CCME

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

2017–2018 Progress Report

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ABBREVIATIONS

CCME	Canadian Council of Ministers of the Environment
CEMS	continuous emissions monitoring system
CVAAS	cold vapour atomic absorption spectrometry
CWSs	Canada-wide Standards for Mercury Emissions from Coal-fired Electric Power Generation Plants
ECRF	Emissions Control Research Facility
EPG	electric power generation
ESP	electrostatic precipitator
MoE	Saskatchewan Ministry of Environment
NPRI	National Pollutant Release Inventory
ppm	parts per million
QA/QC	quality assurance and quality control
RAT	relative accuracy test audit
UDCP	Uniform Data Collection Program

1.0 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 (CWSs). The CWSs set targeted caps for each signatory jurisdiction for the year 2010. This report presents information on the attainment of 2010 emissions caps under the CWSs. Only those jurisdictions with coal-fired electric power generation (EPG) plants are required to report. In 2010, emissions of mercury from the plants covered by the CWSs represented 94% of Canada's total mercury emissions from EPG (Government of Canada 2018).

In the baseline year of 2003, 2,695 kg of mercury were emitted, and there was a total of 3,725 kg of mercury in the amount of coal burned. This represented a capture rate of less than 28%. In 2018, 588.06 kg of mercury were emitted, and the total mercury contained in the coal burned was 1,365.26 kg, representing a capture rate of 57%. The caps have been achieved and represent a 78% reduction in total emissions from 2003 compared to the 2010 emission caps which were expected to produce a 52–58% reduction in total emissions. While the goal for emission reduction has been achieved, CCME will continue to report on progress until 2020.

2.0 SUMMARY

In 2017 620.17 kg of mercury were emitted from coal-fired power generation plants in signatory jurisdictions and, where applicable, jurisdictions have achieved their 2010 mercury emissions cap, except Nova Scotia, which emitted slightly over its emission cap. Nova Scotia Power is required to make up for emissions reported above the established cap. This was achieved by end of 2020 and will be reported in the final CWS report for 2019-2020.

In 2018 588.06 kg of mercury were emitted from coal-fired power generation plants in signatory jurisdictions and, where applicable, jurisdictions have achieved their 2010 mercury emissions cap.

Table 2-1 shows mercury emissions from 2008 to 2018, compared with the 2010 emissions cap from all jurisdictions that had mercury emissions from coal-fired electric power generation plants during this time.

Table 2-1 Mercury emissions from coal-fired electric power generation plants in Canada, 2008–2018

Mercury emissions (kg)	Alberta	Manitoba	New Brunswick	Nova Scotia	Ontario	Saskatchewan	Total
2008	481.00	9.60	41.00	161.00	191.00	646.73	**1,530.33**
2009	579.00	2.80	107.00	140.00	59.00	707.00	**1,594.80**
2010	661.00	1.16	30.00	81.50	87.00	601.00* (credits of 171.00 kg used to meet cap)	**1,461.66**
2011	212.59	1.01	18.00	94.60	43.00	551.00* (credits of 121.00 kg used to meet cap)	**920.20**
2012	200.70	1.22	13.00	93.90	27.00	490.00* (credits of 60.00 kg used to meet cap)	**825.82**
2013	221.51	1.87	15.00	72.50	28.00	463.00* (credits of 33.00 kg used to meet cap)	**801.88**
2014	236.28	1.44	15.00	53.90	3.00	357.00	**666.62**
2015	217.31	1.94	13.00	55.00	0.00	395.00	**682.25**
2016	183.69	0.58	17.00	60.50	0.00	368.00	**629.77**
2017	143.09	0.778	12	65.9	0.00	398.38	**611.15**
2018	97.58	0.055	15	63.4	0.00	412.05	**588.09**
2010 emissions cap	590.00	20.00	25.00	65.00**	not set	430.00	**1,130.00**

*Until 2014 Saskatchewan's cap was achieved with the use of accumulated credits for early action.
**Nova Scotia Power is required to make up for emissions reported above the established cap (2010-2013). This was achieved by the end of 2020 and will be reported in the final CWS report for 2019-2020.

3.0 ACHIEVEMENT OF 2010 CAPS AND REVIEW OF THE STANDARD

Under the CWSs for mercury all jurisdictions were to have met their emissions caps by 2010. The CWSs were scheduled for review by 2012 but based on the progress to date it was agreed that a review will not be undertaken. However, reporting will continue until 2020.

4.0 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* (CCME 2007).

4.1 Alberta

In 2018, Alberta had six coal-fired power plant facilities:

- Battle River Generating Station, Units 3 to 5
- Genesee Thermal Generating Station, Units 1, 2 and 3
- Sheerness Generating Station
- Sundance Generating Plant, Units 3, 4, 5 and 6
- Keephills Generating Plant, Units 1, 2 and 3
- H.R. Milner Generating Station.

Table 4-1 shows mercury emissions from Alberta facilities.

Table 4-1 Mercury emissions from Alberta facilities broken down by stack, 2017 and 2018

	Total Mass Mercury					
Facility	**Emissions (kg)**		**In coal burned (kg)**		**Retained in ash and residue (kg)**	
	2017	**2018**	**2017**	**2018**	**2017**	**2018**
Battle River	7.2	7.5	34.7	42.0	32.1	34.0
Genesee 1/2 Stack 1	17.04	14.38	113.17`	105.37	96.13	90.99
Genesee 3 Stack 2	8.17	8.52	59.31	54.84	51.14	46.32
H.R. Milner	1.50	2.39	2.85	7.83	1.35	10.93
Keephills 1/2	25.42	24.75	133.28	140.02	107.86	115.27
Keephills 3	7.35	7.88	56.48	59.79	49.14	51.91
Sheerness	24.21	18.26	127.49	97.57	103.28	79.31
Sundance 1/2 *	7.12	N/A	42.55	N/A	35.43	N/A
Sundance 3/4	22.85	6.82	122.69	35.88	99.84	29.06
Sundance 5/6	22.23	7.06	138.19	41.29	115.96	34.23
Totals	143.09	97.58	717.54	584.59	692.23	492.02

* Sundance Unit 1 was retired on December 31, 2017 and Sundance Unit 2 was retired on July 31, 2018. Sundance Unit 2 was in a mothballed effective January 1, 2018 prior to retirement so did not operate in 2018.

4.1.1 Battle River Generating Station

(a) Annual emissions of total mercury from each coal-fired EPG plant (kg/year)

Table 4-2 Battle River annual emissions of total mercury, 2017 and 2018

	Battle River	Total (kg)
2017*	7.2 (CEMS)	7.2
2018*	7.5 (CEMS)	7.5

*required data
CEMS: continuous emissions monitoring system

(b) Capture rates (percent capture in coal burned) or emission limits (kg/TWh) for each new EPG unit

Not applicable.

(c) Monitoring methods used for all parameters

- 2017: Stack Testing and Flow Monitoring (CEMS)
- 2018: Stack Testing, Ontario Hydro and Flow Monitoring (CEMS)

(d) Justification for alternative methods

Not applicable.

(e) Any supporting data or any other data requested by a jurisdiction to verify reported emissions or recognition for early action

Not applicable.

(f) Mercury speciation

Table 4-3 Battle River mercury speciation, 2017 and 2018

Year	Stack	Elemental Hg (%)*	Oxidized Hg (%)	Particulate Hg (%)
2017	B	No Ontario Hydro completed in 2017		
	C			
2018	B	81.2	16.5	2.4
	C	69.3	18.6	12.1

* The elemental mercury is different between stacks; therefore, the table shows the values for each stack.
The percentages calculated are based on actual measured values and therefore may not equal exactly 100%.

(g) Mercury content of coal

2017

- Mercury Content – 34.7 kg (37.37 ppb)
- Coal Mass Burned (dry) – 928,293,000kg

2018

- Mercury Content – 42.0 kg (47.10 ppb)
- Coal Mass Burned (dry) – 892,022,000kg

(h) Mercury content of coal combustion residues, the mass amounts (kg) of these coal combustion residues and the means used to manage the disposal of these residues (e.g., to landfill, for sale for cement)

Table 4-4 Battle River Combustion Residues Mercury Content, Mass and Management Method, 2017 and 2018

Year	Residue	Kilograms (dry)	Mercury (ppb)	Disposal
2017	Raw fly ash	133,567,000	242	Marketed and landfill
	Bottom ash	47,662,000	3.0	Landfill
2018	Raw fly ash	114,638,000	295	Marketed and landfill
	Bottom ash	51,951,000	3.6	Landfill

4.1.2 Genesee Generating Station

(a) Annual emissions of total mercury from each coal-fired EPG plant (kg/year)

Table 4-5 Genesee annual emission of total mercury, 2011–2018

	Genesee 1/2	Genesee 3	Combined
Year	Hg emissions to air (kg)	Hg emissions to air (kg)	(kg)
2011	41.50	14.65	56.15
2012	32.59	17.22	49.81
2013	27.57	13.93	41.50
2014	21.03	8.85	29.88
2015	21.54	8.00	29.54
2016	21.73	9.89	31.62
2017	17.04	8.17	25.21
2018	14.38	8.52	22.90

(b) Capture rates (percent capture in coal burned) or emission limits (kg/TWh) for each new EPG unit

Not applicable.

(c) Monitoring methods used for all parameters

Genesee reports based on Stack Testing and Flow Monitoring (Hg CEMS)

(d) Justification for alternative methods

Not applicable.

(e) Any supporting data or any other data requested by a jurisdiction to verify reported emissions or recognition for early action.

The summary results of RATA verification testing follow for Genesee 1 and 2 (Stack 1) and Genesee 3 (Stack 2).

On February 28 and July 26 and 27, 2017, and February 27 and 28 and July 17, 2018 Maxxam Analytics conducted a Compliance Survey and RATA of the Stack 1 Mercury CEMS. Stack testing was conducted in accordance with the requirements of Method #30B (Sorbent Carbon Trap).

On March 1, 2017 and July 25 and 26, 2017, and February 28 to March 2, 2018 and on July 18, 2018 Maxxam Analytics conducted a Compliance Survey and RATA of the Stack 2 Mercury CEMS. Stack testing was conducted in accordance with the requirements of Method #30B (Sorbent Carbon Trap).

(f) Mercury speciation

The summary results of past mercury speciation testing follow for Genesee 1 and 2 (Stack 1) and Genesee 3 (Stack 2). As per agreement with Alberta Environment, Ontario Hydro (speciation) testing drops in frequency to once every two years following 2012. Results are shown in Table 4-6.

Table 4-6 Genesee source emission survey

Stack	Date	Elemental Hg (%)	Oxidized Hg (%)	Particulate Hg (%)
1	April 2018	78.69	14.05	7.26
2	May 2018	97.62	0	2.38

(g) Mercury content of coal

See Table 4-1.

(h) Mercury content of coal combustion residues, the mass amounts (kg) of these coal combustion residues and the means used to manage the disposal of these residues (e.g., to landfill, for sale for cement)

Table 4-7 Genesee Unit 1 and 2 residue, 2017 and 2018

Year		Sold		Returned to mine		Total (10^3 kg)
		10^3 kg	%	10^3 kg	%	
2017	Fly ash	200,443	53.01	177,700	46.99	378,143
	Bottom ash	0	0.0	270,700	100.0	270,700
2018	Fly ash	230,688	68.3	107,300	31.7	241,087
	Bottom ash	0	0.0	217,900	100.0	217,900

Table 4-8 Genesee Unit 3 residue, 2017 and 2018

Year		Sold		Returned to mine		Total (10^3 kg)
		10^3 kg	%	10^3 kg	%	
2017	Fly ash	0	0.0	272,280	100.0	272,280
	Bottom ash	0	0.0	117,000	100.0	117,000
2018	Fly ash	16,760	6.5	240,600	93.5	257,360
	Bottom ash	0	0.0	108,360	100.0	108,360

4.1.3 H.R. Milner Generating Station

(a) Annual emissions of total mercury from each coal-fired EPG plant (kg/year)

Table 4-9 Annual emissions from H.R. Milner Generating Station, 2017 and 2018

Year	Hg emissions to air (kg)	**Total** (kg)
2017	1.5	1.5
2018	2.39	2.39

(b) Capture rates (percent capture in coal burned) or emission limits (kg/TWh) for each new EPG unit

Not applicable.

(c) Monitoring methods used for all parameters

2017

Mass balance and emission factors.

2018

Calculations for the determination of total mercury in coal and ash residues was done by analyzing samples of each product for mercury concentration and multiplying the concentration of the sample by the total mass of the product for the time period the sample represents.

Since it was determined that the total mercury in ash residues was greater than the total mercury in coal, a mass balance calculation to determine total mercury releases to air was not used (it is hypothesized that there may be trace concentrations of mercury in the natural gas used as a secondary fuel in the boiler). A site specific emission factor was developed using the stack testing data shown in section (f) expressed as grams/MW (gross). This factor was multiplied by the 2018 gross generation to determine the total releases to air.

(d) Justification for alternative methods

- 2017: See section (h).
- 2018: See section (c).

(e) Any supporting data or any other data requested by a jurisdiction to verify reported emissions or recognition for early action

Not applicable.

(f) Mercury speciation

2017

Stack testing (and thus mercury speciation) was not performed due to an unexpected shutdown of the facility from April to December as a result of market conditions.

2018

Mercury speciation.

Table 4-10 H.R. Milner mercury speciation, 2018

Date	Elemental Hg (mg/Sm^3)	Oxidized Hg (mg/Sm^3)	Particulate Hg (mg/Sm^3)
August 2018	63.14	29.48	7.37

(g) Mercury content of coal

- 2017 – 2.85 kg
- 2018 – 7.83 kg

(h) Mercury content of coal combustion residues, *the mass amounts (kg)* of these coal combustion residues and the means used to manage the disposal of these residues, e.g., to landfill, for sale for cement, etc.

2017

Both ash waste streams were transported and disposed of at the Flood Creek Ash Disposal Facility in accordance with Alberta Environmental and Enhancement Act Approval 9814-02-00 (as amended). The amount of mercury retained in fly ash and bottom ash is estimated at 1.35 kg.

Mercury content of coal residues were calculated using a mass balance approach as 6.70 kg for fly ash and 0.01 kg for bottom ash. This is illogical since the total amount of mercury in coal consumed was calculated as 2.85 kg. The concentration of mercury measured in fly ash is suspicious and believed to be in error.

Using 2016 stack data, total mercury stack emissions were estimated at 1.50 g/MWh. In 2017 there was 100,484 MWh of electricity generated. Using the 1.50 g/MWh emission factor, it is estimated that 1.50 kg of mercury was released from the Milner stack in 2017. The difference between the amount of mercury consumed in coal (2.85 kg) and the above estimate of mercury emitted via the stack (1.50 kg) can be used to provide a reasonable estimate of mercury retained in fly ash and bottom ash (1.35 kg).

2018

Both ash waste streams were transported and disposed of at the Flood Creek Ash Disposal Facility in accordance with Alberta Environmental and Enhancement Act Approval 9814-02-00 (as amended). The amount of mercury retained in fly ash and bottom ash is estimated at 10.93 kg.

4.1.4 Sheerness Generating Station

(a) Annual emissions of total mercury from each coal-fired EPG plant (kg/year)

Table 4-11 Sheerness annual emissions of total mercury, 2017 and 2018

Year	Hg emissions to air (kg)	Total (kg)
2017*	24.21	24.21
2018*	18.26	18.26

*required data

(b) Capture rates (percent capture in coal burned) or emission limits (kg/TWh) for each new EPG unit

Not applicable.

(c) Monitoring methods used for all parameters

Stack Testing and Flow Monitoring (CEMS)

- Hg CEMS Relative Accuracy Test Audit: Method 30B.
- Stack temperature was determined using a calibrated type "K" thermocouple and digital thermometer. Thermocouples were calibrated as per the protocols in Section 4.3 of Method #2 of the Alberta Stack Sampling Code and 40 CFR 60 Appendix A.
- Flue gas velocities and volumetric flow rates were determined following the protocols in Method #2 of the Alberta Stack Sampling Code.

Mass Balance

- Mercury emissions and percent mercury capture were not determined by mass balance in 2017 or 2018.

Other equivalent method

- Mercury emissions were determined by the Hg CEMS in 2017 and 2018.
- The Hg captured and Hg retained in the ash is the difference between the Hg mass in the coal by analyses and the Hg mass emissions as measured by the Hg CEMS.

(d) Justification for alternative methods

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

(e) Any supporting data or any other data requested by a jurisdiction to verify reported emissions or recognition for early action

Not applicable.

(f) Mercury speciation

Methodology: Uniform Data Collection Program (UDCP) and Ontario Hydro Method – Speciated Mercury.

Table 4-12 Sheerness summary of average mercury results (August 29–30, 2017)

Parameter	Unit	Average
Temperature	°C	172
Particulate mercury	g/hr	0.0154
Oxidized mercury	g/hr	0.8949
Elemental mercury	g/hr	2.26
Total mercury	g/hr	3.15

(g) Mercury content of coal

- 2017: 127.49 kg of Hg
- 2018: 97.57 kg of Hg

(h) Mercury content of coal combustion residues, the mass amounts (kg) of these coal combustion residues and the means used to manage the disposal of these residues, e.g., to landfill, for sale for cement, etc.

Table 4-13 Sheerness mercury content of coal combustion residues, 2017 and 2018

Residues	Tonnes (dry)	Mercury (kg)	Disposal
2017			
Sales fly ash	117,137	36.40	Recycled, concrete production
Raw fly ash and bottom Ash	396,806	66.88	Engineered landfill
2018			
Sales fly ash	119,315	27.95	Recycled, concrete production
Raw fly ash and bottom ash	360,036	51.36	Engineered landfill

4.1.5 TransAlta (Sundance and Keephills)

(a) Annual emissions of total mercury from each coal-fired EPG plant (kg/year)

Table 4-14 TransAlta annual emissions of total mercury, 2017 and 2018

	Sundance 1/2	Sundance 3/4	Sundance 5/6	Keephills 1/2	Keephills 3	Total (kg)
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)	
2017	7.12	22.85	22.23	25.42	7.35	84.97
2018	N/A	6.82	7.06	24.75	3.88	42.51

(b) Capture rates (percent capture in coal burned) or emission limits (kg/TWh) for each new EPG unit

Table 4-15 TransAlta emission limits (kg/TWh) for each new* EPG unit

	Sundance 1/2	Sundance 3/4	Sundance 5/6	Keephills 1/2	Keephills 3
Year	*Intensity (kg/TWh)*	*Intensity (kg/TWh)*	*Intensity (kg/TWh)*	*Intensity (kg/TWh)*	*Intensity (kg/TWh)*
2017	2.04	5.55	5.14	4.65	2.08
2018	N/A	3.87	4.08	4.46	1.18

*Applies to new units only

(c) Monitoring methods used for all parameters

- Stack Testing and Flow Monitoring (CEMS), (2011 – Present)
- Mass Balance, (2008 – 2010)

(d) Justification for alternative methods

Not applicable.

(e) Any supporting data or any other data requested by a jurisdiction to verify reported emissions or recognition for early action

Not applicable.

(f) Mercury speciation

Table 4-16 TransAlta plants mercury speciation

Facility	Year	Elemental %	Oxidized %	Particulate %
Sundance 3/4	2017	77.79	7.34	14.87
Sundance 5/6	2017	82.56	6.56	10.88
Keephills 1/2	2017	93.57	2.95	3.49
Keephills 3	2018	93.90	4.09	2.01

(g) Mercury content of coal

Table 4-17 TransAlta mercury content of coal, 2017 and 2018

	Sundance 1/2	Sundance 3/4	Sundance 5/6	Keephills 1/2	Keephills 3	Total (kg)
Year	Hg content in coal (kg)	Hg content in coal (kg)	Hg content in coal (kg)	Hg content in coal (kg)	Hg content in coal (kg)	
2017	42.55	122.69	138.19	133.28	56.48	493.19
2018	N/A	35.88	41.29	140.02	59.79	276.98

(h) Mercury content of coal combustion residues, the mass amounts (kg) of these coal combustion residues and the means used to manage the disposal of these residues, e.g., to landfill, for sale for cement, etc.

Table 4-18 TransAlta mercury content of coal combustion residues, 2017 and 2018

	Sundance 1/2	Sundance 3/4	Sundance 5/6	Keephills 1/2	Keephills 3	Total (kg)
Year	Captured content (Hg)	Captured content (Hg)	Captured content (Hg)	Captured content (Hg)	Captured content (Hg)	
2017	35.43	99.84	115.96	107.86	49.14	408.23
2018	N/A	29.06	34.23	115.27	51.91	230.47

- At Sundance approximately 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 has approval has developed a dry ash haul system for the plant which is currently in use. All ash from the Keephills Unit 3 facility is disposed of by truck in the Highvale mine.

4.2 Manitoba

Manitoba has only 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 operations to use coal and generate power only to support emergency operations.

Information for 2017 and 2018 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 0.778 kilograms (2017) and 0.055 kilogram (2018) mercury are well within its 2010 cap of 20 kilograms per year. The last combustion took place in July 2018 and operation of the facility was discontinued.

Table 4-19 Mercury emissions from Manitoba facilities broken down by stack, 2017 and 2018

	Total Mass Mercury					
Facility	Emissions (kg)		In coal burned (kg)		Retained in ash and residue (kg)	
	2017	2018	2017	2018	2017	2018
Brandon Unit 5	0.778	0.055			0.027	0.003

4.2.1 Brandon Generating Station

(a) Annual emissions of total mercury from each coal-fired EPG plant (kg/year)

Table 4-20 Brandon Unit 5 annual emission of total mercury, 2003–2018

Year	Hg emissions to air (kg)
2003	20.122
2008	9.575
2009	2.822
2010	1.16
2011	1.01
2012	1.22
2013	1.868
2014	1.442
2015	1.938
2016	0.578
2017	0.778
2018	0.055

(b) Capture rates (percent capture in coal burned) or emission limits (kg/TWh) for each new EPG unit

This is not a requirement as Brandon Unit 5 is not a new generating unit. However, the percent mercury capture rate for 2017 was 4.40% and for 2018 was 6.36%.

(c) Monitoring methods used for all parameters

Manitoba Hydro utilizes the Mass Balance method of determining total annual mercury emissions. Mass balance calculations are made following the UDCP guide for mercury from coal-fired electric power generation.

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 submitted to Manitoba Conservation entitled *Manitoba Hydro Brandon Generating Station Site Specific Test Plan for Mercury in Coal, Ash and 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 (when possible). Bottom ash samples were not obtained in 2017 and 2018 due to the low mercury ash content levels in 2008. The weekly coal and residue sampling program employs the following test methods.

Table 4-21 Applicable reference methods for 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 Sulfur 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*

Table 4-22 Applicable reference methods for fly ash

Topic	Standard	Title
Sampling	No standard	N/A
Sample preparation	No standard*	N/A
% 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 Total Sulfur in Coal and Coke Combustion Residues Using a High-Temperature Tube Furnace Combustion Method with Infrared Absorption*

*Recommended size reduction is 150 µm (No. 100 U.S. standard sieve)

Table 4-23 Applicable reference methods for bottom ash

Topic	Standard	Title
Sampling	No standard	N/A
Sample preparation	No standard*	N/A
Mercury	ASTM D6722	*Standard Test Method for Total Mercury in Coal and Coal Combustion Residues by Direct Combustion Analysis*

*Recommended size reduction is 150 µm (No. 100 U.S. standard sieve)

(d) Justification of alternative methods

No alternative methodologies are employed by Manitoba Hydro for the determination of total annual mercury emissions.

(e) Any supporting data or any other data requested by a jurisdiction to verify reported emissions or recognition for early action

This is not a requirement, as Manitoba Sustainable Development did not receive any requests for supporting data.

(f) Mercury speciation

No speciation was performed in 2017 and 2018, as stack testing was not conducted.

(g) Mercury content of coal and mass amount

The mercury content of the coal during the 2017 calendar year (weekly sampling periods) ranged between 0.045 and 0.075 parts per million (ppm) with an average of 0.063 (the weighted average mercury content was 0.063 ppm). The mass amount of mercury in the coal was 0.805 kilograms.

The mercury content of the coal during the 2018 calendar year (weekly sampling periods) ranged between 0.023 and 0.030 parts per million (ppm) with an average of 0.026 (the weighted average mercury content was 0.024 ppm). The mass amount of mercury in the coal was 0.060 kilograms.

(h) Mercury content of coal combustion residues, the mass amounts (kg) of these coal combustion residues and the means used to manage the disposal of these residues (e.g., to landfill, for sale for cement)

Table 4-24 and Table 4-25 show the coal combustion residue mercury content and mass amounts for 2017 and 2018.

Table 4-24 Brandon coal combustion residue mercury content and mass amounts, 2017

Coal combustion residue type	Number of samples	Hg content (ppm)	Average (ppm)	Mass amounts (tonnes)	Total Hg released in the ash (kg)
Fly ash	9	0.019 to 0.140	0.049	548	0.027
Bottom ash	0	0	0	183	Negligible

Table 4-25 Brandon coal combustion residue mercury content and mass amounts, 2018

Coal combustion residue type	Number of samples	Hg content (ppm)	Average (ppm)	Mass amounts (tonnes)	Total Hg released in the ash (kg)
Fly ash	4	0.009 to 0.030	0.022	100	0.003
Bottom ash	0	0	0	34	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 0.027 kilogram (2017) and 0.003 kilogram (2018) (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 both 2017 and 2018.

4.3 New Brunswick

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

Table 4-26 Mercury emissions from New Brunswick facility, 2017 and 2018

Facility	Total Mass Mercury					
	Emissions (kg)		In coal burned (kg)		Retained in ash and residue (kg)	
	2017	2018	2017	2018	2017	2018
Belledune Generating Station	12	15	28	34	16	19

4.3.1 Grand Lake and Belledune Generating Stations

Through the CWS, New Brunswick 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 emissions of total mercury from each coal-fired EPG plant (kg/year)

Table 4-27 Annual emissions of mercury from Belledune and Grand Lake, 2000–2018

	Belledune	Grand Lake	Total
Year	Hg emissions to air (kg)	Hg emissions to air (kg)	Hg emissions to air (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
2015	13	0	13
2016	17	0	17
2017	12	0	12
2018	15	0	15

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

(b) Capture rates (percent capture in coal burned) or emission limits (kg/TWh) for each new EPG unit

Not applicable.

(c) Monitoring methods used for all parameters

Stack testing and mass balance.

(d) Justification for alternative methods

Not applicable.

(e) Any supporting data or any other data requested by a jurisdiction to verify reported emissions or recognition for early action

Not applicable.

(f) Mercury speciation

Table 4-28 Comparison of mercury stack test results at the Belledune Generating Station, 2000–2017

Parameter	Year						
	2000	2004	2008	2010	2011	2013	2017
Mercury emission rate (g/hr)	5.47	2.13	2.12	3.75	2.70	2.24	0.649
Fuel flow during testing (kg/hr)	158,050	161,700	166,139	163,851	121,700	176,100	160,886
Mercury concentration in fuel (mg/kg)	0.09	0.033	0.020	0.030	0.044	0.026	0.053
Particulate-bound mercury (%)	0.00	3.00	0.50	0.10	0.80	0.07	N/A*
Oxidized mercury (%)	21.50	16.00	16.20	4.50	2.60	3.34	N/A*
Elemental mercury (%)	78.50	81.00	83.20	95.40	96.20	96.60	N/A*

*The speciation of mercury was not completed, as the stack testing was conducted in accordance with US EPA Method 29, Determination of Metals from Stationary Sources.

Table 4-29 Comparison of mercury stack test results at the Grand Lake Generating Station, 2000 and 2003

Parameter	Year	
	2000	2003
Mercury emission rate (g/hr)	14.8	16.29
Fuel flow during testing (kg/hr)	22,007	23,350
Mercury concentration in fuel (mg/kg)	0.5	0.62
Particulate-bound mercury (%)	1.73	0.25
Oxidized mercury (%)	58.73	78.83
Elemental mercury (%)	39.55	20.92

(g) Mercury content of coal

Table 4-30 Mercury content of coal at Belledune Generating Station, 2003–2018

Year	Fuel consumption (tonnes)	Average Hg concentration in fuel (mg/kg)	Mass of Hg in fuel (kg)
2003	1,387,879	0.050	69
2006	1,213,418	0.021	25
2007	1,199,772	0.018	22
2008	1,286,804	0.018	23
2009	1,321,536	0.040	53
2010	1,160,329	0.045	52
2011	1,209,990	0.036	44
2012	951,627	0.031	30
2013	1,166,532	0.029	34
2014	1,183,712	0.029	34
2015	897,361	0.034	31
2016	1,173,255	0.033	39
2017	1,043,060	0.027	28
2018	1,186,221	0.029	34

Table 4-31 Mercury content of coal at Grand Lake Generating Station

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

(h) Mercury content of coal combustion residues, the mass amounts (kg) of these coal combustion residues and the means used to manage the disposal of these residues (e.g., to landfill, for sale for cement)

Table 4-32 Belledune Generating Station combustion residue and mercury amounts, 2008–2018

Year	Combustion residue	Quantity of residue (tonnes)*	Average Hg concentration in residue (mg/kg)*	Mass of Hg in residue (kg)	Destination/disposal of residue
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
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
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
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
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
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
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
2015	Gypsum	89,548	0.093	8.33	Wallboard manufacturing
	Gypsum	864	0.093	0.08	Landfill
	Bottom ash	252	0.008	0.002	Landfill
2016	FGD blowdown	6,180 hrs	1.41 g/hr	8.7	Coal sediment pond
	Fly ash	36,786	0.0367	1.35	Concrete additive
	Fly ash	9,073	0.0367	0.33	Landfill
	Gypsum	125,772	0.113	14.21	Wallboard manufacturing
	Bottom ash	29,773	0.0037	0.110	Landfill
	Coal sediment pond sludge	8,438 hrs	1.41 g/hr	11.9	Landfill
	Fly ash	44,284	0.024	1.063	Concrete additive

Year	Combustion residue	Quantity of residue (tonnes)*	Average Hg concentration in residue (mg/kg)*	Mass of Hg in residue (kg)	Destination/disposal of residue
2017	Gypsum	99,208	0.11	10.91	Wallboard manufacturing
	Bottom Ash	23,629	0.0072	0.17	Landfill
	WWTP Sludge	253	3.2	0.81	Landfill
	Fly Ash	38,493	0.031	1.19	Concrete Additive
	Fly Ash	18,099	0.031	0.56	Landfill
2018	Gypsum	132,218	0.1258	16.64	Wallboard manufacturing
	Bottom Ash	40,419	0.0189	0.76	Landfill
	WWTP Sludge	204	2.05	0.42	Landfill
	Fly Ash	39,340	0.0236	0.93	Concrete Additive
	Fly Ash	23,533	0.0236	0.56	Landfill

* unless otherwise specified

** Emission rate of Hg in FGD Blowdown and Coal sediment pond Sludge (g/hr) was determined during stack emissions testing program and multiplied by the number of hours the FGD was in service for the year to determine the mass of Hg in the FGD Blowdown.

Table 4-33 Grand Lake Generating Station combustion residue, 2008–2010

Year	Combustion residue	Quantity of residue (tonnes)	Average Hg concentration in residue (mg/kg)	Mass of Hg in residue (kg)	Destination/disposal of residue
2008	Bottom ash	2,799	<0.01	0.00	Landfill
	Fly ash	11,195	0.01	0.66	Landfill
2009	Bottom ash	6,249	<0.01	0.00	Landfill
	Fly ash	24,997	0.01	1.70	Landfill
2010	Bottom ash	803	<0.01	0.00	Landfill
	Fly ash	3,210	0.01	0.03	Landfill

4.4 Nova Scotia

Nova Scotia has amended its provincial Air Quality Regulations to extend the achievement date of the 65 kg cap from 2010 to 2014, with annual declining emission caps from 2010 to 2013. These over-emissions are required to be made up by the end of 2020. In addition, the province has established a cap of 35 kg in 2020. Table 4-4 shows the annual emission allocations under provincial regulation for 2010 to 2020.

Table 4-34 Nova Scotia annual emission allocations, 2010–2020

Year	Hg emission cap (kg)
2010	110
2011	100
2012	100
2013	85
2014	65
2020	35

Table 4-35 Mercury emissions from Nova Scotia facilities, 2017 and 2018

Facility	Total Mass Mercury					
	Emissions (kg)		In coal burned (kg)		Retained in ash and residue (kg)	
	2017	2018	2017	2018	2017	2018
Lingan Unit 1	7.4	6.1	14.8	13.0	7.4	6.9
Lingan Unit 2	5.1	6.2	7.1	9.7	2.0	3.5
Lingan Unit 3	11.2	7.0	19.3	14.6	8.1	7.6
Lingan Unit 4	8.6	10.4	13.9	17.9	5.3	7.5
Point Aconi Unit 1	5.9	9.4	16.3	19.7	10.5	10.3
Point Tupper Unit 2	11.6	12.4	20.0	23.1	8.4	10.7
Trenton Unit 5	4.7	2.2	19.6	12.4	15.0	10.2
Trenton Unit 6	11.4	9.6	17.9	17.8	6.5	8.2

4.4.1 Lingan, Point Aconi, Point Tupper and Trenton Generating Stations

(a) Annual emissions of total mercury from each coal-fired EPG plant (kg/year)

Table 4-36 Nova Scotia annual emissions of mercury, 2008–2018

Year	Lingan	Point Aconi	Point Tupper	Trenton	Total
	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)
2008	95.0	2.9	24.0	40.0	163.0
2009	92.0	2.7	16.5	28.8	140.0
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
2015	28.7	1.9	8.0	16.3	55.0
2016	31.8	5.4	11.6	11.6	60.5
2017	32.3	5.9	11.6	16.1	65.9
2018	29.8	9.4	12.4	11.8	63.4

*2009 and 2017 NPRI vary slightly from values submitted to NS Environment. The values submitted to NSE are taken as the correct values. The 2018 data are not yet available on NPRI.

(b) Capture rates (percent capture in coal burned) or emission limits (kg/TWh) for each new EPG unit

Applies to new units only; not applicable.

(c) Monitoring methods used for all parameters

Mass balance was used to calculate mercury emissions from all units with the exception of Trenton Unit 5 which utilizes CEMS for emissions measurement.

(d) Justification for alternative methods

Not applicable.

(e) Any supporting data or any other data requested by a jurisdiction to verify reported emissions or recognition for early action

Not applicable.

(f) Mercury speciation

Table 4-37 Nova Scotia mercury speciation, 2017

	Oxidized (%)	Elemental (%)	Particulate-bound (%)
Lingan 1/2	55.7	44.1	0.258
Lingan 3/4	55.0	44.6	0.468
Trenton 5	93.2	3.33	3.48
Trenton 6	49.0	50.9	0.102
Point Tupper	59.4	40.5	0.0884
Point Aconi	49.3	50.4	0.292

*Based on annual stack test

Table 4-38 Nova Scotia Mercury speciation, 2018

	Oxidized (%)	Elemental (%)	Particulate-bound (%)
Lingan 1/2	72.5	27.4	0.109
Lingan 3/4*	50.4	49.4	0.169
Trenton 5	60.7	7.7	31.6
Trenton 6	49.7	50.2	0.155
Point Tupper	45.2	54.2	0.633
Point Aconi	49.5	50.3	0.200

*Based on annual stack test

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(g) Mercury content of coal

Table 4-39 Nova Scotia total mercury content of coal, 2017 and 2018 (kg*)

	2017	2018
Lingan	22.8	25.5
Point Aconi**	10.5	10.3
Trenton	21.5	18.4
Point Tupper	8.4	10.7
Total	**63.2**	**64.9**

*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) Mercury content of coal combustion residues, the mass amounts (kg) of these coal combustion residues and the means used to manage the disposal of these residues (e.g., to landfill, for sale for cement)

Table 4-40 Nova Scotia mercury content of coal combustion residues, 2017

	Sales (kg)	Landfill (kg)	Total (kg)
Lingan	0.0	22.8	22.8
Point Aconi	0.0	10.5	10.5
Trenton	5.2	16.3	21.5
Point Tupper	0.0	8.4	8.4
Total	5.2	58.0	63.2

Table 4-41 Nova Scotia mercury content of coal combustion residues in 2018

	Sales (kg)	Landfill (kg)	Total (kg)
Lingan	0.0	25.5	25.5
Point Aconi	0.0	10.3	10.3
Trenton	7.4	11.0	18.4
Point Tupper	0.3	10.4	10.7
Total	7.7	57.2	64.9

4.5 Ontario

Ontario phased out the use of coal for EPG in 2014. Ontario's mercury emissions for 2017 and 2018 were 0 kg.

4.6 Saskatchewan

In accordance with Saskatchewan's commitment to the CWSs for mercury, the Saskatchewan Ministry of Environment (ministry) and SaskPower reached an agreement on monitoring mercury emissions from SaskPower's coal-fired power plants. With the application of credits for early action, Saskatchewan achieved its emissions cap in 2010 - 2013.

Table 4-42 Mercury emissions from Saskatchewan facilities, 2017 and 2018

	Total Mass Mercury					
Facility	Emissions (kg)		In coal burned (kg)		Retained in ash and residue (kg)	
	2017	2018	2017	2018	2017	2018
Boundary Dam	203.4	234.43	216.4	250.90	13.0	16.47
Poplar River	132.2	140.40	357.6	338.41	225.4	198.00
Shand	53.8	37.22	132.0	92.46	78.3	55.24

4.6.1 Boundary Dam, Poplar River and Shand Power Stations

(a) Annual emissions of total mercury from each coal-fired EPG plant

Table 4-43 Saskatchewan annual emission of mercury, 2017 and 2018

Facility	2017 mass Hg emissions to air (kg)	2018 mass Hg emissions to air (kg)
Boundary Dam Power Station Unit 1	N/A	N/A
Boundary Dam Power Station Unit 2	N/A	N/A
Boundary Dam Power Station Unit 3	41.18	44.18
Boundary Dam Power Station Unit 4	38.55	48.28
Boundary Dam Power Station Unit 5	40.11	54.37
Boundary Dam Power Station Unit 6	83.60	87.60
Total for Boundary Dam Power Station	**203.44**	**234.43**
Poplar River Power Station Unit 1	60.57	72.21
Poplar River Power Station Unit 2	71.63	68.19
Total for Poplar River Power Station	**132.20**	**140.40**
Shand Power Station Unit 1	53.75	37.22
Total for Shand Power Station	**53.75**	**37.22**
Total for SaskPower *	**389.38**	**412.05**

Note: Boundary Dam Power Station Units 1 and 2 retired in 2013 and 2014 respectively.
* Total may not add up due to rounding.

(b) Capture rates (percent capture in coal burned) for each EPG unit

Table 4-44 Saskatchewan annual mercury capture rate, 2017 and 2018

Facility	Hg captured 2017 (%)	Hg captured 2018 (%)
Boundary Dam Power Station Unit 1	N/A	N/A
Boundary Dam Power Station Unit 2	N/A	N/A
Boundary Dam Power Station Unit 3	5.7	6.6
Boundary Dam Power Station Unit 4	5.7	6.6
Boundary Dam Power Station Unit 5	5.7	6.6
Boundary Dam Power Station Unit 6	5.7	6.6
Average for Boundary Dam Power Station	**5.7**	**6.6**
Poplar River Power Station Unit 1	65.8	56.3
Poplar River Power Station Unit 2	60.1	60.7
Average for Poplar River Power Station	**63.0**	**58.5**
Shand Power Station Unit 1	59.3	59.7
Average for Shand Power Station	**59.3**	**59.7**
Average for SaskPower*	**44.8**	**39.6**

* The corporate averages for mercury captured are not always the same as the average of the individual coal units, as the averages are essentially weighted by the amount of coal being fed to each unit.

The percentage of mercury captured from Boundary Dam Units 3–6 is the same because Units 3–6 burn the same coal and have a common silo for fly ash sampling.

(c) Emission rates for each EPG unit (kg/TWh)

Table 4-45 Saskatchewan mercury emission rate by unit, 2017 and 2018

Facility	kg/TWh 2017	kg/TWh 2018
Boundary Dam Power Station Unit 1	N/A	N/A
Boundary Dam Power Station Unit 2	N/A	N/A
Boundary Dam Power Station Unit 3	37.6	46.0
Boundary Dam Power Station Unit 4	40.7	46.1
Boundary Dam Power Station Unit 5	37.9	46.0
Boundary Dam Power Station Unit 6	35.8	42.9
Average for Boundary Dam Power Station	**37.4**	**44.8**
Poplar River Power Station Unit 1	28.7	35.9
Poplar River Power Station Unit 2	34.6	32.7
Average for Poplar River Power Station	**31.6**	**34.3**
Shand Power Station Unit 1	22.8	18.2
Average for Shand Power Station	**22.8**	**18.2**

(d) 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 the ministry worked together to determine the mercury inventories from SaskPower's coal-fired units during the development of the CWSs for mercury. Any modifications from the previously used methods are based on the requirements of the agreement between the ministry 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).

(e) Any supporting data or any other data requested by a jurisdiction to verify reported emissions or recognition for early action

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.

Table 4-46 SaskPower mercury collected, 2003–2018

	Kilograms of mercury		
Year	**Mercury Collected from Mercury Switches**	**Mercury Collected from Other Sources (non-eligible for credits)**	**Total Mercury Collected**
2003/2004	48.5680	0.0	48.5680
2005	52.5695	0.0	52.5695
2006	36.2759	6.2100	42.4859
2007	41.6000	10.1220	51.7220
2008	29.5410	13.4730	43.0140
2009	37.6740	6.2910	43.9650
2010	26.8880	1.4160	28.3040
2011	15.7010	3.9120	19.6130
2012	18.7230	1.0230	19.7460
2013	15.2350	0.0	15.2350
2014	8.4140	0.0	8.4140
2015	9.2130	0.0	9.2130
2016	6.6570	0.0	6.6570
2017	6.1300	0.0	6.1300
2018	3.8620	0.0	3.8620
Total	**357.0514**	**42.4470**	**399.4984**

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 for 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 (ECRF) in 2004, where selected technologies can be assessed for their capability to remove mercury from a slipstream of Poplar River's flue gas. Other significant activities for mercury removal from Poplar River included:

- 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.
- Canada's first permanent mercury control system was installed for both units of Poplar River in 2009.

Table 4-47 summarizes the changes in mercury emissions at Poplar River from 2003 to 2009.

Table 4-47 Changes in mercury emissions at Poplar River, 2003–2009

Year	Baseline Mercury Emissions (kg)	Mercury Emissions (kg)	Reduction in Mercury Emissions (kg)
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	310.71	-12.89
2008	297.82	240.20	57.62
2009	297.82	308.96	-11.14
Total	**2084.74**	**1955.72**	**129.02**

(f) Mercury speciation

In accordance with the draft MOU on mercury monitoring between the ministry and SaskPower, SaskPower has conducted annual speciated mercury testing at all of its stacks annually from 2009 to 2012. In 2012 the ministry agreed to change the speciated mercury testing to once every three years. Table 4-48 summarizes the average test results from 2009 to 2013.

Table 4-48 Saskatchewan average test results, 2009–2013

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 and 2	8.78	25.56	65.48
Shand	1	0.69	6.49	92.88

Table 4-49 and 4-50 show stack testing results (Ontario Hydro Method) for SaskPower's Boundary Dam Power Station and Poplar River Power Station for 2017 and 2018.

Table 4-49 Stack test results, 2017 (Ontario Hydro Method)

Unit	Test	Particle Bound		Oxidized		Elemental		Total	
		µg/m³	%	µg/m³	%	µg/m³	%	µg/m³	%
BD4	**May 2017 - RWDI#1702678**	0.02	0.23%	0.86	7.98%	9.86	91.80%	10.7	100%
BD5		0.17	1.50%	1.24	11.01%	9.85	87.49%	11.3	100%
BD6		0.04	0.50%	0.68	8.54%	7.28	90.96%	8.0	100%

Table 4-50 Stack test results, 2018 (Ontario Hydro Method)

Unit	Test	Particle Bound		Oxidized		Elemental		Total	
		µg/m³	%	µg/m³	%	µg/m³	%	µg/m³	%
PR1 and PR2	**Sept. 2018 - RWDI#1802400**	1.96	19.03%	1.92	18.66%	6.40	62.31%	10.3	100%

(g) Mercury content of coal (kg)

Table 4-51 Saskatchewan amount of mercury in coal, 2017 and 2018

	2017	2018
Boundary Dam Power Station Unit 3	43.80	47.28
Boundary Dam Power Station Unit 4	41.01	51.67
Boundary Dam Power Station Unit 5	42.67	58.18
Boundary Dam Power Station Unit 6	88.94	93.76
Total for Boundary Dam Power Station	**216.42**	**250.90**
Poplar River Power Station Unit 1	177.80	165.11
Poplar River Power Station Unit 2	179.75	173.30
Total for Poplar River Power Station	**357.55**	**338.41**
Shand Power Station Unit 1	132.05	92.46
Total for Shand Power Station	**132.05**	**92.46**
Total for SaskPower *	**706.02**	**681.77**

* Total may not add up due to rounding.

h) Amount of mercury retained in fly ash (kg)

Table 4-52 Saskatchewan amount of mercury retained in fly ash, 2017 and 2018

	2017	2018
Boundary Dam Power Station Unit 3	2.52	2.98
Boundary Dam Power Station Unit 4	2.36	3.26
Boundary Dam Power Station Unit 5	2.45	3.67
Boundary Dam Power Station Unit 6	5.11	5.91
Total for Boundary Dam Power Station	**12.44**	**15.82**
Poplar River Power Station Unit 1	117.07	92.74
Poplar River Power Station Unit 2	107.96	104.96
Total for Poplar River Power Station	**225.03**	**197.70**
Shand Power Station Unit 1	78.30	55.24
Total for Shand Power Station	**78.30**	**55.24**
Total for SaskPower *	**315.76**	**268.76**

* Total may not add up due to rounding.

i) Amount of mercury retained in bottom ash (kg)

Table 4-53 Saskatchewan amount of mercury retained in bottom ash, 2017 and 2018

	2017	2018
Boundary Dam Power Station Unit 3	0.11	0.12
Boundary Dam Power Station Unit 4	0.10	0.14
Boundary Dam Power Station Unit 5	0.11	0.15
Boundary Dam Power Station Unit 6	0.22	0.24
Total for Boundary Dam Power Station	**0.55**	**0.65**
Poplar River Power Station Unit 1	0.16	0.15
Poplar River Power Station Unit 2	0.17	0.16
Total for Poplar River Power Station	**0.33**	**0.31**
Shand Power Station Unit 1	0.00	0.00
Total for Shand Power Station	**0.00**	**0.00**
Total for SaskPower *	**0.88**	**0.96**

* Total may not add up due to rounding.

k) Amount of coal combustion residues and means to manage their disposal (Mg)

Table 4-54 Saskatchewan amount of coal combustion residues, 2017 and 2018

	2017	2018
Boundary Dam Power Station Unit 3	91,993	101,974
Boundary Dam Power Station Unit 4	86,120	111,435
Boundary Dam Power Station Unit 5	89,609	125,482
Boundary Dam Power Station Unit 6	186,782	202,198
Total for Boundary Dam Power Station	**454,503**	**541,089**
Poplar River Power Station Unit 1	250,163	227,874
Poplar River Power Station Unit 2	252,905	239,185
Total for Poplar River Power Station	**503,069**	**467,059**
Shand Power Station Unit 1	246,272	199,065
Total for Shand Power Station	**246,272**	**199,065**
Total for SaskPower *	**1,203,844**	**1,207,213**

* Total may not add up due to rounding.

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. At Shand, fly ash and bottom ash are dry hauled to a dedicated placement site that is designed to minimize any contact with water. A portion of fly ash at Boundary Dam and Shand is recycled for utilization by other industries such as cement manufacturing.

Roughly 37% of the ash produced at Boundary Dam was utilized in 2017, which is similar to the sales in 2016. Roughly 30% of the ash produced at Boundary Dam was utilized in 2018.

The 2017 fly ash utilization at Shand was roughly 2% which is lower than 2016 sales. The 2018 fly ash utilization at Shand was roughly 10% which is higher than 2017 sales.

5.0 REFERENCES

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