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

2019–2020 Progress Report

PN 1637
ISBN 978-1-77202-087-8 PDF

TABLE OF CONTENTS

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
Ministry	Saskatchewan Ministry of Environment
NPRI	National Pollutant Release Inventory
ppm	parts per million
QA/QC	quality assurance and quality control
RATA	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 2020, 481.89 kg of mercury were emitted, and the total mercury contained in the coal burned was 999.63 kg, representing a capture rate of 52%. The caps have been achieved and represent an 82% reduction in total emissions from 2003 compared to the 2010 emission caps which were expected to produce a 52–58% reduction in total emissions. CCME continued to report on progress after the goal for emissions reduction had been achieved and this will be the final report.

2.0 SUMMARY

In 2019 575.15 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.

In 2020 481.89 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 2020, 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, 2008–2020

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	398.4	**620.17**
2018	97.58	0.055	15	63.4	0.00	412.05	**588.06**
2019	89.93	0.00	11	59.0	0.00	415.22	**575.15**
2020	67.24	0.00	6	59.7	0.00	348.95	**481.89**
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.

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 continued until 2020 and this is the final report.

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 2020, Alberta had six coal-fired power plant facilities:

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

Table 4-1 shows mercury emissions from Alberta facilities.

Table 4-1 Mercury emissions from Alberta facilities broken down by stack, 2019 and 2020

	Total Mass Mercury					
Facility	**Emissions (kg)**		**In coal burned (kg)**		**Retained in ash and residue (kg)**	
	2019	**2020**	**2019**	**2020**	**2019**	**2020**
Battle River	7.4	1.0	38.3	3.6	33.6	2.3
Genesee 1/2 Stack 1	11.92	13.95	86.15	84.15	74.15	74.03
Genesee 3 Stack 2	7.79	6.78	83.55	84.49	39.58	36.94
H. R. Milner	0.995	0.005	2.86	0.003	4.21	0.003
Keephills 1/2	15.60	15.72	81.92	99.75	66.32	84.03
Keephills 3	4.84	9.51	41.43	46.94	36.58	37.43
Sheerness	23.10	13.88	123.29	49.14	100.19	35.26
Sundance 3/4	8.00	4.23	11.33	8.83	3.34	4.60
Sundance 5/6	10.28	2.16	19.29	4.85	9.01	2.69
Totals	89.93	67.24	488.12	381.75	366.98	277.28

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, 2019 and 2020

	Battle River	Total (kg)
2019	7.4 (CEMS)	7.4
2020	1.0 (CEMS)	1.0

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

- 2019: Stack Testing and Flow Monitoring (CEMS)
- 2020: 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, 2019 and 2020

Year	Stack	Elemental Hg (%)*	Oxidized Hg (%)	Particulate Hg (%)
2019	B	No Ontario Hydro completed in 2019		
	C			
2020	B	77.07	22.86	0.07
	C	97.93	1.12	0.95

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

(g) Mercury content of coal

2019:

- Mercury Content – 38.3 kg (43.4 ppb)
- Coal Mass Burned (dry) – 887,474,000 kg

2020:

- Mercury Content – 2.4 kg (37.9 ppb)
- Coal Mass Burned (dry) – 67,523,000 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)

Table 4-4 Battle River Combustion Residues Mercury Content, Mass and Management Method, 2019 and 2020

Year	Residue	Kilograms (dry)	Mercury (ppb)	Disposal
2019	Raw fly ash	135,973,000	254	Marketed & Landfill
	Bottom ash	46,421,000	3.6	Landfill
2020	Raw fly ash	11,487,000	198	Marketed & Landfill
	Bottom ash	15,042,000	8.5	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, 2011–2020

	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
2019	11.92	7.79	19.71
2020	13.95	6.78	20.73

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

Table 4-6 Genesee mercury capture rates, 2011-2020

	Genesee 1/2	Genesee 3
Year	*Capture rates*	*Capture rates*
2011	74.37	80.4
2012	77.71	75.2
2013	80.10	84.05
2014	82.23	86.50
2015	80.51	88.11
2016	81.81	84.29
2017	84.94	86.22
2018	86.35	84.46
2019	86.15	83.55
2020	84.15	84.49

(c) Monitoring methods used for all parameters in from 2011 to 2020

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) for 2019 and 2020:

On March 12, July 30 and 31, 2019 Maxxam Analytics conducted a Compliance Survey and RATA of the Stack 1 Mercury CEMS. On July 8, October 20 and 21, 2020 BV Labs (formerly 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 12 and August 1, 2019 BV Labs conducted a Compliance Survey and RATA of the Stack 2 Mercury CEMS. On July 7 and December 8, 2020 BV Labs 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.

On August 17, 18 and 19 2020 BV Labs conducted a source emission survey on Unit 1/2 (Stack 1) at Genesee for mercury speciation in flue gas. Stack testing was conducted in accordance with the requirements of the Ontario Hydro Method.

On September 22 and 23 2020 BV Labs conducted a source emission survey on Unit 3 (Stack 2) at Genesee for mercury speciation in flue gas. Stack testing was conducted in accordance with the requirements of the Ontario Hydro Method. Results are shown in table 4-7.

Table 4-7 Genesee source emission survey

Stack	Date	Elemental Hg (%)	Oxidized Hg (%)	Particulate Hg (%)
1	August 2020	86.92	11.80	1.27
2	September 2020	96.89	0	3.11

(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 4-8 Genesee Unit 1 and 2 residue, 2019 and 2020

Year		Sold		Returned to mine		Total (10^3 kg)
		10^3 kg	%	10^3 kg	%	
2019	Fly ash	197,000	59.6	133,600	40.4	330,600
	Bottom ash	0	0	196,102	100	196,102
2020	Fly ash	260,300	704	109,500	29.6	369,800
	Bottom ash	0	0	205,000	100	205,000

Table 4-9 Genesee Unit 3 residue, 2019 and 2020

Year		Sold		Returned to mine		Total (10^3 kg)
		10^3 kg	%	10^3 kg	%	
2019	Fly ash	25,660	10.1	229,280	89.9	254,940
	Bottom ash	0	0	113,361	100	113,361
2020	Fly ash	0	0	263,400	100	263,400
	Bottom ash	0	0	109,800	100	109,800

4.1.3 H.R. Milner Generating Station

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

Table 4-10 Annual emissions from H.R. Milner Generating Station, 2019 and 2020

Year	Hg emissions to air (kg)	Total (kg)
2019	0.995	0.995
2020	0.005	0.005

(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

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 period the sample represents. In 2020, due to low volumes of coal burned, the total mass of ash was estimated based on historical values.

Using this methodology, it was calculated that the total mercury in ash residues was greater than the total mercury in coal, therefore 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 gross generation during the period in which coal was burned to determine the total releases to air. Note that 2018 stack testing data was used since mercury emissions testing was not performed in 2019 or 2020.

(d) Justification for alternative methods

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

The final stack testing (and thus mercury speciation) was performed on August 15, 2018. The amount of coal burned since then has been very low and did not warrant testing.

(g) Mercury content of coal

- 2019 – 2.860 kg
- 2020 – 0.003 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.

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 4.21 kg for 2019 and 0.003 kg for 2020.

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, 2019 and 2020

Year	Hg emissions to air (kg)	Total (kg)
2019	23.10	23.10
2020	13.88	13.88

(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 2019 or 2020.

Other equivalent method

- Mercury emissions were determined by the Hg CEMS in 2019 and 2020.
- 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

- Description of the general steps taken
- 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 (December 4 – 5, 2019)

Parameter	Unit	Average
Temperature	°C	162.92
Particulate mercury	g/hr	0.0314
Oxidized mercury	g/hr	0.2174
Elemental mercury	g/hr	0.8597
Total mercury	g/hr	1.1085

(g) Mercury content of coal

- 2019: 123.29 kg of Hg
- 2020: 49.14 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, 2019 and 2020

Year	Residues	Tonnes (dry)	Mercury (kg)	Disposal
2019	Sales fly ash	150,949	64.88	Recycled, concrete production
	Raw fly ash and bottom Ash	339,906	35.31	Engineered landfill
2020	Sales fly ash	85,755	12.43	Recycled, concrete production
	Raw fly ash and bottom ash	133,004	22.83	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, 2019 and 2020

	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)	
2019	8.00	10.28	15.60	4.84	38.72
2020	4.23	2.16	15.72	9.51	31.62

(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 3/4	Sundance 5/6	Keephills 1/2	Keephills 3
Year	*Intensity (kg/TWh)*	*Intensity (kg/TWh)*	*Intensity (kg/TWh)*	*Intensity (kg/TWh)*
2019	7.42	6.87	3.11	1.26
2020	5.51	3.80	3.34	2.84

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	Elemental %		Oxidized %		Particulate %	
	2019	2020	2019	2020	2019	2020
Sundance 3/4	70.58	N/A	28.78	N/A	0.64	N/A
Sundance 5/6	98.84	N/A	1.16	N/A	0.00	N/A
Keephills 1/2	91.93	N/A	0.31	N/A	7.76	N/A
Keephills 3	N/A	98.10	N/A	1.57	N/A	0.33

(g) Mercury content of coal

Table 4-17 TransAlta mercury content of coal, 2019 and 2020

Facility	Mass (kg)	
	2019	2020
Sundance 3/4	11.33	8.83
Sundance 5/6	19.29	4.85
Keephills 1/2	81.92	99.75
Keephills 3	41.43	46.94

(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, 2019 and 2020

Facility	Mass (kg)	
	2019	**2020**
Sundance 3/4	3.34	4.60
Sundance 5/6	9.01	2.69
Keephills 1/2	66.32	84.03
Keephills 3	36.58	37.43

- Sundance: In 2019 and 2020 approximately 75% of fly ash was sold for cement production. The remaining fly ash and bottom ash was disposed of in the Highvale mine.
- Keephills 1/2: In 2019 approximately 1% of fly ash was sold and in 2020 approximately 13% of fly ash was sold for cement production. The remaining ash was disposed of in the Keephills ash lagoon or in the Highvale Mine.
- Keephills 3: All ash produced by this facility is disposed of in the Highvale mine.

4.2 Manitoba

Manitoba phased out the use of coal for electricity generation in 2018. Manitoba's mercury emissions for 2019 and 2020 were 0 kg.

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.

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.

Table 4-19 Mercury emissions from New Brunswick facility, 2019 and 2020

	Total Mass Mercury					
Facility	**Emissions (kg)**		**In coal burned (kg)**		**Retained in ash and residue (kg)**	
	2019	**2020**	**2019**	**2020**	**2019**	**2020**
Belledune Generating Station	11	6	25	14	14	8

4.3.1 Belledune Generating Stations

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

Table 4-20 Annual emissions of mercury from Belledune and Grand Lake, 2000–2020

	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
2019	11	0	11
2020	6	0	6

* 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 4-21 Comparison of mercury stack test results at the Belledune Generating Station, 2000–2019

Parameter	Year							
	2000	2004	2008	2010	2011	2013	2017	2019
Mercury emission rate (g/hr)	5.47	2.13	2.12	3.75	2.70	2.24	0.649	1.27
Fuel flow during testing (kg/hr)	158,050	161,700	166,139	163,851	121,700	176,100	160,886	173,737
Mercury concentration in fuel (mg/kg)	0.09	0.033	0.020	0.030	0.044	0.026	0.053	0.030
Particulate-bound mercury (%)	0.00	3.00	0.50	0.10	0.80	0.07	N/A*	N/A*
Oxidized mercury (%)	21.50	16.00	16.20	4.50	2.60	3.34	N/A*	N/A*
Elemental mercury (%)	78.50	81.00	83.20	95.40	96.20	96.60	N/A*	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.

(g) Mercury content of coal

Table 4-22 Mercury content of coal at Belledune Generating Station, 2003–2020

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
2019	1,004,423	0.025	25
2020	653,978	0.022	14

(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 4-23 Belledune Generating Station combustion residue and mercury amounts, 2008–2020

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
2017	Gypsum	99,208	0.11	10.91	Wallboard manufacturing
	Bottom Ash	23,629	0.0072	0.17	Landfill

Year	Combustion residue	Quantity of residue (tonnes)*	Average Hg concentration in residue (mg/kg)*	Mass of Hg in residue (kg)	Destination/disposal of residue
	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
2019	Gypsum	105,968	0.0587	6.22	Wallboard Manufacturing
	Bottom ash	31,760	0.0041	0.13	Landfill
	Fly ash	43,490	0.0147	0.64	Concrete Additive
	Fly ash	3,100	0.1226	0.38	Landfill
	FGD blowdown	N/A	N/A	7.47	Coal Sedpond
2020	Gypsum	67,181	0.0487	3.27	Wallboard Manufacturing
	Bottom ash	20,581	0.0034	0.07	Landfill
	Fly ash	20,685	0.0116	0.24	Concrete Additive
	Fly ash	2,934	0.1022	0.30	Landfill
	FGD blowdown	N/A	N/A	3.93	Coal Sedpond

* Unless otherwise specified

** Emission rate of Hg in FGD Blowdown and Coal Sedpond 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.

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 4-24 shows the annual emission allocations under provincial regulation for 2010 to 2020.

Table 4-24 Nova Scotia annual emission allocations, 2010–2020

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

* NS Power is permitted to emit above the cap by a restricted amount if they previously earned credits for mercury they diverted away from the environment through other means.

Table 4-25 Mercury emissions from Nova Scotia facilities, 2019 and 2020

Facility	Total Mass Mercury					
	Emissions (kg)		In coal burned (kg)		Retained in ash and residue (kg)	
	2019	2020	2019	2020	2019	2020
Lingan Unit 1	6.2	6.8	19.1	20.9	12.9	14.1
Lingan Unit 2	7.7	8.3	13.7	13	6.0	4.7
Lingan Unit 3	7.5	7.6	16.1	16.8	8.6	9.2
Lingan Unit 4	9.9	10.9	17.2	20.9	7.3	10.0
Point Aconi Unit 1	6.1	7.4	13.4	14.4	7.3	7.0
Point Tupper Unit 2	6.6	7.1	19.7	13.9	13.1	6.8
Trenton Unit 5	6.1	2.0	16.3	7.2	10.2	5.2
Trenton Unit 6	8.9	9.5	19.8	23.9	10.9	14.4

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 4-26 Nova Scotia annual emissions of mercury, 2008–2020

	Lingan	Point Aconi	Point Tupper	Trenton	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)
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
2019	31.3	6.1	6.6	15.0	59.0
2020	33.7	7.4	7.1	11.5	59.7**

*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.
** NS Power is permitted to emit above the cap by a restricted amount if they previously earned credits for mercury they diverted away from the environment through other means.

(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

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 4-27 Nova Scotia mercury speciation, 2019*

	Oxidized (%)	Elemental (%)	Particulate-bound (%)
Lingan 1/2	60.7	38.7	0.57
Lingan 3/4	73.0	26.7	0.32
Trenton 5	82.4	11.6	5.92
Trenton 6	53.1	46.4	0.53
Point Tupper	33.7	55.2	12
Point Aconi	35.6	64.3	0.29

*Based on annual stack test

Table 4-28 Nova Scotia Mercury speciation, 2020*

	Oxidized (%)	Elemental (%)	Particulate-bound (%)
Lingan 1/2	52.5	46.7	0.87
Lingan 3/4	31.3	67.8	0.87
Trenton 5	84.8	10.3	4.9
Trenton 6	50.1	49.7	0.15
Point Tupper	58.7	40.9	0.38
Point Aconi	60.3	39.5	0.23

*Based on annual stack test

(g) Mercury content of coal

Table 4-29 Nova Scotia total mercury content of coal, 2019 and 20120 (kg*)

	2019	2020
Lingan	66.1	71.6
Point Aconi**	13.4	14.4
Trenton	36.1	31.1
Point Tupper	19.7	13.9
Total	**135.3**	**131.0**

*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 4-30 Nova Scotia mercury content of coal combustion residues, 2019

	Total (kg)
Lingan	34.8
Point Aconi	7.3
Trenton	21.1
Point Tupper	13.1
Total	76.3

Table 4-31 Nova Scotia mercury content of coal combustion residues in 2020

	Total (kg)
Lingan	38.0
Point Aconi	7.0
Trenton	19.6
Point Tupper	6.8
Total	71.4

4.5 Ontario

Ontario phased out the use of coal for EPG in 2014. Ontario's mercury emissions from EPG from 2015 and onwards have been 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 4-32 Mercury emissions from Saskatchewan facilities, 2019 and 2020

	Total Mass Mercury					
Facility	**Emissions (kg)**		**In coal burned (kg)**		**Retained in ash and residue (kg)**	
	2019	**2020**	**2019**	**2020**	**2019**	**2020**
Boundary Dam	207.35	171.82	216.12	180.63	8.77	8.81
Poplar River	159.53	146.91	269.73	215.75	110.20	68.85
Shand	48.34	30.22	113.15	76.50	64.82	46.28

4.6.1 Boundary Dam, Poplar River and Shand Power Stations

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

Table 4-33 Saskatchewan annual emission of mercury, 2019 and 2020

Facility	2019 mass Hg emissions to air (kg)	2020 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	47.16	46.76
Boundary Dam Power Station Unit 4	41.64	32.20
Boundary Dam Power Station Unit 5	38.22	38.29
Boundary Dam Power Station Unit 6	80.33	54.57
Total for Boundary Dam Power Station	**207.35**	**171.82**
Poplar River Power Station Unit 1	51.45	66.64
Poplar River Power Station Unit 2	108.08	80.27
Total for Poplar River Power Station	**159.53**	**146.91**
Shand Power Station Unit 1	48.34	30.22
Total for Shand Power Station	**48.34**	**30.22**
Total for SaskPower	**415.22**	**348.95**
Net for SaskPower (with credits for early action)	**415.22**	**348.95**

Note: Boundary Dam Power Station Units 1 and 2 retired in 2013 and 2014 respectively.

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

Table 4-34 Saskatchewan annual mercury capture rate, 2019 and 2020

Facility	Hg captured 2019 (%)	Hg captured 2020 (%)
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	4.1	4.9
Boundary Dam Power Station Unit 4	4.1	4.9
Boundary Dam Power Station Unit 5	4.1	4.9
Boundary Dam Power Station Unit 6	4.1	4.9
Average for Boundary Dam Power Station	**4.1**	**4.9**
Poplar River Power Station Unit 1	54.0	36.8
Poplar River Power Station Unit 2	31.6	27.2
Average for Poplar River Power Station	**40.9**	**31.9**
Shand Power Station Unit 1	57.3	60.5
Average for Shand Power Station	**57.3**	**60.5**
Average for SaskPower*	**30.7**	**26.2**

* 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 4-35 Saskatchewan mercury emission rate by unit, 2019 and 2020

Facility	kg/TWh 2019	kg/TWh 2020
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	41.3	42.2
Boundary Dam Power Station Unit 4	41.3	42.1
Boundary Dam Power Station Unit 5	41.4	42.2
Boundary Dam Power Station Unit 6	37.7	39.2
Average for Boundary Dam Power Station	**39.9**	**41.2**
Poplar River Power Station Unit 1	34.7	45.5
Poplar River Power Station Unit 2	50.9	51.9
Average for Poplar River Power Station	**44.2**	**48.8**
Shand Power Station Unit 1	21.3	18.8
Average for Shand Power Station	**35.1**	**18.8**

(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 4-36 SaskPower mercury collected, 2003–2020

	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
2019	3.5830	0.0	3.5830
2020	2.8680	0.0	2.8680
Total	**363.5024**	**42.4470**	**405.9494**

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 4-37 summarizes the changes in mercury emissions at Poplar River from 2003 to 2009.

Table 4-37 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	0.00
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**

*Emission increases in 2007 and 2009 are attributed to higher mercury content in the coal as well as carbon injection system interruptions.

(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 4-38 summarizes the average test results from 2009 to 2013.

Table 4-38 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&2	8.78	25.56	65.48
Shand	1	0.69	6.49	92.88

Table 4-39 and 4-40 show stack testing (Ontario Hydro Method) results for 2019 and 2020 at Boundary Dam, Poplar River and Shand.

Table 4-39 Ontario Hydro Method stack test results, 2019

Unit	Test	Particle Bound		Oxidized		Elemental		Total	
		µg/m³	%	µg/m³	%	µg/m³	%	µg/m³	%
Shand	**Sept. 2019 - RWDI#1902838**	0.08	2.49%	0.55	17.42%	2.51	80.09%	3.1	100%
BD3/CCS	**Sept. 2019 - RWDI#1902838**	0.01	0.13%	0.33	3.59%	8.84	96.28%	9.2	100%

Table 4-40 Ontario Hydro Method stack test results, 2020

Unit	Test	Particle Bound		Oxidized		Elemental		Total	
		µg/m³	%	µg/m³	%	µg/m³	%	µg/m³	%
BD4	**August 2020 - RWDI#2003952**	0.29	2.89%	1.02	10.13%	8.79	86.98%	10.1	100%
BD5		0.04	0.48%	1.10	12.83%	7.41	86.69%	8.6	100%
BD6		0.14	1.62%	1.52	17.76%	6.88	80.62%	8.5	100%
BD3/CCS		0.11	0.86%	0.04	0.29%	12.72	98.85%	12.9	100%
PR1&PR2	**August 2020 - RWDI#2003952**	0.60	6.41%	1.83	19.74%	6.86	73.86%	9.3	100%

(g) Mercury content of coal (kg)

Table 4-41 Saskatchewan amount of mercury in coal, 2019 and 2020

	2019	2020
Boundary Dam Power Station Unit 3	49.15	49.15
Boundary Dam Power Station Unit 4	43.40	33.86
Boundary Dam Power Station Unit 5	39.84	40.26
Boundary Dam Power Station Unit 6	83.73	57.36
Total for Boundary Dam Power Station	**216.12**	**180.63**
Poplar River Power Station Unit 1	111.73	105.45
Poplar River Power Station Unit 2	158.00	110.30
Total for Poplar River Power Station	**269.73**	**215.75**
Shand Power Station Unit 1	113.15	76.50
Total for Shand Power Station	**113.15**	**76.50**
Total for SaskPower	**599.00**	**472.89**

Total may not add up due to rounding.

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

Table 4-42 Saskatchewan amount of mercury retained in fly ash, 2019 and 2020

	2019	2020
Boundary Dam Power Station Unit 3	1.86	2.25
Boundary Dam Power Station Unit 4	1.64	1.55
Boundary Dam Power Station Unit 5	1.51	1.85
Boundary Dam Power Station Unit 6	3.16	2.63
Total for Boundary Dam Power Station	**8.16**	**8.28**
Poplar River Power Station Unit 1	60.18	38.72
Poplar River Power Station Unit 2	49.77	29.92
Total for Poplar River Power Station	**109.95**	**68.64**
Shand Power Station Unit 1	64.82	46.28
Total for Shand Power Station	**64.82**	**46.28**
Total for SaskPower	**182.93**	**123.21**

Total may not add up due to rounding.

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

Table 4-43 Saskatchewan amount of mercury retained in bottom ash, 2019 and 2020

	2019	2020
Boundary Dam Power Station Unit 3	0.14	0.14
Boundary Dam Power Station Unit 4	0.12	0.10
Boundary Dam Power Station Unit 5	0.11	0.12
Boundary Dam Power Station Unit 6	0.23	0.17
Total for Boundary Dam Power Station	**0.60**	**0.53**
Poplar River Power Station Unit 1	0.10	0.10
Poplar River Power Station Unit 2	0.14	0.11
Total for Poplar River Power Station	**0.25**	**0.21**
Shand Power Station Unit 1	0.00	0.00
Total for Shand Power Station	**0.00**	**0.00**
Total for SaskPower	**0.85**	**0.74**

Total may not add up due to rounding.

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

Table 4-44 Saskatchewan amount of coal combustion residues, 2019 and 2020

	2019	2020
Boundary Dam Power Station Unit 3	114,269	120,111
Boundary Dam Power Station Unit 4	100,882	82,729
Boundary Dam Power Station Unit 5	92,617	98,372
Boundary Dam Power Station Unit 6	194,642	140,175
Total for Boundary Dam Power Station	**502,409**	**441,386**
Poplar River Power Station Unit 1	154,890	153,539
Poplar River Power Station Unit 2	219,030	160,597
Total for Poplar River Power Station	**373,920**	**314,137**
Shand Power Station Unit 1	218,643	155,934
Total for Shand Power Station	**218,643**	**155,934**
Total for SaskPower	**1,094,973**	**911,457**

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. Portion of fly ash at Boundary Dam and Shand are recycled for utilization by other industries such as cement manufacturing.

Roughly 29% of the ash produced at Boundary Dam was sold for utilization in 2019, which is similar to the sales in 2018 (30%). Roughly 42% of the ash produced at Boundary Dam was sold for utilization in 2020.

The 2019 fly ash sold for utilization at Shand was roughly 31% which is significantly higher than 2018 sales (10%). The 2020 fly ash sold for utilization at Shand was roughly 30%.

5.0 REFERENCES

Alberta Environment. 2010. Letter to Kent Santo of Milner regarding; Mercury Control Program. H.R. Milner Grande Cache – Approval No. 9814-02-00. Authorization reduction of Monitoring Frequency.

Canadian Council of Ministers of the Environment (CCME). 2003. The Canadian Uniform Data Collection Program (UDCP) for Mercury from Coal-Fired Electric Power Generation. CCME. Winnipeg, Manitoba.

CCME 2006. Canada-wide Standards for Mercury Emissions from Coal-fired Electric Power Generation Plants. CCME. Winnipeg, Manitoba. https://ccme.ca/en/res/cws_mercury_epg_e.pdf.

CCME 2007. CCME Monitoring Protocol in Support of the Canada-wide Standards for Mercury Emissions from Coal-Fired Electric Power Generation Plants. CCME. Winnipeg, Manitoba. https://ccme.ca/en/res/cws_mercury_monitoring_protocol_e.pdf.

Goodarzi, F.. 2000. Chemical Characteristics of Milled-coal, Ashes and Stack Emitted Materials from the H.R. Milner Generating Station, Alberta. Ottawa, Geological Survey of Canada.

Government of Canada 2018. Access Data from the National Pollutant Release Inventory. https://www.canada.ca/en/environment-climate-change/services/national-pollutant-release-inventory/tools-resources-data/access.html.