2005 Mercury Reduction Progress Report to the Minnesota Legislature

Minnesota Pollution Control Agency

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Executive Summary

Mercury is an environmental problem because it accumulates in fish and can adversely affect the health of the people and wildlife that eat the fish.

Even the trace amounts present after global dilution can cause significant fish contamination. Mercury is released to the environment around the world and transported by the atmosphere to lakes and rivers where a portion accumulates in fish. The primary route of mercury exposure for most Minnesotans is eating contaminated fish — a problem that has been addressed through fish consumption advisories and actions to reduce mercury pollution.

More than 99 percent of the mercury in Minnesota's environment comes from the atmosphere, deposited by rain, snow and attached to dry particles. About 10 percent of mercury deposited in Minnesota comes from air emission sources within the state, with the remainder made up of equal shares from regional, global and natural sources.

In 1999, the Minnesota Legislature called for reductions in mercury emissions, established goals, directed the Minnesota Pollution Control Agency (MPCA) to implement reduction strategies and mandated reports in 2001 and 2005. This is the 2005 report to the legislature.

The 1999 mercury reduction law (Minn. Stat. 116.915 subd. 1) called for a 70 percent reduction in mercury emissions from Minnesota sources by 2005 compared to 1990 levels. The MPCA estimates that from 1990 to 2005, Minnesota sources reduced emissions by 70 percent. However, changes made to the 1990 baseline inventory since the goal was established allowed Minnesota sources to reach the goal with fewer reductions than initially envisioned. The MPCA made this change to reflect new information prior to finalizing the inventory, as called for in the mercury reduction law.

The MPCA estimates that a 93 percent reduction in world-wide emissions contributing to deposition in the state is needed (from 1990 baseline) for its fish to be safe to eat by most Minnesotans. The MPCA is moving toward adoption of this goal — meeting it will require significant reductions from all sources. To achieve the goal, the MPCA will develop a detailed implementation plan in consultation with stakeholders.

Section 1. Introduction and Background

Exposure to elevated levels of mercury can damage the central nervous system of humans and wildlife. Mercury acts as a neurotoxin, a substance which, at high enough concentrations, can damage or destroy nerve tissue or hamper the development of the nervous systems of fetuses and children.

Mercury is a global pollutant; it is released to the environment around the world, transported in the atmosphere, chemically transformed in water and bioaccumulated in fish. The primary route of exposure for most Minnesotans is eating mercury-contaminated fish — a well-documented problem. The Minnesota Department of Health advises people to restrict their consumption of sport fish due to mercury for virtually every lake that has been tested.

Minnesota has been a national leader in addressing mercury releases to the environment since the early 1990s. The legislature, government agencies and businesses in the state have taken steps to significantly reduce emissions. Among other actions in the 1990s, the legislature passed Minn. Stat. 116.915 in 1999, which established state mercury-reduction goals, required the Minnesota Pollution Control Agency (MPCA) to solicit voluntary reduction agreements, and required reports in 2001 and 2005. Specifically the law requires that the reports address the state's success in meeting the mercury release reduction goals, whether different strategies are needed and whether the reduction goals are still appropriate.

This report describes the state's success in meeting mercury-reduction goals and summarizes reductions achieved to date. The report also presents a mercury emissions inventory that includes an update to projected 2005 emissions.

The federal Clean Water Act requires the MPCA to assess lakes, rivers and streams in the state for mercury and other pollutants. Waters with elevated pollution levels are placed on a state list of Impaired Waters. Two-thirds, or 1,239 of the 1,890 waters on Minnesota's 2004 Impaired Waters List, are polluted with elevated mercury levels, mostly in fish tissue. For these waters, the MPCA is required to complete a Total Maximum Daily Load (TMDL) study determining the source of the contamination and the reductions required to resolve the problem.

The MPCA has completed a draft TMDL Study for Mercury and is now getting public comments before submitting it to the U.S. Environmental Protection Agency (EPA) for approval. The draft TMDL document contains more detailed information than is presented in this report on mercury contamination of fish in Minnesota, sources of mercury pollution and pollutant reductions needed to return fish to safe levels. As discussed in Section 6, the draft TMDL also proposes a new state mercury-reduction goal. The draft TMDL study is available on the agency's Web site at www.pca.state.mn.us/publications/wq-iw4-01b.pdf.

Nearly all — more than 99 percent — of the mercury deposited in Minnesota's environment comes from atmospheric deposition; rain and snow transport mercury to the land, lakes and rivers and mercury can also fall as dry deposition. About 30 percent of the mercury deposited from the atmosphere comes from natural sources of mercury.

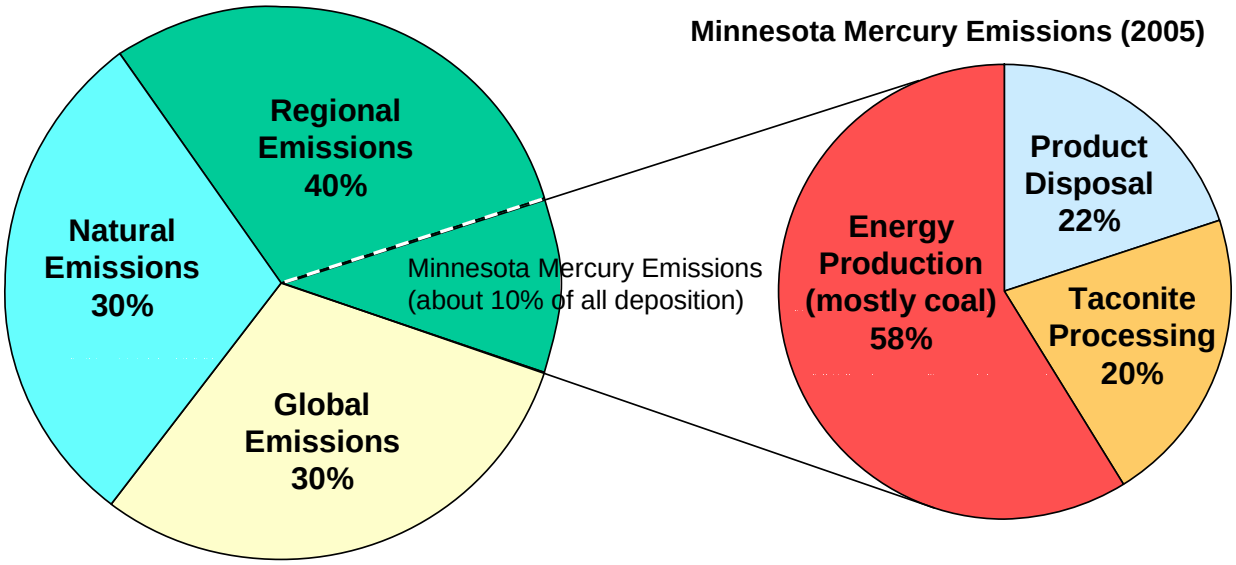
But 70 percent of the deposited mercury is a result of human activities that have increased the release of mercury from the geological materials in which it had been locked up. These activities include the mining of mercury ores, the use of this mercury in products and manufacturing, and the release of trace concentrations of mercury naturally present in coal, crude oil and metal ores.

Because mercury vapor can be transported long distances in the atmosphere, most of Minnesota's emissions are deposited in other states and countries, and Minnesota receives some of their emissions. In Minnesota, about 10 percent of mercury deposition is the result of emissions within the state. The remaining 90 percent is made up of equal shares of regional (North America), global and natural sources as illustrated in Figure 1.

Some of the mercury deposited in Minnesota is chemically transformed in the water and accumulates in the tissue of fish. The MPCA, in partnership with the Minnesota Departments of Health and Natural Resources, tests fish from lakes and rivers for mercury contamination. Testing of fish in Minnesota dates back to 1967, with about half of the fish samples taken since 1990.

About 1,000 of the estimated 5,500 fishing lakes in Minnesota have been tested, and for 184 of those lakes the MPCA has at least two years of data to compare past and present mercury levels. Overall, mercury concentration in fish decreased by about 10 percent from 1990 to 2000. That same small, but significant, decrease appears to be continuing.

Figure 1. **Sources of Atmospheric Mercury Deposition to Minnesota**



Section 2. Current Mercury Emissions in Minnesota

MPCA staff projects that annual human-caused emissions from Minnesota sources will total 3,341 pounds (lb.) for 2005. The MPCA divides mercury that is emitted to the atmosphere due to human activities into three categories: (1) emissions resulting from energy production, mostly from burning coal; (2) emissions due to material processing, mostly taconite; and (3) emissions due to the purposeful use of mercury, mostly related to the disposal of products.

As of 2005, 58 percent of Minnesota's emissions are from energy sources, 20 percent are from taconite processing, and 22 percent are from purposeful uses. Mercury is used in a variety of products, such as electrical switches, thermometers and dental amalgams. Major emission sources related to mercury in products include solid waste handling and combustion, recycling cars with mercury switches, and preparation and cremation of dental amalgams.

A summary of emissions sources within these categories is included in Table 1 on the next page of this report. Appendix A includes the MPCA's full inventory of estimated emissions for 1990, 1995, 2000 and 2005.

Table 1. Minnesota Mercury Emissions 1990–2005 (in pounds)

Mercury Emission Inventory for Minnesota Date of Estimates: October 12, 2005	confidence	1990	1995	2000	2005 (projected)
Incidental to Energy Production					
Coal combustion (total) (1)	high	1,518.6	1,612.1	1,648.7	1,738.1
electric utility coal	high	1,418.3	1,512.8	1,544.8	1,650.0
commercial/industrial coal	medium	60.8	68.5	73.4	51.3
public utility / university & college heating	medium	39.0	30.5	30.2	36.4
residential coal	medium	0.4	0.4	0.4	0.4
Petroleum Product Refining and Consumption (2)	low	136.0	156.0	175.0	175.0
Wood combustion(3)	high	12.5	10.5	10.0	10.0
Natural gas combustion(4)	low	0.2	0.3	0.3	0.3
Subtotal incidental with energy production		1,667	1,779	1,834	1,923
% of total state emissions		15%	42%	50%	58%
Largely Resulting from the Purposeful Use of Mercury					
Latex paint volatilization (5)	medium	2,850.0	2.8	0.0	0.0
Class IV incinerators (6)	low	55.2	28.0	0.0	0.0
Golf course fungicide volatilization (7)	low	1,487.0	1.0	1.0	0.0
Volatilization: land application of compost (8)	low	2.2	1.3	0.3	0.2
Medical waste incineration (9)	high	516.0	36.0	6.1	0.4
Volatilization: land application of sludge (10)	low	3.6	1.8	1.4	0.7
Volatilization from dissipative use (11)	low	0.8	0.8	0.8	0.8
Landfill volatilization (12)	low	5.9	2.2	2.4	1.2
Hazardous waste incineration (13)	medium	5.0	5.0	5.0	5.0
General laboratory use (14)	low	44.0	44.0	22.0	10.0
Sewage sludge incineration (15)	medium	247.0	160.0	112.0	11.0
Fluorescent lamp breakage (16)	low	272.3	59.4	32.2	15.0
Volatilization from spills and land dumping (17)	low	54.7	48.0	48.0	24.0
On-site household waste incineration (18)	low	402.0	93.0	60.0	40.0
Recycling mercury from products within MN (19)	medium	3.5	35.0	50.0	65.0
Crematories (20)	low	30.8	49.5	68.2	80.0
Dental preparations (21)	low	103.0	99.0	95.0	84.0
Municipal solid waste combustion (22)	high	1,806.4	633.9	168.6	93.5
Smelters that recycle cars and appliances (23)	medium	186.0	186.0	176.0	125.0
Volatilization during solid waste collection & processing (24)	low	805.5	251.5	195.9	183.0
Subtotal associated with purposeful use of mercury		8,881	1,738	1,045	739
% of total state emissions		79%	41%	29%	22%
Emissions Incidental to Material Processing					
Taconite processing (25)	high	710.5	742.3	745.4	665.7
Pulp and paper manufacturing (26)	low	0.0	0.0	0.0	0.0
Soil roasting (27)	low	13.3	13.3	13.3	13.3
Subtotal emissions incidental to material processing		724	756	759	679
% of total state emissions		6%	18%	21%	20%
GRAND TOTAL =		11,272	4,273	3,637	3,341
Percent Reduction since 1990=			62%	68%	70%

Section 3. Progress Toward Meeting State Mercury-reduction Goals

The statewide mercury-reduction goal set in Minn. Stat. 116.915 is to reduce annual mercury releases 60 percent by 2000 and 70 percent by 2005, compared to 1990 levels. As reported in the MPCA's January 2002 mercury-reduction progress report to the legislature, the MPCA estimates that the 2000 goal of a 60 percent reduction from 1990 levels was easily met, with an estimated reduction in emissions of 68 percent. Similarly, the MPCA believes that Minnesota will just achieve the 70 percent reduction goal for 2005.

The MPCA estimates that since 1990, emissions of mercury to the air in Minnesota have declined from 11,272 lb. to 3,341 lb. by 2005 — a 70 percent reduction. A combination of federal and state initiatives, local programs and voluntary actions led to these reductions. Emissions related to the use of mercury in products constitute the vast majority of these reductions. Actions that led to significant reductions during this period and anticipated future reductions and increases are discussed in detail in Section 4.

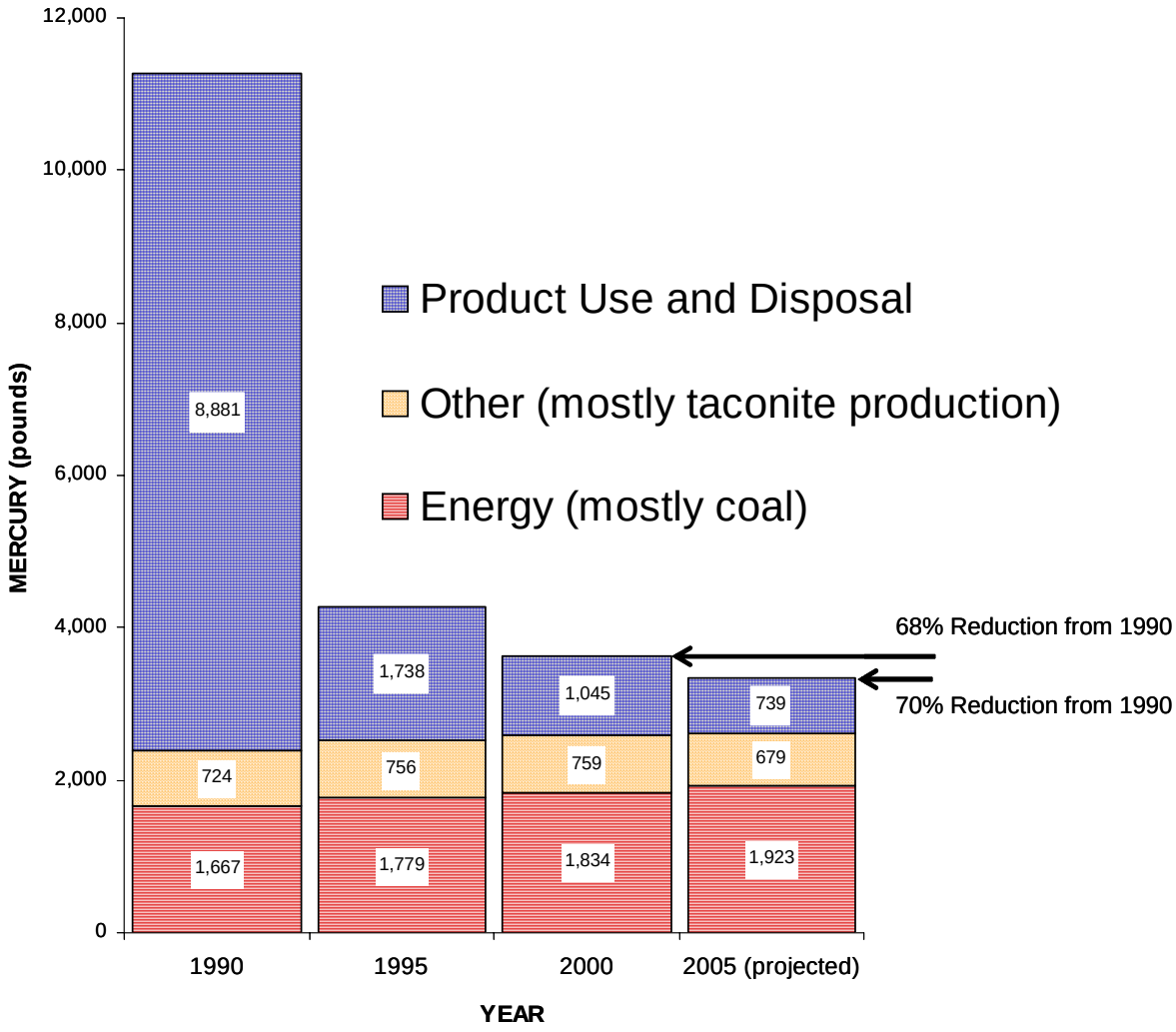
It should be noted that since establishing the 70 percent reduction goal in 1999, the MPCA, in consultation with stakeholders, significantly increased its estimate of the product-related emissions in the baseline year of 1990. This change was made to incorporate the latest scientific understanding of mercury emissions in Minnesota to prepare the inventory for publication in the *State Register*, as required by the mercury reduction law (Minn. Stat. 116.915 subd. 1). The total baseline emissions estimate rose from about 8,450 lb. to 11,272 lb. due primarily to an increase in the estimated amount of mercury released from latex paint.

While the MPCA's mercury emissions inventory is dynamic and changes to reflect new scientific information and new knowledge, a change of this magnitude was not anticipated. As a result, the percent decline in mercury emissions between 1990 and 2000 was much greater than was known when the legislature established the goals. This essentially means that we had met our 2000 reduction goal and came within 2 percent of the 2005 goal before the legislation even took effect.

Had the 1990 baseline emissions estimates not been revised upward, Minnesota emissions sources would not have met the 70 percent reduction goal. Compared to the baseline as presented in 1999 when the goals were established, 2005 estimated emissions of 3,341 lb. represent a 60 percent reduction from 1990 levels. A 70 percent reduction from the original baseline would have required formidable reductions from all sectors. Reductions since 1990 are attributed primarily to product-related sources. Voluntary reductions from the energy and taconite sectors since 1999 account for about a 3.3 percent reduction. These reductions are described in Section 5 of this report.

The stakeholders involved in recommending the goal in 1999 envisioned a reduction of about 1,000 lb. from that time in order to meet the 2005 goal. The MPCA estimates total reductions between 2000 and 2005 to be 296 lb. While the understanding of 1990 emissions was thought to be accurate at the time and the goal was established in good faith, it is likely that the MPCA and stakeholders involved in developing the goal would have recommended a more ambitious goal given what is known now.

Figure 2. **Mercury Air Emissions by Sector, 1990-2005**



Section 4. Mercury Air Emissions by Sector — Past and Future

This section summarizes past reductions and future trends from the three emissions sector categories — product-related, energy production and taconite processing. Future trends for total emissions are discussed, also.

Product Sector

Mercury and mercury compounds have been used in a variety of products and processes for centuries. In the United States, mercury use peaked in the 1960s at more than 2,000 metric tons per year, most of this being added to products such as batteries, switches and paint. Many of these uses have been discontinued and are no longer a concern. Some have been discontinued and the product remains in use or in storage, while other uses continue. In most cases, mercury used in products has the potential to contribute to air emissions through the use of the product, spills or disposal.

Since 1990, emissions of mercury in Minnesota from the use of mercury in products have declined by 92 percent, from 8,881 lb. to 739 lb. by 2005. This impressive reduction occurred largely as a result of discontinued use of mercury in a few key products, controls on waste combustors, and product and waste-stream reduction efforts. The MPCA believes that product-related reductions will continue into the future, albeit at a slower rate, as mercury uses decrease, product-management efforts continue and combustion source controls improve.

Waste Combustor Reductions

In 1990, municipal and medical waste incineration accounted for 1,806 and 516 lb. of mercury emissions, respectively. Due to MPCA-initiated control requirements and reduced mercury content of the waste stream because of source separation and product reductions, these amounts fell to 93.5 lb. from municipal incinerators and 0.4 lb. from medical incinerators by 2005, for a combined reduction of about 2,230 lb. since 1990. In Minnesota, these regulations and resulting emissions reductions preceded federal regulations for these sources.

The largest decrease in mercury emissions from municipal waste incineration came as a result of MPCA permit requirements on the Hennepin Energy Resource Company (HERC), the state's largest unit. In 1993, the HERC installed an activated carbon-injection control system, which reduced annual mercury emissions from 496 lb. in 1990 to 45 lb. in 1995.

After 1995, Minnesota's waste combustor standards banned on-site burners (such as those at businesses, grocery stores and apartment buildings) and required most of the state's remaining municipal incinerators to lower their emissions, resulting in an additional reduction from 1995 to 2005 of about 570 lb. A significant share of this reduction came from Xcel Energy's Red Wing refuse-derived fuel electricity boiler. Pollution-control equipment upgrades completed in 2000 reduced annual emissions by 313 lb., or 91 percent for that one facility.

Since 2000, Olmsted County's waste-to-energy facility upgraded its emissions-control equipment (beginning in 2004) and reduced its emissions from about 48 lb. per year to 3 to 5 lb. per year. Olmsted County is pursuing an expansion of this facility. Still in the early stages of environmental review, this proposed expansion would increase annual emissions by an additional 3 to 5 lb.

In 1990, emissions of 516 lb. came from about 80 medical waste incinerators at hospitals and one commercial facility. The largest facility, Mayo Foundation incinerator, emitted 115 lb. After 1990, the Mayo Foundation constructed a new incinerator with an activated carbon control system to meet MPCA permit limits. Emissions from the new plant were reduced to 1 lb. per year by 1995. After 1995, Minnesota's waste combustor standards and federal regulations required medical waste incinerators to reduce mercury emissions or cease operation. By the end of 2000, all medical waste incineration facilities except Mayo had closed.

Sewage Sludge

Mercury enters the liquid waste stream through discharges from product-related uses, such as dental amalgams and laboratory reagents. In the sewage-treatment process, more than 90 percent of the mercury ends up in sludge. When the sludge is land applied or incinerated, this mercury can be released to the air.

Typically the largest contributor of mercury to a sewage-treatment plant is wastewater from dental practices. Two large wastewater-treatment plants in Minnesota have been national leaders in efforts to work with dentists to reduce the amount of mercury from dental amalgam entering the liquid waste system. The Western Lake Superior Sanitary District in Duluth and Metropolitan Council Environmental Services (MCES) in the Twin Cities have worked extensively with dentists in their service areas and statewide to adopt best management practices for dental amalgam.

Incineration of wastewater-treatment plant sludge releases the mercury into the air, unless it is captured by pollution-control equipment. The MCES operates two sewage sludge incinerators. Mercury emissions from these plants dropped from 247 lb. in 1990 to 112 lb. by 2000, largely due to reducing mercury inputs to the wastewater.

The MCES began operating a new sewage sludge incinerator at its metro plant in January 2005 and has been testing the operation of the new pollution-control equipment that uses activated-carbon removal of mercury. If performance observed in this initial testing stage continues, MCES expects mercury emissions to be reduced by approximately 98 percent or more, from about 95 lb. in 2000 to less than 2 lb. per year.

Product and Waste Stream Mercury-reduction Efforts

Beginning in the early 1990s, the Minnesota Legislature passed laws banning the use of mercury in certain products (most notably batteries), prohibiting the disposal of mercury in solid waste, and requiring the management and recycling of mercury-containing lamps and other items. During this period and continuing to the present, local and state governments, manufacturers, waste haulers, and companies established programs to ensure the proper handling of mercury-containing items.

These initiatives led to direct reductions in mercury releases to the environment and to reductions from municipal and medical waste management. For example, mercury in municipal solid waste declined from about four parts per million (ppm) in 1990 to about 1.5 ppm in 1995. While it is difficult to estimate the air emissions reductions associated with reduced spills and improved management, the MPCA believes that these actions, coupled with the trend of reduced use of mercury in products, significantly contributed to a decline of up to 2,000 lb. per year since the 1990s.

Notable examples of product- and waste-reduction efforts include the establishment of a thermostat take-back program, fluorescent lamp collection and recycling, the removal of mercury manometers used on dairy farms, the auto manufacturer outreach and mercury switch collection program, dental amalgam separation initiatives, and the Mercury-Free Zone Program, which removes mercury from schools.

Fungicide Registration Cancellations

In the early 1990s, the EPA cancelled registrations for two mercury-containing fungicides (discontinuing their sale and subsequent use), resulting in substantial reductions in mercury emissions. Registration for a mercury compound as a preservative in paint was cancelled and withdrawn in the United States, resulting in a 2,847-lb. reduction in annual emissions in Minnesota by 1995 (compared to 1990 levels). Withdrawal of a mercury fungicide for snow mold control resulted in a reduction of 1,486 lb. during the same period. Together, these two actions account for a 38 percent reduction in total mercury emissions from 1990 levels.

Table 2. **Summary of Actions Resulting in Significant Mercury Emission Reductions**

Date	Action	Reduction in annual emissions, if known	Percent reduction for source	Reduction from total 1990 levels
1991-2000	Toxicity reduction/management programs and Minnesota Statutes (disposal restrictions, product bans, labeling and management)	Contributed to reductions from waste management, product breakage of up to 2,000 lb.	64% (approx.)	18% (approx.)
1991	Registration for mercury as a preservative in paint cancelled and withdrawn in the U.S.	2,847-lb. reduction (1990-1995)	100%	25.0%
1993	Registration for mercury fungicide for snow mold control withdrawn in the U.S.	1,486-lb. reduction (1990-1995)	100%	13.0%
1993	HERC installs activated-carbon-injection control systems.	Combined with toxicity reduction actions, led to 451-lb. reduction	91%	4.0%
1994	Mayo constructs new facility and installs activated carbon controls.	Reduced from 115 lb. to 11b.	99%	1.0%
1995	Waste combustor standards for municipal and medical waste incinerators (not incl. HERC and Mayo)	851 lb. (456 lb. municipal, 395 lb. medical) by 2000	86%	7.6%
2000	Minnesota Power switch to lower-mercury coal	70 lb.	20% (company-wide)	0.6%
2000	Red Wing RDF-fired electric boiler upgrades pollution-control equipment	313 lb.	95%	2.8%
2003	Xcel Energy replaces 2 coal-burning units with natural gas at Black Dog plant	35 lb.	47%	0.3%
2004	Olmsted County waste-to-energy-plant control upgrade	44 lb.	92%	0.4%
2005	Metropolitan Council Environmental Services sludge incinerator upgrade	94 lb.	99%	0.8%
2009	Xcel Energy MERP repowers Highbridge and Riverside plants to natural gas and upgrades emissions control at King plant	170 lb. (expected by 2009)	15% company-wide (100% from two gas facilities, 20% from King plant)	1.5%

Energy Sector

Mercury is a trace contaminant in coal and other solid fuels. When these fuels are burned to generate heat for industrial and utility boilers and other purposes, the mercury is released. The vast majority of emissions from this sector result from burning coal to generate power to meet the increasing demand for electricity in the state. Emissions from all energy sector sources increased by about 16 percent between 1990 and 2005.

Electric Power Generation

Since 1990, mercury emissions from coal-fired electric-generation boilers have increased about 16 percent, from 1,418 lb. to 1,650 lb. in 2005. This increase in emissions is the result of burning more coal to produce more electricity at power plants in Minnesota.

In addition to mercury emissions from power plants within the state, Minnesota's consumption of electricity that is generated outside of the state also creates mercury pollution. Power plants located in North Dakota, South Dakota and Wisconsin supply electricity to Minnesota.

Minnesota law requires producers and retailers of electricity, including sources located outside the state, to report the amount of mercury emitted through the generation of electricity. In 2003, facilities located outside the state generating electricity consumed in Minnesota reported mercury emissions of 1,272 lb. attributable to Minnesota's share of the electricity. These out-of-state generation sources also emit on average about 50 percent more mercury per unit of electricity produced than do Minnesota electric generators. This information is summarized in Appendix A of the MPCA's 2005 air quality report to the legislature. This report can be found at www.pca.state.mn.us/publications/reports/lr-airqualityreport-2005.html.

In 2000, as part of a commitment to reduce emissions under the state's voluntary mercury-reduction agreements, Minnesota Power substituted lower-mercury coal to achieve a 70 lb. annual reduction in mercury emissions from its operations. While this is not a permanent reduction in mercury emissions, Minnesota Power intends to continue to burn this lower-mercury coal to keep its mercury emissions at the present level.

In 2003, Xcel Energy completed the replacement of two coal-burning units at its Black Dog generating plant with a natural-gas-fired turbine generator. This new unit eliminates up to 35 lb. of mercury annually compared to the old boilers and produces an additional 100 megawatts of electricity.

In December 2003, the Public Utilities Commission approved Xcel Energy's Metropolitan Emissions Reduction Program (MERP), which will re-fire two coal plants with natural gas and upgrade the pollution-control equipment at a third Twin Cities area plant. When fully implemented in 2009, the MERP will result in an estimated annual mercury emissions reduction of 170 lb., assuming that electrical output at the two re-powered plants is similar to the existing units.

Taken together, Minnesota Power's lower-mercury coal, Xcel's Black Dog re-powering, and Xcel's MERP will result in a reduction of up to 275 lb., an 18 percent reduction in utility-sector emissions and a 7.6 percent reduction in total emissions compared to 2000 levels. These reductions will account for a 2.4 percent reduction in total emissions (based on 1990 levels) when fully implemented.

Based on the utilities' estimates of coal use, the MPCA projects that mercury emissions will decline slightly from 2005 to 2010 due to Xcel's MERP. After 2010, the MPCA estimates that increased coal consumption will cause the sector's emissions to begin to increase again, unless other voluntary, state or federal regulatory measures are taken.

In June 2005, the EPA issued the Clean Air Mercury Rule (CAMR) to reduce mercury emissions from coal-fired utility boilers. This rule establishes a national "cap" or nationwide limit on mercury emissions from coal-fired units greater than 25 megawatts of 15 tons by 2018. This cap represents a 70 percent reduction from 2002 levels from existing plants of this size. It also allows for "trading" or buying and selling of mercury reductions between generating units in order to meet the national cap.

The cap-and-trade program of the CAMR has been challenged legally and its implementation may be delayed. It is even possible that the EPA could be in the position of having to restart the rule-development process.

Cap-and-trade programs are favored by some because total emissions are limited — no further increases can occur from the electric generating sector, even as more coal-fired power plants are constructed. A trading program means that facilities that can remove mercury very cheaply will do so, and sell their mercury allowances to plants that cannot. This means that some plants will reduce emissions more than 70 percent and other plants will reduce less.

Plants where the reductions are the most expensive will purchase credits from plants that are able to achieve greater reductions at lower costs. However, trading for mercury has drawn criticism because it does not guarantee that all states or regions of the country will experience emission reductions nor does it prevent the possibility of regional increases in emissions.

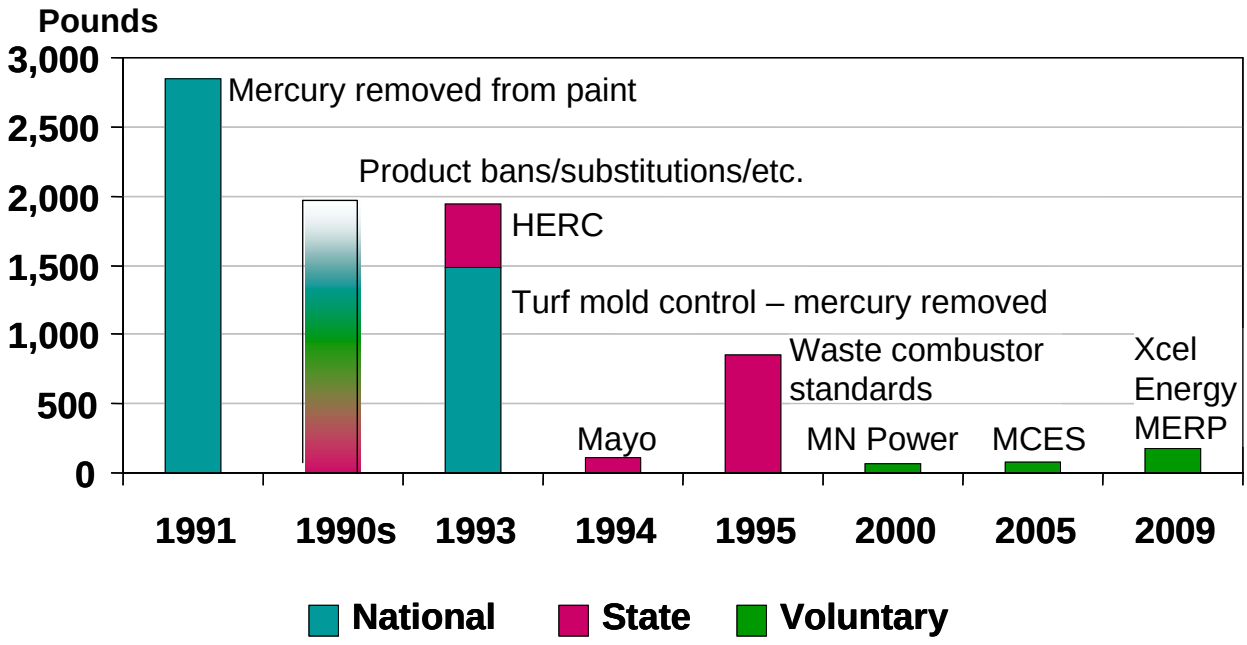
During the public comment period for the CAMR, the MPCA commented that while it is in favor of cap-and-trade programs, the cap must be lower than 15 tons, and should become effective sooner than the rule proposes. The MPCA's comments can be found at: www.pca.state.mn.us/hot/mercury-reductions.html.

The CAMR's impacts on Minnesota emissions are expected to be small because emissions reductions at Minnesota plants are projected to be more expensive than in other states. The EPA's modeling of how trading between electric-generation units would meet the cap predicts that Minnesota utilities, for cost reasons, would purchase allowances rather than make reductions.

Industrial/Commercial Boilers

In 2004, the EPA adopted an industrial boiler and process heater standard, which imposes mercury-emission limits on new and existing solid-fuel boilers and major sources of hazardous air pollutants. This will reduce mercury emissions from sources such as coal-fired industrial boilers by an unknown amount. Current annual emissions from this sector in Minnesota are estimated to be 51 lb. A new coal-burning ethanol production facility in Minnesota will voluntarily meet the requirements of this standard and emit about 4 lb. per year starting in 2007.

***Figure 3*. Annual Reductions in Air Emissions from Selected Activities**



Taconite Sector

Mercury is a trace contaminant in iron ore and is released when the ore is heated in the process of forming more concentrated taconite pellets. Mercury emissions from the processing of iron ore are directly related to the output from taconite-processing facilities.

Between 1990 and 2000, annual sector emissions increased 35 lb. due to increased production of taconite pellets. Since 2000, annual emissions have declined by about 80 lb. due to the closing of one large mine and processing plant.

Current taconite-processing facilities are operating at or near capacity due to a strong international demand for iron. If this strong demand continues, production capacity at Minnesota facilities may expand, resulting in a proportional increase in mercury emissions.

In the fall of 2004, in its settlement agreement with the National Wildlife Federation, the EPA agreed to set maximum achievable control technology (MACT) limits for mercury. This may reduce mercury emissions from taconite processing in the future. Before the EPA can undertake this effort, it is seeking more data, and is likely to rely on research being conducted by Minnesota Department of Natural Resources staff and others on taconite mercury and potential controls. The MPCA does not expect the EPA to propose standards for several years due to constraints on the EPA's resources and data.

Future Emissions from All Sources

The MPCA estimates that emissions from all human-caused sources in Minnesota will continue to decline slightly or level off between 2005 and 2010. While product-related sources will continue to decline and reductions from voluntary measures at existing coal-fired power plants will fully take effect by 2010, these declines are likely to be mostly offset by new known sources, increased taconite production, and increased electrical production. The MPCA estimates that after 2010, without significant voluntary reductions or federal or state regulatory intervention, the recent trend of decreasing emissions will reverse and emissions from Minnesota sources will begin to increase.

Section 5. Voluntary Reduction Agreements

The 1999 mercury law (Minn. Stat. 116.915) directed the MPCA to establish a voluntary mercury-reduction agreement program encouraging the largest emitters in the state to enter into agreements with the state to reduce their mercury air emissions. Participants in the program were expected to implement cost-effective, technologically feasible reduction measures and conduct research into future reductions. The MPCA agreed not to pursue additional state regulations, at least until 2005, as long as adequate progress is made in reducing emissions.

Thirteen companies and two regional waste management jurisdictions participated in the voluntary agreement program and have taken actions or made pledges to reduce mercury emissions in some way (Table 3). These include actions taken to reduce emissions, pledged reductions, reduction research, collected and inventoried mercury products and supported other mercury-reduction efforts.

Actions to date are summarized below. Progress reports submitted by voluntary agreement participants since the 2002 report to the legislature are attached as Appendix B. The 2002 legislative report with progress reports from 2000 and 2001 is available at www.pca.state.mn.us/air/mercury-mn.html.

Table 3. Voluntary Agreement Participants

Company/Entity	Highlights of Voluntary Reductions/Actions/Commitments
Alliant Energy	Plant product inventory and removal. Emits approx. 7 lb. per year.
Flint Hills Resources	Conduct refinery mercury mass balance
Great River Energy	No in-state emissions sources. Participates in research.
Metro Council Environmental Services (MCES)	Upgrade on sludge incinerator, dental clinic amalgam program with Minnesota Dental Assoc.
Minnesota Power	Fuel switching, research, product removal, community involvement
North Star Steel	Automotive switch removal
Otter Tail Power	Supports research, plant and community product removal/management.
Western Lake Superior Sanitary District (WLSSD)	Dental community outreach, community and small business product collection, community involvement
Xcel Energy	Research, product collection, emissions reduction pledge, support mercury-detecting dog
Taconite Industry: (North Shore Mining, Hibbing Taconite, Ispat-Inland Mining, Cliffs Erie, United Taconite, US Steel-Keewatin Taconite	Research, plant and community product removal

Voluntary air emissions reductions

Of the air emission reductions noted in Section 4, four resulted from voluntary actions initiated or fully implemented since the establishment of the voluntary program in 1999. As summarized in Table 4, these actions include fuel switching and increased controls by electric utilities and added controls on sewage-sludge incineration. To date, these voluntary commitments have resulted in approximately 199 lb. of annual emissions avoided. When fully implemented, voluntary reduction agreement actions initiated to date will result in additional reductions in annual emissions of an estimated 369 lb. by 2009, or about 3 percent of 1990 emissions.

Table 4. Recent Voluntary Reductions

Voluntary Agreement Participant	Action	Effective Date	Pounds Reduced
Minnesota Power	Switch to low-mercury coal	2000	70
Xcel Energy	Repowering 2 coal-fired units at Black Dog plant	2003	35
Metropolitan Council Environmental Services	Upgrade sewage sludge incinerator at Metro plant	2005	94
Xcel Energy Metropolitan Emissions Reduction Project	Re-powering two coal fired utility boilers to natural gas, installing upgraded control equipment on a third metro area plant.	2009	170
Total Annual Emissions Reductions from Voluntary Agreement Participants			**369**

Emissions Reduction Research

Taconite and electric power generation sector participants have supported research into reducing mercury at their facilities. A summary of this research is included in the voluntary agreement progress reports in Appendix B.

Mercury Product Inventorying and Removal

Most Voluntary Agreement participants have identified, removed and properly managed mercury-containing equipment from their facilities and plants. While this mercury was probably not contributing to air emissions during use, its removal greatly reduces the possibility that the mercury will enter the environment through spills or improper disposal. Voluntary agreement participants have reported thousands of pounds of mercury removed from service and recycled.

Other Actions

Several voluntary agreement participants have collected mercury-containing products from employees or supported community collection programs. Others have participated in community-awareness activities and release-reduction initiatives outside their facilities. For example, Xcel Energy helped fund Clancy, the MPCA's mercury-detecting dog (Appendix C).

Section 6. Adequacy of State's Emission-reduction Goal and Strategies

The 1999 mercury law directed the MPCA to discuss, in this report, whether the reduction goals and strategies called for in the law are appropriate given the most recent information and whether other voluntary or mandatory reduction strategies are needed.

Since the legislature established reduction goals in 1999 (60 and 70 percent decreases in emissions from 1990 levels by 2000 and 2005 respectively) the MPCA has improved its inventory of estimated mercury emissions in the state. As discussed in Section 3, this change helped Minnesota to reach the reduction goals with less reduction than originally expected.

More importantly, in the past five years, the MPCA has improved its scientific understanding of how mercury contaminates fish in Minnesota and has new information on safe fish mercury levels. Minnesota's draft Total Maximum Daily Load (TMDL) Study for Mercury, required by the Clean Water Act to address lakes and rivers polluted with mercury, summarizes the latest scientific information. With this information the MPCA has set a mercury reduction target that is intended to be protective of human health when it is reached.

In the draft TMDL study the MPCA demonstrates that in order for fish from Minnesota waters to be safe to eat for all but the highest consumers, a 93 percent reduction in human-caused emissions (from 1990 levels) is needed from all sources worldwide that contribute to air-deposited mercury in Minnesota. The draft TMDL establishes 789 lb. in annual mercury emissions, a 93 percent reduction from 1990 levels, as a new goal for air emissions from Minnesota sources. To meet this goal, a reduction of about 2,552 lb. from current levels is needed. This represents a decrease of 76 percent from 2005 estimated emissions.

Since the early 1990s, the MPCA has used an array of regulatory, voluntary and educational approaches to reduce mercury emissions in Minnesota. In concert with similar initiatives on the federal level, efforts by governmental agencies, businesses, the legislature and others in Minnesota, these activities have contributed to a 70 percent decline in mercury emissions during the last 15 years. Appendix C describes these strategies in more detail including the strategies required by the legislature.

Reductions since 1990 occurred mostly by 2000 and were largely due to reductions in product-related emissions. Since 2000, the pace of reductions slowed dramatically compared to the previous 10 years. For 2005, the MPCA estimates that annual air emissions are only 296 lb. less than in 2000.

Since 2000, the MPCA has relied largely on voluntary efforts for reductions from the state's largest emitters through its voluntary agreement program. During this time, mercury emissions reductions of about 199 lb. per year were achieved by voluntary means. Additional annual voluntary reductions of about 170 lb. are expected by 2009 as well as reductions from the implementation of new federal standards for industrial boilers.

Reaching the 93 percent reduction goal established in the draft TMDL study will require significant reductions from all sectors — product-related releases, emissions from taconite processing and the energy-producing sector. While current strategies have been successful in reducing emissions, especially product-related

releases, achieving the reductions needed from all sectors will require additional voluntary and regulatory strategies.

The intended purpose of the TMDL study is to determine the sources of mercury contributing to pollution in Minnesota and how much these sources need to reduce in order for fish from Minnesota waters to be safe to eat. To allow the reader of the TMDL study to understand how the reductions could occur, the draft study includes a brief outline of possible short and long-term actions and strategies to meet the proposed goal, as well as highlights the need for national and international reductions of mercury emissions.

Strategies to reduce emissions will be developed during the TMDL implementation planning phase in collaboration with interested stakeholders. Implementation planning will begin once the draft TMDL study is finalized and will last about a year. The MPCA is in the process of seeking public comments on the draft TMDL study and will finalize the document and forward to the EPA for approval.

Section 7. Conclusions and Recommendations

Minnesota sources have reduced mercury air emissions by 70 percent since 1990, just meeting the reduction goals established by the legislature in 1999. These reductions are the result of voluntary and regulatory actions on the state and national level. The pace of reductions has slowed in the last five years and the MPCA predicts that emissions will begin to rise after 2010 unless additional voluntary or regulatory measures result in new reductions.

Minnesota's 2005 draft Total Maximum Daily Load Study for Mercury summarizes the latest scientific information on mercury in Minnesota fish, the sources of that mercury and the reductions needed for fish from Minnesota waters to be safe to eat. The draft TMDL demonstrates that a 93 percent reduction in worldwide human-caused emissions contributing to deposition in Minnesota (from 1990 levels) is needed.

The MPCA recommends that the state adopt this goal for in-state sources while also continuing to encourage further national and international reductions. National and international reductions are important because 90 percent of the mercury that is deposited from the air on Minnesota comes from sources outside the state. Conversely, most of Minnesota's mercury emissions are deposited in other states and countries.

The TMDL study proposes a tiered approach to reduce mercury emissions in Minnesota that continues existing voluntary and regulatory approaches, enhances aspects of the current MPCA program, and proposes additional state-level regulatory tools. The MPCA intends for the goal in the draft TMDL study and subsequent implementation plan to replace the goals and strategies established in the 1999 mercury law.

Meeting this goal will require significant reductions in emissions from all sources in the state, especially the utility and taconite sectors. A comparison of voluntary reductions from these sectors to date with the statewide reduction goal contained in the draft TMDL study (a 2,552-lb. reduction in annual emissions from today's levels) infers the need for more substantial reductions from these sectors. Additional state or federal regulation will be required to meet the 93 percent reduction goal.

To achieve this reduction goal, the MPCA will work with interested stakeholders to identify reduction strategies and to develop a detailed implementation plan. The draft TMDL study briefly outlines possible implementation strategies; however, the implementation plan is the second phase of the process and is not part of the TMDL study. The draft TMDL must be finalized and submitted to the EPA before development of the implementation plan can begin.

Implementation planning will address the timelines and specific strategies that will be used to achieve the 93 percent reduction called for in the draft TMDL study. The MPCA intends for the development of the implementation plan to be an open process that will last about a year.

The MPCA is in the process of seeking public comments on the draft TMDL study. Based on comments received, the agency may make changes to the draft document, including the reduction goal, before submitting it to the EPA for approval. The strategies to reach the goal will subsequently be developed with extensive stakeholder involvement.

Summary of Conclusions and Recommendations

Conclusions:

- Mercury emissions have decreased by about 70 percent since 1990, meeting the goal established by the legislature in 1999.
- A change in the 1990 baseline inventory incorporating new scientific information allowed Minnesota to reach the goal with fewer reductions than expected by the stakeholders involved in establishing the goal.
- Since 1990 emissions in Minnesota from product-related sources have been reduced by 92 percent, taconite sector emissions have declined by 6 percent and emissions from the energy production sector have increased by 15 percent.
- Actions by voluntary agreement participants have resulted in annual reductions of about 199 lb. with an additional 170 lb. expected by 2009 from reductions in progress at power plants.
- Ninety percent of the mercury deposited in Minnesota comes from air emissions sources outside of the state.
- Mercury in fish from Minnesota lakes decreased 10 percent between 1990 and 2000 and appears to be continuing to decline.
- Scientific work in the last five years allowed MPCA to establish a reduction goal of 93 percent (from 1990 levels) that is protective of human health.

Recommendations:

- Adopt the proposed 93 percent reduction goal (from 1990 levels) contained in the draft TMDL study for Minnesota emissions sources.
- Develop strategies to reach the goal using an open process that involves interested stakeholders in the implementation planning process.
- Pursue additional short-term actions outlined in the draft TMDL study. These include:
    - develop a strategy to limit future emissions from new and expanding facilities;
    - develop monitoring and reporting protocol;
    - continue current reduction strategies including regulatory, voluntary, education and collection efforts;
    - encourage the development of federal regulations and international efforts to reduce emissions; and
    - investigate cooperation among other states in the region.

Appendix A

Mercury Emission Inventory for Minnesota (October 2005 Update)

Appendix A. Estimated Mercury Emissions in Minnesota for 1990 to 2005 — October 2005

To provide a baseline for assessing progress on mercury-reduction efforts, Minnesota Statutes, section 116.915, requires that the Minnesota Pollution Control Agency (MPCA) publish updated estimates of mercury releases. A draft of our most current estimates, or "inventory," of releases in Minnesota due to human activities is provided in Table 1 for every five years from 1990 to 2005. The 2005 estimates are by necessity projections because the year is not yet concluded and data will not be available for at least another half year. Notes 1 through 27 at the end of this document provide explanations of each subcategory listed.

For this update, no changes were made to the 1990-2000 estimates from the last update, released in March 2004. The only difference is that estimates for 2005 are added.

Mercury emissions in Minnesota declined significantly from 1990 to 2000, by about 68 percent. In 1990, emissions are estimated to have been about 11,300 pounds (lbs.). In the early 1990s, emissions declined rapidly to about 4,300 lbs. in 1995, and then less rapidly, to about 3,640 lbs. in 2000. From 2000 to 2005, the rate of decline slowed further, reaching about 3,340 lbs. in 2005.

The trend in reduced emissions is most likely a national or even international trend. Sediment core studies from lakes in Minnesota and elsewhere show slight declines in atmospheric deposition relative to a peak in the 1970s and 1980s. There is evidence that concentrations of mercury in Minnesota's fish have declined about 10 percent, an encouraging response.

The MPCA divides mercury emitted to the atmosphere into three categories: (1) emissions incidental to energy production, (2) emissions due to purposeful use, and (3) emissions due to material processing. Although emissions from fossil fuel combustion and the processing of metal ores are both the result of the incidental release of trace contaminants of natural geological materials, we have placed them in separate categories (energy production and material processing, respectively). Separate categories are appropriate because the emission-reduction strategies, including pollution prevention, can be quite different between energy production and material processing.

Background

Mercury contamination of fish is a well-documented problem in Minnesota. The Minnesota Department of Health advises people to restrict their consumption of sport fish due to mercury on virtually every lake that has been tested. Testing of fish preserved in museums in the 1930s compared to similar fish from the same lakes in the 1980s showed that fish became significantly more contaminated with mercury, roughly in concert with increased atmospheric loading of mercury to lakes, which is about three times higher than natural conditions. Nearly all — probably about 98 percent — of the mercury in Minnesota lakes and rivers comes from the atmosphere. Consequently, the data presented here only include releases to the atmosphere.

About 30 percent of the mercury in the atmosphere is the result of the natural cycling of mercury. The other 70 percent of the mercury in the atmosphere is the result of human activities that have released mercury from the geological materials in which it had been locked up. These activities include the mining of mercury ores, the use of this mercury in products and manufacturing, and the incidental release of trace concentrations of mercury naturally present in coal, crude oil, and metal ores, such as taconite.

Table 1 Estimated mercury emissions (pounds) from human activity in Minnesota for the years 1990, 1995, 2000 and 2005.

Mercury Emission Inventory for Minnesota Date of Estimates: October 12, 2005	confidence	1990	1995	2000	2005 (projected)
Incidental to Energy Production					
Coal combustion (total) (1)	high	1,518.6	1,612.1	1,648.7	1,738.1
electric utility coal	high	1,418.3	1,512.8	1,544.8	1,650.0
commercial/industrial coal	medium	60.8	68.5	73.4	51.3
public utility / university & college heating	medium	39.0	30.5	30.2	36.4
residential coal	medium	0.4	0.4	0.4	0.4
Petroleum Product Refining and Consumption (2)	low	136.0	156.0	175.0	175.0
Wood combustion(3)	high	12.5	10.5	10.0	10.0
Natural gas combustion(4)	low	0.2	0.3	0.3	0.3
Subtotal incidental with energy production		1,667	1,779	1,834	1,923
% of total state emissions		15%	42%	50%	58%
Largely Resulting from the Purposeful Use of Mercury					
Latex paint volatilization (5)	medium	2,850.0	2.8	0.0	0.0
Class IV incinerators (6)	low	55.2	28.0	0.0	0.0
Golf course fungicide volatilization (7)	low	1,487.0	1.0	1.0	0.0
Volatilization: land application of compost (8)	low	2.2	1.3	0.3	0.2
Medical waste incineration (9)	high	516.0	36.0	6.1	0.4
Volatilization: land application of sludge (10)	low	3.6	1.8	1.4	0.7
Volatilization from dissipative use (11)	low	0.8	0.8	0.8	0.8
Landfill volatilization (12)	low	5.9	2.2	2.4	1.2
Hazardous waste incineration (13)	medium	5.0	5.0	5.0	5.0
General laboratory use (14)	low	44.0	44.0	22.0	10.0
Sewage sludge incineration (15)	medium	247.0	160.0	112.0	11.0
Fluorescent lamp breakage (16)	low	272.3	59.4	32.2	15.0
Volatilization from spills and land dumping (17)	low	54.7	48.0	48.0	24.0
On-site household waste incineration (18)	low	402.0	93.0	60.0	40.0
Recycling mercury from products within MN (19)	medium	3.5	35.0	50.0	65.0
Crematories (20)	low	30.8	49.5	68.2	80.0
Dental preparations (21)	low	103.0	99.0	95.0	84.0
Municipal solid waste combustion (22)	high	1,806.4	633.9	168.6	93.5
Smelters that recycle cars and appliances (23)	medium	186.0	186.0	176.0	125.0
Volatilization during solid waste collection & processing (24)	low	805.5	251.5	195.9	183.0
Subtotal associated with purposeful use of mercury		8,881	1,738	1,045	739
% of total state emissions		79%	41%	29%	22%
Emissions Incidental to Material Processing					
Taconite processing (25)	high	710.5	742.3	745.4	665.7
Pulp and paper manufacturing (26)	low	0.0	0.0	0.0	0.0
Soil roasting (27)	low	13.3	13.3	13.3	13.3
Subtotal emissions incidental to material processing		724	756	759	679
% of total state emissions		6%	18%	21%	20%
GRAND TOTAL =		11,272	4,273	3,637	3,341
Percent Reduction since 1990=			62%	68%	70%

Notes to Table 1

Emissions Incidental to Energy Production

1. Coal combustion: This is based on data submitted by facilities with stack tests (Xcel, Minnesota Power and Rochester Public Utility) and extrapolated to other coal combustors. Constant emission factors (pounds of mercury emitted per ton of coal combusted) submitted for 2000 for each unit are applied backwards and forward in time, except for Minnesota Power (MP). In the late 1990s, MP began to burn more low-mercury coal, which decreased its emission factor beginning in 2000. According to the data submitted, MP now burns less of coal "Y" (mercury concentration of 0.055 ppm, standard deviation = 0.012), and more of coal "W" (mercury concentration of 0.026 ppm, standard deviation = 0.006).

The MPCA has made the following assumptions for the calculation of mercury emissions from coal-combustion units. In the absence of evidence to the contrary, it is assumed that coal-combustion units have constant control efficiency for mercury for the period 1990 through 2005. In the absence of evidence to the contrary, it is assumed that the mercury content of coal has been constant since 1990, on a concentration basis. Therefore, net mercury emissions for a given unit can be expressed as a constant emission factor (pounds of mercury per ton of coal combusted) times the coal consumed by that facility in a given year. For facilities that have not submitted data to the MPCA, an emission factor of 8.00 E-05 lbs. per ton of coal is assumed, an average figure for facilities utilizing low-sulfur western subbituminous coal. A constant emission factor is assumed over time because unless there have been documented changes in combustion equipment, pollution-control equipment, or coal types that are predicted to change mercury emissions, multiple stack tests representing mercury emissions are merely different estimates of average emissions and do not represent real changes in emission.

2. Petroleum product refining and consumption: The mercury content of crude oil is poorly known, so estimates of emissions have low confidence. Minnesota has two refineries: Flint Hills Resources (formerly Koch Petroleum Group) Pine Bend Refinery and Marathon Ashland Petroleum's St. Paul Park Refinery.

In 2000, the Pine Bend Refinery had about five times the capacity of the St. Paul Park Refinery — 280,000 barrels per day, compared to about 70,000 barrels per day. Actual production in 2000 for both refineries was about 30 percent more than in 1990. Based on two small studies of the mercury content of crude oils refined in Minnesota, the MPCA estimates that the refineries received 136 lbs. of mercury in 1990 and 175 lbs. in 2000 and 2005. It is not clear how much of this mercury was emitted during refining and how much was contained in products such as fuel oil and gasoline. It is even possible that some of the mercury may have been caught on catalysts during refining. Additional studies on the mercury content of crude oil and the fate of that mercury would be helpful.

3. Wood combustion: Mercury emission factors are from Pang (1997). (Pang, S.M. 1997. *Mercury in wood and wood fuels.* Thesis. Master of Science. University of Minnesota). It is assumed that all the mercury in the wood is emitted to the atmosphere. Pang obtained samples of firewood and samples of mill residues burned in Minnesota, and analyzed 183 samples. Bark had the highest median mercury concentration (5.4 ng/g) among the three types of mill residues (chips = 1.28 ng/g; sawdust = 2.56 ng/g). Bark was also highest in the firewood samples. It is thought that mercury is higher in bark because of atmospherically-derived mercury in the dust and soil that bark is exposed to. Statewide emissions are based on the types of wood and wood waste that are actually burned.

4. Natural gas combustion: This estimate is based on an emission factor of 0.0008 lb. mercury/trillion Btu (Electric Power Research Institute. Mercury in the Environment - A Research Update. TR-107695. Palo Alto, December 1996).

Emissions Largely Resulting from the Purposeful Use of Mercury

5. Latex paint volatilization: Mercury-containing fungicides were added to latex paint until 1991. Estimates of Minnesota emissions are based on *Substance Flow Analysis of Mercury in Products* (August 2001, www.pca.state.mn.us/air/mercury-mn.html#publications). Basically the report concludes that it is reasonable to assume that 75 percent of the mercury in paint volatilizes within a year, with the residual available to volatilize the next year. The report calculates that 3,800 lbs. of mercury was held within painted surfaces in 1990, and that 2,850 lbs. (75 percent) likely volatilized that year. An earlier version of this Minnesota mercury inventory, contained in the January 2001 Report to the Minnesota Legislature, erroneously used the 3,800-lb. figure as the amount of mercury that was volatilized. This inventory uses 2,850 lbs., a change that lowers the 1990 baseline by 950 lbs.

6. Class IV incinerators: Small incinerators were once commonly used at grocery stores and other small businesses to incinerate waste, largely cardboard. All of these small incinerators, of which there were about 1,000 in 1990, closed by January 1996 because of new state regulations to reduce particulate emissions. It is assumed that they mostly burned cardboard with mercury at 0.2 ppm. The MPCA estimates that Class IV incinerators burned about 138,000 tons in 1990 and 70,000 tons in 1995.

7. Golf course fungicide volatilization: Mercury-containing fungicides were used in large quantities on golf courses to prevent snow mold until about 1992. The estimate of volatilization from these fungicides applied to golf courses is based on *Substance Flow Analysis of Mercury in Products* (August 2001, www.pca.state.mn.us/air/mercury-mn.html#publications). An earlier version of this Minnesota mercury inventory, contained in the January 2002 Report to the Minnesota Legislature, estimated that 86 lbs. of mercury were volatilized from golf courses in 1990, an amount that is much lower than the estimate of 1,487 lbs. in the August 2001 report. The estimate of 1,487 lbs. is much better documented than the earlier estimate, so this inventory uses 1,487 lbs.

8. Volatilization from the land application of compost: Assumes that one percent of mercury applied to the surface of the land volatilizes within a year.

9. Medical waste incineration: Emission data are based on stack tests submitted to the MPCA, as summarized in the following table.

Facility	1990 Lb. Hg emitted	1995 Lb. Hg emitted	2000 Lb. Hg/ton	2000 Tons burned	2005 Lb. Hg emitted	2005 Tons burned	2005 Lb. Hg emitted
Mayo Foundation, Rochester[1]	115	1	7.71E-05	5,292	0.40	5,300	0.4
Medical Safety Systems, Cannon Falls[2]	33	25	3.10E-03	1,851	5.70	0	0.0
Small Class IV incinerators at hospitals (about 80 in 1990, 20 in 1995, 6 for part of 2000)	368	10	2.10E-04	200	0.04	0	0.0
Total Mercury Emitted (lb.)	516	36			6.14		0.4

[1] After 1990, the Mayo Foundation Incinerator was replaced with a new facility that controls mercury emissions with activated carbon injection.

[2] The Medical Safety Systems facility in Cannon Falls closed permanently in August 2000.

Most hospital (Class IV) incinerators were required to close by February 2000 due to federal regulations; those still operating in 2000 are listed below:

Date Operation Ceased	Hospital
January 2000	Fairmont Community Hospital
February 2000	Worthington Regional Hospital
February 2000	St. Cloud Hospital
June 2000	Lakewood Health Center, Baudette
October 2000	NW Medical Center, Thief River Falls
November 2000	Northcountry Regional Hospital, Bemidji

10. Volatilization from the land application of sludge: After correcting for the water content, about 50,000 dry tons of sewage sludge are land applied in Minnesota each year. The mercury content of the sludge has been declining over time.

Sludge averaged 3.6 ppm of mercury in 1990, 1.8 ppm in 1995, 1.4 ppm in 2000, and is expected to be 0.7 ppm in 2005. This estimate assumes that one percent of the mercury applied to the surface of the land volatilizes within a year, but does not attempt to calculate any carryover from previous years.

11. Volatilization from dissipative use: Mercury is used purposefully in a variety of ways. When the mercury is contained in a product, it can be captured and recycled. But some purposes simply dissipate the mercury into the environment, especially when it is used as a fungicide, pharmaceutical preservative, or in ritual uses (The use of mercury in rituals is thought to be most common in Caribbean communities, which are not well represented in Minnesota.). The estimate used here, 0.8 lb. per year, is prorated from the U.S. Food and Drug Administration's estimate of use for the entire United States, as discussed in *Substance Flow Analysis of Mercury in Products* (August 2001, www.pca.state.mn.us/air/mercury-mn.html#publications).

12. Landfill volatilization: 0.1 percent of landfilled municipal solid waste (MSW) is assumed to volatilize to the air per year (based on studies of MSW emissions in Florida by S. E. Lindberg and J. L. Price, 1998).

13. Hazardous waste incineration: Minnesota has only one hazardous waste incinerator, 3M Chemolite. Based on data submissions from that facility, the MPCA estimates annual mercury emissions of 5 lbs. per year. 3M did not submit any data recently, and 5 lbs. may be an overestimate.

14. General Laboratory: Chemical laboratories have traditionally used mercury for a variety of uses, including physical measurements and chemical analyses. The EPA Mercury Report to Congress (1997) estimated that in 1995, 2,200 lbs. of mercury were volatilized from laboratories nationally. Given that Minnesota represents two percent of all economic activity nationally, the MPCA estimates that 44 lbs. of mercury were emitted in 1990 and 1995, and that this source declined to 22 lbs. by 2000.

15. Sewage sludge incineration: Sewage sludge contains mercury from a variety of wastewater sources. There are two sludge incinerators in Minnesota — the Metropolitan Plant, and the Seneca Plant. Based on data provided by the Metropolitan Council, the MPCA estimates that 247 lbs. of mercury were emitted in 1990, 160 lbs. in 1995, 112 lbs. in 2000, and only 11 lbs. in 2005. In late 2004, a new incinerator with 99 percent mercury-control efficiency began operation at the Metropolitan plant.

	1990	1995	2000	2005
Metropolitan Plant	212	136	95	1
Seneca Plant	35	24	17	10
Total Emitted (lb.)	247	160	112	11

16. Fluorescent lamp breakage: Mercury is a necessary component of fluorescent lamps, although manufacturers have succeeded in reducing the quantity of mercury in an average four-foot lamp from about 45 mg in 1990 to about 15 mg in 2000. After 1990, Minnesota law no longer allowed the disposal of mercury-containing lamps in the solid waste stream, so that progressively more lamps have been recycled. The MPCA estimates that lamps that are not recycled usually get broken in the solid waste stream, in which case 25 percent of the mercury is volatilized.

	1990	1995	2000	2005
No. lamps disposed of in U.S.	550,000,000	600,000,000	650,000,000	700,000,000
No. lamps disposed of in Minnesota	11,000,000	12,000,000	13,000,000	14,000,000
mg Hg/lamp	45	30	15	10
Percent recycled	0	50	70	80
Hg in lamps not recycled (g)	495,000	108,000	58,500	28,000
Hg volatilized (lb)	272.3	59.4	32.2	15

17. Volatilization from spills and land dumping: The MPCA estimates that large quantities of mercury are in use in Minnesota, and that a portion that is removed from service each year (8 percent) is spilled, and that five percent of the mercury that is spilled volatilizes:

Year	Hg in use (lb.)	Hg removed from use (lb.)	Spilled (%)	Hg volatilized (lb.)
1990	190,000	13,667	8.0	54.7
1995	160,000	12,000	8.0	48.0
2000	130,000	12,000	8.0	48.0
2005	70,000	6,000	8.0	24.0

It may appear unlikely that such large amounts of mercury are being removed from use, yet these estimates are supported by mercury content of the solid waste stream, as quantified by stack tests at solid waste incinerators.

Based on stack tests, the solid waste stream contained at least 16,000 lbs. of mercury in 1990, 5,000 lbs. in 1995, and 4,000 lbs. in 2000. Although it is likely that more mercury was properly disposed of after 1990, it also seems likely that as long as mercury is in use, it will be accidentally spilled and volatilized.

18. On-site household waste incineration: It is thought that a significant quantity of solid waste produced by households in Minnesota is not introduced into any organized collection system, but rather is burned on site. This practice could be a significant source of mercury emissions, given that there is no pollution-control equipment and that we know from testing at large municipal solid waste (MSW) incinerators that MSW contains mercury.

In rural areas, on-site disposal often takes the form of an outdoor "burn barrel." In urban and suburban areas, older houses and apartments were designed with a basement incinerator, although the use of these incinerators has undoubtedly decreased since regulation in the early 1970s.

The following table outlines available data on the production and fate of MSW in Minnesota, and estimates mercury emissions. These figures imply that about two percent of MSW is burned on site. This may be an underestimate, given that at least two studies have shown much higher rates of on-site incineration. Zenith Research Group (1997) found that 11 percent of residents in the Duluth area affirmed that they use a burn barrel. A 2000 Zenith study of Minnesota residents in the Duluth area found that 18 percent of residents surveyed admitted to the practice (Zenith Research Group. 2000. Increased Awareness. Prepared for Western Lake Superior Sanitary District.).

Fate of Municipal Solid Waste	1990	1995	2000	2005 (projected)[4]
Recycling (tons)	1,381,690	1,766,528	2,267,952	2,400,000
MSW Compost (tons)	Not available	67,997	21,092	20,000
Resource Recovery (combustion) (tons)	Not available	1,379,329	1,228,830	1,230,000
Landfill (tons)	Not available	1,145,067	1,909,152	2,400,000
PMNR[1] (tons)	Not available	110,868	110,841	120,000
On-site disposal[2] (tons)	Assume 110,000	95,226	96,064	80,000
TOTAL (tons)	Not available	4,565,015	5,633,932	6,250,000
Mercury Content[3] (Assumes 30% control at mass-burn waste combustors.)	3.7 ppm	1.0 ppm	0.6 ppm	0.4 ppm
Mercury Emissions (Assumes 50% is emitted from burn barrels.)	402 lb.	93 lb.	60 lb.	40 lb.

[1] PMNR = Problem Materials Not Recycled, such as washing machines, tires, oil filters and used oil.

[2] The State of Minnesota did not estimate on-site disposal until 1992 (estimated 113,000 tons for that year). For this calculation, 110,000 tons is assumed for 1990, which may be a slight underestimate.

[3] The mercury content of the waste is based on the average emissions of mass-burn MSW incinerators that do not sort or process waste before combustion, excluding Fergus Falls, which had unusually good mercury capture due to the use of a wet scrubber.

[4] Please refer to Minnesota's SCORE reports for more up-to-date data as it becomes available at www.moea.state.mn.us/lc/score.cfm. 2004 data will be available about November 1, 2005.

19. Recycling mercury from products within Minnesota: It is difficult to estimate the emissions associated with recycling mercury in Minnesota because the recyclers are not required to submit information to the state and because it is unclear what the emission factor is for recycling mercury. This estimate was made by Brian Golob, who at the time was employed by one of the three mercury recycling companies in Minnesota.

20. Crematoria: Cremation can release significant quantities of mercury because of the mercury amalgam that is present as dental fillings, and cremation probably releases all of this mercury to the atmosphere. The MPCA estimates for this source are based on calculations presented in Substance Flow Analysis of Mercury in Products (August 2001, www.pca.state.mn.us/air/mercury-mn.html#publications).

21. Dental preparations: Dentists have used mercury amalgam for more then 150 years in the United States. Mercury amalgams typically contain between 42 and 50 percent mercury.

The mercury used in the amalgam has a variety of pathways to the atmosphere, including direct volatilization during preparation in the dental office, from the patient's mouth, after removal in the dental office, during transit in wastewater pipes, from sewage sludge, from crematoriums, and a variety of more subtle pathways. In this estimate, the MPCA includes direct volatilization from the dental office, from the consumer, and during transit in wastewater pipes, but excludes all other pathways, which are included in other emission categories. The MPCA based the estimates on information in the report *Substance Flow Analysis of Mercury in Products* (August 2001, www.pca.state.mn.us/air/mercury-mn.html#publications).

However, the MPCA reduced volatilization during transit from 10 to five percent, although no data on the subject are presently available.

	1990	1995	2000	2005 (projected)
Dental office (lb)	46.2	46.2	46.2	
Customer breathing (lb)	11	12.1	13.2	
Transit loss (lb)	46.2	40.7	35.2	
Total Emissions (lb)	103.4	99.0	94.6	84.0

Note: 1995 figures are extrapolated from 1990 and 2000.

22. Municipal solid waste (MSW) combustion: The mercury emissions in the table on the following page are based on stack tests submitted to the MPCA. "Mass burn" facilities burn solid waste with virtually no sorting, except to exclude the largest and most obvious undesirable waste, such as propane tanks. "RDF" facilities burn refuse-derived fuel, which is municipal solid waste that has been sorted and shredded before combustion.

	1990		1995		2000		2005 (projected)	
Facility Type	**MSW (tons)**	**Hg emitted (lb.)**	**MSW (tons)**	**Hg emitted (lb.)**	**MSW (tons)**	**Hg emitted (lb.)**	**MSW (tons)**	**Hg emitted (lb.)**
Mass Burn Facilities								
Covanta (HERC)	321,900	496	365,000	45	372,258	20.7		40.6
Perham	27,150	89	30,500	52	0	0.0		8.7
Pope Douglas	17,455	26	20,562	25	25,494	33.0		0.8
Olmsted County	58,935	201	67,838	63	62,500	48.0		4.2
City of Fergus Falls	25,187	8	30,900	8	22,983	18.0		8.2
City of Red Wing	18,149	153	17,030	25	16,800	9.0		10.4
Richards Asphalt	24,831	326	23,510	42	Closed		Closed	
Polk	25,446	101	28,785	46	20,700	29.0		3.9
RDF Facilities								
NSP Wilmarth	90,312	5	194,117	5	203,320	1.0		4.5
WLSSD*	33,900	47	35,748	13	0		0	
NSP Red Wing	178,274	333	197,818	304	181,697	0.1		9.8
Great River Energy (Elk River)	277,970	22	277,800	6	279,800	2.4		2.4
TOTAL	1,099,509	1,807	1,289,608	634	1,185,552	161.1		93.5

* By 2000, WLSSD had switched to burning sewage sludge and coal, not RDF. Combustion at WLSSD was later ceased. MSW is being landfilled, and sewage sludge is being treated and land applied as a soil amendment.

23. Smelters that recycle cars and appliances: Mercury is released during the recycling of cars and appliances because of the mercury switches in these products. There is one mini-mill in Minnesota that melts steel from recycled cars and appliances, North Star Steel. These figures are based on a mercury mass balance for North Star Steel's Minnesota facility submitted to the MPCA on December 28, 1999 by the company.

The mass balance shows that in 1998 the total mercury output from the facility was 449 lbs., of which 11 lbs. were recycled and 147 lbs. were emitted directly to the air (136 from the electric arc furnace stack, plus 11 lbs. from the auto shredder stack). According to the mass balance, 214 lbs. of mercury per year is associated with the flue dust captured by pollution-control equipment on the electric arc furnace. The flue dust is processed outside of Minnesota to reclaim useful metals, such as zinc. The mercury in the flue dust is likely released to the atmosphere during the processing, but little information is available on that stage of recycling.

The MPCA utilized the findings of the 1998 mass balance to calculate air emissions for 1990 and 2000, assuming the increased processing of scrap steel in 2000. Mercury emissions are calculated to have been 186 lbs. in 1990, which decreased in 2000 to 176 lbs. as a result of removing mercury-containing switches prior to shredding at North Star Steel. Emissions for 2005 are estimated to be 125 lbs., as a result of continued efforts to remove mercury-containing switches.

24. Volatilization from solid waste collection and processing: This estimate is based on the assumption that five percent of the mercury in solid waste is volatilized during collection, transportation and mechanical processing. It includes MSW that is landfilled, incinerated and composted, but does not include Problem Materials Not Recycled (washing machines, oil filter, tires), waste that is recycled

(newspaper, glass, cans), demolition, medical waste incineration, MSW compost, backyard burn barrels. Emissions from steel-recycling facilities and fluorescent lamp breakage are calculated separately.

Fate of Municipal Solid Waste	1990	1995	2000	2005 (projected)*
Recycling	1,381,690	1,766,528	2,267,952	2,400,000
MSW Compost	30,000	67,997	21,092	20,000
Resource Recovery (combustion)		1,379,329	1,228,830	1,230,000
Landfill	800,000	1,145,067	1,909,152	2,400,000
PMNR		110,868	110,841	120,000
On-site Disposal	110,000	95,226	96,064	80,000
TOTAL (tons)		4,565,015	5,633,932	6,250,000
Calculated Mercury Content (ppm) (from incinerators)	3.66	0.97	0.62	.5
Total landfill, combusted, composted (tons)	2,200,000	2,592,393	3,159,074	3,650,000

Mercury content (lb) of SW (excluding recycling, PMNR)	16,109	5,031	3,919	3,650
Volatilization during handling and transport (lb) (5% of landfill, combustion, composting)	805	252	196	183

Emissions Incidental to Material Processing

25. Taconite processing: In Minnesota, the iron in taconite ore is concentrated and marble-size pellets are baked, or indurated, for ease of handling before they are shipped for smelting outside of the state. Induration volatilizes virtually all of the mercury that is present in the concentrate.

For this volatilization estimate, emission factors (lbs. per million long ton) are calculated from Jiang et al., 2000 ("Mercury Emissions from Induration of Taconite Concentrate Pellets – Stack Testing Results from Facilities in Minnesota." A presentation at the U.S. Environmental Protection Agency conference, Assessing and Managing Mercury from Historic and Current Mining Activities, San Francisco, Calif., November 28-30, 2000.).

Taconite Facility	Mercury Emission Factor (lb. Hg/million Long Tons)		1990	1995	2000	2005 (projected)
LTV	11.24	L tons/yr.	7,798,292	7,440,366	7,400,000	0
		lb Hg/yr.	87.7	83.6	83.2	0
EVTAC	25.20	L tons/yr.	4,417,255	5,141,072	4,200,000	4,400,000
		lb. Hg/yr.	111.3	129.6	105.8	110.9
Hibbing	27.80	L tons/yr.	8,136,923	8,386,431	8,100,000	8,100,000
		lb. Hg/yr.	226.2	233.1	225.2	225.2
Inland	11.89	L tons/yr.	2,265,876	2,560,350	2,878,000	2,900,000
		lb. Hg/yr.	26.9	30.4	34.2	34.5
National	22.18	L tons/yr.	4,809,930	5,026,048	5,450,000	5,400,000
		lb. Hg/yr.	106.7	111.5	120.9	119.8
Northshore	1.10	L tons/yr.	2,384,061	3,658,130	4,300,000	4,300,000
		lb. Hg/yr.	2.6	4.0	4.7	4.7
Minntac	11.73	L tons/yr.	12,709,299	12,788,787	14,607,000	14,600,000
		lb. Hg/yr.	149.1	150.0	171.3	171.3
SUM		L tons/yr.	42,521,636	45,001,184	46,935,000	397,00,000
		lb. Hg/yr.	710.5	742.3	745.4	666

26. Pulp and paper manufacturing: In earlier mercury emission inventories for Minnesota, 3.5 lbs. per year were attributed to emissions from boilers at pulp and paper facilities. However, these emissions are primarily due to combustion of fuels (coal and wood products, such as bark) that are accounted for elsewhere in the inventory.

27. Soil roasting: An average of 83,000 tons of surface soil is heated annually in Minnesota to remove organic contaminants. A concentration of 0.08 ppm of mercury is assumed in the soil, and it is assumed that all of the mercury in the soil is emitted to the atmosphere.

Appendix B

Voluntary Agreement Participant Progress Reports Submitted to MPCA, January 1, 2002-October 15, 2005

Alliant Energy

Metropolitan Council Environmental Services

Minnesota Power

Otter Tail Power Company

Taconite Industry Combined Reports

- **Cliffs Erie**
- **Ispat Inland Mining Company**
- **Hibbing Taconite Mining Company**
- **Northshore Mining Company**
- **United States Steel-Keewatin Taconite**
- **United Taconite LLC**

Western Lake Superior Sanitary District

Xcel Energy

2002 ANNUAL PROGRESS REPORT
VOLUNTARY MERCURY REDUCTION AGREEMENT
ALLIANT ENERGY'S FOX LAKE STATION

INTENT

Alliant Energy supports the efforts of the State of Minnesota in the implementation of a voluntary program to reduce mercury use and emissions. It is Alliant Energy's intent to participate in a voluntary mercury reduction agreement with the Minnesota Pollution Control Agency (MPCA).

SPECIFIC PLANS AND OBJECTIVES

Mercury From Fuel Combustion

One objective is to reduce the mercury emissions associated with the generation of electricity in Minnesota. In 1990, mercury emissions from the generation of electricity at the Fox Lake Power Station were 11.1 pounds. Due to the reduction in coal burned by the facility, the mercury emissions were reduced to 0.5 pounds in 2002, a reduction of 95% from 1990. The emissions decreased from the previous year due to burning less fuel oil in 2002.

Year	Mercury Emissions (Lbs)
1990	11.1
1995	2.4
1998	0.1
1999	0.2
2000	0.15
2001	5.4
2002	0.5

Mercury-Containing Equipment

Another objective of Alliant Energy's voluntary mercury reduction program is to reduce the amount of mercury used within the Fox Lake Power Station. As mercury-containing equipment and instrumentation requires repair or is taken out of service, Alliant Energy evaluates non-mercury options. Non-mercury replacement options are selected if they are technologically proven and economically feasible.

Year	Mercury Contained in Plant Equipment (Lbs)
1990	124.5
2000	65.5
2001	65.5
2002	30

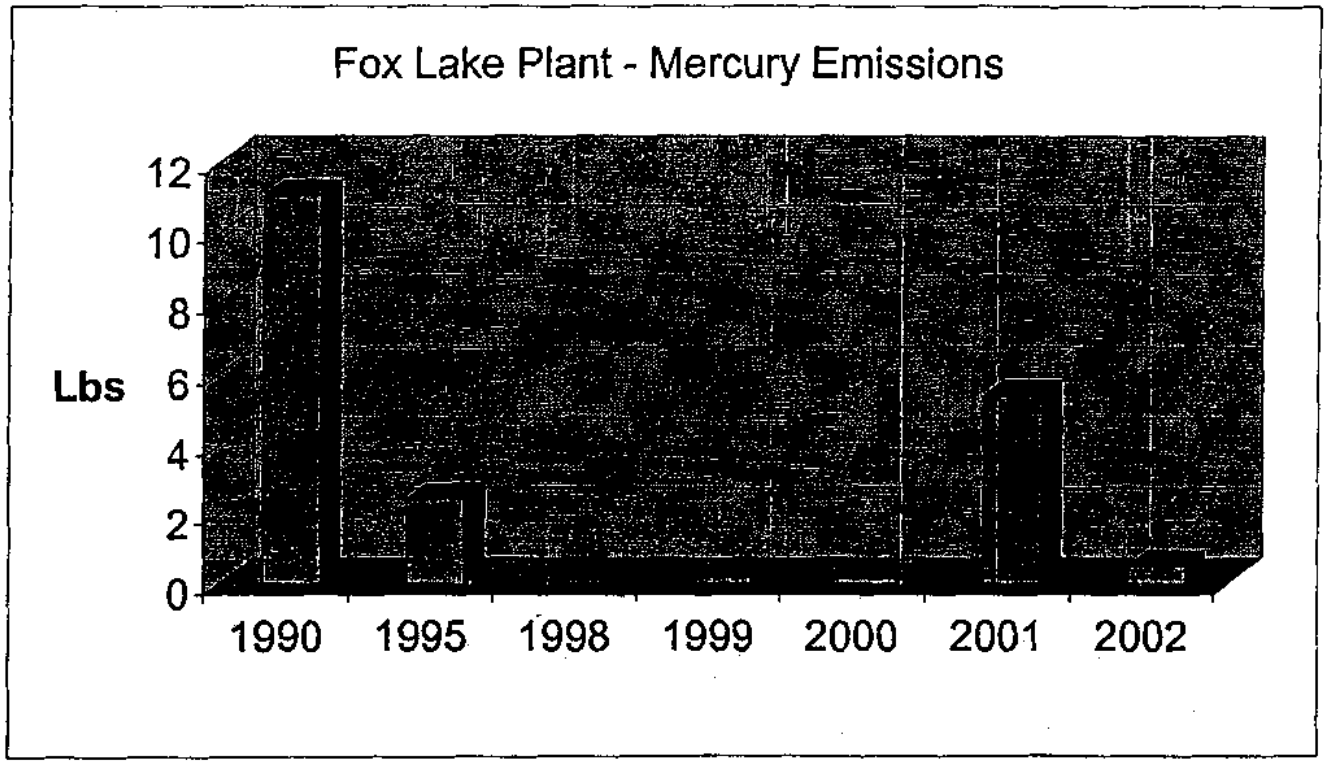
MPCA Mercury Emissions Inventory
Interstate Power & Light Co. (d.b.a. Alliant Energy)
Fox Lake Power Station
Year: **2002**

Combustion Source	Fuel Type	Hg Emissions (Lbs)	Heat Input E12 Btu	Hg Factor (Lb/E12 Btu)	Fuel Burned	Units	Heat Content	Units
Boiler #1	Nat. Gas	0.0000	0.05521	0.0008	54.613	MMCF	1011	Btu/CF
	#6 Oil	0.0060	0.00036	16.7	2400	Gal	149,700	Btu/gal
	Total	**0.006**						
Boiler #2	Nat. Gas	0.0000	0.05329	0.0008	52.706	MMCF	1011	Btu/CF
	#6 Oil	0.0027	0.00016	16.7	1100	Gal	149,700	Btu/gal
	Total	**0.003**						
Boiler #3	Nat. Gas	0.0008	1.02043	0.0008	1009.33	MMCF	1011	Btu/CF
	#6 Oil	0.4950	0.02964	16.7	198,000	Gal	149,700	Btu/gal
	Bit. Coal	0.0000	0.00000	6.4	-	Tons	10,993	Btu/Lb
	Total	**0.496**						
C.T. #4	#2 Oil	**0.004**	0.00877	0.46	62,799	Gal	139,650	Btu/Gal
Htg. Boiler	Nat. Gas	0.0000	0.01834	0.0008	18.144	MMCF	1011	Btu/CF
		-	0.00000	0.46	0	Gal	139,650	Btu/Gal
		0.000						
Plant Total		**0.509**						

Fuel use info from plant statistics as submitted for MPCA annual emissions inventory.
HG emissions factors from 12/8/97 letter from E. Swain, citing EPRI report "Mercury in the Environment - A Research Update", 1996
#6 Fuel Oil Hg factor from EPA-Fire database for emission factors.
All emissions are uncontrolled with no control efficiency applied.

MPCA Mercury Emissions Inventory
Interstate Power & Light Co. (d.b.a. Alliant Energy)
Fox Lake Power Station
Mercury Emissions Trend from Fuel Burned

Year	Mercury Emissions (Lbs)
1990	11.061
1995	2.441
1998	0.101
1999	0.198
2000	0.145
2001	5.381
2002	0.509



MPCA Mercury Emissions Inventory
Interstate Power & Light Co. (d.b.a. Alliant Energy)
Fox Lake Power Station
Year: **2002**

Combustion Source	Fuel Type	Hg Emissions (Lbs)
Boiler #1	Nat. Gas	0.0000
	#6 Oil	0.0060
	Total	**0.006**
Boiler #2	Nat. Gas	0.0000
	#6 Oil	0.0027
	Total	**0.003**
Boiler #3	Nat. Gas	0.0008
	#6 Oil	0.4950
	Bit. Coal	-
	Total	**0.496**
C.T. #4	#2 Oil	**0.004**
Htg. Boiler	Nat. Gas	0.0000
		-
		0.000
Plant Total		**0.509**

Heat Input E12 Btu	Hg Factor (Lb/E12 Btu)	Fuel Burned	Units	Heat Content	Units
0.05521	0.0008	54.613	MMCF	1011	Btu/CF
0.00036	16.7	2400	Gal	149,700	Btu/gal
0.05329	0.0008	52.706	MMCF	1011	Btu/CF
0.00016	16.7	1100	Gal	149,700	Btu/gal
1.02043	0.0008	1009.33	MMCF	1011	Btu/CF
0.02964	16.7	198,000	Gal	149,700	Btu/gal
0.00000	6.4	0	Tons	10,993	Btu/Lb
0.00877	0.46	62,799	Gal	139,650	Btu/Gal
0.01834	0.0008	18.144	MMCF	1011	Btu/CF
0.00000	0.46	0	Gal	139,650	Btu/Gal

Year: **1990**

Combustion Source	Fuel Type	Hg Emissions (Lbs)
Boiler #1	Nat. Gas	0.00002
	#6 Oil	0
	Total	**0.000**
Boiler #2	Nat. Gas	0.00002
	#6 Oil	0
	Total	**0.000**
Boiler #3	Nat. Gas	0.0006
	#6 Oil	0.1565
	Bit. Coal	10.9028
	Total	**11.060**
C.T. #4	#2 Oil	**0.001**
Htg. Boiler	Nat. Gas	-
Plant Total		**11.061**

Heat Input E12 Btu	Hg Factor (Lb/E12 Btu)	Fuel Burned	Units	Heat Content	Units
0.02067	0.0008	20.665	MMCF	1000	Btu/CF
	16.7	0			
0.01997	0.0008	19.972	MMCF	1000	Btu/CF
	16.7	0			
0.75511	0.0008	755.11	MMCF	1000	Btu/CF
0.00937	16.7	62,385	Gal	150,172	Btu/Gal
1.7036	6.4	76,297	Tons	11,164	Btu/Lb
0.00232	0.46	16,840	Gal	138,000	Btu/Gal
0	0.0008	0	MMCF	0	Btu/CF

Fuel use info from plant statistics as submitted for MPCA annual emissions inventory.
HG emissions factors from 12/8/97 letter from E. Swain, citing EPRI report "Mercury in the Environment - A Research Update", 1996
#6 Fuel Oil Hg factor from EPA-Fire database for emission factors.

MPCA Mercury Emissions Inventory
Interstate Power & Light Co. (d.b.a. Alliant Energy)
Fox Lake Power Station
Mercury-Containing Devices

At the end of 2002, the following items were located at the plant:

12 lbs	mercury; in 1 barometer and 3 vacuum manometers
14 lbs	mercury; in tank level indicator (#1&2 distilled water tank)
4 lbs	estimate of mercury in miscellaneous switches, flourescent bulbs, other equipment in small quantities at the plant.
30 lbs	in service
33 lbs	out of service w/recylcing pending

Significant past events:

In 2002, 21.5 lbs of mercury was recovered from two gas regulators The material, along with 11.5 lbs from the lab, are scheduled for recycling in early 2003.

In 1996, 59 lbs of mercury from retired equipment was recovered and recycled through Dynex.

In 1996, the light fixtures in the plant were replaced with high efficiency lighting. As a result, the following fixtures and bulbs were sent to Dynex: 171 4-ft flourescent units, 283 HIDs, 142 compact flourescent units.

2004 ANNUAL PROGRESS REPORT
VOLUNTARY MERCURY REDUCTION AGREEMENT
ALLIANT ENERGY'S FOX LAKE STATION

INTENT

Alliant Energy supports the efforts of the State of Minnesota in the implementation of a voluntary program to reduce mercury use and emissions. It is Alliant Energy's intent to participate in a voluntary mercury reduction agreement with the Minnesota Pollution Control Agency (MPCA).

SPECIFIC PLANS AND OBJECTIVES

Mercury From Fuel Combustion

One objective is to reduce the mercury emissions associated with the generation of electricity in Minnesota. In 1990, mercury emissions from the generation of electricity at the Fox Lake Power Station were 11.1 pounds. Due to the reduction in coal burned by the facility, the mercury emissions were reduced to 6.73 pounds in 2004, a reduction of 39% from 1990. The emissions increased from the previous year due to burning more fuel in 2004.

Year	Mercury Emissions (Lbs)
1990	11.1
1995	2.4
1998	0.1
1999	0.2
2000	0.15
2001	5.4
2002	0.5
2003	4.5
2004	6.73

Mercury-Containing Equipment

Another objective of Alliant Energy's voluntary mercury reduction program is to reduce the amount of mercury used within the Fox Lake Power Station. As mercury-containing equipment and instrumentation requires repair or is taken out-of-service, Alliant Energy evaluates non-mercury options. Non-mercury replacement options are selected if they are technologically proven and economically feasible.

Year	Mercury Contained in Plant Equipment (Lbs)
1990	124.5
2000	65.5
2001	65.5
2002	30
2003	30
2004	30

MPCA Mercury Emissions Inventory
Interstate Power & Light Co. (d.b.a. Alliant Energy)
Fox Lake Power Station
Mercury-Containing Devices

At the end of 2004, the following items were located at the plant:

12 lbs	mercury; in 1 barometer and 3 vacuum manometers
7 lbs	mercury; in tank level indicator (#1distilled water tank)
7 lbs	mercury; in tank level indicator (#2 distilled water tank)
4 lbs	estimate of mercury in miscellaneous switches, flourescent bulbs, other equipment in small quantities at the plant.
30 lbs	in service

Significant past events:

In 2002, 21.5 lbs of mercury was recovered from two gas regulators The material, along with 11.5 lbs from the lab, were recycled in early 2003.

MPCA Mercury Emissions Inventory
Interstate Power & Light Co. (d.b.a. Alliant Energy)
Fox Lake Power Station
Year: **2004**

Combustion Source	Fuel Type	Hg Emissions (Lbs)	Heat Input E12 Btu	Hg Factor (Lb/E12 Btu)	Fuel Burned	Units	Heat Content	Units
Boiler #1	Nat. Gas	0.0000	0.01659	0.0008	16.455	MMCF	1008	Btu/CF
	#6 Oil	0.0000	0.00000	16.7	0	Gal	154,807	Btu/gal
	Total	**0.000**						
Boiler #2	Nat. Gas	0.0000	0.01641	0.0008	16.275	MMCF	1008	Btu/CF
	#6 Oil	0.0000	0.00000	16.7	0	Gal	154,807	Btu/gal
	Total	**0.000**						
Boiler #3	Nat. Gas	0.0001	0.12725	0.0008	126.241	MMCF	1008	Btu/CF
	#6 Oil	6.7190	0.40234	16.7	2,598,953	Gal	154,807	Btu/gal
	Bit. Coal	0.0000	0.00000	6.4	-	Tons	10,993	Btu/Lb
	Total	**6.719**						
C.T. #4	#2 Oil	**0.008**	0.01751	0.46	125,366	Gal	139,700	Btu/Gal
Htg. Boiler	Nat. Gas	0.0000	0.01598	0.0008	15.853	MMCF	1008	Btu/CF
		0.0003	0.00068	0.46	4,851	Gal	139,700	Btu/Gal
		0.000						
Plant Total		**6.728**						

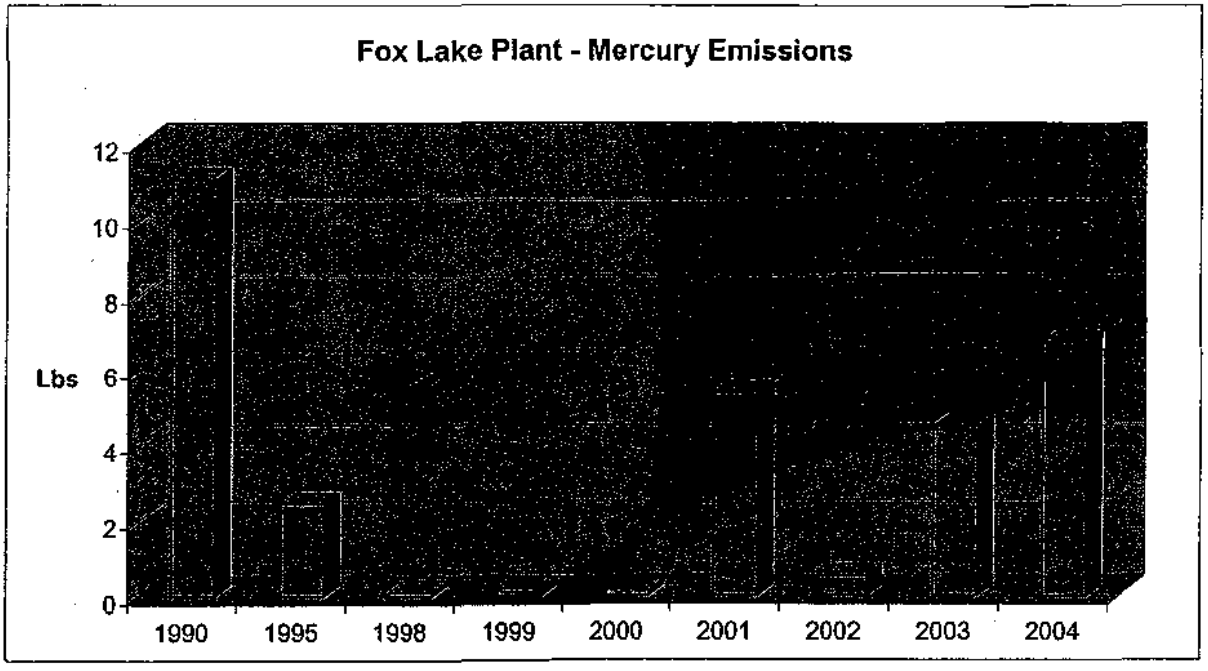
Year: **1990**

Combustion Source	Fuel Type	Hg Emissions (Lbs)	Heat Input E12 Btu	Hg Factor (Lb/E12 Btu)	Fuel Burned	Units	Heat Content	Units
Boiler #1	Nat. Gas	0.00002	0.02067	0.0008	20.665	MMCF	1000	Btu/CF
	#6 Oil	0		16.7	0			
	Total	**0.000**						
Boiler #2	Nat. Gas	0.00002	0.01997	0.0008	19.972	MMCF	1000	Btu/CF
	#6 Oil	0		16.7	0			
	Total	**0.000**						
Boiler #3	Nat. Gas	0.0006	0.75511	0.0008	755.11	MMCF	1000	Btu/CF
	#6 Oil	0.1565	0.00937	16.7	62,385	Gal	150,172	Btu/Gal
	Bit. Coal	10.9028	1.7036	6.4	76,297	Tons	11,164	Btu/Lb
	Total	**11.060**						
C.T. #4	#2 Oil	**0.001**	0.00232	0.46	16,840	Gal	138,000	Btu/Gal
Htg. Boiler	Nat. Gas	-	0	0.0008	0	MMCF	0	Btu/CF
Plant Total		**11.061**						

Fuel use info from plant statistics as submitted for MPCA annual emissions inventory.
HG emissions factors from 12/8/97 letter from E. Swain, citing EPRI report "Mercury in the Environment - A Research Update", 1996
#6 Fuel Oil Hg factor from EPA-Fire database for emission factors.

MPCA Mercury Emissions Inventory
Interstate Power & Light Co. (d.b.a. Alliant Energy)
Fox Lake Power Station
Mercury Emissions Trend from Fuel Burned

Year	Mercury Emissions (Lbs)	Mercury Emissions Percent Reduction From 1990 Emissions
1990	11.061	N/A
1995	2.441	78%
1998	0.101	99%
1999	0.198	98%
2000	0.145	99%
2001	5.381	51%
2002	0.509	95%
2003	4.48	59%
2004	6.73	39%



Metropolitan Council Environmental Services
Voluntary Mercury Reduction Agreement

2001 ANNUAL REPORT
March 2002

1.0 Introduction and Background

The Metropolitan Council Environmental Services (MCES), a division of the Metropolitan Council, submitted a Voluntary Mercury Reduction Agreement (VMRA) to the Minnesota Pollution Control Agency (MPCA) on December 28, 2000. MPCA approved the VMRA on January 12, 2001. The VMRA summarizes the past actions and outlines the commitments under this agreement, according to topic area. This annual report describes the activities and accomplishments that occurred during the year 2001. These activities and accomplishments are arranged using the same major headings found in the VMRA.

2.0 Control of Discharges to the MDS

- In 1998, MCES lowered its Local Limit from 100 µg/l to 2 µg/l. During 2001 MCES reevaluated its Local Limits and the limit for mercury was retained. As in past years, if mercury was found at significant levels in wastewater from industries, MCES worked with the industries to identify sources and requested that they minimize their mercury loadings. MCES staff wrote "case studies" describing the situation so that other staff could learn about sources of mercury and ways to minimize the discharge of mercury. If an industry's discharge levels were above the local limit, MCES issued a Notice of Violation (NOV), which required more formal investigation and reduction efforts by the industry.

- A study and associated report titled "Evaluation of Amalgam Removal Equipment and Dental Clinic Loadings to the Sanitary Sewer" was completed in 2001. The study, done in cooperation with the Minnesota Dental Association, found that amalgam removal equipment is available from many vendors, it operates efficiently, and that mercury loadings to wastewater treatment systems from dental clinics can be significant. The report will be available for distribution in the spring of 2002.

- Hospitals form an industrial group which has been issued industrial discharge permits for many years. Unlike other industrial permittees, they tend to use products that contain mercury, either as ingredients in solutions or as elemental mercury in many types of devices. Therefore, MCES works closely with hospitals, in providing guidance and technical assistance, as well as imposing individualized requirements on the group. For example, MCES sent a mailing on January 24, 2001 which required hospitals to inventory their products which contain mercury as an intentional ingredient, and to write a mercury spill prevention and control plan.

MCES sent each permitted hospital a video promoting mercury minimization. The video, "Our Waste, Our Responsibility," was produced by the University of Vermont, and purchased by MCES for distribution.

In addition, MCES invited permitted hospitals to an MCES open house to see various types of amalgam removal equipment, since some hospitals also house a dental clinic.

- MCES issues a regular newsletter targeting its industrial users, "Open Channel News." Issue No. 9 of the newsletter (December 2001) included an article to help permittees locate and minimize sources of mercury.

- The "Community-wide Dental Amalgam Removal Study," a cooperative study with the Minnesota Dental Association and the Cottage Grove and Hastings area dentists was completed during 2001. For approximately a 3-month period, amalgam removal equipment was installed in all Hastings dental offices. This equipment was subsequently removed and installed in the Cottage Grove dental offices. Daily sludge samples were collected at the Cottage Grove and Hastings Wastewater Treatment Plants and monitored for mercury concentrations. The sludge mercury loadings were determined to be 29% at the Cottage Grove Wastewater Treatment Plant and 44% at the Hastings Wastewater Treatment Plant when the amalgam removal equipment was installed in the sewershed dental clinics. A project report has been prepared and is available upon request.

3.0 Policy-Related Actions

- MCES continued to participate in the Minnesota Mercury Contamination Reduction Initiative.

- MCES was a strong supporter of the 2001 legislative program of the Minnesota Office of Environmental Assistance (MOEA) which resulted in the passage of Minn. Stat. § 116.92, subd. 6, restricting the sale and distribution of mercury thermometers.

- In 2001, MCES awarded $3,058,830 of the $7.5 million in grant monies available (over a five-year period - 1999-2004) to reduce non-point source (NPS) runoff. Since mercury strongly associates with soil particles, reductions in NPS runoff will lead to reductions in mercury in runoff to surface waters.

4.0 External Pollution Prevention

MCES has dedicated much staff time to help other organizations learn about and minimize the use of mercury and mercury compounds, as well as minimizing the potential release of mercury to the environment. Among the activities involving technical assistance and support which were undertaken in 2001 are the following:

- The University of Minnesota Dental School installed a new air/water separator tank and a 10 micron filter in the dental school vacuum system. These new components will be fully evaluated in 2002. The dental school operates 370 dental "chairs."

- MCES has been an active participant in the Mercury Work Group of the Association of Metropolitan Sewerage Agencies (AMSA), a trade group of major publicly owned treatment works (POTW). This group has been active in persuading the U.S. Environmental Protection Agency (EPA) to resume validation testing of EPA's mercury Method 245.7 and conducting follow-up sampling of EPA's 1994 study of Great Lakes POTWs. The AMSA Work Group has prepared a Domestic Waste Characterization Study that has been presented to EPA. MCES contributed to the study by characterizing mercury in domestic-only wastewater and in report preparation.

- AMSA and its consultant, Larry Walker Associates, began drafting a report "Mercury Source Control and Pollution Prevention Program Evaluation." This report evaluates the percent contributions from dental clinics and other key sources of mercury to wastewater treatment plants, and will help treatment plant operators focus their efforts to maximize the reduction of mercury releases to the sanitary sewer. MCES staff served as peer reviewers for the report. AMSA expects the report to be released early in 2002.

- MCES continued its partnership with Park Nicollet Health Services (formerly HealthSystem Minnesota) and the Minnesota Technical Assistance Program (MnTAP). PNHS operates Methodist Hospital and other medical clinics in the Minneapolis-St. Paul area. MCES provided analytical services to evaluate various hospital reagents and chemicals to determine mercury concentrations in frequently used materials. PNHS provided staff support and access to their facility.

- MOEA sponsors meetings of healthcare providers, regulators, technical service providers, trade associations, and others through a group known as the "Healthcare Environmental Awareness and Resource Reduction Team." (HEARTT, formerly the Healthcare Industry Environmental Management

Advisory Group). MCES continues to be a participant in the activities of HEARTT.

- The Environmental Technology Verification Program (ETV) is being coordinated by NSF International, with sponsorship from the U.S. Environmental Protection Agency. This technology verification program evaluates amalgam removal equipment by conducting testing in dental clinics. Other well-known testing (ISO) is done "benchtop" in a laboratory, and not in an operational setting. The ETV testing is meant to gain real-life experience using a set protocol in the actual operating clinics. MCES is providing peer review of the testing.

- MCES staff have spoken at a number of conferences, disseminating information and promoting the minimization of the use and release of mercury.

- The Waste Management & Research Center (WMRC) is a division of the Office of Scientific Research and Analysis in the Illinois Department of Natural Resources. MCES is providing peer review of a report written by University of Illinois' professors on dental wastewater, to be published by WMRC.

- The Massachusetts Strategic Envirotechnology Partnership (STEP) is a joint program between the Executive Office of Environmental Affairs (EOEA) and the University of Massachusetts to assist business with the development and promotion of innovative, technology-based solutions to environmental problems in the Commonwealth. The STEP program is currently evaluating methods to test amalgam removal equipment, looking for a simpler, less expensive benchtop method that could replace the ISO method. Their testing compares a new benchtop method with clinic testing of equipment to determine if the benchtop method is "predictive" of amalgam removal equipment operating in clinics. MCES is providing peer review of the study. MCES also has provided assistance to wastewater operations personnel at the Massachusetts Water Resources Authority in Boston regarding dental mercury issues.

5.0 Internal Pollution Prevention

- MCES staff who conduct or manage demolition projects have been informed that all mercury-containing devices must be removed and recycled prior to demolition.

- In 2001, MCES continued its mercury fever thermometer exchange program, this time expanding it to include other Metropolitan Council divisions. For each mercury-containing thermometer that was brought in, employees were given a mercury-free digital thermometer at no cost to the employee. Each digital thermometer cost the Council $1.52 (down from the cost of $3.29 in the first year of the program). In 2001, 245 mercury fever thermometers and eight mercury thermostats were collected for recycling through this program. This brings the total number of mercury thermometers collected in the two years of the program to 533.

- MCES Research and Development (R&D) staff determined total mercury concentrations in 20 sediment samples for the Lake St. Croix Sediments Study, in partnership with the Science Museum of Minnesota. This study is funded through a Metropolitan Council MetroEnvironment Partnership grant.

- Also during 2001, MCES R&D staff continued to monitor mercury concentrations in streams in the Minnesota River basin. A total of 206 water samples were analyzed for both total mercury and methyl mercury.

- As part of a collaborative project with the MPCA, MCES R&D staff determined both total mercury and methyl mercury in 42 water samples from 15 Minnesota lakes.

- In conjunction with staff from the St. Croix Watershed Research Station of the Science Museum of Minnesota, MCES R&D staff determined methyl mercury concentrations in 32 daphnia ephippia (egg) samples collected from sediment cores taken from two Minnesota lakes.

- MCES Laboratory Services has developed a Standard Operating Procedure (SOP) for the use of EPA Method 1631 for low-level mercury analysis in water and wastewater. Work continued throughout 2001 to develop proficiency in using Method 1631 in order to obtain the required minimum detection level (MDL) for subsequent certification by the Minnesota Department of Health.

- In 2001, MCES modified EPA method 245.7 to include an optional gold amalgam trap, which enables a lower reporting level. The reporting level without the gold amalgam trap is 12 ng/L (parts per trillion) and with the gold amalgam trap is 3 ng/L. MCES Laboratory Services has been granted an alternative test procedure approval from U.S. EPA, Region 5 to use this method, and the Minnesota Department of Health has recently added this method to the laboratory's certification.

- Procedures have been developed and implemented to use EPA Method 1669 for collection of effluent samples for low-level mercury analysis at the Cottage Grove, Rosemount, and Metropolitan Wastewater Treatment Plants.

6.0 Technology-based Controls

Included in the Metropolitan Wastewater Treatment Plant (MWWTP) Solids Processing Improvements Project is the installation of air pollution control equipment specifically designed to remove mercury from air emissions from the new fluidized bed incinerators being installed at the MWWTP. The project is being implemented through the following three contracts:

- MWWTP Fluidized Bed Incineration/Air Pollution Control Systems: This is a design-build contract that will provide the fluid bed incinerators, all incinerator emissions control equipment, and the turbine generator. The contract was awarded to Von Roll, Inc. in March of 2001. Design and equipment procurement activities have been proceeding since that time, with installation of the incinerators scheduled to begin in June of 2002. The new air pollution control systems for the fluidized bed incinerators are being designed with the capability to treat exhaust gases with carbon which are expected to achieve a goal of reducing mercury in air emissions by approximately 70% from 1997 emission estimates. The cost for the carbon injection technology and the enhanced particulate removal technology, which is integral to enhanced mercury removal, is approximately $5.7 million. Start-up of the entire incineration and emission control system is scheduled to begin in the third calendar quarter of 2004.

- MWWTP Solids Processing Improvements – Site Preparation: This contract consists of preliminary site preparation activities for the new Solids Management Building. Key components of the project include site excavation and partial foundation construction. Early construction of this work, in advance of the main building construction, was initiated to expedite the overall project schedule. The contract was awarded to Madsen-Johnson Corporation in September 2001. The majority of the building excavation has been completed, and installation of the foundation piles began in January 2002.

- MWWTP Solids Processing Improvements: This is the main contract for construction of the Solids Management Building that will house the incineration and air pollution control systems furnished by Von Roll, Inc. The contract also includes facilities for sludge storage, sludge dewatering, sludge chemical stabilization along with electrical, mechanical and odor control systems. Plans and specifications for this project have been completed and construction is scheduled to begin in May 2002.

In July 2001, MCES amended the VMRA to insert a new item in section 6. This item states the following:

"**6.3.4 VMRA Commitment:** Management of ash from the fluidized bed incinerators will be conducted in such a manner as to minimize the re-release of mercury into the atmosphere to the greatest extent practicable."

7.0 Mercury Reductions Achieved

- Previous actions taken to control sources of mercury discharged to the collection system have resulted in a reduction of mercury concentrations in sewage sludge at the Metro Plant from approximately 3.0 milligrams per kilogram (mg/kg) in 1990 to 1.10 mg/kg in 2001.

8.0 VMRA Administration

- MCES agreed to provide an annual report of the progress made under the VMRA by March 1 of each year for the preceding calendar year. This report fulfills that commitment.

Metropolitan Council Environmental Services
Voluntary Mercury Reduction Agreement

2002 ANNUAL REPORT
March 2003

Metropolitan Council
Building communities that work

1.0 Introduction and Background

The Metropolitan Council Environmental Services (MCES), a division of the Metropolitan Council, submitted a Voluntary Mercury Reduction Agreement (VMRA) to the Minnesota Pollution Control Agency (MPCA) on December 28, 2000. The VMRA summarizes the past actions and outlines the commitments under this agreement, according to topic area. This annual report describes the activities and accomplishments that occurred during the year 2002. These activities and accomplishments are arranged using the same major headings found in the VMRA.

2.0 Control of Discharges to the MDS

MCES formed a partnership with the Minnesota Dental Association (MDA) in 1998 as part of our Mercury Reduction Program, and undertook the two studies noted below. The studies evaluated dental amalgam separation equipment and loadings of mercury in amalgam to the sanitary system.

Evaluation of Amalgam Removal Equipment

This study and associated report titled "Evaluation of Amalgam Removal Equipment and Dental Clinic Loadings to the Sanitary Sewer" were completed and distributed in 2002. The study, done in cooperation with the MDA, found that amalgam removal equipment is available from many vendors, it operates efficiently, and that mercury loadings to wastewater treatment systems from dental clinics can be significant. The results showed an overall weighted average discharge rate of 234 milligrams of mercury per dentist per operating day with basic filters in place. Five models of amalgam removal equipment were installed within the vacuum systems of seven dental clinics for a cumulative total of 87 "clinic-weeks." The amalgam removal equipment was shown to remove 91-99 percent of the mercury discharged, primarily by capturing amalgam. It is important to point out that mercury discharged from dental clinics is primarily in the form of amalgam and the levels are quite variable, ranging from 28-540 mg mercury/dentist/day. MCES and MDA encourage caution when using the data because of the large variability.

Community-Wide Study

A community-wide study was conducted to quantify the amount of mercury discharged from dental clinics to MCES' wastewater treatment plants (WWTPs). This was accomplished by an intensive sludge sampling and analysis program at the Hastings and Cottage Grove (now known as Eagles Point) WWTPs before and during the testing period when amalgam removal equipment was in place at the dental clinics upstream of the WWTPs.

While the amalgam removal equipment was in place, a 44 percent reduction of mercury in sludge was found at the Hastings WWTP and a 29 percent reduction was found at the Cottage Grove WWTP. Based on the measured reductions of mercury in sludge at the WWTPs, and estimating the removal rates of mercury in WWTP grit, efficiency of the amalgam removal equipment in the dental offices and the number of days of operation of each clinic, a mercury loading from dental clinics was estimated. The mercury loading from the dental clinics to the WWTPs was estimated at 120 mg mercury/dentist/operating day.

To obtain the executive summaries of either the equipment evaluation or community-wide study, please contact Peter Berglund at 651-602-4708 or via e-mail at peter.berglund@metc.state.mn.us.

Dental Amalgam Separator Program

The results of the two studies noted above established a scientific basis for concluding that advanced amalgam separation equipment can be cost-effective in removing amalgam particles from the dental office wastewater stream resulting in reduced mercury loadings to the sanitary sewer, and should be installed. As a result, during the year, MCES and MDA developed a "Voluntary Dental Office Amalgam Separator Program." This is a jointly managed program that will ensure the installation of advanced amalgam separation equipment in all general practice dental offices throughout the state. The program will involve more than 1,300 general practice dentists or about 1,000 dental offices in the MCES service area. Rollout of the program began on January 1, 2003, and the final date for installation and operation of amalgam separators is set for February 1, 2005.

MDA will take the lead in promoting the program within the metropolitan wastewater service area and throughout the state. MCES and MDA will provide technical support to the dental community in order to facilitate decision-making and separator installation by dental offices. MDA will keep a database of all dental office activities. When an office has satisfactorily completed installation and reported waste management plans, MCES will provide a certificate of compliance. Each office will be expected to report to MCES on an annual basis in order to maintain compliance. If an office does not satisfactorily respond to the voluntary program, MCES will take steps toward regulatory action.

The voluntary approach of this program will be less burdensome and less expensive than a conventional regulatory approach for each dental office as well as for MCES. This program is a fair and low-cost means of reducing the dental contribution of mercury to the sanitary sewer system. It avoids costly infrastructure expenses at MCES facilities, enhances protection of the environment, continues the partnership with MDA and dentists, and promotes equity and fairness across sewer user groups.

The Environment Committee of the Metropolitan Council recommended adoption of the program on November 12, 2002, with final Metropolitan Council approval on December 11, 2002.

In addition, the April 2002 and December 2002 issues of MCES' regular newsletter targeting its industrial users, "Open Channel News" included articles describing the activities regarding amalgam control. Information on the dental amalgam studies was also shared with member organizations of the Association of Metropolitan Sewerage Agencies (AMSA).

3.0 Policy-Related Actions

The following policy related actions were taken in 2002:

- In 2002, MCES awarded $1,436,330 of the $7.5 million in grant monies available (over a five-year period - 1999-2004) to reduce non-point source (NPS) runoff. Since mercury strongly associates with soil particles, reductions in NPS runoff will lead to reductions in mercury in runoff to surface waters. To date, the Council has approved about $6.5 million in competitive and targeted grants for nonpoint source pollution abatement and prevention projects.

- As part of its Dental Insurance Program benefits, the Council continued to encourage employees and their dependents to use mercury-free posterior restorations (dental cavity

fillings) by removing the cost disincentive to selecting the significantly more expensive mercury-free composites.

4.0 External Pollution Prevention

MCES has dedicated much staff time to help other organizations learn about and minimize the use of mercury and mercury compounds, as well as minimizing the potential release of mercury to the environment. Among the activities involving technical assistance and support that were undertaken in 2002 are the following:

- MCES has been an active participant in the Mercury Work Group of the Association of Metropolitan Sewerage Agencies (AMSA), a trade association representing publicly owned treatment works (POTW). This group has been active in persuading the U.S. Environmental Protection Agency (EPA) to resume validation testing of EPA's mercury Method 245.7 and conducting follow-up sampling of EPA's 1994 study of Great Lakes POTWs.

- In March 2002, AMSA released "Mercury Source Control and Pollution Prevention Program Evaluation – Final Report." MCES staff served as peer reviewers of the report, which evaluates the percent contributions from dental clinics and other key sources of mercury to wastewater treatment plants, and will help treatment plant operators focus their efforts to maximize the reduction of mercury releases to the sanitary sewer.

- MCES is a participant in another AMSA project that began in 2002. This will involve tracking mercury levels within wastewater treatment plants as certain cities implement their programs to control mercury contributions from dental offices.

- The Minnesota Office of Environmental Assistance sponsors meetings of healthcare providers, regulators, technical service providers, trade associations, and others through a group known as the "Healthcare Environmental Awareness and Resource Reduction Team (HEART)." MCES continues to be an active participant in the activities of HEART.

- MCES staff have spoken at a number of conferences, disseminating information and promoting the minimization of the use and the release of mercury.

- The Massachusetts Strategic Envirotechnology Partnership (STEP) is a joint program between the Executive Office of Environmental Affairs (EOEA) and the University of Massachusetts to assist business with the development and promotion of innovative, technology-based solutions to environmental problems in the Commonwealth. The STEP program is currently evaluating methods to test amalgam removal equipment, looking for a simpler, less expensive benchtop method that could replace the ISO method. Their testing compares a new benchtop method with clinic testing of equipment to determine if the benchtop method is "predictive" of amalgam removal equipment operating in clinics. MCES is providing peer review of the study. MCES also has provided assistance to wastewater operations personnel at the Massachusetts Water Resources Authority in Boston regarding dental mercury issues.

- MCES has assisted the States of New Hampshire and Vermont, serving as an advisor to address issues related to mercury from dental offices.

5.0 Internal Pollution Prevention

Among the activities involving internal pollution prevention that were undertaken in 2002 are the following:

- In 2002, MCES did not aggressively promote its thermometer exchange program; nonetheless, staff collected 69 mercury thermometers from employees and exchanged for digital thermometers. MCES has collected a total of 602 mercury thermometers during the three years of the program. In addition, the mercury thermometers in the MCES first responder kits were replaced with digital thermometers.

- In collaboration with the MPCA, MCES R&D staff collected and analyzed over 360 river and lake water samples for total mercury and methylmercury. River water samples were collected from the Mississippi, Minnesota, St. Croix, Elk, Rum, St. Louis, and Poplar Rivers. Lake water samples were collected from 15 lakes across Minnesota. These efforts were in support of the MPCA's development of mercury total maximum daily loads (TMDL) for Minnesota surface waters.

- Working with scientists from the MPCA and the St. Croix Watershed Research Station of the Science Museum of Minnesota, MCES R&D staff analyzed 96 sediment samples from six Minnesota lakes (Brule, Sawbill, Alton, Kabetogama, Winnibigoshish, and Side) for total mercury (THg) and methylmercury (MeHg). Historical rates of THg and MeHg accumulation in dated sediment cores were compared with levels of Hg in fish in these lakes over the past 70 years.

- MCES R&D staff provided analytical and consulting services to the Minneapolis Park and Recreation Board in support of their stormwater mercury monitoring program. The Board provides stormwater monitoring services under contract to the cities of Minneapolis and St. Paul. MCES staff trained Board scientists in "clean" mercury sampling procedures and provided analytical support services throughout 2002.

- During 2002, the MCES Laboratory Services discontinued the use of the atomic absorbance mercury analysis on liquid sample matrices. All liquid sample matrices are now analyzed for mercury by atomic fluorescence, using U.S. EPA Region 5 approved alternate test procedure (ATP) of a modified version of EPA 245.7 method, with an optional gold amalgam trap. The Minnesota Department of Health certified the laboratory for the use of Method 245.7 on January 8, 2002. Efforts were focused to develop a lower quantitation level, originally determined to be 3 ng/L, utilizing the gold amalgam trap. The new quantitation level is 0.5

ng/L and was placed into operation in July 2002. Low level mercury samples are collected using EPA method 1669 at the Eagles Point, Rosemount, St. Croix Valley, and Metropolitan Wastewater Treatment Plants and analyzed in the laboratory using the ATP approved EPA method 245.7 with the gold amalgam trap. In August, at the request of MCES, MPCA approved the use of EPA method 245.7 (without the gold amalgam trap) for analysis of mercury in the effluents for the Blue Lake and Seneca Wastewater Treatment Plants, since the permits specified the use of the preceding less-sensitive analytical method (Method 245.1).

- As a result of the "Voluntary Dental Office Amalgam Separator Program", the Laboratory was, and currently is, involved in developing an analytical procedure that will sufficiently oxidize all forms of mercury present in the treatment plant influent matrix. The contribution of amalgam associated with the grit is also being quantified using an established Laboratory modified method that has been shown to effectively recover mercury in a known weight of actual amalgam.

6.0 Technology-based Controls

The MCES is currently constructing new solids processing facilities at its Metropolitan Wastewater Treatment Plant. Site preparation, including site excavation and partial foundation construction for the new building, was completed in July 2002. The contract for construction of the Solids Management Building itself (that will house the incineration and air pollution control systems) began in May 2002 with final completion to occur in October 2005. This contract also includes facilities for sludge storage, sludge dewatering, and sludge chemical stabilization along with electrical, mechanical and odor control systems.

Installation of three fluidized bed incinerators and their corresponding air emission process trains within the solids building began in June 2002. The new air pollution control systems for the fluidized bed incinerators are being designed with the capability to treat exhaust gases with carbon which are expected to achieve a goal of reducing mercury in air emissions by approximately 70% from 1997 emission estimates. The cost for the carbon injection technology and the enhanced particulate removal technology, which is integral to enhanced mercury removal, is approximately $5.7 million. Start-up of the entire incineration and emission control system is scheduled to begin in June 2004.

7.0 Mercury Reductions Achieved

Actions taken to control sources of mercury discharged to the collection system have resulted in a reduction of mercury concentrations in sewage sludge at the Metro Plant from approximately 3.0 milligrams per kilogram (mg/kg) in 1990 to 1.02 mg/kg in 2002.

8.0 VMRA Administration

MCES agreed to provide an annual report of the progress made under the VMRA by March 1 of each year for the preceding calendar year. This report fulfills that commitment.

Metropolitan Council Environmental Services
Voluntary Mercury Reduction Agreement

2004 ANNUAL REPORT
March 2005

Metropolitan Council
Building communities that work

1.0 Introduction and Background

The Metropolitan Council Environmental Services (MCES), a division of the Metropolitan Council (Council), submitted a Voluntary Mercury Reduction Agreement (VMRA) to the Minnesota Pollution Control Agency (MPCA) on December 28, 2000. The VMRA summarizes the past actions and outlines the commitments under this agreement, according to topic area. This annual report describes the activities and accomplishments that occurred during the year 2004. These activities and accomplishments are arranged using the same major headings found in the VMRA.

2.0 Control of Discharges to the Metropolitan Disposal System (MDS)

Background

MCES formed a partnership with the Minnesota Dental Association (MDA) in 1998 as part of the Council's Mercury Reduction Strategy, and completed two major studies in cooperation with the MDA, related to discharges of mercury-containing dental amalgam waste to the Metropolitan Disposal System (MDS). These two extensive studies determined that an average of 44% of mercury reaching Council wastewater treatment plants was directly the result of discharges from dentists. These results indicated that some kind of action would be necessary to recover the mercury-containing amalgam before it reaches the MDS.

Voluntary Dental Clinic Amalgam Recovery Program

Beginning in 2003, the Council and the MDA established the Voluntary Dental Clinic Amalgam Recovery Program, a jointly managed program designed to reduce the amount of mercury discharged to the Council's wastewater treatment plants, and ultimately to the environment. The reduction of mercury would be achieved through the voluntary installation and proper operation of amalgam separators in the 709 general practice dental clinics in the seven-county Minneapolis-Saint Paul metropolitan area. The MDA represents approximately 81% of the 1452 practicing dentists in Minnesota and is marketing the program statewide. To facilitate this statewide effort, the MDA provides an update of the contractors and amalgam separator equipment on its website (See Attachment 1.)

Program Implementation

In the two years since initiation of the program, significant progress has been made in installation of amalgam removal equipment in dental clinics. Amalgam separators that have been tested by the ISO test method 11143, and have been shown to remove an average of at least 99% of the amalgam particles, will be considered an approved separator. By early February 2005, approximately 91% of the general practice clinics in the metropolitan area had committed to installing a separator. As of February 2005, 468 of the 709 metropolitan area clinics had installed a separator. The MDA and the Council will continue public outreach efforts to encourage the remaining clinics to install the separators.

Program Administration

After installation, the dental clinics are expected to operate and maintain the separator equipment as designed and appropriately manage all separator wastes. In order to assure adequate operation, the Council and the MDA sent out a mailing in March 2004 to remind clinics to operate separators in accordance with tested flow rates. Dental clinics are required to submit annual reports to MCES in order to assure compliance.

A steering committee of MDA and Council representatives oversees the direction and progress of the program. A technical advisory committee was also set up and includes representatives of dental supply companies, waste management service providers, metropolitan area counties, plumbing companies, and others.

The voluntary approach of this program has been less burdensome and less expensive than a conventional regulatory approach for each dental office as well as for MCES. This program is an equitable and low-cost means of reducing the dental contribution of mercury to the sanitary sewer system. It avoids costly infrastructure expenses at MCES wastewater treatment facilities, enhances protection of the environment, continues the partnership with MDA and dentists, and promotes equity and fairness across sewer user groups.

The Voluntary Dental Clinic Amalgam Recovery Program received a Minnesota GREAT! Award from the Minnesota Office of Environmental Assistance, and was a public sector finalist for the 2004 Environmental Initiative Award sponsored by the Minnesota Environmental Initiative. (See Attachments 2 and 3).

3.0 Policy-Related Actions

The following policy related actions were taken in 2004:

- MCES completed allocation of the $7.5 million in grant monies available (over the five-year period - 1999-2004) to reduce non-point source (NPS) runoff. Of the 133 grant projects in the program, 13 contracts remain to be finalized. Since mercury strongly associates with soil particles, reductions in NPS runoff will lead to reductions in mercury in runoff to surface waters.

- As part of its Dental Insurance Program benefits, the Council has continued coverage of employees and their dependents to use mercury-free posterior restorations (dental cavity fillings) by removing the cost disincentive to selecting the significantly more expensive mercury-free composites.

4.0 External Pollution Prevention

MCES has dedicated significant staff time to help other organizations learn about and minimize the use of mercury and mercury compounds, as well as minimizing the potential release of mercury to the environment. Among the activities involving technical assistance and support that were undertaken in 2004 are the following:

- MCES has been an active participant in the Mercury Work Group of the Association of Metropolitan Sewerage Agencies (AMSA), a trade association representing publicly owned treatment works (POTW).

- MCES continues to be a participant in an AMSA project that began in 2002 and which continues into 2005. The project involves tracking mercury levels within wastewater treatment plants as certain cities implement their programs to control mercury contributions from dental offices. AMSA is also working on drafting guidance to help POTWs and others understand issues related

to setting amalgam separator programs.

- An MCES staff person is the lead in another AMSA group addressing amalgam separator ISO test method issues and related amalgam separator program issues. This work began in 2003 and continues into 2005.A formal process is underway to revise the ISO test method and a proposal has been sent to the ISO for revision.

- The Minnesota Office of Environmental Assistance sponsors meetings of healthcare providers, regulators, technical service providers, trade associations, and others through a group known as the "Healthcare Environmental Awareness and Resource Reduction Team (HEARRT)." MCES continues to be an active participant in the activities of HEARRT.

- MCES staff have spoken at conferences, disseminating information and promoting the minimization of the use and the release of mercury.

- MCES staff continue to provide technical assistance to other municipalities and states on mercury and amalgam separator related issues.

5.0 Internal Pollution Prevention

Among the activities involving internal pollution prevention that were undertaken in 2004 are the following:

- MCES staff who conduct or manage demolition projects have been informed that all mercury-containing devices must be removed and recycled prior to demolition.

- MCES continued its emphasis with employees on the importance of appropriate management of fluorescent lamps and mercury-containing materials from its operations. In 2004, a total of 4,312 fluorescent lamps were shipped for recycling.

- MCES R&D staff collected and determined total mercury (Hg) beyond permit monitoring requirements in: 94 daily composite samples of Metropolitan Plant influent; 53 daily composite samples of Blue Lake Plant influent; and 52 daily composite samples of Hastings Plant influent. The data will allow MCES staff to track the anticipated reductions in mercury loading at these plants due to new controls applied to dental office discharges.

- MCES R&D staff developed a more accurate and precise method for the determination of total Hg in dewatered sludge. The precision of the method is characterized by a typical relative standard deviation of less than 5%. Accuracy is characterized by a typical recovery of 95% when analyzing certified reference dewatered sludge materials.

- MCES R&D staff collected and analyzed six dewatered sludge samples for total Hg in support of tests to characterize the removal of Hg by the activated carbon injection/baghouse portion of the air pollution control train of the new fluidized bed incinerators.

- MCES staff measured total Hg and methylmercury in filtered and unfiltered samples collected across the activated sludge treatment process to characterize Hg speciation and partitioning in

this process. A total of 48 samples were analyzed for total Hg, and 60 samples were analyzed for methylmercury.

- MCES staff determined methylmercury in 45 water samples from the St. Louis River and its tributaries in support of a project carried out by the Western Lake Superior Sanitary District.

- MCES staff determined total Hg in 20 sediment samples from Markham Pond, a storm water detention pond in Maplewood, MN, in support of an MCES project to characterize metal and organic pollutant loads in detention pond sediments.

6.0 Technology-based Controls

The MCES has initiated operation of facilities in the Solids Management Building with completion of construction scheduled for October 2005.

The first of the new fluidized bed incinerators went into operation in September 2004. As of February 1, 2005, all three new units are in operation. The existing multiple hearth incinerators are no longer receiving sludge feed. The air pollution control systems for the fluidized bed incinerators are designed with the capability to treat exhaust gases with carbon to achieve a goal of reducing mercury in air emissions by approximately 70% from 1997 emission estimates. The cost for the carbon injection technology and the enhanced particulate removal technology, which is integral to enhanced mercury removal, is approximately $2.9 million.

Initial testing of the mercury removal of the control systems of the first two units indicates an average mercury removal efficiency of greater than 99%.

7.0 Mercury Reductions Achieved

In addition to the reductions being achieved in mercury emissions from the incineration systems, actions taken to control sources of mercury discharged to the collection system have resulted in a reduction of mercury concentrations in sewage sludge at the Metro Plant from approximately 3.0 milligrams per kilogram (mg/kg) in 1990 to 0.78 mg/kg in 2004.

8.0 VMRA Administration

MCES agreed to provide an annual report of the progress made under the VMRA by March 1 of each year for the preceding calendar year. This report fulfills that commitment.

List of Attachments

Attachment 1: Copy of web pages. Revised-Features of Approved Amalgam Separators (October 14, 2004) http://www.mndental.org/client_files/documents/amsep.pdf

Attachment 2: Winner's Booklet. MnGREAT! Awards 2004. Page 2. Available at http://www.moea.state.mn.us/mngreat/2004/MnGREAT2004-Web.pdf

Attachment 3: Minnesota Environmental Initiative 2004 Environmental Initiative Awards Finalists. Page 5. Available at http://www.mn-ei.org/awards/images/2004finalists.pdf

ATTACHMENT 1
http://www.mndental/org

Revised -- Features of Approved Amalgam Separators (October 14, 2004)

The following listing of Features of Approved Amalgam Separators should be used as a replacement for page 14 of your "re: amalgam recovery" booklet. The listing will change occasionally throughout the course of the voluntary amalgam recovery program. Before making purchasing decisions, please reference this Web site, or call the MDA office at 651/646-7454.

Manufacturer or distributor of amalgam separator: Air Techniques

Model name or number: Guardian Amalgam Collector

Removal technology used: Sedimentation

Capacity: Variable, as determined by the volume of the air-water separator tank

Flow rate factors: 3 liters per minute

Location: Single central location at the outlet of an air-water separator

Physical dimensions: Height: 7.5", Width: 10.5", Depth: 6.25"

Cost: $1,500 initial purchase (which includes 1 replacement box, $750 for additional replacement boxes)

Other information: System designed for gravity flow, so the amalgam collection container must be installed below the air-water separator. An air-water separator must be purchased if current vacuum system does not include one. Cost includes amalgam recycling fees. Replacement boxes typically needed every 6-12 months.

Manufacturer or distributor of amalgam separator: R&D Services

Model name or number: The Amalgam Collector CH9 or CH12

Removal technology used: Sedimentation

Capacity: 1 per chair

Flow rate factors: Working capacity is 2.3 liters for the CH9 and 3.7 liters for the CH 12

Location: Chairside

Physical dimensions: Height: 9" or 12" (plus 4" for fittings), Diameter: 8"

Cost: $495

Other information: Select height of a unit to be purchased based on your flow rate. Dental office regularly adjusts outlet tube height, decants liquid and occasionally empties the sludge waste. Canisters may be replaced or reused. Dental office to manage the amalgam waste solids.

Manufacturer or distributor of amalgam separator: R&D Services

Model name or number: The Amalgam Collector CE18 or CE24

Removal technology used: Sedimentation

Capacity: Variable

Flow rate factors: Working capacity is 6.5 liters for the CE 18 and 16.4 liters for the CE 24

Location: Single central location just upstream of the vacuum pump

Physical dimensions: Height: 18" or 24" (plus 4" or 6" for fittings), Diameter: 8" or 10"

Cost: $695 for the CE18 and $1,250 for the CE 24

Other information: Select height of a unit to be purchased based on your flow rate. Dental office regularly adjusts outlet tube height, decants liquid and occasionally empties the sludge waste. Canisters may be replaced or reused. Dental office to manage the amalgam waste solids.

Manufacturer or distributor of amalgam separator: American Dental Accessories

Model name or number: Asdex AS-9

Removal technology used: Filtration

Capacity: One filter unit per chair

Flow rate factors: 500 ml/minute

Location: Chairside

Physical dimensions: Height: 11.5", Diameter: 3"

Cost: $229 for the initial unit; $79 per filter

Other information: Dental office replaces a used filter with a new filter every 4-6 weeks. Dental office to manage waste filters.

Manufacturer or distributor of amalgam separator: American Dental Accessories

Model name or number: AD-1000

Removal technology used: Filtration

Capacity: 12 chairs

Flow rate factors: 2 l/minute

Location: Single central location at outlet of air/water separator for either a wet or dry vacuum pump system

Physical dimensions: Height: 8", Width 14", Depth 10.5"

Cost: $796 for the initial unit; $496 per replacement filter box

Other information: Filter lasts 18 months based on one full time dentist. Cost of replacement filter includes pre-paid mailer and disposal.

Manufacturer or distributor of amalgam separator: Dental Recycling North America (DRNA)

Model name or number: BullfroHg 10

Removal technology used: Sedimentation

Capacity: 6 chairs

Flow rate factors: Holding tank volume is 10 liters

Location: Single central location just upstream of the vacuum pump

Physical dimensions: Height: 20.5", Diameter: 8.5"

Cost: $50/month service agreement (2 year minimum contract)

Other information: 120 V AC power supply needed to pump settled effluent from unit. Utilizes an automatic timer. Service fee includes recycling of amalgam waste. Unit is available in larger sizes and priced accordingly.

Manufacturer or distributor of amalgam separator: Dental Recycling North America (DRNA)

Model name or number: MRU

Removal technology used: Sedimentation, filtration and ion exchange

Capacity: 6 chairs

Flow rate factors: Holding tank volume is 10 liters

Location: Single central location just upstream of the vacuum pump

Physical dimensions: Height: 24", Width 16", Depth 12"

Cost: Call DRNA for pricing information

Other information: 120 V AC power supply needed to pump settled effluent from unit. Utilizes an automatic timer. Service fee includes recycling of amalgam waste. Unit is available in larger sizes and priced accordingly.

Manufacturer or distributor of amalgam separator: SolmeteX

Model name or number: Hg 5

Removal technology used: Sedimentation, filtration, and chemical binding

Capacity: 10 chairs

Flow rate factors: 50 ml/minute. Surge tank capacity is 4.6 liters

Location: Single central location just upstream of the vacuum pump.

Physical dimensions: Height: 29", Width: 14" , Depth: 8"

Cost: $695 for the initial unit; $250 per filter

Other information: Filter replaced approximately every 6 months or when full. The $250 filter purchase includes recycling. Lease plan also available ($59.95/mo.) if purchased direct from manufacturer.

Manufacturer or distributor of amalgam separator: SolmeteX

Model name or number: Hg 10

Removal technology used: Sedimentation, filtration, and chemical binding

Capacity: 10-25 chairs

Flow rate factors: Not applicable since it uses a 95 liter (25 gallon) holding tank and batch treatment

Location: Single central location downstream of the vacuum pump.

Physical dimensions: Tank Dimensions: Height: 48", Diameter: 25", plus 6 filters mounted on the wall

Cost: $7,450 for the initial unit and filters, $1,050 for a 6-filter replacement kit. Individual filter units also available.

Other information: Units are custom made to accommodate an office's flow rate. Filter kit would be replaced from quarterly to annually. 120V AC power supply needed to pump effluent through the treatment.

Manufacturer or distributor of amalgam separator: Maximum Separation Systems

Model name or number: MSS 2000

Removal technology used: Sedimentation and filtration

Capacity: 16 chairs

Flow rate factors:
-Surge tank capacity: 22 liters
- Flow through rate: 2.5liters/minute

Location: Single central location just upstream of the vacuum pump.

Physical dimensions: Height: 28", Width: 18.5" , Depth: 15"

Cost: $1,395 per unit. $165 per settling tank plus $185 recycling fee.

Other information: Initial cost includes two initial settling tanks, both of which would last one dentist approximately two years or two dentists approximately one year. 120V AC power supply needed.

Manufacturer or distributor of amalgam separator: Maximum Separation Systems

Model name or number: MSS 1000

Removal technology used: Sedimentation and filtration

Capacity: 6 chairs

Flow rate factors:
- Surge tank capacity: 11 liters
- Flow through rate: 1 liter/minute

Location: Single central location just upstream of the vacuum pump.

Physical dimensions: Height: 24", Width: 18.5" , Depth: 15"

Cost: $968 per unit, $165 per settling tank plus $185 recycling fee.

Other information: The MSS 1000 has one settling tank (rather than two tanks) which would last one dentist approximately one year. 120V AC power supply needed.

Manufacturer of distributor of amalgam separator: AB Dental Trends

Model name or number: Rasch 890 - 1000

Removal technology used: Sedimentation, filtration, and ion exchange

Capacity: 12 chairs

Flow rate factors: 2 liters/minute

Location: Single central location at the outlet of a wet system

Physical dimensions: Height: 28.5", Depth: 10.25", Width: 12.75"

Cost: $1,190 which includes an air-water separator

Other information: Cost of a replacement canister is $596. The Rasch 890-1000 is for use with a wet vacuum pump system. The standard canister is typically replaced about every 18 months per doctor. Canister replacement cost includes management of the waste.

Name of amalgam separator: AB Dental Trends

Model name or number: Rasch 890-6000

Removal technology used: Sedimentation, filtration, and ion exchange

Capacity: 12 chairs

Flow rate factors: 2 liters/minute

Location: Single central location at the outlet of a dry system.

Physical dimensions: Height: 5.25", Width: 9" , Depth: 12.25"

Cost: $666 which include canister and connectors

Other information: Cost of a replacement canister is $596. The Rasch 890-6000 is for use with a dry vacuum pump system. The standard canister is typically replaced about every 18 months per doctor. Canister replacement cost includes management of the waste.

Manufacturer or distributor of amalgam separator: AB Dental Trends

Model name or number: Rasch 890-1000/4000

Removal technology used: Sedimentation, filtration, and ion exchange

Capacity: 12 chairs

Flow rate factors: 4 liters/minute

Location: Single central location at the outlet of an air-water separator for a wet system.

Physical dimensions: Height: 36", Width: 10" , Depth: 13"

Cost: Approx. $1,900, which includes an air-water separator

Other information: Both models are two-stage systems. Cost of a replacement box for either the first stage or the second stage is $596. The Rasch 890-1000/4000 is for use with a wet vacuum pump system that does not have an air-water separator and the Rasch 890-6000/4500 is for a dry vacuum pump system or for a wet system that has an air-water separator. The standard canister is typically replaced about every 18 months. Cost includes management of the waste.

Manufacturer or distributor of amalgam separator: AB Dental Trends

Model name or number: Rasch 890-6000/4500

Removal technology used: Sedimentation, filtration, and ion exchange

Capacity: 12 chairs

Flow rate factors: 4 liters/minute

Location: Single central location at the outlet of an air-water separator for a dry system.

Physical dimensions: Height: 6", Width: 9" , Depth: 12"

Cost: $1,330 which does not include an air-water separator

Other information: Both models are two-stage systems. Cost of a replacement box for either the first stage or the second stage is $596. The Rasch 890-1000/4000 is for use with a wet vacuum pump system that does not have an air-water separator and the Rasch 890-6000/4500 is for a dry vacuum pump system or for a wet system that has an air-water separator. The standard canister is typically replaced about every 18 months. Cost includes management of the waste.

Manufacturer or distributor of amalgam separator: Rebec

Model name or number: Catch 1000 (formerly called RME 2000-CatchHg)

Removal technology used: Sedimentation and filtration

Capacity: 8 chairs

Flow rate factors: 1 liter/minute. Surge tank capacity: 19 liters

Location: Single central location just upstream of the vacuum pump.

Physical dimensions: Height: 23.5", Width: 20" , Depth: 8"

Cost: $1,895 per unit. $395 per replaced settling tank.

Other information: Cost includes processing of the waste. For 8 operatories, the settle tank would be changed out annually. Larger systems are available.

Manufacturer or distributor of amalgam separator: Rebec

Model name or number: Catch 400

Removal technology used: Sedimentation and filtration

Capacity: 4 chairs

Flow rate factors: 1 liter/minute. Surge tank capacity: 8 liters

Location: Single central location just upstream of the vacuum pump.

Physical dimensions: Height: 18", Width: 14" , Depth: 8"

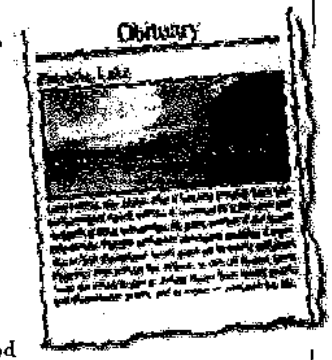
Cost: $985 per unit. $395 per replaced settling tank.

Other information: Cost includes processing of the waste. For 4 operatories, the settle tank would be changed out annually. Larger systems are available.

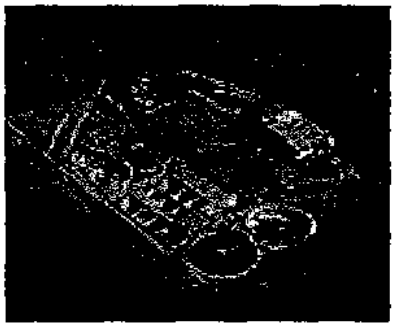
MnGREAT! 2004 Award Recipients

MINNESOTA GOVERNMENT REACHING ENVIRONMENTAL ACHIEVEMENTS TOGETHER

The Metro WaterShed Partners, a collaboration of water resource educators in the Twin Cities, for their "Minnesota Water – Let's Keep It Clean" stormwater education program that provided consistent clean-water messages in mass media across the Twin Cities metro area. The Metro WaterShed Partners also made ready-to-adapt stormwater educational materials available to cities and neighborhood organizations.



The Metropolitan Council Environmental Services Division for sustainable design in the expansion of the Eagles Point Wastewater Treatment Plant in Cottage Grove. The plant was tripled in capacity while in continuous operation on a limited-area site in a sensitive environmental location on the bluffs above the Mississippi River. Sustainable design features include building orientation, insulation, lighting and daylighting, office furnishings, recycling of demolition debris, and stormwater control and landscaping. Two remarkable features are elimination of specific toxic chemicals and heating and cooling. Chlorine gas and liquid sodium bisulfite were replaced by ultraviolet lamps for disinfection of the 3,000,000 gallon daily flow of effluent. Heating and cooling of the plant administration building is supplemented by a thermal heat pump exchange with the relatively year-round consistent temperature of that same effluent.



The Metropolitan Council Environmental Services Division for its partnership with the Minnesota Dental Association to develop and implement a voluntary dental clinic amalgam recovery program. The project staff completed two research studies showing that dental clinics are a significant source of mercury to wastewater treatment plants and that cost-effective amalgam separators are available to dentists. The goal is to have all general practice dentists who place or remove amalgam install and operate a separator, significantly improving water quality in the state.

The Rice Creek Watershed District for its comprehensive wetland management plan, covering approximately 1,200 acres of land in the growth corridor of Blaine, that consolidates and preserves large tracts of high-quality wetlands while still allowing for development. The plan promotes smart growth and natural resource-based planning, improves wetland and ecological integrity, meets stormwater needs, satisfies landowner issues, and solves a 15-year legal impasse.

The Solid Waste Management Coordinating Board for Community POWER (Partners on Waste Education and Reduction), a program that reaches people with waste reduction messages through organizations or institutions they are already part of, such as churches, senior groups, youth groups, schools, arts organizations, neighborhood associations, social service agencies, and civic groups. In its first two years, Community POWER involved over 3,100 people in waste reduction activities and reached 150,000 other people with waste reduction messages through newsletters, e-mail, direct mail, presentations, and community newsletters.

The Steele County Sheriff's Office incorporates many design features that benefit the environment into its newly constructed Steele County Detention Center. A geothermal heating and cooling system reduces the need for natural gas, and daylighting reduces the need for artificial lighting and improves the general atmosphere. The building's architects carefully selected materials with recycled content that can also be recycled later, along with products that have fewer emissions of volatile organic compounds.

2004 Environmental Initiative Awards Finalists

Voluntary Dental Clinic Amalgam Recovery Program

In January 2003, the Metropolitan Council of the Twin Cities and the Minnesota Dental Association established a jointly managed Voluntary Dental Clinic Amalgam Recovery Program that will reduce the amount of mercury loadings to the sanitary sewer system by up to 44 percent, significantly improving water quality in the state of Minnesota. This program is the result of ground-breaking scientific studies that proved conclusively, and for the first time nationally, that: dental clinics contribute up to 44 percent of mercury loadings to wastewater; the amount of mercury-containing amalgam entering wastewater from dental clinics can be easily controlled with the installation of proper equipment (amalgam separators); and proper installation and operation of approved separators can result in a 99 percent reduction in the amount of amalgam entering wastewater.

The goal of this program is the voluntary participation of all of the 3,200 dentists in the state who place or remove amalgam in the proper installation and operation of separators by February 2005. Thus far, 64 percent of the clinics throughout Minnesota have committed to installing a separator, and 20 percent have installed a separator. This program has been more cost-effective than a traditional regulatory approach, which would have required industrial discharge permits and related fees, as well as on-going sampling and analysis of clinic wastewater. It can be replicated elsewhere because the long-term research reached conclusions that are valid regardless of location and professional organizations similar to MDA exist in other states.

~ Land Use ~

Dakota County Farmland and Natural Area Protection

The Dakota County Farmland and Natural Area Protection Program was initiated in response to growing citizen concerns about rapid urbanization and associated issues. State-of the-art geographic information system technology was used to identify and analyze high-quality agricultural land and natural areas. Through an extensive public participation process, collaboration with non-governmental organizations and inter-governmental coordination, the county developed a prioritization and implementation plan to permanently protect 5,000 to 10,000 acres of contiguous blocks of agricultural land, natural areas and greenway corridors, while also enhancing water quality.

The county board adopted the countywide plan in January 2002. A citizens group then developed and implemented an advocacy campaign to provide funding for this initiative. In November 2002, voters approved a $20 million bond referendum. In June 2003, the county board established a citizens advisory committee and approved guidelines for implementing the Farmland and Natural Area Program. A comprehensive outreach effort resulted in 29 farmland and 22 natural area applications. The board has now approved 12 farmland easement projects totaling 2,672 acres and seven natural area projects totaling 641 acres.

Minnow Ponds Restoration

In December 1996, the Minnesota Department of Natural Resources purchased the 18-acre Minnow Ponds site. Over a 50-year period, the site had been systematically changed from a natural wetland ecosystem with nine flowing springs into a managed minnow-raising operation with 20 man-made basins connected by over 4,000 feet of metal pipe, concrete structures and bituminous paving.

Metropolitan Council Environmental Services
Voluntary Mercury Reduction Agreement

2003 ANNUAL REPORT
March 2004

Metropolitan Council
Building communities that work

1.0 Introduction and Background

The Metropolitan Council Environmental Services (MCES), a division of the Metropolitan Council, submitted a Voluntary Mercury Reduction Agreement (VMRA) to the Minnesota Pollution Control Agency (MPCA) on December 28, 2000. The VMRA summarizes the past actions and outlines the commitments under this agreement, according to topic area. This annual report describes the activities and accomplishments that occurred during the year 2003. These activities and accomplishments are arranged using the same major headings found in the VMRA.

2.0 Control of Discharges to the MDS

MCES formed a partnership with the Minnesota Dental Association (MDA) in 1998 as part of our Mercury Reduction Program, and undertook the two studies noted below. The studies evaluated dental amalgam separation equipment and loadings of mercury in amalgam to the sanitary system.

Voluntary Dental Clinic Amalgam Recovery Program

In January 2003, the Metropolitan Council of the Twin Cities (Council) and the Minnesota Dental Association (MDA) established the Voluntary Dental Clinic Amalgam Recovery Program, a jointly managed program to significantly reduce the amount of mercury discharged to wastewater treatment plants, and ultimately to the environment. The Council and MDA issued a joint press release and associated fact sheet on the program on January 3, 2003 (See attachments 1 and 2.) A booklet promoting this program was produced by the Council and the MDA, and sent to all Minnesota dentists in March of 2003. (See Attachment 3.) In addition, the MDA provides an update of the contractors and equipment on its website (See Attachment 4.) The reduction of mercury will be accomplished through the installation and proper operation of amalgam separators in the 825 general practice dental clinics in the seven-county Minneapolis-Saint Paul metropolitan area (approximately 1656 statewide). The Council operates the wastewater collection and treatment system for the Twin Cities metropolitan area and the MDA represents approximately 81% of all practicing dentists in Minnesota. The Minnesota Chapter of the American Public Works Association presented its 2003 annual "Technical Innovation Award" to the Council and to the MDA for this program.(See Attachment 5.)

Background

The Council and the MDA began working together in 1998 to explore the best options for keeping mercury-containing amalgam from entering wastewater – intercepting a pollutant at one of its sources. Council staff conducted extensive studies from 1998-2001, including analysis of mercury loads in dental clinic wastewater and on-site evaluation of various types of amalgam separators, in seven clinics. The comprehensive nature of the studies was unique. The first study tested five separators for effectiveness and all of the mercury containing wastewater from the clinic vacuum systems was captured, thereby eliminating the problem of collecting unrepresentative subsamples. Custom made sampling equipment was designed and installed to operate under vacuum, within the clinic vacuum systems. The second study involved monitoring mercury levels in biosolids at two WWTPs, each with and without amalgam separators in place at virtually all dental clinics tributary to those plants. These studies confirmed that dental clinics are a significant source of mercury in wastewater, up to 44%, and there are economical separators that can effectively treat clinic wastewater. Based on what was learned from the studies, staff from the Council and the MDA worked together to create a program that promotes the installation and proper operation of amalgam separators.

Program Implementation

The Environment Committee of the Metropolitan Council recommended adoption of the program on November 12, 2002, with final Metropolitan Council approval on December 11, 2002. The Voluntary Dental Clinic Amalgam Recovery Program was announced in the Twin Cities in January 2003, with the MDA and the Council promoting the program with the goal of achieving voluntary installation and operation of acceptable amalgam separators by all dentists who place or remove amalgam (primarily general practice clinics) within the Council's wastewater service area, by February 2005. The Council and the MDA provided necessary program information to the dental community, such as mailings and notifications, lists of approved amalgam separators and service providers, and an informational booklet on the program. In addition, the MDA also began promoting separator installation to dentists throughout the state of Minnesota. Dental clinics are expected to operate the separators appropriately after installation and to properly manage the amalgam waste collected by the separators and other devices such as chairside traps.

The program targeted February 2005 as the date by which the amalgam separators would be installed and operational. As of mid-November 2003, less than one year after the announcement of the program, 1047 general practice clinics out of approximately 1656 general practice clinics statewide have committed to installing a separator. (By February 20, 2004 this had increased to 1054 clinics.) This represents approximately two-thirds of all applicable Minnesota clinics. On-going outreach and technical assistance efforts are expected to be successful in achieving the program timelines. As of November 2003, 140 of the 825 metropolitan area clinics have installed a separator. (See Attachment 6.) (By February 20, 2004 this had increased to 162 metropolitan area clinics.)

Program Administration

At the outset, MDA asks each dental clinic to make a commitment to install an amalgam separator. After installation, clinics will report to MDA on their amalgam separator installation and related waste-management practices. The Council will then provide a certificate of compliance to the clinic. After being issued a certificate, a clinic will be presumed to be meeting the Council local limit, exempt from needing a Council Industrial Discharge Permit and paying permit fees, and exempt from self-monitoring requirements (sampling and analysis). In order to maintain the certificate of compliance, the clinic will be expected to report to the Council on an annual basis.

To maintain certification, dental clinics must operate within the expectations of the Voluntary Amalgam Recovery Program, including ongoing operation of the amalgam separator equipment and proper management of all amalgam wastes. Amalgam separators that have been tested by the ISO test method (No. 11143), and have been shown to remove an average of at least 99% of the amalgam particles, will be considered an approved separator. This 99% criterion is above the 95% called for in the basic ISO test, meaning up to 1% can pass the separator, rather than up to 5%. The Council has also put forth a considerable effort in 2003 to address a discrepancy in the ISO test method related to flowrates used for conducting the test. This effort should lead to an improved awareness by others using the ISO test procedure as a method to evaluate separators.

A steering committee of MDA and Council representatives oversees the direction and progress of the program. A technical advisory committee was also set up and includes representatives of dental supply companies, waste management service providers, metropolitan area county hazardous waste representatives, plumbing companies, and others.

The voluntary approach of this program will be less burdensome and less expensive than a conventional regulatory approach for each dental office as well as for MCES. This program is a fair and low-cost means of reducing the dental contribution of mercury to the sanitary sewer system. It avoids costly infrastructure expenses at MCES wastewater treatment facilities, enhances protection of the environment, continues the partnership with MDA and dentists, and promotes equity and fairness across sewer user groups.

3.0 Policy-Related Actions

The following policy related actions were taken in 2003:

- In 2003, MCES awarded $1,172,874, and reallocated $627,500 of the $7.5 million in grant monies available (over a five-year period - 1999-2004) to reduce non-point source (NPS) runoff. Since mercury strongly associates with soil particles, reductions in NPS runoff will lead to reductions in mercury in runoff to surface waters. To date, the Council has approved about $7.5 million in competitive and targeted grants for nonpoint source pollution abatement and prevention projects.

- As part of its Dental Insurance Program benefits, the Council continued coverage of employees and their dependents to use mercury-free posterior restorations (dental cavity fillings) by removing the cost disincentive to selecting the significantly more expensive mercury-free composites.

4.0 External Pollution Prevention

MCES has dedicated much staff time to help other organizations learn about and minimize the use of mercury and mercury compounds, as well as minimizing the potential release of mercury to the environment. Among the activities involving technical assistance and support that were undertaken in 2003 are the following:

- MCES has been an active participant in the Mercury Work Group of the Association of Metropolitan Sewerage Agencies (AMSA), a trade association representing publicly owned treatment works (POTW). This group has been active in persuading the U.S. Environmental Protection Agency (EPA) to resume validation testing of EPA's mercury Method 245.7 and conducting follow-up sampling of EPA's 1994 study of Great Lakes POTWs.

- MCES is a participant in an AMSA project that began in 2002, and is still underway. This will involve tracking mercury levels within wastewater treatment plants as certain cities implement their programs to control mercury contributions from dental offices.

- An MCES staff person is the lead in another AMSA group addressing amalgam separator ISO test method issues and related amalgam separator program issues. This work began in 2003, and is now ongoing.

- The Minnesota Office of Environmental Assistance sponsors meetings of healthcare providers, regulators, technical service providers, trade associations, and others through a

group known as the "Healthcare Environmental Awareness and Resource Reduction Team (HEARRT)." MCES continues to be an active participant in the activities of HEARRT.

- MCES staff have spoken at a number of conferences, disseminating information and promoting the minimization of the use and the release of mercury. MCES staff testified before a U.S. House of Representatives' Subcommittee on Human Rights & Wellness Hearing in Washington D.C. on dental amalgam waste issues.

- The Massachusetts Strategic Envirotechnology Partnership (STEP) is a joint program between the Executive Office of Environmental Affairs (EOEA) and the University of Massachusetts to assist business with the development and promotion of innovative, technology-based solutions to environmental problems in the Commonwealth. The STEP program is currently evaluating methods to test amalgam removal equipment, looking for a simpler, less expensive benchtop method that could replace the ISO method. Their testing compares a new benchtop method with clinic testing of equipment to determine if the benchtop method is "predictive" of amalgam removal equipment operating in clinics. MCES is providing peer review of the study.

5.0 Internal Pollution Prevention

Among the activities involving internal pollution prevention that were undertaken in 2003 are the following:

- MCES staff who conduct or manage demolition projects have been informed that all mercury-containing devices must be removed and recycled prior to demolition.

- MCES continued its emphasis with employees on the importance of appropriate management of fluorescent lamps and mercury-containing materials from its operations. In 2003, a total of 1,944 fluorescent lamps and six pounds of elemental mercury were shipped for recycling.

- MCES R&D staff collected and analyzed 132 stream water samples for filtered and unfiltered total mercury and methylmercury and 30 other water quality parameters. Samples were collected from the Mississippi and Rum Rivers, and from Trott Brook and Cedar Creek, two tributaries of the Rum River. The research has demonstrated that methylmercury inputs to these streams are seasonal and primarily associated with high discharge events during mid-summer. Higher methylmercury concentrations are correlated with reducing conditions in these stream waters, suggesting that wetlands are sources of methylmercury to these streams.

- MCES R&D staff collected and determined total mercury in 59 daily composite samples of Metropolitan Plant influent over a cumulative period of 8 weeks. The data will allow MCES staff to track anticipated reductions in mercury loading at the plant due to new controls applied to dental office discharges.

- MCES R&D staff collected and analyzed 32 samples of treatment plant effluent for filtered and unfiltered total mercury. Twenty samples were collected at the Metropolitan Plant, and 4 each were collected at the Blue Lake, Seneca, and Empire Plants. The results provided

information on the degree to which mercury partitions to solid phases in these effluent streams.

- MCES R&D staff provided analytical and consulting services to the Minneapolis Park and Recreation Board in support of their stormwater mercury monitoring program. The Board provides stormwater monitoring services under contract to the cities of Minneapolis and St. Paul.

- In 2003, the MCES Laboratory purchased a new mercury analyzer capable of detecting mercury using either atomic fluorescence or atomic absorption technique. This instrument is dedicated to low level mercury analyses.

In 2003, the MPCA added low-level mercury monitoring requirements to newly reissued NPDES permits for Hastings, Empire, Seneca and Blue Lake. The monitoring frequency varies from monthly to quarterly and is determined by each permit requirement.

The Laboratory has completed its developmental work to measure all forms of mercury, including dental amalgam, present in the wastewater influent matrix. This project was conducted in conjunction with the MCES Research & Development Section and has since been taken over by this section.

6.0 Technology-based Controls

The MCES is currently constructing new solids dewatering, chemical stabilization and incineration facilities at its Metropolitan Wastewater Treatment Plant. Construction of the new Solids Management Building began in May 2002 with final completion scheduled to occur in October 2005.

Installation of three fluidized bed incinerators and their corresponding air emission process trains within the solids building began in June 2002. The new air pollution control systems for the fluidized bed incinerators are being designed with the capability to treat exhaust gases with carbon which are expected to achieve a goal of reducing mercury in air emissions by approximately 70% from 1997 emission estimates. The cost for the carbon injection technology and the enhanced particulate removal technology, which is integral to enhanced mercury removal, is approximately $5.7 million. Initial start-up of the incineration and emission control system is scheduled to begin in June 2004.

7.0 Mercury Reductions Achieved

Actions taken to control sources of mercury discharged to the collection system have resulted in a reduction of mercury concentrations in sewage sludge at the Metro Plant from approximately 3.0 milligrams per kilogram (mg/kg) in 1990 to 0.94 mg/kg in 2003.

8.0 VMRA Administration

MCES agreed to provide an annual report of the progress made under the VMRA by March 1 of each year for the preceding calendar year. This report fulfills that commitment.

List of Attachments

Attachment 1: Press release. "Government, dentists team up to protect environment." Metropolitan Council and Minnesota Dental Association. January 3, 2003

Attachment 2: Fact Sheet. "Dental amalgam and mercury." Metropolitan Council and Minnesota Dental Association. January 3, 2003

Attachment 3: Booklet. "Take Preventive Action Now. Capture Amalgam So It Doesn't Release Mercury. Re: amalgam recovery." Metropolitan Council and Minnesota Dental Association. 2003

Attachment 4: Copy of web page. Revised-Features of Approved Amalgam Separators (October 14, 2003) http://www.mndental.org/professional/amalgam_recovery/revised_chart

Attachment 5: Newsletter article. "Program to reduce mercury wins award." Metropolitan Council *Directions*. December 2003

Attachment 6: Newsletter article. "Region's dentists sign on to reduce mercury waste." Metropolitan Council *Directions*. October 2003

MINNESOTA POWER PROGRESS REPORT ON OUR MERCURY VOLUNTARY AGREEMENT SUBMITTED TO THE MINNESOTA POLLUTION CONTROL AGENCY JANUARY 24, 2003

1. INTRODUCTION

Minnesota Power ("MP") supports the Minnesota Mercury Contamination Reduction Initiative, and the Advisory Council recommendations that culminated from that effort. One recommendation of the Advisory Council was for mercury sources to enter into voluntary agreements with the Minnesota Pollution Control Agency ("MPCA") that detail action items to reduce or work towards reducing mercury releases. MP submitted a Mercury Voluntary Agreement to the MPCA on July 6, 2000 that described our commitment to explore additional opportunities to further reduce mercury. MP submitted a progress report on August 15, 2001. MP submits this second progress report to outline the activities that have been implemented since the previous report, and any additional activities that are planned for the future or are being evaluated at this time.

For many years, MP has had a mercury reduction program. MP has been and continues to be actively involved in trying to develop solutions to the mercury issue. Past activities include such things as voluntary emissions testing and environmental monitoring, co-sponsoring mercury control technology studies, and various mercury product and waste management programs for MP and our customers. These activities are summarized in more detail in the Mercury Voluntary Agreement document referenced above.

2. EFFORTS TO ADDRESS STACK MERCURY EMISSIONS

Efforts that MP has undertaken over the past year to address stack emissions of mercury are summarized below. These efforts focused on control technology research aimed at finding solutions for longer-term, more significant mercury emission reductions while continuing to achieve feasible short-term emission reductions.

2.1 Control Technology Research

2.1.1 Laskin Control Technology Study

As described in the August 2001 progress report, MP worked with EPRI (formerly the Electric Power Research Institute) in the year 2000 to assess mercury emissions from our Boswell Energy Center ("Boswell") and conduct control technology experiments. The objectives of the study were to evaluate flue gas mercury concentration, mercury speciation, and removal effectiveness for the existing air pollution control equipment at Boswell, assess potential options to further reduce stack mercury emissions to different levels, and project feasibility and cost impacts.

As a follow up to our work at Boswell, MP partnered with Xcel Energy, EPRI, Apogee Scientific and URS to conduct full scale mercury control technology studies at our Laskin Energy Center ("Laskin"). These studies consisted of three phases, including chemical additives/fuel blending, activated carbon injection, and Mercury Capture by

Amalgamation Processes ("MerCAP™"). Our initiatives are some of the first actual, full-scale mercury control efforts in the nation.

2.1.1.1 Chemical Additives/Fuel Blending

It is known that the speciation of mercury in flue gas affects the ability of scrubbers to remove mercury. Oxidized mercury has been assumed to be water soluble, and scrubbers tend to be effective at removing oxidized mercury. Elemental mercury, on the other hand, is insoluble and is not readily removed by wet scrubbers. It is also known that the form of mercury depends to a degree on the chloride content of the coal. Bituminous coals tend to have higher chloride content, and the mercury tends to be primarily in the oxidized form. Sub-bituminous coals, on the other hand, tend to be quite low in chloride content and the mercury is primarily in the elemental form. MP facilities burn primarily low sulfur, low mercury sub-bituminous coals as a compliance coal for SO_2 emissions. The purpose of this study was to evaluate the effect of adding chloride to sub-bituminous coal, either through chemical addition or blending with bituminous coal, on the mercury speciation and subsequent capture by the existing scrubber. The studies were conducted in May 2002.

The chemical additives study, conducted on Unit 2 at Laskin, consisted of adding chloride compounds at varying rates to the coal feed. Two different chloride compounds were tested. Tests were designed to evaluate the effect of chloride source as well as feed rate on mercury speciation and capture. Most tests were conducted over a 24-hour period, with the whole study lasting approximately two weeks. Speciated mercury measurements were made using EPRI's semi-continuous mercury analyzers both before and after the wet scrubber, to assess the amount of formation of oxidized mercury, and capture across the scrubber. Support data were also collected (e.g., trace metals, hydrogen chloride, and plant operation data).

Preliminary results indicate that the addition of chloride compounds have the potential to increase the oxidation of mercury, and subsequent capture, although the results are mixed. Under baseline conditions, the oxidized mercury fraction averaged approximately ten percent at the inlet to the scrubber, with approximately eight percent total mercury removal across the scrubber. Mercury oxidation in the flue gas generally increased as the chloride compound feed rate increased. Addition of chloride compound #1 resulted in over 80% oxidation at the highest feed rate. However, with this particular chloride compound, there was no apparent increase in mercury capture with the increase in mercury oxidation. Addition of chloride compound #2 resulted in up to 50% oxidation, with over 30% mercury capture at the highest feed rate. These results indicate that the type of chloride compound may impact the ability of the wet scrubber to remove the oxidized mercury.

Significant operational impacts were observed during the testing. Opacity tended to increase with increased chloride compound feed rate. Hydrogen chloride ("HCl") in the flue gas increased with increased chloride compound addition, although the wet scrubber was effective at removing most of the added HCl. This increased the chloride concentration in the scrubber liquor. It is not known what impact this increase in chloride

would have on operations over the long term. Another unknown is whether addition of chloride, with subsequent formation of HCl in the flue gas, would result in significant corrosion impacts in the boiler. Long term testing would be needed to be able to assess this issue.

In addition to the chloride compound addition study, MP looked at blending bituminous coal with sub-bituminous as a way to increase chloride content. Three fuel blends were assessed, 33%, 67%, and 100% bituminous coal. Tests were run for approximately 36 hours, with time in between to allow for conditions to return to baseline. Mercury oxidation at the inlet to the scrubber increased with increased bituminous coal fractions. At 100% bituminous, the mercury speciation was approximately 60% oxidized mercury, with approximately 30% removal across the scrubber. However, at the 33% and 67% blends, even though there was significant mercury oxidation, test results indicate negative removal across the scrubber. These unusual results are still being evaluated. There are some indications from this and tests at other sites that not all oxidized mercury species formed can be removed in a scrubber, or some scrubbed mercury species may be re-emitted. Operational impacts included a ceramic type buildup in the bottom of the boiler, which required an outage to remove.

To summarize, the results of the chemical additives and fuel blending study indicate that addition of chloride, through either chloride compound addition or blending with higher chloride bituminous coal, may result in an increase in mercury oxidation and subsequent removal across the wet scrubber. However, there are significant operational issues that would need to be addressed.

2.1.1.2 Activated Carbon Injection

Activated carbon injection ("ACI") upstream of baghouses and electrostatic precipitators is currently the most promising control option for mercury removal from flue gas. However, no data existed for the effectiveness of ACI before a wet scrubber. The purpose of this series of tests was to evaluate the effectiveness of ACI in conjunction with a wet particulate scrubber. Parametric testing was conducted with four activated carbons. An extended injection test was also conducted with one of the carbons. Semi-continuous mercury measurements were made both upstream and downstream of the scrubber. The full scale testing was conducted at Laskin Unit 2 over an 8-day period in August 2002.

Preliminary results indicate that for three of the carbons tested, mercury removal was relatively poor (<15 percent mercury removal). However, for the activated carbon treated with iodine (a much more expensive type of activated carbon), the results were more promising, at the highest injection rate mercury removal across the scrubber was greater than 50 percent during the short-term test. The results of this phase of the study are still being evaluated.

2.1.1.3 MerCAP™

MerCAP™ is a novel technology that uses plates coated with thin layers of gold materials to capture mercury in the flue gas. This technology has shown promise when

applied to low dust conditions (located after the primary particulate removal device). However, this technology may not be compatible with a wet particulate scrubber due to the wet flue gas conditions typically found after the scrubber (previous results from the Boswell Unit 3 study, where MerCAP™ was installed after the scrubber, were not promising). The purpose of this test was to evaluate the effectiveness of MerCAP™ under high dust conditions (prior to the scrubber).

A preliminary screening test indicated some removal (approximately 37 percent). However, initial testing with a 10-foot probe inserted in the duct upstream of the scrubber indicated poor removal (< 20 percent). The results from longer term testing with the probe are still being evaluated.

2.1.2 EnviroScrub

EnviroScrub is a proprietary process that has been shown to be very effective at removing SO2 and NOx from utility flue gas, based on a demonstration unit tested extensively at our Boswell Energy Center and elsewhere. MP worked with EnviroScrub to also test the effectiveness of the process for mercury removal from flue gas. Preliminary tests are promising. A proposal has been submitted to the Department of Energy to scale up the technology, likely at Boswell. If the proposal gets funded, mercury testing will be included as a part of the project.

2.1.3 Mercury Removal Research and Demonstration Project

In late 2001, the Natural Resources Research Institute ("NRRI") Coleraine Minerals Research Laboratory ("CMRL") was awarded a three-year, $1.2 million grant for mercury removal research from industrial stack gases. The primary focus of this project is to develop a low cost, mineral based sorbent system to remove all forms of mercury from industrial stack gases. Minnesota Power offered our Boswell Energy Center as a host site for conducting relevant portions of the research and demonstration project. A Right of Entry Agreement between MP and NRRI/CMRL allows the researchers to install mercury removal equipment and implement technologies utilizing a slipstream of flue gas from one of the operating units at Boswell. This option allows for a unique opportunity to test several promising mercury reduction alternatives under actual power plant conditions. In addition to providing the testing locations, MP will provide plant services, including technical support, as needed.

Work so far has focused on getting the analytical and gas sampling system installed and operating as well as completing the installation of a bench-scale, flue gas simulator system. NRRI/CMRL has recently begun to test various sorbents with the simulated gas stream.

NRRI/CMRL has also signed a non-disclosure agreement with MP and EnviroScrub to look at ways to develop and test mercury removal techniques in conjunction with EnviroScrub's system for SO2 and NOx removal.

Future Planned Activities: Testing of the various sorbents using a slip-stream of actual flue gas at Boswell is anticipated to begin in the second quarter of 2003. In the

meantime, screening tests of various sorbents at the bench scale with simulated flue gas will continue to be conducted in the lab. Longer-term plans call for construction and installation of a larger pilot-scale mercury removal system at Boswell.

2.1.4 EERC Mercury Control Technology Study

MP is a co-sponsor of a 3-year, two-phase project to develop and demonstrate mercury control technologies for utilities that burn lignite coal, which is being conducted by the Energy and Environmental Research Center ("EERC"). The objectives of Phase I (currently underway) are to gain a better understanding of mercury interactions with flue gas constituents, test sorbent-based technologies targeted at removal of elemental mercury, and do pilot scale demonstrations of the most promising technologies. The objective of Phase II will be to quantify sorbent effectiveness, performance and cost at an actual lignite-fired power plant.

2.1.5 Ash Leachability Study

One of the outstanding issues that needs to be further assessed, is whether mercury which is captured in pollution control devices is stable in the by-product. MP has volunteered to participate in a study to assess the leachability and volatility of mercury from the by-product using standard leaching tests. We will provide coal and ash in the near future from Boswell unit 1 or 2, both of which have baghouses that demonstrate good mercury capture.

2.1.6 Research Support

MP continues to support additional mercury control technology research as a funding member of the Integrated Controls Target of EPRI.

2.2 Utilization of Lower Mercury Coal

One aspect of our short-term strategy is to consider mercury coal content when making coal procurement decisions. Characterization of coals for mercury content indicates that coal switching is not likely to be a viable means to achieve significant, long-term reductions in mercury emissions. However, as described in our August 2001 progress report, MP was able to take advantage of an opportunity to achieve modest mercury reductions in the short term through our choices in coal supply. Through coal blending, MP was able to achieve roughly a fifteen to twenty percent reduction in mercury emissions beginning in 2000. These reductions were demonstrated through stack testing, and verified through coal mercury analysis.

Many factors are considered when making coal procurement decisions, including price, availability, transportation costs, sulfur content, ash, Btu content, and other parameters which may impact operations. As part of our Voluntary Agreement with the MPCA, MP has committed to including coal mercury content as one parameter to consider in making coal procurement decisions, now and into the future.

Future Planned Activities: MP intends to continue burning the lower mercury coal in amounts comparable to the year 2000. MP will also continue to consider mercury along

with other environmental and operational factors when making coal supply decisions in the future.

2.3 Routine Coal Mercury Monitoring

MP participated in the 1999 EPA Information Collection Request (ICR), where we gathered numerous coal samples representing shipments from the various coal providers throughout the year for mercury analysis. Since then, MP has voluntarily monitored coal mercury content on a routine basis to determine if there are any changes in coal mercury content over time from the various suppliers. Two samples from each coal supplier have been collected and analyzed on a quarterly basis beginning in March 2000. However, coal mercury analysis was suspended in mid-2002 due to changes in coal sampling procedures. The coal analysis shows the same relative mercury concentrations of the various coals we burn as we saw in the ICR data.

MP also conducts coal mercury analysis from potential new coal sources to aid in future decisions on coal procurement.

Future Planned Activities: There are currently no plans to continue coal analysis for mercury due to the changes in coal sampling mentioned above. However, a review will be conducted in late 2003 to determine whether it makes sense to resume coal sample analysis for mercury, and if so, how the sampling protocol can be designed to ensure the samples are representative of the coal that we actually burn. MP will continue to include mercury on the list of parameters to test for when assessing potential new coal sources.

3. EFFORTS TO ADDRESS MERCURY IN PRODUCTS

In our August 2000 report, we summarized several efforts that MP undertook as part of our commitment to address mercury in products. These activities included a product use inventory and labeling at Boswell and Laskin, updating the MP purchase policy for mercury-containing products, and an employee mercury thermometer exchange. Since then, MP has continued to remove bulk mercury and mercury containing products from within company facilities for proper disposal.

3.1 Mercury Waste Management

In late 2000, MP purchased the Taconite Harbor Energy Center. As part of a facility cleanup following our purchase, we collected and recycled approximately 31 pounds of elemental mercury. From our other facilities, MP also recycled over 50 pounds of bulk mercury in 2002. In addition, MP recycled over 265 pounds of mercury-containing materials in 2002, including thermometers, wetted contacts, batteries, floats, and other devices. Much of the bulk mercury and mercury-containing devices were removed from our Hibbard Energy Center, where a concerted effort was initiated to remove all mercury and mercury devices that were not essential.

Future Planned Activities: MP will continue to implement our mercury policy, responsibly remove and recycle unwanted mercury, and evaluate ways that we can further reduce our dependence on mercury containing products.

3.2 Community Education and Waste Management Program Evaluation

Through the St. Louis River Watershed TMDL Partnership, MP is participating in a WLSSD grant for developing educational materials on mercury sources and identifying gaps in mercury collection efforts in the Lake Superior Basin. Also, MP is on the planning committee of the Lake Superior Binational Forum, developing a workshop for 2003 on mercury sources and potential reduction efforts

Future Planned Activities: MP will continue to be involved in these activities. The information gathered might be useful in determining where MP could assist the public in furthering mercury reduction efforts.

4. RELATED RESEARCH AND INVENTORY ACTIVITIES

Summarized below are activities that MP has participated in that will not in and of themselves directly result in mercury reductions. However, these activities will enhance the understanding of the sources, cycling, and fate of mercury in Minnesota.

4.1 Fish Tissue Monitoring

As described in our 2001 progress report, MP has voluntarily conducted fish tissue monitoring for mercury over the past several years on the headwater reservoirs of the St. Louis River watershed.

Future Planned Activities: MP will continue to conduct fish tissue monitoring on our reservoirs.

4.2 Mercury Watershed Assessment Model Development

MP has been spearheading an effort to develop a watershed assessment model to be able to integrate point and non-point source data (including atmospheric deposition) related to water quality standards. The focus of the effort at this time is to take the Watershed Analysis Risk Management Framework ("WARMF") model, created by EPRI, and customize it for addressing mercury sources to the Lake Superior watershed. MP has pulled together a wide range of sponsors, including the Western Lake Superior Sanitary District, Minnesota Sea Grant, City of Superior, St. Louis River Watershed TMDL Partnership, and other interested parties. Efforts are also underway to incorporate the education program NEMO so that local communities, stakeholders, and other regulatory agencies can readily use the model results to make informed land use decisions regarding mercury. Information developed and provided in this manner will be useful to state and local governments and others involved in management and protection of watershed resources and compliance with water quality criteria for mercury. The model is currently being customized for mercury, and relevant data for populating it for the Lake Superior watershed is being pulled together.

Future Planned Activities: MP will continue to work with others to broaden the participation in this effort. Also, there are plans to have the current version of the model customized for mercury to be peer reviewed.

MINNESOTA POWER PROGRESS REPORT ON OUR MERCURY VOLUNTARY AGREEMENT SUBMITTED TO THE MINNESOTA POLLUTION CONTROL AGENCY

June 29, 2005

1. INTRODUCTION

Minnesota Power ("MP") supports the Minnesota Mercury Contamination Reduction Initiative, and the Advisory Council recommendations that culminated from that effort. One recommendation of the Advisory Council was for mercury sources to enter into voluntary agreements with the Minnesota Pollution Control Agency ("MPCA") that detail action items to reduce or work towards reducing mercury releases. MP submitted a Mercury Voluntary Agreement to the MPCA on July 6, 2000 that described our commitment to explore additional opportunities to further reduce mercury. MP submitted progress reports on August 15, 2001 and January 24, 2003. MP submits this third progress report to outline the activities that have been implemented since the previous report, and any additional activities that are planned for the future or are being evaluated at this time.

For many years, MP has had a mercury reduction program. MP has been and continues to be actively involved in trying to develop solutions to the mercury issue. Past activities include such things as voluntary emissions testing and environmental monitoring, co-sponsoring mercury control technology studies, and various mercury product and waste management programs for MP and our customers. These activities are summarized in more detail in the Mercury Voluntary Agreement and progress report documents referenced above. Accomplishments under the voluntary agreement with the MPCA include:

- Approximate 17% reduction in mercury emissions in 2000 compared to 1990 baseline levels through fuel choices
- An average of approximately 12% reduction in mercury emissions for the years 2000 through 2004 compared to 1990 levels for our baseline facilities, even though electricity production has increased
- An average mercury emission rate reduction of approximately 20% at the Taconite Harbor Energy Center in 2003 and 2004 through fuel choices
- Recycling of over 70 pounds of bulk mercury, and over 455 pounds of mercury-containing products (not including fluorescent bulbs) since the year 2000

In addition, MP has made significant progress towards reducing mercury through focused mercury emissions control technology research (for which we received one national and one international award).

2. BACKGROUND

As requested in the MPCA 2003 draft Proposed Progress Reporting Guidelines, MP is providing annual estimated mercury emissions for our facilities (Table I). As reported in a previous progress report, MP was able to achieve an approximate 17 percent reduction in mercury emissions between the baseline year (1990) and the first milestone year (2000), primarily through fuel choices. Since that time, emissions have increased slightly primarily due to load growth, not due to any change in our choice of fuels. We anticipate no significant change in annual emissions going forward.

Since 2000, MP has added Rapids Energy Center and Taconite Harbor Energy Center to our fleet of facilities. These are not new facilities, they are just new to our system. MP has not attempted to estimate mercury emissions from these facilities under prior ownership. The estimates for Taconite Harbor for 2003 and 2004 are likely higher than actual. The annual emission inventory report to the MPCA has a specific hierarchy for estimating emissions. Sources are expected to use stack test data if it is less than five years old. MP has done that. However, since taking ownership of the Taconite Harbor facility, MP has switched coal suppliers to a lower mercury coal. Weekly composite coal sampling has confirmed that the amount of mercury entering the facility is less than what is reported for emissions based on the previous stack testing. MP estimates that the actual emissions, based on coal mercury content and assuming no removal in the pollution control devices, are 62 pounds and 60 pounds for 2003 and 2004, respectively.

The estimates for Rapids Energy Center and Hibbard Energy Center/DSD2 are higher than what was reported in the annual emission inventory report to the MPCA. This is due to the fact that the emissions inventory report relates only to the amount of mercury emitted due to electricity generation. The primary function of these two facilities is to provide steam for the paper-making process. The numbers below reflect emissions for both electricity and steam generation.

Table I. Estimated Annual Mercury Emissions

Facility	1990	2000	2001	2002	2003	2004
Boswell Energy Center	332	263	286	297	292	251
Laskin Energy Center	5	17	19	19	19	18
Hibbard Energy Center/DSD2	6	5	7	4	5	10
Rapids Energy Center*	N/A	N/A	5	4	4	5
Taconite Harbor Energy Center**	N/A	N/A	N/A	46	78	76

* MP took operational control of Rapids Energy Center during the year 2000.

** Taconite Harbor was historically a part of the LTV mining operations. MP purchased the assets in late 2001. 2003 was the first full year of operation under MP ownership.

3. EFFORTS TO ADDRESS STACK MERCURY EMISSIONS

Efforts that MP has undertaken over the past few years to address stack emissions of mercury are summarized below. These efforts focused on control technology research aimed at finding solutions for longer-term, more significant mercury emission reductions while continuing to achieve feasible short-term reductions.

3.1 Control Technology Research

3.1.1 Laskin Control Technology Study

As described in the previous progress reports, MP has worked quite extensively with EPRI to evaluate a number of promising technologies for controlling mercury emissions from coal-fired power plants. Work over the past several years has evaluated processes such as sorbent injection, catalytic mercury oxidation, fly ash mercury capture, SCR oxidation of mercury, and chemical addition at Minnesota Power's Boswell and Laskin Energy Centers. Additional tests have evaluated flue gas mercury concentration and speciation at these plants and the effectiveness of existing pollution control devices at removing mercury. Full-scale tests, conducted at Laskin in 2002, evaluated the ability of activated carbon injection and chemical addition to the boiler to reduce mercury emissions. These were some of the first full-scale tests conducted in the U.S. This work has led to significant progress in the understanding of how the mercury control processes work. The results of previous testing have indicated that the costs associated with removing mercury from flue gas may be quite high, and there are potentially significant adverse operational impacts. EPRI continues to work with Minnesota Power to evaluate mercury control concepts in attempts to determine lower-cost, viable options.

As a follow-up to the mercury control technology studies conducted in 2002, MP once again partnered with EPRI to conduct additional full-scale testing of potentially viable mercury control technologies at Laskin in 2003. The tests performed in this program represent the second stage of the testing at Laskin in 2002 in which chemical addition, fuel blending, and activated carbon injection were evaluated for mercury control. The 2002 results showed some success, but indicated that achieving high levels of mercury removal at Laskin may be challenging.

The 2003 test program was performed to evaluate the addition of two chlorine-containing solutions directly to the boiler in attempts to enhance mercury removal across the wet particulate scrubber. The test objective was to achieve higher levels of mercury removal than observed during previous tests with alternate compounds, with less impact on plant operations. Another objective of the 2003 testing was to evaluate two activated carbons, one chemically treated and one not, for mercury removal. An additional test was performed to evaluate the simultaneous addition of chloride solution and activated carbon.

3.1.1.1 Chemical Additives

It is known that the speciation of mercury in flue gas affects the ability of scrubbers to remove mercury. Oxidized mercury has been assumed to be water soluble, and scrubbers tend to be effective at removing oxidized mercury. Elemental mercury, on the other hand, is insoluble and is not readily removed by wet scrubbers. It is also known that the

form of mercury depends to a degree on the chloride content of the coal. Bituminous coals tend to have higher chloride content, and the mercury tends to be primarily in the oxidized form. Sub-bituminous coals, on the other hand, tend to be quite low in chloride content and the mercury is primarily in the elemental form. MP facilities burn primarily low sulfur, low mercury sub-bituminous coals as a compliance coal for SO_2 emissions. Previous full-scale testing at Laskin demonstrated that adding chloride as a solid to the coal did increase mercury oxidation, and in some instances increased mercury capture across the wet scrubber. However, there were significant operational impacts. The purpose of this study was to evaluate the effect of adding chloride as a liquid directly to the boiler instead of to the coal to potentially reduce operational impacts, and try new chloride-containing substances. The study was conducted in September 2003.

The chemical additives study, conducted on Unit 2 at Laskin, consisted of adding aqueous solutions of chloride at varying rates directly to the boiler. Two different chloride compounds were tested. Tests were designed to evaluate the effect of chloride source as well as feed rate on mercury speciation and capture. Speciated mercury measurements were made using EPRI's semi-continuous mercury analyzers both before and after the wet scrubber, to assess the amount of formation of oxidized mercury, and capture across the scrubber.

Preliminary results indicate that the addition of chloride compounds have the potential to increase the oxidation of mercury, and subsequent capture, although the results are mixed. Under baseline conditions, the oxidized mercury fraction averaged approximately ten to twenty percent at the inlet to the scrubber, with less than fifteen percent total mercury removal across the scrubber. These findings are somewhat higher than what was seen during the 2002 testing. Mercury oxidation in the flue gas generally increased as the chloride solution feed rate increased for each of the two chloride solutions, with the highest feed rates resulting in up to 70 percent oxidation. Higher oxidation also resulted in increased removal across the wet scrubber, with the highest feed rates of one of the two solutions resulting in close to 60 percent removal.

Some of the significant operational impacts observed during the testing in 2002 were not observed in 2003. However, a new issue appeared. Chemical addition via injecting solution into the boiler resulted in increased slagging and subsequent corrosion of the boiler tubes, resulting in tube leaks.

To summarize, the results of the chemical additives study indicate that addition of chloride may result in an increase in mercury oxidation and subsequent removal across the wet scrubber. However, there are significant operational issues that would need to be addressed.

3.1.1.2 Activated Carbon Injection

Activated carbon injection ("ACI") upstream of baghouses and electrostatic precipitators is currently the most promising control option for mercury removal from flue gas. However, until the full-scale testing at Laskin in 2002, no data existed on the effectiveness of ACI before a wet scrubber. Additional ACI testing was conducted in

2003 at Laskin. Increased mercury removal was achieved across the scrubber with increased ACI injection rates, similar to the 2002 study results. Semi-continuous mercury measurements were made both upstream and downstream of the scrubber. The full scale testing was conducted at Laskin Unit 2 during September, 2003.

Preliminary results indicate that for the basic activated carbon, up to 25 percent of the mercury was captured, however at relatively high feed rates. For the activated carbon treated with iodine (a much more expensive type of activated carbon), the results were more promising, at the highest injection rate mercury removal across the scrubber was greater than 50 percent during the short-term test. The results, comparable to the results of 2002, indicate that the impregnated carbons will perform better in the Laskin flue gas than less expensive "unmodified" activated carbons. This is likely due to the low chloride levels present in the fuel.

3.1.1.3 Activated Carbon with Chemical Additives

Co-injection of the "unmodified" activated carbon with chemical addition was also tested. The purpose was to increase the HCl in the flue gas, in order to improve the effectiveness of the carbon. Results indicate increased removal compared to the activated carbon alone. However, this is likely due to an additive, not synergistic effect.

3.1.2 Boswell Testing of EnviroScrub's Pahlman™ Process

EnviroScrub is a proprietary process that has been shown to be very effective at removing SO2 and NOx from utility flue gas, based on a demonstration unit tested extensively at our Boswell Energy Center and elsewhere. Bench- and pilot-scale testing have also been conducted to determine whether this technology is effective at removing mercury. Previous short-termed tests at Boswell showed some promise. So, Minnesota Power, along with EnviroScrub, the Energy & Environmental Research Center, and the U.S. Department of Energy sponsored some additional testing in December 2003 and January 2004.

Testing was conducted on a slipstream of flue gas from the Boswell Unit 4 duct at the ESP outlet on the scrubber reheat duct. Both the Ontario Hydro method as well as semi-continuous Hg monitors were used to measure mercury in the flue gas, both at the inlet and outlet of the EnviroScrub Pahlman™ Process pilot unit. Results indicate that up to 94% of total mercury and up to 99% of elemental mercury could be removed. However, since the Pahlmanite needs to be regenerated and reused to meet commercial performance targets as part of the proprietary process, one outstanding issue is how to recover the mercury prior to reuse.

3.1.3 Mercury Removal Research and Demonstration Project

In late 2001, the Natural Resources Research Institute ("NRRI") Coleraine Minerals Research Laboratory ("CMRL") was awarded a three-year, $1.2 million grant for mercury removal research from industrial stack gases. The primary focus of this project is to develop a low cost, mineral based sorbent system to remove all forms of mercury from industrial stack gases. Minnesota Power offered our Boswell Energy Center as a host site for conducting relevant portions of the research and demonstration project. A

Right of Entry Agreement between MP and NRRI/CMRL allowed the researchers to install mercury removal equipment and implement technologies utilizing a slipstream of flue gas from one of the operating units at Boswell. This option allowed for a unique opportunity to test several promising mercury reduction alternatives under actual power plant conditions. In addition to providing the testing locations, MP provided plant services, including technical support, as needed.

Initial NRRI research work focused on purchase and installation of state of the art Ultra Trace Mercury analytical and gas sampling systems as well as on installing bench-scale sorbent testing equipment to evaluate mercury reduction in live stack gas slip streams. Heated Teflon sampling lines were installed to deliver representative live stack gas streams into a mercury reduction laboratory facility installed on Unit 4 at Boswell. Numerous bench scale mercury reduction tests were run on a variety of mineral based sorbents to evaluate their ability to remove both oxidized and elemental forms of mercury. Following the bench scale test work, a larger pilot scale mercury sorbent system was installed at the end of the three year grant period to evaluate mercury reduction in a 250 cubic feet per minute live stack gas stream from Unit 4. Several of the novel sorbents produced by the NRRI/CMRL research team showed promise in removing portions of both the oxidized and elemental forms of mercury and additional test work is planned to commence in July, 2005 to continue the research effort. Future research goals include running short term full scale mercury sorption tests on stack gas emissions from smaller sized 50 MW generator units.

3.1.4 EERC Mercury Control Technology Study

MP cofunded a 3-year, two-phase project investigating possible mercury control technologies that are applicable to utilities that burn lignite coal. The overall intent of this project is to help maintain the viability of lignite-fired energy production by providing utilities with low-cost options for meeting mercury regulations.

Phase I objectives were to develop a better understanding of mercury interactions with flue gas constituents, test a range of sorbent-based technologies targeted at removal of Hg^0 from flue gases. Phase I efforts included bench- and pilot-scale testing to explore and identify sorbents, operating conditions, and combinations of particulate control devices that show promise for full-scale application. This work indicated that sorbents, including activated carbons, could provide good mercury removal for lignite and that research at a larger scale with actual flue gas was warranted. For a large scale demonstration project, two lignite-based activated carbons were identified as the best options for use with an electrostatic precipitator (ESP)– fabric filter (FF) configuration with AC injected between the two particulate control devices.

Phase II objectives are to demonstrate on a slipstream of actual lignite-derived flue gas at SaskPower's Poplar River Station and quantify sorbent technology effectiveness, performance, and provide a preliminary evaluation of cost. The Emission Control Research Facility (ECRF), which was completed in 2004, includes two FFs, also called a baghouse, with sorbent injection typically occurring prior to the second FF. Preliminary data from both laboratory and field tests indicate that injecting finely dispersed solid

catalytic sorbents can facilitate both mercury oxidation and eventual removal by an ESP or FF.

Tests to screen candidate sorbents for effectiveness of mercury capture have been conducted using this slipstream facility. The effects of operational parameters such as temperature, dust loading, and air-to-cloth ratio on mercury capture have also been investigated.

On a short-term basis, many tests have demonstrated mercury removals ≥50% with various sorbents. Treated carbons show improved mercury removal when compared to standard ACs injected at the same feed rate, but at a higher cost. Long-term tests are scheduled for later in 2005.

3.1.5 Future Planned Activities For Control Technology Research

MP is currently planning on doing a third phase of full-scale mercury control testing with EPRI at our Laskin facility. The test plan calls for additional sorbent injection work, as well as fuel additives, which currently show the most promise for our facilities. The testing is currently scheduled for the latter half of August. MP also continues to evaluate participation in other control technology studies.

3.2 Utilization of Lower Mercury Coal

One aspect of our short-term strategy is to consider mercury coal content when making coal procurement decisions. Characterization of coals for mercury content indicates that coal switching is not likely to be a viable means to achieve significant, long-term reductions in mercury emissions. However, as described in our August 2001 progress report, MP was able to take advantage of an opportunity to achieve modest mercury reductions in the short term through our choices in coal supply. Through coal blending, MP was able to achieve roughly a fifteen to twenty percent reduction in mercury emissions in 2000 compared to 1990 levels. These reductions were demonstrated through stack testing, and verified through coal mercury analysis.

Many factors are considered when making coal procurement decisions, including price, availability, transportation costs, sulfur content, ash, Btu content, and other parameters which may impact operations. As part of our Voluntary Agreement with the MPCA, MP has committed to including coal mercury content as one parameter to consider in making coal procurement decisions, now and into the future.

Future Planned Activities for Coal Usage: MP intends to continue burning the lower mercury coal in amounts comparable to the year 2000. MP will also continue to consider mercury along with other environmental and operational factors when making coal supply decisions in the future.

4. EFFORTS TO ADDRESS MERCURY IN PRODUCTS

In our previous progress reports, we summarized several efforts that MP undertook as part of our commitment to address mercury in products. These activities included a product use inventory and labeling at Boswell and Laskin, updating the MP purchase policy for mercury-containing products, and an employee mercury thermometer exchange. Since then, MP has continued to remove bulk mercury and mercury containing products from within company facilities for proper disposal.

4.1 Mercury Waste Management

Approximately 223 pounds of mercury-containing materials were recycled in June, 2003, which contained 46 pounds of mercury. In July 2004, approximately 58 pounds of mercury-containing materials were recycled. Since that time, approximately 28 pounds of mercury-containing devices have been collected from our facilities for recycling, and 19 pounds of bulk mercury.

Future Planned Activities for Mercury Waste Management: MP will continue to implement our mercury policy, responsibly remove and recycle unwanted mercury, and evaluate ways that we can further reduce our dependence on mercury containing products.

5. RELATED ACTIVITIES

Summarized below are activities that MP is participating in voluntarily to enhance the understanding of the sources, cycling, and fate of mercury in Minnesota and move responsible mercury policy development forward.

5.1 Lake Superior Forum

Minnesota Power has sponsored membership in the Forum and is an active participant in Forum activities in pursuit of achieving the Lake Superior Binational Program goals. Through its citizen member Minnesota Power provides the US utility perspective for reduction initiatives and outreach activities. MP has sponsored Forum workshops and has participated in the development of outreach projects designed to inform and implement local stakeholder projects which promote the reduction of toxic substances within the Lake Superior Basin. Participation on the Forum is a voluntary effort by MP to reduce toxics in the environment. MP is also participating in a basin-wide mercury project focused on the shipping industry.

5.2 Great Lakes Binational Toxics Strategy

Minnesota Power participates in the Binational Toxics Strategy's (BTS) Integration, Mercury and PCB Work Groups. Efforts as a BTS member are designed to work with industry partners to further the goals of the BTS. Participation on the BTS is another one of the voluntary efforts designed to reduce toxics in the environment.

5.3 St Louis River Watershed TMDL Partnership (SLRWTP)

Minnesota Power is one of the original founders of the SLRWTP. The goal of this organization is to reduce mercury levels in the St Louis River Basin through voluntary efforts with the long term goal of developing a TMDL and implementation to bring the St Louis River into compliance with water quality standards. MP is an active member of Partnerships Board of Directors and its Steering Committee. The partnership has completed several projects which will set the stage for the development of TMDL's and implementation plans. The Partnership is comprised of business and industry, municipalities, local governments, tribes, citizens, non-governmental organizations, research and education organizations.

5.4 WARMF Project

Minnesota Power and Western Lake Superior Sanitary District, with the support of the SLRWTP, are developing a watershed analysis risk management framework which will assist in the development of mercury TMDL's in Minnesota's portion of the Lake Superior Basin. Once completed in mid 2005, this tool will have a data warehouse consolidating the necessary data to make informed decisions for load and waste load allocations. The framework will also assist in developing consensus recommendations amongst stakeholders. MP has coordinated this project and has been responsible for obtaining project funding.

5.5 3rd Party Mercury TMDL

MP and the WLSSD are leading an effort to develop a 3rd party mercury TMDL for the Lake Superior Basin. If successful in working out an agreement with the MPCA this would be the first stakeholder driven mercury TMDL in the country. The MPCA has expressed interest in working with the WLSSD, MP and the St Louis River Watershed Partnership.

5.6 Cooperative Studies

MP is participating in an effort with EPRI and the USGS to develop a riverine mechanistic mercury framework to evaluate the effectiveness of management strategies and alternatives on a watershed scale.

5.7 Federal and State Efforts

Minnesota Power has participated in numerous mercury forums through the Edison Electric Institute, Electric Power Institute, Federal Water Quality Coalition, Minnesota Chamber of Commerce and the Minnesota Environmental Initiative. These efforts have focused on addressing mercury concerns, air and water control technologies, TMDL's, and stakeholder informational sessions.

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Otter Tail Power Company
Voluntary Mercury Reduction Initiative
Progress Report
2001

The following is a status report of the activities conducted during 2001 as part of Otter Tail Power Company's voluntary mercury reduction. The voluntary plan was submitted to the Minnesota Pollution Control Agency on June 28, 2000.

2001 Status Report

1. Otter Tail Power Company has joined with the local City of Fergus Falls and Otter Tail County to reduce the amount of mercury disposed of in the local solid waste stream. Currently solid waste from the city and several surrounding counties is burned at the Fergus Falls waste to energy incinerator. By removing the products containing mercury from the waste stream, there should be a significant decrease in mercury emissions from the incinerator.

   The first step in the plan was to introduce a ban on the sale of mercury fever thermometers in the City of Fergus Falls. The concept was introduced to the City Council of Fergus Falls on November 6th and was well received. The ordinance passed and was effective December 30, 2000. Since that time the Minnesota Legislature has passed a statewide ban of mercury thermometers.

   Otter Tail County has conducted some mercury thermometer exchange programs. During 2000 a locally conducted exchange in Fergus Falls in October netted the collection of 373 thermometers, which resulted in the recycling of 11.4 pounds of mercury thermometers and a few switches.

   During 2001 Otter Tail Power Company donated 576 digital thermometers to Otter Tail County for their exchange program. $1,782 was spent to purchase the thermometers. Collections were held in eight communities from spring through the fall of 2001. There were 1, 111 participants with 798 mercury thermometers collected. This amounted to about 15 pounds of mercury recovered and removed from possible exposure to the environment. See the attached table for details.

2. Education on the proper handling and disposal of mercury wastes is also part of the Mercury reduction plan. During February 2001, Bev Rund of Otter Tail Power Company participated in electrical contractor training and discussed disposal options to approximately 100 electrical contractors.

3. Otter Tail Power Company financially contributed to the University of North Dakota Energy and Environmental Research Center's Center for Air Toxic Metals. Otter Tail is a charter member of the group and has financially supported its research since 1992. The Center is conducting $1.3million of research that would support development of new technologies to remove mercury and other toxics from emissions. Otter Tail is also part of a second $1.3 million study being conducted by the EERC. The Department of Energy's National Energy Technology Laboratory is providing funding for the project as part of their mercury reduction program. Otter Tail's Big Stone Plant near Big Stone City South Dakota is the host site for that project. Finally, Otter Tail Power Company is contributing to a mercury control technologies study for electric utilities burning lignite coal that is also being conducted by the EERC. Phase I of the study is $833,000.

4. During 2000, Otter Tail Power Company test burned a lower mercury coal at the Hoot Lake Plant in Fergus Falls, Minnesota. In addition to economic considerations, the coal also increased NO_x emissions over the annual limit and was therefore undesirable. As other fuels are test burned, we will evaluate their mercury content in addition to other parameters. There were no test burns of different coals during 2001.

5. In addition to test burning low mercury coals, Hoot Lake Plant is also evaluating all equipment at the plant that contains mercury. Where feasible, mercury containing switches, thermometers and manometers are being replaced with non-mercury containing products. During 2001, there were no instances of breakage and mercury releases as a result of the use of these products. In the case of a spill, mercury spill kits were purchased for the plant during 2001.

Plans for 2002

The biggest difficulty in planning mercury reduction activities is the uncertainty of upcoming regulations and the absence of current mercury control technology for coal burning electric generating facilities.

Although Otter Tail Power Company is not a > 50 pound mercury emitter in Minnesota, we developed and submitted a Voluntary Mercury Reduction Agreement to the Minnesota Pollution Control Agency to show our support for the Agency's plan to reduce the state's mercury emissions on a voluntary basis. Otter Tail Power Company currently contributes to research programs, totally over $3 million, toward the goal of finding cost-effective ways of removing mercury from flue gasses.

The technology to remove mercury from flue gasses is not currently available. Funding research to develop these activities is the best way for Otter Tail Power Company to contribute to mercury reduction activities.

If you have any questions, please contact me at 218.739.8249 or brund@otpco.com.

Beverly E. Rund
Senior Compliance Specialist

C Terry Graumann, Otter Tail Power Company
Mike Ellingson, Hoot Lake Plant - Otter Tail Power Company

Otter Tail Power Company
Update of Minnesota Voluntary Mercury Reduction Initiative
June 2004

I. Background

Otter Tail Power Company has one coal-fired facility in Minnesota. Hoot Lake Plant is 136 MW and is located in Fergus Falls. Although this facility emits less than 50 pounds of mercury per year, we submitted a voluntary plan in order to be proactive in the reduction of mercury emissions in Minnesota.

Otter Tail Power Company has had a history of good stewardship. This is exemplified by some of the mercury reduction activities that were conducted prior to the creation of the voluntary reduction initiative.

- In 1988, Hoot Lake Plant switched from using a lignite coal to a subbituminous coal as a primary fuel. Although both lignite and subbituminous have relatively low concentrations of mercury, the mercury content of the subbituminous coal is about two-thirds the mercury content of lignite. Due to the higher Btu of subbituminous, 25% less fuel was needed to produce the same number of kWh. As a result, subbituminous coal emits approximately half of the mercury produced by lignite.
- Since 1989 bulk mercury has been collected and shipped to mercury recycling facilities. To date, 476 pounds have been recycled.
- Otter Tail Power Company financially contributes to the University of North Dakota Energy and Environment Research Center's Center (EERC) for Air Toxic Metals. Otter Tail Power is a charter member of the group and has financially supported its research since 1992. The Center conducted number of research projects that would support development of new technologies to remove mercury and other toxics from emissions at Big Stone Plant. The Department of Energy's National Energy Technology Laboratory (DOE NETL) provided funding for the projects as part of their mercury reduction program. Finally, Otter Tail Power is contributing to a mercury control technologies study for electric utilities burning lignite coal that is also being conducted by the EERC in cooperation with North Dakota lignite industry. Phase I of the study was $833,000. The DOE National Energy Technology Laboratory has approved additional projects totaling over $12 million.

  Applications for similar testing has been made to the DOE National Energy Technology Laboratory for funding of a full-scale mercury control project at Otter Tail Power Company's Hoot Lake Plant in Fergus Falls, Minnesota. If approved, this project will be conducted in conjunction with other subbituminous coal interests. We are expecting the DOE to decide on the funding award in late 2004.
- Otter Tail Power Company is in the process of phasing out mercury containing switches in communications equipment and SCADA and microwave site mercury relays. As of June 2004 most of the mercury containing equipment has been replaced with the exception of two microwave sites.
- In 2000 and 2001 Otter Tail Power Company partnered with the Otter Tail County and the City of Fergus Falls to reduce the amount of mercury disposed of in the local solid waste stream. During 2001 Otter Tail Power Company donated 576 digital thermometers (cost $1,782) and participated with Otter Tail County in a mercury thermometer collection and swap. About 15 pounds of mercury was collected.

- Education on the proper handling and disposal of mercury containing products is ongoing. In 2001 Otter Tail Power Company participated in electrical contractor training and discussed disposal options with approximately 100 electrical contractors. Spill kits and education in the proper cleanup of mercury spills is part of the mercury reduction program at Hoot Lake Plant.

II. Barriers to Reducing Mercury Emissions

There are currently no viable mercury removal systems for coal burning power plants. Different types of boilers, types of coal, and also emission control equipment affect the quality and the type of emissions. Only through research will effective methods be determined. Researchers have concluded that most of the anthropogenic emissions that fall on Minnesota are from outside the state and even the country and there would be no improvement in the mercury concentrations in the waters of the state if the mercury emissions in Minnesota dropped to zero.

Mercury emissions from subbituminous coal and lignite coal are comparably lower than those from bituminous coal. However, lignite and subbituminous coals release elemental mercury, which is considerably more difficult to collect using conventional emission control equipment.

III. Releases of Mercury

A. Estimate of 1990 Emissions

Based on the fuel used and an estimate of mercury content in the coal burned at Hoot Lake Plant in 1990, the total amount of mercury that contained in the coal that could potentially be emitted was 21.24 pounds. Based on Electric Power Research Institute (EPRI) testing, an emission factor of 0.8 is used to estimate 17.19 pounds emitted to the air in 1990.

B. Mercury content in pounds beginning in 2000.

Calculations are based on amount of fuel used and results of mercury analyses on the coal. These numbers are calculated using the total amount of mercury available in the coal and the EPRI 0.8 emission factor. There are currently no actual test emissions for the Hoot Lake Plant facility.

2000	36.57 pounds to air	
2001	26.81 pounds to air	7.9 pounds to land
2002	32.0 pounds to air	8.9 pounds to land
2003	29.0 pounds to air	7.2 pounds to land

The land application figures are from the TRI reports for those years.

C. Future Projections

As of June 2004, we predict that the emissions for the year 2004 will most likely be lower than those seen in 2003. There was an extended outage on one of the units during May and June 2004, which will impact the total amount of coal burned at Hoot Lake Plant. At this time we do not have any plans to change to the fuel source or the operating schedule.

Otter Tail Power Company
Update of Minnesota Voluntary Mercury Reduction Initiative
June 2003

I. Background

Otter Tail Power Company has one coal-fired facility in Minnesota. Hoot Lake Plant is 136 MW and is located in Fergus Falls. Although this facility emits less than 50 pounds of mercury per year, we submitted a voluntary plan in order to be proactive in the reduction of mercury emissions in Minnesota.

Otter Tail Power Company has had a history of good stewardship. This is exemplified by some of the mercury reduction activities that were conducted prior to the creation of the voluntary reduction initiative.

- In 1988, Hoot Lake Plant switched from using a lignite coal to a subbituminous coal as a primary fuel. Although both lignite and subbituminous have relatively low concentrations of mercury, the mercury content of the subbituminous coal is about two-thirds the mercury content of lignite. Due to the higher Btu of subbituminous, 25% less fuel was needed to produce the same number of kWh. As a result, subbituminous coal emits approximately half of the mercury produced by lignite.
- In 1989, 280 pounds of bulk mercury was collected by Otter Tail Power Company and shipped to Mercury Refining of Albany, NY. In 1999, an additional 60 pounds was collected and shipped to the same company.
- Otter Tail Power Company financially contributed to the University of North Dakota Energy and Environment Research Center's Center (EERC) for Air Toxic Metals. Otter Tail Power is a charter member of the group and has financially supported its research since 1992. The Center conducted number of research projects that would support development of new technologies to remove mercury and other toxics from emissions at Big Stone Plant. The Department of Energy's National Energy Technology Laboratory provided funding for the projects as part of their mercury reduction program. Finally, Otter Tail Power is contributing to a mercury control technologies study for electric utilities burning lignite coal that is also being conducted by the EERC in cooperation with North Dakota lignite industry. Phase I of the study was $833,000. Funding requests have been made to the Department of Energy's National Energy Technology Laboratory for additional projects totaling over $12,000,000.
- Otter Tail Power Company is in the process of phasing out mercury containing switches in communications equipment and SCADA and microwave site mercury relays by 2004.
- In 2000 and 2001 Otter Tail Power Company partnered with the Otter Tail County and the City of Fergus Falls to reduce the amount of mercury disposed of in the local solid waste stream. During 2001 Otter Tail Power Company donated 576 digital thermometers (cost $1,782) and participated with Otter Tail County in a mercury thermometer collection and swap. About 15 pounds of mercury was collected.
- Education on the proper handling and disposal of mercury containing products is on going. In 2001 Otter Tail Power Company participated in electrical contractor

training and discussed disposal options with approximately 100 electrical contractors. On-going education of employees in the proper cleanup of mercury spills and the need to evaluate

II. Barriers to Reducing Mercury Emissions

Mercury emissions from subbituminous coal and lignite coal are comparably lower than those from bituminous coal. However, lignite and subbituminous coals release elemental mercury, which is considerably more difficult to collect using conventional emission control equipment.

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B. Mercury content in pounds beginning in 2000.

Calculations are based on amount of fuel used and results of mercury analyses on the coal. These numbers are calculated using the total amount of mercury available in the coal and the EPRI 0.8 emission factor. There are currently no actual test emissions for the Hoot Lake Plant facility.

2000	36.57 pounds to air	
2001	26.81 pounds to air	7.9 pounds to land
2002	32.40 pounds to air	7.8 pounds to land

The land application figures are from the TRI reports for those years.

C. Future Projections

As of June 2003, we predict that the emissions will most likely be comparable to those seen in 2002. There have been no changes in the plant operating schedule or the source of the coal burned at Hoot Lake Plant. At this time we do not have any plans to change to the fuel source or the operating schedule.

Otter Tail Power Company
Update of Minnesota Voluntary Mercury Reduction Initiative
June 2005

I. Background

Otter Tail Power Company has one coal-fired facility in Minnesota. Hoot Lake Plant is 136 MW and is located in Fergus Falls. Although this facility emits less than 50 pounds of mercury per year, we submitted a voluntary plan in order to be proactive in the reduction of mercury emissions in Minnesota.

Otter Tail Power Company has had a history of good stewardship. This is exemplified by some of the mercury reduction activities that were conducted prior to the creation of the voluntary reduction initiative.

- In 1988, Hoot Lake Plant switched from using a lignite coal to a subbituminous coal as a primary fuel. Although both lignite and subbituminous have relatively low concentrations of mercury, the mercury content of the subbituminous coal is about two-thirds the mercury content of lignite. Due to the higher Btu of subbituminous, 25% less fuel was needed to produce the same number of kWh. As a result, subbituminous coal emits approximately half of the mercury produced by lignite.
- Since 1989 bulk mercury has been collected and shipped to mercury recycling facilities. To date, 495 pounds have been recycled.
- Otter Tail Power Company financially contributes to the University of North Dakota Energy and Environment Research Center's Center (EERC) for Air Toxic Metals. Otter Tail Power is a charter member of the group and has financially supported its research since 1992. The Center conducted a number of research projects that would support development of new technologies to remove mercury and other toxics from emissions at Big Stone Plant. The Department of Energy's National Energy Technology Laboratory (DOE NETL) provided funding for the projects as part of their mercury reduction program. Finally, Otter Tail Power is contributing to a mercury control technologies study for electric utilities burning lignite coal that is also being conducted by the EERC in cooperation with North Dakota lignite industry. Phase I of the study was $833,000 and has now been completed. The DOE National Energy Technology Laboratory has approved additional projects totaling between $13.2 and $15.4 million.
- Otter Tail Power Company has in the process of phasing out mercury containing switches in communications equipment and SCADA and microwave site mercury relays. As of June 2005 all of the mercury containing equipment has been replaced.
- In 2000 and 2001 Otter Tail Power Company partnered with the Otter Tail County and the City of Fergus Falls to reduce the amount of mercury disposed of in the local solid waste stream. During 2001 Otter Tail Power Company donated 576 digital thermometers (cost $1,782) and participated with Otter Tail County in a mercury thermometer collection and swap. About 15 pounds of mercury was collected.
- Education on the proper handling and disposal of mercury containing products is ongoing. In 2001 Otter Tail Power Company participated in electrical contractor training and discussed disposal options with approximately 100 electrical contractors. Spill kits and education in the proper cleanup of mercury spills is part of the mercury reduction program at Hoot Lake Plant.

II. Barriers to Reducing Mercury Emissions

There are currently no viable mercury removal systems for coal burning power plants. Different types of boilers, types of coal, and also emission control equipment affect the quality and the type of emissions. Only through research will effective methods be determined. Researchers have concluded that most of the anthropogenic emissions that fall on Minnesota are from outside the state and even the country and there would be no improvement in the mercury concentrations in the waters of the state if the mercury emissions in Minnesota dropped to zero.

Mercury emissions from subbituminous coal and lignite coal are comparably lower than those from bituminous coal. However, lignite and subbituminous coals release elemental mercury, which is considerably more difficult to collect using conventional emission control equipment.

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B. Mercury content in pounds beginning in 2000.

Calculations are based on amount of fuel used and results of mercury analyses on the coal. These numbers are calculated using the total amount of mercury available in the coal and the EPRI 0.8 emission factor. There are currently no actual test emissions for the Hoot Lake Plant facility.

2000	36.57 pounds to air	
2001	26.81 pounds to air	7.9 pounds to land
2002	32.0 pounds to air	8.9 pounds to land
2003	29.0 pounds to air	7.2 pounds to land
2004	26.2 pounds to air	6.5 pounds to land

The land application figures are from the TRI reports for those years.

C. Future Projections

As was predicted in June 2004, the total emissions for the year 2004 were lower than those seen in 2003. There was an extended outage on one of the units during May and June 2004, which impacted the total amount of coal burned at Hoot Lake Plant. At this time we do not have any plans to change to the fuel source or the operating schedule.

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	730.2 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.

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

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
Total	*3485 Bulbs*

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.

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:

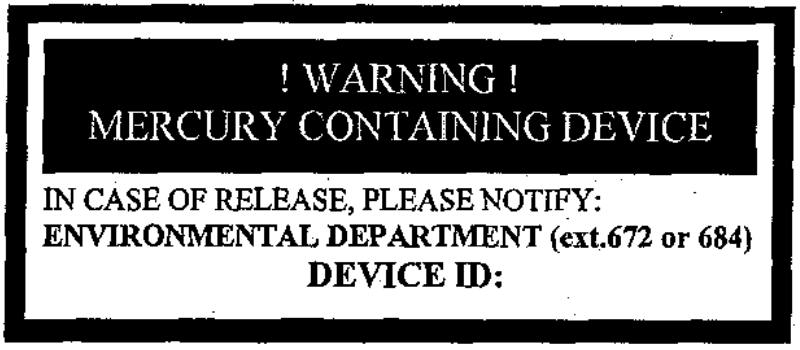
- Mining (drilling, blasting, loading, hauling) – removes the ore from the rock body.
- Crushing (in-pit crushers, primary mills, secondary mills) – reduces the size of the ore to a face powder consistency and aids in removing contaminants such as silica and rock.
- Concentrating (magnetic cobbers, disc filters) – separates the ore by magnetic extraction and dewaters 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.

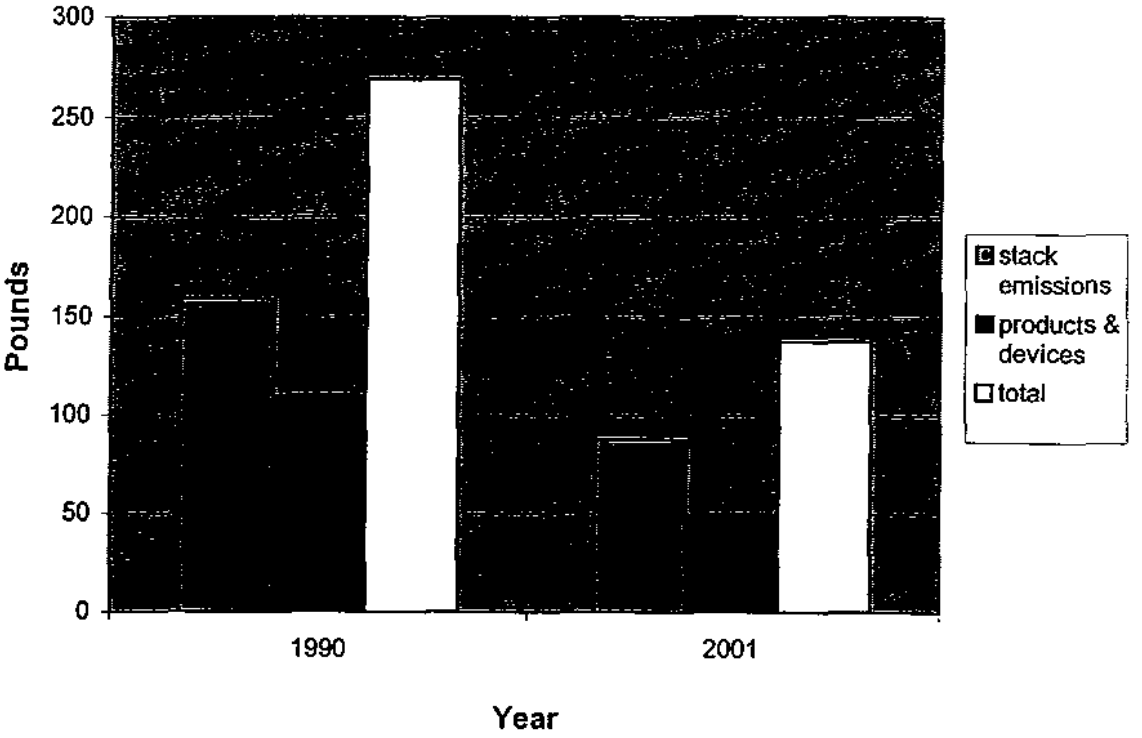
Table 1: Fluorescent Light Shipments

Item	Quantity
8-Foot Fluorescent Bulbs	235
4-Foot Fluorescent Bulbs	1029
HIDs	271
Ballasts (lbs)	360
Total	*1535 Bulbs*

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!

Taconite Industry 2002-2005 Voluntary Mercury Reduction Progress Report

Submitted To The MPCA

Pursuant To Individual Mine Voluntary Mercury Reduction Agreements

September 30, 2005

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 listed 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 list of the projects undertaken (summary reports of the projects are included in previous Taconite Industry annual reports):

- Mercury Volatilization From Taconite Tailings (Field work complete during 2000, report pending.)
- Preparation Of A Certified Mercury Standard For Taconite (Project completed during 2000; certified samples in storage.)
- Determination Of Stages In The Induration Process Where Mercury Volatilization Occurs (Project completed during 2001; report on file.)

During the period 2003-2005, the Minnesota taconite mines partnered with the Minnesota Department of Natural Resources DNR to investigate the potential for reductions in mercury emissions from the mines. Michael Berndt and John Engesser of the DNR were the primary investigators for the research project. Following is a summary of the research:

(1) The DNR collected quarterly baseline data on mercury capture by taconite wet scrubbers and it's fate in mercury processing plant. Estimates of mercury capture rates were made based on mass balance calculations and the fate of captured mercury during taconite processing was further quantified. The data suggest that both chlorine concentrations and dust abundance in the gas stream play an important role in increasing capture rate for mercury. Mercury captured in most, but not all, plants is currently recycled to the indurating furnaces.

(2) Undergrate samples were systematically collected from four processing plants and studied using Mössbauer spectroscopy for mineralogy and wet chemical methods to measure mercury concentration. It was found that mercury concentration in process dust, composed mostly of magnetite, *increases* rather than decreases as the solids approach the firing zone. This is because the outer grain boundaries of heated magnetite are converted to maghemite, which has been shown elsewhere to capture mercury from gas streams. These data show that the taconite pellet bed is actively involved in mercury transport processes during taconite induration.

(3) Numerous experiments were conducted to determine fate of captured mercury. Once captured, mercury in wet scrubbers is found predominantly on the surfaces of non-magnetic minerals. This is significant because it means that plants may reclaim the magnetic fraction of their scrubber dust without recycling mercury back to the furnace.

(4) Bench scale experiments were performed to characterize chemistry of mercury upon release during heating. Most mercury is released well before the pellets reach peak temperatures during induration. A significant fraction of the released mercury is present in the oxidized form at the time it is released, and this fraction is increased greatly when the process gas contains Chlorine.

(5) A coordinated mercury research effort was begun, involving researchers from the DNR, EERC (University of North Dakota, Energy and Environmental Resource Center), CMRL (University of Minnesota- Coleraine Mineral Research Laboratory, and IRM (University of Minnesota- Institute for Rock Magnetism. Numerous reports and publications have been or will soon be generated (see below).

(6) A research plan has been developed for future research, and funding was appropriated from a variety of industry and government sources for fiscal years 2006 and 2007. Future plans call for in-plant testing of Chlorine addition to enhance oxidation and capture of mercury during induration, further study of sorbent injection options, and further development and plant testing of means to focus captured mercury to tailings basins.

DNR Mercury Research Papers:

(1) Berndt, M. E. (2003) *Mercury and mining in Minnesota*. Final report, Minnesota Department of Natural Resources, 58p.

(2) Berndt, M. E. and Engesser, J. (2003) On the distribution of mercury in taconite plant

scrubber systems. Minnesota DNR report prepared for MPCA. 30 p.

(3) Berndt, M. E. and Engesser, J. E. (2005) Mercury transport in taconite processing facilities: (I) Release and capture during induration. Iron Ore Cooperative Research Final Report. Aug. 15, 2005; 60 p.

(4) Berndt, M. E., Engesser, J. E., and Berquó, T. S. (2005) Mercury chemistry and Mössbauer spectroscopy of iron oxides during taconite processing on Minnesota's Iron Range. Proceedings of Air Quality V conference: Washington, D.C., Sept. 19-21, 2005. 15 pages. *In press.*

(5) Berndt, M. E. and Engesser, J. E. (2005) Mercury transport in taconite processing facilities: (II) Fate of mercury captured by wet scrubbers. Report to the Environmental Protection Agency, Great Lakes National Program Office. *In preparation.*

Other reports from studies initiated and contracted by the DNR

(1) Benner, B. Mercury Release from Taconite During Heating (CMRL report TR-05-06/NRRI/TR-2005-17), June 15, 2005, 2 p.

(2) Berquó, T. S. (2005) Mössbauer spectroscopy analyses of taconite dust samples, Institute for Rock magnetism, Department of Geology and Geophysics, University of Minnesota. 13 pages.

(3) Galbreath, K., Liggett, R. and Dunham, G., (2005) Preliminary mercury release profiles from greenball samples. 12. p. (final report due Oct. 1, 2005).

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 updated summary of the total amount of mercury removed from the taconite mines during the period 1990 - 2002:

United Taconite	16.9 lbs.
Hibbing Taconite	75 lbs.
Ispat-Inland Mining	15 lbs.
Cliffs Erie LLC	1,860 lbs.
Keewatin Taconite	214.3 lbs.

Northshore Mining	730.2 lbs.
TOTAL	**2,901.4 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.

Cliffs Erie

Voluntary Mercury Reduction Report

Year 2005

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

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

The status of actions is shown in italics.

Specific Plans and Objectives

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 done, Cliffs Erie will retain 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. *LTVSMC removed mercury-containing devices from the Taconite Processing Plant as part of shutdown procedures. Four hundred and twenty pounds of mercury have been disposed.*

Specific Plans and Objectives (continued)

Community Outreach

Voluntary Reduction Action:

LTVSMC will participate in any joint effort which 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 which 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.*

Ispat Inland Mining Company

Voluntary Mercury Reduction Progress Report

Years 2002-2005

Ispat Inland Mining Company is located approximately two miles north of the city of Virginia. The plant produces an average of 2.8 million long tons of fully fluxed taconite pellets for shipment to Ispat Inland blast furnaces located in East Chicago, Indiana.

Mercury Reduction Initiatives

Like most large industrial facilities constructed prior to the 1990's, Ispat Inland Mining Company facilities contained mercury containing devices like thermostats, switches, lamps and bulbs, ballasts, thermometers, manometers and valves. Since 1990, Ispat Inland Mining Company has been removing, replacing and recycling mercury-containing devices.

In 2002 Ispat Inland Mining Company recycled the following:

Item	Quantity
8' fluorescent bulbs	108
4' fluorescent bulbs	1302
HID Bulbs	788
55 gallon drums of batteries	2

Similar quantities of mercury containing devices were collected during the period 2003-2005 and were disposed in accordance with appropriate regulations.

Cooperative Research on Mercury Removal from Processing

Ispat Inland Mining Company is one of four mines participating in a cooperative research project with the department of Minnesota Department of Natural Resources and Minnesota Pollution Control Agency on mercury cycling and distribution in northeastern Minnesota and the taconite industry. This study is expected to take two years.

Hibbing Taconite Company

Voluntary Mercury Reduction Progress Report

Years 2002-2004

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, has historically used many products that contain mercury. Such devices are 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. In 2002-2004, Hibbing Taconite recycled the following:

Item	2002	2003	2004
≥5-Foot Fluorescent Bulbs	45	56	0
≤4-Foot Fluorescent Bulbs	1248	647	620
Compacts	2	0	0
Circular Bulbs	22	0	0
U-Shaped Bulbs	0	68	2
HIDs	181	737	168
Thermostats	2	0	0
Thermometers	0	0	0
Mercury Relay Switches	0	1	0
Total	*1500*	*1509*	*790*

Employee Mercury Recycling Center

Hibbing Taconite commenced operation of an onsite Mercury Recycling Center for its employees to recycle their 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 2002-2004, the following items were recycled in the onsite Mercury Recycling Center:

Item	2002	2003	2004
≥5-Foot Fluorescent Bulbs	174	314	525
≤4-Foot Fluorescent Bulbs	935	865	884
Compacts	8	17	14
Circular Bulbs	16	4	0
U-Shaped Bulbs	0	5	0
HIDs	1	48	1
Thermostats	5	3	0
Thermometers	2	3	2
Mercury Relay Switches	0	2	0
Total	*1141*	*1261*	*1426*

City of Hibbing Mercury Reduction Task Force Participation

The City of Hibbing, and Barr Engineering 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 gets into 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 was 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. Although not a user of the City of Hibbing's wastewater treatment system, Hibbing Taconite was an active member of this Mercury Reduction Task Force from beginning to end (2002-2003). Information sharing and assisting in identifying how the City of Hibbing can best reduce the amount of mercury released to wastewater were the accomplished objectives.

Minnesota Department of Natural Resources / Cooperative Research Projects

Hibbing Taconite participated in a study that the Minnesota Department of Natural Resources has been conducting on the distribution and fate of mercury at four Minnesota taconite-processing facilities. As a part of this study, the DNR has been studying wet scrubbers and process lines at the four taconite processing facilities, Hibbing Taconite being one, to evaluate potential mercury control options for stack emissions. The projects are funded by Iron Ore Cooperative Research (IOCR) and the Environmental Protection Agency-Great Lakes National Program Office (EPA-GLNPO). In addition, this research is supplemented by funds from the Department of Natural Resources-Environmental Cooperative Research (DNR-ECR) fund. The IOCR project is more concerned with evaluating mercury release and capture mechanisms while the EPA-GLNPO funds were solicited with the objective of evaluating the ultimate fate of oxidized mercury once it has been captured by the wet scrubbers. The IOCR project ended June 2005. For the full report, refer to the Iron Ore Cooperative Research Final Report titled *Mercury Transport in Taconite Processing Facilities: Release and Capture During Induration* (August

15, 2005) by Michael Berndt and John Engesser – Minnesota Department of Natural Resources Division of Lands and Minerals. The DNR has only just begun studying the factors that control the cycling of captured mercury back to the induration furnace. Each taconite plant routes its scrubber waters differently and the DNR hopes to use these differences to shed light on mercury adsorption processes in taconite plants. The first set of samples for this phase of the study was collected in early May 2005. This line of research will go through October of 2005 when the EPA-GLNPO project ends.

Mercury Mass Balance Study

As a result of a 1994 Minnesota Pollution Control Agency (MPCA) Mercury Task Force report titled *Strategies for Reducing Mercury in Minnesota,* the Legislative Commission on Minnesota Resources funded an MPCA investigation of mercury emissions in Minnesota industries. One of these industries was Minnesota Taconite Mining. The investigation's scope required the development of a mercury emission balance for the taconite industry. The following mines were tested for the development of this balance: Hibbing Taconite, USX Minntac, Northshore Mining, and LTV Steel Mining Company. The Coleraine Research Laboratory was contracted by the MPCA to develop the balance. The mass balance testing was completed in 1996 and a report was issued to the MPCA in 1997.

Because of inadequate funding allocated by the Legislative Commission, the scope of sampling required to conduct a full balance had to be limited to stay within the budget. Therefore, the balances determined were not specific enough for the mines to understand where mercury existed in the process and what potential existed for mercury emission reductions. Moreover, this project resulted in a rough estimate of the overall mercury emissions for the taconite mining industry in Minnesota. Literally overnight, the mining industry went from not being listed on Minnesota's top industrial mercury emitters to being one of the top five on the list. As a result of this, the taconite industry chose to voluntarily participate in the MPCA's Voluntary Mercury Reduction Initiative.

Because of Hibbing Taconite's voluntary commitment to reduce mercury emissions, completing a mercury mass balance is a crucial first step in understanding the mercury emissions within the process. A completed mercury mass balance would allow Hibbing Taconite to move forward with a program to investigate reducing these emissions. Furthermore, the testing and analyses required to complete the mercury mass balance fulfill several of Hibbing Taconite's commitments in the 2001 MPCA Voluntary Mercury Reduction Agreement.

At Hibbing Taconite, the cost for conducting a mass balance project was approved in 2002. Planning began in 2003, and in 2004, mercury stack testing and mercury process samples were collected and analyzed. With ongoing interpretation of the results, the mercury mass balance is continuing, with additional sampling/testing planned for future years.

Northshore Mining Company

Voluntary Mercury Reduction Progress Report

Years 2002-2005

Reduction of Mercury Containing Products

Northshore continues to collect all fluorescent lamps and waste mercury containing devices and disposes of them in accordance with applicable regulations.

Partnering With Local Communities

Since entering into a Voluntary Mercury Reduction Agreement with the MPCA, Northshore has conducted a community mercury collection day in Silver Bay, Minnesota. Each year numerous fluorescent lamps and a number of thermometers and thermostats were collected. During 2005, Northshore's community mercury collection day netted 1,850 fluorescent lamps, a number of mercury thermostats and thermometers, and a two-pound jar of mercury.

In conjunction with the community mercury collection, during 2005 Northshore sponsored the collection and proper disposal of 3,600 pounds of waste electronics that might otherwise have been improperly disposed. These items contain heavy metals such as lead, but are difficult and expensive for individuals to recycle properly.

Mercury Reduction Research

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

United States Steel – Keewatin Taconite

Voluntary Mercury Reduction Progress Report

Years 2002-2005

Mercury-Containing Materials

The following table summarizes the mercury and mercury containing materials sent offsite for reclamation by the National Steel Pellet Company (2002 to May 2003) and United States Steel Corporation, Keewatin Taconite (April 2003 to Current).

Item	2002 (lbs)	2003 (lbs)	2004 (lbs)	2005 to Date (lbs)
Bulk mercury-containing material	20	6	2	1
Liquid mercury	46	0	0	8
Total	*66 lbs*	*6 lbs*	*2 lbs*	*9 lbs*

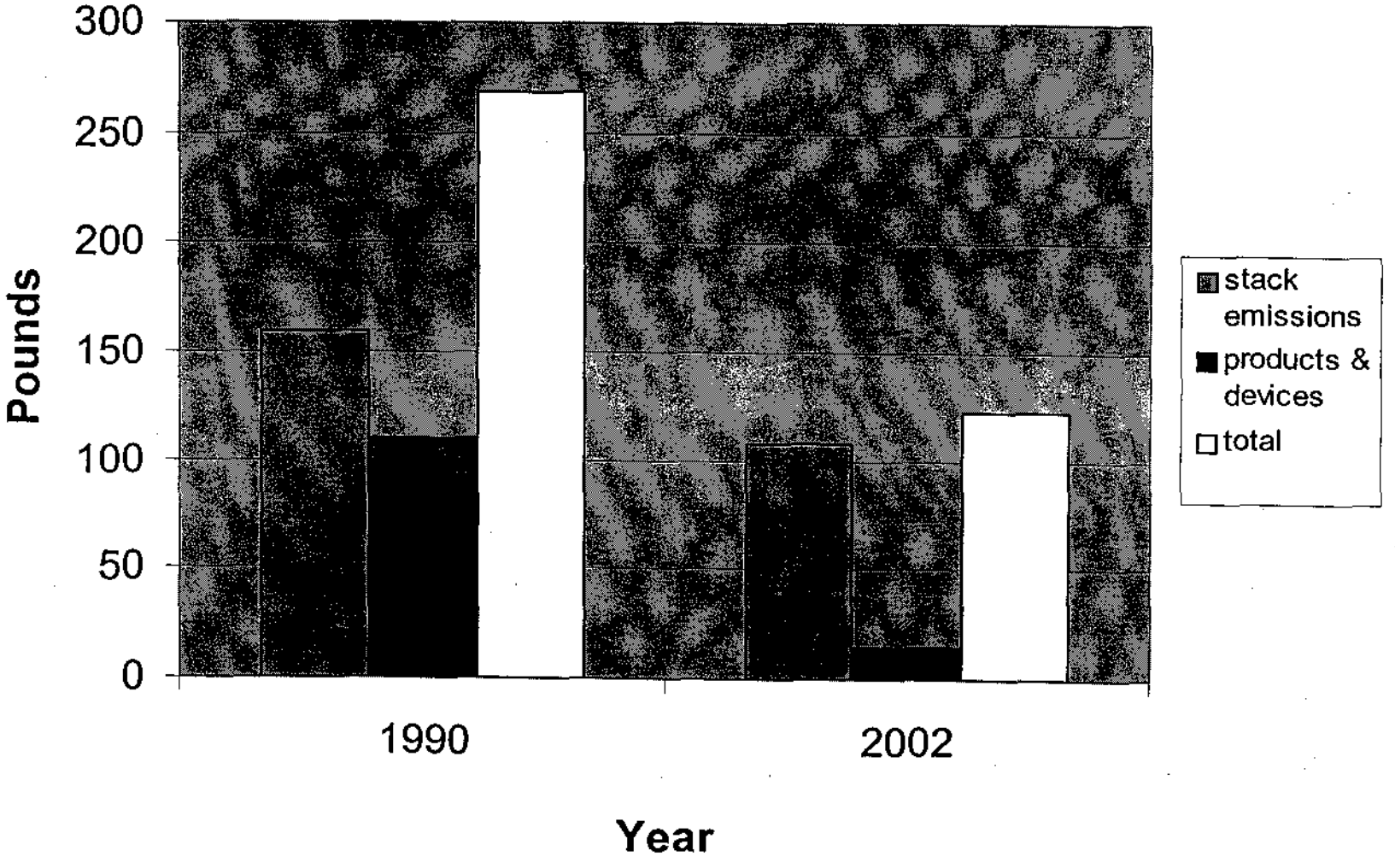
Item	2002	2003	2004	2005 to Date
8-Foot Fluorescent Bulbs	269	163	344	272
4-Foot Fluorescent Bulbs	1152	673	1374	659
HIDs	349	137	277	283
Broken Tubes	195 lbs	5 lbs	34	0
Total	*1616 Bulbs*	*973 Bulbs*	*1995 Bulbs*	*1219Bulbs*

Mercury – Stack Emissions

Keewatin Taconite continues to work to understand how mercury travels through the process. January 2004 Keewatin Taconite conducted a mass balance on mercury traveling through the process. This exercise was a repeat of the mass balance that was previously conducted in 1999.

Keewatin Taconite is subject to the Taconite Maximum Achievable Control Technology (MACT) rule. Keewatin Taconite's main process stacks (waste gas) will not meet the new MACT standard. Therefore new controls are required. Keewatin Taconite utilized the information gained from conducting the mercury mass balance as well as research being conducted by DNR to help design the scrubber. The new wet scrubber will be operational in October 2005. Additional research and testing will be conducted on the new waste gas dust collector to determine its effects on mercury.

Chart 1: Mercury Inventory



United Taconite LLC

Voluntary Mercury Reduction Progress Report

Years 2002-2005

Reduction Of Mercury Containing Products

United Taconite, previously known as EVTAC Mining, continues to participate in the Voluntary Mercury Reduction Program with the MPCA. In similar fashion to the other taconite mines, United Taconite continues to collect waste mercury containing devices and dispose of them in accordance with appropriate regulations.

Mercury Reduction Research

In conjunction with the other taconite mines, United has participated in the partnership between the industry and the Minnesota Department of Natural Resources (DNR) in a research effort that hopefully will lead to reductions in mercury emissions from the taconite mines. United is one of four mines from which furnace related samples are routinely collected by the DNR as the research progresses.

WLSSD

Clear Answers for Clean Water™

February 5, 2002

Ms. Elizabeth Shevi
Director, Policy & Planning Division
Minnesota Pollution Control Agency
520 Layfayette Road North
St. Paul, MN 55155-4194

RE: WLSSD Voluntary Mercury Reduction Annual Report

Dear Ms. Shevi:

The Western Lake Superior Sanitary District (WLSSD) is a strong supporter of the Minnesota Voluntary Mercury Reduction Project. WLSSD is an active member of the Minnesota Pollution Control Agency's (MPCA's) Mercury Contamination Reduction Initiative and enthusiastically supports the consensus that programs that encourage voluntary participation are preferable to a broad regulatory approach. Additionally, WLSSD has complied with mercury emission limits for both its sludge/solid waste incinerator and its wastewater discharges, and will continue to minimize releases to the environment from these sources. This report will document WLSSD's mercury reduction activities that occurred within the last year.

In July 2001, WLSSD discontinued its sludge incineration process; this was WLSSD's only mercury point source emission to air. In the first half of the year, prior to the shut down, 8 pounds of mercury were emitted via the incinerator. The new wastewater solids treatment process utilizes anaerobic digestion and a comprehensive biosolids land application program. This was also the first year of a MPCA project to document air emissions of mercury from WLSSD biosolids land application sites. WLSSD assisted the MPCA researchers in locating a farm field that met the criteria of the testing plan, and secured approval for testing from the landowner. The early results (see attached graph) showed there was no increase of mercury emissions at the site post-application versus pre-application. Further testing will be conducted and reported during 2002.

WLSSD staff continues to work with dental practices in order to reduce the amount of amalgam particles discharged to the sewer or released to other media where mercury may be emitted to the environment. WLSSD, in cooperation with the Northeast District Dental Society, applied for and received a local environmental improvement grant. Grant funds are being used to purchase improved sedimentation traps, which capture fine

Western Lake Superior Sanitary District
2626 Courtland Street • Duluth, MN 55806-1894 • 218/722-3336 • FAX 218/727-7471

www.wlssd.duluth.mn.us

amalgam particles that normally would be sewered from dental suction systems. These treatment systems, when properly installed and operated, capture 99 percent of the amalgam particles (ISO standard) released through dental suction systems. This is far superior to conventional traps, which capture 60-80 percent of the amalgam. As of the end of the 2001, 25 of the 52 dental practices in the WLSSD service area had installed the improved capture devices. Eight (8) additional practices scheduled installation in January 2002. The project goal is to have 75 percent of the dental practices using improved systems by the end of 2002. WLSSD is seeking additional funding to purchase improved traps for all the dental practices in the service area. The concentration and mass of mercury in the wastewater sludge is being tracked by WLSSD in order to measure the success of this project.

WLSSD has worked with the MPCA during the last two years to help eliminate mercury use in school laboratories by collecting mercury-containing items and offering non-mercury alternatives in exchange. Laboratory and fever thermometers have been the most common items exchanged, although numerous other items were turned in. Two thousand one hundred and five (2105) laboratory thermometers were collected in 2000 and 2001 and properly disposed of through the WLSSD Household Hazardous Waste Facility. Three hundred pounds of mercury were collected from schools during 2000 and 2001.

Schools are not the only customers that use the WLSSD Household Hazardous Waste Facility and Clean Shop program to manage mercury-containing wastes. Households and small businesses disposed of 645 pounds of mercury waste in 2000, and 968 pounds in 2001. Households that choose to turn in mercury-containing fever thermometers to WLSSD for proper disposal receive a mercury-free thermometer in exchange.

The table below shows the actual mercury emissions from WLSSD facilities and the estimates that were projected for 2001 and 2008.

Mercury Emissions from WLSSD Facilities

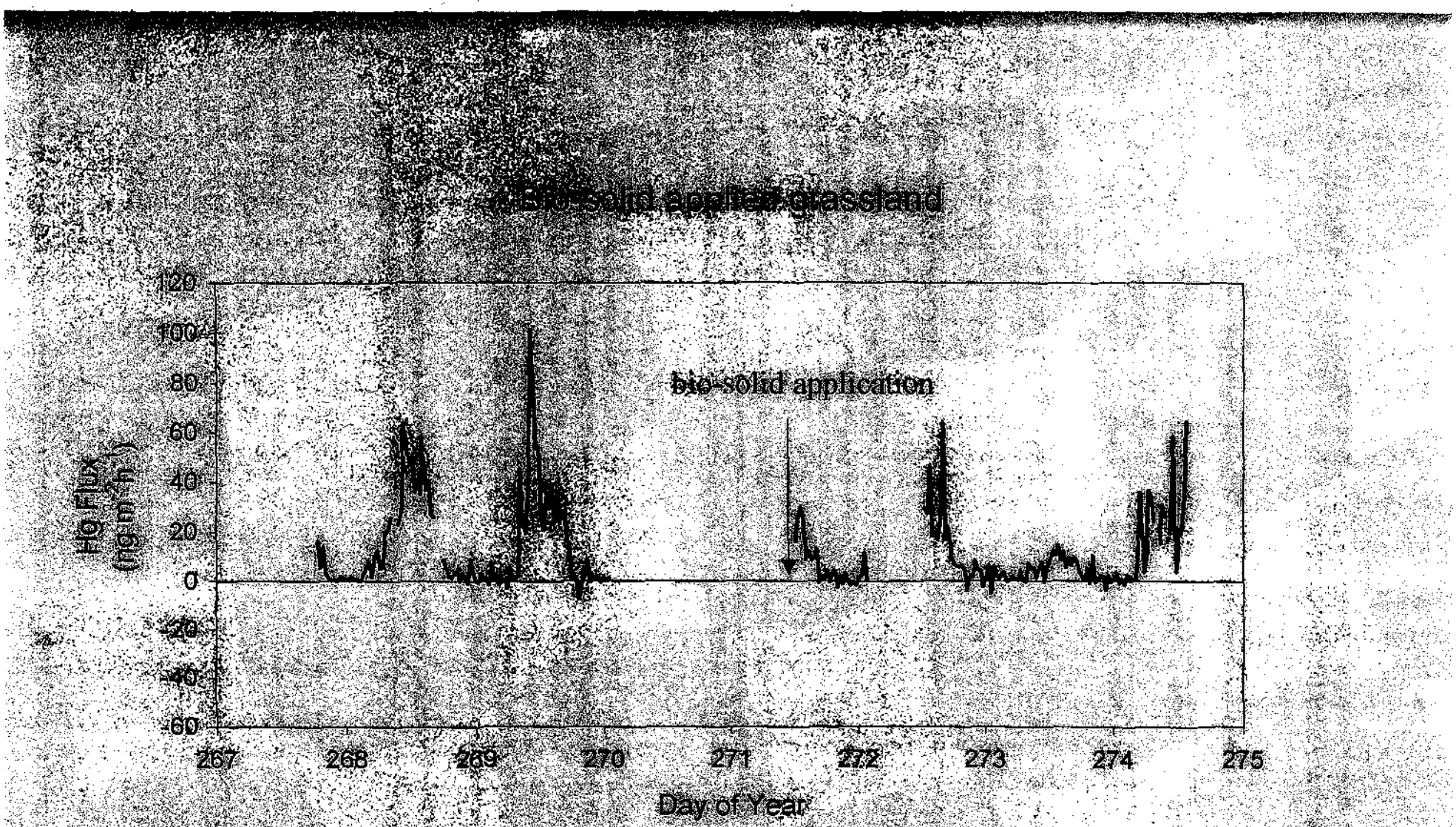
Type of Emission	**1990**	**1998**	**2000**	**2001 Estimate**	**2001 Actual**	**2008 Estimate**
	Lbs/yr	Lbs/yr	Lbs/yr	Lbs/yr	Lbs/yr	Lbs/yr
Incinerator Stack (AIR)	47	10	11	5	8	0
Wastewater Effluent (WATER)	42.4	2.0	1.0	0.8	0.7	0.5
Incinerator ash (Landfill)	1.3	52.5	5	2	0.9	0
Biosolids (Land Application)	0	5.9	5	10	7.5	11
Subtotal	**90.7**	**70.4**	**23.4**	**17.8**	**17.1**	**11.5**
Solid waste Estimate (Landfill)	118	55.2	100	95	95	80
Total	**208.7**	**125.6**	**123.4**	**112.8**	**112.1**	**91.5**

The total wastewater influent mercury load for 2001 was 10.2 pounds per year. Industrial sampling shows WLSSD industrial customers discharged 0.69 pounds. The source of the remaining mercury was households, small businesses, and unregulated industries. Mass balance analysis determined that 93% of the mercury received as a component of WLSSD wastewater influent appears in the biosolids product; only 7% of the mercury received is discharged to the receiving waters.

If you have any further questions concerning WLSSD's efforts to reduce mercury emissions, please feel free to call Tim Tuominen of my staff at (218) 722-3336 extension 324.

Sincerely,

Kurt N.W. Soderberg
Executive Director


Bio-solid applied grassland
bio-solid application
Hg Flux
(ng m-2 h-1)
120
100
80
60
40
20
0
-20
-40
-60
267
268
269
270
271
272
273
274
275
Day of Year

February 13, 2003

Mr. Ned Brooks
Mercury Coordinator
Minnesota Pollution Control Agency
520 Layfayette Road North
St. Paul, MN 55155-4194

RE: WLSSD Voluntary Mercury Reduction 2002 Annual Report

Dear Mr. Brooks:

The Western Lake Superior Sanitary District (WLSSD) is a strong supporter of the Minnesota Voluntary Mercury Reduction Project. WLSSD is an active member of the Minnesota Pollution Control Agency's (MPCA's) Mercury Contamination Reduction Initiative and enthusiastically supports the consensus that programs that encourage voluntary participation are preferable to a broad regulatory approach. Additionally, WLSSD has complied with mercury emission limits for biosolids land application program and its wastewater discharges, and will continue to minimize releases to the environment from these sources. This report will document WLSSD's mercury reduction activities that occurred within the last year.

WLSSD staff continues to work with dental practices in order to reduce the amount of amalgam particles discharged to the sewer or released to other media where mercury may be emitted to the environment. WLSSD, in cooperation with the Northeast District Dental Society, applied for and received a local environmental improvement grant. Grant funds are being used to purchase improved sedimentation traps, which capture fine amalgam particles that normally would be sewered from dental suction systems. These treatment systems, when properly installed and operated, capture 99 percent of the amalgam particles (ISO standard) released through dental suction systems. This is far superior to conventional traps, which capture 60-80 percent of the amalgam. As of December 2003, 45 advanced treatment systems have been installed out of a possible total 50 possible dental practices in the WLSSD service area. The remaining practices will continue to be pursued to volunteer for the program by the WLSSD until treatment units are installed in all practices. The concentration and mass of mercury in the wastewater sludge is being tracked by WLSSD in order to measure the success of this project.

WLSSD operates a Household Hazardous Waste Facility and Clean Shop program to manage hazardous wastes including mercury-containing wastes. Households and small businesses disposed of 645 pounds of mercury waste in 2000, 968 pounds in 2001, and 1121 pounds in 2002. (See attached spreadsheet for itemization of mercury items recycled.) Households that choose to turn in mercury-containing fever thermometers to WLSSD for proper recycling receive a mercury-free thermometer in exchange.

The table below shows the actual mercury emissions from WLSSD facilities and the reductions we originally committed to achieve for 2001 and 2008.

Mercury Emissions from WLSSD Facilities

Type of Emission	**1990**	**1998**	**2000**	**2001 Commitment**	**2001 Actual**	**2002 Actual**	**2008 Commitment**
	Lbs/yr	Lbs/yr	Lbs/yr	Lbs/yr	Lbs/yr	Lbs/yr	Lbs/yr
Incinerator Stack (AIR)	47	10	11	5	8	0	0
Wastewater Effluent (WATER)	42.4	2.0	1.0	0.8	0.7	0.22	0.5
Incinerator ash (Landfill)	1.3	52.5	5	2	0.9	0	0
Biosolids (Land Application)	0	5.9	5	10	7.5	9.8	11
Subtotal	**90.7**	**70.4**	**23.4**	**17.8**	**17.1**	**10.3**	**11.5**
Solid waste Estimate (Landfill)	118	55.2	100	95	95	92	80
Total	**208.7**	**125.6**	**123.4**	**112.8**	**112.1**	**102.3**	**91.5**

The total wastewater influent mercury load for 2002 was 9.1 pounds per year. Industrial sampling shows WLSSD industrial customers discharged 1.46 pounds. The source of the remaining mercury was households and unregulated small businesses. Mass balance analysis determined that 97.6% of the mercury received as a component of WLSSD wastewater influent appears in the biosolids product; only 2.4% of the mercury received is discharged to the receiving waters. This was the first year of using ultra-low level EPA method 1631 for effluent mercury testing at WLSSD.

If you have any further questions concerning WLSSD's efforts to reduce mercury emissions, please feel free to call Tim Tuominen of my staff at (218) 722-3336 extension 324.

Sincerely,

Kurt N.W. Soderberg
Executive Director

2626 Courtland Street
Duluth, MN 55806-1894
phone 218.722.3336
fax 218.727.7471

WLSSD
Western Lake Superior Sanitary District

RECEIVED
FEB 0 2 2004

January 30, 2004

Mr. Ned Brooks
Mercury Coordinator
Minnesota Pollution Control Agency
520 Layfayette Road North
St. Paul, MN 55155-4194

RE: WLSSD Voluntary Mercury Reduction Annual Report

Dear Mr. Brooks:

The Western Lake Superior Sanitary District (WLSSD) is a strong supporter of the Minnesota Voluntary Mercury Reduction Project and of Minnesota Pollution Control Agency's (MPCA's) Mercury Contamination Reduction Initiative and enthusiastically supports the consensus that programs that encourage voluntary participation are preferable to a broad regulatory approach. Additionally, WLSSD has complied with mercury emission limits for biosolids land application program and its wastewater discharges, and will continue to minimize releases to the environment from these sources. This report will document WLSSD's mercury reduction activities that occurred within the last year.

WLSSD staff continues to work with dental practices in order to reduce the amount of amalgam particles discharged to the sewer or released to other media where mercury may be emitted to the environment. WLSSD, in cooperation with the Northeast District Dental Society, applied for and received a local environmental improvement grant. Grant funds have been used to purchase improved amalgam separators, which capture fine amalgam particles that normally would be sewered from dental suction systems. These treatment systems, when properly installed and operated, capture 99 percent of the amalgam particles (ISO standard) released through dental suction systems. This is far superior to conventional traps, which capture 60-80 percent of the amalgam. As of December 2003, 51 advanced treatment systems have been installed out of a possible total 53 possible dental practices in the WLSSD service area. The MPCA also was a source of grant money that allowed the district to upgrade many amalgam separators from 95% removal to the 99% removal models. Practices that do not have separators will continue to be pursued to volunteer for the program by the WLSSD staff until treatment units are installed in all practices.

The concentration and mass of mercury in the wastewater sludge is being tracked by WLSSD in order to measure the success of this project. This information along with other cities that require use of amalgam separators is being shared with the Association of Metropolitan Sewerage Agencies (AMSA) in order to document the improvements of such source reduction efforts. The WLSSD staff has been actively promoting the use of amalgam separators by working with the Minnesota and American Dental Association at their annual conventions in St. Paul and San Francisco

WLSSD operates a Household Hazardous Waste Facility and Clean Shop program to manage hazardous wastes including mercury-containing wastes. Households and small businesses disposed of 645 pounds of mercury waste in 2000, 968 pounds in 2001, 1121 pounds in 2002, and 303 pound in 2003. (See attached spreadsheet for itemization of mercury items recycled.) Households that choose to turn in mercury-containing fever thermometers to WLSSD for proper recycling receive a mercury-free thermometer in exchange.

The table below shows the actual mercury emissions from WLSSD facilities and the reductions we originally committed to achieve for 2001 and 2008.

Mercury Emissions from WLSSD Facilities

Type of Emission	**1990**	**1998**	**2000**	**2001 Commitment**	**2001 Actual**	**2002 Actual**	**2003 Actual**	**2008 Commitment**
	Lbs/yr	Lbs/yr	Lbs/yr	Lbs/yr	Lbs/yr	Lbs/yr	Lbs/yr	Lbs/yr
Incinerator Stack (AIR)	47	10	11	5	8	0	0	0
Wastewater Effluent (WATER)	42.4	2.0	1.0	0.8	0.7	0.22	0.24	0.5
Incinerator ash (Landfill)	1.3	52.5	5	2	0.9	0	0	0
Biosolids (Land Application)	0	5.9	5	10	7.5	9.8	9.9	11
Subtotal	**90.7**	**70.4**	**23.4**	**17.8**	**17.1**	**10.0**	**10.1**	**11.5**
Solid waste Estimate (Landfill)	118	55.2	100	95	95	92	90	80
Total	**208.7**	**125.6**	**123.4**	**112.8**	**112.1**	**102**	**100.1**	**91.5**

The total wastewater influent mercury load for 2003 was 10.6 pounds per year. Industrial sampling shows WLSSD industrial customers minimal. The major source mercury is households and unregulated small businesses. Mass balance analysis determined that 97.7% of the mercury received as a component of WLSSD wastewater influent appears in

the biosolids product; only 2.3% of the mercury received is discharged to the receiving waters. This was the second year of using ultra-low level EPA method 1631 for effluent mercury testing at WLSSD. The mercury mass balance for our treatment plant is attached.

If you have any further questions concerning WLSSD's efforts to reduce mercury emissions, please feel free to call Tim Tuominen of my staff at (218) 740-4815.

Sincerely,

Kurt N.W. Soderberg
Executive Director

Attachments

Western Lake Superior Regional Household Hazardous Waste Program

Accumulating Annual Report for Mercury

January 1, 2003 - December 31, 2003

GENERAL INFORMATION

Facility Location Duluth, MN

The containers of waste listed here are full and sealed, ready for shipment. Any partial containers at the end of 2000 are not listed. They will be on the following year's report as sealed.

	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Year Total
Lab Pack Hg Items (lb)	18.40		89.80	73.60	181.80
Inorganic Hg Compounds (lb)			77.00		77.00
Organic Hg Compounds (lb)			16.60		16.60
Amalgam Waste (lb)		21.86		6.00	27.86
Hg contaminated soil (lb)					0.00
Total (lb)	18.40	21.86	183.40	79.60	303.26

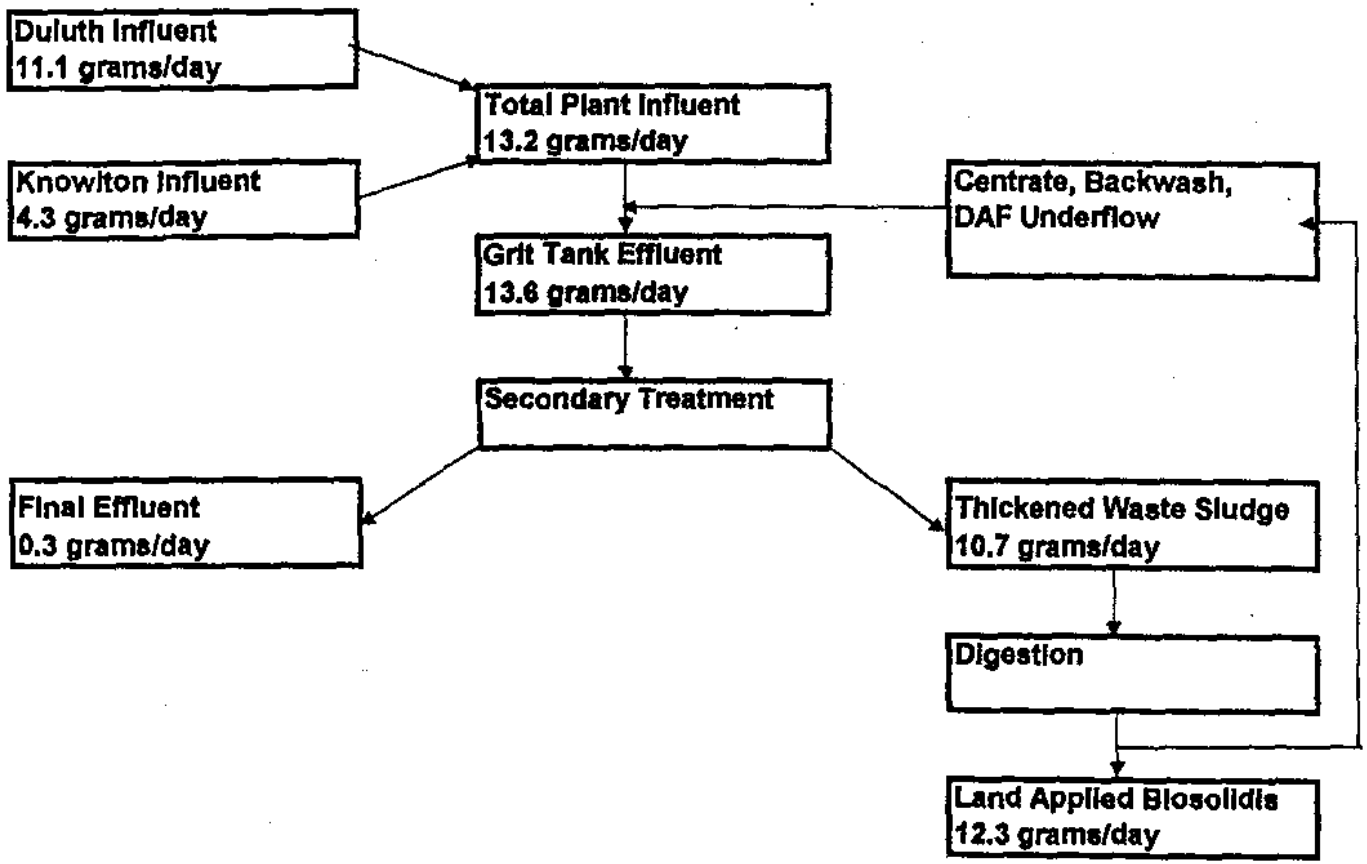
Breakdown of the Hg Items

items by count					
Contaminated Containers/spill kits	0	0	0	3	3
Containers of Elemental Hg	5	0	33	13	51
Organic Compounds	0	0	23	0	23
Inorganic Compounds	0	0	20	0	20
Thermostats	12	0	22	37	71
Switches	1	0	48	16	65
Blood Pressure Meters	0	0	0	0	0
Barometers	0	0	0	0	0
Fever Thermometers	22	0	460	54	536
Lab Thermometers	0	0	26	18	44
Outdoor thermometer	0	0	1	0	1
Mercury Maze Game	0	0	1	0	1
Monometers	0	0	3	0	3
Cooking thermometers	0	0	1	4	5
Total # of items =	40	0	638	145	823

Total Fluorescent Lamps Recycled = 22,488

Crushed (lbs.) of Fluorescent Bulbs Recycled = 110 lbs.

2003 WLSSD Mercury Mass Balance



January 15, 2005

Ms. Mary Kimlinger
Water Quality Submittals
Minnesota Pollution Control Agency
520 Lafayette Road
St. Paul, Minnesota 55155-4194

RE: WLSSD Mercury Reduction Progress Report
NPDES/SDS MN 0049786, Chapter 1, part 6.3

Dear Ms. Kimlinger:

Please find a summary of our mercury reduction efforts that we hope will lead to permit compliance in meeting the final March 23, 2007 effluent limits. This report is also to satisfy the conditions of Chapter 1, part 6.3 of our NPDES permit which is due February 1st of each year. We will also forward this report to Ned Brooks of the MPCA as part of our Voluntary Mercury Reduction Annual Report for the MPCA's Mercury Reduction Initiative.

The summary of our activities is as follows:

Western Lake Superior Sanitary District (WLSSD) has had a successful mercury source reduction effort in place since the early 1990's. The project has been a multimedia effort, including source reduction in both the solid waste and wastewater streams. The low limits in the Great Lakes Water Quality Agreement were the driving force behind WLSSD's program. After an evaluation of end-of-pipe treatment options, a decision was made to target our efforts toward source reduction. Many of our successes have become the blueprint for mercury reduction efforts for other wastewater utilities. We also are a strong supporter of the Minnesota Voluntary Mercury Reduction Project. WLSSD was an active member of the Minnesota Pollution Control Agency's (MPCA's) Mercury Contamination Reduction Initiative and enthusiastically supports the consensus statement recommending programs that encourage voluntary participation.

The table below shows the actual mercury emissions from WLSSD facilities and the reductions we originally committed to achieve for 2001 and 2008.

Mercury Emissions from WLSSD Facilities

Type of Emission	1990	1998	2000	2001 Commit-ment	2001	2002	2003	2004	2008 Commit-ment
	Lb/yr	Lb/yr	Lb/yr	Lb/yr	Ls/yr	Lb/yr	Lb/yr	Lb/yr	Lb/yr
Incinerator Stack (AIR)	47	10	11	5	8	0	0	0	0
Wastewater Effluent (WATER)	42.4	2.0	1.0	0.8	0.7	0.22	0.24	0.31	0.5
Incinerator ash (Landfill)	1.3	52.5	5	2	0.9	0	0	0	0
Biosolids (Land Application)	0	5.9	5	10	7.5	9.8	9.9	9.9	11
Subtotal	**90.7**	**70.4**	**23.4**	**17.8**	**17.1**	**10.0**	**10.1**	**10.2**	**11.5**
Solid waste Estimate (Landfill)	118	55.2	100	95	95	92	90	88	80
Total	**208.7**	**125.6**	**123.4**	**112.8**	**112.1**	**102**	**100.1**	**98.2**	**91.5**

Although our largest mercury reductions occurred in the first half of the 1990s we also have seen a trend of reduced mercury in our wastewater influent, sludge, and effluent through the 1990 and 2003. In 2004 it appears the reduction trend may be leveling off. This may be due to some specific activities that occurred in the summer months of this year. The slight increase in mercury loadings could also be due to a sample or two that were higher than the norm. A few extreme data points during the year can easily skew a larger data set. This may have been the case since some of our monitoring points showed no significant increase over previous years.

WLSSD continues to test and requires industrial customers to document the level of mercury in their discharge. The industrial limit is presently set at 0.300 ug/l. Nearly all analysis of industrial samples are below the detection limits. The loading attributed to industrial discharge is hard to determine because of lack of data above the detection level. Previous work we have done has identified the major source of the mercury to our plant is from the commercial and residential sector. The attached mass balance for 2005 shows this continues to be the case. The Duluth influent (mostly commercial and residential) accounts for 6.4 grams of mercury per day while the Knowlton influent (mostly industrial) adds 6.0 grams of mercury per day; yet the volume of wastewater from Knowlton influent is over double that of the Duluth influent.

Mercury in the sludge is being analyzed at two points: undigested thickened waste activated sludge contains 13.4 grams/day and the average digested dewatered biosolids contain 12.3 grams/day. The wastewater discharge completes the mass balance and contains 0.38 g/day on the average day. The balance of the mass of mercury is really quite close considering WLSSD treats nearly 14 billion of gallons of wastewater per year.

In 2002 WLSSD started using EPA Method 1631 in order to detect the low levels of mercury found in our effluent. (See attached table.) It is likely that the effluent should be following the same reduction trends as the influent and sludge but it is not yet apparent in the discharge. We have noticed any increase of suspended solids in the effluent also increases the total mercury in the discharge. Therefore it is going to be very important to keep solids low in the effluent in order to meet the 2007 limits. Below is a table of data showing the total mercury, dissolved mercury, and methyl mercury for 3 samples taken this year. This shows the relative importance of the type of mercury in our effluent. It is important to note that the dissolved mercury, which is harder to remove than particulate mercury, can exceed the 2007 monthly average limit of 1.8 ng/l.

Species of Mercury in WLSSD Effluent

Date	Total Mercury	Dissolved Mercury	Methyl Mercury
4/16/2004	2.0	1.4	0.07
7/23/2004	1.8	1.2	0.10
9/16/2004	4.1	1.9	0.12

In 2004 WLSSD conducted a larger amount of interceptor cleaning than usual. We believe some of the higher mercury levels we saw this year may have been related to sewer line cleaning that WLSSD conducted. We have previously seen increased levels of mercury when sewer line cleaning occurs below historic dischargers of mercury containing wastes.

Our mercury source reduction efforts have continued; some are focused towards solid waste reduction such as reducing mercury use in schools and fever thermometer exchanges. Such efforts could potentially have a positive impact on wastewater discharge. An example would be elimination of broken thermometers in a sink that could have an impact on the wastewater plant. WLSSD's Household Hazardous Waste facility collects mercury containing wastes from residential customers and the Clean Shop Program collects mercury wastes from small businesses. Attached is a table listing mercury wastes collected.

Another major effort over the last few years at WLSSD has been the program to install amalgam capture devices at dental practices. Fine amalgam particles from dental practices are passed to the sewer via the suction systems at the dental offices. The new devices being installed capture between 95-99% of fine amalgam particles. Conventional equipment only captures between 50-80% of the amalgam waste from dental offices. This reduction effort may or may not impact the mercury concentration in the effluent; however we believe the reduction seen in our sludge and biosolids may be due to this effort. The partnership with the local dental society has resulted in improved treatment systems in 56 out of 57 dental practices. This effort has been made possible by a local environmental improvement grant. Many older less efficient systems were replaced last year with the help of a MPCA grant. More efficient and easier to maintain equipment

should reduce the amount of amalgam discharged to the sewer. The table below shows the number of separators installed and the impact on mercury at our treatment plant.

WLSSD Mercury History

YEAR	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Influent ng/l	180	160	150	160	120	100	90	80	96	100
Effluent ng/l	20.6	15.3	11.2	10.1				1.9	2.3	2.6
% Removal	88.6	90.4	92.5	93.7				97.6	97.6	97.4
Sludge mg/kg dry	1.3	0.99	0.75	0.84	0.64	0.45	0.47	0.32	0.32	0.37
Separators installed		3				11	11	20	6	5
(57 practices operating)										

YEAR	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Influent g/day	28	26	22	24	18	15	13	12	13	14
Effluent g/day	3.1	2.2	1.5	1.3				0.27	0.30	0.38
% Removal	89.3	91.2	93.3	94.4				97.8	97.7	97.4
Sludge g/day	44.6	44.5	24	29.5	22.2	16.3	10.9	11.4	10.7	13.4
Separators installed		3				11	11	20	6	5
(57 practices operating)										

Biosolids/RFD incineration ended in 1999

A project that we hope will have an impact on the amount of mercury in our effluent is our clarifier and channel improvement project that was completed in 2003. This project includes improving the flow distribution and removal and replacement of clarifier equipment. Since 97% of the mercury load is captured in the sludge solids; this project, designed to improve solids capture, will help control solids loss to the effluent and the mercury associated with solids. Other capital projects we are planning will also be evaluated for impact they would have on mercury concentrations in the effluent.

WLSSD also belongs to the St. Louis River Watershed TMDL Partnership. The major effort of that group in the last year has been: the WARMF modeling of mercury in the St. Louis River basin. As part of the WARMF effort, the WLSSD conducted a sampling effort of the St. Louis River and its tributaries at 18 points. This information should help calibrate and validate the computer model. It is interesting to note that the concentrations of total mercury, dissolved mercury, and methyl mercury are higher in the St. Louis River than the WLSSD effluent. On the dates the river was sampled the WLSSD effluent discharge contained an average of 0.4 grams of mercury per day while the mercury contained in the flow from the river contained 19 grams per day.

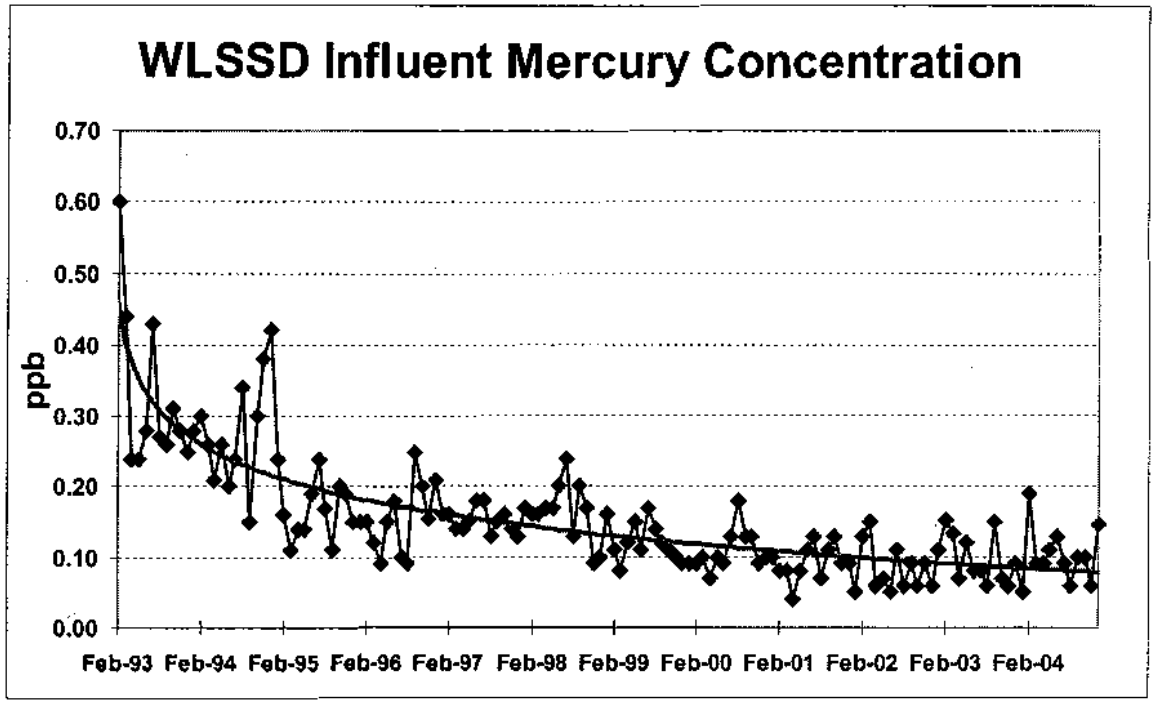
In early 2005, WLSSD will host a meeting of state wastewater mercury experts to determine what further actions WLSSD could take in order to meet the 2007 discharge

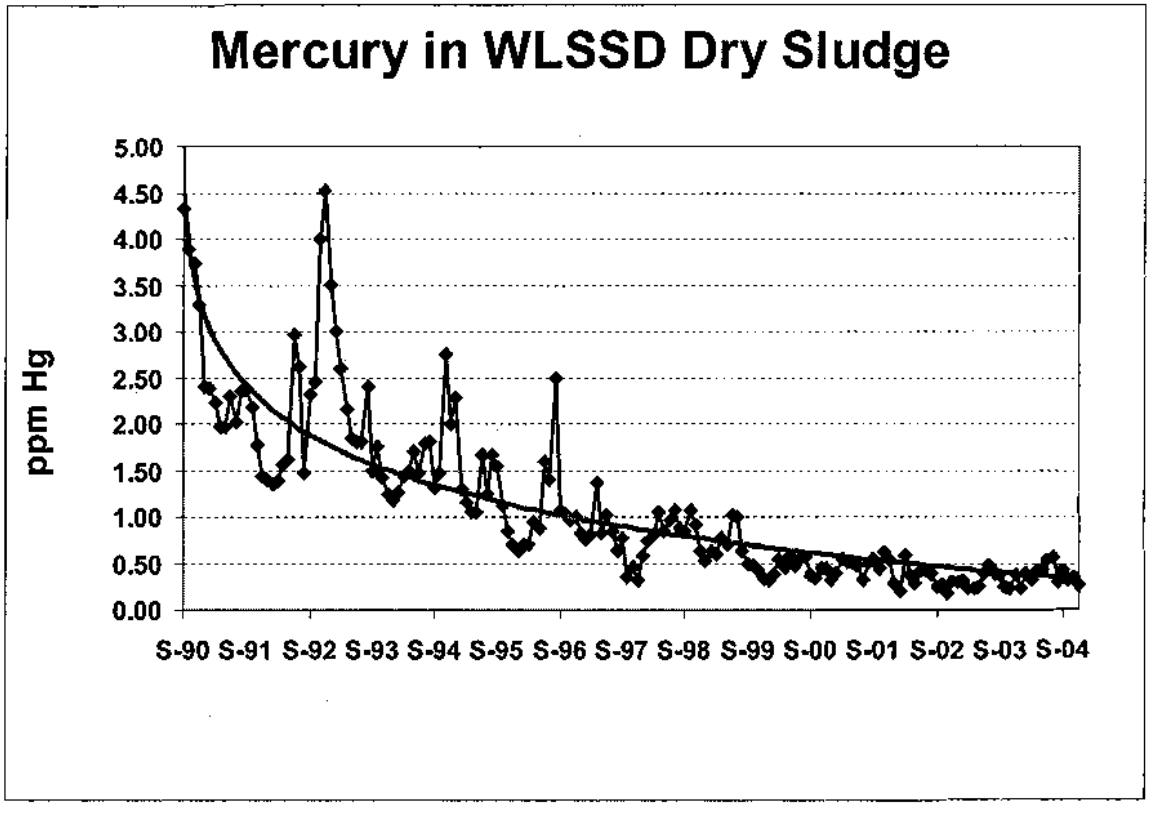
limit. The recommended actions from this meeting will be documented and added to our pollutant minimization planning efforts in the future. Some MPCA staff have already been invited to this meeting if any other staff wishes to attend the meeting or if there are any other questions about this report please call Tim Tuominen at (218) 740-4815 or email him at tim.tuominen@wlssd.duluth.mn.us .

Sincerely,

Kurt N.W. Soderberg
Executive Director

Attachments

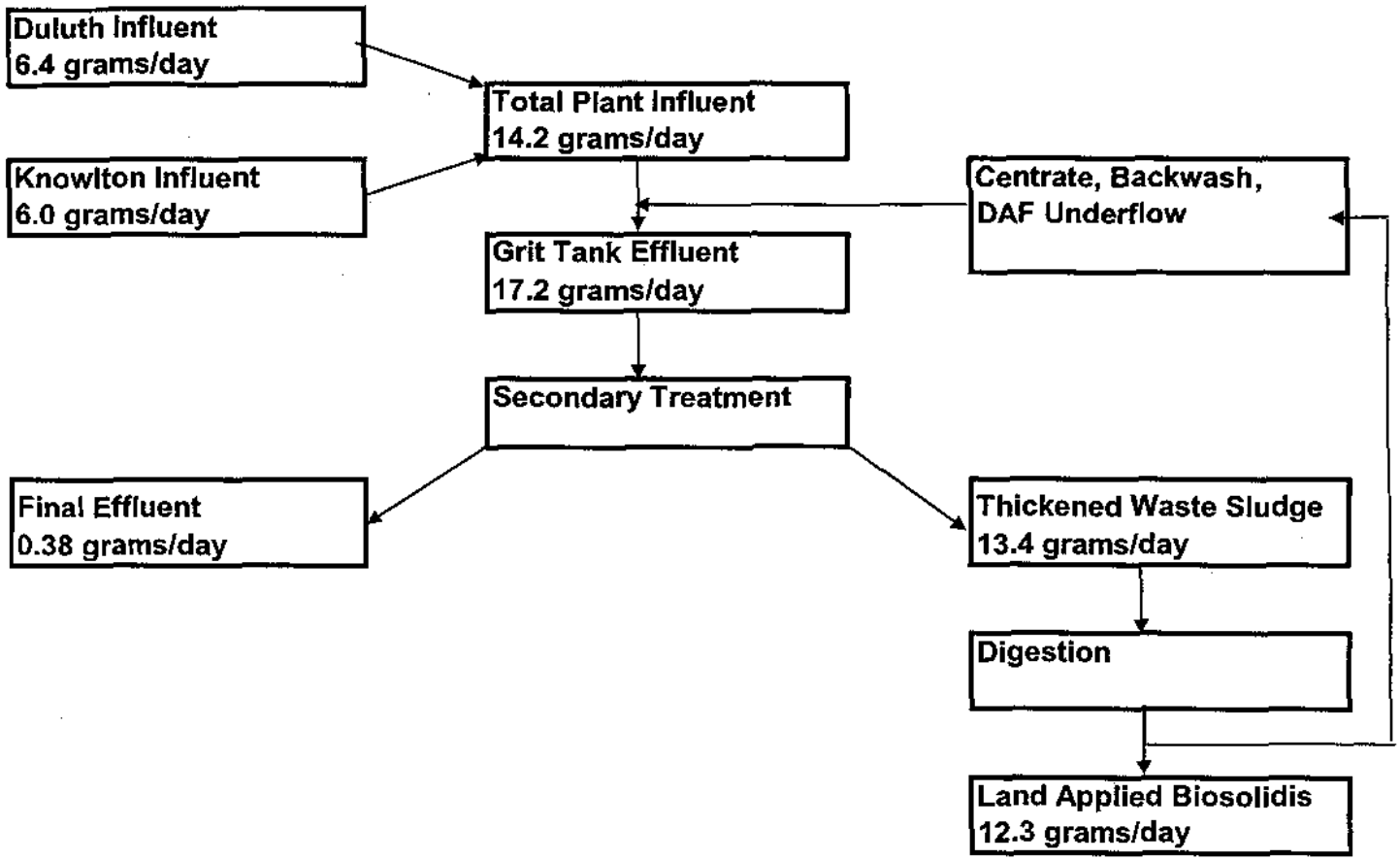

WLSSD Influent Mercury Concentration
ppb
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Feb-93 Feb-94 Feb-95 Feb-96 Feb-97 Feb-98 Feb-99 Feb-00 Feb-01 Feb-02 Feb-03 Feb-04


Mercury in WLSSD Dry Sludge
ppm Hg
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
S-90 S-91 S-92 S-93 S-94 S-95 S-96 S-97 S-98 S-99 S-00 S-01 S-02 S-03 S-04

WLSSD Plant Effluent Mercury

DATE	ng/L (ppt)	AVE Present Limit 12 ng/l March - 2007 Limit 1.8 ng/L	MAX Present Limit 21 ng/l March - 2007 Limit 3.2 ng/L
2/7/2002	1.4		
2/15/2002	1.4	1.4	1.4
3/8/2002	2.2		
3/15/2002	2.2	2.2	2.2
4/1/2002	1.4		
4/15/2002	1.5	1.5	1.5
5/1/2002	2.7		
5/15/2002	1.5	2.1	2.7
6/3/2002	1.3		
6/15/2002	1.4	1.4	1.4
7/1/2002	2.3		
7/15/2002	1.2	1.8	2.3
8/1/2002	1.8		
8/16/2002	2.2	2.0	2.2
9/3/2002	1.9		
9/23/2002	1.8	1.9	1.9
10/1/2002	2.5		
10/16/2002	2.8	2.7	2.8
11/1/2002	1.8		
11/15/2002	2.7	2.3	2.7
12/2/2002	1.7		
12/17/2002	1.5	1.6	1.7
1/1/2003	1.7		
1/15/2003	2.5	2.1	2.5
2/3/2003	1.4		
2/14/2003	1.2	1.3	1.4
3/3/2003	1.6		
3/17/2003	2.0	1.8	2.0
4/1/2003	2.0		
4/15/2003	1.7	1.9	2.0
5/1/2003	4.5		
5/15/2003	1.4	3.0	4.5
6/2/2003	1.6		
6/15/2003	3.1	2.4	3.1
7/2/2003	1.8		
7/15/2003	1.8	1.8	1.8
8/1/2003	1.9		
8/15/2003	2.3	2.1	2.3
9/3/2003	1.4		
9/15/2003	3.4	2.4	3.4
10/1/2003	3.0		
10/14/2003	3.0	3.0	3.0
11/3/2003	2.8		
11/17/2003	3.1	3.0	3.1
12/1/2003	3.0		
12/15/2003	2.8	2.9	3.0
1/5/2004	2.2		
1/15/2004	2.4	2.3	2.4
2/3/2004	2.8		
2/13/2004	3.3	3.1	3.3
3/1/2004	2.5		
3/15/2004	2.2	2.4	2.5
4/1/2004	3.1		
4/16/2004	2.0	2.6	3.1
5/7/2004	1.8		
5/18/2004	2.0	1.9	2.0
6/10/2004	4.3		
6/15/2004	5.3	4.8	5.3
7/1/2004	2.6		
7/23/2004	1.8	2.2	2.6
8/4/2004	2.5		
8/17/2004	2.2	2.4	2.5
9/1/2004	1.7		
9/16/2004	4.1	2.9	4.1
10/4/2004	1.8		
10/18/2004	2.1	2.0	2.1
11/1/2004	2.0		
11/15/2004	2.7	2.4	2.7
12/1/2004	2.8		
12/20/2004	2.4	2.6	2.8

2004 WLSSD Mercury Mass Balance



Western Lake Superior Regional Household Hazardous Waste Program

Accumulating Annual Report for Mercury

January 1, 2004 - December 31, 2004

GENERAL INFORMATION

Facility Location **Duluth, MN**

The containers of waste listed here are full and sealed, ready for shipment. Any partial containers at the end of 2001 are not listed. They will be on the following year's report as sealed.
** Weights include shipping containers and packing material.

	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Year Total
Lab Pack Hg Items (lb)	26.80	55.80	4.00	66.40	153.00
Inorganic Hg Compounds (lb)	0.00	0.00	0.00	0.00	0.00
Organic Hg Compounds (lb)	0.00	0.00	0.00	0.00	0.00
Amalgam Waste (lb)	102.80	74.00	0.00	179.00	355.80
Hg contaminated soil (lb)	0.0	0.00	0.00	0.00	0.00
Total (lb)	129.60	129.80	4.00	245.40	508.80

Breakdown of the Hg Items

items by count	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Year Total
Contaminated Containers/spill kits	0	0	2	2	4
Containers of Elemental Hg	0	0	9	21	30
Organic Compounds	0	0	0	0	0
Inorganic Compounds	0	0	0	0	0
Thermostats	124	0	12	58	194
Switches	0	0	96	19	115
Blood Pressure Meters	0	0	0	1	1
Barometers	0	0	0	0	0
Fever Thermometers	0	0	226	148	374
Lab Thermometers	0	0	19	17	36
Hg Probe	0	0	0	1	1
Hg aquarium thermometer	0	0	6	0	6
hydrometer	0	0	0	1	1
soil thermometers	0	0	0	0	0
pasteurizing/cooking thermometers	0	0	0	2	2
Totals:	124	0	370	270	767

Fluorescent Bulbs for Recycling Total: 24,076

SEP 1 6 2002

XCEL ENERGY'S PROGRESS REPORT UNDER THE MINNESOTA MERCURY INITIATIVE VOLUNTARY AGREEMENT
September 13, 2002

SECTION 1: INTRODUCTION

Xcel Energy submitted a Voluntary Mercury Reduction Plan to the Minnesota Pollution Control Agency (MPCA) on May 17, 2000. This plan identified activities that Xcel Energy would undertake to contribute to reducing the amount of mercury utilized at our facilities and released to the environment. This progress report summarizes the activities Xcel Energy has pursued in 2001 and 2002 (year-to-date).

SECTION 2: ACTIVITIES & PROGRESS TO DATE

1. PRODUCT INVENTORY AND PHASE OUT

   A mercury inventory and disposal database has been developed in Xcel Energy North (NSP). In 2001 work on this database continued. In 2002 our intention is to verify and update this data for reporting.

   All mercury and mercury containing devices removed in 2001 and 2002 (year-to-date) were shipped to the Xcel Energy Chestnut Hazardous Waste Storage Facility where they were placed in bulk containers and shipped off-site for recycling of the mercury. In 2001 and 2002 (year-to-date), a total of 741 pounds of mercury from broken lamps, mercury filled equipment and metallic mercury were collected.

   In 2001 and 2002 (year-to-date) we continued to recycle all lamps, which contain mercury. Activities in Minnesota, Wisconsin, North Dakota and South Dakota resulted in the recycling of 53,504 fluorescent lamps and 51,101 high intensity discharge lamps.

2. EPRI FUNDING

   Xcel Energy continued its support of the Electric Power Research Institute's (EPRI) Air Toxics Health and Risk Assessment programs focused on understanding mercury in the environment and control of mercury from coal fired boilers. EPRI's program provides a nationally unique approach for addressing remaining key scientific uncertainties concerning the exposure, environmental fate, and potential health effects of hazardous pollutants. Research is tightly coordinated with work performed under several EPRI programs involving fuels, plant operations, water quality and environmental control. Products included improved methods for estimating air toxics exposures, as well as better techniques and data for estimating health risks. Field methods for more accurately measuring concentrations and emissions in background environments are developed and tested for wider use by the research community in determining source contributions.

3. EERC CENTER FOR AIR TOXICS METALS FUNDING

   Xcel Energy continued its support of the University of North Dakota Energy and Environmental Research Center's (EERC) Center for Air Toxic Metals (CATM) research on the behavior of air toxic metals to develop methods for prevention and control of air toxic metal emissions from the combustion of fossil fuels.

   In 2002, EERC began work on a project entitled, Mercury Control Technologies for Electric Utilities Burning Lignite Coal". While Xcel Energy operates sub-bituminous coal-fired units in Minnesota, we are funding this

research through EPRI because sub-bituminous coal and lignite coal behave in similar manners in terms of mercury emissions. This research is designed to: 1) provide a better understanding of mercury interactions with flue gas constituents, 2) test a range of sorbent-based technologies targeted at removal of elemental mercury from flue gases, and 3) demonstrate effectiveness of promising control technologies at the pilot scale. Bench-scale testing has been performed to screen potential sorbents. This testing showed that steam-activated carbons made from lignite produce comparable mercury sorbents to commercially available activated carbons. Pilot-scale testing was performed in late June 2002 and results are not yet available for publication.

4. EPRI ASH STUDY

Xcel Energy participated in a collaborative project with EPRI, U.S. Department of Energy (DOE), EERC, Mineral Solutions, Inc., and the University of Minnesota Department of Soil, Water, and Climate on an environmental evaluation for utilization of ash in soil stabilization. The overall project goal was to evaluate the potential for release of constituents into the environment from ash used in soil stabilization projects. The objective was met by determining trace element transport from stabilized sites in both runoff and leachate generation. The results of the testing protocols all indicate that the use of fly ash for soil stabilization can be done in an environmentally sound manner with good engineering performance. The tests also demonstrate that there can be some variability between different fly ash samples, although few leachate trace element concentrations were above any problematic levels.

The University of Minnesota's portion of the study assessed water quality in runoff from ash-stabilized soils. Although the concentration of mercury in the fly ash used in the demonstration was 4 times that of the clay soil, the relative concentration of mercury in runoff water from ash-stabilized soil was less than that from unamended soil. Concentrations of both soluble and particulate-bound mercury were lower in runoff from clay stabilized with 12% fly ash than from unamended clay. As was expected, the large majority of the mercury movement caused by surface water runoff was associated with particulate transport. The cementing action of the fly ash significantly lowered the total concentration of particulate in the runoff.

5. EPRI CONTROL TECHNOLOGY RESEARCH

Xcel Energy is partnering with EPRI and Minnesota Power to evaluate three potential approaches for mercury control at the Minnesota Power's Laskin Energy Center (LEC). LEC has two sub-bituminous coal-fired boilers equipped with wet scrubbers for particulate control. Full scale testing on this type of unit has not been performed to date. The testing was split into three distinct phases:

Phase 1 – Chemical Additive to the Coal and Fuel Blending

EPRI is working with Minnesota Power and Xcel Energy to evaluate potential mercury control processes for coal-fired power plants. As part of this effort, tests were performed at Minnesota Power's Laskin Energy Center to evaluate the effects of both chlorine addition into the boiler and fuel blending on the speciation and fate of mercury across the wet particulate scrubber system.

The fate of mercury in coal-fired flue gas is determined by many factors associated with boiler operation, fuel type, and unit configuration, including installed environmental controls. Mercury speciation (e.g., the fraction of elemental and oxidized forms of mercury present) can be important in determining the ultimate fate of mercury across the flue gas path. Although the exact mechanisms that determine mercury speciation in flue gas are not well understood, data indicate that the amount of chloride in the fuel may play a role. Eastern bituminous coals contain high levels of chlorine and typically produce flue gases with relatively high levels (>50%) of oxidized mercury. Oxidized forms of mercury are assumed soluble in water and can be removed in wet absorbers.

Western coals are typically low in chlorine and produce flue gases with high fractions of elemental mercury, which is insoluble in water.

Minnesota Power's LEC fires a low-sulfur subbituminous coal. This coal would be expected to produce a flue gas high in elemental mercury. Mercury removal in the wet particulate scrubber would therefore be expected to be low. In this program, tests were performed to determine if addition of chlorine to the LEC fuel results in enhanced oxidation of mercury in the flue gas and, subsequently, enhanced removal of mercury across the downstream wet absorber. Mercury measurements were made by URS using EPRI semi-continuous mercury analyzers to evaluate mercury speciation downstream of the air preheater as well as mercury removal across the wet particulate scrubber system. Manual gas sampling was also conducted using EPRI's mini-gas sampling unit to measure flue gas chloride (HCl) concentrations upstream and downstream of the scrubber.

Two groups of tests evaluated different methods of adding chlorine to the LEC boiler. In the first test group, dry chloride salts were added to the fuel feed just upstream of the mill; therefore, as the fuel is added to the boiler, the salts were also added. Tests evaluated the effect of chloride salt type and feed rate on flue gas mercury speciation and scrubber removal. In the second test group, bituminous and sub-bituminous coals were co-fired as a blend to create fuels of different chlorine content. It was anticipated that the addition of the high-chloride eastern coal to the Laskin fuel would result in increased mercury oxidation in the flue gas and, subsequently, higher removal across the absorber.

Tests to date with the addition of chemical compounds to the boiler showed that some of these can convert a significant portion of the elemental to oxidized mercury. However, not all of the oxidized mercury formed was easily removed in the downstream wet particulate scrubber units. Different chemical additives appeared to produce different oxidized mercury species, although this cannot be confirmed due to limitations in the current mercury measurement techniques. There appeared to be some mercury re-emissions from the scrubber. Some of the chemical additives did improve the overall mercury removal across the wet particulate scrubber. A number of balance-of-plant impacts were also observed, including boiler tube and air heater fouling and increased opacity. These impacts, along with potential corrosion problems, need to be assessed with longer-term tests and plant operation before judgments are made on the viability of this approach towards reducing mercury emissions.

Phase 2 – Activated Carbon Injection

Activated Carbon Injection (ACI) upstream of ESP's and baghouses is currently the most viable near term method for flue gas mercury control (this is especially true for control of elemental mercury). No data, however, exists for the effectiveness of ACI before a wet particulate scrubber (WPS). Thus, it is uncertain whether ACI before a WPS can be a cost-effective option, the maximum removal achievable, and the impact on WPS outlet particulate emissions and waste disposal. This testing was only recently completed and results are not currently available for publication.

Phase 3 – MerCAP™

Another potential novel option for mercury control at LEC is EPRI's MerCAP™ technology. This concept removes mercury with plates coated with thin layers of gold materials that form amalgams with mercury—MerCAP™, or Mercury Capture by Amalgamation Processes. The plates are placed at suitable locations in the ductwork downstream of the air heater where temperatures are normally <400°F. Mercury in the flue gas would be removed by the gold on the plate surface as the flue gas passes over the plates. Upon saturation with mercury, the plates could be regenerated by heating. This testing is currently under way, so results are pending.

6. FUEL SAMPLING

Xcel Energy has completed its fourth year of mercury testing in fuel samples. Daily fuel samples were taken from each of the coal and RDF fired electric generating plants. The daily fuel samples were then made into quarterly composites and analyzed for mercury. The mercury data was utilized in mass balance formulas to calculate total release information for the annual Toxic Release Inventory. Xcel Energy continues to utilize coal that has one of the lowest mercury contents available in the United States.

7. REPOWERING

Xcel Energy has completed the repowering of Black Dog units 1 and 2 with a natural gas combined-cycle unit 5. The original unit 1 boiler/turbine and the unit 2 boiler were originally installed in the 1950s and were coal-burning units. These units were physically removed from the plant with the new unit 5 being installed in their place. The new unit 5 consists of a natural gas-fired turbine-generator combined with a heat recovery steam generator. Exhaust heat from unit 5 powers the unit 2 steam turbine. The repowering project, completed in summer of 2002, boosts output from the two original units by more than 100 MWs and results in greater operating efficiency and cleaner power production. Specifically, the new unit will eliminate upto 35 pounds of mercury emitted annually from the Xcel Energy system.

8. CONVERSION TO NATURAL GAS STUDIES AND METRO EMISSION REDUCTION PLAN

In 2000, Xcel Energy commented on evaluation studies done on converting the High Bridge and Riverside plants to natural gas. These evaluations were the precursors to a much bigger study of repowering options.

In May 2002, Xcel Energy proposed a $1 billion package of projects over the next seven years at three of its generating plant to improve air quality in the Twin Cities metropolitan area and beyond. This proposal, also known as the Metro Emissions Reduction Plan, has been submitted to the Minnesota Public Utilities Commission (MPUC) for review. An additional filing was submitted to the MPUC in July 2002. The Minnesota Pollution Control Agency is actively reviewing this proposal to assist the MPUC in their review of this proposal.

The proposed Metro Emissions Reduction Plan consists of converting the High Bridge and Riverside Plants to natural gas and installing state-of-the-art pollution control equipment at the Allen S. King Plant. Upon completion of this project, mercury emission reductions of approximately 20%, 100% and 100% from the King, High Bridge, and Riverside Plants, respectively, are expected from current levels. These percentages translate to approximately 170 pounds per year of mercury that would not be released to the environment if these projects were approved.

9. INFORMATION DISSEMINATION

Selected Xcel Energy customer communications vehicles have contained information on mercury and identified mercury-containing products typically used in a residential home along with detailing alternatives and proper disposal techniques. Xcel Energy has also incorporated information about mercury on its website.

10. Hg Sniffing Dog

Xcel Energy helped fund Clancy, a dog specially trained to detect mercury, which the MPCA utilizes in its Mercury-Free Zone program. Clancy is being used to detect mercury mainly in sink traps at schools, institutional and industrial sites. As part of this cooperative effort, Xcel Energy is credited with 100% of the mercury reductions due to Clancy's investigations at Xcel Energy facilities and Xcel Energy receives credit for 15% of the reductions made due to Clancy's investigations at non-Xcel Energy facilities for the first 18 months of this project (September 2001 through March 2003). So far Clancy has sniffed out a total of about 270 pounds of pure mercury, which has been removed from these facilities and kept out of the environment. Total mercury reductions credited to Xcel Energy due to Clancy's investigations, are 40.5 pounds of mercury.

11. Combustion Byproducts Recycling Coalition R&D Project

Xcel Energy partnered with ADA Technologies, Inc. under a Combustion Byproducts Recycling Coalition Project at its Comanche Generating Station in Colorado. This project investigated pilot scale testing of fly ash materials as mercury sorbents as an alternative to activated carbon. This testing showed that fly ash materials successfully remove mercury from flue gas streams at high injection rates. The testing showed that there is also significant particulate matter removal but there was no change in the level of SO_2 removal. This work continues to offer promise.

Section 3: Summary of Reductions to Date

This progress summarizes Xcel Energy's mercury reduction efforts for 2001 and 2002 (year-to-date). Xcel Energy has implemented a number of initiatives since 1990, which have reduced the amount of mercury utilized at our facilities and released to the environment. The repowering of Black Dog units 1 and 2 will result in a reduction of 35 pounds of mercury per year not being released to the atmosphere each year from the Xcel Energy system. Efforts such as product inventory and phase out, fluorescent light bulb rebates, and Clancy-the mercury-sniffing dog have resulted in mercury reductions of 781 pounds which are not being released to the environment. In addition, Xcel Energy continued to advance the understanding of mercury in the environment by funding research with EPRI, EERC and DOE. Last but not least, Xcel Energy has proposed a Metro Emissions Reduction Plan, which is expected to reduce annual mercury emissions by nearly 170 pounds per year once implemented.

XCEL ENERGY'S 2002 PROGRESS REPORT UNDER THE MINNESOTA MERCURY INITIATIVE VOLUNTARY AGREEMENT

November 6, 2003

Xcel Energy submitted a Voluntary Mercury Reduction Plan to the Minnesota Pollution Control Agency (MPCA) on May 17, 2000. This plan identified activities that Xcel Energy would undertake to contribute to reducing the amount of mercury utilized at our facilities and released to the environment. This progress report summarizes the activities Xcel Energy has pursued in 2002 and 2003 (year-to-date).

Section 1: Background

Xcel Energy was formed in 2000 by the merger of Denver-based New Century Energies and Minneapolis-based Northern States Power Company. Xcel Energy is the fourth-largest combination electricity and natural gas energy company in the United States. We offer a comprehensive portfolio of energy-related products and services to 3.2 million electricity customers and 1.7 million natural gas customers. We have regulated operations in 11 Western and Midwestern states and operate regulated power plants that generate about 15,246 megawatts (MW) of electric power.

Northern States Power Company, d/b/a Xcel Energy operates the following generating plants in Minnesota which report mercury emissions:

Generating Plants	Location	Fuel Type
Allen S. King Generating Plant	Oak Park Heights	Coal
Black Dog Generating Plant	Burnsville	Coal (units 3 & 4) Gas (unit 5/2)
Blue Lake Generating Plant	Shakopee	Distillate Fuel Oil
Granite City Generating Pant	St. Cloud	Natural Gas or Distillate Fuel Oil
High Bridge Generating Plant	St. Paul	Coal
Inver Hills Generating Plant	Inver Grove Heights	Natural Gas or Distillate Fuel Oil
Key City Generating Plant	Mankato	Distillate Fuel Oil
Minnesota Valley Generating Plant	Granite Falls	Coal
Red Wing Generating Plant	Red Wing	Refuse Derived Fuel
Riverside Generating Plant	Minneapolis	Coal
Sherburne County Generating Plant	Becker	Coal
West Faribault Generating Plant	West Faribault	Natural Gas or Distillate Fuel Oil
Wilmarth Generating Plant	Mankato	Refuse Derived Fuel

All fuels contain mercury in varying amounts. Combustion of fuel results in the release of the mercury contained in the fuel itself.

Section 2: Voluntary Agreement Program Support

Xcel Energy supports the Voluntary Agreement Program and has been a participant in this program since May 2000. Our support is based on the following principles: 1) voluntary programs enable participants to look at many alternatives and choose those that best fit an organization's needs; 2) this program allows for the continued development of the science behind mercury emissions; 3) this program encourages the development of mercury control technologies; and 4) this program documents actual emissions from the participants.

Section 3: Efforts to Support Reduction of Hg Releases Outside of the Facility/Company

Xcel Energy's primary activities supporting mercury reductions outside of the company fall into two primary areas, information dissemination and through Clancy, the Mercury-sniffing dog. Information dissemination consisted of developing and distributing selected Xcel Energy customer communications vehicles containing information on mercury. These materials also identify mercury-containing products typically used in a residential home along with detailing alternatives and proper disposal techniques. Xcel Energy has also incorporated information about mercury on our website.

The second area of outside activities supporting mercury reductions focused on Clancy, the Mercury sniffing dog. Xcel Energy helped fund Clancy, a dog specially trained to detect mercury, which the MPCA utilizes in its Mercury-Free Zone program. Clancy is being used to detect mercury mainly in sink traps at schools, institutional and industrial sites. As part of this cooperative effort, Xcel Energy is credited with 100% of the mercury reductions due to Clancy's investigations at Xcel Energy facilities and Xcel Energy receives credit for 15% of the reductions made due to Clancy's investigations at non-Xcel Energy facilities for the first 18 months of this project (September 2001 through March 2003). So far Clancy has sniffed out a total of about 550 pounds of pure mercury[1], which has been removed from these facilities and kept out of the environment. Total mercury reductions credited to Xcel Energy due to Clancy's investigations, are 74.1 to 82.5 pounds of mercury.

Section 4: Use and Management of Mercury Containing Products

Northern States Power Company, d/b/a Xcel Energy, has developed a mercury inventory and disposal database. All mercury and mercury containing devices removed in 2002 and 2003 (through 9/30/2003) were shipped to the Xcel Energy Chestnut Hazardous Waste Storage Facility where they were placed in bulk containers and shipped off-site for recycling of the mercury. During this time, a total of 953 pounds of mercury from broken lamps, mercury filled equipment and metallic mercury were collected [703 lbs in 2002 and 250 lbs in 2003 (through 9/30/2003)].

In 2002 and 2003 (through 9/30/2003) we continued to recycle all lamps, which contain mercury. Activities in Minnesota, Wisconsin, North Dakota and South Dakota resulted in the recycling of 52,699 fluorescent lamps [33,642 in 2002 and 19,057 in 2003 (through 9/30/2003)] and 68,015 high intensity discharge lamps [35,391 in 2002 and 32,624 in 2003 (through 9/30/2003)].

Section 5: Mass Balance Studies

Xcel Energy has completed its fifth year of mercury testing in fuel samples. Daily fuel samples were taken from each of the coal and RDF fired electric generating plants. The daily fuel samples were then made into quarterly composites and analyzed for mercury. The mercury data was utilized in mass balance formulas to calculate total release information for the annual Toxic Release Inventory. Xcel Energy continues to utilize coal that has one of the lowest mercury contents available in the United States.

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[1] As of May 1, 2003 Clancy has found 550 lbs of mercury. We can estimate the value as of the end of March, 2003 by using the values: 550 lb (5/03) and 270 lb (7/02):

Total = 270 lb + [(550 – 270 lb) * (8 months/10 months)] = 494 lb

15% of the 20 month total is [0.15 * 550 lb] = 82.5 lbs

15% of the estimated 18 month total is [0.15 * 494 lb] = 74.1 lbs.

Section 6: Release Reduction Research

Xcel Energy continues to seek a cost-effective mercury control solution for coal-burning boilers. A description of our efforts to date is presented below.

A. EPRI Funding

Xcel Energy supported the Electric Power Research Institute's (EPRI) Integrated Environmental Controls (Hg, SO_2, NOx, & Particulate) program. This program has a near-term focus of completing the development and demonstration of least-cost mercury controls for coal-fired power plants and on evaluating integrated multi-pollutant processes, as they are developed and mature. The program has a mercury control goal of 70-90% reduction (relative to the mercury in the coal entering the plant) at costs that are 25-50% below currently estimated costs, including measures needed to mitigate any potential impacts. EPRI seeks to achieve this goal in part through development of lower cost reagents, alternative approaches to activated carbon injection, methods of delivering a flue gas with a high proportion of soluble mercury to SO_2 control devices, etc.

B. EERC Funding

Xcel Energy continued its support of the University of North Dakota Energy and Environmental Research Center's (EERC) Center for Air Toxic Metals (CATM) research on the behavior of air toxic metals to develop methods for prevention and control of air toxic metal emissions from the combustion of fossil fuels. Our support of EERC comes through funding to EPRI, who contracted with EERC to perform this work.

In 2002, EERC began work on a project entitled, "Mercury Control Technologies for Electric Utilities Burning Lignite Coal". While Xcel Energy operates sub-bituminous coal-fired units in Minnesota, we are funding this research through EPRI because sub-bituminous coal and lignite coal behave in similar manners in terms of mercury emissions. This research is designed to: 1) provide a better understanding of mercury interactions with flue gas constituents, 2) test a range of sorbent-based technologies targeted at removal of elemental mercury from flue gases, and 3) demonstrate effectiveness of promising control technologies at the pilot scale. Phase I testing consists of bench and pilot-scale testing to identify sorbents, operating and process conditions and combinations of particulate control devices that are most effective for removing mercury from lignite combustion flue gases.

The conclusions of Phase I of this testing were presented at the Combined Power Plant Air Pollution Control Mega Symposium held in May 2003 in Washington, D.C., which included:

- The relative proportion of Hg^0, Hg^{2+}, and Hg(p) in North Dakota lignite combustion flue gases were approximately 85%, 15% and <1%, respectively.
- Increasing activated carbon injection rates and decreasing flue gas temperatures in the control devices tested significantly improved mercury removal.
- A reduction in activated carbon particle size did not consistently improve mercury capture.
- The relative mercury removal efficiencies for the control device technologies tested were: ESP-FF ≈ *Advanced Hybrid*™ filter (similar performance) > Fabric Filter (FF) > Electrostatic Precipitator (ESP).

- Pilot-scale results show lignite-burning units require higher activated carbon injection rates to achieve similar Hg removals compared to full-scale test data for eastern bituminous coals.

Based on these results, the project is moving into Phase II, where activities will focus on a field-testing demonstration of a fabric filter coupled with sorbent injection mercury control system. Xcel Energy will not be directly funding the Phase II testing, therefore this data will not be included in future progress reports.

C. EPRI Control Technology Research – Project 1

In 2002, Xcel Energy partnered with EPRI and Minnesota Power to evaluate three potential approaches for mercury control at Minnesota Power's Laskin Energy Center (LEC). LEC has two sub-bituminous coal-fired boilers equipped with wet scrubbers for particulate control. Full scale testing on this type of unit has not been performed to date. The testing was split into three distinct phases:

Phase 1 – Chemical Additive to the Coal and Fuel Blending

The first set of tests performed at Minnesota Power's LEC evaluated the effects of both chlorine addition into the boiler and fuel blending on the speciation and fate of mercury across the wet particulate scrubber system.

The fate of mercury in coal-fired flue gas is determined by many factors associated with boiler operation, fuel type, and unit configuration, including installed environmental controls. Mercury speciation (e.g., the fraction of elemental and oxidized forms of mercury present) can be important in determining the ultimate fate of mercury across the flue gas path. Although the exact mechanisms that determine mercury speciation in flue gas are not well understood, data indicate that the amount of chloride in the fuel may play a role. Eastern bituminous coals contain high levels of chlorine and typically produce flue gases with relatively high levels (>50%) of oxidized mercury. Oxidized forms of mercury are assumed soluble in water and can be removed in wet absorbers. Western coals are typically low in chlorine and produce flue gases with high fractions of elemental mercury, which is insoluble in water.

Minnesota Power's LEC fires a low-sulfur sub-bituminous coal. This coal would be expected to produce a flue gas high in elemental mercury. Mercury removal in the wet particulate scrubber would therefore be expected to be low. In this program, tests were performed to determine if addition of chlorine to the LEC fuel results in enhanced oxidation of mercury in the flue gas and, subsequently, enhanced removal of mercury across the downstream wet scrubber. Mercury measurements were made by URS using EPRI semi-continuous mercury analyzers to evaluate mercury speciation downstream of the air preheater as well as mercury removal across the wet particulate scrubber system. Manual gas sampling was also conducted using EPRI's mini-gas sampling unit to measure flue gas chloride (HCl) concentrations upstream and downstream of the scrubber.

Two groups of tests evaluated different methods of adding chlorine to the LEC boiler. In the first test group, dry chloride salts were added to the fuel feed just upstream of the mill; therefore, as the fuel is added to the boiler, the salts were also added. Tests evaluated the effect of chloride salt type and feed rate on flue gas mercury speciation and scrubber removal. In the second test group, bituminous and sub-bituminous coals were co-fired as a blend to create fuels of different chlorine content. It was anticipated that the addition of the

high-chloride eastern coal to the Laskin fuel would result in increased mercury oxidation in the flue gas and, subsequently, higher removal across the absorber.

The addition of chemical compounds to the boiler showed that some of these do convert a significant portion of the elemental to oxidized mercury. However, not all of the oxidized mercury formed was easily removed in the downstream wet particulate scrubber units. Different chemical additives appeared to produce different oxidized mercury species, although this cannot be confirmed due to limitations in the current mercury measurement techniques. There appeared to be some mercury re-emissions from the scrubber. Some of the chemical additives did improve the overall mercury removal across the wet particulate scrubber. A number of balance-of-plant impacts were also observed, including boiler tube and air heater fouling and increased opacity. These impacts, along with potential corrosion problems, need to be assessed with longer-term tests and plant operation before judgments are made on the viability of this approach towards reducing mercury emissions.

Phase 2 – Activated Carbon Injection

The second set of tests performed at Minnesota Power's Laskin Energy Center evaluated the effectiveness of Activate Carbon Injection (ACI) upstream of a wet scrubber system for mercury control. ACI upstream of ESP's and baghouses is currently the most viable near term method for flue gas mercury control (this is especially true for control of elemental mercury). No data, however, exists for the effectiveness of ACI before a wet particulate scrubber (WPS). Thus, it is uncertain whether ACI before a WPS can be a cost-effective option. This testing sought to determine the maximum mercury removal rate achievable with ACI. In addition, it sought to determine the impact on WPS outlet particulate emissions and waste disposal that ACI would have.

The conclusions from this testing were:

- Most of the vapor phase mercury at LEC was the elemental form.
- The untreated activated carbons displayed poor mercury removal effectiveness at injection rates up to 12 lb/MMACF.
- The activated carbon treated with iodine demonstrated improved mercury removal performance compared to the untreated carbons. At the highest injection rate of 11 lb/MMACF, the mercury removal across the scrubber was 54%. Further tests will be needed to determine the tradeoff of increased mercury removal versus higher sorbent costs.
- Testing indicates that mercury is captured in-flight within 1 second downstream of sorbent injection and that some of the mercury collected by the untreated sorbents may be released in the scrubber. Test data shows that for treated carbon injection, most of the mercury was removed by the carbon prior to entering the scrubber and the mercury concentration did not increase across the scrubber.

A more detailed discussion of the of the chemical addition and activated carbon injection testing and results at LEC was presented in at the Combined Power Plant Air Pollution Control Mega Symposium held in May 2003 in Washington, D.C. in a paper titled "Full-Scale Evaluation of Mercury Control Across A Wet Particulate Scrubber."

Phase 3 – MerCAP™

EPRI's novel mercury control technology, MerCAP™, or Mercury Control Adsorption Process, was also tested at LEC. This technology consists of placing a rigid, mercury adsorbing sorbent-coated structure in a duct. Mercury is removed from the flue gas as it flows past the rigid structure. When the plates or tubes are saturated with mercury, they can be removed as a cartridge or regenerated in-situ. The mercury can be recovered and isolated.

At LEC, tests were performed using gold-coated MerCAP™ plates. The gold probe was installed into a vertical test port at the inlet of the wet scrubber. Theoretical predictions suggested that 60% mercury removal should be achieved across the 10-foot probe at a gas velocity of 34 ft/sec. Initial mercury measurements showed only 20% removal. After 1,120 hours, the probe was partially plugged with fly ash. Mercury measurements made at the highest flow achievable through the plugged probe (14 ft/sec) indicated 9% mercury removal. This data supports earlier results indicating lower effectiveness on unscrubbed low-rank coal flue gas.

A more detailed discussion of the of the MerCAP™ testing and results at LEC was presented in at the Combined Power Plant Air Pollution Control Mega Symposium held in May 2003 in Washington, D.C. in a paper titled "Development and Demonstration of Mercury Control by Adsorption Processes (MerCAP™)."

D. EPRI Control Technology Research – Project 2

Xcel Energy has partnered with EPRI to evaluate the flue gas mercury concentration, speciation and removal effectiveness of the existing pollution control equipment at Xcel Energy's Sherburne County Generating Plant, Unit 1. EPRI is also evaluating the technical potential and economic feasibility of other options to further reduce stack mercury concentrations and particulate emissions.

The work in this testing program was split between evaluation of EPRI's multi-Pollutant Control Test (multi-PoCT) system and evaluation of EPRI's Mini-MerCAP™. Mercury concentrations were made using EPRI's continuous mercury analyzet, which is capable of total and speciated mercury measurements.

The multi-PoCT system was configured as a dual compartment pulse-jet baghouse to assess mercury removal effectiveness across a baghouse downstream of a wet ESP. A variety of materials were injected into the system upstream of the PoCT baghouse to characterize mercury removal effectiveness. A number of variables were examined, including: sorbent injected, fabric filter media, flue gas temperature, and sorbent particle size.

Testing has been completed, however analysis of the results continues. Based on this fact, the results are not yet available for publication, although they will be included in future progress reports as they become available.

E. Continuing Barriers to Reducing Mercury Emissions

Several barriers continue to exist which prevent utilities from installing control technology for mercury removal.

- Regulatory Uncertainty – Until Federal regulations are finalized, it is unknown what removal rates will be required. It is risky to invest in control technologies, which may not satisfy future requirements.
- No Proven Commercial Control Technology – Several short-term control technology tests have been completed on small- and full-scale units that have shown some success. However, a long-term, full-scale commercial installation of mercury control technology has not been made and fully tested. As a result, all mercury control technologies are still consideted experimental technologies.
- Balance of Plant Issues – Long-term testing of different control technologies is needed to determine the full range of plant impacts. Boiler corrosion, boiler fouling, increased opacity, etc. are all examples of Balance of Plant Issues that must be investigated and corrected before full-scale implementation of any technology.
- Ash Issues – Sorbent injection for mercury removal can adversely impact ash utilization efforts. Ash contaminated with activated carbon cannot be sold for utilization and must be landfilled.
- Activated Carbon Issues – Suppliers of Activated Carbon do not currently have the production capacity to supply the entire utility industry. It will take suppliers several years to build the necessary production capacity if activated carbon injection is required on utility boilers.

Section 7: Past Efforts to Reduce Emissions

Northern States Power Company, d/b/a Xcel Energy, has submitted the annual Mercury Emissions Reports as required by the Mercury Emissions Consumer Information Act. This information is summarized in Appendix A.

A. Repowering

In 2002, Xcel Energy completed the repowering of Black Dog units 1 and 2 with a natural gas combined-cycle unit 5. The original unit 1 boiler/turbine and the unit 2 boiler were originally installed in the 1950s and were coal-burning units. These units were physically removed from the plant with the new unit 5 being installed in their place. The new unit 5 consists of a natural gas-fired turbine-generator combined with a heat recovery steam generator. Exhaust heat from unit 5 powers the unit 2 steam turbine. The repowering project, completed in summer of 2002, boosts output from the two original units by more than 100 MWs and results in greater operating efficiency and cleaner power production. Specifically, the new unit will eliminate upto 35 pounds of mercury emitted annually from the Xcel Energy system. In 2002, unit 5 emitted 0.6 pounds of mercury.

B. Metro Emissions Reduction Project

In May 2002, Xcel Energy proposed a $1 billion package of projects at three of its generating plants to improve air quality in the Twin Cities metropolitan area and beyond. This proposal, also known as the Metro Emissions Reduction Plan (MERP), has been submitted to the Minnesota Public Utilities Commission (MPUC) for review. The MPUC is expected to make their decision by the end of 2003.

The proposed MERP consists of converting the High Bridge and Riverside Plants to natural gas and installing state-of-the-art pollution control equipment at the Allen S. King Plant. Upon completion of this project, mercury emission reductions of approximately 20%, 100% and 100% from the King, High Bridge, and Riverside Plants, respectively, are expected from current levels. These percentages translate to approximately 170 pounds per year of mercury that would not be released to the environment if these projects were approved.

Section 8: Summary

This progress report summarizes Xcel Energy's mercury reduction efforts for 2002 and 2003 (through 9/30/03). Xcel Energy has implemented a number of initiatives since 1990, which have reduced the amount of mercury utilized at our facilities and released to the environment. A number of projects have resulted in mercury reductions over the years, including the repowering of Black Dog units 1 and 2 **[upto 35 pounds per year]**, and the pollution control technology upgrade at the Red Wing Steam Plant **[324.6 pounds per year]**. Other mercury reduction efforts, which have occurred within the Xcel Energy system, include activities such as product inventory and phase-out **[953 pounds]**, fluorescent light bulb rebates and Clancy, the Mercury-sniffing dog **[74.1 to 82.5 pounds]**. These efforts have resulted in reductions of mercury, which is no longer being released to the environment. In addition, Xcel Energy continues to advance the understanding of mercury in the environment by funding research with EPRI and DOE. Last but not least, Xcel Energy has proposed a Metro Emissions Reduction Plan, which is expected to reduce annual mercury emissions by nearly 170 pounds per year once implemented.

Appendix A
Northern States Power Company d/b/a Xcel Energy Mercury Emission History

Generating Plants	Emissions Data (lb/yr)			
	1990	2000	2001	2002
Allen S. King Generating Plant	59	69	69	68.8
Black Dog Generating Plant	75	49	36	48.0
Blue Lake Generating Plant	0	<3	0.1	0.1
Granite City Generating Plant	0	0	0	0.0
High Bridge Generating Plant	102.6	66	71	67.2
Inver Hills Generating Plant	0	<3	<3	0.3
Key City Generating Plant	0	<3	0	0.0
Minnesota Valley Generating Plant	0	0	0	0.0
Red Wing Generating Plant	332.8	<3	10.3	8.2
Riverside Generating Plant	60	98	91	98.0
Sherburne County Generating Plant	637	886	685	877.8
West Faribault Generating Plant	0	0	0	0.0
Wilmarth Generating Plant	4.6	7	2.6	2.1
TOTAL	1,271	1,175	965	1,170.5
Reduction from 1990 levels	-	96	306	100.5

XCEL ENERGY'S 2003 & 2004 PROGRESS REPORT UNDER THE MINNESOTA MERCURY INITIATIVE VOLUNTARY AGREEMENT

December 28, 2004

Xcel Energy submitted a Voluntary Mercury Reduction Plan to the Minnesota Pollution Control Agency (MPCA) on May 17, 2000. This plan identified activities that Xcel Energy would undertake to contribute to reducing the amount of mercury utilized at our facilities and released to the environment. This progress report summarizes the activities Xcel Energy has pursued in 2003 and 2004 (year-to-date).

Section 1: Background

Xcel Energy was formed in 2000 by the merger of Denver-based New Century Energies and Minneapolis-based Northern States Power Company. Xcel Energy is a major U.S. electric and natural gas utility, with a comprehensive portfolio of energy-related products and services to 3.3 million electricity customers and 1.8 million natural gas customers. We have regulated operations in 11 Western and Midwestern states and operate regulated power plants that generate about 15,433 megawatts (MW) of electric power.

Northern States Power Company, d/b/a Xcel Energy operates the following generating plants in Minnesota which report mercury emissions:

Generating Plants	Location	Fuel Type
Allen S. King Generating Plant	Oak Park Heights	Coal
Black Dog Generating Plant	Burnsville	Coal (units 3 & 4) Gas (unit 5/2)
Blue Lake Generating Plant	Shakopee	Distillate Fuel Oil
Granite City Generating Pant	St. Cloud	Natural Gas or Distillate Fuel Oil
High Bridge Generating Plant	St. Paul	Coal
Inver Hills Generating Plant	Inver Grove Heights	Natural Gas or Distillate Fuel Oil
Key City Generating Plant	Mankato	Distillate Fuel Oil
Minnesota Valley Generating Plant	Granite Falls	Coal
Red Wing Generating Plant	Red Wing	Refuse Derived Fuel
Riverside Generating Plant	Minneapolis	Coal
Sherburne County Generating Plant	Becker	Coal
West Faribault Generating Plant	West Faribault	Natural Gas or Distillate Fuel Oil
Wilmarth Generating Plant	Mankato	Refuse Derived Fuel

All fuels contain mercury in varying amounts. Combustion of fuel results in the release of the mercury contained in the fuel itself.

Section 2: Voluntary Agreement Program Support

Xcel Energy supports the Voluntary Agreement Program and has been a participant in this program since May 2000. Our support is based on the following principles: 1) voluntary programs enable participants to look at many alternatives and choose those that best fit an organization's needs; 2) this program allows for the continued development of the science behind mercury emissions; 3) this program encourages the development of mercury control technologies; and 4) this program documents actual emissions from the participants.

Section 3: Efforts to Support Reduction of Hg Releases Outside of the Facility/Company

Xcel Energy's primary activity supporting mercury reductions outside of the company was through Clancy, the Mercury-sniffing dog. Xcel Energy helped fund Clancy, a dog specially trained to detect mercury, which the MPCA utilizes in its Mercury-Free Zone program. Clancy is being used to detect mercury mainly in sink traps at schools, institutional and industrial sites. As part of this cooperative effort, Xcel Energy is credited with 100% of the mercury reductions due to Clancy's investigations at Xcel Energy facilities and Xcel Energy receives credit for 15% of the reductions made due to Clancy's investigations at non-Xcel Energy facilities for the first 18 months of this project (September 2001 through March 2003). During this time, Clancy has sniffed out a total of about 550 pounds of pure mercury[1], which has been removed from these facilities and kept out of the environment. Mercury reductions credited to Xcel Energy due to Clancy's investigations totaled 74.1 pounds.

Section 4: Use and Management of Mercury Containing Products

Northern States Power Company, d/b/a Xcel Energy, has developed a mercury inventory and disposal database. All mercury and mercury containing devices removed in 2003 and 2004 (through 11/30/2004) were shipped to the Xcel Energy Chestnut Hazardous Waste Storage Facility where they were placed in bulk containers and shipped off-site for recycling of the mercury. During this time, a total of 3,531 pounds of mercury from broken lamps, mercury filled equipment and metallic mercury were collected [2,787 lbs in 2003 and 744 lbs in 2004 (through 11/30/2004)].

In 2003 and 2004 (through 11/30/2004) we continued to recycle all lamps, which contain mercury. Activities in Minnesota, Wisconsin, North Dakota and South Dakota resulted in the recycling of 49,407 fluorescent lamps [24,906 in 2003 and 24,501 in 2004 (through 11/30/2004)] and 86,704 high intensity discharge lamps [44,316 in 2003 and 42,388 in 2004 (through 11/30/2004)].

Totals from both of these areas over time are summarized in Appendix A.

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[1] As of May 1, 2003 Clancy has found 550 lbs of mercury. The value as of the end of March, 2003 was estimated by using the values: 550 lb (5/03) and 270 lb (7/02):
Total = 270 lb + [(550 – 270 lb) * (8 months/10 months)] = 494 lb
15% of the 20 month total is [0.15 * 550 lb] = 82.5 lbs
15% of the estimated 18 month total is [0.15 * 494 lb] = 74.1 lbs.

Section 5: Mass Balance Studies

Xcel Energy has completed its sixth year of mercury testing in fuel samples. Daily fuel samples were taken from each of the coal and RDF fired electric generating plants. The daily fuel samples were then made into annual composites and analyzed for mercury. The mercury data was utilized in mass balance formulas to calculate total release information for the annual Toxic Release Inventory. Xcel Energy continues to utilize coal that has one of the lowest mercury contents available in the United States.

Section 6: Release Reduction Research

Xcel Energy continues to seek cost-effective mercury control solutions for coal-burning boilers. A description of our efforts to date is presented below.

A. EPRI Funding

Xcel Energy supports the Electric Power Research Institute's (EPRI) Integrated Environmental Controls (Hg, SO_2, NOx, & Particulate) program. This program has a near-term focus of completing the development and demonstration of least-cost mercury controls for coal-fired power plants and on evaluating integrated multi-pollutant processes, as they are developed and mature. The program has a mercury control goal of 70-90% reduction (relative to the mercury in the coal entering the plant) at costs that are 25-50% below currently estimated costs, including measures needed to mitigate any potential impacts. EPRI seeks to achieve this goal in part through development of lower cost reagents, alternative approaches to activated carbon injection, methods of delivering a flue gas with a high proportion of soluble mercury to SO_2 control devices, etc.

B. EPRI Control Technology Research

During the two projects discussed below, both activated carbon and Amended Silicates sorbents were injected separately into the flue gas over a range of rates, and researchers measured the level of mercury removal for each material. Sorbents are solid particles that can be injected into flue gas to remove emissions before they leave a power plant's stack. Amended Silicates sorbent is similar to sand or clay and is impregnated with chemicals that attract mercury and mercury compounds. Activated carbon is a finely powdered carbon treated to make it highly absorbent. After the mercury adheres to the sorbent, it is collected with the station's fly ash in a baghouse. Baghouses contain thousands of bags that capture more than 99 percent of particulates in flue gas.

Previous small-scale testing by Xcel Energy and others indicated that both sorbents have the potential to effectively remove mercury from flue gas. Amended Silicates sorbent may offer an additional advantage in that it does not affect future use of fly ash. Fly ash can be recycled for beneficial purposes, such as in concrete or road base material, if it does not contain certain emission removal by-products, such as carbon, that can make it unmarketable.

The coal used by Xcel Energy contains extremely low amounts of mercury, and much of that mercury is already captured in baghouses installed on the company's coal-fired units. Mercury removal technology is being developed to further reduce mercury emissions to meet potential environmental regulation. Several of the company's power plants in Colorado and Minnesota have hosted mercury removal research, using different technologies and testing scenarios.

1. Pilot Testing at Sherco 1

Xcel Energy partnered with EPRI to evaluate pollution control technologies including options for mercury control, acid gas control, and particulate control. One option for control addressing these areas is the EPRI-patented TOXECON™ (sorbent injection after a primary particulate collector such as a wet ESP but before a downstream baghouse) arrangement with sorbent injection for mercury and acid gas control. Although research using the TOXECON™ technology has been conducted for several years, several questions remain. These include the effectiveness of novel, lower cost fabrics for emission control and the performance (e.g. cleaning frequency, pressure drop, and expected lifetime) resulting from baseline operation and sorbent injection. Another mercury control option evaluated at Sherco 1 was MerCAP™ (Mercury Control via Adsorption Process), a novel mercury removal concept using both gold-coated and silver-coated screens.

Pilot-scale parametric testing was conducted at Xcel Energy's Sherburne County Generating Plant, Unit 1 (Sherco 1) in Becker Minnesota. Sherco 1 is a tangential-fired boiler with a net capacity of 712 MW that burns a Powder River Basin (PRB) coal and is equipped with a wet venturi scrubber/ESP (wet ESP) module for control of sulfur dioxide and particulate emissions.

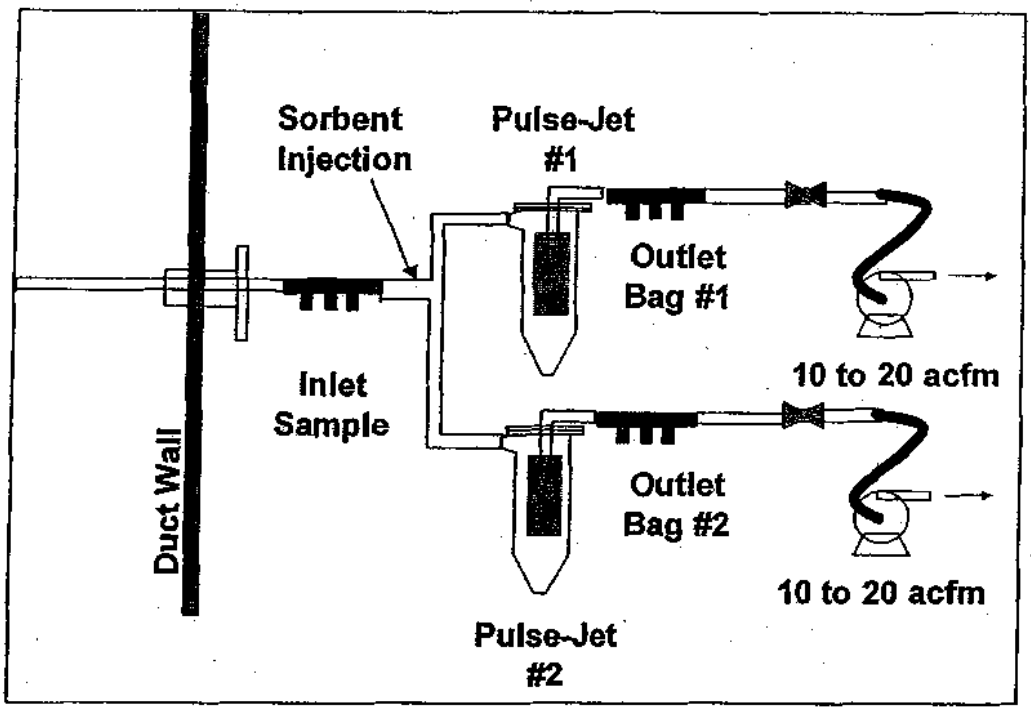
a. TOXECON™ Testing

Testing was conducted using the EPRI multi-Pollutant Control Test (PoCT) system on a slipstream extracted immediately downstream of one of the 12 wet ESP modules. Mercury removal across the slipstream injection device was measured with and without sorbent injection.

The objectives of this test were to:

- Characterize the effect of sorbent injection on mercury removal downstream of the wet ESP module and before a baghouse at Sherco 1.
- Evaluate a variety of sorbent mixtures to look at the possibility for multi-pollutant control on various flue gas constituents, including mercury, NO_x, and SO_2. These sorbent injection evaluations were also done using the PoCT system configured as a TOXECON™ baghouse.
- Evaluate fabric filter performance, including cleaning frequency, pressure drop, and particulate emissions for two different bag fabrics operating in the TOXECON™ configuration.
- Evaluate particulate emissions with a variety of bags and sorbents.

The pilot-scale PoCT system was configured as a TOXECON™ unit with two pulse-jet modules in parallel. The sample flue gas was extracted from a point located downstream of Sherco 1 Wet ESP Module 110 for the tests conducted during this program. The filter bags within the baghouse modules were 24 inches long and had a flat width of 7-5/8 inches. Flue gas was pulled through the filter bags at rates of 10 to 20 actual cubic feet per minute (acfm). This is less than 0.001% of the total flue gas flow rate of Sherco 1. The diagram below shows the test setup.



The key findings during the TOXECON™ evaluations at Sherco 1 include the following:

Baseline Mercury Emissions:

- Baseline outlet vapor mercury emissions varied by a factor of greater than two and ranged from 3.0 to 7.9 lb/TBtu during the test period.

Sorbent Injection for Mercury Control:

These sorbents were injected at concentrations between 0.5 to 18.3 lb/Macf for approximately 60 to 120 minutes per test.

- Commercially available activated carbon (Norit's FGD™ or simply FGD carbon) was able to achieve 60 to >90% mercury capture at 2 pounds per million actual cubic feet (lb/Macf). The Amended Silicates (AMS) sorbent achieved about 60% mercury capture at 7 lb/Macf and required >16 lb/Macf to reach >90% mercury capture. Iodine impregnated activated carbon (IAC) was injected at a concentration of 0.7 lb/Macf and captured >90% vapor mercury.
- Overall, IAC performed better than FGD and both were significantly better than AMS. The IAC costs >7 times FGD while the AMS developer initial estimate had AMS costs about the same as FGD in commercial quantities. In the TOXECON™ configuration, there may not be an advantage for using AMS over regular activated carbon.
- The removal efficiency of FGD carbon varied significantly (from 60 to >90%) during testing. This may be attributable to the differences in the coals that were burned during this period. During the testing, coal from four different mines was burned in Sherco 1. The coal samples and analysis provided by the plant did not provide any clear distinction between the constituents in the various coals burned; therefore it is difficult to determine which coal constituent differences caused the varying removal efficiencies during these short tests.

Sorbent Evaluations for Multi-Pollutant Control:

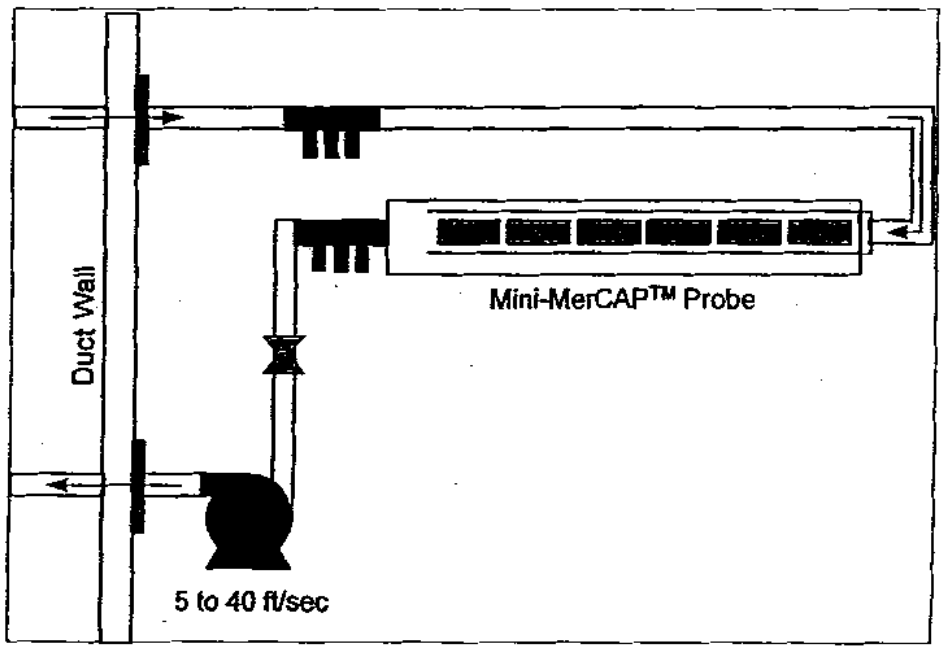
- When hydrated lime was injected into the PoCT system the increase in mercury removal was marginal. Lowering the flue gas temperature did not result in any additional measurable effect on mercury removal.
- Some SO_2 removal was seen when injecting the hydrated lime, 19% to 22% reduction at 180°F. Removal of NO_x was between 4% and 23%. No significant change in SO_2 removal was seen at the lower temperature.

Bag Fabric Evaluations:

- During the long-term FGD carbon injection tests (a 10-hour injection period), the high permeable polyester bag and a 7-Denier Torcon bag were evaluated. Cleaning frequency of both bag fabric types increased over time. The high permeable polyester bag cleaned about twice as often as the 7-Denier Torcon. **The cleaning frequency for both evaluated bags ranged from 1 to 18 times per hour whereas typical full-scale applications operate at 1 or 2 times per hour.** This issue needs to be resolved in order for this technology to be considered further.

b. MerCAP™ Testing

A novel mercury removal concept using both gold-coated and silver-coated screens, MerCAP™ (Mercury Control via Adsorption Process) was also evaluated using EPRI's Mini-MerCAP™ probe. The screens can be inserted anywhere along the duct downstream of the particulate control device where mercury is adsorbed by the substrate. The substrate can then be thermally regenerated to recover the mercury. With the MerCAP™ concept no sorbents are needed and only a concentrated mercury waste is generated. This technology was evaluated on a pilot scale at the outlet of the wet ESP Module 110 on Sherco 1. The diagram below shows the Mini-MerCAP™ probe configuration.



The key findings during the MerCAP™ evaluations at Sherco 1 include the following:

- Two different gold screen arrangements were evaluated. The gold screen mercury removal appeared to stay fairly constant over 1394 hours and was around 40 to 50% after flyash was cleaned periodically from the surface.
- The silver-coated screening removed only 6% of the incoming mercury after 18 hours of service.

Additional work is required to develop both of these technologies before they can be considered for additional testing.

2. Full-scale Testing at Arapahoe 3

Xcel Energy, Amended Silicates LLC and EPRI conducted full-scale testing of materials that could further reduce mercury emissions from coal-fired generating stations. A three-week demonstration project at Xcel Energy's Arapahoe Generating Station tested the effectiveness of two sorbent materials at reducing mercury. Arapahoe Unit 3 is a 44 MW PRB coal-fired unit in the Denver metro area. The unit is equipped with a reverse air baghouse and more importantly, a dry sodium injection system for SO_2 removal.

There were 5 specific objectives for the trial:

- Evaluate the use of Amended Silicates sorbent for mercury control in an operating coal-fired power plant over a range of injection ratios;
- Collect mercury concentration data before and after sorbent injection trials to characterize baseline mercury capture by the native fly ash;
- Perform trials with powdered activated carbon over a range of injection ratios to provide a basis for comparison with the Amended Silicates sorbent;
- Collect fly ash plus sorbent samples to evaluate the effect of mercury sorbent on the use of fly ash as a cement replacement in the manufacture of concrete; and
- Determine the impact of co-injection of dry sodium sorbent for SO_2 control on the removal of mercury by the Amended Silicates and powdered activated carbon materials.

Conclusions from the three-week trial are presented below.

- ***Coal type and mine can have a significant impact on mercury emissions.*** There was a coal change after the first week of trial operations. The host site shifted from Antelope PRB coal to Black Thunder PRB coal. The net result was a significant increase in the vapor-phase mercury in the flue gas, rising from a range of 1 to 5 micrograms per normal cubic meter ($\mu g/Nm^3$) to a range of 10 to 16 $\mu g/Nm^3$.
- ***The Amended Silicates sorbent and activated carbon behave similarly from a material handling perspective.***
- Amended Silicates sorbent removed up to 68% of the vapor-phase mercury in the host unit at an injection rate of 8 lb/Macf. At a sorbent injection rate of 4 lb/Macf, the mercury capture was 38%. Upstream vapor-phase mercury concentrations for these trial cases ranged from 9.8 to 16.6 $\mu g/Nm^3$ of flue gas.

- Mortar air tests with samples of fly ash mixed with Amended Silicates showed that the addition of the Amended Silicates mercury sorbent to the fly ash did not affect the ability to use the mixture as a cement replacement (pozzolan additive).
- Data obtained on operation of the Unit 3 baghouse did not show any discernable impact in pressure drop or baghouse flow due to the injection of Amended Silicates sorbent at 8 lb/Macf.
- Powdered activated carbon was shown to be an efficient mercury control technique on Unit 3, achieving removals as high as 85% at an injection rate of 8 lb/Macf, and 62% at an injection rate of 4 lb/Macf. Trial cases at the lower injection rates for powdered activated carbon were run with the Antelope coal, with much lower vapor-phase mercury concentrations in the flue gas (<5.3 $\mu g/Nm^3$).
- When Amended Silicates sorbent was co-injected with trona (sodium sesquicarbonate), there appeared to be an interaction of the dry materials that severely degraded the mercury capture efficiency of the sorbent.
- There was no deleterious effect noted with the simultaneous injection of powdered activated carbon and trona (sodium sesquicarbonate). Mercury control values remained at 86% at a powdered activated carbon injection rate of 8 lb/Macf.
- It was discovered that operation of the boiler has a significant impact on the level of vapor-phase mercury present in the flue gas. The concentration of vapor-phase mercury in the flue gas is affected by numerous parameters, including the type of coal being burned, the fuel/air ratio in the boiler, the temperature of the fireball in the boiler, the temperature of the flue gas exiting the air heater, ambient air temperatures and others.

C. Continuing Barriers to Reducing Mercury Emissions

As discussed in the "Mercury Control Study" submitted to the MPCA on November 17, 2004, as required under the MERP Settlement Agreement, several barriers continue to exist which prevent utilities from installing control technology for mercury removal. Among theses barriers are:

- Regulatory Uncertainty – Until Federal regulations are finalized, it is unknown what removal rates will be required. It is risky to invest in control technologies, which may not satisfy future requirements.
- No Proven Commercial Control Technology – Several short-term control technology tests have been completed on small- and full-scale units that have shown some success. However, a long-term, full-scale commercial installation of mercury control technology has not been completed and fully tested. As a result, no mercury control technology can be considered commercially available at this time.
- Balance of Plant Issues – Long-term testing of different control technologies is needed to determine the full range of plant impacts. Boiler corrosion, boiler fouling, increased opacity, etc. are all examples of Balance of Plant Issues that must be investigated and corrected before full-scale implementation of any technology.
- Ash Issues – Sorbent injection for mercury removal can adversely impact ash utilization efforts. Ash contaminated with activated carbon cannot be sold for utilization and must be landfilled.

- Activated Carbon Issues – If activated carbon injection is selected as the mercury control technology of choice, suppliers of Activated Carbon do not currently have the production capacity to supply the entire utility industry. It will take suppliers several years to build the necessary production capacity if activated carbon injection is required on utility boilers.

Section 7: Past Efforts to Reduce Emissions

Northern States Power Company, d/b/a Xcel Energy, has submitted the annual Mercury Emissions Reports as required by the Mercury Emissions Consumer Information Act. This information is summarized in Appendix B.

A. Repowering

In 2003, Xcel Energy completed the repowering of Black Dog units 1 and 2 with a natural gas combined-cycle unit 5. The original unit 1 boiler/turbine and the unit 2 boiler were originally installed in the 1950s and were coal-burning units. These units were physically removed from the plant with the new unit 5 being installed in their place. The new unit 5 consists of a natural gas-fired turbine-generator combined with a heat recovery steam generator. Exhaust heat from unit 5 powers the unit 2 steam turbine. The repowering project, completed in summer of 2003, boosts output from the two original units by more than 100 MWs and results in greater operating efficiency and cleaner power production. Specifically, the new unit will eliminate up to 35 pounds of mercury emitted annually from the Xcel Energy system. In 2003, unit 5 emitted 0.6 pounds of mercury.

B. Red Wing Air Quality Control System Upgrade

In 2000, Xcel Energy completed the Air Quality Control System (AQCS) upgrade on Red Wing units 1 and 2. A duct scrubber followed by a fabric filter was installed in place of the electrostatic precipitator (ESP) on each unit. This AQCS upgrade project, completed in 2000, results in cleaner power production. Specifically, installation of the new AQCS at the Red Wing Plant has eliminated 313.2 pounds of mercury emitted annually from the Xcel Energy system. In 2003, the Red Wing Plant emitted 19.6 pounds of mercury.

C. Metro Emissions Reduction Project

In May 2003, Xcel Energy proposed a $1 billion package of projects at three of its generating plants to improve air quality in the Twin Cities metropolitan area and beyond. This proposal, also known as the Metro Emissions Reduction Project (MERP), was submitted to the Minnesota Public Utilities Commission (MPUC) for review. The MPUC completed their review and approved the MERP project in December 2003.

The MERP consists of converting the High Bridge and Riverside Plants to natural gas and installing state-of-the-art pollution control equipment at the Allen S. King Plant. Upon completion of this project, mercury emission reductions of approximately 20%, 100% and 100% from the King, High Bridge, and Riverside Plants, respectively, are expected from current levels. These percentages translate to approximately 170 pounds per year of mercury that will not be released to the environment after these projects are completed.

Section 8: Summary

This progress report summarizes Xcel Energy's mercury reduction efforts for 2003 and 2004 (through 11/30/04). Xcel Energy has implemented a number of initiatives since 1990, which have reduced the amount of mercury utilized at our facilities and released to the environment. A number of projects have resulted in mercury reductions over the years, including the repowering of Black Dog units 1 and 2 **[up to 35 pounds per year]**, and the air pollution control technology upgrade at the Red Wing Steam Plant **[313.2 pounds per year]**. Other mercury reduction efforts, which have occurred within the Xcel Energy system, include activities such as product inventory and phase-out **[4,890 pounds mercury recovered since 2000]**, fluorescent and HID lamp recycling **[364,331 lamps since 2000]** and Clancy, the Mercury-sniffing dog **[74.1 pounds]**. These efforts have resulted in reductions of mercury, which is no longer being released to the environment. In addition, Xcel Energy continues to advance the understanding of mercury in the environment by funding research with EPRI and DOE. Last but not least, Xcel Energy has begun implementing the Metro Emissions Reduction Project, which is expected to reduce annual mercury emissions by nearly 170 pounds per year when completed.

Appendix A

Northern States Power Company d/b/a Xcel Energy
Mercury Recovered From Products History

Mercury Recovery Activity Description	2000	2001	2002	2003	2004 (through 11/30)	Total (2000 to Present)
Mercury Recovered from Broken Lamps, Mercury Filled Equipment and Metallic Mercury Collected	56	600	703	2,787	744	4,890
Fluorescent Lamps Recovered	45,013	36,162	33,642	24,906	24,501	164,224
High Intensity Discharge Lamps Recovered	43,753	34,259	35,391	44,316	42,388	200,107

Appendix B

Northern States Power Company d/b/a Xcel Energy
Mercury Emission History

Genetating Plants	Mercury Emission Data (lb/yr)				
	1990	2000	2001	2002	2003
Allen S. King Generating Plant	59	69	69	68.8	72.6
Black Dog Generating Plant	75	49	36	48.0	67.4
Blue Lake Generating Plant	0	<3	0.1	0.1	0.1
Granite City Generating Plant	0	0	0	0.0	0.0
High Bridge Generating Plant	102.6	66	71	67.2	79.6
Inver Hills Generating Plant	0	<3	<3	0.3	0.1
Key City Generating Plant	0	<3	0	0.0	0.0
Minnesota Valley Generating Plant	0	0	0	0.0	0.0
Red Wing Generating Plant	332.8	<3	10.3	8.2	19.6
Riverside Generating Plant	60	98	91	98.0	108.6
Sherburne County Generating Plant	637	886	685	877.8	1,105.6[1]
West Faribault Generating Plant	0	0	0	0.0	0.0
Wilmarth Generating Plant	4.6	7	2.6	2.1	7.0
TOTAL	1,271	1,175	965	1,170.5	1,460.6
Reduction from 1990 levels	-	96	306	100.5	189.6

[1] The increase at the Sherburne County Generating Plant is a result of the use of a more conservative emission factor rather than a dramatic change in operations.

XCEL ENERGY'S 2004 PROGRESS REPORT UNDER THE MINNESOTA MERCURY INITIATIVE VOLUNTARY AGREEMENT

June 14, 2005

Xcel Energy submitted a Voluntary Mercury Reduction Plan to the Minnesota Pollution Control Agency (MPCA) on May 17, 2000. This plan identified activities that Xcel Energy would undertake to contribute to reducing the amount of mercury utilized at our facilities and released to the environment. This progress report summarizes the activities Xcel Energy has pursued in 2004.

Section 1: Background

Xcel Energy was formed in 2000 by the merger of Denver-based New Century Energies and Minneapolis-based Northern States Power Company. Xcel Energy is a major U.S. electric and natural gas utility, with a comprehensive portfolio of energy-related products and services to 3.3 million electricity customers and 1.8 million natural gas customers. We have regulated operations in 10 Western and Midwestern states and operate regulated power plants that generate about 15,295 megawatts (MW) of electric power.

Northern States Power Company, d/b/a Xcel Energy operates the following generating plants in Minnesota which report mercury emissions:

Generating Plants	Location	Fuel Type
Allen S. King Generating Plant	Oak Park Heights	Coal
Black Dog Generating Plant	Burnsville	Coal (units 3 & 4) Gas (unit 5/2)
Blue Lake Generating Plant	Shakopee	Distillate Fuel Oil
Granite City Generating Pant	St. Cloud	Natural Gas or Distillate Fuel Oil
High Bridge Generating Plant	St. Paul	Coal
Inver Hills Generating Plant	Inver Grove Heights	Natural Gas or Distillate Fuel Oil
Key City Generating Plant	Mankato	Distillate Fuel Oil
Minnesota Valley Generating Plant	Granite Falls	Coal
Red Wing Generating Plant	Red Wing	Refuse Derived Fuel
Riverside Generating Plant	Minneapolis	Coal
Sherburne County Generating Plant	Becker	Coal
West Faribault Generating Plant	West Faribault	Natural Gas or Distillate Fuel Oil
Wilmarth Generating Plant	Mankato	Refuse Derived Fuel

All fuels contain mercury in varying amounts. Combustion of fuel results in the release of the mercury contained in the fuel itself.

Section 2: Voluntary Agreement Program Support

Xcel Energy supports the Voluntary Agreement Program and has been a participant in this program since May 2000. Our support is based on the following principles: 1) voluntary programs enable participants to look at many alternatives and choose those that best fit an organization's needs; 2) this program allows for the continued development of the science behind mercury emissions; 3) this program encourages the development of mercury control technologies; and 4) this program documents actual emissions from the participants.

Section 3: Efforts to Support Reduction of Hg Releases Outside of the Facility/Company

Xcel Energy's primary activity supporting mercury reductions outside of the company was through Clancy, the Mercury-sniffing dog. Xcel Energy helped fund Clancy, a dog specially trained to detect mercury, which the MPCA utilizes in its Mercury-Free Zone program. Clancy is being used to detect mercury mainly in sink traps at schools, institutional and industrial sites. As part of this cooperative effort, Xcel Energy is credited with 100% of the mercury reductions due to Clancy's investigations at Xcel Energy facilities and Xcel Energy receives credit for 15% of the reductions made due to Clancy's investigations at non-Xcel Energy facilities for the first 18 months of this project (September 2001 through March 2003). During this time, Clancy has sniffed out a total of about 550 pounds of pure mercury[1], which has been removed from these facilities and kept out of the environment. Mercury reductions credited to Xcel Energy due to Clancy's investigations totaled 74.1 pounds.

Section 4: Use and Management of Mercury Containing Products

Northern States Power Company, d/b/a Xcel Energy, has developed a mercury inventory and disposal database. All mercury and mercury containing devices removed in 2004 were shipped to the Xcel Energy Chestnut Hazardous Waste Storage Facility where they were placed in bulk containers and shipped off-site for recycling of the mercury. During this time, a total of 777 pounds of mercury from broken lamps, mercury filled equipment and metallic mercury were collected.

In 2004 we continued to recycle all lamps, which contain mercury. Activities in Minnesota, Wisconsin, North Dakota and South Dakota resulted in the recycling of 26,382 fluorescent lamps and 45,126 high intensity discharge lamps in 2004.

Totals from both of these areas over time are summarized in Appendix A.

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[1] As of May 1, 2003 Clancy has found 550 lbs of mercury. The value as of the end of March, 2003 was estimated by using the values: 550 lb (5/03) and 270 lb (7/02):
Total = 270 lb + [(550 – 270 lb) * (8 months/10 months)] = 494 lb
15% of the 20 month total is [0.15 * 550 lb] = 82.5 lbs
15% of the estimated 18 month total is [0.15 * 494 lb] = 74.1 lbs.

Section 5: Mass Balance Studies

Xcel Energy has completed its seventh year of mercury testing in fuel samples. Daily fuel samples were taken from each of the coal and RDF fired electric generating plants. The daily fuel samples were then made into annual composites and analyzed for mercury. The mercury data was utilized in mass balance formulas to calculate total release information for the annual Toxic Release Inventory. Xcel Energy continues to utilize coal that has one of the lowest mercury contents available in the United States.

Section 6: Release Reduction Research

Xcel Energy continues to seek cost-effective mercury control solutions for coal-burning boilers. A description of our efforts to date is presented below.

A. EPRI Funding

Xcel Energy supports the Electric Power Research Institute's (EPRI) Integrated Environmental Controls (Hg, SO_2, NOx, & Particulate) program. This program has a near-term focus of completing the development and demonstration of least-cost mercury controls for coal-fired power plants and on evaluating integrated multi-pollutant processes, as they are developed and mature. The program has a mercury control goal of 70-90% reduction (relative to the mercury in the coal entering the plant) at costs that are 25-50% below currently estimated costs, including measures needed to mitigate any potential impacts. EPRI seeks to achieve this goal in part through development of lower cost reagents, alternative approaches to activated carbon injection, methods of delivering a flue gas with a high proportion of soluble mercury to SO_2 control devices, etc.

B. EPRI Control Technology Research

Xcel Energy, Amended Silicates LLC and EPRI conducted full-scale testing of materials that could further reduce mercury emissions from coal-fired generating stations. A three-week demonstration project at Xcel Energy's Arapahoe Generating Station tested the effectiveness of two sorbent materials at reducing mercury. Arapahoe Unit 3 is a 44 MW PRB coal-fired unit in the Denver metro area. The unit is equipped with a reverse air baghouse and more importantly, a dry sodium injection system for SO_2 removal.

There were 5 specific objectives for the trial:

- Evaluate the use of Amended Silicates sorbent for mercury control in an operating coal-fired power plant over a range of injection ratios;
- Collect mercury concentration data before and after sorbent injection trials to characterize baseline mercury capture by the native fly ash;
- Perform trials with powdered activated carbon over a range of injection ratios to provide a basis for comparison with the Amended Silicates sorbent;
- Collect fly ash plus sorbent samples to evaluate the effect of mercury sorbent on the use of fly ash as a cement replacement in the manufacture of concrete; and
- Determine the impact of co-injection of dry sodium sorbent for SO_2 control on the removal of mercury by the Amended Silicates and powdered activated carbon materials.

Conclusions from the three-week trial are presented below.

- ***Coal type and mine can have a significant impact on mercury emissions.*** There was a coal change after the first week of trial operations. The host site shifted from Antelope PRB coal to Black Thunder PRB coal. The net result was a significant increase in the vapor-phase mercury in the flue gas, rising from a range of 1 to 5 micrograms per normal cubic meter ($\mu g/Nm^3$) to a range of 10 to 16 $\mu g/Nm^3$.
- ***The Amended Silicates sorbent and activated carbon behave similarly from a material handling perspective.***
- Amended Silicates sorbent removed up to 68% of the vapor-phase mercury in the host unit at an injection rate of 8 lb/Macf. At a sorbent injection rate of 4 lb/Macf, the mercury capture was 38%. Upstream vapor-phase mercury concentrations for these trial cases ranged from 9.8 to 16.6 $\mu g/Nm^3$ of flue gas.
- Mortar air tests with samples of fly ash mixed with Amended Silicates showed that the addition of the Amended Silicates mercury sorbent to the fly ash did not affect the ability to use the mixture as a cement replacement (pozzolan additive).
- Data obtained on operation of the Unit 3 baghouse did not show any discernable impact in pressure drop or baghouse flow due to the injection of Amended Silicates sorbent at 8 lb/Macf.
- Powdered activated carbon was shown to be an efficient mercury control technique on Unit 3, achieving removals as high as 85% at an injection rate of 8 lb/Macf, and 62% at an injection rate of 4 lb/Macf. Trial cases at the lower injection rates for powdered activated carbon were run with the Antelope coal, with much lower vapor-phase mercury concentrations in the flue gas (<5.3 $\mu g/Nm^3$).
- When Amended Silicates sorbent was co-injected with trona (sodium sesquicarbonate), there appeared to be an interaction of the dry materials that severely degraded the mercury capture efficiency of the sorbent.
- There was no deleterious effect noted with the simultaneous injection of powdered activated carbon and trona (sodium sesquicarbonate). Mercury control values remained at 86% at a powdered activated carbon injection rate of 8 lb/Macf.
- It was discovered that operation of the boiler has a significant impact on the level of vapor-phase mercury present in the flue gas. The concentration of vapor-phase mercury in the flue gas is affected by numerous parameters, including the type of coal being burned, the fuel/air ratio in the boiler, the temperature of the fireball in the boiler, the temperature of the flue gas exiting the air heater, ambient air temperatures and others.

C. Continuing Barriers to Reducing Mercury Emissions

As discussed in the "Mercury Control Study" submitted to the MPCA on November 17, 2004, as required under the MERP Settlement Agreement, several barriers continue to exist which prevent utilities from installing control technology for mercury removal. Among theses barriers are:

- Regulatory Uncertainty – On March 15, 2005, US EPA issued the Clean Air Mercury Rule (CAMR) to permanently cap and reduce mercury emissions from coal-fired power plants. On May 18, 2005, CAMR was published in the *Federal Register*. However, some

groups have expressed dissatisfaction with CAMR and have file lawsuits stating the rule is inadequate. Until Federal regulations are finalized and litigation is complete, it is risky to invest in control technologies, which may not satisfy future requirements. Xcel Energy is evaluating CAMR and will comply with all regulatory requirements.

- No Proven Commercial Control Technology – Several short-term control technology tests have been completed on small- and full-scale units that have shown some success. However, a long-term, full-scale commercial installation of mercury control technology has not been completed and fully tested. As a result, no mercury control technology can be considered commercially available at this time.
- Balance of Plant Issues – Long-term testing of different control technologies is needed to determine the full range of plant impacts. Boiler corrosion, boiler fouling, increased opacity, etc. are all examples of Balance of Plant Issues that must be investigated and corrected before full-scale implementation of any technology.
- Ash Issues – Sorbent injection for mercury removal can adversely impact ash utilization efforts. Ash contaminated with activated carbon cannot be sold for utilization and must be landfilled.
- Activated Carbon Issues – If activated carbon injection is selected as the mercury control technology of choice, suppliers of Activated Carbon do not currently have the production capacity to supply the entire utility industry. It will take suppliers several years to build the necessary production capacity if activated carbon injection is required on utility boilers.

Section 7: Past Efforts to Reduce Emissions

Northern States Power Company, d/b/a Xcel Energy, has submitted the annual Mercury Emissions Reports as required by the Mercury Emissions Consumer Information Act. This information is summarized in Appendix B.

A. Repowering

In 2003, Xcel Energy completed the repowering of Black Dog units 1 and 2 with a natural gas combined-cycle unit 5. The original unit 1 boiler/turbine and the unit 2 boiler were originally installed in the 1950s and were coal-burning units. These units were physically removed from the plant with the new unit 5 being installed in their place. The new unit 5 consists of a natural gas-fired turbine-generator combined with a heat recovery steam generator. Exhaust heat from unit 5 powers the unit 2 steam turbine. The repowering project, completed in summer of 2003, boosts output from the two original units by more than 100 MWs and results in greater operating efficiency and cleaner power production. Specifically, the new unit will eliminate up to 35 pounds of mercury emitted annually from the Xcel Energy system. In 2004, unit 5 emitted <0.1 pounds of mercury.

B. Red Wing Air Quality Control System Upgrade

In 2000, Xcel Energy completed the Air Quality Control System (AQCS) upgrade on Red Wing units 1 and 2. A duct scrubber followed by a fabric filter was installed in place of the electrostatic precipitator (ESP) on each unit. This AQCS upgrade project, completed in 2000, results in cleaner power production. Specifically, installation of the new AQCS at the Red Wing Plant has eliminated 313.2 pounds of mercury emitted annually from the Xcel Energy system. In 2004, the Red Wing Plant emitted 9.8 pounds of mercury.

C. Metro Emissions Reduction Project

In May 2003, Xcel Energy proposed a $1 billion package of projects at three of its generating plants to improve air quality in the Twin Cities metropolitan area and beyond. This proposal, also known as the Metro Emissions Reduction Project (MERP), was submitted to the Minnesota Public Utilities Commission (MPUC) for review. The MPUC completed their review and approved the MERP project in December 2003. In April 2005, construction began on the Allen S. King Plant Rehabilitation project.

The MERP consists of converting the High Bridge and Riverside Plants to natural gas and installing state-of-the-art pollution control equipment at the Allen S. King Plant. Upon completion of this project, mercury emission reductions of approximately 20%, 100% and 100% from the King, High Bridge, and Riverside Plants, respectively, are expected from current levels. These percentages translate to approximately 170 pounds per year of mercury that will not be released to the environment after these projects are completed.

Section 8: Summary

This progress report summarizes Xcel Energy's mercury reduction efforts for 2004. Xcel Energy has implemented a number of initiatives since 1990, which have reduced the amount of mercury utilized at our facilities and released to the environment. A number of projects have resulted in mercury reductions over the years, including the repowering of Black Dog units 1 and 2 **[up to 35 pounds per year]**, and the air pollution control technology upgrade at the Red Wing Steam Plant **[313.2 pounds per year]**. Other mercury reduction efforts, which have occurred within the Xcel Energy system, include activities such as product inventory and phase-out **[4,923 pounds mercury recovered since 2000]**, fluorescent and HID lamp recycling **[368,950 lamps since 2000]** and Clancy, the Mercury-sniffing dog **[74.1 pounds]**. These efforts have resulted in reductions of mercury, which is no longer being released to the environment. In addition, Xcel Energy continues to advance the understanding of mercury in the environment by funding research with EPRI. Last but not least, Xcel Energy has begun implementing the Metro Emissions Reduction Project, which is expected to reduce annual mercury emissions by nearly 170 pounds per year when completed.

Appendix A

Northern States Power Company d/b/a Xcel Energy
Mercury Recovered From Products History

Mercury Recovery Activity Description	2000	2001	2002	2003	2004	Total (2000 to Present)
Mercury Recovered from Broken Lamps, Mercury Filled Equipment and Metallic Mercury Collected	56	600	703	2,787	777	4,923
Fluorescent Lamps Recovered	45,013	36,162	33,642	24,906	26,382	166,105
High Intensity Discharge Lamps Recovered	43,753	34,259	35,391	44,316	45,126	202,845

Appendix B

Northern States Power Company d/b/a Xcel Energy
Mercury Emission History

Generating Plants	Mercury Emission Data (lb/yr)					
	1990	2000	2001	2002	2003	2004
Allen S. King Generating Plant	59	69	69	68.8	72.6	66.2
Black Dog Generating Plant	75	49	36	48.0	67.4	68.4
Blue Lake Generating Plant	0	<3	0.1	0.1	0.1	0.0
Granite City Generating Plant	0	0	0	0.0	0.0	0.0
High Bridge Generating Plant	102.6	66	71	67.2	79.6	80.5
Invet Hills Generating Plant	0	<3	<3	0.3	0.1	0.0
Key City Generating Plant	0	<3	0	0.0	0.0	0.0
Minnesota Valley Generating Plant	0	0	0	0.0	0.0	0.0
Red Wing Generating Plant	332.8	<3	10.3	8.2	19.6	9.8
Riverside Generating Plant	60	98	91	98.0	108.6	98.7
Sherburne County Generating Plant [1]	637	886	685	877.8	1,105.6[2]	984.3[2]
West Faribault Generating Plant	0	0	0	0.0	0.0	0.0
Wilmarth Generating Plant	4.6	7	2.6	2.1	7.0	4.5
TOTAL	1,271	1,175	965	1,170.5	1,460.6	1,143.2
Change from 1990 levels	-	(96)	(306)	(100.5)	189.6	(127.8)

[1] Includes SMMPA's ownership portion of Sherburne County Unit 3.
[2] The increase at the Sherburne County Generating Plant is a result of the use of a more conservative emission factor rather than a dramatic change in operations.
( ) Denotes a negative number, reflecting a reduction from baseline values.

Appendix C

Minnesota Strategies to Reduce Mercury Emissions

Appendix C. Minnesota Strategies to Reduce Mercury Emissions

Since the early 1990s, Minnesota has been a national leader in reducing mercury releases to the air, water and land, especially from product-related sources. The state employs an array of voluntary, regulatory, legislative, incentive-based and educational tools that involve state agencies, local government, nongovernmental organizations, and businesses. In concert with similar initiatives on the federal level, Minnesota's efforts have contributed to a 70 percent decline in mercury emissions during the last 15 years. Table 1 summarizes a variety of voluntary, educational and regulatory initiatives employed in the state; several are described below.

In the 1990s, the Minnesota Legislature enacted ground-breaking laws banning mercury from products, banning mercury and mercury-product disposal in municipal waste streams, requiring the labeling of most mercury-containing products, and requiring proper management. For example, Minnesota was the first state to ban the sale of mercury-added alkaline batteries. Several years later, the federal government took the same action.

Minnesota was also the first state to ban the sale of mercury-containing pigments, dyes, paints, toys, games, apparel, manometers used in the dairy industry and all thermometers (not just fever thermometers). Minnesota was the first state to prohibit disposal of fluorescent tubes, the first state to require the removal of mercury switches from automobiles, and the first state to require manufacturer-based programs for thermostats and relay switches. Similar laws and regulations have since been enacted by many other states.

In addition to playing a supporting role in legislative actions to address mercury, the MPCA played an important role in pioneering programs and regulations addressing mercury products. The agency led a national effort to ensure that mercury lamps were not exempted from proper management. And, ours was the first state to adopt a framework subsequently adopted by the U.S. Environmental Protection Agency (the Universal Waste Rule) to facilitate management of mercury wastes.

Businesses in Minnesota also pioneered the recycling of mercury-containing products and fluorescent lamps. Many of the first recycling facilities for these products in the country were established in Minnesota. The thermostat industry's take-back program for mercury thermostats started as a collaborative pilot in Minnesota and is now a nationwide program.

The MPCA also adopted rules that set mercury standards for municipal and medical waste incinerators ahead of federal requirements. These rules call for stricter emissions limits than the current federal standard. The waste combustor standards, coupled with increased mercury product management and reduction, resulted in major emissions reductions.

Minnesota also has implemented notable outreach programs targeting the general public and key mercury use sectors, such as hospitals, dental clinics and schools. One unique effort is the MPCA's Mercury-Free Zone Program. By pledging to reduce mercury-containing equipment from science labs and health-care facilities, schools are eligible to receive a visit from Clancy,

the MPCA's mercury-detecting dog. Clancy is trained to detect mercury vapors, such as those from spills in a lab, which are subsequently removed.

Since 2001, the Mercury-Free Zone Program has removed more than 1,000 lbs. of elemental mercury from over 500 middle and high schools. Clancy has located several significant spills that had escaped detection by other means. In addition to reducing exposure to mercury vapors, Clancy has helped to educate more than 16,000 students and teachers about the dangers of mercury and he is the only dog used in this manner in the country.

In addition, two large wastewater-treatment plants in Minnesota have been national leaders in efforts to work with dentists to reduce the amount of mercury from dental amalgam entering the liquid waste system. The Western Lake Superior Sanitary District in Duluth and Metropolitan Council Environmental Services (MCES) in the Twin Cities have worked extensively with dental clinics in their service areas and statewide to adapt best management practices for dental amalgam.

In 1996, the MPCA initiated the Mercury Contamination Reduction Initiative aimed at reducing mercury contamination of fish in Minnesota lakes and rivers. As part of the initiative, the agency formed a stakeholder advisory council to develop recommendations on mercury-reduction strategies. The advisory council's recommendations were adopted by the Minnesota Legislature in 1999 and continue to form the basis of Minnesota's mercury-reduction program. These strategies include establishing reduction goals, national and international strategies, research, reducing use and voluntary agreements. The status of these strategies is summarized in Table 3-2.

The 1999 law established a voluntary mercury-reduction agreement program encouraging the largest emitters in the state to enter into agreements with the MPCA to voluntarily reduce their mercury air emissions. Participants in the program are expected to implement cost-effective, technologically feasible reduction measures. The MPCA agreed not to pursue additional state regulations, at least until 2005, as long as adequate progress is made in reducing emissions. To date, voluntary reduction agreement participants' actions have resulted in approximately 183 lbs. of annual emissions avoided. When fully implemented, reduction agreement actions initiated to date will result in additional reductions in annual emissions of an estimated 370 lbs. by 2009.

Table 3-1 **Summary of mercury-reduction strategies used in Minnesota since 1990**

Voluntary Programs	
Health Care Outreach	Education on identification, management and reduction of mercury-containing equipment and chemicals. 1996 and on-going.
Household/Small Business Hazardous Waste Collection	Many county-run programs that accept mercury-containing items from homeowners and small businesses. 1993 and on-going.
Dental Office Outreach	Municipal wastewater-treatment plants and the Minn. Dental Assoc. established best management practices and goals for 100% participation. 1993 and on-going.
Thermostat Takebacks	Through a reverse distribution system involving contractors and wholesalers, manufacturers take back out-of-service units. Law requires manufacturers to provide education and incentives. 1993 and on-going.
Mercury Switches in Automobiles	1995 law requires "good faith effort" to remove mercury switches before crushing by salvage yards; bounty of $40/lb. of switches is offered by major steel recycler. Auto manufacturer-funded collection and recycling program initiated in 2004.
Mercury-Free Zone Program	Schools pledge to be mercury free and receive an assessment and educational visit by the MPCA's mercury educator and its mercury-detecting dog. 2001 and on-going.
Voluntary Reduction Agreements	Large emitters enter into voluntary agreements to reduce emissions. 1999/2000 and ongoing.
Regulatory Programs	
Waste Combustor Standards	Sets air emission limits on mercury and requires mercury-reduction plans for municipal and medical waste incinerators. 1993-1995. Small, on-site incinerators banned.
Industrial Boiler MACT	MPCA implements federal industrial boiler and process heater standard imposing mercury-emission limits on new and existing solid-fuel boilers and major sources of hazardous air pollutants.
Water Discharge Standards	Wastewater dischargers are required to monitor for mercury using ultra-low detection limits (EPA Method 1631); mercury effluent limits are set in some cases.
Special Waste Pilot Project/Universal Waste Rule	Minnesota adopted streamlined regulatory framework to facilitate recycling of mercury-containing products, 1993. Preceded federal Universal Waste Rule promulgated in 1995 and expanded in 1999 and 2005.
State Laws	
Fluorescent Lamp, Other Product Disposal Ban	Requires businesses and households to recycle fluorescent lamps, stimulating development of recycling infrastructure. 1993-94.
Mercury-containing Product Sales Bans	Toys and games, apparel and thermometers that contain mercury may not be sold in Minnesota. 1992, 1994, 2001 respectively
Mercury Product Labeling	Requires labeling of most mercury –containing products to inform of the presence of mercury and need to manage properly. 1992
Dairy Manometer Ban and Buy-back	Bans the sale, installation and repair of mercury-containing manometers, establishes $100 incentive for turning in old gauge. 1997-2000
Relay Manufacturer Responsibility	Requires manufacturers of mercury displacement relays to cover costs of managing out-of-service units. 1997
Battery Mercury Reduction	Bans mercuric oxide batteries and the addition of mercury to alkaline batteries. Establishes a 25-mg/0.025% limit in button batteries. 1993
Mercury in Construction and Demolition	Law prohibits disposal, implying removal prior to demolition. Education and enforcement are conducted. 1992
Mercury Reduction Law (1999)	Requires the state to pursue advisory-council-recommended strategies, establishes a goal of 70% reduction in emissions by 2005 based on 1990 levels. 1999

Table 3-2. **Status of Strategies Recommended by Advisory Council in 1999**

Strategy	Status
National Recommendations	
International Mercury Management Plan/ National Mercury Product Labeling/ National Mercury Research/ Lower Emissions Limits for Medical Waste Combustors	Since 1999, the MPCA has become increasing involved in working with other states and the EPA to address mercury on a national level including addressing international mercury supplies, national product labeling surplus, national research and lowering site-specific waste combustor standards
Change Reporting Protocols for U.S. Toxics Release Inventory (TRI) for Mercury	Reporting threshold reduced from 10,000 lbs. to 10 lbs. in 2000. Utilities required to report for the first time.
Evaluate Feasibility of Lower Emission Limits from Sewage Sludge Incinerators	The MPCA has not participated in national activity on sewage sludge incinerators.
Establish a National Credit-for-Early-Action Program	The MPCA has offered support to the Center for Clean Air Policy's efforts.
Create a Mercury-Related Outreach Position for Minnesota	Various staff have played a role in encouraging national and international strategies
Minnesota Mercury Inventory, Research, Monitoring and Reporting	
Develop comprehensive release inventory	Minnesota's air emissions inventory is one of the most comprehensive of all states' and most releases to other media are quantified.
Conduct research on issues relevant or unique to Minnesota reductions	Minnesota research includes fish monitoring and studying the effects of sulfate deposition on mercury methylation.
Establish measurement, monitoring and reporting protocols	These are proposed to be established as part of the TMDL implementation
Reducing Purposeful Use	
Improve collection infrastructure/ Conduct "clean-sweeps"	MPCA has worked with regional household hazardous waste programs to collect mercury and conduct "clean sweeps." Most comprehensive efforts have taken place in the Lake Superior Basin.
Label products currently in use	Healthcare providers, voluntary reduction agreement participants and others have labeled mercury products in use.
Improve compliance with current laws/ Increase compliance with current disposal bans / Reduce mercury in buildings	Enforcement of product disposal bans occurs for lamps and in the demolition sector. Some enforcement of labeling laws.
State Avoids buying mercury-containing products	Vehicle, healthcare supplies and other procurement contracts contain disclosure/no mercury clauses.
Explore additional bans	Comprehensive mercury thermometer sales ban in 2001.
Educate users of mercury/ Educate dental offices	Various outreach programs including the Mercury-Free Zone, dental sector, healthcare and voluntary agreements.
Use mercury detecting dog	MPCA employs the only mercury-detecting dog in the country in the Mercury-Free Zone Program
Develop Voluntary Agreements	
Develop voluntary agreements	15 companies and organizations participating