteries entering the waste stream.**

#### **Small Lead Acid**

Lead is a constituent of significant concern. Vermont has previously banned large lead acid and non-consumer small sealed lead acid batteries from landfill disposal. Small lead acid batteries may be harmful to human health and the environment. **Agency must plan for comprehensive management system for small lead acid batteries.**

#### **Silver Oxide**

Silver oxide batteries do not contribute significant levels of mercury or cadmium into the environment. They do fail TCLP tests for silver but as discussed in III - A, it is likely that in the future the EPA will be delisting silver as one of the constituents of concern, and silver has been delisted from drinking water. We have decided not to incorporate into our determinations a standard which is expected to change. **We do not find that current disposal practices for silver oxide batteries contribute to environmental harm and public health risk.**

#### **Zinc Air**

At this time we do not find that current disposal practices for zinc air batteries contribute to environmental harm and public health risk.

#### **Lithium**

Although lithium may be explosive when it comes in contact with water, we are not aware of any cases where this has happened except through intentional manipulation. **We do not find that current disposal practices of lithium batteries contributes to environmental harm and public health risk.**

#### **Carbon Zinc**

Carbon zinc batteries do not fail TCLP for mercury, cadmium, or lead. There is only a small percentage of mercury in carbon zinc batteries and they continue to have a decreasing market share. **We do not find that current disposal practices of carbon zinc batteries contribute to environmental harm and public health risk.**

#### **Nickel Hydride**

These batteries do not fail TCLP for mercury, cadmium or lead. As recommended, the Agency will make determinations of environmental harm and public health risk on all new battery types before they are introduced into Vermont. **At this time we do not find that disposal for nickel hydride batteries contribute to environmental harm and public health risk.**

## SECTION IV

### VERMONT DRY CELL BATTERY IMPLEMENTATION PLAN

The Vermont Dry Cell Battery Implementation Plan was developed in accordance with the program requirements of 10 V.S.A 6621b. The requirements include:

*- Creation of a comprehensive system for the collection, recovery, recycling, reuse, treatment, or disposal of all those batteries determined to be harmful to humans or the environment which ensures that those batteries, determined to be harmful, are separated and removed from the waste stream by no later than January 1, 1993.*

As a result of the environmental and human harm determinations, this implementation plan will include all **nickel cadmium**, and **small sealed lead acid batteries** sold at retail in the State of Vermont. It also includes management of waste **alkaline** batteries which were purchased at retail, destined for incinerators or MSW composting facilities, until the time when only zero mercury added alkaline batteries are being sold in the state.

The Agency has decided to limit alkaline collection to those programs that are currently operating or at those facilities which will incorporate front-end separation capabilities (e.g. the proposed Rutland municipal waste-to-energy facility. ANR has determined that instituting new programs is not practical because only short term collection is needed (product manufacturers have indicated that they plan to meet the zero mercury added requirement by 1995). Furthermore, the collection program for alkaline manganese batteries will be limited to those municipalities which use incineration and MSW composting facilities. The diversion program will include the New Hampshire/Vermont Solid Waste Project battery collection program which serves those Vermont towns utilizing the Claremont, New Hampshire waste-to-energy facility, and front end diversion at planned in-state MSW and waste-to-energy facilities.

Although **mercuric oxide** batteries were determined to pose environmental harm and public health risk, the proposed sales prohibition will make a mercuric oxide management program unnecessary. Voluntary collection of **silver oxide** batteries is also included in the Plan since profitable recycling markets are available and the law contains a prohibition on their placement into mixed municipal solid waste by January 1, 1993, unless the Plan finds it not feasible.

*- An emphasis on the responsibility of those manufacturers and wholesalers.*

ANR found there were many constraints to creating a collection program based entirely on "manufacturer responsibility". The ability to do so is primarily affected by the number of manufacturers within the industry, the

existence of non-domestic manufacturers, some manufacturers willingness to join together to undertake voluntary contributions, and the State's enforcement capabilities. Manufacturers will be responsible for supplying markets or disposal outlets for targeted waste batteries. Local collection activities will be the shared responsibility of the State, the solid waste districts and regions, towns, volunteer retail collection points, disposal facilities, and consumers. [See Appendix D].

**- Consideration and discussion of alternative battery collection systems giving preference to a returnable battery deposit system for the state**

Alternative battery collection systems were identified and evaluated in accordance with the criteria discussed in the next section. The site for collection was the variable factor; retail stores, regional retail centers (select large centers), permanent municipal/district facilities, temporary municipal/district facilities, curbside collection at home, manufacturer take-back centers, and mail-back systems were considered. A returnable battery deposit system was determined to not be the optimal system. [See Appendix E]

**- Incentives to encourage consumers to return used batteries to the collection system.**

Incentives to encourage program participation include convenient and accessible collection points, program promotion, and clear and accurate information about disposal and recycling opportunities for waste household batteries. Incentives to encourage program participation are discussed for the programs outlined below.

**IV A: Scope, Goals, and Decision Criteria**

Some commenters to the draft plan recommended that the collection program for batteries should not include alkaline batteries since the program would only be short term, the costs of such a program could be high, and the impacts negligible. Other commenters recommended that all alkaline batteries should be collected, including those that are destined for landfill disposal, since even small amounts of mercury can be highly toxic to humans and the environment.

Several states, as well as the U.S. E.P.A., have also made recommendations about what batteries to target for collection programs and the success of separation programs<sup>46</sup>. In the Federal Register discussion of Municipal Waste Combuster Regulations, (see Appendix A), the EPA found that "it has not been shown that battery separation programs have a sufficiently significant effect on mercury emissions to warrant their inclusion as part of a national standard at this time."

ANR has considered these recommendations and has determined that no new programs should be created to collect alkalines but that

existing programs should continue until all alkaline batteries sold in the State have zero mercury added.

#### 1) Implementation Date

Program implementation for all targeted batteries will begin upon plan approval. The collection system will be fully operational by Jan 1, 1993.

#### 2) Program Duration

An ongoing program is planned for the collection of nickel cadmium and small sealed lead acid waste batteries. For alkaline batteries, the collection program will continue until one year after the Agency makes the determination that all alkalines sold in Vermont have "zero mercury added". Individual alkaline product manufacturers may petition the Secretary for exemption from their share of any disposal cost responsibility, if they can verify that their alkaline batteries being sold in the state only have zero mercury added.

#### 3) Program Goals

The goal of Vermont's program is to divert those batteries that are determined to be harmful in the most cost effective way. The diversion goal is a 90% capture rate for those batteries targeted for collection.

#### 4) End use

Nickel cadmium and small lead acid batteries will be diverted for recycling. The preferred management for source separated alkaline batteries is disposal at a certified hazardous waste disposal facility, until recycling options become available.

#### 5) Evaluation Criteria for Collection System Options

The primary factors used for evaluating collection options were participation rates and cost-effectiveness. Participation and cost were influenced by the marketing system (sales points, free standing or in an appliance) and use characteristics (numbers used, turn-around time from purchase to disposal) of those targeted batteries.

##### **a) Ability to achieve high rates of participation.**

Convenience is the single greatest factor in the design of a collection program. For dry cell batteries, this may mean integration with existing trash disposal system, integration with existing recycling system (if not same as trash disposal), integration with existing Household Hazardous Waste Collection, or collection at special targeted sites such as retail stores, hospitals, or recreation centers. To maximize participation, requirements on consumers should be minimized. It is not optimal to require consumers to make a special trip to a postoffice for a mail back, or to require extra financial expenditures. If a consumer usually brings a battery back when getting a replacement battery, (video camera store, service center) it is convenient to have a collection opportunity at that site. The State of Minnesota found retail collection sites to be very convenient for consumers<sup>47</sup>.

However, the low capture rates of most battery source separation programs, and the resulting low mercury diversion rates, has led the Environmental Protection Agency to conclude earlier this year that battery diversion programs would not result in an appreciable improvement in the environment quality (See Appendix B). High capture rates can be expected to be obtained by materials separation at the front-end of a disposal facility.

**b) Cost effectiveness.**

Consumers will ultimately bear the program costs and it is in everyone's interest to keep program cost down. Integrating battery collection with existing collection systems for other materials will help to keep program costs down. This may take the form of integrating battery collection with solid waste or recycling collection programs, or front end separation at the disposal facility. Requiring manufacturers to physically take-back their waste products will result in higher program costs due to increased handling and sorting requirements. Other program costs include program set up, program monitoring, program promotion, disposal, and enforcement of any manufacturer requirements within the collection system.

**6) State Support/Involvement**

Implementation of the battery collection program will require State involvement in spite of the "manufacturer responsibility" requirement. Based upon past experience, ANR believes that state support is necessary to ensure a successful implementation program:

**Startup-** All effected parties (product manufacturers retailers, districts, towns, consumers), need to be notified of the program requirements and their responsibilities.

**Facilitate Development of Collection Sites-** Information will need to be disseminated about regulatory requirements pertaining to battery collection, and about guidelines for collecting, shipping, and packing of the collected batteries. The State will also need to be available to serve as a liaison between battery manufacturers and local collection programs, and to solicit voluntary retail involvement.

**Promotion/Education-** Educational material development and distribution should be supervised by State staff so that information is consistent with other Vermont programs and educational activities. Program will need to be promoted through recycling hotline, newsletters, and media campaigns.

**Monitoring/Tracking/Enforcement-** Manufacturer involvement needs to be monitored and enforced. State will need to ensure that legislated mandates are being met and that disposal/market options are available to those collecting the targeted batteries. The requirements must be enforced so that manufacturers that are meeting the requirements are not inadvertently being penalized by lack of enforcement.

**IV B: Ni-Cad and Small Sealed Lead Acid (SLA) Battery Collection System**

Certain elements of the Ni-Cd/SLA collection program will be effected by the regulatory status of Ni-Cd/SLA batteries. The Ni-Cd industry is currently petitioning the EPA for a recycling exemption under RCRA which is similar to the recycling exemption that exists for lead-acid batteries. An expected impact of this exemption, which could come about as early as summer 1992, is a lower cost collection program and a greater availability of end use markets. A lower cost program will come about from reduced transport and processing costs for "exempt" batteries.

This exemption would affect commercial battery users since all consumer batteries are already exempt from Hazardous Waste Management Regulations. In the interim, Ni-Cads from non-consumer users will have to be handled as hazardous waste. Plans for the collection of consumer Ni-Cd's will progress as outlined below.

**Collection**

**1) Consumer Mail back**

All free standing Ni-Cds sold in Vermont will be accompanied by a mail-back package. The destination for mail-back will be determined by the manufacturer and/or the manufacturer representative. (Free standing Ni-Cds comprise about 20% of all consumer Ni-Cds).

**2) Targeted Retail Dropoff**

Dropoff collection will be available at distribution and service centers for products/equipment using Ni-Cds/SLA batteries, and at retail sites that sell high volume of rechargeable appliances. Collected Ni-Cds/SLA will be returned by the retailers to the manufacturer or manufacturer representative for proper management.

**3) Integration with Existing Recycling/HHW Collection Programs**

All recycling collection programs will send collected Ni-Cds/SLA to a manufacturer designated location within the U.S. The sender will pay only for shipping, while the manufacturer will assume costs for any processing. The sender (municipality, district, private contractor), would be subject to any solid waste regulations regarding temporary collection and storage, and would need to meet any packing standards for mailing or transport. It is expected that it would be most efficient for the manufacturers to designate a regional consolidation facility. A minimum shipment size can be determined.

**Incentives**

The collection system for Ni-Cds/SLA will include both financial incentives and an extensive education program. Participation incentives will include convenience, promotion, dealer rebates, price reductions on future Ni-Cd/SLA purchases, and lifetime guarantees on Ni-Cd batteries. The incentives to involve retailers in the program will be an enhanced public relations image and in the future, increased revenue for recyclable Ni-Cd/SLA batteries. For local collection programs, the convenience

of having collection integrated with other trash and recycling collection programs will serve as a participation incentive.

### Education

Education about the separation requirements and collection opportunities will be provided by battery and product manufacturers, retail collection points, the solid waste districts and the State of Vermont. The manufacturers will provide battery removal instructions along with a product, and participating retailers will post signs indicating that they are a Ni-Cd/SLA battery collection point. The district and the State will promote the program through ongoing promotion and educational activities; newsletters, recycling hotline, press releases, etc.

### Funding

#### **COSTS**

#### **SOURCES**

Collection and Shipping	Towns/districts (operating budgets). Volunteer retailers. Manufacturers (mail back-tubes). Consumers (postage for mail-back). Private waste businesses/facilities
Processing	Manufacturers (incorporated into product price).
Advertising	Towns, districts, State, retailers, manufacturers. (education budgets).
Administration	State (facilitating start-up, coordination, monitoring, tracking, regulatory interpretation, etc.)

Since the turn-around time for rechargeable batteries is variable, it is difficult to predict capture rates, and to figure out the program costs for the first few years of collection. Specific cost breakdowns for collection will depend on the extent to which collection is integrated with other collection systems. Those implementing the collection programs may need to assume any storage and/or staff costs. Shipping may be done through U.S. Postal Service (4th class mail), or UPS. U.S. Postal 4th Class mailing costs are approximately \$24.00 for 25 lbs, and \$33.00 for 70 lbs.

The processing costs, to be borne by the product manufacturers will be dependent on the volume collected. Reprocessing costs as quoted by a domestic end market (INMETCO 6/21/91) are \$40.00 for a 0-25 lb. package and \$70.00 for a 26-70 lb. package.

If the following assumptions are used:

- Sales remain constant at 1990 level ( 401,472) Ni-Cds per year.
- The program captures 50% of those Ni-Cd batteries (200,736).
- 10 batteries equal 1 lb. ( 20,074 lbs.)
- \$ 1.00 lb. processing cost.

The total processing cost to manufacturers per year, under these conditions would be \$ 20,074 a year. In the future, the increased market share of Ni-Cd batteries may be offset by a more favorable end market for spent Ni-Cd batteries.

#### IV C: Alkaline Collection System

The alkaline collection system focuses on those alkaline batteries destined for waste-to-energy incinerators and MSW composting. There is currently no permitted MSW incinerator in Vermont; however, approximately 6-11% of Vermont's waste stream is incinerated out of state<sup>48</sup>. The proposed collection program provides for those alkalines being sent out-of-state for incineration, and for any future waste streams destined for instate incineration. This collection program will end when it is determined by the Agency that only "zero mercury-added batteries" are entering the waste stream.

The alkaline collection program necessarily differs from the Ni-Cd/SLA program for the following reasons;

- 1) Alkaline batteries will need to be diverted from incineration and MSW composting operations only. Currently only 6-11% of Vermont's waste stream would be included in the collection program at this time. It is possible that a larger share of Vermont's trash may be destined for incineration during the life of this program.
- 2) The alkaline collection program is a limited short term program, expected to terminate by Jan 1995, and at the latest by 1997.

#### Collection

##### 1) Targeted Retail Drop-off

A continuation of voluntary retail collection sites for towns under contract with an out-of-state incinerator. This is part of the collection program for NH/VT Solid Waste Project Towns using the Claremont incinerator.

##### 2) Targeted Consumer Recycling and HHW Collection Programs

A continuation of ongoing and planned collection programs in towns that send their trash for incineration out of state. This would include alkaline collection integrated with drop-off, curbside, and special collection events.

##### 3) Collection at Facility Front End

For any future instate incinerator and MSW composting facilities, separation of alkaline batteries will be necessary. The Air Pollution Control Division (Vermont DEC) currently requires MSW incinerator operators to divert batteries containing mercury and

cadmium due to the potential releases of these metals from batteries into the atmosphere. The Solid Waste Management Division (Vermont DEC) draft rules require MSW composting facilities to implement separation programs for hazardous wastes which are the equivalent of bag breaking, ferrous metal removal and hand picking. The State of Vermont currently has one MSW waste-to-energy facility which has been constructed (Rutland City) but is currently not operating. Alkaline batteries will be captured through the sorting process at the incinerator or MSW composting facility.

### Incentives

Participation in the collection system for alkalines will be encouraged through education and a convenient collection program. The creation of a deposit system, was not considered optimal given the small targeted population and the limited time frame. The incentives to involve retailers will be an enhanced public relations image for participation in a short term program.

### Education

Education about the separation mandate and collection opportunities will be provided by battery and product manufacturers, retail collection points, the solid waste districts and the State of Vermont. The district's and the State will promote the program through ongoing promotion and educational activities; newsletters, recycling hotline, press releases, etc.

### Funding

Funding for the alkaline collection system differs from the Ni-Cd program partly because alkalines are not recyclable. There is no demand for alkaline batteries, and they are usually disposed of as hazardous waste.

Act 78, Vermont's Solid Waste Law passed in 1987, states that the costs of managing wastes should be borne by the user of those products, while 10 VSA 6621b, enacted in 1991, requires that the purchasers of the products pay for disposal costs at the time of purchase. The difference between these laws is in how the fee is routed; through a waste hauler or facility, or at the time of product sale. The funding option chosen for alkaline disposal is that users will pay upfront as product manufacturers integrate disposal costs into product costs. Under this Plan, product manufacturers will pay for disposal of alkaline batteries collected from instate waste-to-energy and MSW composting facilities, and Vermont towns using out-of-state waste-to-energy and MSW composting facilities. Collected alkalines would be sent to a manufacturer designated location within the U.S. The sender will pay only for shipping, while the manufacturer will assume the costs for any processing or disposal.

This approach was judged more equitable than the alternative option considered, in which the incinerator or composting facility would pay the disposal costs. Having the manufacturer pay the disposal costs would place the costs directly on the users of the product rather, than being spread out amongst all trash generators. Administration of the chosen system potentially could be more complex than the alternative, but it was judged to be more consistent with the intent of the legislation.

One obstacle identified in implementing the chosen funding option is that it presumes that all battery manufacturers selling alkaline batteries in Vermont will be able to work cooperatively to pay for disposal costs. The primary challenges to this assumption are:

1) The ability to accurately identify the relative market shares of different battery manufacturers for purposes of calculating relative disposal costs; and

2) The ability to assure that all battery manufacturers participate in the process.

**Costs**

Collection and Shipping

**Sources**

- Towns/districts sending alkalines to out-of-state incineration/composting facilities (operating budgets).  
- Volunteer retailers.  
- Instate incineration and MSW composting facilities (operating budgets).

Disposal

- Manufacturers (incorporated into product price). With the exception of manufacturers selling only zero mercury added alkalines.

Advertising

-Towns, districts, sending alkalines to out-of-state incineration/composting facilities (education budgets). Also State support for promotion.

Administration

State (facilitating start-up, coordination, monitoring, tracking, regulatory interpretation, etc.)

One of the costs to manufacturers of the alkaline collection program will be the costs of disposal. If the following assumptions are used:

- 10% of Vermont's trash is disposed of through incineration (446,080 alkaline batteries).
- The program captures 50% of those alkaline batteries (223,040).
- 10 batteries equal 1 lb. (23,040 lbs.)
- 600 lbs of batteries fit in a 55 gallon drum ( 38 drums)
- Disposal cost is \$450 a drum.

The total disposal cost to manufacturers per year, under current conditions would be approximately \$ 17,100. If new waste-to-energy facilities or MSW composting facilities become utilized, disposal costs will increase accordingly.

Other program costs are difficult to assess but will depend on the extent to which alkaline collection is integrated with other collection systems. Collection, shipping, and advertising costs will only need to be borne by those towns/districts sending trash to out-of-state incineration/composting facilities.

## SECTION V

## APPENDIX A

HOUSEHOLD BATTERIES: TYPES, SIZES, AND COMMON USES		
Battery Type	Sizes	Uses
Alkaline	9 volt, D, C, AA, AAA, Button	Flashlights, cassettes, radios, toys, electronics and other portable appliances
Carbon-zinc (Leclanche and Heavy Duty)	9 volt, D, C, AA, AAA	Flashlights, toys, etc.
Mercuric oxide	Button, some cylindrical	Hearing aids, watches, photography
Silver oxide	Buttons	Hearing aids, watches, photography
Zinc air	Buttons	Hearing aids
Nickel-cadmium	9 volt, D, C, AA, Coin & Button, packs	Rechargeable, cordless appliances, i.e. power tools, camcorders.
Lithium	9 volt, C, AA, Coin & Button	Cameras, pacemakers, calculators, watches
Small Lead Acid	packs, in sealed plastic container	lap top computers, lawnmowers.

concerns as to the variability of recycling markets, and whether the proposed requirement satisfied the requirement of Executive Order 12291 that, where permitted by law, regulatory actions maximize net social benefits. See President's Council on Competitiveness Fact Sheet (December 19, 1990), which is part of the record for this rulemaking. The concern over net social benefits mirrors the Agency's own concern and the concerns reflected in the public comments regarding variable costs and fluctuations in markets for recycled materials, and reinforce the Agency's decision not to proceed with a mandatory national 25 per cent material separation requirement for MWCs at this time.

Numerous other comments on the specifics of materials separation were made during the comment period. The comments addressed concerns over how sources could measure compliance with the standards, what type of recordkeeping would be required, what materials could be credited, the technical achievability of 25% separation, lead-in time necessary to achieve 25%, the workability of the combustion permit and the legal authority to require source separation. Because the Agency has determined that it is not appropriate to require materials separation in this rulemaking, those comments are not addressed in detail in this notice. The discussion of these issues can be found in the response to comments in the Background Information Document cited above. (EPA-450-3-91-004, December 1990.)

## 2. Household Battery Separation Program

The proposal also included a separate requirement to establish a household battery separation program. See 54 FR 52286. Many commenters endorsed the requirements for household battery separation as a way to reduce emissions of toxic metals such as mercury and cadmium. Several commenters said that if add-on controls cannot reliably remove mercury from the MWC flue gas stream, separation of mercury-containing items, such as batteries, is the only way to remove mercury. Some commenters advocated mandatory deposit/return systems, mandatory retailer take-back programs, or curbside pickup. Others said that automatic sorting equipment would remove household batteries from mixed MSW. Some commenters thought that EPA should limit or ban the use of heavy metals in batteries until technologies are available for recycling them.

Several commenters said that there are several successful battery

separation programs in the United States, Europe, and Japan, and that there is evidence to show that such programs can reduce mercury emissions from MWC's.

In contrast, other commenters thought that requirements for household battery separation are premature because the amount of mercury in MSW or MWC emissions due to batteries is not clear. Several commenters said that separation programs for household batteries are not necessary because the battery industry has already reduced the mercury content of alkaline batteries, the most common type of household battery, by over 90 percent in the last 5 years. Some battery manufacturers reported that the mercury level in a typical alkaline battery is currently between 0.025 percent and 0.05 percent, and that by 1993, alkaline batteries sold in the United States will contain no more than 0.025 percent mercury. (In the early 1980's the typical mercury content of an alkaline battery was about 1.0 percent.) Some commenters stated that community household battery separation programs in the United States were inefficient and would have little effect on mercury emissions. Other commenters said that mechanical technologies for separating household batteries are unavailable.

Some commenters opposed mandatory separation because there are no markets for household batteries, there are no facilities in the United States that reclaim metals from mixed household batteries, and there are no other affordable alternatives for disposing of separated batteries. Others opposed separation because of the health risk of accidental ingestion of batteries by small children or elderly persons.

Following proposal of the MWC standards the Agency met with representatives of several community household battery separation programs in the United States. (See Docket No. A-89-08, Item No. IV-E-2.) In general, these programs have achieved household battery recycling rates of less than 15 percent. The most successful programs in Europe and Japan have only achieved battery recycling rates of 20 to 30 percent. Also, as noted, the amount of mercury used in alkaline batteries in the United States has declined significantly. In view of the low battery recycling rates achieved, the declining amount of mercury in household batteries, and the fact that there are many other sources of mercury in the waste stream, the Agency finds that it has not been shown that battery separation programs have a sufficiently significant effect on mercury

emissions to warrant their inclusion as part of a national standard at this time. Accordingly, battery separation programs do not represent BDT. Further, the health risk noted by commenters from accidental ingestion of button-cell batteries by small children and elderly persons also supports the decision that battery separation programs are not appropriate elements of BDT at this time.

Representatives of the household battery separation programs in the United States also said that there were no cost-effective means for disposing of separated mixed household batteries. They generally dispose of them in hazardous waste landfills since there are no facilities in the United States for recycling mixed household batteries. Indeed, the Agency was unable to identify any company in the United States that recovers metals from mixed household batteries. (See the BID on materials separation, EPA-450/3-90-021, November 1990.) One company was identified that recovers mercury and silver from mercury oxide and silver oxide batteries including small button batteries such as those found in hearing aids and watches. Two other companies expressed a willingness to accept separated household nickel-cadmium batteries. However, there is currently no option available for the recycling of the majority of household batteries. Furthermore, the storage and transportation of mixed household batteries may pose a risk of mercury outgassing and explosion if not handled properly.

While the amount of mercury used in alkaline batteries has declined to low levels as described in the BID on materials separation, mercury oxide button cell batteries contain higher proportions of mercury (about 35 percent) and this level is not expected to decline since the mercury in these cells is part of the energy-producing electrode. Therefore, MWC's or communities that want to remove specific mercury-containing materials from the waste stream may want to target mercury oxide button batteries.

In response to commenters who said that mechanical technologies are available for household battery separation, the Agency is aware of equipment that separates household batteries and other ferrous metals magnetically or concentrates batteries in small or dense waste fractions. However, the Agency is unaware of any automatic equipment that subsequently separates the batteries from the magnetic ferrous fraction. Batteries concentrated in small or dense waste

tractions may be subsequently screened to further concentrate the batteries, but the Agency is unaware of, and commenters have not identified, any automatic process specifically to separate the batteries. While these technologies may be effective in separating most household batteries from MSW prior to combustion, many nickel-cadmium batteries and some silver oxide and mercury oxide button batteries may not be removed by this equipment since they may be encased in items such as watches, cameras, and small appliances.

After thorough consideration, the Agency has decided not to require mandatory programs for separation of household batteries in the final MWC standards. As noted above, however, the Clean Air Act Amendments of 1990 direct the Agency to set numerical emission limits for mercury (and also lead and cadmium) by November 1991.

### 3. Lead Acid Battery Prohibition

EPA has decided not to adopt the proposed prohibition on burning lead acid batteries. Although many commenters supported the proposal, others questioned whether it was possible to achieve 100 percent compliance with a prohibition. On considering these comments, it is EPA's view that, although lead acid batteries are certainly a significant source of lead in MWC emissions, there are already strong regulatory mechanisms in place to discourage combustion of lead acid batteries. In particular, section 3001(f) of RCRA requires municipal waste combustors to have in place inspection procedures to avoid accepting hazardous wastes as a condition to being exempt from subtitle C regulation. This requirement would apply to lead acid batteries generated from commercial and industrial establishments, which typically are hazardous wastes. 48 FR at 14488-89 (April 4, 1983) and 40 CFR 268.89 (RCRA subtitle C rules regulating spent lead acid batteries). Given this existing system (concurrent with many industry commenters who stated they already seek to remove all lead acid batteries from MSW), the Agency does not believe a further prohibition is necessary.<sup>7</sup>

<sup>7</sup> EPA also is investigating whether to adopt a comprehensive approach to recycling lead acid batteries pursuant to section 6 of TSCA. 56 FR 52289 (Dec. 24, 1991).

## C. Standards for Municipal Waste Combustor Emissions

### 1. Dioxin/Furan Emission Limits

Some commenters said a dioxin/furan emission limit in the lower end of the proposed range of 5 to 30 ng/dscm (2 to 12 gr/billion dscf) could not be met by all MWC's with SD/FF systems. One of these submitted data from a new MWC with an SD/FF system showing an average dioxin emission level in the upper end of the proposed range. Two commenters recommended the emission limit be no lower than 30 ng/dscm (12 gr/billion dscf). This recommendation was based on the available data as well as consideration of uncertainties due to the limited amount of dioxin/furan emission data available and the lack of data over the expected life of a typical MWC. Another commenter thought a margin for uncertainty should be included because NSPS limits are never to be exceeded. One commenter suggested the NSPS require the same level as the emission guidelines for existing MWC's (125 ng/dscm [51 gr/billion dscf]).

Some commenters thought the same dioxin/furan emission levels should be required for all MWC technologies, including RDF. However, another commenter said literature indicates RDF MWC's emit more dioxin/furan than mass burn MWC's and, therefore, higher emission limits should be set for new RDF plants.

The Agency reviewed performance data from 10 MWC plants with state-of-the-art, well-operated SD/FF control systems (proposal BID No. EPA-450/3-89-27c and Chapter 3 and the appendix of promulgation BID No. EPA-450/3-91-004). Average outlet total dioxin/furan concentrations measured at 8 of the 10 facilities were toward the low end of the proposed emission range (below 10 ng/dscm [4 gr/billion dscf] at 7 percent O<sub>2</sub>). Average emissions at one facility were about 23 ng/dscm (10 gr/billion dscf), and individual test runs measured as high as 29 ng/dscm (12 gr/billion dscf). New source performance standard emission limits are not to be exceeded, and must be set at levels that are achievable by all MWC's using best demonstrated technology. After review of all available data, it is the Agency's judgment that the best demonstrated technology for affected MWC's (GCP and SD/FF) can achieve the same dioxin/furan level for mass burn and RDF MWC's. Therefore, in the final standards, a single emission limit for new MWC's has been set at 30 ng/dscm (12 gr/billion dscf) total dioxins/furans. The Agency believes that with proper

maintenance and operation, there will be negligible degradation in performance over time and that the 30 ng/dscm (12 gr/billion dscf) limit provides an adequate margin to cover operating conditions over the life of the equipment.

### 2. Sulfur Dioxide and Hydrogen Chloride Emission Requirements

Several commenters noted that short-term compliance tests had shown SO<sub>2</sub> reductions of 85 percent, but suggested that the continuous 85-percent SO<sub>2</sub> reduction requirement (24-hour average basis) proposed for new plants with capacities above 225 Mg/day (250 tpd) was not consistently achievable on a long-term basis. They claimed that short-term variability in SO<sub>2</sub> inlet levels (due to variation in waste composition) would make achieving 85-percent reduction or 90 ppm SO<sub>2</sub> on a 24-hour average basis difficult. Others said it would be possible to achieve 85-percent control, but it would require a much more costly acid gas control system than analyzed by EPA. For example, the air-to-cloth ratio of the baghouse used in the SD/FF system would need to be lower, and the stoichiometric ratio (and lime feed rate) of the SD would need to be higher. The commenters claimed the higher lime feed rate would result in increased operating and maintenance costs as well as an increase in the quantities of waste (ash) generated by MWC's, leading to increased ash disposal costs.

Most of the commenters suggested that the standards should require 80-percent SO<sub>2</sub> control, although a few suggested 70 percent.

Based on similar arguments, these commenters also requested the HCl standard be changed from the proposed level of 85-percent reduction to a level of 90-percent reduction.

With regard to the averaging time for SO<sub>2</sub>, some commenters suggested use of a rolling 24-hour average rather than a block 24-hour average (midnight to midnight). Others suggested a shorter averaging period than 24 hours to protect against potential short-term environmental impacts or to be consistent with prevention of significant deterioration (PSD) permits.

After proposal, the Agency obtained continuous SO<sub>2</sub> emission data for a new MWC with SD/FF control. The SO<sub>2</sub> data were obtained by CEMS at the SD/FF inlet and outlet and were corrected to 7 percent O<sub>2</sub>. Hourly emission data were analyzed (see the appendix to promulgation BID No. EPA-450/3-91-004). The long-term average percent reduction in SO<sub>2</sub> for this data set is

**SECTION V**  
**APPENDIX C: LIST OF TAC WASTE BATTERY SUBCOMMITTEE PARTICIPANTS**

Raymond L. Balfour-	Vice President, Rayovac Corporation
Michael Bender-	Solid Waste Planner Central Vermont Regional Planning Commission
Albert Cicchetti-	Portnow, Little, and Cicchetti (Vermont Wholesale Distributors),
Jim Harrison-	Director, Vermont Grocers Association
Nancy Heininger-	Central Vermont Landfill
Carl Hirth-	Solid Waste Planner NH/VT Solid Waste Project
Jennifer Holliday-	HHW Program Coordinator Chittenden Solid Waste Management District
Joan Mulhern-	Legislative Director Vermont Public Interest Research Group
Mike Nelson-	Pollution Solutions of Vermont
Chuck Nichols-	Legislative Dept. Vermont Chamber Of Commerce
Karen Odat-	Member Randolph Solid Waste Committee
Richard Opatick-	Section Staff Executive National Electrical Manufacturers Assoc.
Frank Reed-	Environmental Law Foundation
Jane Shiley-	Attorney Gates Energy Products, Inc.,
Lisa Silverstone-	National Electrical Manufacturers Assoc.
Lori Stratton-	Environmental Law Foundation
Todd Tatar-	Strategic Marketing Manager, Sanyo Energy (USA) Corp.
Terry N. Telzrow-	Manager of Standards and Product Safety, Everready Battery Company.
David Thompson-	Environmental Manager, Panasonic Industrial Co.,
Patty Turley-	William Shouldice and Assoc. (Vermont Grocers Association)
Al Voegele-	Director, Vermont Republic Industries
Bruce Watts-	Duracell Battery
Fred Wehmeyer-	Gates Energy Products

**SECTION V**  
**APPENDIX D: MANUFACTURER RESPONSIBILITY**

ANR found there were many constraints to creating a collection program based entirely on "manufacturer responsibility". The ability to do so is primarily affected by the number of manufacturers within the industry, and the State's enforcement capabilities. In the Ni-Cd industry, 5 manufacturers comprise over 90% of market share. In the alkaline industry, the top 3 producers comprise 90% of the market. The ability of the alkaline industry to offer cooperative solutions is also somewhat affected by the existence of non-domestic manufacturers. The collection programs outlined below will require that the Legislature and the Agency follow through with the enforcement recommendations as outlined in the Plan Summary (Section II).

H. 124 states that plan implementation shall emphasize manufacturer responsibility. The Agency has attempted to interpret this, as well as to analyze the related enforcement capabilities within our regulatory power. We have found that our ability to require comprehensive product stewardship for waste household batteries may be limited although there are some ways that manufacturers can be brought into the loop. Manufacturer responsibility, as incorporated in the plan includes:

Technical assistance for planning, and ensuring that some type of system is put in place.

This is already demonstrated by manufacturer's participation in plan development, including the submission of technical information.

Assistance with labeling, marking, and packaging.

As demonstrated by entire industry through expected compliance with labeling standards as created in H. 124.

Product and packaging reformulation.

As demonstrated in both voluntary and mandated toxicity reduction activities by the alkaline industry and product reformulation by equipment manufacturers to provide access to rechargeable batteries.

Payment for Costs of Disposal/Recycling

This responsibility only falls on manufacturers of those batteries determined to be harmful.

Manufacturer responsibility in this plan does not include:

Manufacturer "Take-back"-

We have determined that a "take-back" program does not necessarily require that a waste product be delivered to a manufacturer's site but rather that the manufacturer makes available free or low costs means for recycling/disposal of those products. This may take the form of providing for a collection program to send batteries c.o.d. to a metals reclamation facility or for a consumer to be able to mail-back a waste battery in a postage paid envelope. The general idea is that disposal costs are not paid for by the taxpayer, or at the back end by the waste generator, but rather the costs are integrated into the purchase price.

For Vermont's waste battery program the only way in which a "take-back" program could be created is if:

a) The manufacturer wanted the product back because of it's economic value.

For the batteries in Vermont program this may result for the Ni-Cd stream in the future because of the metals reclamation opportunities. For the meantime, hazardous waste determinations, and reclamation facilities only out of the country make Ni-Cd management costly. Alkalines are not likely to show value for the duration of the mandatory collection for batteries diverted from incinerators.

b) The manufacturer volunteered to participate in a program in order to demonstrate a commitment to customers and the environment.

Although this may encourage product stewardship, this type of commitment is not consistent or guaranteed. Voluntary programs alone will not be sufficient to capture a sufficient amount of batteries in an ongoing collection program.

c) A manufacturer is concerned that their product would be prohibited from sale if the manufacturer did not participate in a "take back" program.

This is probably the only way a long term on-going product stewardship program could be created and sustained. This approach will be effective only if requirements are strictly enforced so that "cheaters" do not inadvertently get rewarded. This program should not be instigated unless the State is very serious about following through with sales prohibitions.

#### Other Factors Affecting Manufacturer Responsibility

The cost effectiveness of a "take-back" program, will be influenced by the degree to which manufactures can provide and utilize a common system. In some cases, it might be that a take-back program would be cost prohibitive. This would probably occur if each manufacturer set up their own separate path for a recycling/ disposal system. A more cost effective system would result if there was a single account at a reclamation/ disposal facility which handled a larger quantity of materials. Moreover, collection costs would be prohibitive if there was a need to separate batteries according to manufacturer source.

One factor that influences the ability of manufacturers to integrate systems is the number of manufactures of the battery type. The fewer the number of manufacturers, the simpler it is to organize and be inclusive. It is also important to consider any legal constraints, such as anti-trust law, in the design of the system.

**We conclude that manufacturer "take-back" will only be feasible if**

- 1) Manufacturers are motivated by threat of sales prohibition,**
- 2) The State engages in thorough enforcement of the proposed sales prohibition,**
- 3) Manufacturers are able to cooperate and participate in an integrated system for battery recycling/disposal.**

**SECTION V**  
**APPENDIX E: DEPOSIT SYSTEM**

The legislation directs the Agency to consider alternate battery collection systems, giving preference to a returnable battery deposit system for the state. Upon our analysis of the feasibility of a deposit system we have found that the bottle bill model is not easily transferable to household batteries:

-There is a long turn around time for a battery, especially rechargeables which is about 5 years. This makes it less likely that a battery purchased in year #1 will be returned in year #5.

-The relatively small number of batteries used, and the long intervals between disposal needs makes it hard for a consumer to accumulate large collections. This makes return less convenient and worthwhile.

-Having manufacturers label batteries just for Vermont would be difficult since the battery distribution chain is very complex. Deposit batteries may end up being sold in other states and then brought into Vermont for redemption. For batteries embedded in appliances, it is even more difficult to control the sale into Vermont.

-Relative toxicity. Batteries types are quite heterogenous and an equal deposit on all types might be misleading to the public (e.g. the new low mercury batteries and the rechargeables). Conversely, anything but an equal deposit would be very difficult from an administrative perspective.

These reasons, as well as the additional amount of time and money that would be spent in setting up a deposit system infrastructure, have caused us to explore alternative incentives to ensure participation levels at or above those expected with a deposit system. These incentives include targeted and convenient collection, disposal prohibitions, and education/promotion activities.

**SECTION V  
APPENDIX F**

**RESPONSIVENESS SUMMARY  
to Comments received on draft Waste Battery Report**

**I. ENVIRONMENTAL HARM AND PUBLIC HEALTH RISK ASSESSMENTS**

**Criteria And Definitions**

1. " Public health risk is usually based on exposure levels, not on the amount emitted to the environment".

For this report we were asked to report on the "environmental harm and public health risk" posed by different battery types. Exposure levels will be influenced by the amount of metals available to be released and the release potential from different disposal methods. Methodology for determination is discussed in the introduction to Section 3.

2. "...This office understood the Legislature to find that within the municipal solid waste stream there are several used products that, when disposed may present harm or the potential of harm to humans and/or the environment. It is unclear if this harm had to be solely a toxicity harm. It was also unclear if a toxicity harm had to be a proven harm or the potential of harm. In addition to toxicity harm, harm might also include loss of the use of environmental space because of the need to provide landfill space for these wastes...".

We agree that the definition of harm can be very far reaching. It was beyond the means available for this report to do a thorough cost/benefit analysis. If we had, we would also have to account for any "harm" that would result of sending hazardous waste out of state for disposal, etc. Please see the introduction to Section 3 for more information about decision criteria.

3. "How did you define "harmful" ?

We never defined "environmental harm" in the draft report but rather, created criteria for its determination. We have added the following definition at the beginning of section 3:

"Environmental harm" is defined as environmental injury, damage, or deterioration of environmental quality. "Environmental harm" will be posed when a battery type contains a constituent of concern (e.g. mercury, cadmium, lead), and this constituent is released into the environment in exceedences of environmental standards through various disposal practices (landfill, incineration, composting). Further, ANR examined the toxicity concentrations (TCLP) of battery types as an additional measure of whether a battery type was "harmful to the humans or the environment".

The environmental standards used (e.g. water quality standards), incorporate public health risk guidelines, thus the determination process also encompassed public health risk considerations.

## What Are The Metals of Concern in Household Batteries?

1. "Determinations of problem batteries should also include information on whether specific battery types exhibit characteristics of hazardous waste, (corrosive, explosive)".

The only battery that we know about that has been classified as having other hazardous waste characteristics other than toxicity is lithium cells. Although lithium may become explosive when it comes into contact with water, we are not aware of there ever being a case where this has happened except through intentional manipulation.

2. "Section 3(A) pg. 6 states that 'Lithium is not considered to be a toxicity problem in the environment since it is tolerated in reasonable concentrations in both plants and animals.' However, the preceding sentence reads 'potential risk to humans or the environment may also result from exposure to lithium, manganese and zinc.' These two thoughts appear to be contradicting....As no quantitative data was presented in the draft plan on lithium levels, it is my assumption that they are far below these concentrations (990-2400 mg/day, threshold dose for drug therapy). Would it ever be possible that lithium contaminants could reach these concentration levels?"

Excessive exposure to lithium can cause health risk as you suggest. However, risk of exposure is small given the relative market share of lithium batteries (.2%) and the small percentage of lithium within those cells (probably less than 8%). A button lithium cell may weigh 1.5 grams. Approximately 12,950 lithium batteries, mostly button batteries, were sold in Vermont in 1990. Using these estimates it figures that each lithium battery contained .12 grams of lithium, a total of 1,554 grams of lithium, in lithium batteries, was purchased in Vermont in 1990. The State of Vermont has co-sponsored a study, due out soon, that will contain more detailed composition information.

The chance of lithium concentrations ever reaching the 990-2400 mg/day drug therapy threshold limits is difficult to compare since as you suggest, the drug therapy threshold is based on daily dose. Current disposal practices of lithium batteries results in a dispersion of the lithium through the waste stream, which is unlikely to provide a consistent and daily exposure. At this time, we have determined that lithium cells do not contribute to environmental harm and public health risk. Lithium cells have also been found to be preferable to mercury containing batteries, and they also have the longest shelf life of all consumer batteries.

## What Are the Means Through Which These Metals May Be Released Into The Environment and Is There Any Data Indicating That Releases Exceed Environmental Standards ?

1. " Gross heavy metals contributions from all natural sources and all solid waste sources was not clarified or mentioned as a possible data gap. The Clean Water Action Report, Mercury Rising, incidently states that the largest contributor of airborne mercury is coal fired utility plants, not MSW incinerators. Quote page iii- 'Coal-fired utility plants represent the largest single source of atmospheric release.'(of mercury). Unfortunately there is no tonnage estimate. As for MSW incinerators, the authors of the enclosed Waste

Age article estimate that 44 tons of mercury are emitted annually. This compares with 4,500 tons from all man made sources and 3,000 tons from all natural sources".

ANR agrees that this data gap existed in the draft and this information has been included in Section III C. We used E.P.A. information, which had natural emissions at 3,000-20,000 tons/year and humanmade emissions at 21,000 tons/year. While this additional information is important in order to place the relative contribution of mercury from batteries in perspective, this does not change ANR's legislative charge of determining which battery types may contribute to environmental harm.

2. "...The degassing of the earth's crust will produce between 25,000 and 150,000 metric tons of mercury vapor per year...This ambient value indicates that a summation of the total poundage of mercury above the state may equal as much as 3,172 pounds...The loading due to batteries per year is significantly less than that which occurs due to ambient air loading the environment each year, a natural phenomenon.

Although there is a significant amount of mercury loading into the environment from other sources, dry cell batteries are still one of the top two contributors into the municipal solid waste stream. Mercury used in chlorine and caustic soda manufacturing, the leading user of mercury is disposed of through the hazardous waste stream. Loading from batteries is still of concern because it may contribute to environmental exceedences.

3. " Besides using TCLP, batteries should be further evaluated to determine whether they fail total threshold limit concentration (TTL) of total loading to the environment, as defined in California's Code of Rules and Regulations, Title 22, Article 11".

At earlier TAC Battery Subcommittee meetings, ANR had discussed using information from California's Total Threshold Limit Concentration (TTL) limits as additional information for making our harm determinations. We did not use the TTL limits in our analysis because we felt that the Toxicity Characteristics Leaching Procedure (TCLP) information was most pertinent for landfill determinations. The Total Threshold Limit Concentration is based on the total elemental concentration, or weight percentage, of the listed substances present in a waste material. The regulatory limit for mercury and/or mercury compounds is 20 ppm and the limit for cadmium is 100 ppm. It is likely that with the exception of lithium cells, all consumer batteries would classify as hazardous waste under TTL definitions. Alkaline batteries would fail TTL, not because of mercury, but because of the values for zinc. For determinations of batteries going to MSW incinerators, we used information on the total amount, not total concentration, of constituents going into an incinerator.

#### **Incineration**

4. " A complete technical review of different incineration emissions equipment and specifically the Wheelabrator Claremont and VIWS Rutland facility regarding dry cell battery components. Citing various Minnesota, Massachusetts, and Swedish MSW combustion facilities with different equipment is not necessarily relevant. It is recommended that this review be done by technically qualified personnel".

Some specific information about emissions equipment at the VIWS and Claremont facilities has been integrated into the text of the Report at the commenters request. It is important to recognize that data from other facilities is relevant and necessary for our analysis since mercury testing is not conducted at the Claremont facility, and the VIWS facility is not currently operating. While it is not possible to offer any direct statement about emissions from those facilities, some more general information about tests from relevant emissions control equipment has been added into the text.

5. " The present text and bibliography does not reflect two submitted reports from the waste-to-energy association, IRR. In addition, two articles from November 1991 Waste Age are also enclosed as technical combustion information for the ANR review. One article indicates an average 50% removal rate of mercury on mass burn plants with spray dry absorbers/fabric filters or electrostatic preceptors. Both Wheelabrator Claremont and VIWS reportedly have these types of systems. The appropriate companies however could be contacted to substantiate this information.

The Department of Environmental Services in New Hampshire informed us that the Wheelabrator Facility in Claremont, New Hampshire has an acid/gas control with a baghouse. As discussed in the text, some studies suggest that a system with a baghouse may achieve up to 85% mercury control, while other sources show they are not effective in capturing gaseous mercury.

The application for the VIWS facility shows an ESP precipitator with a wet scrubber that can be expected to achieve better mercury control than a dry scrubber. If VIWS receives an operating permit they will do emissions testing in the first year of start-up. The VIWS application has metals separation, which included dry cell batteries, as part of the proposed operating procedure.

6."... Certain references used in the draft do not support the point ANR is trying to make about diverting alkaline batteries from the Claremont MSW incinerator. The Hennepin County, Minnesota reference and the Sweden citation, undercut rather than support ANR's recommendation. In a paper presented by Mr. Randy Johnson, a Hennepin County Commissioner, he found little factual support which linked batteries with a mercury emission spike. In Sweden, the installation of pollution control equipment had much to do with the sharp drop in mercury emissions".

We agree that those two studies cited on page nine of the draft do not stand as strong arguments that mercury in batteries contribute to mercury emissions, although they do stand as examples of mercury exceedences from facilities. These two references have been removed from the final report.

7. "The Vermont ANR has not cited any evidence showing that the Claremont MWC has exceeded its mercury emissions in the past. Because of the sharp reduction in mercury content in alkaline batteries, the Claremont MWC will be much less likely to exceed its permitted mercury emissions in the 1993-7 time period.

There is no data available about mercury emissions from the Claremont facility since the State of New Hampshire has never required testing. We agree that any waste-to-energy facility will be much less likely to exceed emissions standards as mercury in batteries is reduced, and that is why ANR is recommending a diversion program until there is zero mercury added to alkaline batteries.

8. " The draft report totally ignores several important references whose conclusions disagree with the report's recommendations. ANR must either change recommendations or alternatively discuss the omitted references and then state either (i) that the conclusions in the references were not based on concern for environmental harm and public health risk or (ii) that the ANR disagrees with the conclusions reached in the references.

a) U.S. EPA Municipal Waste Combuster (MWC) Regulations- Federal Register 2/11/91 F.R. "After thorough consideration, decided not to require mandatory programs for separation of household batteries in the final MWC standards". In explaining its reasoning, the EPA devoted much of its discussion to alkaline batteries.

b) Institute of Resources Recovery (IRR)- IRR supports the conclusions of the US EPA in which the Agency decided to not require separation of household batteries. "Mercury emissions from MWC facilities do not pose a significant health risk. Environmental health risk assessments completed over the past several years on new and existing MWC facilities consistently show that the levels of mercury emissions result in exposures that are 10 to 100 times less than threshold health effects standards established by federal and state regulatory agencies.

c) Waste Management of North America- "Pilot Program-Household Dry Cell Battery Collection". Paper presented in November 1991 at Deerfield Beach, Florida, Battery Seminar. Waste Management of North America decided to conduct pilot programs to assess collection center methods for removing household dry cell batteries from the waste stream in response to concerns regarding the incineration of wastes. They wrote; "collection of alkaline and carbon-zinc batteries for metals reclamation is not feasible at this time. Although they represent the greatest amount collected, it is recommended that carbon-zinc and alkaline batteries not be collected at this time."

d) Carl Hirth and Randy Johnson. In an article in Waste Age magazine, June 1990, they concluded that keeping alkaline manganese batteries out of the solid waste stream is unnecessary.

Yes, we do have an obligation and an interest in reviewing all pertinent references and to discuss those which we do not concur with. We have incorporated some of these references into the Plan in Section IV, where program implementation is discussed. We have incorporated into the Report those references we find to have particular relevance and substance.

a) We have added that excerpt of the Federal Register as Appendix A in the report, and discussed the EPA final ruling in the text. We find that the EPA's reasoning and findings do not negate ANR's determination of harm, although they do have some bearing on collection system implementation. ANR has decided to not initiate new source separation programs for the collection of alkaline batteries, yet recommends front end diversion programs at instate composting and MSW incinerator facilities.

The EPA statement is included in the Federal Register in a section responding to comments on a proposed battery separation program. It does not address the issue of whether mercury in batteries pose a risk when incinerated, such as we were charged. The Vermont legislation charges ANR to require separation based on a harm determination, not on whether recycling markets are available or on successful participation rates as the EPA references. The legislation did not direct us to remove certain batteries, if economically feasible to do so, but rather, to target certain batteries if they contribute to environmental harm. In the Plan's proposed collection program, we are striving towards the most cost-effective program that will also achieve high capture rates.

b) We have reviewed the information submitted to us on October 25, 1991 by IRR. We acknowledge the receipt of this information, and have included some of the information in the text. However, we do not find all of it substantively relevant to our determinations. IRR's support of the EPA decision still does not address the fact that our task is different than the EPA's, and that our findings are based solely on environmental harm and public health risk.

The IRR position that mercury emissions do not pose a significant health risk is not accompanied by any information about how those samples were made; who implemented them, what criteria was used, and how many were undertaken. Although IRR states that emissions consistently show that the levels of mercury emissions are 10 to 100 times below federal and state standards, there is not citation or documentation to support this claim.

c) ANR agrees that segregation of alkalines for metals reclamation is not feasible at this time, but reclamation is not the basis of why ANR determined that certain batteries needed to be segregated. Once again, the Agency's charge was to make determinations of environmental harm and public health risk associated with specific battery types. As worded in the legislation, the plan "shall contain a comprehensive system for the collection, recovery, recycling, reuse, treatment or disposal of all those batteries determined to be harmful to humans or the environment." There are many management options available after batteries are segregated, and economics will determine whether they are ultimately recycled or landfilled.

d) The article mentioned here recommends targeted collection programs for those batteries "that still contain concentrations of mercury and other heavy metals". This is exactly what the plan proposes to do. The authors do not conclude that keeping alkaline manganese batteries out of the waste stream is unnecessary. We agree with many of the articles findings and recommendations; toxicity reduction is the most efficient means of diverting mercury away from waste-to-energy facilities, and mercuric oxide buttons cells need to be targeted. In fact, most of the battery legislation and battery management plan is consistent with the

recommendations in the article. Nonetheless, even if alkalines can not yet be recycled, and even with the already dramatic reductions in mercury content, ANR has still determined that alkalines contribute to environmental exceedences and need to be diverted from municipal solid waste incinerators until they have zero mercury added.

### **Landfilling**

9. "...The study cited on page 10 (1977/78 English study) seems awfully old-- was this the only study used to conclude that alkaline batteries do not pose a mercury pollution problem in landfills?"

Other data was added to support the findings of the English study and ANR's determination that alkaline batteries, at the .025% mercury level, do not contribute to environmental harm and public health risk if landfilled. This includes data from Vermont's landfill assessment program, Toxicity Characteristic Leaching Procedure data, and data from lined landfills. These alkaline batteries do not fail TCLP for mercury, cadmium, or lead.

10. "... The landfill data does not necessarily point to household batteries as the source of those metals. Does not support there is a risk. Should rely on TCLP, not lined landfill data, to ban a particular battery type".

Although the landfill data can not show a direct causality from batteries, we do know that household batteries are currently the second largest contributor of mercury into the solid waste stream, and that nickel cadmium batteries may contribute up to 50% of the cadmium in the waste stream. We relied on both TCLP data and the landfill data for our findings. (The cadmium estimates are from the Franklin Associates 1988 Report for the EPA. The Ni-Cd industry now believes that 20% is a more accurate estimate).

11. " ....the Agency needed to look less at groundwater data and more at the quality of leachate collected from lined landfills...One may need to address whether or not the waste water treatment plants to which the leachate is sent can adequately remove mercury contaminants. Also lined landfills are not a panacea to the problem of ground water contamination from leachate".

ANR examined leachate data from lined landfills, as presented in Section III B. Mercury is not a constituent of primary concern in lined landfill leachate.

12. "...With many regional solid waste plans looking at both composting/co-composting or incineration as components of their waste management strategies, this percentage is likely to increase significantly in the near future. Therefore, perhaps it would be interesting to project just what the volume of MSW going directly to lined landfills ? One might find this percentage to be relatively low and thus collecting alkaline batteries from this waste stream may not be as burdensome as it initially appears to be"

At this time we can not predict quantities that will be going to incinerators or composting operations. We expect that this percentage will increase beyond what it is today. Regardless, the program does not call for the diversion from lined landfills of alkaline batteries since they were not found to contribute to harm.

13. "...The information presented in Section 3 part B (starting on page 8, draft copy) is inconclusive, as is stated in the plan, and does not completely back up the plans recommendations. On page 10, in the unlined landfill section, the plan states that 'the long term impacts of metals, such as mercury, in landfills is unknown', yet the plan only addresses diversion of alkalines from incinerators and assumes landfilling is an acceptable practice..."

The beginning of the sentence quoted here reads; " It is generally believed that certain metals, like mercury, would get bound up in the soil and not be released rapidly from landfills, although the long term....". To get more information of the behavior of batteries in landfills we used TCLP data. Since alkaline batteries at .025% mercury levels do not fail TCLP for mercury, we were able to make a more accurate determination that the alkalines being purchased for use today will not contribute to harm when disposed of in landfills.

Other information in the Plan shows that mercury is not presenting a problem in MSW landfills. The Landfill Assessment Data indicates that in the long term, mercury is not a problem in unlined landfills. The short term leachate data collected from lined landfill in Colchester does not show any mercury problems. This is supported by other lined landfill data as presented. The TCLP information also does not indicate that mercury from alkalines are a problem in landfills. Based on this information, we concluded that we had sufficient information to determine that alkalines do not cause a problem in landfills.

#### **Composting**

14. "... The European and Canadian Governments have recently promulgated rules for compost indicating much lower level for zinc than what is proposed for Vermont...It would seem useful to determine why these governments have used these lower standards before finalizing the arrangements for dry cell batteries..

We will follow the development of the draft composting rules and integrate them as the standards used in this Report.

#### **What Is The Total Amount of Those Metals Available From A Battery Source ?**

1. "Contributions of non-consumer mercuric oxide batteries was not cited in Draft #2. Only consumer button battery mercuric oxide was cited on page 13.

The legislature directed ANR to focus on batteries sold at retail level. The legislature has previously recognized the impact and significance of nonconsumer mercuric oxide batteries by prohibiting their placement in mixed municipal solid waste, and by requiring those users to segregate those batteries for collection and return them to a manufacturer designated facility.

The bulk of mercuric oxide batteries are medical, industrial, and military batteries, not for the button batteries. Figures from the National Electrical Manufacturers Association list a total of 172.6 tons of mercury in mercuric oxide batteries with the breakdown being:

-Consumer applications	46.8	27%
-Medical Hospital Applications	24.7	14%
-Other Industrial Applications	18.0	10%
-Military Applications	83.1	48%

We have added a discussion of these and other mercury sources into the body of the Report.

2. "...The actual percentage of Vermont trash incinerated at Wheelabrator Claremont has varied from 6 %- 11% for the past five years..."

This new information will be incorporated into the Plan. Previously, the figure of 12% was used. The old and new estimates include trash from Vermont towns of the NH/VT Solid Waste District, as well as spot tonnage from Vermont. We will also add to the report the information that if the Rutland waste-to energy facility begins operations, it could potentially handle 30% of Vermont's trash.

### Agency Determinations of Environmental Harm and Public Health Risk From Particular Battery Types

1. " In Report Summary it says "the harm determination may be withdrawn and the separation requirement may no longer apply" (for alkalines). This language should be much stronger saying 'shall' instead of 'may' in the two places in the sentence.

This change was made in the Report Summary as recommended.

2. " Household alkaline batteries do not need to be separated before incineration because of the small relative contribution of mercury from alkaline battery sources. Compare the estimated 10 lb. mercury per year input to Claremont incinerator (and estimated 5 lb. output into the air) compared to 3,172 lbs. per year existing in ambient air over Vermont.

The final Plan includes further discussion about the relative contribution of mercury from batteries versus other sources. We still find that mercury in alkaline batteries, at current levels, contribute to environmental harm if incinerated. The additional five lbs. of emissions into the air from the Claremont facility is of concern because of the high toxicity of mercury and additional releases are likely to occur if in-state incineration operations commence. Alternatively, the short term nature of the needed program, and the low expected capture rates in source separation programs, has caused us to determine that only existing programs will be utilized for alkaline battery collection until the time all alkalines are at zero mercury added.

3. It is not practical to require separation of alkaline batteries due to the small benefit achieved through a difficult and expensive program; a) Mercury content is being reduced, the program would only need to be in place for a few years, b) It would take that long to educate consumers and get high participation, c) The program would add confusion to consumers on top of all other required programs. An ANR report dated December 6, 1988 says; 'We believe, as a general rule of thumb, that the toxicity of the solid waste stream should be reduced. Therefore, since household batteries add toxic materials to the waste stream, we should be looking for safe and appropriate ways to separate them or otherwise reduce their impact. Before adopting or

endorsing alternative management systems for batteries, however, we should be sure that they do not in fact make the problem worse or have costs that greatly exceed the benefits. We cannot yet reach these conclusions on separate battery collection programs'."

Since December 1988, we have spent time gathering more information about the problems posed by consumer dry cell batteries and have reached the conclusion that the separation of alkaline batteries from the waste-to-energy stream will be beneficial until 1997 when only zero mercury batteries will be entering the waste stream. Environmental protection is most assured when mercury containing alkaline batteries are disposed of in a secure landfill rather than being released into the environment from municipal waste combustors. Mercury is an extremely toxic and dangerous heavy metal, and the full benefits of curbing its release to the environment have yet to be realized. None-the-less, we agree that it is not efficient to set up new programs for only the short term.

4. Along with the EPA, the Legislators of Minnesota, New Jersey, and New York have developed no known specific bans on alkaline batteries from 1991 to 1997 at any MSW combustors. From reported accounts, these states have studied the issues in depth (for example the Minnesota 1990 and 1991 Reports). Why did those Agencies and Legislatures decide not to ban or restrict alkalines, but the Vermont Agency of Natural Resources does in its Battery Plan ?

As discussed now in the body of the text, the EPA and some other states had program goals that were different from Vermont's goals. The EPA decided not to create a national standard because of the expected capture rates of collection programs, not because batteries do not contribute to environmental harm. Minnesota also did not believe a short term program for alkalines was worth the effort, but Minnesota never made the determination that alkalines did not contribute to harm. We are not familiar with the most recent activities in New Jersey but we believe they are targeting all battery types. The State of New York, Executive Order No. 142, requires that a battery plan be developed that provides for the return of all dry cell batteries.

5. "... Even if Vermont is successful in preventing one pound/month of mercury from entering the Claremont incinerator, how does ANR reach the conclusion that this will make any significant difference on the environmental harm and public health?"

ANR has not been specifically charged to prove a "significant difference". A diversion program will contribute to a decrease in the potential environmental harm and public health risk from mercury releases into the environment. Every mercury reduction and diversion effort will effect the amount of release and the extent of the harm posed to human health and the environment.

6. "...prohibit placement of alkalines in any waste stream. Without this addition, the likelihood of attaining program goals of high capture rates for alkalines is diminished with the spot market being the only determinant of trash destination".

High capture rates can be achieved for alkalines going to in-state incinerator and MSW facilities by separation capabilities at the facility which will also account for spot markets. For alkalines going to out-of-state facilities, it is likely that Vermont towns with spot tonnage arrangements will have difficulty being able to perform diversion. This does not mean that all alkalines need to be collected from every waste stream, however, it means we should explore ways to divert targeted batteries from spot tonnage.

7. " Considering the amount of time, energy, and hard work that is currently being directed to setting up programs for the safe management of waste batteries, would it not be prudent at this point to also keep alkaline batteries out of landfills, as well as incinerators and composting operations ? It is well known that low levels of mercury can be highly toxic to both humans and the environment...".

We agree that even small amount of mercury can be highly toxic, but we have also made the determination that alkaline batteries do not need to be diverted from landfills. Adding this type of requirement would add expense to the program. Keeping alkalines out of landfills would require resources that are likely to be better spent on materials that have been determined to contribute to harm.

8. " The proposed regulations give the impression that the decision to not divert alkaline batteries from landfill disposal was based predominantly on the difficulties in managing/coordinating the collection system with the vast number of manufacturers, rather than on available scientific data. This impression is derived from a number of inconsistencies in the information presented on the potential health and environmental hazards of mercury in alkaline batteries...it is stated that data from landfill soils is inconclusive, especially when relating to long term effects...it was never stated whether alkaline batteries pass or fail TCLP for mercury...although landfill disposal of alkalines is viewed as innocuous, those collected from the incinerator/composting waste streams will be taken to a certified hazardous waste disposal facility...".

Mercury is a metal of concern but we found no evidence to suggest it is a problem when disposed of in unlined or lined landfills. We have added further citations to substantiate our findings. Further, we have included information from industry supplied TCLP tests that show that alkaline batteries do not fail TCLP for mercury. The collected alkaline batteries are best disposed of at a certified hazardous waste disposal facility because they are a concentrated mass, not typical of the concentrations when these batteries are mixed in with municipal solid waste.

9 ." If certain quantities of mercury from mercuric oxide button batteries are determined to present environmental harm, (regardless of the particular method of disposal), then it seems logical to assume that similar quantities of mercury from a large number of alkaline batteries also present environmental harm (regardless of the particular method of disposal). Why has the Agency assumed otherwise?"

Method of disposal does influence harm determinations because metals react differently if buried or burned. Mercuric oxides fail TCLP for mercury because they contain a high concentration of mercury. They were also determined to pose harm if incinerated. This is stated more clearly in the body of the final report.

10. "...the amount of mercury that could reach landfills from alkaline batteries exceeds or is close to the amount that could reach landfills from all button batteries if all were landfilled. Yet, the plan calls for allowing the alkalines to be continued to be landfilled. This apparent conflict in reasoning should be explained. Is it reasonable to say the Agency has concluded that if each unit causes a little harm it is permissible to overlook it? This ignores the cumulative impact related to the number of units and the overall loading to the environment".

The cumulative impact in landfills is influenced by metals concentration because of how metals may leach and/or bind with soil in unlined landfills. The same total amount of mercury may leach more readily if concentrated in one spot because the binding ability of the surrounding environment may be exceeded. We have never meant to indicate that alkalines only cause a "little harm", but rather we have said they do not cause harm. Mercuric oxides do potentially cause harm because TCLP data indicates that they are likely to leach mercury.

#### **SECTION 4: IMPLEMENTATION PLAN**

1. "...We need to look at the practical effects of the plan requirements. A management plan that requires source separation in 1993 is likely to only be in effect for a few years...It may take that long to educate consumers to the point where there is good participation and by that time it may not be needed...The

VIWS facility, on the other hand, will have a mechanism to pull out the batteries. Their method makes it so much easier for the consumer. If ANR continues to feel its necessary to keep the alkaline ban in the plan, I would suggest it be for in-state incineration only, unless the state hosting such an incinerator also requires separation... Are we going to be adding an unnecessary level of confusion and cost to consumer recycling and waste disposal with the alkaline battery requirement?"

For the alkaline collection program the only consumers that need to be educated to segregate alkalines are those sending their trash to out of state incineration and/or MSW composting facilities. Those towns that are currently under contract with the Claremont facility have been involved with a mixed battery collection program for several years.

2. "...Is one year really long enough to assume that after the 'zero-mercury' goal is attained, consumers will not be throwing away mercury-laden batteries? One year life span seems short".

The commonly used turn around time, from the time an alkaline battery is purchased, is 1 year. Some users will hold onto spent batteries longer while some will have a shorter use and disposal cycle.

3. " The draft plan does not include direct discussion on the collection system for small lead acid batteries. Is it to be assumed that these batteries are to be collected in the same manner as the Nickel-Cadmium batteries, since this is mentioned under Section 2(1) on page 3 ? "

We clarified the language in the final Plan, small sealed lead acid batteries will be collected in the same manner as nickel-cadmium, except for the mail-back program since different regulatory requirements apply for mailing these types of batteries.

4. "... The law requires collection of silver oxide batteries from nonconsumers because they can be recycled. This should be continued for consumer silver oxides as well".

The Plan recommends a voluntary collection system for silver oxide batteries because they are recyclable, not because of a harm determination. Since the silver in these batteries is valuable and reclaimable, recycling opportunities are already available.

5. "...The program goal for capturing problem batteries should be 90% or better". That is the goal that was included in the draft and final plan.

#### Manufacturer Responsibility

1. " There are not a large number of alkaline manufacturers. The top three comprise 80% of the market share.

The information presented in the draft was inaccurate and we have made the change as recommended in the final Report.

2. "...The legislature discussed the need to relieve the taxpayer from the burden of paying for solid waste management. Instead, the Legislature discussed the concept of "closing the loop" by removing government from direct participation in the management of such wastes and substituting the manufacturer and consumer as the management component. The plan does not seem to move in this direction".

In development of the Plan, we tried to maximize the involvement of product manufacturers and found that efficiency is gained by integrating the battery collection program with other collection programs as much as possible. We also found that oversight and guidance will need to be offered by the State, especially if manufacturers are reluctant to get involved. We believe that the plan moves towards manufacturer responsibility as the manufacturers are responsible for disposal and other associated program costs.

3. "...The program(s) should emphasize voluntary compliance by manufacturers first. Let's examine how the existing requirements in H. 124 in section 6621b (c) (3) , (that representatives of the manufacturers agreed to), can or already are working in Vermont and Minnesota". (Other models to incorporate; Canadian manufacturers taking back bottles, Canadian Petroleum Institute putting \$ 30 million into a disposal pool. Switzerland manufacturer voluntary disposal fee on batteries".

ANR has been working with battery manufacturers from July 1991 through January 1992 in the development of this management program. We have determined that it is in the best interest of the program to keep implementation flexible to allow the manufacturers the ability to respond to changing conditions. Voluntary disposal fees and/or voluntary contributions into a pool are not among the systems being presented by the manufacturers. It is important to note that alternatives being used on a national level may not be applicable to a single state such as Vermont.

4. "The funding section seems to disregard the intent of the legislature by indicating the complexity of the battery industry. Battery manufacturers work cooperatively to lobby against proposals. They work together and communicate frequently regarding reduction efforts.... What led to the conclusion that they could not work together to cooperatively pay for disposal and collection costs? They could hire one firm to manage everything for them and pay based on the weight of batteries processed from each manufacturer.

The draft Plan identified obstacles that would need to be addressed if manufacturers are required to work together. The greatest obstacle is likely to be the willingness of the manufacturers if they do not believe working together is in their best interest. We agree that there are ways in which they could work together and it is up to the manufacturers to do so in the most cost effective way.

### Collection

1. "...Collection programs should not be determined the responsibility of towns, districts, or facilities unless the financial incentives are presented by manufacturers for proper management, and the interested public parties voluntarily agree to participate...Many districts and associations have passed resolutions stating that full responsibility for collection, recycling, and disposal of paint, oil and dry cell batteries should be assumed by manufacturers.

Collection program responsibility is shared between the towns/districts, facilities and the State because this was found to be the most efficient and cost effective means. Manufacturer responsibility is assumed for the disposal/processing of targeted batteries. Many incentives will be available to the collection entities in the form of Solid Waste planning and implementation grants.

2. "...What is meant by collection facilities "having the ability" to send batteries to manufacturer designated facility (pg. 19)? Will recycling centers and collection programs have to meet hazardous waste collection standards? What kind of storage will be needed? And who will pay for this. And which "user" will pay for shipping--the recycling program, or the actual generator? It seems to me that for recycling collection programs to have this 'ability' involves a bit more explanation".

Please refer to Section IV (Collection), of the final Plan for a discussion of what is involved in the collection of batteries through district/town collection systems. Recycling and collection centers will have to store batteries in accordance with Solid Waste Management guidelines since consumer generated batteries are exempt from the Hazardous Waste Management Regulations. Collected batteries will need to be kept separate from other household hazardous waste materials. The collection program will need to pay for shipping, but the manufacturers of the targeted batteries will need to pay the disposal/processing costs.

3. "...Our opposition to your plan is based upon our experience of marketing the SEC 'TUBE' program....Sanyo's mail-back/recycle program for spent NiCd batteries. The program has been in development for the past 18 months. Product shipping began this past summer".

Concerns:

- 1) Do not require manufacturers to participate in a mail back program that involves having prepaid postage.
  - The enclosed coupons are the reward for consumer and more than cover the cost of mail-back. Included with the purchase is a plastic tube to be used for future mailings of NiCd batteries. In addition, we will accept all brands of NiCd batteries received in our tube and the plastic tube will be recycled.
  - Wrong Product/Empty Containers/Abuse of the System. We want to collect only NiCds. If the consumer is required to pay postage, will take an interest in only sending back Ni-Cds.

Upon consideration, ANR agrees with these concerns and has incorporated them into the final Plan. ANR will not require mail-

back programs to include prepaid postage since it may encourage misuse of the system. We expect that consumers will be informed as to what postage is required in order to facilitate their use of the mail-back system.

### Incentives/Participation/Education

1. " The deposit refund system for problem batteries should be further investigated in light of new information just received from the Danish EPA. They indicate that a battery deposit refund system went into effect in January, 1991 in Denmark...Experience in Vermont has shown that a bottle deposit refund system receives a much greater capture rate, due to monetary incentive, than either a drop off system or a curbside collection system".

A bottle deposit/refund system is not easily transferable to batteries as explained in Appendix E. The system would not be as effective because there is usually a long turn around time for a battery, there are relatively few batteries used, labeling would be very difficult, and relative toxicity would require differential deposits, etc. Moreover, in order to stimulate return, the deposit would need to be so high that it would be prohibitive.

2." The ability of the public to understand what battery collection program is appropriate for which battery in a given area of the State will not only be confusing and complicated for the resident, but also for the haulers and waste managers as well".

All Vermont residents will be educated to separate Ni-Cd and button batteries for collection. It is only those consumers that use out- of-state trash incinerators that will also need to be educated to separate out alkaline batteries. Those consumers are already involved in a mixed battery collection program so they will not need to be newly educated.

3. "...I wonder if it would be easier in terms of education and promotion to simply collect all alkalines rather than just those destined for incineration..". Collecting all alkalines would probably be easier in terms of education but it would not be consistent with the criteria used to target batteries for diversion, or the program goal of cost effectiveness. Since alkaline batteries can not be recycled, collection of all alkalines would add great expense to the collection program when ANR had already determined this type of diversion was not necessary.

4. " Educational information needs to be posted and available at all retail sales locations indicating what batteries are problems and how batteries may be returned for proper collection".

ANR plans to incorporate battery-specific information as part of the Household Hazardous Product Shelf Labeling Program. ANR has not yet decided whether to supply a pamphlet or a poster to the retailers that sell the targeted batteries. We expect that the manufacturers of the targeted batteries will contribute to the costs of materials development and distribution.

5. "...Legislating an 800# is a little strong. What if everyone agreed the 800# program was not working and wanted to stop? Would it be possible if the program had been legislated. Since the manufacturers have been very

cooperative why not see if a voluntary program can work? Legislation can always be introduced at a future date".

In response to this comment the recommended legislative change will have a sunset provision that the requirement will be dropped after 5 years.

#### **End use**

1. "...Will batteries that are separated before an incinerator or a compost facility then be landfilled as a concentrated waste stream?"

2. "If alkalines do not fail TCLP it is costly and inappropriate to send them to HHW disposal when diverted from incinerators".

At this time, ANR would not recommend that a large volume of diverted alkaline batteries be disposed of in a solid waste landfill. The finding that alkaline batteries do not contribute to harm if disposed of in a landfill was based in part on the fact that alkalines are dispersed through the solid waste stream. A concentration of alkaline batteries was not examined as part of the harm determinations, but at this time we do not find it to be a sound management practice.

#### **Cost Effectiveness**

1. "...Cost effectiveness should not only be evaluated in terms of collection and management program costs, but also in terms of pollution prevention, human health costs, and avoided costs as well".

Pollution prevention and preserving human health were incorporated into the overall program goal. As explained in the introduction to Section III, cost effectiveness is a goal of the diversion program, after the specific batteries were targeted for collection.

2. " The section on cost effectiveness reaches conclusions in the absence of data offering support. It also appears the Agency has concluded that a taxpayer supported system run by government is more acceptable than a manufacturer based system funded by the consumer. This seems to contradict the intent of the legislature".

The findings presented in the paragraph on cost effectiveness were based on the discussions amongst staff, and with the technical advisory committee. A system that piggy backs onto an already existing system saves not only on startup costs, but also on staff, capital expenditures, and other operating expenses. It was beyond the means available for this Report to do an extensive cost/benefit analysis but it is our belief that these findings are well supported. A manufacturer based system funded by the consumer is the basis for the disposal/recycling element of the program while the collection element will be funded through the solid waste management assistance fund (waste surcharge), and a smaller percentage of town/district funding.

#### **Funding**

"...Has the actual costs associated with Funding option 2 been assessed (all transportation and disposal costs assumed by the waste-to-energy or composting facility)? Seems like the easiest means".

Although option 2 was likely to be simpler to administer, option #1 (manufacturers responsible for disposal costs), was determined to be more consistent with the legislated intent. Please refer to Section IV, Funding, for further discussion.

### Agency Staff

"...I think some discussion of what might be expected of a 1/2 time position might be in order. This is a program that once up and running should not require a lot of monitoring."

Please refer to the additional subsection added to Section 4 which discusses the need for State involvement and support. To ensure a successful program, staff would need to perform notification, technical assistance, promotion, tracking, and enforcement.

### Enforcement

" Will the 'good players'- those (manufacturers) who are paying for the recycling/disposal- be penalized due to the inability by the state to enforce against those manufactures who are not participating?

ANR has determined that the top three alkaline manufacturers comprise over 90% of the alkaline market share, and that the top five Ni-Cd manufacturers comprise 90% of the Ni-Cd market share. The relatively few manufacturers will help to facilitate tracking and enforcement.

### Other

1. "... It would be helpful to have examples of these types of batteries (for example, mercuric oxide batteries are used in hearing aids, etc.). The plan's discussions would be more easily understood.

As per this recommendation, Appendix A has been added to include a briefing on different battery types and uses.

2. "... The Agency should not decide which batteries are appropriate for use in Vermont (summary 5(F)). Such a task might be performed by the EPA, an Agency with the level of staffing probably required for such an undertaking".

ANR has decided to keep this requirement in place until there is an indication that the EPA is willing to assume this responsibility. ANR will remain in contact with the EPA on this issue and will consult with other states which may have a similar requirement.

3. "... What if EPA drops TCLP as a method-there would have to be a legislative change (to the proposed requirement that manufacturers submit full TCLP test data to the Agency of Natural Resources before new batteries can be sold at retail). Language saying 'tested to current SPA methods' would allow for flexibility".

The Report Summary in Section II (5E) has been changed to allow for changes in EPA standards.

### Comments were received from:

Addison County Solid Waste District  
Bennington County Regional Commission  
Central Vermont Regional Planning Commission  
Environmental Law Foundation  
Panasonic Industrial Co.  
Rayovac Corporation  
Rutland Regional Planning Commission  
Sanyo Energy Corp.  
Southern Windsor/Windham Solid Waste District  
Vermont Grocers Association  
Vermont Chamber of Commerce  
Windham Regional Commission  
David Hurd, R2B2 (Verbal comments on 11/25/91)

## SECTION VI: NOTES

- 1) National Primary Drinking Water Regulations, Federal Register, Vol 56, No 20, Wednesday, January 30, 1991.
- 2) EPA Hazardous Waste Management System, Federal Register, Vol, 55, No.61, Thursday, March 29, 1990.
- 3) Household Hazardous Products and Wastes in New Hampshire, July 1990, p. 95
- 4) Household Hazardous Products, p.95
- 5) Household Hazardous Products, p.94
- 6) Personal Communication from Craig Volland, Spectrum Technologies, January 1990, as reported in Mercury Rising From Incinerators to the Foodchain: The Growing Threat of Mercury, Clean Water Fund Research and Technical Center, January 1990, p.4
- 7) Mercury Rising, p.4
- 8) Mercury Rising, p.7
- 9) Micropollutants in Norway, Norwegian State Pollution Control Authority, 1987, p.3.1.1.
- 10) Household Hazardous Products, p.95
- 11) Household Hazardous Products, p.95
- 12) Handbook on the Toxicity of Inorganic Compounds, ed. Hans B. Sellen and Helmut Sigel, 1988.
- 13) Micropollutants in Norway, p. 3.2.1.
- 14) Household Hazardous Products, p.95
- 15) Household Battery Recycling and Disposal Study, Minnesota Pollution Control Agency, June 1991, p.17-19.
- 16) Mercury Rising, p.1.
- 17) Personal Communication, Ann McGahan, New Hampshire Department of Environmental Services, 1/16/92.
- 18) Ditz, Daryl, PH.D, "Air Emissions from Solid Waste Incinerators: New Developments and Emerging Issues", Fact Sheet 3, Cornell Waste Management Institute, Ithaca, NY. Summer 1990.
- 19) Institute of Resource Recovery (IRR), Personal Correspondence, 10/25/91. Margaret Ann Charles, Manager, State Government Affairs.  
Report submitted that claims mercury emissions from MWC facilities result in exposures that are 10 to 100 times less than the threshold health effects standards established by federal and

state regulatory agencies. ANR did not find that report contained sufficient supporting data to make this claim.

20) Vogg, H., et.al, The Specific Role of Cadmium and Mercury in M.S.W. Incineration, Waste Management and Research, Vol.4, pp 65-74.

21) Denison, R.A., 1989, mimeo. As reported in Household Battery Recycling and Disposal, p.23

22) IRR, Personal Correspondence, 10/25/91

23) Ash Monofill Data from MA,NH,CT,MN. (April 20, 1990)

24) IRR, Personal Correspondence, 10/25/91

25) Ash leachate data from Claremont NH Wheelabrator facility. On file at the Vermont Solid Waste Management Division.

26) Data from Vermont Landfill Assessment Program, Supplied by Ian Robertson, Solid Waste Division, Technical Assistance Section in Memorandum Dated August 20, 1991.

27) An Investigation of Degradation of Some Dry Cell Batteries Under Domestic Waste Landfill Conditions, C.J. Lones et al, Journal of Hazardous Materials, Vol. 2, 1977/78, p.259-289.

28) Oda, S. 1989, The Disposal of Ni-Cd Batteries in Landfills and the Affect of Cadmium on the Human System, In: Proceedings of the First International Seminar on Battery Waste Management.

29) Leachate Data, Colchester Vt. Landfill, Site 4, Feb. 1990-July 1991.

30) Vermont Department of Environmental Conservation, Draft Copy, Policy on Treatment and Disposal of Leachate From Lined Municipal Solid Waste Landfills. November 1, 1989.

31) Household Battery Recycling and Disposal, p.25

32) Data derived from US Data in Minnesota Household Battery Recycling and Disposal Report, p.11. Vermont is .2% of U.S. population.

33) Data derived from Minnesota Data in Minnesota Household Battery Recycling and Disposal Report, p.12. Vermont is 13.12% of Minnesota population.

34) Source Reduction of Toxic Metals in Household Batteries: Federal, State, and Industry Initiatives, Prepared for The Northeast Waste Management Officials' Association (NEWMOA), May 1991, p.14.

35) Table supplied by Ray Balfour, Rayovac Battery, at Sept.9, 1991 meeting at the Waste Battery Subcommittee of the Vermont Technical Advisory Committee (TAC), Conversion of United States

Production of Alkaline Manganese Batteries to Maximum of .025% Mercury.

36) Information Supplied by Ray Balfour, Rayovac Battery, at Sept. 9, 1991 TAC Battery Subcommittee Meeting.

37) National Electrical Manufacturers Association data presented in Household Hazardous Products and Wastes in New Hampshire, p.100.

38) Source Reduction of Toxic Metals in Household Batteries, (NEWMOA), May 1991, p. 12.

39) U.S. Bureau of Mines Data, submitted by Ray Balfour, Rayovac.

40) U.S. EPA data as presented in N.Y. Times article "Ancient Hazards of Mercury Re-Emerge". (?) 10/91

41) U.S. E.P.A., 55 FR 11799, Col 3., March 29, 1990.

42) In F.R. Vol 56, No. 20, Wed. January 30, 1991, silver was delisted from National Primary Drinking Water Regulations, and was given a Secondary Maximum Contaminant Level (MCL). The rationale was that the only potential adverse effect from exposure was cosmetic (argyria) and silver has never been identified as the cause of argyria in the U.S. Following from this, it is expected that when EPA revisits TCLP, silver will be considered for delisting as indicated in the explanation of the final TCLP rule (FR, Vol 55, No. 61, Thursday March 29, 1990). Revisiting TCLP is not a top priority for the EPA at this time according to a personal communication (10/4/91) from Dave Topping, Office of Solid Waste, EPA.

43) Vermont data derived from US data as presented in NEWMOA report p.14

44) Franklin Associates, Characterization of Products Containing Lead and Cadmium in Municipal Solid Waste in the United States, 1970 to 2000. U.S. EPA. October 17, 1988. p.24

45) Data Submitted by Ray Balfour, Rayovac Corporation, personnel correspondence September 18, 1991.

46) In the same Federal Register excerpt the EPA does suggest that facilities or communities that want to remove specific mercury-containing materials from the waste stream may want to target mercuric oxide button batteries. Many communities and States (Minnesota) just collect those batteries that are recyclable. Other communities collect all batteries regardless of means of disposal, or only batteries that contain concentrations of mercury.

47) Household Battery Recycling and Disposal, p.64

48) Information from Carl Hirth, Planner, NH/VT Solid Waste Project, personal correspondence November 25, 1991.

**Section VII**  
**DRY CELL BATTERY BIBLIOGRAPHY**

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- 3) Municipal Recycling Associates. Batteries in the Municipal Solid Waste Stream, A Report prepared for the State of Vermont. Tarry Elm Business Center, New York .(Response report to NEMA 1988 Written Statement), 1988.
- 4) Minnesota Pollution Control Agency, Household Battery Recycling and Disposal Study, Minnesota, June 1991.
- 5) National Electrical Manufacturers Association (NEMA). NEMA Written Statement to State of Vermont Concerning Battery Disposal. November 1988.
- 6) Northeast Waste Management Officials' Association. Source Reduction of Toxic Metals in Household Batteries: Federal, State, and Industry Initiatives. May 1991.
- 7) Rugg, Mack and Hanna, Nabil K., P.E., Mercury Concentrations in Municipal Solid Waste Components in Cape May County, New Jersey, presented at the Seventh Annual Waste-to-Energy Symposium of the Solid Waste Association of North America, Minneapolis Minnesota. January 28-30, 1992.
- 8) Schillinger, Salerni, and Boyd, Inc. Batteries in New York's Municipal Waste Stream, for New York State Department of Environmental Conservation, September 6, 1988.

**II. Composition and Market Specific Data**

- 1) Typical Carbon/Zinc and Alkaline Formulations. April 16, 1991. (Submitted by Terry Telzrow-Everready).
- 2) U.S. Dry Cell Battery Market Data. Submitted July 1991. (Submitted by Ray Balfour-Rayovac).
- 3) Quantities of Mercury in Dry Cell Batteries. Submitted July 1991. (Submitted by Ray Balfour-Rayovac).
- 4) Sources and Uses of Mercury in Mercuric Oxide Batteries-Calendar Year 1988. Submitted September 1991. (Submitted by Ray Balfour-Rayovac).
- 5) Mercury Consumed in the United States, By Use. United States Bureau of Mines (1980-1990). (Submitted by Ray Balfour-Rayovac).

### III. Health and Environmental Impact

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- 2) Balfour, Ray. Health and Environmental Effects of Dry Cell Battery Disposal. Rayovac. Report submitted to State of Vermont July 1991.
- 3) Bazilchuck, Nancy. "Lake Study Finds Signs of Mercury- Toxic Chemical Found at Several Sites". Burlington Free Press, December 6, 1991.
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