

**DATA ANALYSIS IN SUPPORT OF THE DEVELOPMENT OF A  
CANADA-WIDE STANDARD FOR MERCURY EMISSIONS  
FROM COAL-FIRED ELECTRIC POWER GENERATION PLANTS**

The CCME Mercury Canada-wide Standards (CWS) Development Committee (DC), industry, environmental non-government organizations, and other stakeholders identified the need for nationally consistent, comparable and compatible information upon which to base mercury standards development for coal-fired electric power generation plants. To facilitate and guide this data collection, CCME developed the Uniform Data Collection Program (UDCP).

In response, member companies of the Canadian Electricity Association (CEA) undertook and made public the results of a program of mercury measurement and analysis to satisfy the data collection and quality assurance needs of the CCME CWS development process. CEA developed guidelines for an intensive program to sample and analyze the mercury in coal, residue and flue gas at the generation facilities over the last two years (late 2002 to early 2005). Sample collection, handling, and storage followed standard procedures, where practicable, as agreed among the companies and the respective provincial governments. Quality-assured analyses, verified by laboratory audits, were conducted on mercury and other key substances associated with mercury emissions. Sampling and analysis results from the CEA mercury program, and other related information, is available on the CEA website at [http://www.ceamercuryprogram.ca/EN/mercury\\_home.html](http://www.ceamercuryprogram.ca/EN/mercury_home.html).

The DC undertook a quality assurance and quality control review and analysis of the coal and residue data provided by the utility monitoring program. A summary of the DC's analysis of mercury in coal and mercury emissions is attached. Also attached is the DC's summary of mercury emission values for different capacity factors.

The DC used the results of the utility monitoring program to estimate the mercury in coal in the baseline year (2003/2004) and the annualized mercury emissions. The DC also incorporated the results into the development of the provincial caps for existing facilities and capture rates and emission limits for new plants in the CWS.

The following table presents a summary of the how the new plant standards were derived:

<b>Proposed New Plant Standards</b>	<b>Lignite</b>	<b>Bituminous</b>	<b>Sub-bituminous</b>	
<b>Emission rates*</b>	58.1	16.8	30.1	kg/TWh
<b>Required percent capture</b>	75%	85%	75%	
<b>Calculated new plant standards</b>	14.52	2.52	7.52	kg/TWh
<b>Proposed new plant standards in CWS</b>	15	3	8	kg/TWh

\* Based on utility monitoring program results. These emission rates were adjusted to represent 0% capture.

The following table, from the CWS, presents estimated baseline mercury emissions and the 2010 caps for existing facilities:

<b>Province</b>	<b>Estimated Emissions<sup>1</sup> (kg/yr)</b>	<b>2010 Cap (kg/yr)</b>
Alberta	1,180 <sup>2</sup>	590
Saskatchewan	710	430 <sup>3</sup>
Manitoba	20	20
Ontario	495	0
New Brunswick	140	25
Nova Scotia	150	65
<i>Total</i>	<b>2,695</b>	<b>1,130</b>

<sup>1</sup> Based on 2002 to 2004 utility monitoring program results.

<sup>2</sup> Alberta's commitment is through the implementation of the Clean Air Strategic Alliance Electricity Project Team recommendations. Alberta emissions are based on a 90% capacity factor.

<sup>3</sup> Saskatchewan's early actions, between 2004 and 2009, will be used to meet its provincial caps for the years 2010 to 2013. Examples of early actions include a mercury switch collection program and early mercury controls at the Poplar River Power Station.

In 2003, the coal-fired electric power generation (EPG) sector emitted an estimated 2,695 kilograms of mercury from an estimated 3,725 kilograms of mercury in coal burned.

The 2010 cap for existing plants of 1,130 kg, with recognition for early action, represents a 70% national capture of mercury from coal burned. Without recognition for early action of 170 kg, the 2010 cap of 1,300 kg represents a 65% national capture of mercury from coal burned.

The 2010 national cap for existing plants represents mercury emission reductions of approximately 58% with recognition for early action, or 52% without recognition for early action.

Utility Mercury Data Analysis Summary

Mercury Emission Summary

Province	Owner	Power Plant	Units	Quarters Reported	Annualized Generation GWh	Mercury In kg	Annualized Emission kg	Mercury Emission Rate kg/TWh		
Alberta	ATCO	H.R.Milner	3	x	935.0		5.4	5.8	x Based on personal communications with Alberta Environment. Generation average of 2002, 3 and 4. ** Average annual generation based on 1995-2001 statistics. Mercury data were calculated based on the assumption that the characteristics of units 3 & 4 were similar to BR unit 5.  xx Based on personal communications with Alberta Environment. *** Average annual generation based on 1995-2001 statistics. Mercury data were calculated based on the assumption that the characteristics of units 1&2 and 3 & 4 were similar to Sundance units 5&6.  **** Average annual generation based on 1995-2001 statistics. Mercury data were calculated based on the assumption that the characteristics of Wabmun units 1&2, 3 abd 4 were similar to Sundance units 5&6.  ***** Average annual generation based on 1995-2001 statistics. Mercury data were calculated based on the assumption that the characteristics of Keephills units 1 and 2 were similar to Sundance units 5&6. 1,180 in the CWS - based on 90% capacity factor	
			4	**	1019.8	17.8	13.2	12.9		
		5	**	1105.2	19.3	14.3	12.9			
		EPCOR	Sheerness	3	3	2848.0	49.7	36.8		12.9
			Genesee	1 & 2	3	6012.3	166.8	124.0		20.6
	Transalta	Sundance	3	xx	6376.0	125.3	88.1	13.8		
			1 & 2	***	82.0	75.0				
			3 & 4	***	4261.7	171.9	126.6	29.7		
		Wabamun	5 & 6	***	5481.0	221.1	162.8	29.7		
			1 & 2	***	5350.7	216.1	159.1	29.7		
		Keephills	3	****	961.8	38.8	28.6	29.7		
			4	****	967.6	39.0	28.7	29.7		
	Total		2	****	1518.4	61.3	45.1	29.7		
			1	*****	3012.6	121.5	89.5	29.7		
		2	*****	3013.1	121.5	89.5	29.7			
				<b>39803.2</b>	<b>1415.1</b>	<b>1086.5</b>				
Manitoba	Manitoba Hydro	Brandon		4	559.0	19.0	16.6	29.7		
		Total			<b>559.0</b>	<b>19.0</b>	<b>16.6</b>	<b>20 in the CWS</b>		
New Brunswick	NB Power	Belledune	2	6	3958.0	60.0	54.1	13.7		
		Grand Lake*	1	*		100.0	85			
		Total			<b>3958.0</b>	<b>160.0</b>	<b>139.1</b>	<b>140 in the CWS - includes emissions from Grand Lake</b>		
Nova Scotia	NS Power	Lingan	1 to 4	6	4685.0	77.4	76.7	16.4		
		Point Aconi	1	6	1342.5	11.4	2.5	1.9		
		Point Tupper	2	6	1177.4	25.6	25.4	15.4		
		Trenton	5	6	944.2	35.6	28.2	29.9		
		Trenton	6	6	1129.9	18.9	14.3	12.6		
		Total			<b>9279.0</b>	<b>168.9</b>	<b>147.1</b>	<b>150 in the CWS</b>		
Ontario	Ontario Power Ge	Atikokan		6	1034.0	70.5	69.2	67.0		
		Lakeview *			2520.0	51.2	25.3	10.0		
		Lambton	1 & 2	6	4495.3	91.3	45.1	10.0		
		Lambton	3 & 4	6	5412.7	170.4	38.2	7.1		
		Nanticoke		5	19844	524.0	149.7	7.5		
		Thunder Bay		5	1461.6	53.8	53.2	36.4		
		Total			<b>34767.6</b>	<b>961.2</b>	<b>380.7</b>	<b>495 in the CWS - monitoring program did not reflect typical operations e.g. lengthy transformer outage and installation of 4 SCR's (2 at Nanticoke &amp; 2 at Lambton)</b>		
Saskatchewan	Sask Power	Boundary Dam	all units	6	6115.3	337.2	305.8	50.0		
		Poplar River	1	6	2140.7	150.4	144.3	67.4		
		Poplar River	2	6	2308.4	165.0	146.4	63.4		
		Shand		6	2054.7	112.2	105.4	51.3		
		Total			<b>12619.1</b>	<b>764.8</b>	<b>701.9</b>	<b>710 in the CWS</b>		
					<b>Annualized Generation GWh</b>	<b>Mercury In kg</b>	<b>Annualized Emission kg</b>			
					<b>100985.9</b>	<b>3489.0</b>	<b>2471.9</b>	<b>Total annualized emission of 2,695 kg in the CWS (sum of adjusted figures above)</b>		
								<b>Total mercury in coal of 3,725 kg in the CWS (adjusted to reflect emissions of 2,695)</b>		

Utility Mercury Data Analysis Summary

		Mercury In Coal ppm	Standard Deviation	Coefficient of Variation	Mercury In Fly Ash ppm
<b>Battle River</b>	5	0.040	0.009	0.23	0.073
<b>Sheerness</b>		0.060	0.016	0.27	0.130
<b>Genesee</b>	1 & 2	0.043	0.008	0.19	0.087
<b>Sundance</b>	5 & 6	0.070	0.012	0.17	0.138
<b>Brandon</b>		0.080	0.028	0.35	0.199
<b>Beldune</b>	2	0.043	0.012	0.28	0.051
<b>Lingan</b>	1 to 4	0.053	0.024	0.45	0.009
<b>Point Aconi</b>	1	0.027	0.016	0.59	0.128
<b>Point Tupper</b>	2	0.049	0.023	0.47	0.008
<b>Trenton</b>	5	0.099	0.021	0.21	0.077
<b>Trenton</b>	6	0.040	0.012	0.30	0.035
		0.108	0.081	0.75	0.017
<b>Atikokan</b>		0.053	0.016	0.30	0.383
<b>Lambton</b>	1 & 2	0.095	0.030	0.32	0.321
<b>Lambton</b>	3 & 4	0.068	0.010	0.15	0.678
<b>Nantikoke</b>		0.088	0.033	0.38	0.002
<b>Thunder Bay</b>		0.047	0.022	0.47	
<b>Boundary Dam</b>	all units	0.076	0.008	0.11	0.058
<b>Poplar River</b>	1	0.088	0.009	0.10	0.032
<b>Poplar River</b>	2	0.088	0.008	0.09	0.092
<b>Shand</b>		0.078	0.016	0.21	0.043

# Mercury Generation Capacity Factors

Province	Owner	Power Plant	Units	Unit Rating	Annual Generating Capacity	Actual Annualized Production	Annualized Capacity Factor	Annualized Mercury Emissions	Mercury Emissions 85% Capacity	Mercury Emissions 90% Capacity	Mercury Emissions 95% Capacity			
				MW	GWh	GWh	%	kg	kg	kg	kg			
Alberta	ATCO	H.R.Milner	3	143	1253	935.0	74.6	5.4	6.1	6.5	6.9			
			4	150	1314	1019.8	77.6	13.2	14.5	15.3	16.2			
		Battle River	5	375	3285	2848.0	86.7	36.8	36.1	38.2	40.3			
			1	383	3355									
			2	383	3355	6012.3	95.0	124.0	110.9	117.4	124.0			
	EPCOR	Genesee	1	410	3592									
			2	410	3592	6376.0	88.8	88.1	84.4	89.3	94.3			
			3 *	450	3942	3547.8	90.0	75.0	70.8	75.0	79.2	* Actual Annual Generation data are not currently available. A 90% capacity factor was assumed.		
	Transalta	Sundance	1	300	2628									
			2	300	2628	4261.7	81.1	126.6	132.7	140.5	148.3			
			3	375	3285									
			4	375	3285	5481.0	83.4	162.8	165.9	175.6	185.4			
			5	375	3285									
			6	387	3390	5350.7	80.2	159.1	168.7	178.6	188.6			
		Wabamun	1	66	578									
			2	66	578	961.8	83.7	28.6	29.1	30.8	32.5			
			3	150	1314	967.6	73.6	28.7	33.1	35.1	37.0			
			4	300	2628	1518.4	57.8	45.1	66.3	70.3	74.2			
	Keephills	1	403	3530	3012.6	85.3	89.5	89.1	94.4	99.6				
		2	403	3530	3013.1	85.4	89.5	89.1	94.4	99.6				
<b>Alberta Totals</b>					<b>55661</b>	<b>46411.0</b>	<b>83.4</b>	<b>1086.7</b>	<b>1111.4</b>	<b>1176.7</b>	<b>1242.1</b>	<b>1,180 in the CWS - based on 90% capacity factor</b>		
Manitoba	Manitoba Hydro	Brandon	5	105	920	559.0	60.8	16.6	23.2	24.6	25.9			
<b>Manitoba Totals</b>					<b>920</b>	<b>559.0</b>	<b>60.8</b>	<b>16.6</b>	<b>23.2</b>	<b>24.6</b>	<b>25.9</b>	<b>20 in the CWS</b>		
New Brunswick	NB Power	Belledune	2	480	4205	3958.0	94.1	54.1	48.9	51.7	54.6			
		Grand Lake*		60				85				* The Grand lake facility was not part of the utility monitoring program.		
<b>New Brunswick Totals</b>					<b>4205</b>	<b>3958.0</b>	<b>94.1</b>	<b>139.1</b>	<b>48.9</b>	<b>51.7</b>	<b>54.6</b>	<b>140 in the CWS - includes emissions from Grand Lake</b>		
Nova Scotia	NS Power	Lingan	1	150	1314									
			2	150	1314									
			3	150	1314									
			4	150	1314	4685.0	89.1	76.7	73.1	77.4	81.7			
		Point Aconi	1	186	1629	1342.5	82.4	2.5	2.6	2.7	2.9			
			2	150	1314	1177.4	89.6	25.4	24.1	25.5	26.9			
		Point Tupper	5	150	1314	944.2	71.9	28.2	33.4	35.3	37.3			
			6	160	1402	1129.9	80.6	14.3	15.1	16.0	16.9			
		<b>Nova Scotia Totals</b>					<b>10915</b>	<b>9279.0</b>	<b>85.0</b>	<b>147.1</b>	<b>148.3</b>	<b>157.0</b>	<b>165.7</b>	<b>150 in the CWS</b>
		Ontario	Ontario Power Gen	Atikokan		230	2014.8	1034.0	51.3	69.2	114.6	121.4	128.1	
Lakeview *						4846	2520.0	52.0	25.2	41.2	43.6	46.0	* Lakeview data are calculated on the assumption that it is similar to Lambton Units 1&2 and that it has a capacity factor of 52%.	
Lambton	1			505	4424									
	2			505	4424	4495.3	50.8	45.1	75.5	79.9	84.3			
	3			505	4424									
Nanticoke	4			505	4424	5412.7	61.2	38.2	53.1	56.2	59.3			
	1			564	4941									
	2			564	4941									
	3			564	4941									
	4			564	4941									
	5	564	4941											
6	564	4941												

Utility Mercury Data Analysis Summary

Province	Owner	Power Plant	Units	Unit Rating	Annual Generating Capacity	Actual Annualized Production	Annualized Capacity Factor	Annualized Mercury Emissions	Mercury Emissions 85% Capacity	Mercury Emissions 90% Capacity	Mercury Emissions 95% Capacity	
				MW	GWh	GWh	%	kg	kg	kg	kg	
			7	564	4941							
			8	564	4941	19844.0	50.2	149.7	253.4	268.4	283.3	
		<b>Thunder Bay</b>	2	163	1428							
			3	163	1428	1461.6	51.2	53.2	88.4	93.6	98.7	
	<b>Ontario Totals</b>				<b>66937</b>	<b>32248</b>	<b>48.2</b>	<b>380.6</b>	<b>626.1</b>	<b>663.0</b>	<b>699.8</b>	<b>495 in the CWS - adjusted to reflect normal operating levels</b>
<b>Saskatchewan</b>	<b>Sask Power</b>	<b>Boundary Dar</b>	1	66	578							
			2	66	578							
			3	150	1314							
			4	150	1314							
			5	150	1314							
			6	300	2628	6115.3	79.1	305.8	328.4	347.7	367.0	
		<b>Poplar River</b>	1	300	2628	2140.7	81.5	144.3	150.6	159.4	168.3	
		<b>Poplar River</b>	2	300	2628	2308.4	87.8	146.4	141.7	150.0	158.3	
		<b>Shand</b>		300	2628	2054.7	78.2	105.4	114.6	121.3	128.1	
	<b>Saskatchewan Totals</b>				<b>15610</b>	<b>12619</b>	<b>80.8</b>	<b>701.9</b>	<b>735.2</b>	<b>778.5</b>	<b>824.9</b>	<b>710 in the CWS</b>
				Unit Rating	Annual Generating Capacity	Actual Annualized Production	Annualized Capacity Factor	Annualized Mercury Emissions	Mercury Emissions 85% Capacity	Mercury Emissions 90% Capacity	Mercury Emissions 95% Capacity	
				MW	GWh	GWh	%	kg	kg	kg	kg	
	<b>National Totals</b>			17115	154248	106334	68.9	2472.0	2693.1	2851.5	3011.5	<b>2,695 in the CWS (sum of adjusted figures above)</b>