

Taconite Industry 2001 Voluntary Mercury Reduction Progress Report

Submitted To The MPCA

Pursuant To Individual Mine Voluntary Mercury Reduction Agreements

December 19, 2002

Background

Mercury is a naturally occurring element and, in conformance with the natural laws of physics, it can neither be created nor destroyed. In this regard, mercury is distinctly different from organic chemicals such as PCBs, certain solvents, pesticides, herbicides, and other compounds that can be broken down into their component parts. When it is collected with the intent of removing it from further use, it can only be stored in some form of repository. Currently, no permitted waste mercury repositories exist in the United States. Under these circumstances, all mercury shipped from a source is sent to mercury recyclers where the potential exists for it to be returned to use in some form of mercury containing device or product.

Minnesota's 1999 Mercury Reduction legislation sets a statewide goal of reducing the release of mercury into the air and water of the state by 60 percent from 1990 levels by the end of 2000 and by 70 percent from 1990 levels by the end of 2005. To assist the state in achieving these goals, the Minnesota Pollution Control Agency (MPCA) invited sources that emit more than 50 pounds of mercury per year to enter into Voluntary Mercury Reduction Agreements.

The Iron Mining Association of Minnesota (IMA) member taconite mining companies accepted the MPCA's invitation, and each mine entered into a Voluntary Mercury Reduction Agreement with the Agency. This list of taconite mining companies includes EVTAC Mining, Hibbing Taconite Company, Ispat-Inland Mining Company, Cliffs Erie LLC – formerly LTV Steel Mining Company, National Steel Pellet Company, and Northshore Mining Company. It should be noted that not all of the mining companies release more than 50 pounds of mercury per year. Nevertheless, all of the IMA member companies chose to participate in the voluntary reduction program.

The mercury legislation requires the MPCA to submit mercury reduction progress reports to the legislature on October 15, 2001, and October 15, 2005. To assist the MPCA in preparing its 2005 report, the Taconite Industry submits this report on its mercury reduction efforts. Due to the similarity in approaches to mercury reductions among the mines, the industry chose to submit a single report. The specific mercury reduction programs at each mine are included in subsections of the report.

Mercury Association With Taconite Mining

A more detailed description of mercury's association with taconite mining is contained in the Taconite Industry's 2000 Mercury Reduction Progress Report dated April 30, 2001. In summary, mercury is present in the iron ore that is mined and processed. A study conducted by

the Coleraine Minerals Research Laboratory (CMRL) during 1996-97 found that 60% to 93% of the mercury present in the ore is rejected with the non-iron bearing rock and reports to the tailings basins where it remains attached to the fine tailings particles. The remaining 7% to 40% of the mercury is volatilized in the indurating furnaces during the formation of taconite (iron) pellets. As stated in the Taconite Industry's 2000 report, approximately 96% of the volatilized mercury is elemental mercury and approximately 4% is oxidized. Virtually all of the elemental mercury passes through the particulate air emission control equipment and approximately 70% of the oxidized mercury is captured. This equates to approximately 3% of the total mercury entering the furnaces. Unfortunately, technically and economically viable emission control equipment currently does not exist for capture of elemental mercury from the indurating furnace emissions.

Overview Of Mercury Release Reduction Efforts

As previously stated, the primary sources of mercury releases are from the indurating furnaces in the taconite pellet plants, and technically and economically viable emission control equipment is not available to capture the mercury. However, the industry is hopeful that once mercury removal technology is developed for coal fired electric power plants it can be adapted for use on the taconite indurating furnaces.

Because of the recent nature of the information on mercury associated with taconite ore and the lack of technology to capture mercury from taconite processing plant emissions, the mines have chosen to focus their voluntary mercury reduction efforts in the following general areas:

- Conduct further mercury research.
- Inventory mercury used in various pieces of equipment and monitoring devices at the mines.
- Collect and dispose of mercury from devices removed from service.
- Partner with other groups to promote mercury awareness, collection, and recycling.

As part of the mercury research effort, all of the Minnesota taconite mines jointly partnered with the Minnesota Department of Natural Resources (DNR) and the MPCA by providing matching funds to conduct three mercury research projects. The projects were started in 2000 with the majority of the work completed during 2001. A small portion of the work is pending. Following is a brief description and status report on each of the projects:

- **Mercury Volatilization From Taconite Tailings (Field work complete, report pending)**

During the summer of 2000, Dr. Ed Swain of the MPCA used a mercury flux meter to measure the amount of mercury volatilizing from taconite mine tailings basins. Dr. Swain's final report on this project has yet to be released. As previously stated in the year 2000 Voluntary Mercury Reduction Report, Dr. Swain reported verbally that the mercury concentrations in the air above the tailings were among the lowest he had measured from

various sources in the state up to that point in time. This supports the conclusion of the CMRL study that mercury reporting to the tailings basins binds with the tailings particles and very little of the mercury is subsequently released.

- **Preparation Of A Certified Mercury Standard For Taconite (Project complete)**

The concentrations of mercury now of concern are so low that new sampling and analytical techniques had to be developed. Trace-level mercury analyses in solids have additional complications due to interference from other elements typically present. The resulting variability and uncertainty in laboratory analyses of bulk samples have made accurate mass balances difficult and very expensive. Analytic standards must be established that help assure repeatability of analytical results and that provide a basis for comparison between laboratories, as well as over time.

To accomplish this, the Coleraine Minerals Research Laboratory collected bulk samples of taconite ore, concentrate, and pellets from National Steel Pellet Company and submitted representative sub-samples to several commercial laboratories for mercury analysis. The laboratory results were used to establish certified mercury concentration values for the samples. Certified samples are now available to the taconite mines from CMRL. Taconite facilities can submit the certified samples along with samples from mass balance studies or other testing programs to establish a high level of confidence in the laboratory results.

- **Determination Of Stages In The Induration Process Where Mercury Volatilization Occurs (Project complete)**

CMRL collect samples from EVTAC, Hibbing Taconite, Ispat-Inland, Minntac, and Northshore and conducted tests to determine where in the induration process mercury is volatilized and whether it changes oxidation state at some point in the process. The objective was to determine if volatilization of oxidized mercury occurs in a specific process area with its own stack, and if possible, to focus mercury removal efforts on that stack. Also if oxidized mercury could be captured before it is converted to elemental mercury, overall mercury removal could be increased.

Emission control equipment collects fine particulate matter containing iron units from indurating furnace emissions. A portion of the oxidized mercury in the furnace off gasses is associated with the fine particulates. As stated previously in this report, approximately 96% of the mercury emitted by the furnaces is elemental mercury and approximately 4% is oxidized mercury. Wet scrubbers, in turn, collect approximately 70% of the oxidized mercury, which is equivalent to approximately 3% of the total mercury. The collected iron units at most plants are recycled to form new pellets to maximize the production efficiency of the pellet making process.

The report suggested the iron units could be directed to the tailings basins for disposal and sequestering of the contained mercury rather than the iron units being recycled. Unfortunately, a number of data gaps were present in the study, which required various assumptions to be made on the amount of mercury that could be captured. In addition, each company would have to assess the economic impact of discarding iron units to accomplish

mercury removal. This is an important consideration because the steel industry, including the taconite mines, must compete in the world market. The price of taconite pellets is based on market conditions and costs associated with the loss of iron units for mercury removal cannot be passed on to the consumer.

Mercury Removal Accomplished Since 1990

The Taconite Industry has removed a significant quantity of mercury from the mine sites since 1990. In fact, each of the mines began proactively removing mercury several years before voluntary mercury reduction agreements with the MPCA were developed. Greater opportunities for mercury removal existed for older mines such as Cliffs Erie and Northshore that were constructed during the 1950s when mercury use in products and measuring devices was more common than it was in later years.

Following is an accounting of the total amount of mercury removed from the taconite mines since 1990. Some of this information is contained either directly or indirectly in the individual mine sections of the Taconite Industry 2000 and 2001 Voluntary Mercury Reduction Progress Reports. The remainder of the data was collected from a more thorough review of waste shipment records by each of the mines.

EVTAC Mining	16.9 lbs.
Hibbing Taconite	75 lbs.
Ispat-Inland Mining	15 lbs.
Cliffs Erie LLC	1,860 lbs.
National Steel Pellet Co.	131.3 lbs.
Northshore Mining	<u>730.2</u> lbs.
TOTAL	2,818.4 lbs.

Individual Mine Mercury Reduction Summaries

Details of mercury research conducted by individual mines, a mine's efforts to inventory mercury containing devices, and any associated mercury collection and disposal are discussed in the individual mine sections of this report that follow.

EVTAC Mining

2001 Voluntary Mercury Reduction Progress Report

December 19, 2002

The following items summarize EVTAC's 2001 mercury reduction activities:

Mercury Balance

EVTAC contributed to Coleraine Minerals Research Laboratory efforts to study the mercury balance in the pellet plant waste gas scrubber system. The results of this study will be published in 2002.

Mercury-Containing Process Materials and Equipment

Since the mid-1990's EVTAC has recycled all its mercury-containing fluorescent lamps and high intensity discharge lamps.

Prior to 1995, EVTAC Mining changed its iron ore assay method to eliminate the use of mercury chemicals in the analysis. EVTAC continues to use non-mercury reagents in all laboratory analyses.

EVTAC has conducted an informal inquiry concerning the locations of mercury-containing equipment. The results of the informal questioning indicate that there is very little mercury-containing equipment at EVTAC. A more systematic approach to identify and inventory mercury-containing equipment and chemicals will be conducted during 2002. This will start with a search of MSDS information and a search of the warehouse inventory list. Results of these searches will be followed by physical verification of identified items.

Iron Mining Association Efforts

EVTAC is continuing to support mercury research sponsored by the Minnesota Department of Natural Resources through the Natural Resources Research Institute, the Coleraine Minerals Research Laboratory, and other research facilities. These activities include:

- Certified crude ore, concentrate, and pellet mercury standards have been produced by Coleraine Minerals Research Laboratory and are available for interested parties to use in mercury studies related to iron ore processing. Coleraine Minerals Research Laboratory is storing the certified standards and will make them available for mercury studies.
- The DNR completed a preliminary screening analysis of mercury volatilization from various soil surfaces including tailings basins. The results of this study indicate a maximum of less than 2 kg per year are volatilized from active tailings basins. More comprehensive studies

are recommended to better characterize the quantities of volatilization and possible practices that could reduce the small amount of volatilization that is taking place.

- Coleraine Minerals Research Laboratory is completing a study of the fate of mercury in several pelletizer waste gas scrubber systems. This study may lead to practices that could reduce the amount of mercury emitted.

Hibbing Taconite Company

2001 Voluntary Mercury Reduction Progress Report

December 19, 2002

Hibbing Taconite Company, an unincorporated joint venture managed by Cliffs Mining Company, is located approximately 3 miles to the North of the City of Hibbing in St. Louis County. Hibbing Taconite produces on average 8 million Dry Long Tons (DLT) of standard pellets per year. Since plant startup annual pellet production has ranged from a high of 8.6 million tons (1988) and a low of 4.1 million tons (1983). This annual production variation results from Hibbing Taconite's competition against a global market.

Reduction Of Mercury Containing Products

Hibbing Taconite, a large industrial complex, historically used many products that contain mercury. Such devices include thermometers; thermostats; pressure, tilt, and relay switches; batteries; and fluorescent and high intensity discharge (HID) lamps.

Hibbing Taconite has been recycling fluorescent and HID lamps since 1992. During 2001 Hibbing Taconite recycled the following:

Item	Quantity
8-Foot Fluorescent Bulbs	301
4-Foot Fluorescent Bulbs	2688
Circular Bulbs	5
U-Shaped Bulbs	8
HIDs	483
<i>Total</i>	<i>3485 Bulbs</i>

Hibbing Taconite also recycled the following during 2001:

45 pounds of liquid mercury

35 pounds of mercury containing products

Employee Mercury Recycling Center

Hibbing Taconite commenced operation of an onsite Mercury Recycling Center for its employees to recycle their household mercury containing products on December 1, 2000. The items collected from this effort have been tracked separately from the rest of Hibbing Taconite's mercury waste products to maintain a separate accounting of the items removed from the environment. During 2001, the following items were recycled in the onsite Mercury Recycling Center:

Item	Quantity
8-Foot Fluorescent Bulbs	133
6-Foot Fluorescent Bulbs	161
5-Foot Fluorescent Bulbs	9
4-Foot Fluorescent Bulbs	485
2.5-Foot Fluorescent Bulbs	5
2-Foot Fluorescent Bulbs	18
18-Inch Fluorescent Bulbs	3
10-Inch Fluorescent Bulbs	1
6-Inch Fluorescent Bulbs	2
Batteries	4
Thermometer	1
Thermostat	3
Circular 12-Inch Bulb	1

City of Hibbing Mercury Reduction Task Force Participation

The City of Hibbing, and Barr Engineering have developed a Pollutant Minimization Plan (PMP) that is serving as a guide for the City's mercury reduction efforts. The plan calls for using pollution prevention to reduce the amount of mercury that enters the treatment plant system as an alternative to installing "end-of-pipe" treatment methods that would be extremely expensive and less effective. Implementation of the PMP, which is a requirement of the City's wastewater treatment plant operating permit, relies heavily on efforts to educate people regarding proper disposal of mercury-containing products and reducing the use of mercury where feasible alternatives exist.

One of the action items in this PMP is the formation of a *Mercury Reduction Task Force* to help users of the City's wastewater treatment system reduce the amount of mercury being introduced into that system. In 2001, Hibbing Taconite was an active member of this Mercury Reduction Task Force and will be throughout 2002 as well. To date, information sharing and assisting in identifying how the City of Hibbing can best reduce the amount of mercury released to wastewater have been the accomplished objectives.

Ispat-Inland Mining Company

2001 Voluntary Mercury Reduction Progress report

December 19, 2002

Ispat-Inland completed the following mercury reduction actions during 2001:

- Changed procedures in the on-site laboratory to eliminate the use of mercuric chloride as a reagent. As a result, no mercury containing lab waste is generated.
- Continued the program of replacing mercury vapor lights and ballasts with low sodium lights. This is a long-term program that is approximately 50% completed. The objective is to complete the changeover by 2005.
- Removed two large automatic fire valves containing mercury, and replaced them with valves that do not contain mercury. These valves have been secured in storage for future disposal.
- Continued the program of identifying, labeling and replacing mercury containing switches, thermostats, thermometers and other equipment.
- Recycled 2,000 fluorescent bulbs and three drums of mercury vapor bulbs.

Cliffs Erie LLC

2001 Voluntary Mercury Reduction Progress Report

December 19, 2002

As stated in the previous report, LTV Steel Mining Company (LTVSMC) ceased operation during January 2001. The facility was sold on October 30, 2001. The mine related assets were sold to Cliffs Erie LLC and the power plant asset was sold to Rainy River Energy, a subsidiary of Minnesota Power Company.

Cliffs Erie is submitting this final report covering the status of the mine-related portions of LTVSMC's Voluntary Mercury Reduction Agreement.

Specific Plans and Objectives

The status of actions is shown in italics.

Mercury in the Ore

Voluntary Reduction Action:

LTVSMC will perform stack testing on furnace emissions to verify mercury emissions from furnaces with wet and dry collectors. *Some testing was done; Cliffs Erie will retain the records.*

LTVSMC will work with the MPCA to verify that mercury remains with the tailings and explore changes in tailings handling operating procedures that will maximize retention of mercury within the tailings. *Cancelled.*

LTVSMC will perform a mass balance to better understand the fate of mercury within the process and will explore process changes that result in more mercury reporting to tailings (based on verification that mercury reporting to tailings is retained by the tailings). *Cancelled.*

Mercury in Products and Devices

Voluntary Reduction Action:

LTVSMC will develop a more formal Mercury Elimination Program at the Hoyt Lakes Taconite Processing Plant. The program will include an inventory of mercury containing devices, a plan to phase out those devices where feasible and a methodology to avoid introduction of new mercury containing devices or products where mercury free alternatives exist. *See following discussion titled Mercury Removal Pursuant To Plant Shutdown.*

Community Outreach

Voluntary Reduction Action:

LTVSMC will participate in any joint effort that may be undertaken with other taconite processors and Minnesota Power to develop a Mercury Awareness Program targeted at Northeastern Minnesota and deliver it to the local community via brochures, newspaper advertising and radio advertising. Once the group finalizes the plan, LTVSMC will support a portion of this effort based on a funding strategy developed by the group. *Cancelled.*

LTVSMC will participate in any joint effort that may be undertaken with other taconite processors and Minnesota Power to develop a Community Mercury Recycling Program targeted at Northeastern Minnesota. Once the group finalizes a plan, LTVSMC will support a portion of this effort based on a funding strategy developed by the group. *Cancelled.*

Mercury Removal Pursuant To Plant Shutdown

As part of the LTVSMC shutdown, the company implemented a program to remove all equipment, products, chemicals, and wastes from the site that posed a significant risk to the environment. Recognizing the potential risks associated with mercury, all mercury and mercury-containing devices were removed from the Taconite Processing Plant and shipped to a mercury recycling facility.

Total Mercury Removed: 420 pounds

National Steel Pellet Company

2001 Voluntary Mercury Reduction Progress Report

December 19, 2002

Background

National Steel Pellet Company (NSPC), a wholly owned subsidiary of National Steel Corporation, is a taconite ore processing plant located approximately 1 mile north of Keewatin, MN. Original construction of the facility occurred during 1965-1967. The original plant consisted of a surface combustion rotary hearth system. This system was replaced with an Allis Chalmers 15-ft. grate-kiln system in 1969 (Phase I). In 1976, NSPC expanded with a larger Allis Chalmers 18-ft. grate-kiln system (Phase II). In 1980, the Phase I grate-kiln system was idled and has not been operated since that time.

Five main steps are employed during ore beneficiation:

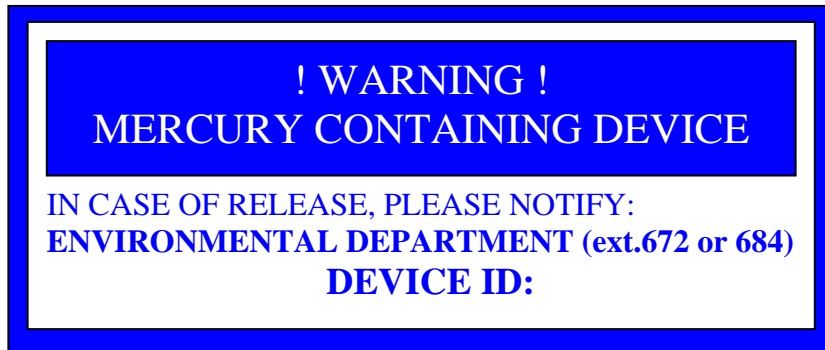
- Mining (drilling, blasting, loading, hauling) – removes the ore from the rock body.
- Crushing (in-pit crushers, primary mills, secondary mills) – reduces the size of the ore to a fine powder consistency and aids in removing contaminants such as silica and rock.
- Concentrating (magnetic cobbles, disc filters) – separates the ore by magnetic extraction and dewateres it to approximately 10% moisture.
- Balling (balling drums) – combines the ore with limestone and bentonite to produce ½” to ¾” “green” balls.
- Induration (grate-kiln, cooler) – hardens the “green” balls by heating to 2400 °F to optimize the oxidation process thereby producing taconite pellets.

Average annual production is 5.4 million long tons per year. The pellets are transferred to customers: by rail to Granite City, IL; and by ship to Ecorse, MI. NSPC employs approximately 520 people.

Mercury Product Identification

During 2001, NSPC identified the location of all mercury-containing products on the property. This information is contained on a spreadsheet updated regularly by the Environmental Department with assistance from the Electrical Department. All mercury-containing switches and thermostats removed from service are consolidated at the Instrumentation Workshop and shipped off-site to a licensed facility. To help ensure proper disposition, labels were placed on all gauges containing mercury switches in 2001. The labels communicate emergency response information as well as mercury awareness. Figure 1 is an illustration of the label used.

Figure 1: Mercury Identification Label



Mercury-Containing Materials

All NSPC mercury-containing products are ultimately sent off-site for recycling. A total of 6 pounds of liquid mercury from mercury switches and thermostats, and 1801.4 pounds of fluorescent lights were recycled from January 2001 through December 2001.

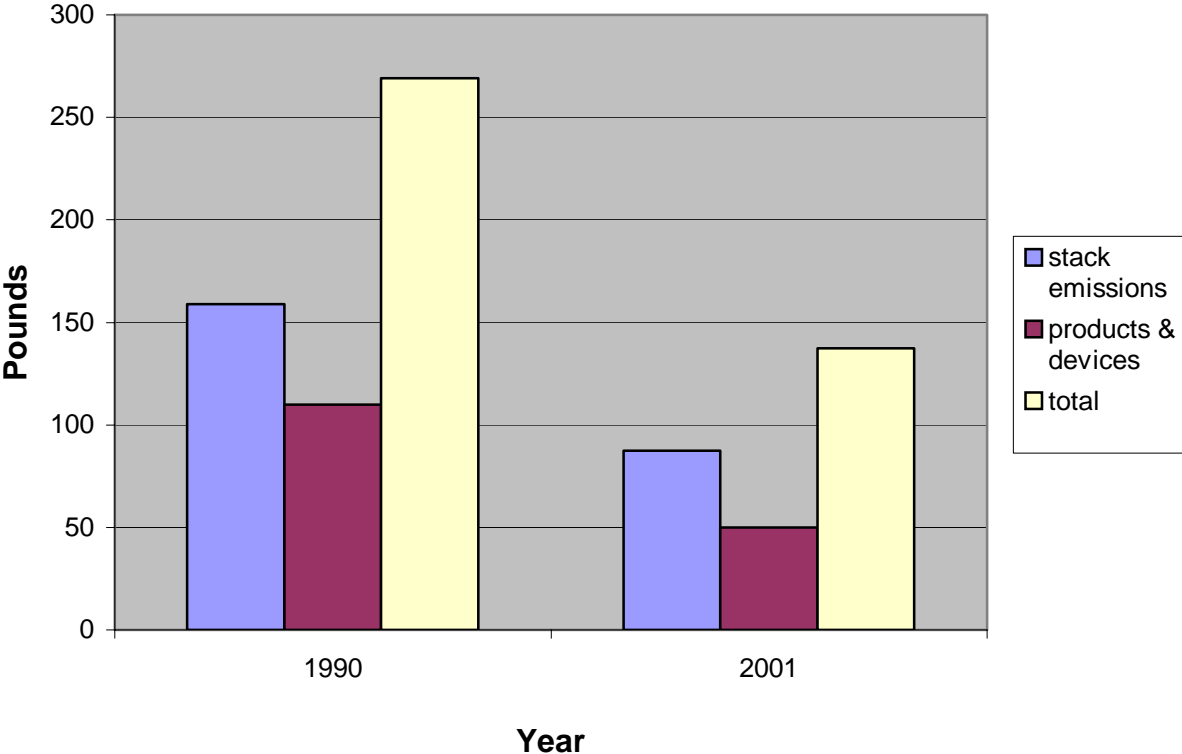
Table 1: Fluorescent Light Shipments

Item	Quantity
8-Foot Fluorescent Bulbs	235
4-Foot Fluorescent Bulbs	1029
HIDs	271
Ballasts (lbs)	360
<i>Total</i>	<i>1535 Bulbs</i>

2002 Activities

NSPC will continue to work with the other taconite facilities on mercury research in 2002. This research may provide an economic, viable solution to effectively reduce the amount of mercury released to the environment. NSPC will also: continually update the mercury inventory as new information is received; and continue to recycle mercury-containing products.

Chart 1: NSPC Mercury Inventory



Northshore Mining Company

2001 Voluntary Mercury Reduction Progress Report

December 19, 2002

Reduction of Mercury Containing Products

During 2001 Northshore Mining collected and recycled mercury from its own devices. Following is a list of these items:

1,289 4-foot Fluorescent Bulbs
537 8-foot Fluorescent Bulbs
423 High Intensity Discharge Lamps

2,249 Total Bulbs and Lamps Recycled

Partnering With Local Communities

A community-wide mercury collection program was launched, with advertising to Silver Bay, Beaver Bay, and the surrounding communities. On June 2, 2001, Northshore Mining hosted a community mercury collection day by paying for a collection truck and the final recycling of mercury-containing devices. The effort collected over 1000 fluorescent lamps and several mercury switches and thermostats that were previously in people's houses and garages. The big catch was two small jars of elemental mercury that a homeowner had been using as a gun-cleaning material. The weight of the elemental mercury was roughly 5 pounds. Northshore's collection effort may have prevented that material from being released into a drain or into the trash. Only one community collection day was held during 2001 due to economic pressures during the latter half of the year. Notwithstanding this dilemma, fluorescent lamps were routinely accepted from community members and small businesses for recycling. At least one collection day is planned for 2002. A copy of the flyer that was distributed is attached.

Mercury Reduction Research

Northshore also participated in the research efforts discussed previously in this report.

HEY, EVERYONE! IT'S TIME TO...

JERK THE MERC OUT!

Fluorescent lamps
Mercury thermostats
Mercury thermometers
Button batteries
Mercury relays, silent switches, old sump pump float switches

Northshore Mining will collect any of the above and recycle them, at no cost to you.

As part of our program to reduce mercury in the environment, Northshore Mining will assist in the collection and disposal of mercury-containing devices in your household or small business.

At full production of taconite and power, Northshore Mining releases about 9 pounds of mercury into the air every year from its entire facility from its taconite processing and coal burning. That's a small amount, but we're looking for ways to reduce it still more. Process research has not yet shown ways to cut back our airborne emissions, but since 1990 we have made large reductions on the amount of mercury used in our machinery and labs, and in so doing we have cut back on the amount of mercury wastes that we generate and have to handle. We believe we can help reduce the amount of mercury released to the environment every year by helping our neighbors recycle old lamp bulbs, thermometers, and other stray materials that contain mercury.

WHERE: Zup's Parking Lot, Silver Bay. Look for the John's Sanitary Service truck

WHEN: Saturday, June 2, 2001, from 9 a.m. to

WHO: Any household or small business. (Churches, here's your chance!)

WHAT: Fluorescent lamps, mercury thermometers, mercury switches, thermostats, button batteries. **PLEASE DO NOT BREAK THESE ITEMS!**