Report to the Joint Standing Committee on Environment and Natural Resources
126th Legislature, First Session

Mercury Reduction Report

March 2013

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Executive Summary

The Maine Department of Environmental Protection (the department) is submitting this report to the Joint Standing Committee on Environment and Natural Resources pursuant to 38 M.R.S.A. § 585-B, as amended by Public Law 2009, Chapter 535. The amendment requires the department to submit an update to the *Mercury Reduction Report* submitted in March 2009.

The department's update incorporates new data on mercury emissions through 2012, provides mercury reduction plan updates for Dragon Products Company, LLC, and proposes updated recommendations for the committee's consideration.

Most sources in the state can meet the 25 lb/year of mercury limit or 90% mercury control efficiency. Currently, one source has requested an alternative mercury limit, which would instead be explicitly addressed through the department's recommendation to amend the current legislation.

Based on the department's review of the information summarized in this report and the specific conclusions expounded upon below, the department makes the following recommendations:

- Retain the existing mercury provisions of:
  - A 25 lb/yr mercury emission limit from an air emission source beginning January 1, 2010,
  - the option to apply to the Board of Environmental Protection for an alternative higher emission limit, or
  - achieve ninety percent mercury emission control efficiency by January 1, 2012;
- Amend 38 MRSA §585-B:
  - To allow Portland Cement facilities to meet the applicable requirements of the National *Emission Standards for Hazardous Air Pollutants for the Portland Cement Manufacturing Industry and Standards of Performance for Portland Cement Plants*, 40 CFR Part 63, Subpart LLL as an alternative to meeting the 25 lb/year mercury emission limit.
  - Remove provisions that are no longer applicable, as the dates for those requirements have been passed and been fulfilled.
  - Change rulemaking authority from the Board of Environmental Protection to the department to reflect PL 2011, ch. 305. As this portion of the statute is considered routine technical, the department is charged with conducting rulemaking under this section. This specific amendment is included in the department's omnibus bill to be heard during this session.

I. Introduction

Mercury, a naturally occurring element with serious toxicological effects on human health and the environment, is emitted from a variety of sources located within the State of Maine. However, a large portion of the mercury affecting Maine's environment is transported primarily in the ambient air, from sources located in states upwind from Maine. Recognizing the significant public health and environmental threat posed by mercury emissions, the Maine Legislature enacted Public Law 2005, Chapter 590 on April 14, 2006 which established stringent new limits on mercury emissions from air emissions sources. These limits found at 38 M.R.S.A. §585-B(5), included a mercury emission limit of thirty-five (35) pounds per year (lb/yr) after January 1, 2007, which decreased to twenty-five (25) pounds per year after January 1, 2010. In addition, the law at 38 M.R.S.A. §585-B(6) required those sources emitting more than ten (10) pounds of mercury per year after January 1, 2007 to submit mercury reduction plans to the department detailing their efforts to reduce mercury emissions, and whether additional emission reductions could be achieved cost-effectively.

In March 2009, the department submitted a Mercury Reduction Report with a subsequent addendum submitted in January 2010. The report and addendum resulted in the following changes to the statute:

1) As an alternative to the mercury emission standard of 11.4 kilograms, or 25 pounds after January 1, 2010, an air emission source may reduce mercury emissions by 90 percent by weight after January 1, 2010.
2) An air emission source emitting mercury in excess of 10 pounds in calendar year 2010 must:
    a. Conduct a stack test for mercury twice in calendar year 2011 and twice in calendar year 2012. The stack tests must be conducted at least four (4) months apart; and
    b. By January 1, 2013, develop a mercury reduction plan and submit the plan to the department. The plan must include the results of the four (4) stack tests conducted.
3) Allows compliance to be determined by averaging, in accordance with guidance provided by the department, the results of multiple stack tests. The department may approve an alternative to the stack testing requirements in statute, such as but not limited to mercury input data or a continuous mercury emission monitoring system.
4) Requires the department to submit an updated report to the committee by March 1, 2013. The joint standing committee of the Legislature having jurisdiction over natural resources matters is authorized to report out to the 126th Legislature a bill relating to the evaluation of the updated report.

Maine has been very successful in reducing mercury emissions through the implementation of legislation, regulations, pollution prevention practices and voluntary commitments such as the New England Governors Eastern Canadian Premiere's Mercury Action Plan. Mercury emissions from a wide variety of sources ranging from large industrial facilities to consumer products have been reduced including the closure of the Holtra Chem chlor-alkali plant, closure of all medical waste incinerators, add-on controls at facilities, alternate technologies to replace medical waste incinerators, product substitution, and recycling.

In 2010, Dragon was the only source with mercury emissions greater than 10 pounds per year. Three of Maine's resource recovery facilities, ecomaine, Penobscot Energy Recovery Company, and Maine

Energy Recovery Company, amended their licenses to incorporate the 90% alternative to meet statutory requirements.

Dragon is pursuing a license modification from the Board of Environmental Protection to establish alternative emission limits for mercury. Dragon submitted timely and complete air emission license amendment applications to the department in accordance with 38 M.R.S.A. §585-B(5)(B), which included information to support their arguments for obtaining approval for alternative mercury emission limits.

Dragon's mercury emissions depend on the amount of mercury present in the process feedstock (limestone and fly ash) and fuel types (oil, petroleum coke, coal, or tires) that are input into their process, with emissions increasing linearly with production increases. The federal Environmental Protection Agency (EPA) recently amended the nationwide Portland Cement Manufacturing Maximum Achievable Control Technology (MACT) standards for hazardous air pollutant emissions, including mercury.

In this report, the department summarizes the information provided in Dragon's mercury reduction plan, including an examination of additional control options and associated costs for Dragon to reduce their mercury emissions and the potential impact of the Portland Cement MACT.

Based on our review and analyses, the department recommends the following:

- Retain the existing mercury provisions of:
  - A 25 lb/yr mercury emission limit from an air emission source beginning January 1, 2010,
  - the option to apply to the Board of Environmental Protection for an alternative higher emission limit, or
  - achieve ninety percent mercury emission control efficiency by January 1, 2012;

- Amend 38 MRSA §585-B:
  - To allow Portland Cement facilities to meet the applicable requirements of the National *Emission Standards for Hazardous Air Pollutants for the Portland Cement Manufacturing Industry and Standards of Performance for Portland Cement Plants*, 40 CFR Part 63, Subpart LLL as an alternative to meeting the 25 lb/year mercury emission limit.
  - Remove provisions that are no longer applicable, as the dates for those requirements have been passed.
  - Change rulemaking authority from the Board of Environmental Protection to the department to reflect PL 2011, ch. 305. As this portion of the statute is considered routine technical, the department is charged with conducting rulemaking under this section. This specific amendment is included in the department's omnibus bill to be heard during this session.

II. Mercury in Maine

Almost all mercury compounds are toxic and can be dangerous at very low levels in both aquatic and terrestrial ecosystems. Mercury is a persistent bioaccumulative toxin, which means it does not

break down and that it builds up in the food chain over time. Predatory fish, birds, and mammals will exhibit higher mercury concentrations in their tissue and organs. Researchers have found that mercury levels in Maine fish, loons, and eagles are among the highest in North America.[1]

The human health effects of mercury are well documented; exposure at sufficiently high levels can harm the brain, heart, kidneys, lungs, and immune system of people of all ages. High levels of methyl mercury in the bloodstream of unborn babies and young children may harm the developing nervous system, affecting a child's cognitive function and ability to learn. Mercury impairs a child's fine motor, language, visual-spatial (e.g. drawing) and verbal memory skills; it may also adversely affect the cardiovascular, immune and reproductive systems of a child.[2] While there are many pathways to mercury exposure in today's environment, research indicates that the primary route of exposure in humans is through the consumption of fish.

In response to the mercury levels found in fish, the Maine Department of Health and Human Services (MEDHHS) has issued health advisories for the consumption of fish caught in Maine.[3] These advisories recommend that pregnant and nursing women, women who may get pregnant, and children under the age of eight (8) not eat any freshwater fish from Maine's inland waters. All other adults and children older than eight should not eat more than two freshwater fish meals per month. For brook trout and landlocked salmon, the suggested limit is one meal per week.[4] MEDHHS has issued similar health advisories for salt-water fish.[5]

The economic impacts of mercury contamination in Maine include increased health care costs, loss of productivity, special education costs, natural resource damages and reduced tourism. Fish consumption advisories and wildlife impacts are at odds with Maine's efforts to promote tourism and aquaculture. Tourism is Maine's largest industry, supporting 58,000 Maine jobs[6] and generating $8.9 billion in sales and $344 million in tax revenue. Maine's image of pristine mountains, quiet lakes, and rugged coast is an integral part of this success.

The fish consumption advisories also undercut efforts to encourage people to eat more fish as a way of reducing the risk of heart disease. In Maine, cardiovascular disease is the leading cause of death. The disease accounts for 29,000 hospitalizations and about 4,000 deaths every year. Advising Maine women of childbearing age and young children to limit their fish consumption has secondary health implications.

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[1] Northeast Ecological Research Consortium (www.briloon.org)

[2] Woodruff, Tracey J., Daniel A Axelrad, Amy D. Kyle, Onyemaechi Nweke, Gregory G. Miller America's Children and the Environment: Measures of Contaminants, Body Burdens and Illness, 2nd Ed., US Environmental Protection Agency and National Center for Environmental Economics (EPA240-R-03-001) February 2003, Pg 59.

[3] MEDHHS, 2/20/01 Procedure for Developing Fish Tissue Action Levels (This document is only available via a PDF file at: http://www.maine.gov/dhhs/mecdc/environmental-health/eohp/fish/ documents/action-levels-writeup.pdf

[4] MEDHHS, Freshwater Fish Safe Eating Guidelines (August 29, 2000); (http://www.maine.gov/dhhs/mecdc/environmental-health/eohp/fish/2kfca.htm)

[5] MEDHHS, Saltwater Fish and Lobster Tomalley Safe Eating Guidelines (June 3, 2009); (http://www.maine.gov/dhhs/mecdc/environmental-health/eohp/fish/saltwater.htm)

[6] Maine State Planning Office, June 2004, Maine's Biggest Industries; Structural Overview of the Maine Economy (http://www.maine.gov/spo/economics/release.php?id=97964)

A. Efforts to Reduce Mercury Emissions

In response to the increasing awareness of the harm mercury exposure does to Maine's people and its economy, Maine has significantly reduced statewide emissions of mercury over the past decade through regional cooperative efforts among the states and provinces as well as through Maine's own legislative initiatives.

Over the past several years, the Maine Legislature has passed laws that:

- Banned by July 1, 2006, the sale of most mercury-added products including all mercury switches, relays, thermostats, thermometers and other measuring;
- Require fluorescent lamps and other mercury-added products that remain in use and production be recycled when they are removed from service;
- Provide financial and technical assistance to help municipalities separate mercury-added products from the waste stream;
- Require automakers to buy back mercury switches they put in cars; and
- Require dentists who use mercury amalgam to install separator systems to prevent the discharge of mercury to wastewater.

III. Mercury Emissions at Maine Facilities

On May 16, 2008, the department mailed outreach letters to eight facilities with mercury emissions potentially over 10 lb/yr based on 2002 and 2005 mercury estimates. All of the facilities contacted responded to the department, by either clarifying that their emissions were below 10 lb/yr or through the submittal of a mercury reduction plan in accordance with 38 M.R.S.A. §585-B(6). The statute required facilities with mercury emissions greater than 10 lb/year after January 1, 2007 to submit a mercury reduction plan to the department by September 1, 2008. Formal reduction plans were received from Dragon, ecomaine, and Penobscot Energy Recovery Company (PERC). Dragon, ecomaine, and PERC estimated 2007 emissions to be 12.68 lb/hr, 17.5 lb/hr, and 14.3 lb/hr, respectively. Dragon and ecomaine initially submitted license amendments for alternative mercury emission limits as allowed by the statute. Although PERC's 2007 mercury emissions were estimated to be 14.3 lb/yr, PERC's average emissions were typically below 10 lb/yr. PERC's mercury reduction strategy was based on programs designed to limit the amount of mercury in the waste stream entering the facility to stay below 10 lb/yr.

As part of the subsequent statutory revisions made to 38 M.R.S.A. §585-B in 2009, language was added allowing for a 90% mercury emissions reduction by weight as an alternative to the 25 pound a year limit effective as of January 1, 2010. Per 38 M.R.S.A. §585-B(7), which was added to the statute in 2009, facilities emitting mercury in excess of 10 pounds in calendar year 2010 were required to stack test twice in 2011 and twice in 2012, as well as submit a mercury reduction plan by January 1, 2013.

The statutory revision resulted in ecomaine's submittal of an air emission license application and the issuance of an amendment bringing the facility into compliance with the mercury statute using the

90% reduction provision. ecomaine's alternative mercury emission limit application was withdrawn.

Maine's top three highest mercury emitting facilities calculated their 2010 emissions as follows:

- PERC less than 3.25 lb/yr;
- ecomaine at 7.8 lb/yr maintaining a 94% removal reduction; and
- Dragon at 21.58 lb/yr.

Dragon is currently the only remaining facility with an alternative mercury emission limit application pending and the only facility with mercury emissions in excess of 10 lb/yr in 2010. Dragon performed two stack tests for mercury in 2011 and two stack tests in 2012 as required by the statute. Dragon's mercury reduction plan was submitted to the department on December 31, 2012, which included the results of the four statutorily required stack tests and an updated mercury reduction plan.

Table 1 has been updated with mercury estimates for 2008 and 2011 as reported to the department's air emission inventory group. Hazardous air pollutant emissions data, such as mercury, is collected every 3 years.

Table 1: Estimated mercury emissions, updated with 2008 and 2011 data

	Reporting Year			
Facility Name	**2002** (lb/yr)	**2005** (lb/yr)	**2008 (lb/yr)**	**2011 (lb/yr)**
Dragon Products Co., LLC - Thomaston	24.1	14.6	27	11.3
ecomaine (formerly RWS)	15.9	22.1	13	10.5*
Penobscot Energy Recovery Co.	7.4	7.0	2.5	2.5

*at 95.8% control efficiency, which meets the statutory requirements.

IV. Dragon Products Company, LLC

Dragon Products Company, LLC is a Portland cement facility located in Thomaston, Maine. Portland cement, a basic ingredient of concrete, is manufactured using limestone, silica, and other materials (calcium, silicon, aluminum, iron, etc.) to which gypsum is added in the final grinding process to regulate the setting time of the concrete.

A. Federal Rules: 40 CFR Part 63, Subpart LLL

Dragon is subject to 40 CFR, Part 63, Subpart LLL, *National Emission Standards for Hazardous Air Pollutants from the Portland Cement Manufacturing Industry* (also referred to as the Portland Cement Maximum Achievable Control Technology (MACT)). In the development of MACT standards, EPA collects information and reviews data from facilities throughout a specific industrial category. The MACT standards are established based on the performance of the top 12% best controlled facilities in an industrial category.

On December 20, 2006, EPA reissued the Subpart LLL rule which included emission standards pursuant to section 112(d) of the Clean Air Act for mercury and total hydrocarbons (THC) for new Portland cement kilns. The regulation did not include standards for mercury or THC emissions from *existing* kilns. The D.C. Circuit court remanded the rule *without vacatur* to EPA, and as part of the settlement, EPA issued a new rule addressing mercury, hydrochloric acid and total hydrocarbons from existing Portland cement kilns. The revised final rule was issued September 9, 2010 and was clarified with a January 1, 2011 amendment. An additional amendment was published on December 20, 2012. The amendment retained emission standards for mercury, hydrogen chloride (HCl), and THC, and amended the particulate matter (PM) standard under the Portland Cement MACT. It included provisions for the alternative monitoring of PM, set work practice standards for startups and shutdowns, and revised the compliance date for the PM, mercury, HCL, THC and clinker storage piles standards.

40 CFR Part 63, Subpart LLL will require Dragon to do the following:

- Comply with emission standards for dioxin/furans, mercury, total hydrocarbons, hydrochloric acid, and PM by September 9, 2015.
- Monitor mercury emissions using a continuous emissions monitor or sorbent traps.
- Monitor PM, total hydrocarbons, and hydrochloric acid.

The new 40 CFR Part 63, Subpart LLL mercury emission limit for Dragon is 55 pounds per million tons of clinker. At a maximum production of 766,500 tons of clinker, this equates to 42 pounds of mercury per year. At Dragon's maximum production, the Portland Cement MACT standard results in a higher annual level than the 25 pounds/year in the statute, however, the MACT limit is linearly proportional to production. Therefore, at normal production, the facility's mercury emission limit under the MACT standard is significantly less than 42 lb/yr. For example, under the production rates achieved during calendar years 2011 and 2012, Dragon's mercury equivalent lb/yr emission rate limit under the MACT standard would have been 19.96 and 19.31 lb/year, respectively. With the MACT limit, Dragon will be on an equal playing field with other Portland cement kilns in the US.

To demonstrate compliance with the mercury emission standard, Dragon will be required to continuous monitor mercury emissions under the Portland Cement MACT. Continuous monitoring will result in a better understanding of the operational aspects impacting mercury, such as fuel type, raw material input, and different operational configurations. The effect of a change in operation will be able to be seen in the monitoring data. This timely feedback is more beneficial than stack tests which involve data collection for a particular short period of time during normal operations. The continuous mercury emission monitoring data will also result in a more complete dataset of actual emissions, including normal operations, variations in operations, and under upset conditions. The continuous mercury monitors are subject to specific quality assurance and quality control requirements that must be met to ensure that the data collected is valid.

B. Dragon Process Description

The Dragon facility, which manufactures Portland cement using a dry process, consists of a single pre-heater, pre-calciner cement kiln and an in-line raw mill. Associated processes include quarrying, raw material processing, and finished material processing.

Limestone is the primary raw material, quarried on-site. Additional raw materials include iron ore, recycled waste clinker, sand, utility fly ash, and other miscellaneous permitted raw material. Fuels include coal, #2 and #4 fuel oil, specification and non-specification waste oil, tires and tire chips, and petroleum coke.

Limestone, iron ore, sand, recycled waste clinker and other raw materials are combined in the raw mill, ground, and stored in the raw feed blend silo. Recycled cement kiln dust (CKD) is mixed with the raw meal in the blend silo and is fed to the pre-calciner. From the pre-calciner, utility fly ash is mixed into the kiln feed prior to being fed to the rotary kiln. Clinker discharged from the kiln is cooled in a clinker cooler, transferred to clinker storage, and then sent to the finishing mills to be combined with gypsum, cement kiln dust from the facility's cement kiln dust pile and other additives to make Portland cement.

C. Dragon's Mercury Emissions

Mercury emissions from Dragon can be calculated using different methods. Currently, either stack test data extrapolated using annual operating hours or mass balance is used. The results of these methods for 2007 were 12.68 lb/yr using 2005 stack test data and 2007 operating hours, and 23.37 lb/yr using mass balance and mercury estimates from periodic mercury analysis of the raw materials and fuels used in the cement kiln, as well as the clinker exiting the kiln. Dragon currently recycles all cement kiln dust captured in the air pollution control devices, so mercury can only leave the kiln process as part of the clinker, which is the cement kiln's product, or as stack emissions.

The four stack tests performed in 2011 and 2012 resulted in the emissions shown in Table 2.

Table 2: Estimated 2011 and 2012 Mercury Emissions Using Stack Test Data[7]

Calendar Year	Test Condition	Test Date	Test Hourly Emissions (lb/hr)	Average Emissions (lb/hr)	Annual Operating Hours (hrs/year)	Annual Emissions (lbs/year)	Total Annual Emissions (lbs/year)
2011	RM On	6/7/2011	2.48E-03	2.00E-03	3200.2	6.41	7.87
		6/7/2011	2.47E-03				
		12/1/2011	1.69E-03				
		12/1/2011	1.37E-03				
	RM Off	6/7/2011	2.92E-03	2.42E-03	604.6	1.46	
		11/15/2011	2.15E-03				
		11/15/2011	2.19E-03				
2012	RM On	7/17/2012	9.16E-04	7.74E-04	3107.3	2.4	3.86
		7/17/2012	9.81E-04				
		11/20/2012	6.32E-04				
		11/20/2012	5.66E-04				
	RM Off	7/17/2012	2.41E-03	2.44E-03	597.7	1.46	
		11/20/2012	2.47E-03				

[7] Dragon Mercury Reduction Plan submitted to the department, December 28, 2012

Dragon conducted the stack test during two different operating scenarios; in-line raw mill (RM) on and in-line RM off. Studies at other Portland Cement facilities indicate the operating scenario may affect mercury emissions.

During the period from September 17, 2008 to October 24, 2008, Dragon installed and operated a mercury Continuous Emission Monitoring System (CEMS) on its kiln stack. Using the CEMS stack, mercury concentration data (in units of micrograms per dry standard cubic meter (µg/dscm)), along with the facility's monitored stack flow rate and temperature data, hourly mercury mass emission rates were calculated.

Average Stack Hg Concentration	Average Stack Exhaust Gas Flow Rate	Average Mercury Emission Rate
7.0 µg/dscm	199,760 acfm*	0.00524 lb/hr

*acfm- actual cubic feet per minute

Using the hourly emission obtained from the stack CEMS, annual emission rates can be estimated using the hours of operation for the year, assuming that the CEMS data are representative of the entire year.

Calendar Year	Mercury Emission Rate/Factor (lb/hr)	Operating Hours (hr/yr)	Annual Mercury Emissions (lb/yr)
2011	0.00524	3805	19.94
2012	0.00524	3705	19.41

D. Mercury Controls and Costs for Dragon

In the initial 2008 mercury reduction plan Dragon reviewed control options for further mercury reductions. These options included: feed rate controls, activated carbon injection, wet scrubber, and recycled cement kiln dust (CKD) removal. The control options and associated costs estimated by Dragon are described below:

- *Feed Rate Controls*:
  Reducing raw material input or using fuel substitution for substances containing mercury could reduce mercury emissions.

  - *Limestone*
    Limestone, the primary feed material in Portland cement production, has been shown to be a large contributor of mercury. Dragon quarries three types of limestone on site: low rock, high rock, and magnesium rock. Dragon has asserted that it would be infeasible to switch their limestone source based on mercury content, since the limestone would have to be transported from elsewhere and would make further operation at Thomaston impractical.

- *Iron Ore*
  Iron ore supplements the iron content in the process. Dragon uses off-site iron ore, so switching iron ore may be feasible. However, the mercury content from iron ore has been calculated to be only 2.3 to 4% of the mercury fed into the kiln.

- *Reclaimed Clinker*
  Reclaimed waste clinker from the on-site waste clinker pile is used as an additional raw material source. The mercury content represents 3.1 to 3.5% of the detectable mercury feed. Eliminating the use of waste clinker would increase the use of limestone used at the site. Dragon is also required by the department's solid waste Orders to actively reclaim the waste clinker until the area is returned to wetland (for another 7 to 10 years).

- *Fly Ash*
  Dragon uses fly ash as an alternative raw material to shale or clay. The fly ash is currently obtained from external sources one of which is Schiller Station in Portsmouth, New Hampshire. Fly ash represents a significant portion of the estimated mercury fed into Dragon's process: approximately 45.5% assuming non-detect analysis values are zero and 26.8% assuming non-detect analysis are present at half the detection level. Therefore replacing it with an alternative raw material is a potential mercury reduction option. However, Dragon asserts that if shale and/or clay replace the present fly ash, it may result in higher total hydrocarbon emissions. Shale and clay have a higher organic content than fly ash and would necessitate additional fuel consumption in the kiln to remove the organic carbon. By eliminating the use of fly ash, the resulting fuel usage increase would result in increased emissions of pollutants such as sulfur dioxide (SO_2), oxides of nitrogen (NOx), carbon monoxide, the greenhouse gas carbon dioxide (CO_2), and higher production costs. Shale and clay also require more grinding and crushing during processing than fly ash. It may be possible, however, to replace the Schiller fly ash with a fly ash from a different source that has lower mercury content. Dragon will continue to evaluate potential new sources of lower mercury content fly ash to minimize emissions and comply with the Portland Cement MACT.

- *Other Raw Materials*
  Dragon is allowed to feed sand, foundry sand, oil contaminated soil, perlite, and slag into the process. The mercury analysis did not detect mercury in these components.

- *Fuels*
  Petroleum coke is currently the main fuel fired at Dragon with a mercury content of non-detect to 0.02 ppm. The facility also has the potential to fire coal (mercury content range from 0-1.3 ppm). Dragon may need to consider alternate fuels to further reduce mercury.

- *Activated Carbon Injection:*
  Using activated carbon injection, the mercury is adsorbed onto injected carbon, which is then removed from the process. The cost associated with activated carbon is estimated by

  EPA to be $761,000 to $5.5 million per kiln[8] with an annual cost of $477,000 to $3.7 million[9].

Table 3: Estimated Mercury Control Costs for Activated Carbon Injection[10]

Calendar Year	Estimated Annualized Cost ($)(a)	Emission Method	Uncontrolled Hg Emissions (lb/yr)(b)	Assumed Control Efficiency (%)(c)	Controlled Hg (lb/yr)	Cost per lb controlled ($/lb)
2011	$702,625	Stack Test	7.87	80%	6.30	$111,599
		CEMs	19.94		15.95	$44,046
		Stack Test	7.87	90%	7.08	$99,199
		CEMs	19.94		17.95	$39,152
2012		Stack Test	3.86	80%	3.09	$227,534
		CEMs	19.41		15.53	$45,249
		Stack Test	3.86	90%	3.47	$202,252
		CEMs	19.41		17.47	$40,221

(a) Summary of Environmental and Cost Impacts for Final Portland Cement NESHAP and NSPS, USEPA, August 6, 2010.
(b) Stack test emissions based on 2011 and 2012 stack.
(c) Control efficiencies estimated by EPA as part of the PC MACT rule development range from 80% to 90%.

- *Wet Scrubbers:*
  Wet Scrubbers are not widely used to control mercury. Five cement kilns in the United States utilize wet scrubbers for SO_2 emission control, but there is insufficient data on control efficiency for mercury. EPA has stated that there is "a reasonable basis that wet scrubbers remove oxidized mercury from cement kiln emissions"[11]. Using EPA's best-case efficiency of 80%, and EPA's estimated annualized cost of a wet scrubber system of $1.5 million per year, [12] the resulting mercury control costs are provided in Table 4 below.

[8] 70 FR 72334, December 2, 2005
[9] 70 FR 72335, December 2, 2005
[10] Dragon Mercury Reduction Plan submitted to the department, December 28, 2012, Table 5-1, page 15
[11] 71 FR 76523, December 20, 2006
[12] Dragon Mercury Reduction Plan submitted to the department, December 28, 2012

Table 4: Estimated Mercury Control Costs for a Wet Scrubber System[13]

Calendar Year	Estimated Annualized Cost ($)[(a)]	Emission Method	Uncontrolled Hg Emissions (lb/yr)[(b)]	Assumed Control Efficiency (%)[(c)]	Controlled Hg (lb/yr)	Cost per lb controlled ($/lb)
2011	$1,542,000	Stack Test	7.87	80%	6.30	$244,917
		CEMs	19.94		15.95	$96,665
2012		Stack Test	3.86	80%	3.09	$499,352
		CEMs	19.41		15.53	$99,304

(a) 71 FR 76525, December 20, 2006.
(b) Stack test emissions based on 2011 and 2012 stack test results. CEMs emissions values based on hourly emission rate (measure by CEMS) multiplies by the operating hours for each year.
(c) Control efficiencies estimated by EPA as part of the PC MACT rule development at 80%.

- *Cement Kiln Dust (CKD) Removal*:
  Cement kiln dust consists mostly of clinker dust and small amounts of raw material which is usually recycled back into the kiln. Studies have shown that some mercury adsorbs on the CKD captured in the air pollution control devices. The annual cost for the replacement of CKD (which is used as a raw material) and the disposal of the additional solid waste generated is estimated by EPA to be $3.7 million.[14]

Table 5: Estimated Mercury Control Costs for CKD Removal[15]

Calendar Year	Estimated Annualized Cost ($)[(a)]	Emission Method	Uncontrolled Hg Emissions (lb/yr) [(b)]	Assumed Control Efficiency (%)[(c)]	Controlled Hg (lb/yr)	Cost per lb controlled ($/lb)
2011	$3,700,000	Stack Test	7.87	100%	7.87	$470,140
		CEMs	19.94		19.94	$185,557
2012		Stack Test	3.86	100%	3.86	$958,549
		CEMs	19.41		19.41	$190,623

(a) 71 FR 76525, December 20, 2006.
(b) Stack test emissions based on 2011 and 2012 stack test results. CEMs emissions values based on hourly emission rate (measure by CEMS) multiplies by the operating hours for each year.
(c) Control efficiencies estimated by EPA as part of the PC MACT rule development range from 80% to 90%.

[13] Dragon Mercury Reduction Plan submitted to the department, December 28, 2012, Table 5-1, page 15
Dragon Mercury Reduction Plan submitted to the department, December 28, 2012, Table 5-2, page 17
[14] 71 FR 76524, December 20, 2006
[15] Dragon Mercury Reduction Plan submitted to the department, December 28, 2012, Table 5-3, page 18

Table 6 compiles the control technology information and its associated costs.

Table 6: Cost Calculations Based on Emission Estimates[16]

Control Technology	Estimated Annualized Costs ($)	Uncontrolled Mercury Emissions*	Assumed Control Efficiency	Controlled Mercury (lb/yr)	Cost per pound Mercury controlled ($/lb)
Activated Carbon Injection	$702,625	12.77	85%	10.8545	$64,731
Wet Scrubber	$1,542,000	12.77	80%	10.216	$150,940
CKD Removal	$3,700,000	12.77	100%	12.77	$289,742

* average of stack test and CEM emission during 2011 and 2012.

E. Alternative Mercury Emission Limit: Status of Dragon's License Application

Dragon submitted a license application for an alternative mercury emission limit in December 2008. The requested limit was 50 lb/yr. Dragon cited that their emissions can be calculated in a variety of ways: stack tests, mass balance, and mercury CEMS (a trial with CEMS was performed in the fall of 2008). A range of results occur depending on the method used, although Dragon's current license specifies that stack testing must be used to determine compliance with mercury emission limits. Using the CEMS data and the operating hours for 2005, 2006, and 2007, the estimated annual emissions were 37.5 lb/yr, 31.5 lb/yr, and 30.5 lb/yr respectively.

In accordance with the provisions of 38 M.R.S.A. § 585-B (5), pending a decision on the application, the 35 lb/yr limit applies to the source. Dragon is currently in compliance with this mercury emission limit. The delay in action on the amendment application was due to the uncertainty of the 40 CFR Part 63, Subpart LLL requirements which EPA recently finalized. The review of Dragon's license application for the alternative mercury emission limit will be subject to standard procedures for license amendments for sources subject to 06-096 C.M.R. ch. 140, including an evaluation of control options, the technical and economic feasibility of each option, and an opportunity for public input.

[16] Dragon Mercury Reduction Plan submitted to the Department, December 28, 2012

F. Conclusions Concerning Dragon's Mercury Emission Requirements

Based on the review of Dragon's submittal, including the cost of additional control technologies for relatively low mercury reductions achieved, and the requirements set forth in the recently published 40 CFR Part 63, Subpart LLL amendment (the Portland Cement MACT), the department concludes that mercury requirements for Dragon should be aligned with the federal regulations. The Portland Cement MACT equalizes the control requirements for Portland cement kilns by establishing production-based mercury emission limits and requiring continuous monitoring of those emissions based on the top 12% performing cement kilns in the country.

Maine's mercury emissions standard, 38 M.R.S.A. § 585-B, allows emissions to be measured using stack testing which is a snapshot in time during normal operations. Mass balance calculations can also be performed to calculate mercury emissions from a facility. However, these two methods do not provide continuous actual data. The Portland Cement MACT requires Dragon to monitor mercury emissions continuously, which provides emissions data under various operating conditions including process upsets. The mercury monitors are subject to specific quality assurance and quality control requirements to ensure the validity of the collected data. Thus, the CEM requirement will be more comprehensive and harder to meet than the Maine standard. In addition, the development of the Portland Cement MACT mercury emission standard is based on the compilation of mercury emission data, obtained both continuously and by stack tests, from many Portland Cement kilns resulting in a standard that is very specific to this industry. Based on Dragon's preliminary continuous emissions monitoring data, Dragon may have to investigate the fly ash substitution option, as well as the other options listed in this report to maintain compliance with the Portland Cement MACT mercury emission limits.

V. Department Recommendations

Most sources in the state can meet the 25 lb/year of mercury limit or 90% mercury control efficiency. Currently, one source has requested an alternative mercury limit, which would instead be explicitly addressed through the department's recommendation to amend the current legislation.

Based on the department's review of the information summarized in this report and the specific conclusions in section 5.2.6 above, the department makes the following recommendations:

- Retain the existing mercury provisions of:
  - A 25 lb/yr mercury emission limit from an air emission source beginning January 1, 2010,
  - the option to apply to the Board of Environmental Protection for an alternative higher emission limit, or
  - achieve ninety percent mercury emission control efficiency by January 1, 2012;
- Amend 38 MRSA §585-B:
  - To allow Portland Cement facilities to meet the applicable requirements of the National *Emission Standards for Hazardous Air Pollutants for the Portland Cement Manufacturing Industry and Standards of Performance for Portland Cement Plants*, 40 CFR Part 63, Subpart LLL as an alternative to meeting the 25 lb/year mercury emission limit.

- Remove provisions that are no longer applicable, as the dates for those requirements have been passed.
- Change rulemaking authority from the Board of Environmental Protection to the department to reflect PL 2011, ch. 305. As this portion of the statute is considered routine technical, the department is charged with conducting rulemaking under this section. This specific amendment is included in the department's omnibus bill to be heard during this session.

Appendix A

Suggested statutory amendment to 38 M.R.S.A. § 585-B

§585-B. Hazardous air pollutant standards

1. Standards. The board may establish and amend emission standards for hazardous air pollutants, and regulations to implement these standards. If emission standards are not feasible, the board may adopt design, equipment, work practice or operational standards for activities emitting hazardous pollutants.

2. Procedure. All standards and regulations under this section shall be adopted in conformance with the Maine Administrative Procedure Act, Title 5, Chapter 375, except as provided in this section. Prior to the establishment or amendment of these standards and regulations, the board shall conduct a public hearing to receive testimony on:

A. Any health risk assessment on the pollutants proposed to be controlled that has been conducted by the Department of Health and Human Services;

B. The extent to which the public is exposed to the pollutant;

C. The availability, effectiveness and cost of any air pollution control apparatus designed to prevent or control the emissions of hazardous pollutants; and

D. Any other information that would assist the board in establishing standards adequate to protect the public health and safety.

3. Relation to ambient standards. The board may control hazardous air pollutants if no ambient air quality standards have been established for those pollutants.

4. Legislative review.

[1989, c. 144, §6 (RP) .]

5. Standards for mercury. Notwithstanding subsection 1, an air emission source may not emit mercury in excess of ~~45.4 kilograms, or 100 pounds, per year after January 1, 2000; 22.7 kilograms, or 50 pounds, per year after January 1, 2004; 15.9 kilograms, or 35 pounds, after January 1, 2007; and~~ 11.4 kilograms~~,~~ or 25 pounds, per year ~~after January 1, 2010~~. As an alternative to not emitting mercury in excess of 11.4 kilograms~~,~~ or 25 pounds, per year, ~~after January 1, 2010,~~ an air emission source may reduce mercury emissions by 90 percent by weight ~~after January 1, 2010~~ or meet the requirements of 40 CFR Part 63, Subpart LLL, National Emission Standards for Hazardous Air Pollutants from the Portland Cement Manufacturing Industry. Compliance with these limits must be specified in the license of the air emission source. The ~~board~~ department shall establish by rule testing protocols and measurement methods for emissions sources for which the ~~board~~ department has not established such protocols and methods for determining compliance with the emission standard for mercury. These rules are routine technical rules under Title 5, chapter 375, subchapter 2-A.

~~An air emission source may apply to the board for an extension or modification of the 11.4 kilogram, or 25 pound, limit as follows.~~

~~A. An emission source may submit an application to the board no later than January 1, 2009 for a 6 month extension of the January 1, 2010 deadline to meet the 11.4 kilogram, or 25 pound, limit. The board shall grant the extension if the board determines, based on information presented by the source, that compliance with the limit is not achievable by the deadline due to engineering constraints, availability of equipment or other justifiable technical reasons.~~

~~B. An emission source may submit an application to the board no later than January 1, 2009 for a license modification establishing an alternative emission limit for mercury. The board shall grant~~

the license modification if the board finds that the proposed mercury emission limit meets the most stringent emission limitation that is achievable and compatible with that class of source, considering economic feasibility.

Pending a decision on an application for an extension or a license modification under this subsection, the 15.9 kilogram, or 35 pound, limit applies to the emission source.

Notwithstanding the January 1, 2000 compliance date in this subsection, a resource recovery facility that is subject to an emissions limit for mercury adopted by rule by the board before January 1, 2000 shall comply with the 45.4 kilogram, or 100 pound, mercury emissions limit after December 19, 2000.

For determining compliance with this subsection, the results of multiple stack tests may be averaged in accordance with guidance provided by the department.

6. Mercury reduction plans. An air emission source emitting mercury in excess of 10 pounds per year after January 1, 2007 must develop a mercury reduction plan. Except as provided in subsection 7, the mercury reduction plan must be submitted to the department no later than September 1, 2008. The mercury reduction plan must contain:

A. Identification, characterization and accounting of the mercury used or released at the emission source; and

B. Identification, analysis and evaluation of any appropriate technologies, procedures, processes, equipment or production changes that may be utilized by the emission source to reduce the amount of mercury used or released by that emission source, including a financial analysis of the costs and benefits of reducing the amount of mercury used or released.

C. [RR 2005, c. 2, §24 (RP).]

The department may keep information submitted to the department under this subsection confidential as provided under section 1310-B.

The department shall submit a report to the joint standing committee of the Legislature having jurisdiction over natural resources matters no later than March 1, 2009 summarizing the mercury emissions and mercury reduction potential from those emission sources subject to this subsection. In addition, the department shall include an evaluation of the appropriateness of the 25 pound mercury standard established in subsection 5. The evaluation must address, but is not limited to, the technological feasibility, cost and schedule of achieving the standards established in subsection 5. The department shall submit an updated report to the committee by March 1, 2013. The joint standing committee of the Legislature having jurisdiction over natural resources matters is authorized to report out to the 126th Legislature a bill relating to the evaluation and the updated report.

7. Stack tests for mercury. An air emission source emitting mercury in excess of 10 pounds in calendar year 2010 must:

A. Conduct a stack test for mercury twice in calendar year 2011 and twice in calendar year 2012. The stack tests must be conducted at least 4 months apart; and B. By January 1, 2013, develop a mercury reduction plan and submit the plan to the department in accordance with subsection 6. The plan must contain the results of the 4 stack tests conducted pursuant to paragraph A.

For determining compliance with subsection 5, the results of multiple stack tests under this subsection may be averaged in accordance with guidance provided by the department.

The department may approve an alternative to the stack testing requirements in this subsection, such as, but not limited to, mercury input data or a continuous mercury emission monitoring system.