Canadian Council of Ministers of the Environment
Le Conseil canadien des ministres de l'environnement

CANADA-WIDE STANDARDS FOR MERCURY EMISSIONS FROM COAL-FIRED ELECTRIC POWER GENERATION PLANTS

2013/14 PROGRESS REPORT

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1. Introduction

In 2006 the Canadian Council of Ministers of the Environment (CCME) endorsed Canada-wide Standards for Mercury Emissions from Coal-fired Electric Power Generation Plants (CWS). The CWS set targeted caps for each signatory jurisdiction for the year 2010. This report presents information on the attainment of 2010 emissions caps under the CWS. Only those jurisdictions with coal-fired electric power generation plants are required to report. In 2010, emissions of mercury from the plants covered by the CWS represented 94% of Canada's total mercury emissions from electric power generation.[1]

In the baseline year of 2003, 2695 kg of mercury were emitted and there was a total of 3725 kg of mercury in the amount of coal burned. This represented a capture rate of less than 28%. In 2014, 666.62 kg of mercury were emitted and the total mercury contained in the coal burned was 1947.48 kg representing a capture rate of 67%. This exceeds the CWS goal of 60% capture and represents reduction of more than 75% in total emissions from 2003. The 2010 emission caps were expected to produce a 52-58% reduction in total emissions. More information on the CWS may be found on the CCME website at www.ccme.ca.

2. Summary

In 2013 there were 802.88 kilograms of mercury emitted in total from coal-fired power generation plants in signatory jurisdictions and, where applicable, jurisdictions have achieved their 2010 mercury emissions cap (using credits in the case of Saskatchewan), or have put a plan in place with timelines for achievement.

In 2014 there were 666.62 kilograms of mercury emitted in total from coal-fired power generation plants in signatory jurisdictions and, where applicable, jurisdictions have achieved their 2010 mercury emissions cap.

Province	2008 Mercury Emissions (kg)	2009 Mercury Emissions (kg)	2010 Mercury Emissions (kg)	2011 Mercury Emissions (kg)	2012 Mercury Emissions (kg)	2013 Mercury Emissions (kg)	2014 Mercury Emissions (kg)	2010 Emissions Cap (kg)
Alberta	481	579	661	212.59	200.7	222.51	236.28	590
Manitoba	9.6	2.8	1.16	1.01	1.22	1.87	1.44	20
New Brunswick	41	107	30	18	13	15	15	25
Nova Scotia	161	140	81.5	94.6	93.9	72.5	53.9	65*
Ontario	191	59	87	43	27	28	3	Not set
Saskatchewan	648	707	601** (credits of 171 kg used to meet cap)	551** (credits of 121 kg used to meet cap)	490** (credits of 60 kg used to meet cap)	463** (credits of 33 kg used to meet cap)	357	430
Total	**1532**	**1594.8**	**1461.66**	**920.2**	**825.82**	**802.88**	**666.62**	**1130**

*Nova Scotia's cap for 2010 was changed in provincial regulations from 65 kg to 110 kg.
**Until 2014 Saskatchewan's cap was achieved with the use of accumulated credits for early action.

[1] National Emission Trends -- Heavy Metals and Persistent Organic Pollutants: www.ec.gc.ca/inrp-npri/default.asp?lang=EN&n=0EC58C98-1

3. Achievement of 2010 Caps and Review of the Standard

Under the CWS for Mercury Emissions from Coal-fired Electric Power Generation Plants all jurisdictions were to have met their emissions caps by 2010. The CWS was scheduled for review by 2012. Because several jurisdictions were not yet in achievement of the standard in 2010, the review was postponed.

4. Jurisdiction Reports

The following information was submitted by signatory jurisdictions in accordance with Section 2.1 of the CCME Monitoring Protocol in Support of the Canada-wide Standards for Mercury Emissions from Coal-Fired Electric Power Generation Plants.

4.1 ALBERTA

The eight coal-fired power plant facilities in Alberta are the Battle River Generating Station, the Genesee Thermal Generating Station – Units 1 and 2, the Genesee Thermal Generating Station – Unit 3, the Sheerness Generating Station, the Sundance Generating Plant, the Keephills Generating Plants 1, 2 and 3, and the H.R. Milner Generating Station. The Wabamun plant was shut down in early 2010 as were Sundance units 1 and 2 in early 2011. Sundance Units 1 and 2 have been restored to service.

Mercury Emissions from Alberta Facilities by Year

	Total Mass Mercury					
Facility	**Emissions (kg)**		**In coal burned (kg)**		**Retained in ash and residue (kg)**	
	2013	**2014**	**2013**	**2014**	**2013**	**2014**
Battle River	18.5	9.6	96.0	73.8	77.5	64.2
Sheerness	27.54	30.19	170.89	163.91	143.35	133.72
Genesee 1&2 Stack 1	27.57	21.03	138.54	118.36	110.97	97.33
Genesee 3 Stack 2	13.93	8.85	87.34	65.57	73.41	56.72
Sundance Stack 1	4.53	14.38	17.27	56.14	12.74	41.76
Sundance Stack 2	42.76	46.28	159.65	168.91	117.04	122.63
Sundance Stack 3	43.49	49.66	175.24	190.53	131.75	140.87
Keephills Stack 1	30.41	37.19	105.97	155.11	75.56	117.92
Keephills Stack 2	5.32	9.54	54.85	83.08	49.53	73.54
H.R. Milner	8.46	9.56	11.83	19.94	3.38	10.38
Totals	**222.51**	**236.28**	**1017.58**	**1095.35**	**795.23**	**859.07**

4.1.1 BATTLE RIVER GENERATING STATION

a) Annual Emission of Total Mercury
See Mercury Emissions from Alberta Facilities by Year (table above).

b) Mercury Capture Rate
Not applicable, no new EPG units.

c) Monitoring Methods Used for All Parameters
2013: Stack Testing and Flow Monitoring (CEMS)
2014: Stack Testing, Ontario Hydro and Flow Monitoring

d) Justification for Alternative Methods
Not applicable.

e) Additional Supporting Data
Not applicable.

f) Mercury Speciation (Averages)

Year	Stack	Elemental Mercury	Oxidized Mercury	Particulate Mercury
2013	B	No Ontario Hydro Completed in 2013		
	C			
2014	B	47.1%	36.4%	16.5%
	C	69.4%	20.9%	9.8%

*% calculated is based on actual measured values, therefore totals may not equal 100%
** The Elemental Mercury is different between stacks; therefore, the table shows the values for each stack

g) Mercury Content of Coal

	2013	2014
Mercury Content kg (ppb)	96.0 (46.37)	73.8 (36.43)
Coal Mass Burned (dry kg)	2,070,565,000	2,026,431,000

h) Combustion Residues Mercury Content, Mass and Management Method

Year	Residue	Tonnes (dry)	Mercury (ppb)	Disposal
2013	Raw Fly Ash	225,037,000	271	Marketed & Landfill
	Bottom Ash	172,324,000	3	Landfill
2014	Raw Fly ash	231,276,000	235	Marketed & Landfill
	Bottom Ash	158,895,000	2	Landfill

4.1.2 GENESEE GENERATING STATION

a) Annual Emission of Total Mercury
See table, p. 2.

b) Mercury Capture Rate

	Genesee 1/2	**Genesee 3**
Year	**Capture Rate %**	**Capture Rate %**
2013	80.10	84.05
2014	82.23	86.38

c) Monitoring Methods Used for All Parameters
Stack Testing and Flow Monitoring (Mercury CEMS)

d) Justification for Alternative Methods
Not applicable

e) Additional Supporting Data
On March 5, May 28 and 29, 2013, and August 19 and October 16, 2014 Maxxam Analytics conducted Compliance Surveys on Unit 1 and 2 (Stack 1); on April 17, 18, May 29 and 30, 2013, and June 19 and August 20 2014, Maxxam Analytics conducted Compliance Surveys on Stack 2 at Genesee and RATA on the Mercury CEMS (Sorbent Carbon Trap).

f) Mercury Speciation

Ontario Hydro Method
Unit 3:

Year	Stack	Elemental Mercury %	Oxidized Mercury %	Particulate Mercury %
2014	1	83.4	13.6	3.1
	2	89.3	1.7	9.0

On February 14 and 15, 2012, Maxxam Analytics conducted a source emission survey on Unit 3 (Stack 2). This test was to achieve the originally intended number of data sets on Stack 2 by the regulators for the test which could not be completed in 2011 owing to a forced outage which disabled Unit 3 from November 11 to January 19.

g) Mercury Content of Coal
See table, p. 2.

h) Combustion Residues Mercury Content, Mass and Management Method

G1/2 2013 Residue	Sold		Returned to Mine		Total (10^3 kg)
	10^3 kg	%	10^3 kg	%	
Fly Ash	206,987	47.49	228,900	52.51	435,887
Bottom Ash	13,891	3.61	371,000	96.39	384,891

G1/2 2014 Residue	Sold		Returned to Mine		Total (10^3 kg)
	10^3 kg	%	10^3 kg	%	
Fly Ash	194,585	46.91	220,260	53.09	414,845
Bottom Ash	840	0.27	308,300	99.73	309,140

G3 2013 Residue	Sold		Returned to Mine		Total (10^3 kg)
	10^3 kg	%	10^3 kg	%	
Fly Ash	0	0.0	343,440	100.0	343.440
Bottom Ash	0	0.0	151,560	100.0	151,560

G3 2014 Residue	Sold		Returned to Mine		Total (10^3 kg)
	10^3 kg	%	10^3 kg	%	
Fly Ash	335	0.1	284,760	99.9	285,095
Bottom Ash	0	0.0	124,200	100.0	124,200

4.1.3 Sheerness Generating Station

a) Annual Emission of Total Mercury
See table, p. 2

b) Mercury Capture Rate
Applies to new units only.

c) Monitoring Methods Used for All Parameters

Stack Testing and Flow Monitoring (CEMS)

- The protocol of US EPA Method 30B for Relative Accuracy Test Audit of the Mercury CEMS was followed.
- The Alberta Stack Sampling Code, Method #2, Determination of Stack Gas Velocity and Volumetric Flow Rates.
- The protocols of method 1, 2, 3 and 4 of the Alberta Stack Sampling Code were used to test Volumetric Flow and Sample Level Temperature.

Other equivalent methods

A Mercury CEMS was installed and fully operational as of January 1, 2012. The mercury captured and retained in the ash is the difference between the mercury mass in the coal by analysis and the mercury emissions as measured by the mercury CEMS.

d) Justification for Alternative Methods

Installation, operation and determination of mercury emissions using mercury CEMS were prescribed by Alberta Regulation 34/2006 Mercury Emissions From Coal-Fired Power Plants Regulation.

e) Additional Supporting Data

Not applicable

f) Mercury Speciation

Summary of Speciated Mercury Emissions Survey Results, November 5 and 6, 2013.
UDCP Ontario Hydro Method – Speciated Mercury
Main Stack (Boilers #1 and #2).

	Average of 3 Tests
Total Mercury	4.45 g/h
Particulate Mercury	2.2%
Back Half (Oxidized Mercury)	19.3%
Elemental Mercury	78.6%

g) Mercury Content of Coal

See table, p. 2

h) Combustion Residues Mercury Content, Mass and Management Method

Year	**Residue**	**Tonnes (dry)**	**Mercury (kg)**	**Disposal**
2013	Raw Fly Ash and Bottom Ash	380,389.71	111.88	Engineered landfill
	Sales Fly Ash	106,994.75	31.47	Sold, recycled, concrete production
2014	Raw Fly Ash and Bottom Ash	410,366.20	103.21	Engineered landfill
	Sales Fly Ash	121,318.75	30.51	Sold, recycled, concrete production

4.1.4 TRANSALTA (SUNDANCE AND KEEPHILLS)

a) Annual Emission of Total Mercury

	Sundance Stack 1	**Sundance Stack 2**	**Sundance Stack 3**	**Keephills Stack 1**	**Keephills Stack 2**	**Total**
Year	***Hg Emissions to Air (kg)***	***Hg Emissions to Air (kg)***	***Hg Emissions to Air (kg)***	***Hg Emissions to Air (kg)***	***Hg Emissions to Air (kg)***	***(kg)***
2013	4.53	42.76	43.49	30.41	5.32	126.51
2014	14.38	46.28	49.66	37.19	9.54	157.05

b) Mercury Capture Rate
N/A

c) Monitoring Methods Used for All Parameters
Stack Testing and Flow Monitoring (CEMS)

d) Justification for Alternative Methods
N/A

e) Additional Supporting Data
N/A

f) Mercury Speciation (Averages)

Ontario Hydro Stack Test

Stack	Date	Elemental Mercury %	Oxidized Mercury %	Particulate Mercury %
Keephills Stack 1	July 3-4, 2013	86.3	12.6	1.1
Sundance Stack 2	July 9-10, 2013	77.3	20.2	2.5
Sundance Stack 3	July 10-11, 2013	65.9	25.5	8.6
Keephills Stack 2	April 11-15, 2014	92.6	6.5	0.9
Sundance Stack 1	August 6-7, 2014	35.9	61.7	2.4

No Ontario Hydro stack tests were completed at Keephills unit 1-2 facility in 2014.

g) Mercury Content of Coal

Facility	In coal burned (kg)	
	2013	**2014**
Sundance Stack 1	17.27	56.14
Sundance Stack 2	159.65	168.91
Sundance Stack 3	175.24	190.53
Keephills Stack 1	105.97	155.11
Keephills Stack 2	54.85	83.08

h) Combustion Residues Mercury Content, Mass and Management Method

Facility	Retained in ash and residue (kg)	
	2013	**2014**
Sundance Stack 1	12.74	41.76
Sundance Stack 2	117.04	122.63
Sundance Stack 3	131.75	140.87
Keephills Stack 1	75.56	117.92
Keephills Stack 2	49.53	73.54

At Sundance ~73 % of fly ash is disposed of in the Highvale mine. The remaining 27% is sold for cement production. Bottom ash is disposed of in the Highvale mine.

Keephills 1-2 ash is all transported via pipeline to the Keephills Ash Lagoon. Keephills 1-2 has approval and is developing a dry ash haul system for the plant which is currently not yet in use.

All ash from the Keephills Unit 3 facility is disposed of by truck in the Highvale mine.

4.1.5 H.R. MILNER GENERATING STATION

a) Annual Emission of Total Mercury
See table, p. 2.

b) Mercury Capture Rate
Not applicable

c) Monitoring Methods Used for All Parameters
Stack Testing and Flow Monitoring (CEMS).
Ontario Hydro Method/Stack Testing data used for speciation of emissions to air.
Mass Balance used average of CANMET test analysis for coal, fly ash and bottom ash (Method ASTM D6722).
Other equivalent method.

d) Justification for Alternative Methods

Description of the general steps taken:

- Coal, fly ash, and bottom ash samples were collected and tested. Levels of mercury were calculated using Equation 1.1b from CCME (2007). Total mercury in each medium was calculated for both years and the stack estimates were based upon stack surveys.
- A water totalizer was installed at the Ash Silo in late 2013, which allowed for a more accurate mass balance in 2014 than previous years. Water is added in the fly ash so that it can be taken to the Flood Creek disposal area. The scale that weighs the fly ash trucks is calibrated. This totalized water is then subtracted from the total weight to get the dry weight. The 2013 water balance was calculated using an average for the entire year and could partly explain the -62% mass balance.
- A mercury mass balance was conducted following Appendix A of the CCME Monitoring Protocol (CCME, 2007). Based on the 2013 results, 3.38 kg of Mercury (Hg) was accounted for in fly and bottom ash compared with 11.83 kg of Hg consumed at the plant representing 28% capture. Milner's total Hg emissions for 2013 using equation 1.1b (CCME, 2007) were 8.46 kg and below the 20 kg/year threshold criterion for Low Mass Emitter status. The mass balance was, however, outside +/- 20% required by Alberta Environment (AENV, 2010). Mercury levels in fly ash from 2013 and 2014 were variable and about 4 times lower on average compared with 2012.

e) Additional Supporting Data
Not applicable

f) Mercury Speciation (Averages)
Mercury Speciation Results, from the 2013 and 2014 source testing reports. The 2013 Mercury speciation was conducted by A. Lanfranco and Associates Inc. over the period October 9-10, 2013. The 2014 speciation was conducted by AGAT Laboratories on September 23, 2014.

Date	Elemental Mercury	Oxidized Mercury	Particulate Mercury
2013 (mg/m^3)	0.00039	0.00006	<0.00002
2014 (mg/m^3)	0.0000425	0.0000419	0.0000286

g) Mercury Content of Coal
2013: 11.83 kg
2014: 19.94 kg

h) Combustion Residues Mercury Content, Mass and Management Method

Both ash waste streams were transported and disposed of at the Flood Creek Ash Disposal Facility in accordance with Approval 9814-02-05. Waste volumes reported in the station's Annual Waste Report to AESRD and when due, in the annual NPRI report (National Pollutant Release Inventory).

2013 Hg:
Hg content of fly ash and bottom ash = 3.38 kg.

2014 Hg:
Hg content of fly ash and bottom ash = 10.38 kg.

4.2 MANITOBA

Manitoba has one small coal-fired electricity generation plant located in the City of Brandon. Since January 1, 2010, Manitoba Hydro operated this facility in accordance with Manitoba Regulation 186/2009, *Coal-fired Emergency Operations Regulation*, under Manitoba's *Climate Change and Emissions Reduction Act*, C.C.S.M. c. C135. The Act and Regulation limits the facility to use coal and generate power only to support emergency operations.

Information for 2013 and 2014 were generated in accordance with the *Monitoring Protocol in Support of the Canada-wide Standards for Mercury Emissions from Coal-fired Electric Power Generation Plants.* Manitoba's total emissions of 1.868 kilograms (2013) and 1.442 kilograms (2014) mercury are well within its 2010 cap of 20 kilograms per year.

4.2.1 BRANDON GENERATING STATION

a) Annual Emission of Total Mercury

	Brandon Unit 5	**Total**
Year	**Mercury Emissions to Air (kg)**	**(kg)**
2003	20.122	20.122
2008	9.575	9.575
2009	2.822	2.822
2010	1.16	1.16
2011	1.01	1.01
2012	1.22	1.22
2013	1.868	1.868
2014	1.442	1.442

b) Mercury Capture Rate
This is not a requirement as Brandon Unit 5 is not a new generating unit. However, the percent mercury capture rate for 2013 was 7.63% and for 2014 was 7.49%.

c) Monitoring Methods Used for All Parameters

Manitoba Hydro uses the Mass Balance method of determining its total annual mercury emissions. Mass balance calculations are made following the *Uniform Data Collection Program* (UDCP) guide for mercury from coal-fired electric power generation. The stack testing program for mercury emissions provides mercury speciation data to support the mass balance calculations. The results of the 2014 stack testing program are within ±20% of the mass balance results, thereby corroborating the mass balance results reported in same year. No stack testing was performed in 2013.*

The mercury speciation in flue gas sampling program was designed to comply with the requirements of *The Canadian Uniform Data Collection Program (UDCP) for Mercury from Coal-Fired Electric Power Generation*, developed by the Canadian Council of Ministers of the Environment Mercury Canada-Wide Standards Development Committee in January 2003. This test program employed wet chemistry stack testing in accordance with the Ontario Hydro Method. The table (2014) below outlines the test matrix that was followed in completing this objective.

*Stack testing at Brandon- Unit 5 facility is not required for the year 2013. Stack testing is scheduled for 2014 and 2016 and subsequently will depend on the new CWS. Brandon Unit 5 had been classified as a low mass emitter facility (Monitoring Protocol in Support of the CWS for Mercury Emissions from Coal-fired EPG Plants) hence the reduced stack testing.

Sampling Locations	**No. of Runs**	**Sample/Type Pollutant**	**Sampling Method**	**Sample Run Time (min)**	**Analytical Method**	**Analytical Laboratory**
Precipitator Inlet	3	Speciated Mercury	Ontario Hydro Method	144	CVAAS(1) or CVAFS(2)	ALS(3)
Precipitator Outlet	3	Speciated Mercury	Ontario Hydro Method	150	CVAAS(1) or CVAFS(2)	ALS(3)

(1) CVAAS – Cold vapour atomic absorption spectrometry
(2) CVAFS – Cold vapour atomic fluorescence spectrometry
(3) ALS – ALS Laboratory Group, Burlington, Ontario

The speciated mercury samples were collected isokinetically which allowed the simultaneous determination of stack gas temperatures and velocities, stack gas composition and moisture content.

Mercury content of coal and coal combustion residues (fly ash, bottom ash) are determined routinely by Manitoba Hydro throughout the year. The sampling protocol is outlined in the document entitled *Manitoba Hydro Brandon Generating Station Site Specific Test Plan for Mercury in Coal, Ash & Residue Sampling and Analysis Program*. The program is designed to collect and analyze coal and residue composite samples every week during the year when Brandon Unit #5 is generating. Weekly composite samples are comprised of three daily samples taken during the week. Bottom ash samples were not obtained in 2013 and 2014 due to the low mercury ash content levels since 2008. The weekly coal and residue sampling program employs the following test methods:

Applicable Reference Methods

COAL

TOPIC	STANDARD	TITLE
Sampling	ASTM D6609	Standard Guide for Part-Stream Sampling of Coal
Sample Preparation	ASTM D2013	Standard Practice of Preparing Coal Samples for Analysis
% Moisture	ASTM D7582	Standard Test Methods for Proximate Analysis of Coal and Coke by Macro Thermogravimetric Analysis
Mercury	ASTM D6722	Standard Test Method for Total Mercury in Coal and Coal Combustion Residues by Direct Combustion Analysis
% Ash	ASTM D7582	Standard Test Methods for Proximate Analysis of Coal and Coke by Macro Thermogravimetric Analysis
% Sulphur	ASTM D4239	Standard Test Methods for Sulphur in the Analysis Sample of Coal and Coke Using High Temperature Tube Furnace Combustion
Higher Heating Value	ISO 1928	Solid mineral fuels -- Determination of gross calorific value by the bomb calorimetric method, and calculation of net calorific value

FLY ASH

TOPIC	STANDARD	TITLE
Sampling	No Standard	Not Applicable
Sample Preparation	No Standard	Recommended size reduction is 150-um (No. 100) U.S.A. standard sieve
% Moisture	ASTM D7582	Standard Test Methods for Proximate Analysis of Coal and Coke by Macro Thermogravimetric Analysis
Mercury	ASTM D6722	Standard Test Method for Total Mercury in Coal and Coal Combustion Residues by Direct Combustion Analysis
% Sulphur	ASTM D5016	Standard Test Method for Sulphur in Ash from Coal, Coke, and Residues from Coal Combustion Using High-Temperature Tube Furnace Combustion Method with Infrared Absorption

BOTTOM ASH

TOPIC	STANDARD	TITLE
Sampling	No Standard	Not Applicable
Sample Preparation	No Standard	Recommended size reduction is 150-um (No. 100) U.S.A. standard sieve
Mercury	ASTM D6722	Standard Test Method for Total Mercury in Coal and Coal Combustion Residues by Direct Combustion Analysis

Additionally, coal and ash composite samples were collected in conjunction with the speciated mercury emission testing to allow mercury mass balance calculations per the UDCP for mercury guide. Coal composite samples from the pulverizer pipes were collected, prepared and analyzed for ultimate and proximate analysis, calorific value, % chlorine, % sulphur, % ash, % moisture and mercury. Composite samples from the coal feeders were also collected, prepared and analyzed for % moisture and mercury. Composite combustion residue (fly ash and bottom ash) samples were collected for analysis of mercury, % chlorine, % carbon, % sulphur and % moisture.

d) Justification for Alternative Methods
No alternative methodologies are employed by Manitoba Hydro for the determination of total annual mercury emissions.

Minor modifications to the speciated mercury emissions testing methodologies were employed for the July 2014 source testing program. These modifications were previously discussed with and presented to Manitoba Conservation in a Pre-test Plan. Approval to proceed with the sampling program and minor test method modifications was received from Manitoba Conservation prior to the 2008 testing program.

e) Additional Supporting Data
N/A

f) Mercury Speciation
No speciation was performed in 2013 as stack testing was not conducted.

In 2014, mercury speciation of the total annual mercury air emissions is available from the results of the mercury source testing program. The Ontario Hydro Method allows for the determination of elemental mercury and oxidized mercury (both particle-bound and nonparticle-bound). The table below (2014) summarizes the results of the electrostatic precipitator inlet/outlet triplicate source testing program and the results of mercury analyses performed on coal, fly ash and bottom ash samples collected concurrently with the air emissions testing. Based on the flue testing results, the majority of mercury loading to the electrostatic precipitator and emissions from the electrostatic precipitator is in the elemental form. The quantity of particle-bound mercury represents approximately 3% of the total mercury in the upstream flue and less than 0.1% of the total mercury in the downstream flue. Non-particle bound oxidized mercury represents 5.1% of the total mercury in the upstream flue and 5.5% of the total mercury in the downstream flue.

In summary, elemental mercury represents 94.4% of the total mercury emissions and oxidized mercury represents 5.6% of the total mercury emissions, based on the downstream flue results.

Mercury Speciation				
Sample Location	**Elemental Mercury (g/hr)**	**Oxidized Mercury (g/hr)**	**Particle-Bound Mercury (g/hr)**	**Total Mercury (g/hr)**
Coal				
Run 1	Not applicable	Not applicable	Not applicable	1.54
Run 2				1.61
Run 3				1.68
Average				1.61
Bottom Ash				
Run 1	Not applicable	Not applicable	Not applicable	0.002
Run 2				0.002
Run 3				0.003
Average				0.002
Fly Ash				
Run 1	Not applicable	Not applicable	Not applicable	0.063
Run 2				0.132
Run 3				0.115
Average				0.103
Downstream Flue				
Run 1	1.46	0.043	0.002	1.50
Run 2	1.19	0.084	0.001	1.27
Run 3	1.39	0.108	0.001	1.50
Average	1.35	0.078	0.001	1.42
Upstream Flue				
Run 1	1.06	0.033	0.018	1.11
Run 2	1.18	0.106	0.083	1.36
Run 3	1.44	0.067	0.025	1.53
Average	1.22	0.069	0.042	1.34

Note 1: All bottom ash mercury contents were non-detect.
Note 2: Run 2 results were discarded due to a leak in the sampling train, and therefore excluded from the Upstream Flue average results.

g) Mercury Content of Coal

The mercury content of the coal during the 2013 calendar year (weekly sampling periods) ranged between 0.058 and 0.097 parts per million (ppm) with an average of 0.071 (the weighted average mercury content was 0.069 ppm). The mass amount of mercury in the coal was 1.981 kilograms.

The mercury content of the coal during the 2014 calendar year (weekly sampling periods) ranged between 0.050 and 0.078 parts per million (ppm) with an average of 0.062 (the weighted average mercury content was 0.062 ppm). The mass amount of mercury in the coal was 1.528 kilograms. The mercury content of the coal during the annual stack test (comprised of three test runs) were 0.057, 0.054 and 0.055 ppm.

h) Combustion Residues Mercury Content, Mass and Management Method

The coal combustion residue mercury content and mass amounts are provided in the following tables:

2013

Coal Combustion Residue Type	Number of Samples	Mercury Content (ppm)	Average (ppm)	Mass Amounts (tonnes)	Total Mercury Released in the Ash (kgs)
Fly Ash	16	0.031 to 0.176	0.086	1,251	0.113
Bottom Ash	0	0	0	417	Negligible

2014

Coal Combustion Residue Type	Number of Samples	Mercury Content (ppm)	Average (ppm)	Mass Amounts (tonnes)	Total Mercury Released in the Ash (kgs)
Fly Ash	16	0.022 to 0.193	0.073	1,099	0.086
Bottom Ash	0	0	0	366	Negligible

Combining the amount of mercury in bottom ash and fly ash released results in a total release of mercury in the combustion residues of 0.113 kilograms (2013) and 0.086 kilograms (2014) (plus a negligible amount of bottom ash).

The coal combustion residues are sent to an ash lagoon for storage. The Brandon Generating Station has approval to utilize the coal combustion residues for various purposes, including, but not limited to: unstabilized sub-base or base course in roads; as a component of cement-stabilized road bases; and as an embankment material for roads, area fills and dikes. However, no coal ash was removed from the ash lagoon for use in 2013 and 2014.

4.3 NEW BRUNSWICK

<u>4.3.1 GRAND LAKE AND BELLEDUNE GENERATING STATIONS</u>

Through the CWS, New Brunswick has committed to reducing mercury emissions from existing coal-fired power plants within the province to 25 kilograms per year by 2010.

The Belledune Generating Station is the only remaining coal-fired power plant operating in New Brunswick. The Grand Lake Generating Station was taken out of service permanently in February 2010.

a) Annual Emission of Total Mercury

	Facility 1 Belledune	**Facility 2 Grand Lake**	**Total**
Year	**Mercury Emissions to Air (kg)**	**Mercury Emissions to Air (kg)**	**(kg)**
2000	43	105	148
2001	44	112	156
2002	12	106	118
2003	13	105	118
2004	17	101	118
2005	12	88	100
2006	7	56	63
2007	7	88	95
2008	11	33	44
2009	23	84	107
2010	22	8*	30
2011	18	0	18
2012	13	0	13
2013	15	0	15
2014	15	0	15

* The Grand Lake Generating Station ceased operation on February 23, 2010.

b) Mercury Capture Rate
Applies to new units only.

c) Monitoring Methods Used for All Parameters
- Stack Testing
- Mass Balance

d) Justification for Alternative Methods
Not applicable.

e) Additional Supporting Data
Not applicable

f) Mercury Speciation
Comparison of Mercury Stack Test Results at the Belledune Generating Station

Year	2013	2011	2010	2008	2004	2000
Parameter						
Mercury Emission Rate (g/hr)	2.24	2.70	3.75	2.12	2.13	5.47
Fuel Flow during Testing (kg/hr)	176,100	121,700	163,851	166,139	161,700	158,050
Mercury Concentration in Fuel (mg/kg)	0.026	0.044	0.030	0.020	0.033	0.09
Particulate Bound Mercury (%)	0.07	0.8	0.1	0.5	3	0
Oxidized Mercury (%)	3.34	2.6	4.5	16.2	16	21.5
Elemental Mercury (%)	96.6	96.2	95.4	83.2	81	78.5

Comparison of Mercury Stack Test Results at the Grand Lake Generating Station

Year	2003	2000
Parameter		
Mercury Emission Rate (g/hr)	16.29	14.8
Fuel Flow During Testing (kg/hr)	23,350	22,007
Mercury Concentration in Fuel (mg/kg)	0.62	0.5
Particulate Bound Mercury (%)	0.25	1.73
Oxidized Mercury (%)	78.83	58.73
Elemental Mercury (%)	20.92	39.55

g) Mercury Content of Coal
Belledune Generating Station:

Year	Fuel Consumption (tonnes)	Avg. Mercury Conc. in Fuel (mg/kg)	Mass of Mercury in Fuel (kg)
2014	1,183,712	0.029	34
2013	1,166,532	0.029	34
2012	951,627	0.031	30
2011	1,209,990	0.036	44
2010	1,160,329	0.045	52
2009	1,321,536	0.040	53
2008	1,286,804	0.018	23
2007	1,199,772	0.018	22
2006	1,213,418	0.021	25
2003	1,387,879	0.05	69

Grand Lake Generating Station:

Year	Fuel Consumption (tonnes)	Avg. Mercury Conc. in Fuel (mg/kg)	Mass of Mercury in Fuel (kg)
2010	14,485	0.52	8
2009	133,532	0.57	76
2008	75,234	0.41	31
2007	177,992	0.46	82
2006	109,193	0.48	52
2003	156,395	0.74	116

h) Combustion Residues Mercury Content, Mass and Management Method
Belledune Generating Station:

Year	Combustion Residue	Quantity of Residue (tonnes)	Avg. Mercury Conc. in Residue (mg/kg)	Mass of Mercury in Residue (kg)	Destination/Disposal of Residue
2014	Gypsum	123,723	0.118	14.6	Wallboard manufacturing
	Bottom Ash	22,847	0.014	0.32	Landfill
	Fly Ash	46,957	0.027	1.27	Concrete additive
	Fly Ash	14,208	0.027	0.38	Landfill
2013	Gypsum	114,206	0.069	7.9	Wallboard manufacturing
	Bottom Ash	22,847	0.019	0.43	Landfill
	Fly Ash	28,887	0.027	0.78	Concrete additive
	Fly Ash	19,852	0.027	0.54	Landfill
2012	Gypsum	95,550	0.08	7.64	Wallboard manufacturing
	Bottom Ash	20,493	0.018	0.37	Landfill
	Fly Ash	36,956	0.036	1.33	Concrete additive
	Fly Ash	2,728	0.036	0.1	Landfill
2011	Gypsum	131,772	0.095	12.5	Wallboard manufacturing
	Gypsum	1,623	0.095	0.154	Landfill
	Bottom Ash	27,098	0.017	0.46	Landfill
	Fly Ash	49,796	0.047	2.34	Concrete additive
	Fly Ash	962	0.047	0.045	Landfill
2010	Gypsum	111,034	0.113	12.5	Wallboard manufacturing

	Gypsum	168	0.113	0.02	Landfill
	Bottom Ash	27,206	0.015	0.4	Landfill
	Fly Ash	45,089	0.017	0.77	Concrete additive
2009	Gypsum	144,830	0.09	13.0	Wallboard manufacturing
	Bottom Ash	32,267	0.008	0.3	Landfill
	Fly Ash	57,896	0.02	1.2	Concrete additive
2008	Gypsum	139,441	0.09	12.5	Wallboard manufacturing
	Gypsum	1,052	0.09	0.1	Landfill
	Bottom Ash	22,920	0.008	0.2	Landfill
	Fly Ash	72,583	0.02	1.5	Concrete additive

Grand Lake Generating Station:

Year	**Combustion Residue**	**Quantity of Residue (tonnes)**	**Avg. Mercury Conc. in Residue (mg/kg)**	**Mass of Mercury in Residue (kg)**	**Destination/Disposal of Residue**
2010	Bottom Ash	803	<0.01	0	Landfill
	Fly Ash	3,210	0.01	0.03	Landfill
2009	Bottom Ash	6,249	<0.01	0	Landfill
	Fly Ash	24,997	0.01	1.7	Landfill
2008	Bottom Ash	2,799	<0.01	0	Landfill
	Fly Ash	11,195	0.01	0.66	Landfill

4.4 NOVA SCOTIA

Nova Scotia has amended its provincial Air Quality Regulations to extend achievement of the 65 kg cap to 2014 from 2010, with annual declining emission caps from 2010 to 2013. In addition the province has established a cap of 35 kg in 2020. The annual emission allocations under provincial regulation for the years 2010 to 2020 are identified in the following table.

Year	**Mercury Emission Cap (kilograms)**
2010	110
2011	100
2012	100
2013	85
2014	65
2020	35

4.4.1 LINGAN, POINT ACONI, POINT TUPPER AND TRENTON GENERATING STATIONS

a) Annual Emission of Total Mercury

	Lingan	**Point Aconi**	**Point Tupper**	**Trenton**	**Total**
Year	**Mercury Emissions to Air (kg)**	**Mercury Emissions to Air (kg)**	**Mercury Emissions to Air (kg)**	**Mercury Emissions to Air (kg)**	**Mercury Emissions to Air (kg)**
2003	83	2.5	24	49	158.5
2008	95	2.9	24	40	163
2009	92.0	2.7	16.5	28.8	140
2010	49.7	2.8	9.5	19.4	81.5
2011	61.2	4.4	6.4	22.6	94.6
2012	53.2	3.6	11.8	25.4	93.9
2013	42.3	3.7	7.03	19.4	72.5
2014	29.1	2.3	9.3	13.2	53.9

b) Mercury Capture Rate
Applies to new units only.

c) Monitoring Methods Used for All Parameters

- Mass Balance

d) Justification for Alternative Methods
Not applicable.

e) Additional Supporting Data
Not applicable.

f) Mercury Speciation

	Mercury Speciation 2013		
	Oxidized (%)	**Elemental (%)**	**Particulate Bound (%)**
Lingan 1/2	45.5	53.1	1.38
Lingan 3/4	60.9	39.0	0.1
Trenton 5	59.3	15.0	25.7
Trenton 6	45.5	54.4	0.16
Point Tupper	52.1	45.8	2.13
Point Aconi	91.9	6.96	1.1

	Mercury Speciation 2014		
	Oxidized (%)	**Elemental (%)**	**Particulate Bound (%)**
Lingan 1/2	69.1	30.0	0.9
Lingan 3/4*	53.2	46.5	0.3
Trenton 5	70.2	26.6	3.2
Trenton 6	50.6	49.4	0.0
Point Tupper	50.7	46.3	3.0
Point Aconi	78.4	21.3	0.3

*Mercury speciation can vary significantly depending on the coal blend at the time of testing.

g) Mercury Content of Coal

	Total Mercury Content of Coal (kg)*	
Year	2013	2014
Lingan	84.1	53.88
Point Aconi**	33.5	20.5
Trenton	32.6	35.9
Point Tupper	13.7	18.3
Total	**163.8**	**128.6**

*The compliance requirement for Nova Scotia Power is total mercury emitted on a fleet-wide basis. Unit specific inlet mercury content will vary each year.
**Point Aconi mercury content includes the mercury content in the limestone used in the circulating fluidized bed which is used as part of the mass balance equation.

h) Combustion Residues Mercury Content, Mass and Management Method

	Mercury Content of Coal Combustion Residues in 2013		
	Sales (kg)	**Landfill (kg)**	**Total (kg)**
Lingan	0	30.2	30.2
Point Aconi	0	28.5	28.5
Trenton	3.7	5.7	9.4
Point Tupper	1.3	3.5	4.8
Total	**5.0**	**68.0**	**73.0**

	Mercury Content of Coal Combustion Residues in 2014		
	Sales (kg)	**Landfill (kg)**	**Total (kg)**
Lingan	0	25	25.14
Point Aconi	0	18	18.1
Trenton	6.9	15.9	22.8
Point Tupper	0	9	9.0
Total	**6.9**	**68.0**	**75.1**

4.5 ONTARIO

In 2007, Ontario passed a regulation stating that Ontario will phase out the use of coal at its thermal electricity generating stations (GS) by the end of 2014. The first retirement of coal-fired generating units occurred in 2010 when two units at both Lambton and Nanticoke GS were retired. In 2011, an additional two more units where retired at Nanticoke GS. In September 2012, the Atikokan GS came offline for conversion to burn biomass fuels. In October 2013, Lambton GS stopped burning coal. Nanticoke GS stopped burning coal on January 8, 2014 and Thunder Bay GS stopped burning coal on April 15, 2014.

In 2014 Ontario had one operating coal-fired thermal electric generating station: Thunder Bay GS.

For 2014, Ontario's total mercury emissions from coal-fired electric generating stations were 3 kilograms.

Generating Station	Kilograms Emitted in 2013	Kilograms Emitted in 2014
Lambton	3 kg	N/A
Nanticoke	24 kg	N/A
Thunder Bay	1 kg	3 kg
Atikokan	N/A	N/A
Total	**28 kg**	**3 kg**

4.5.1 LAMBTON GENERATING STATION

a) Annual Emission of Total Mercury

Year	Mass Mercury Emissions – to Air (kg)
2000	174
2001	164
2002	130
2003	122
2004	46
2005	67
2006	53
2007	107
2008	58
2009	19
2010	8
2011	2
2012	7
2013	**3**

b) Mercury Capture Rate
Applies to new units only.

c) Monitoring Methods Used for All Parameters
The sampling and analytical procedures used to compile the mercury data are described in the accepted MMRP dated November 2010.

d) Justification for Alternative Methods
A removal efficiency method was used to determine emissions.

Selective catalytic reduction (SCR) operation was determined by assessing the positions of the inlet, outlet and bypass dampers. Based on this information the SCR was flagged as being either online or bypassed for all periods when the unit was operational. The SCR operational data were summarized into monthly % totals for each operating scenario and the monthly total mass of input mercury was split using this information. The removal efficiency was then applied for each operating scenario to determine the mercury emissions to air. The equations below detail these calculations.

$$\text{Hg}_{\text{SCR Online}} = \text{Hg}_{\text{Coal}} \times \%\ \text{SCR Online} \times (1\text{-Removal Efficiency}_{\text{SCR Online}})$$
$$\text{Hg}_{\text{SCR Bypassed}} = \text{Hg}_{\text{Coal}} \times \%\ \text{SCR Bypassed} \times (1\text{-Removal Efficiency}_{\text{SCR Bypassed}})$$
$$\text{Hg}_{\text{Total to Air}} = \text{Hg}_{\text{SCR Online}} + \text{Hg}_{\text{SCR Bypassed}}$$

e) Supporting Data
The following table shows the monthly total mass consumed of coal and average mercury concentrations used to calculate the 2013 mercury emissions. It also presents the % of time the unit was operating with the SCR online and bypassed as well as the measured mercury removal efficiencies.

Unit 3&4 Operational Data

Unit 3&4	Coal		SCR Operation		Measured Mercury Removal Efficiency	
	Mass (Tonnes)	Mercury (mg/kg)	SCR Bypassed	SCR Online	SCR Bypassed	SCR Online
January	117628	0.104	2.00%	98.00%	77.20%	97.00%
February	110776	0.104	6.80%	93.20%		
March	52720	0.081	26.78%	73.22%		
April	16072	0.089	89.93%	10.10%		
May	33058	0.076	7.09%	92.90%		
June	67926	0.077	9.03%	91.00%		
July	118474	0.075	0.10%	99.90%		
August	72369	0.09	2.49%	97.50%		
September	23312	0.148	81.71%	18.30%		
October	0	0	0.00%	0.00%		
November	0	0	0.00%	0.00%		
December	0	0	0.00%	0.00%		

Note: Due to rounding, re-computation of the values in this table may not yield the exact results.

The following tables show the monthly mass of mercury in coal, the mercury emissions to air and the quantity of mercury diverted to by-products (gypsum, ash and flue gas desulphurization sludge).

Unit 3&4 Mercury Mass (kg)

Unit 3&4	Input	Emitted to Air			Total Diverted
	Coal	**SCR Bypassed**	**SCR Online**	**Total Released**	**Gypsum, Ash & FGD Sludge**
January	12.23	0.06	0.36	0.42	11.82
February	11.52	0.18	0.32	0.5	11.02
March	4.27	0.26	0.09	0.35	3.92
April	1.43	0.29	0	0.3	1.13
May	2.51	0.04	0.07	0.11	2.4
June	5.23	0.11	0.14	0.25	4.98
July	8.89	0	0.27	0.27	8.62
August	6.51	0.04	0.19	0.23	6.29
September	3.45	0.64	0.02	0.66	2.79
October	0	0	0	0	0
November	0	0	0	0	0
December	0	0	0	0	0
Total	56.05	1.62	1.47	3.09	52.96

Note: Due to rounding, re-computation of the values in this table may not yield the exact results.

Source Test Verification

To show that these assumptions are reasonable, a source test verification was performed on the total mass of mercury released (shown in the Table above) for each operating scenario versus a calculated total mass of mercury for units 3 and 4. The evaluations were weighted using a weighting factor which equates to the percent of time in the reporting year each operating scenario applied. The error between the weighted calculated mercury emissions based on the results of the annual source tests and removal efficiency calculated emission method should be less than 20%.

The following formula was used.

$$\begin{matrix}\text{Calculated Annual}\\ \text{Hg Release (kg)}\end{matrix} = \frac{\text{Annual Gross Load}\left(\text{Gw - hr}\right)\times\text{Measured Hg Emission Rate}\left(\frac{\text{mg}}{\text{s}}\right)}{\text{Avg. Load During Source Test}\left(\text{Gw}\right)}\times\frac{3600\left(\frac{\text{s}}{\text{hr}}\right)}{1{,}000{,}000\left(\frac{\text{mg}}{\text{kg}}\right)}\times\begin{matrix}\text{Weighting}\\ \text{Factor}\end{matrix}$$

The table below shows the inputs as well as the resultant calculated annual release of mercury.

Mercury Source Test Verification	**Unit 4 - SCR Bypassed***	**Unit 3 - SCR Online***
Annual Gross Load (Gw-Hr)	1754.99	1754.99
Average Load during Source Test (Gw)*	0.292	0.292
Measured Mercury Emission Rate (mg/s)*	0.52	0.17[1]
Weighting Factor	25.10%	74.90%
Calculated Annual Release (kg)	2.82	2.7
Annual Release from Table “Unit 3&4 Mercury Mass” (kg)	1.62	1.47
Difference (kg)	1.21	1.23
% Difference	75%	84%

* depicts conditions of 2013 Source Test

[1]Testing was not completed on Unit 3 in 2013 therefore averages of 3 previous reports were used to obtain Measured Mercury Emission Rate during source testing.

The results of Unit 4 verification test shows acceptable agreement between the calculated mercury emissions and the removal efficiency method calculated emissions.

Emissions during periods when SCR was bypassed shows 25% agreement. Lambton operated under these conditions for approximately 25% of its annual output. Although the % difference is above the 20% guideline, Ontario Power Generation (OPG) considers these emissions identified in the table containing Unit 3 and 4 operational data to be reasonable and the data quality is still considered to be good under the flue-gas desulfurization (FGD) online, SCR bypassed scenario.

Emissions during periods when SCR was online are estimated from previous years reports and shows 16% agreement. Lambton operated under these conditions for approximately 75% of its annual output. To establish values for the Measured Mercury Emission Rate for 2013 Lambton GS used data from 2012, 2011 and 2010 reports; this average may have attributed to artificially induced error. However, under both SCR and FGD online scenario OPG considers these emissions identified in the table containing Unit 3 and 4 operational data to be reasonable and the data quality is still considered to be good.

f) Mercury Speciation

The following table summarizes the results of mercury tests conducted to date.

Historic Mercury Emission Testing at Lambton Generating Station

Emission Source	Unit	Sample Date	Particulate Mercury (mg/s)	Oxidized Mercury (mg/s)	Elemental Mercury (mg/s)	Total Mercury (mg/s)	Emission Concentration (ug/Rm3 dry)
<u>Group 4</u>							
Lambton	2	July, 2000	0.04	2.88	0.91	3.83	7.1
			1%	75%	24%		
Lambton	1	October, 2008	0.27	2.13	0.06	3	6
			9%	71%	20%		
Lambton	2	June, 2009	0.003	1.3	0.42	1.72	4.7
			0.2%	75.4%	24.4%		
<u>Group 5</u>							
Lambton	3	May, 2001	<0.01	0.06	0.64	0.7	1.3
			<1%	9%	91%		
Lambton	4	September, 2003	<0.01	0.07	0.14	0.21	0.4
			<1%	32%	67%		
Lambton	4	November, 2004	<0.01	0.02	0.13	0.16	0.3
			1%	15%	84%		
Lambton	3	September, 2005	0.01	0.09	0.18	0.27	0.5
			4%	33%	67%		
Lambton	3	September, 2008	0.01	0.18	0.33	1.37	2.7
			3%	34%	64%		
Lambton	4	April, 2009				0.39	0.75
Lambton	3	July, 2010				0.3	0.58
Lambton	4	March, 2011				0.13	0.28
Lambton	3	March, 2012				0.10	0.25
Lambton	4	March, 2012				0.46	1.35
Lambton	4	February, 2013				0.52	1.41

Note: special mercury stack testing was discontinued at Lambton in 2009 as described in section 2.7 of the approved MMRP.

g) Mercury Content of Coal

Please see section e) on Supporting Data. It details the quantity of coal consumed as well as the associated mercury content.

h) Mercury Content of Coal Combustion Residues

In 2013, bottom ash was sold as a gravel substitute and gypsum was sold into the wallboard industry. Fly ash was either landfilled on site or sold to various industries and FGD sludge was landfilled onsite.

Mercury Content of Coal Combustion Residues

Ash Type	Quantity Diverted from Disposal (tonnes)	Quantity Land Filled on Site (tonnes)	Total (tonnes)	Avg. Mercury Concentration (ug/g)
Bottom Ash	7,170	0	7,170	0.05
Fly Ash	42,386	9569.7	51,956	0.288
Gypsum	135,839	0	135,839	0.336
FGD Sludge	0	6914.72	6,915	19.49

The historical stack sampling results are reported in section f) on Mercury Speciation or Total Mercury Stack Test Results. A summary of the coal, ash and gypsum data from the year 2005 – 2013 follows.

Year	Material	Mercury Concentration (mg/kg)	Moisture (%)	Amount Consumed or Produced (tonnes)	Total Mercury (kg)	Mercury Emitted to Air (kg)
2013	Low Sulphur Bituminous Coal	0	0	0	0	3.09
	High-Sulphur Bituminous Coal	0.094	8.74	612,335	56.04639	
	Bottom Ash	0.058		7170		
	Fly Ash	0.288		51,956		
	Gypsum	0.249		74,849		
2012	Low Sulphur Bituminous Coal	0		0	0	6.59
	High-Sulphur Bituminous Coal	0.116	6.9	846,242	101.5	
	Bottom Ash	0.05		3,160		
	Fly Ash	0.39		69,822		
	Gypsum	0.336		135,839		
2011	Low Sulphur Bituminous Coal	0		0	0	2.1

<table>
<tr><th>Year</th><th>Material</th><th>Mercury Concentration (mg/kg)</th><th>Moisture (%)</th><th>Amount Consumed or Produced (tonnes)</th><th>Total Mercury (kg)</th><th>Mercury Emitted to Air (kg)</th></tr>
<tr><td rowspan="4"></td><td>High-Sulphur Bituminous Coal</td><td>0.107</td><td></td><td>466,075</td><td>49.1</td><td rowspan="4"></td></tr>
<tr><td>Bottom Ash</td><td>0.08</td><td></td><td>5,251</td><td></td></tr>
<tr><td>Fly Ash</td><td>0.03</td><td></td><td>36,776</td><td></td></tr>
<tr><td>Gypsum</td><td>0.2</td><td></td><td>102,437</td><td></td></tr>
<tr><td rowspan="6">2010</td><td>Low Sulphur Bituminous Coal</td><td>0.07</td><td></td><td>165,018</td><td>11</td><td rowspan="6">8.1</td></tr>
<tr><td>Mid-Sulphur Bituminous Coal</td><td>0.08</td><td>7.5</td><td>1,073,754</td><td>94</td></tr>
<tr><td>Bottom Ash</td><td>0.06</td><td></td><td>14,506</td><td></td></tr>
<tr><td rowspan="2">Fly Ash</td><td>U1&2 – 0.326</td><td></td><td>16,596</td><td></td></tr>
<tr><td>U3&4 – 0.213</td><td></td><td>79,478</td><td></td></tr>
<tr><td>Gypsum</td><td>0.303</td><td></td><td>155,532</td><td></td></tr>
<tr><td rowspan="6">2009</td><td>Low Sulphur Bituminous Coal</td><td>0.08</td><td>8.1</td><td>191,117</td><td>16</td><td rowspan="6">19</td></tr>
<tr><td>Mid-Sulphur Bituminous Coal</td><td>0.1</td><td>5.8</td><td>1,174,917</td><td>121</td></tr>
<tr><td>Bottom Ash</td><td>0.043</td><td></td><td>15,806</td><td></td></tr>
<tr><td rowspan="2">Fly Ash</td><td>U1&2 - 0.328</td><td></td><td>17,535</td><td></td></tr>
<tr><td>U3&4 - 0.272</td><td></td><td>87,258</td><td></td></tr>
<tr><td>Gypsum</td><td>0.222</td><td></td><td>199,014</td><td></td></tr>
<tr><td rowspan="6">2008</td><td>Low Sulphur Bituminous Coal</td><td>0.09</td><td>6.9</td><td>651,737</td><td>56</td><td rowspan="6">58</td></tr>
<tr><td>Mid-Sulphur Bituminous Coal</td><td>0.1</td><td>7.9</td><td>1,692,915</td><td>175</td></tr>
<tr><td>Bottom Ash</td><td>0.049</td><td></td><td>28,764</td><td></td></tr>
<tr><td rowspan="2">Fly Ash</td><td>U1&2 - 0.300</td><td></td><td>63,511</td><td></td></tr>
<tr><td>U3&4 - 0.230</td><td></td><td>128,712</td><td></td></tr>
<tr><td>Gypsum</td><td>0.26</td><td></td><td>219,284</td><td></td></tr>
</table>

* Assume 90% retained by FGD units, and 31% retained by non-FGD units.
Note: Re-computation of the values in this table may not yield the exact results due to rounding.

A summary of the ash and other residues disposition data from the year 2005 - 2012 follows:

Year	Ash Type	Quantity Diverted from Disposal (tonnes)	Quantity Landfilled on Site (tonnes)	Total (tonnes)
2012	Bottom Ash	9,975	0	9,975
	Fly Ash	58,155	11,666	69,822
	Gypsum	135,839	0	135,839
2011	Bottom Ash	5,251	0	5,251
	Fly Ash	36,388	378	36,766
	Gypsum	102,437	0	102,437
2010	Bottom Ash	14,506	0	14,506
	Fly Ash	40,518	55,556	96,074
	Gypsum	155,533	0	155,532
2009	Bottom Ash	15,806	0	15,806
	Fly Ash	34,819	69,974	104,793
	Gypsum	199,014	0	199,014
2008	Bottom Ash	28,763	0	28,763
	Fly Ash	23,395	168,828	192,223
	Gypsum	219,284	0	219,284
2007	Bottom Ash	38,358	0	38,358
	Fly Ash	3,228	265,279	268,507
	Gypsum	241,305	0	241,305
2006	Bottom Ash	29,193	0	29,193
	Fly Ash	1,264	203,088	204,352
	Gypsum	243,983	0	243,983
2005	Bottom Ash	39,388	0	39,388
	Fly Ash	0	275,603	275,603
	Gypsum	268,870	0	268,870

4.5.2. NANTICOKE GENERATING STATION

a) Annual Emission of Total Mercury

Year	Mass Mercury Emissions to Air (kg)
2000	229
2001	226
2002	250
2003	205
2004	134
2005	156
2006	145
2007	148
2008	84
2009	27
2010	51
2011	32
2012	16
2013	**24**

b) Mercury Capture Rate
Applies to new units only.

c) Monitoring Methods Used for All Parameters
The sampling and analytical procedures used to compile the mercury emission figures are described in the accepted Mercury Monitoring and Reporting Program (MMRP) dated September 2012.

d) Justification for Alternative Methods
No alternate methods were used in 2013.

e) Additional Supporting Data
The following table shows the coal consumption, ash production, and average mercury concentrations used to calculate emissions for 2013.

Material	Mercury Concentration (mg/kg)	Moisture (%)	Amount Consumed or Produced (tonnes)	Total Mercury (kg)
Sub-bituminous Coal (PRB)	0.081	20.02	445,937	30
Bituminous Coal (USLS)	0.094	11.04	244,520	21
Bottom Ash	0.018		7,155	0
Fly Ash	0.663		39,970	27
Emitted to Air				24

Note: Due to rounding, re-computation of the values in this table may not yield the exact results.

f) Mercury Speciation
The reports for the mercury source tests conducted on Unit 5 (Group 2), Unit 6 (Group 1) and Unit 7 (Group 3) in 2012 are attached. The 2012 source testing on all units measured total vapour phase mercury emissions.

Emission Source	Unit	Sample Date	Particulate Mercury (mg/s)	Oxidized Mercury (mg/s)	Elemental Mercury (mg/s)	Total Mercury (mg/s)	Emission Concentration (μg/m^3 dry)
Group 1							
Nanticoke	6	Jan 2012	-	-	-	0.75	2.04
Nanticoke	1	Nov 2010	-	-	-	0.69	1.55
Nanticoke	2	July 2009	0.0034	0.34	0.56	0.89	1.9
			0.4%	37.5%	62.1%		
Nanticoke	3	June 2008	0.0044	0.89	1.31	2.2	4.2

Emission Source	Unit	Sample Date	Particulate Mercury (mg/s)	Oxidized Mercury (mg/s)	Elemental Mercury (mg/s)	Total Mercury (mg/s)	Emission Concentration (µg/m³ dry)
			0.2%	40.4%	59.4%		
Nanticoke	2	April 2007	0.018	0.84	1.0	1.86	3.4
			1.0%	45.6%	54.3%		
Nanticoke	2	April 2005	0.021	0.86	1.24	2.12	4.2
			1.0%	40.5%	58.5%		
Nanticoke	3	June 2007	0.00	0.89	1.31	2.20	4.2
			0.2%	40.3%	59.5%		
Nanticoke	3	April 2005	0.16	0.65	0.47	1.28	2.4
			12.5%	50.8%	36.7%		
Nanticoke	6	Aug 2004	0.02	0.59	0.63	1.24	2.5
			1.9%	47.4%	50.7%		
Nanticoke	6	June 1999	0.04	0.44	0.54	1.03	2.1
			4.1%	43.0%	52.9%		
Group 2							
Nanticoke	5	Jan 2012	-	-	-	1.60	5.13
Nanticoke	5	May 2011	-	-	-	1.30	2.97
Nanticoke	5	June 2010	-	-	-	1.59	3.71
Nanticoke	5	Dec 2009	0.004	0.52	0.70	1.22	2.3
			0.3%	42.9%	57.1%		
Nanticoke	5	March 2009	0.012	0.38	0.73	1.12	2.1
			1.0%	33.6%	65.2%		
Nanticoke	5	March 2007	0.23	0.53	0.43	1.18	2.3
			19.2%	44.5%	36.3%		
Nanticoke	5	Sept 2004	0.02	1.02	0.28	1.32	2.5
			1.7%	76.9%	21.4%		
Nanticoke	5	April 2002	0.54	0.73	0.23	1.50	2.8
			35.9%	49.0%	15.1%		
Group 3							
Nanticoke	7	Jan 2012	-	-	-	1.80	4.54
Nanticoke	8	March 2011	-	-	-	1.06	2.82
Nanticoke	7	April 2010	-	-	-	2.48	5.01
Nanticoke	8	July 2009	-	-	-	0.96	2.2
Nanticoke	7	June 2008	0.01	2.04	0.63	2.68	5.1
			0.4%	76.0%	23.6%		
Nanticoke	7	April 2005	0.09	1.10	0.11	1.31	2.4
		Test 1	6.9%	84.4%	8.7%		

Emission Source	Unit	Sample Date	Particulate Mercury (mg/s)	Oxidized Mercury (mg/s)	Elemental Mercury (mg/s)	Total Mercury (mg/s)	Emission Concentration (µg/m^3 dry)
Nanticoke	7	April 2005	0.20	0.89	0.09	1.18	2.3
		Test 2	16.5%	75.7%	7.8%		
Nanticoke	7	Aug 2004	0.03	1.46	0.36	1.85	3.7
			1.9%	78.8%	19.3%		
Nanticoke	7	July 2004	0.01	2.17	0.13	2.31	4.6
			0.6%	93.9%	5.5%		
Nanticoke	7	May 2004	0.01	1.16	0.20	1.37	2.7
			0.6%	84.7%	14.7%		
Nanticoke	7	April 2004	0.17	1.05	0.08	1.30	2.5
			12.8%	81.2%	6.0%		

g) Mercury Content of Coal, and Mercury Content of Coal Combustion Residues

Please see section (e) on Supporting Data. Section (e) details the amount of the different types of coal consumed and the amount of ash generated as well as the associated mercury content.

In 2013 fly ash was sold to the cement industry. Ash was reclaimed from storage where sales exceeded ash production.

Ash Type	Quantity Diverted from Disposal (tonnes)	Quantity Land Filled on Site (tonnes)	Total (tonnes)
Bottom Ash	1,073	7,155	8,228
Fly Ash	104,127*	0*	39,970

* Indicates that sales exceeded production

h) Historical Stack Sampling, Fuel and Residue Analytical Results

The historical stack sampling results are reported in section (f), Mercury Speciation or Total Mercury Stack Test Results section.

A summary of the coal and ash data from 2005. Re-computation of the values in this table may not yield the exact results due to rounding.

Year	Material	Mercury Concentration (mg/kg)	Moisture (%)	Amount Consumed or Produced (tonnes)	Total Mercury (kg)
2013	Sub-bituminous Coal	0.081	20.02	445,937	30
	Bituminous Coal	0.094	11.04	244,520	21
	Bottom Ash	0.018			0
	Fly Ash	0.663			27
	Emitted to Air				24 (Nanticoke)
2012	Sub-bituminous Coal	0.074	27.56	818,040	44
	Bituminous Coal	0.073	9.08	185,909	12
	Bottom Ash	0.022		7,611	0
	Fly Ash	0.747		42,525	40
	Emitted to Air				16 (Nanticoke)
2011	Sub-bituminous Coal	0.071	28.45	1,175,897	60
	Bituminous Coal	0.068	8.81	259,390	16
	Bottom Ash	0.006		13,244	0
	Fly Ash	0.594		74,003	44
	Emitted to Air				32
2010	Sub-bituminous Coal	0.068	28.8	3,476,672	167.4
	Bituminous Coal	0.062	9.3	824,221	46.1
	Bottom Ash	0.015		40,405	0.6
	Fly Ash	0.716		225,787	161.6
	Emitted to Air				51
2009	Sub-bituminous Coal	0.067	28.3	2,390,197	115.1
	Bituminous Coal	0.069	7.8	607,403	38.8
	Bottom Ash	0.09		28,200	2.4
	Fly Ash	0.79		157,588	124.3

Year	Material	Mercury Concentration (mg/kg)	Moisture (%)	Amount Consumed or Produced (tonnes)	Total Mercury (kg)
	Emitted to Air				27
2008	Sub-bituminous Coal	0.060	28.0	6,385,386	277
	Bituminous Coal	0.070	7.1	1,427,466	92
	Bottom Ash	0.01		72,793	<1
	Fly Ash	0.70		406,739	285
	Emitted to Air				84
2007	Sub-bituminous Coal	0.071	28.8	7,564,352	382
	Bituminous Coal	0.071	8.1	1,496,324	98
	Bottom Ash	0.02		83,557	2
	Fly Ash	0.70		472,955	330
	Emitted to Air				148
2006	Sub-bituminous Coal	0.071	28.8	6,551,991	332
	Bituminous Coal	0.071	8.1	1,535,669	100
	Bottom Ash	0.01		74,714	0
	Fly Ash	0.69		422,929	287
	Emitted to Air				145
2005	Sub-bituminous Coal	0.068	28.8	6,190,571	300
	Bituminous Coal	0.065	8.1	2,206,795	131
	Bottom Ash	0.03		82,276	2
	Fly Ash	0.59		465,702	273
	Emitted to Air				156

A summary of the ash disposition data from the year 2005 follows:

Year	Ash Type	Quantity Diverted from Disposal (tonnes)	Quantity Land Filled on Site (tonnes)	Total (tonnes)
2013	Bottom Ash	1,073	7,155	8,228
	Fly Ash	104,127*	*	39,970
2012	Bottom Ash	1,439	8,144	9,583
	Fly Ash	89,831	*	53,547
2011	Bottom Ash	1,985	11,259	13,244
	Fly Ash	51,885	22,118	74,003
2010	Bottom Ash	6,062	34,343	40,405
	Fly Ash	145,519	80,268	225,787
2009	Bottom Ash	4,230	23,970	28,200
	Fly Ash	118,286	39,302	157,588
2008	Bottom Ash	55,330	17,463	72,793
	Fly Ash	253,168	153,571	406,739
2007	Bottom Ash	110,314	*	83,557
	Fly Ash	320,934	152,021	472,955
2006	Bottom Ash	106,233	*	74,714
	Fly Ash	279,023	143,906	422,929
2005	Bottom Ash	118,975	*	82,276
	Fly Ash	256,640	209,062	465,702

* indicates that sales exceeded production

4.5.3 THUNDER BAY GENERATING STATION

a) Annual Emission of Total Mercury

Year	Mass Mercury Emissions – to Air (kg)
2000	56
2001	78
2002	72
2003	57
2004	37
2005	37
2006	39
2007	24
2008	31
2009	4
2010	7
2011	4
2012	2
2013	**1**

b) Mercury Capture Rate
Applies to new units only.

c) Monitoring Methods Used for All Parameters
The sampling and analytical procedures used to compile the mercury emission figure are described in the accepted MMRP dated September 2012.

d) Justification for Alternative Methods
No alternate methods were used in 2013.

e) Additional Supporting Data
The following table shows the coal consumption, ash production, and average mercury concentrations used to calculate emissions. Due to rounding, re-computation of the values in this table may not yield the exact results.

Material	Mercury Concentration (mg/kg dry)	Coal Consumed (tonnes wet)	Coal Consumed or Ash Produced (tonnes dry)	Total Mercury (kg)
PRB Coal	0.0555	18,786	12,908	**0.716**
Bottom Ash	0.016		185	**0.003**
Fly Ash	0.020		522	**0.011**
Emitted to Air				1

f) Mercury Speciation

The following table summarizes the results of mercury tests conducted to date.
No stack testing was performed in 2013 as per accepted MMRP dated September 2012.

Emission Source	Unit	Sample Date	Particulate Mercury (mg/s)	Oxidized Mercury (mg/s)	Elemental Mercury (mg/s)	Total Mercury (mg/s)	Emission Concentration (ug/m3 dry)
Group 6							
Thunder Bay	2	June, 1998	<0.01	0.07	1.76	1.83	10.7
			1%	4%	96%		
Thunder Bay	2	Dec, 2006	<0.01	0.16	1.59	1.75	10.0
			0%	9%	91%		
Thunder Bay	2	Dec, 2008	<0.01	0.05	1.09	1.14	6.3
			0%	4%	96%		
Thunder Bay	2	Jan, 2010*				0.54	5.23
Thunder Bay	3	Feb, 2011*				0.53	5.37
Thunder Bay	3	Feb, 2012*				0.58	5.72

* source testing did not include Mercury Speciation (as per MMRP)

g) Mercury Content of Coal

h) Mercury Content of Coal Combustion Residues

Please see section (e) on Supporting Data. It details the amount of the different types of coal consumed and the amount of ash generated as well as the associated mercury content.

In 2013, fly ash was sold to the cement making and concrete industries. The remainder was landfilled on site.

Ash Type	Quantity Diverted from Disposal (tonnes)	Quantity Land Filled on Site (tonnes)	Total (tonnes)
Bottom Ash	0	185	**552**
Fly Ash	697	0*	**185**

* indicates that sales exceeded production; the remainder was recovered from storage

i) Historical Stack Sampling, Fuel and Residue Analytical Results

The historical stack sampling results are reported in the Mercury Speciation or Total Mercury Stack Test Results section.

A summary of the coal and ash data from 2005 follows. Re-computation of the values in this table may not yield the exact results due to rounding.

	Material	Mercury Concentration (mg/kg dry)	Coal Consumed (tonnes wet)	Coal Consumed or Ash Produced (tonnes dry)	Total Mercury (kg)
2012	Sub-bituminous Coal	0.0605	39,289	27,459	1.665
	Bottom Ash	0.016		416	0.007
	Fly Ash	0.020		1,243	0.025
	Mercury Emitted to Air				2
2011	Sub-bituminous Coal	0.0605	74,851	54,731	3.34
	Bottom Ash	0.025		852	0.021
	Fly Ash	<0.005		2,457	0.012
	Mercury Emitted to Air				4
2010	Sub-bituminous Coal	0.0605	110,832	81,040	4.90
	Lignite Coal	0.100	35,986	23,743	2.37
	Bottom Ash	<0.005		2,014	0.010
	Fly Ash	<0.005		6,024	0.030
	Mercury Emitted to Air				7
2009	Sub-bituminous Coal	0.055	91,193.86	67,902.95	3.8
	Lignite Coal	0.067	555.61	358.70	0.02
	Bottom Ash	0.022	854.35	843.75	0.02
	Fly Ash	<0.005	2,563.04	2,554.25	0.01
	Mercury Emitted to Air				4
2008	Sub-bituminous Coal	0.085	243,075	181,212	15
	Lignite Coal	0.112	212,913	142,183	16
	Bottom Ash	0.034		7,463	0
	Fly Ash	<0.005		22,385	0
	Mercury Emitted to Air				31
2007	Sub-bituminous Coal	0.063	89,673	66,849	4
	Lignite Coal	0.086	345,230	231,493	20
	Bottom Ash	0.035		8,383	0
	Fly Ash	0.010		25,146	0
	Mercury Emitted to Air				24
2006	Sub-bituminous Coal	0.050	55,865	41,450	2
	Lignite Coal	0.085	662,449	446,481	38

	Material	Mercury Concentration (mg/kg dry)	Coal Consumed (tonnes wet)	Coal Consumed or Ash Produced (tonnes dry)	Total Mercury (kg)
2006	Bottom Ash	0.038		15,716	1
	Fly Ash	0.01		47,148	0
	Mercury Emitted to Air				39
2005	Sub-bituminous Coal	0.050	108,589	80,573	4
	Lignite Coal	0.085	597,323	401,243	34
	Bituminous Coal	0.05	4,548	3,400	0
	Bottom Ash	0.043		15,205	1
	Fly Ash	0.010		45,616	0
	Mercury Emitted to Air				37

A summary of the annual ash disposition data from 2005 follows:

Year	Ash Type	Quantity Diverted from Disposal (tonnes)	Quantity Land Filled on Site (tonnes)	Total (tonnes)
2012	Bottom Ash	0	416	416
	Fly Ash	1,804	0*	1,243
2011	Bottom Ash	0	822	822
	Fly Ash	3,403	0*	2,457
2010	Bottom Ash	0	2,014	2,014
	Fly Ash	1,517	4,507	6,024
2009	Bottom Ash	767	87	854
	Fly Ash	3,116	0*	2,563
2008	Bottom Ash	0	7,463	7,463
	Fly Ash	24,099	0*	22,385
2007	Bottom Ash	0	8,383	8,383
	Fly Ash	18,819	6,327	25,146
2006	Bottom Ash	11	15,705	15,716
	Fly Ash	35,834	11,314	47,148
2005	Bottom Ash	0	15,205	15,205
	Fly Ash	44,444	1,172	45,616

* indicates that sales exceeded production; the remainder was recovered from storage

4.6 SASKATCHEWAN

In accordance with Saskatchewan's commitment to the Canada-wide Standards for Mercury Emissions From Coal-Fired Electric Power Generation Plants, an agreement on monitoring mercury emissions from SaskPower's coal-fired power plants was reached between the Saskatchewan Ministry of

Environment (MoE) and SaskPower. With the application of credits for early action, Saskatchewan achieved its emissions cap in 2011 and 2012.

4.6.1 BOUNDARY DAM, POPLAR RIVER AND SHAND POWER STATIONS

a) Annual Emission of Total Mercury

Facility	2013 Mass Mercury Emissions – to Air (kg)	2014 Mass Mercury Emissions – to Air (kg)
Boundary Dam Power Station Unit 1	6	
Boundary Dam Power Station Unit 2	19	13
Boundary Dam Power Station Unit 3	7	16
Boundary Dam Power Station Unit 4	40	33
Boundary Dam Power Station Unit 5	43	38
Boundary Dam Power Station Unit 6	77	68
Total for Boundary Dam Power Station	**192**	**168**
Poplar River Power Station Unit 1	98	77
Poplar River Power Station Unit 2	108	74
Total for Poplar River Power Station	**206**	**151**
Shand Power Station Unit 1	65	38
Total for Shand Power Station	**65**	**38**
Total for SaskPower	**463**	**357**
Net for SaskPower (with credits for early action)	**430**	**357**

The total mercury emissions for 2013 are lower than in 2012, primarily due the retirement of Boundary Dam Unit 1 and the shutdown of Unit 3 for Clean Coal Conversion. Improvements to the operation of the Shand activated carbon injection system also helped decrease overall mercury emissions.

The total mercury emissions for 2014 are lower than in 2013, this is due the retirement of Boundary Dam Unit 2 mid-2014, the continued shutdown of Unit 3 for Clean Coal Conversion as well as lower overall generation. Improvements to the operation of the Shand and Poplar River activated carbon injection systems also helped decrease overall mercury emissions.

Under the Canada-wide standards for mercury SaskPower is eligible to claim credits for collecting mercury vehicle switches and for mercury reduced as a result of the research program at Poplar River Power Station, up to the end of 2009. Credits in the amounts of 33 kg were used to achieve the compliance limit of 430 kg in 2013, no credits were needed to achieve compliance in 2014. SaskPower's collection of mercury credits is discussed in more detail in section f) below.

b) Mercury Capture Rate

Facility	Percent of Mercury Captured 2013	Percent of Mercury Captured 2014
Boundary Dam Power Station Unit 1	13.82%	
Boundary Dam Power Station Unit 2	5.02%	5.59%
Boundary Dam Power Station Unit 3	6.50%	7.93%
Boundary Dam Power Station Unit 4	7.48%	7.93%
Boundary Dam Power Station Unit 5	7.61%	7.93%
Boundary Dam Power Station Unit 6	7.73%	7.93%
Average for Boundary Dam Power Station	**7.54%**	**7.44%**
Poplar River Power Station Unit 1	38.84%	56.5%
Poplar River Power Station Unit 2	39.10%	63.5%
Average for Poplar River Power Station	**39.98%**	**60.0%**
Shand Power Station Unit 1	46.33%	68.8%
Average for Shand Power Station	**46.33%**	**68.8%**
Average for SaskPower	**30.55%**	**45.4%**

The percentage of mercury captured from coal in each unit is quite consistent for Boundary Dam Power Station (BDPS). For Poplar River Power Station (PRPS) the percentage of mercury captured decreased in 2013, due to challenges with activated carbon injection performance. For Shand Power Station (SHPS) the percentage of mercury captured increased from 2012 from optimization of the activated carbon injection system.

Emission Rate of Mercury for Each Unit (kg/TWh)

Facility	kg/TWh 2013	kg/TWh 2014
Boundary Dam Power Station Unit 1	37.7	
Boundary Dam Power Station Unit 2	44.3	44.2
Boundary Dam Power Station Unit 3	38.4	36.1
Boundary Dam Power Station Unit 4	39.0	39.1
Boundary Dam Power Station Unit 5	38.0	36.4
Boundary Dam Power Station Unit 6	33.6	34.4
Average for Boundary Dam Power Station	**36.8**	**36.5**
Poplar River Power Station Unit 1	47.8	35.8
Poplar River Power Station Unit 2	47.8	31.0
Average for Poplar River Power Station	**47.8**	**33.2**
Shand Power Station Unit 1	25.7	18.3
Average for Shand Power Station	**25.7**	**18.3**
Average for SaskPower	**36.9**	**29.3**

In 2013, the emission rate of mercury remained largely unchanged for BDPS, the emission rate for SHPS decreased as expected with the increased mercury capture while the emission rate for PRPS increased as expected with the challenges the activated carbon injection system operation faced in 2013.

In 2014, the emission rate of mercury remained largely unchanged for BDPS, the emission rates for SHPS and PRPS decreased as expected with the increased mercury capture.

c) Monitoring Methods Used for All Parameters

Mass Balance Approach

SaskPower uses the mass balance approach where over a given period of time the masses of mercury entering the unit in the coal stream and leaving the unit in solid by-product residue streams are determined. The difference between these masses represents the amount of mercury emitted from the unit. The methods for mass balance determinations are based on the successful program in which SaskPower and Saskatchewan Ministry of the Environment (MoE) worked together to determine the mercury inventories from SaskPower's coal-fired units during the development of the CWS from Coal-Fired Electric Power Generation Plants. Any modifications from the previously used methods are based on the requirements of the agreement between MoE and SaskPower and recommendations from the report *Review of and Comments on SaskPower's Past and Future Sampling Protocols for Mercury in Coal and Coal Combustion By-Products* prepared by Champagne Coal Consulting Inc. (CCCI).

Over time SaskPower has observed very consistent levels of mercury in the coal at its three plants and the amount of mercury retained over various operating conditions. SaskPower has been developing good relationships between plant operating conditions, activated carbon injection and mercury capture. These relationships have been used as a check on the mass balance data.

In late 2014 SaskPower started operating its carbon capture system at Unit 3 of its Boundary Dam Power Station. A continuous emissions monitoring system for mercury has been installed at this unit. However, commissioning issues associated with the unique environment of the carbon capture system at Boundary Dam Unit 3 kept this CEM from operating in 2014. Tests at a previous pilot carbon capture system installed at Boundary Dam showed that significant oxidation of elemental mercury and its subsequent capture, resulting in reduced mercury emissions. However, because the CEM systems were not operating at Boundary Dam Unit 3 in 2014, the amount of mercury captured by the carbon capture system could not be determined and mercury emissions for Boundary Dam Unit 3 are somewhat over-reported.

Mercury in Coal Monitoring

The coal sampling procedure is in line with existing plant practices where coal is collected by automated sampling equipment on a daily basis according to ASTM D2234. Mercury analysis is performed at SaskPower's Asset Management chemistry laboratory using either the Leeman Labs Hydra C or the Leeman Labs Hydra C Appendix K mercury analyzer. In the event SaskPower's mercury analytical equipment is not available, even with this redundancy, samples are still collected as described below and analyzed once the equipment becomes operational again. If the mercury analytical equipment is not available for a lengthy period of time, SaskPower may use the services of an external lab with a demonstrated ability to analyze mercury.

Under conditions of normal plant coal sampling equipment availability, three daily samples are collected over a two week period and analyzed for mercury according to ASTM D-6722. If the sampling equipment is not available, feeder samples are collected and analyzed considering the recommendations of the Champagne Coal Consulting Inc. report. The mercury mass entering the unit is determined from the mercury concentration of the coal analyzed and the amount of coal fed to the unit over the period of time represented by the analyzed coal.

Mercury in Fly Ash Monitoring

Fly ash samples representing each unit are collected once every two weeks and analyzed according to ASTM D-6722 using either the Leeman Labs Hydra C mercury analyzer or the Leeman Hydra C Appendix K.

At Shand fly ash is collected from the silo used for holding fly ash before it is sent to storage or from the trucks transporting the fly ash for utilization.

At Poplar River fly ash was initially collected from the hoppers of each depth of an electrostatic precipitator (ESP) row. Subsequent data analysis has shown that representative data could be obtained by analyzing mercury from the first ESP fields. However, due to the variability seen in mercury concentrations once carbon injection started occurring Poplar River fly ash is now sampled from all fields.

There is statistical evidence showing that mercury determined in the first ESP field can reliably estimate the total mercury in Boundary Dam fly ash; therefore, sampling of the BDPS ESPs since 2010 has been done by sampling the first ESP field exclusively with the values for the remaining rows projected from first row analysis.

The mercury mass leaving the unit in the fly ash is determined from the mercury concentration of the fly ash analyzed and the amount of fly ash leaving the unit over the period of time represented by the analyzed fly ash.

Mercury in Bottom Ash Monitoring

The mercury content of bottom ash tends to be insignificant due to the almost complete volatilization of mercury during combustion and the subsequent transport of mercury with the flue gas away from where bottom ash is formed. Consequently, bottom ash sampling was concluded in 2013, now using historical averages from 2007-2012 for bottom ash mercury content.

Quality Assurance and Quality Control (QA/QC)

SaskPower employs a number of QA/QC practices including the following:

i. performing mercury analyses for each sample in quadruplicate. In cases where three of these mercury values do not agree within 10%, the analyses are repeated until three values agreeing within 10% are obtained

ii. daily analysis of standard and blank samples to verify the validity of mercury data collected for that day

iii. documentation and reasoning for any deviations from previously discussed methods

iv. comparison of data between reporting periods and determination of reasons for any differences

v. annual stack testing for speciated mercury to be performed from 2009 to 2012 after which time it was discussed with Saskatchewan MoE to reduce the testing to once every 3 years for plants that have had consistent test results. Boundary Dam Power station has been reduced to one test every three years. The other plants may still be looked at.

Using carbon injection at Poplar River and Shand Power Stations to control mercury emissions over time has shown that the differences between mercury in the coal entering the plant and the mercury retained in the ash has become considerably more variable than previously when mercury emissions were uncontrolled and greater fluctuations in mercury emissions determinations have been noted. In order to deal with this and to assess SaskPower's mercury compliance status on a more timely basis, a predictive tool has been developed to estimate mercury emissions based on previous mass balance data.

Deviations from the above methods are discussed below.

Mercury Analysis

Mercury analysis was performed using ASTM D-6722. The coal and fly ash analysis was done using the Leeman Hydra-C instrument and the Hydra C Appendix K instrument. Both instruments experienced some maintenance issues as is usual with analytical equipment that is used as much as the two mercury analyzers.

Mercury in Coal Monitoring

Boundary Dam Power Station

In 2014, 61 of the 79 (77%) scheduled coal samples were collected by ASTM D-2234 and subsequently analyzed for mercury by ASTM D-6722.

Poplar River Power Station

In 2014, 39 of the 79 (49%) scheduled coal samples were collected by ASTM D-2234 and subsequently analyzed for mercury by ASTM D-6722.

Shand Power Station

The mechanical sampler at Shand did not operate correctly in 2014; therefore, feeder samples were collected throughout the reporting period. In order to compensate for the reduced representativeness of the feeder compared to the mechanical samples, feeder samples were collected each regular working day at the plant. 219 total feeder samples were collected during 2014, with data for the remaining days backfilled by using the respective quarterly average.

Mercury in Fly Ash Monitoring

Boundary Dam Power Station

In 2014, fly ash samples were collected and analyzed for Unit 2 from the first fields of the ESP, the common silo for the remaining units. Mercury data for the remaining rows were estimated using statistical analysis as discussed previously. A total of 124 samples were collected out of the total 139 samples for all of BDPS (89%).

For Boundary Dam, if one sample is missing, the average of the sample taken before and sample taken after is used; if two consecutive samples are missing, the average for several samples before and after is used; if more than two consecutive samples are missed, the quarterly average is used.

Poplar River Power Station

In 2014, 202 out of 243 scheduled samples were collected (83%). Missing samples are backfilled using a combination of daily PAC injection operation for missed samples as well as a formula that uses the average of maximum observed Hg retention and minimum observed mercury retention.

Shand Power Station

In 2014, 66 out of the 105 (62%) scheduled samples were collected. Missing samples are backfilled using the same method described for Poplar River.

Quality Assurance and Quality Control (QA/QC)

SaskPower employs a number of QA/QC practices including the following:

i. Performing mercury analyses for each sample in quadruplicate. In cases where three of these mercury values do not agree within 10%, the analyses are repeated until three values agreeing within 10% are obtained.
ii. Daily analysis of standard and blank samples to verify the validity of mercury data collected for that day.
iii. Documentation and reasoning for any deviations from previously discussed methods.
iv. Comparison of data between reporting periods and determination of reasons for any differences.
v. Annual stack testing for speciated mercury to be performed from 2009 to 2012 after which time Saskatchewan MoE is to review the data to determine whether mercury testing can be coordinated with the stack testing required for criteria air contaminants under the Permit to Operate for each plant. Initially, the Ontario Hydro Method is to be used for speciated mercury emissions determination. Alternative methods may be used once they become available upon agreement to do this between SaskPower and MoE.

d) Justification for Alternative Methods

Mercury Analysis

Mercury analysis was performed using ASTM D-6722. The coal and fly ash analysis was done using the Leeman Hydra-C instrument and the Hydra C Appendix K instrument. Both instruments experienced some maintenance issues as is usual with heavily used analytical equipment.

Mercury in Coal Monitoring

Boundary Dam Power Station

In 2012, 75 of the 79 (95%) scheduled coal samples were collected by ASTM D-2234 and subsequently analyzed for mercury by ASTM D-6722.

Poplar River Power Station

In 2012, 74 of the 79 (94%) scheduled coal samples were collected by ASTM D-2234.

Shand Power Station

The mechanical sampler at Shand did not operate correctly in 2012; therefore, feeder samples were collected throughout the reporting period. In order to compensate for the reduced representativeness of the feeder compared to the mechanical samples, feeder samples were collected each regular working day at the plant. 155 total feeder samples were collected during 2012 with data for the remaining days backfilled by using the respective quarterly average. The total number of feeder samples is less than in previous years due to the three month long major overhaul at Shand in 2012.

Mercury in Fly Ash Monitoring

Boundary Dam Power Station

In 2012, fly ash samples were collected and analyzed for all units for the first fields. Mercury data for the remaining rows were estimated using statistical analysis as discussed previously. A total of 164 samples were collected out of the total 182 samples for all of BDPS (90%).

Poplar River Power Station

In 2012, 217 out of 234 scheduled samples were collected (97%). Additional fly ash samples were taken in the last 3 months of 2012 to see if additional samples provided more information on fly ash mercury retention where activated carbon injection was occurring.

Shand Power Station

In 2012, 15 out of the 21 (71%) scheduled samples were collected, five fewer samples were scheduled to be collected due to the overhaul from May to July. Due to fewer samples collected in 2012, a rolling 3 sample average was not used. The week before and after were averaged for one sample missed; when two to three samples in succession were missed the two weeks before and after were averaged; when greater than three samples were missed, the yearly average was used.

Mercury in Bottom Ash Monitoring
Boundary Dam Power Station

In 2012, bottom ash samples were supposed to be collected for each unit once per sampling quarter as specified by the CWS. No bottom ash samples were taken for the third quarter, all other quarters had the scheduled samples taken.

Poplar River Power Station

In 2012, bottom ash samples were supposed to be collected for each unit once per sampling quarter as specified by the CWS. All samples were collected in 2012.

Shand Power Station

In 2012, bottom ash samples were supposed to be collected once per sampling quarter as specified by the CWS. All samples were collected in 2012.

e) Mercury Speciation

In accordance with the draft MOU between the Saskatchewan Ministry of Environment and SaskPower on mercury monitoring, SaskPower has conducted annual speciated mercury testing at all of its stacks annually from 2009-2012. In 2012 the Saskatchewan Ministry of Environment agreed to switching the speciated mercury testing to once every three years. Below is a summary of the average test results from 2009-2013.

2009-2013 Averages				
Plant	**Unit**	**Particle Bound (%)**	**Oxidized (%)**	**Elemental (%)**
Boundary Dam	3	0.27%	9.72%	89.82%
	4	0.06%	18.45%	81.71%
	5	0.30%	16.75%	82.89%
	6	0.40%	17.19%	82.49%
Poplar River	1&2	8.78%	25.56%	65.48%
Shand	1	0.69%	6.49%	92.88%

f) Credits for Early Action

The Canada-wide Standards contain provisions for SaskPower to use credits for early actions to meet its caps. Examples of early actions include a mercury switch collection program and early mercury controls at the Poplar River Power Station up to the end of 2009.

- **Mercury collection**

Starting in 2003, SaskPower implemented a collection program with several scrap metal companies to recover old mercury switches in automobiles before they were fed to a steel mill furnace. The mercury collected to date is summarized below:

Year	Mercury Collected from Mercury Switches, kg	Mercury Collected from Other Sources, kg	Total Mercury Collected, kg
2003/2004	48.568	0	48.568
2005	52.570	0	52.570
2006	36.276	6.210	42.486
2007	41.600	10.122	51.722
2008	29.541	13.473	43.014
2009	37.674	6.291	43.965
2010	26.888	1.416	28.304
2011	15.701	3.912	19.613
2012	18.285	1.461	19.746
2013	15.235	0	15.235
2014	8.414	0	8.414
Total	**330.752**	**42.885**	**373.636**

- **Mercury Reduction at Poplar River Power Station**

SaskPower has taken on an extensive research and development program to enhance the development of technologies that may be used to control the mercury emitted from SaskPower's units, which is primarily elemental in nature. This work also has applications to other Canadian utilities that emit mainly elemental mercury, in contrast to U.S. coal plants where flue gas mercury tends to have significant fractions of oxidized mercury. A key milestone of this work was the commissioning of SaskPower's Emissions Control Research Facility where selected technologies can be assessed for their capability to remove mercury from a slipstream of Poplar River's flue gas. Since the ECRF started operations, mercury removal from Poplar River has become more significant as:

- the ECRF has operated more consistently
- a full-scale mercury removal demonstration occurred on Poplar River Unit 2
- various modifications were made to the plant to prepare for the installation of long-term mercury controls and
- Canada's first permanent mercury control system was installed for both units of Poplar River in 2009.

The changes in mercury emissions at Poplar River over this time are summarized below:

Year	Baseline Mercury Emissions, kg	Mercury Emissions, kg	Reduction/Increase in Mercury
2003	297.82	297.82	0
2004	297.82	294.80	3.02
2005	297.82	281.11	16.71
2006	297.82	222.12	75.70
2007	297.82	311.73	-13.91
2008	297.82	239.13	58.69
2009	297.82	308.96	-11.14
Total	**2084.74**	**1955.67**	**129.07**

The overall inventory of mercury credits collected and used is summarized below.

Year	Mercury Collected from Mercury Switches, kg	Reduction of Mercury Emissions from PRPS Early Action, kg	Total Credits for Early Action	Mercury Collected from Other Sources, kg (non-eligible for credits)	Credits Used, kg	Current Year Credits Remaining, kg
2003/04	48.568	3.02	51.588	0	-	51.59
2005	52.570	16.71	69.280	0	-	120.87
2006	36.276	75.70	111.976	6.21	-	232.84
2007	41.600	-13.91	27.690	10.122	-	260.53
2008	29.541	58.69	88.231	13.473	-	348.77
2009	37.674	-11.14	26.534	6.291	-	375.30
2010	26.888	n/a	26.888	1.416	171	231.19
2011	15.701	n/a	15.701	3.912	121	125.89
2012	18.285	n/a	18.285	1.461	60	84.17
2013	15.235	n/a	15.235	0	33	66.41
2014	8.414	n/a	8.414	0	0	74.82
Total	**330.752**	**129.07**	**451.408**	**42.885**	**385**	

The net amount of mercury credits available for further use is 74.8 kg. With the trend of decreasing mercury emissions from carbon injection system operation at Poplar River and the installation/commissioning of the control system at Shand, the remaining 74.8 kg of credits should cover any emissions exceeding limits in 2015.

g) Amount of Mercury in Coal (kg)

Facility	2013	2014
Boundary Dam Power Station Unit 1	7	
Boundary Dam Power Station Unit 2	20	13
Boundary Dam Power Station Unit 3	7	18
Boundary Dam Power Station Unit 4	43	36
Boundary Dam Power Station Unit 5	46	41
Boundary Dam Power Station Unit 6	84	73
Total for Boundary Dam Power Station	**207**	**182**
Poplar River Power Station Unit 1	160	177
Poplar River Power Station Unit 2	178	202
Total for Poplar River Power Station	**338**	**379**
Shand Power Station Unit 1	122	123
Total for Shand Power Station	**122**	**123**
Total for SaskPower	**667**	**683**

Mercury concentration in coal is relatively stable, therefore any changes to yearly total mass of mercury in coal is due primarily to generation differences.

h) Amount of Mercury Retained in Fly Ash (kg)

Facility	2013	2014
Boundary Dam Power Station Unit 1	0.9	
Boundary Dam Power Station Unit 2	1.0	0.7
Boundary Dam Power Station Unit 3	0.5	1.4
Boundary Dam Power Station Unit 4	3.1	2.9
Boundary Dam Power Station Unit 5	3.4	3.2
Boundary Dam Power Station Unit 6	6.3	5.8
Total for Boundary Dam Power Station	**15.1**	**14.1**
Poplar River Power Station Unit 1	6.2	100
Poplar River Power Station Unit 2	69.3	128
Total for Poplar River Power Station	**131.3**	**228**
Shand Power Station Unit 1	56.5	85
Total for Shand Power Station	**56.5**	**85**
Total for SaskPower	**202.9**	**327**

The amount of mercury retained in fly ash is quite similar for Boundary Dam in 2013 and 2014. Poplar River had increased mercury retained in fly ash due to improved efficiencies with operation and performance of the activated carbon injection system. Shand also had more mercury retained in fly ash from 2013, also due to improved efficiencies with operation and performance of its activated carbon injection system.

i) Amount of Mercury Retained in Bottom Ash (kg)

Facility	2013	2014
Boundary Dam Power Station Unit 1	0.02	
Boundary Dam Power Station Unit 2	0.05	0.03
Boundary Dam Power Station Unit 3	0.02	0.05
Boundary Dam Power Station Unit 4	0.11	0.09
Boundary Dam Power Station Unit 5	0.11	0.10
Boundary Dam Power Station Unit 6	0.21	0.18
Total for Boundary Dam Power Station	**0.51**	**0.45**
Poplar River Power Station Unit 1	0.15	0.16
Poplar River Power Station Unit 2	0.16	0.18
Total for Poplar River Power Station	**0.31**	**0.34**
Shand Power Station Unit 1	0.00	0.00
Total for Shand Power Station	**0.00**	**0.00**
Total for SaskPower	**0.82**	**0.79**

The amount of mercury retained in bottom ash is consistent with previous years, very little overall capture. This is based on historical averages for mercury content in bottom ash and total bottom ash produced.

j) Amount of Coal Combustion Residues and Means to Manage their Disposal (tonnes)

Facility	2013	2014
Boundary Dam Power Station Unit 1	14,763	
Boundary Dam Power Station Unit 2	41,828	28,224
Boundary Dam Power Station Unit 3	14,503	37,201
Boundary Dam Power Station Unit 4	88,406	76,256
Boundary Dam Power Station Unit 5	93,620	85,358
Boundary Dam Power Station Unit 6	173,989	153,554
Total for Boundary Dam Power Station	**427,109**	**380,594**
Poplar River Power Station Unit 1	219,174	249,500
Poplar River Power Station Unit 2	243,651	285,696
Total for Poplar River Power Station	**462,824**	**535,196**
Shand Power Station Unit 1	231,208	233,221
Total for Shand Power Station	**231,208**	**233,221**
Total for SaskPower	**1,121,142**	**1,149,010**

The amounts of coal combustion residues are consistent with generation for the respective units.

Fly ash and bottom ash are hydraulically transported to ash lagoons at both Boundary Dam and Poplar River and the transport water is circulated back to the plant to collect more ash. Lagoons at both plants are lined and monitored to ensure ash constituents do not migrate into the environment. Extensive testing of by-products resulting from the test work at the ECRF have demonstrated that any mercury captured by activated carbon is effectively fixed and that less mercury is released than when activated carbon is not present. Consequently ashes containing carbon at Poplar River are also placed in the lagoons. None of the ash produced at Poplar River is currently utilized. Roughly 69% of the ash produced at Boundary Dam was utilized in 2014, which shows the increased demand of SaskPower fly ash.

At Shand fly ash and bottom ash are dry hauled to a dedicated placement site that is designed to minimize any contact with water. The site is also lined and monitored to prevent ash constituents from entering the environment. 2014 fly ash utilization at Shand was roughly 7% which is lower than 2013 sales, showing a decrease in fly ash sales from previous years that averaged about 25%. Applications for most, if not all, of the fly ash produced at Shand are expected to occur in the next few years.

5. **Research and Development**

The CWS implementation plan states “SaskPower will participate in a significant research and development program to determine the most suitable way to manage mercury emissions from lignite-fired power plants.”

SaskPower has carried out significant research and development to ensure that this provision of the CWS is met. Much of this work has been described in previous Mercury Monitoring Reports. Highlights of work for 2014 included:

- Emissions Control Research Facility

The most significant work SaskPower has been involved in is the work leading to the design, construction and subsequent test work of its Emissions Control Research Facility (ECRF), which draws a continuous stream equivalent to about 1 MW of generation from its Poplar River Power Station. The ECRF was originally designed and built in order to determine how to comply with the CWS for mercury for the Electric Power Generation sector, which were under development at the time. Because of the work done at the ECRF, SaskPower was awarded the Canadian Environmental Agency’s Environmental Commitment and Responsibility Award for Environmental Stewardship in January 2009. In 2011 this work was recognized through the presentation of the Distinguished Service Award for Research and Development by the Lignite Energy Council. SaskPower belongs to the Lignite Energy Council (LEC) along with several utilities and other lignite stakeholders in order to jointly develop solutions to problems associated with producing electricity by burning lignite.

The primary success of the ECRF test program was the determination that injecting brominated activated carbon upstream of an electrostatic precipitator was the most suitable means of controlling mercury emissions for power plants burning the kind of coal used at SaskPower. Recent improvements in product formulations have been claimed by numerous activated carbon suppliers. In addition, some suppliers have been promoting alternate materials to activated carbon for mercury control. In 2012 MoE granted approval to SaskPower to test several of these products at the ECRF. Testing began in 2012, and has continued through 2014. Further work is planned for 2015. In particular, SaskPower started discussions in 2013 with a major activated carbon supplier about doing long term tests at the ECRF in order determine the effectiveness of various products being developed by this supplier for several different applications. Test work started in 2014 and is expected run for about five years.

After achieving encouraging results in the ECRF tests, a temporary full-scale system was installed on Unit 2 of Poplar River in 2007 and run until 2009. This led to the installation of Canada's first permanent utility-scale carbon injection system to control mercury at both units at Poplar River. This system incorporated many design changes based on experiences with the temporary system, and was handed over to the plant on June 5, 2009. Various problems have been encountered in achieving the reliability required for consistent on-going mercury removal. Considerable effort has been made to address these and much better reliability was achieved in 2011, with further improvements noted in subsequent years. In 2012 a full-scale carbon injection system was installed at Shand. Several design features were incorporated into this system, based on experiences with the Poplar River system. In addition, several design innovations were included in the Shand system and considerable work was done to ensure the reliability of the Shand system.

SaskPower has installed equipment at the ECRF that was designed to achieve better flue gas mixing in order to reduce particulate emissions. This mixing should also achieve better contact between injected activated carbon and mercury in flue gas, resulting in more efficient mercury capture.

- Coal Treatment

SaskPower continues investigating various options to treat coal prior to combustion in order to remove mercury and other undesirable constituents of the coal.

Pilot-scale tests on several novel physical coal separation technologies have demonstrated that significant reductions in mercury could be achieved for the coals SaskPower burns. This is largely due to the removal of dense pyritic material that contains relatively high concentrations of mercury, as well as sulphur. However, it was found that the high moisture concentrations associated with the coals that SaskPower burns limited the amount of separation. SaskPower has devoted considerable effort in evaluating a technology that both dries the coal and separates dense constituents from the coal and the analyses have been promising, but boiler heat balance issues could arise from burning the drier coal. More work is required to address this, but resources to do this have been limited due to the effort required to complete the installation and commissioning of carbon dioxide controls at Boundary Dam Unit 3.

SaskPower has also worked with the Canadian Clean Power Coalition to further examine the suitability of various coal beneficiation technologies. Results to date have largely been consistent with SaskPower's previous test work, with the lignite burned by SaskPower being identified as being particularly suitable for technologies that involve coal drying.

In 2014 SaskPower started investigating a process that modifies mill operations to reject higher amounts of pyrite where much of the mercury resides in the coal that SaskPower burns. Arrangements are being made to ship a sample of coal burned at Poplar River for testing, which is planned in 2015.

- Other Research

SaskPower conducted a program to evaluate sorbent trap monitoring for mercury analysis at the ECRF. Although good determinations of mercury have been noted, various issues associated with the operations of SaskPower's facilities have been noted, and further testing of sorbent trap technologies have been placed on hold.

The mercury continuous emissions monitoring systems installed at the ECRF have proven effective for assessing mercury removal in test work there. However, they have proven problematic for reliable long-term operations required for compliance monitoring when sampling flue gas from Poplar River. At the end of 2013 SaskPower acquired newly designed probes to address probe plugging issues encountered by the ECRF systems. In 2014 these probes were incorporated into two of the ECRF mercury CEM systems and performed well. A similar probe has been acquired for the remaining ECRF mercury CEM and will be installed in 2015. With the success of the new probes, one of the ECRF CEMS was used for performing parametric tests for mercury capture at Poplar River Unit 1. Data analysis will be done in 2015 and similar tests are planned for Poplar River Unit 2 and Shand.

In May of 2011 SaskPower started construction of a carbon capture system on Unit 3 at Boundary Dam Power Station and this system was commissioned in late 2014. In addition, a mercury CEM system was installed to monitor mercury in the Boundary Dam Unit 3 exhaust stream. This is because the CO_2 capture system has multiple process streams that makes the mass balance monitoring currently used by SaskPower challenging. Because the exhaust stream from a carbon dioxide capture system has several key differences compared to other power plant flue gas streams, considerable method development for the mercury CEM system at Boundary Dam Unit 3 has been required and full commissioning of the this system is to be completed in 2015. Once this mercury CEM has been commissioned, a study to determine the fate of mercury in a carbon capture system is planned. In tests at a previous pilot-scale carbon capture system at Boundary Dam it was found that of elemental mercury was oxidized at various process points of the system and that the oxidized mercury was removed from the flue gas.

6. **Canada-wide Standards Achievement Determination**

For SaskPower's existing units the total annual mercury emissions are capped at 430kg, a 40% reduction from 2003 emissions levels starting in 2010. SaskPower has met this cap through the use of its carbon injection systems at Poplar River and Shand plus application of credits for early action earned through the collection of mercury switches plus reductions in mercury emissions at Poplar River prior to 2010, as discussed in previous sections of this report.

In 2014 SaskPower did not use any of its credits for early action to achieve compliance with the Canada-wide Standards for mercury. At the end of 2014 75 kg of credits remained. Assuming credits similar in amount may be required in 2015 as was required in 2013 for compliance; SaskPower should have enough credits left to meet compliance. The continued work on optimizing the Shand and PRPS activated carbon injection systems should ensure that SaskPower meets the 430kg limit once the credits are exhausted.

For any new units, the mercury emissions will be compared to the amount of mercury content of the coal to determine whether the 75% reduction required for lignite is achieved.

Mercury emissions will also be compared to the amount of electricity generated by the unit to determine whether the emissions rate limit of 15 kg/TWh for lignite is achieved. No new units have come on line at SaskPower during this reporting period; therefore, meeting the new unit limits is not currently a concern. Any new units that may be installed in the future will clearly be designed to meet these limits.