Appendix F

CALCULATION OF SEVERSTAL EMISSIONS

SUPPORT DOCUMENTATION

FOR THE

FINE PARTICULATE SIP

May 2008

Determining the emissions from Severstal North America steel mill for Michigan's AERMOD modeling evaluation was complicated process that involved using: 1)PM emissions reported from MDEQ permit #182-05B (Severstal permit) and 2)emissions and calculation from the steel mill study done by RTI (2006) to determine $PM_{2.5}$. This appendix gives the details in how the emissions estimates for modeling were developed.

Table 1 shows how PM was calculated for the Severstal permit showing the throughput and emissions factors used by Severstal in their permit. The 2009 future potential limits for PM are the maximum emission limits allowed in the Severstal permit once controls are installed (fall 2007 for most emission sources).

Table 2 compares the 2002 PM emissions and emissions factors used in the Severstal permit, the RTI report, and MDEQ that were used to develop the AERMOD modeling emissions. MDEQ used a hybrid between the Severstal permit emissions and the RTI report, based on recommendations of MDEQ permit engineers. The RTI report indicated that Severstal has a local hood to capture charging and tapping emissions from the BOF and send the emissions to the ESP for control. Severstal uses an estimated capture efficiency of 95 percent for charging and tapping emissions (emission factors of 0.03 and 0.046 lb/ton, respectively). RTI research indicated that 95 percent capture is more appropriate for hoods designed and dedicated to capture fugitive emissions, not for a local hood like Severstal had. Furthermore, Severstal had several exceedances of the 20 percent opacity limit for the BOF shop, which supported a lower capture efficiency as in the RTI report.

There is no emission factor for the type of blast furnace casthouse roof monitor as used at Severstal. Severstal uses 85 percent capture efficiency, however, one study, as indicated in the RTI report, found a 74 percent reduction using a similar system. RTI used a75 percent reduction which would also be supported by the opacity exceedences reported for the casthouses as well.

Since the Severstal permit does not contain $PM_{2.5}$ emissions numbers, they had to be calculated using the $PM_{2.5}$-FIL:PM-FIL ratio provided in the RTI report. Table 3 shows the generic source types and ratios used to calculate $PM_{2.5}$ from PM (this table is Table 5-2 in the RTI report). Table 4 show the ratio used for each Severstal specific emission sources to calculate the 2002 actual $PM_{2.5}$ emissions and the 2009 $PM_{2.5}$ future potential emissions used for MDEQs AERMOD modeling.

Table 1. PM calculations from Severstal permit.

Source	2002 ACTUAL		2009 PROJECTED		PM						
	Throughput	Value	Throughput	Value	2009 Emission Factor Value	Units	2009 Potential Emissions (tpy)	2002 Emission Factor	Units	2002 Emissions (tpy)	Net Change (tpy)
B BF Stoves (BFG)	13,392.0	MMSCF	15,136.6	MMSCF	2.9	lb/MMSCF	21.95	2.9	lb/MMSCF	19.42	2.53
C BF Stoves (BFG)	24,003.0	MMSCF	37,841.1	MMSCF	2	lb/MMSCF	37.84	2.9	lb/MMSCF	34.80	3.04
B BF Stoves (NG)	459.0	MMSCF	483.7	MMSCF	7.6	lb/MMSCF	1.84	7.6	lb/MMSCF	1.74	0.09
C BF Stoves (NG)	434.0	MMSCF	655.3	MMSCF	7.6	lb/MMSCF	2.49	7.6	lb/MMSCF	1.65	0.84
B BF Casthouse (Roof Monitor)	900,533.0	TPY	949,000.0	TPY	0.012	lb/ton	5.69	0.09	lb/ton	40.52	-34.83
C BF Casthouse (Roof Monitor)	1,571,337.0	TPY	2,372,500.0	TPY	0.012	lb/ton	14.24	0.09	lb/ton	70.71	-56.48
B BF Bleeders	80.5	MMSCF	84.9	MMSCF	2.9	lb/MMSCF	0.12	2.9	lb/MMSCF	0.12	0.01
C BF Bleeders	140.5	MMSCF	212.2	MMSCF	2.9	lb/MMSCF	0.31	2.9	lb/MMSCF	0.20	0.10
B BF Taphole Burning	1,440.0	ft. of pipe	1,517.5	ft. of pipe	0.5	lb Fe/lb fume	0.15	0.5	lb Fe/lb fume	0.14	0.01
C BF Taphole Burning	1,020.0	ft. of pipe	1,540.1	ft. of pipe	0.5	lb Fe/lb fume	0.15	0.5	lb Fe/lb fume	0.10	0.05
BF B Casthouse Baghouse Stack			250,000	ACFM	0.003	gr/dscf	24.46				24.46
BF C Casthouse Baghouse Stack			500,000	ACFM	0.003	gr/dscf	48.93				48.93
Lime Unloading - BOF Receiving	14,000	ACFM	14,000	ACFM	0.005	gr/dscf	2.63	0.600	lb/hr	2.63	0.00
Reladling South - STACK	130,000	ACFM						0.010	gr/dscf	13.58	-13.58
Reladling South - FUGITIVES	2,471,870.0	TPY	3,321,500.0	TPY	0.0038	lb/ton	6.31	0.0038	lb/ton	4.697	1.61
Torch Cutting	39,745.2	TPY			0.1	lb/ton	0.00	0.1	lb/ton	1.987	-1.99
BOF Natural Gas	520.0	MMSCF	698.7	MMSCF	7.6	lb/MMSCF	2.66	7.6	lb/MMSCF	1.98	0.68
BOF ESP Stack	841,000	ACFM	841,000	ACFM	0.0152	gr/dscf	223.12	0.0152	gr/dscf	202.35	20.77
BOF Secondary Emiss. Baghouse			1,000,000	ACFM	0.003	gr/dscf	32.62				32.62
BOF Tapping (Roof Monitor)	2,944,089.0	TPY	4,052,230.0	TPY	0.0026	lb/ton	5.27	0.046	lb/ton	67.71	-62.45
BOF Slag Tap (Roof Monitor)	372,502.0	TPY	500,538.2	TPY	0.0026	lb/ton	0.65	0.046	lb/ton	8.57	-7.92
BOF Charging (Roof Monitor)	2,471,870	TPY	3,321,500.0	TPY	0.0060	lb/ton	9.96	0.030	lb/ton	37.08	-27.11
Desulfurization - STACK	94,500	ACFM	94,500	ACFM	0.010	gr/dscf	9.15	0.010	gr/dscf	9.15	0.00
Desulfurization - FUGITIVES	2,471,870.0	TPY	3,321,500.0	TPY	0.0218	lb/ton	36.20	0.0218	lb/ton	26.94	9.26
#1 LRF Stack	175,000	ACFM	175,000	ACFM	0.0052	gr/dscf	29.68	0.0052	gr/dscf	29.68	0.00
#2 LRF Stack	100,000	ACFM	100,000	ACFM	0.0052	gr/dscf	16.96	0.0052	gr/dscf	16.96	0.00
Vacuum Degasser	EMISSIONS RESTRICTED BY LIMITS IN EXISTING PERMIT										
DD Baghouse - Coke Transfer	20,000.0	ACFM	20,000.0	ACFM	0.005	gr/dscf	3.75	0.005	gr/dscf	3.75	0.00
EE Baghouse - Coke Unloading	25,000.0	ACFM	25,000.0	ACFM	0.005	gr/dscf	4.69	0.005	gr/dscf	4.69	0.00
EE Baghouse - Natural Gas	5.0	MMSCF	6.7	MMSCF	7.6	lb/MMSCF	0.03	7.6	lb/MMSCF	0.02	0.01
Raw Material Handling	RULE 290 EXEMPT EMISSION UNIT				1.00	PPH	4.38	1.00	PPH	4.38	0.00
Annealing Furnaces	883.2	MMSCF	1,215.7	MMSCF	10	lb/MMSCF	6.08	10	lb/MMSCF	4.42	1.66
Reheat Furnace #1	2,367.0	MMSCF	2,593.4	MMSCF	10	lb/MMSCF	12.97	10	lb/MMSCF	11.84	1.13
Reheat Furnace #2	2,367.0	MMSCF	2,593.4	MMSCF	10	lb/MMSCF	12.97	10	lb/MMSCF	11.84	1.13
Reheat Furnace #3	2,367.0	MMSCF	2,593.4	MMSCF	10	lb/MMSCF	12.97	10	lb/MMSCF	11.84	1.13
Hand Scarfing	262,805.0	TPY	353,136.0	TPY	0.1	lb/ton	17.66	0.1	lb/ton	13.14	4.52
B BF Slag Pit	156,692.7	TPY	165,126.0	TPY	0.0088	lb/ton	0.73	0.0088	lb/ton	0.69	0.04
C BF Slag Pit	273,412.6	TPY	412,815.0	TPY	0.0088	lb/ton	1.82	0.0088	lb/ton	1.20	0.61
Desulfurization Slag Pit	81,571.7	TPY	109,609.5	TPY	0.09	lb/ton	4.93	0.09	lb/ton	3.67	1.26
Parts Cleaning	2,131.0	Gallons	2,131.0	Gallons							
Maintenance Paint Booth	70.0	Gallons	70.0	Gallons							
J-9 Dip Tank	1,210.0	Gallons	1,210.0	Gallons	0.1	lb/1000lb	0.00				0.00
Equipment and Emissions from On-Site Coal Pulverization											
Fine Coal Silo Baghouse			6,200.0	ACFM	0.005	gr/dscf	1.16				1.16
Filter #4 (Pulverizer Baghouse)			16,000.0	ACFM	0.005	gr/dscf	3.00				3.00
Rail Unloading Baghouse			30,000.0	ACFM	0.005	gr/dscf	1.88				1.88
Raw Coal Silo Baghouse			1,800.0	ACFM	0.005	gr/dscf	0.34				0.34
Rail Car Building Heater			214.7	MMSCF	7.6	lb/MMSCF	0.82				0.82
Pulverizer Hot Gas Generator			214.7	MMSCF	7.6	lb/MMSCF	0.82				0.82
Process Fugitives							8.56				8.56
Totals							573.14			664.20	-36.84

Table 2. 2002 PM emissions and emissions factors comparisons used in the Severstal permit, RTI report and MDEQ AERMOD modeling. Numbers in red used RTI values instead of Severstal permit numbers.

Source	Severstal 2002 Emission Factor	Severstal 2002 Emissions (tpy)	RTI 2002 Emission Factor	RTI 2002 Emissions (tpy)	MDEQ 2002 Emission Factor	MDEQ 2002 Emissions (tpy)	Units for emissions factors
B BF Stoves (BFG)	2.9	**19.42**	2.9	19.42	2.9	**19.42**	lb/MMSCF
C BF Stoves (BFG)	2.9	**34.80**	2.9	34.80	2.9	**34.80**	lb/MMSCF
B BF Stoves (NG)	7.6	**1.74**	1.9	0.44	7.6	**1.74**	lb/MMSCF
C BF Stoves (NG)	7.6	**1.65**	1.9	0.41	7.6	**1.65**	lb/MMSCF
B BF Casthouse (Roof Monitor)	0.09	**40.52**	0.15	67.54	0.15	67.54	lb/ton
C BF Casthouse (Roof Monitor)	0.09	**70.71**	0.15	117.85	0.15	117.85	lb/ton
B BF Bleeders	2.9	**0.12**	2.9	0.12	2.9	**0.12**	lb/MMSCF
C BF Bleeders	2.9	**0.20**	2.9	0.20	2.9	**0.20**	lb/MMSCF
B BF Taphole Burning	0.5	**0.14**	inventory	0.14	0.5	**0.14**	lb Fe/lb fume
C BF Taphole Burning	0.500	**0.10**	inventory	0.10	0.5	**0.10**	lb Fe/lb fume
BF B Casthouse Baghouse Stack							
BF C Casthouse Baghouse Stack							
Lime Unloading - BOF Receiving	0.600	**2.63**	0.005	2.63	0.600	**2.63**	lb/hr
Reladling South - STACK	0.01	**13.58**	0.010	13.58	0.010	**13.58**	gr/dscf
Reladling South - FUGITIVES	0.0038	**4.697**	0.0095	11.74	0.0038	**4.697**	lb/ton
Torch Cutting	0.1	**1.987**	0.1	1.99	0.1	**1.987**	lb/ton
BOF Natural Gas	7.6000	**1.98**	1.9	0.49	7.6	**1.98**	lb/MMSCF
BOF ESP Stack	0.0152	**202.35**	39.9 lb/hr	174.80	0.0152	**202.35**	gr/dscf
BOF Secondary Emiss. Baghouse							
BOF Tapping (Roof Monitor)	0.046	**67.71**	0.230	338.57	0.230	338.57	lb/ton
BOF Slag Tap (Roof Monitor)	0.046	**8.57**			0.230	42.84	lb/ton
BOF Charging (Roof Monitor)	0.030	**37.08**	0.150	185.39	0.150	185.39	lb/ton
Desulfurization - STACK	0.01	**9.15**	0.010	9.15	0.010	**9.15**	gr/dscf
Desulfurization - FUGITIVES	0.0218	**26.94**	0.055	67.98	0.0218	**26.94**	lb/ton
#1 LRF Stack	0.0052	**29.68**	0.0052	29.68	0.0052	**29.68**	gr/dscf
#2 LRF Stack	0.0052	**16.96**	0.0052	16.96	0.0052	**16.96**	gr/dscf
Vacuum Degasser							
DD Baghouse - Coke Transfer	0.005	**3.75**	inventory	3.75	0.005	**3.75**	gr/dscf
EE Baghouse - Coke Unloading	0.005	**4.69**			0.005	**4.69**	gr/dscf
EE Baghouse - Natural Gas	7.60	**0.02**			7.6	**0.02**	lb/MMSCF
Raw Material Handling	1	**4.38**	inventory	4.38	1.00	**4.38**	PPH
Annealing Furnaces	10	**4.42**	1.9	0.84	10	**4.42**	lb/MMSCF
Reheat Furnace #1	10	**11.84**	1.9	2.25	10	**11.84**	lb/MMSCF
Reheat Furnace #2	10	**11.84**	1.9	2.25	10	**11.84**	lb/MMSCF
Reheat Furnace #3	10	**11.84**	1.9	2.25	10	**11.84**	lb/MMSCF
Hand Scarfing	0.1	**13.14**	0.1	13.14	0.1	**13.14**	lb/ton
B BF Slag Pit	0.0088	**0.69**	0.0088	0.69	0.0088	**0.69**	lb/ton
C BF Slag Pit	0.0088	**1.20**	0.0088	1.20	0.0088	**1.20**	lb/ton
Desulfurization Slag Pit	0.09	**3.67**	0.09	3.67	0.09	**3.67**	lb/ton
Parts Cleaning							
Maintenance Paint Booth							
J-9 Dip Tank							
Equipment and Emissions from On-Site Coal Pulverization							
Fine Coal Silo Baghouse							
Filter #4 (Pulverizer Baghouse)							
Rail Unloading Baghouse							
Raw Coal Silo Baghouse							
Rail Car Building Heater							
Pulverizer Hot Gas Generator							
Process Fugitives							
Emissions reported in RTI report only							
Storage piles			tpy PM10	3.10			
Unpaved roads			inventory	75.00			
Paved roads			tpy PM10	34.00			
Parking lots, open areas			inventory	22.00			
CC baghouse coke transfer			inventory	4.70			
Totals		664.20		1267.21		1191.80	

Table 3. Ratios to calculate $PM_{2.5}$-Fil from the RTI report (Table 5.2 in RTI report)

Source	$PM_{2.5}$-FIL: PM-FIL	Basis	PM-CON: PM-FIL	Basis
Blast furnace stove (NG)	1	AP-42	3	AP-42
Boiler (NG)	1	AP-42	3	AP-42
Boiler (BFG)	1	AP-42	0.55	Average from Geneva Steel and Allegheny County
Boiler (COG)	1	AP-42	0.55	Average from Geneva Steel and Allegheny County
Blast furnace casthouse	0.23	AP-42	0.7	Allegheny County inventory
Desulfurization fugitives	0.11	AP-42	0.7	Assume same as casthouse
Desulfurization baghouse	0.42	AP-42	0.045	Allegheny County inventory
BOF ESP stack	0.73	Rouge Steel test average	0.29	LTV Steel, WCI Steel
BOF charging fugitives	0.22	AP-42	0.7	Assume same as casthouse
BOF charging baghouse	0.22	AP-42	0.77	Average from Geneva Steel and Allegheny County
BOF tapping fugitives	0.37	AP-42	0.7	Assume same as casthouse
BOF tapping baghouse	0.16	AP-42	0.77	Average from Geneva Steel and Allegheny County
Ladle metallurgy baghouse	0.16	Assume same as tapping baghouse	0.05	LTV Steel
Slag	0.2	AP-42 (aggregate storage)	0	Allegheny County inventory
Raw material and slag storage and handling	0.2	AP-42 (aggregate storage)	0	Allegheny County inventory
Coke pushing baghouse	0.74	AP-42	0.08	Allegheny County inventory
Pushing fugitives	0.17	AP-42	0.002	Allegheny County inventory
Combustion stack	0.935	AP-42	159 lb/hr	Site-specific test results for Battery 5
Storage piles	0.4	AP-42 ratio to PM_{10}	0	Allegheny County inventory
Unpaved roads	0.15	AP-42 ratio to PM_{10}	0	Allegheny County inventory
Paved roads	0.25	AP-42 ratio to PM_{10}	0	Allegheny County inventory
Quenching emissions	0.06	AP-42 (baffles, clean water)	0.48	Based on 0.15 lb/ton (see text)
Coal Charging	0.39	AP-42	0.8	AP-42
Door, lid, offtake leaks	1	AP-42	0.9	AP-42

Table 4. Ratio used from the RTI report to determine $PM_{2.5}$ fraction of PM reported in Severstal permit. Numbers in red were not in Appendix B-2 in the RTI report.

Source Name (from Severstal permit)	Sources in RTI Report in Appendix B-2 (unless otherwise noted)	PM2.5 fil ratio: PM	MDEQ 2002 PM2.5 Emissions	MDEQ 2009 Potential PM2.5 Emissions	Net Change (tpy)
B BF Stoves (BFG)	B BF Stoves (BFG)	1.00	19.42	21.95	2.53
C BF Stoves (BFG)	C BF Stoves (BFG)	1.00	34.80	37.84	3.04
B BF Stoves (NG)	B BF Stoves (NG)	1.00	1.74	1.84	0.09
C BF Stoves (NG)	C BF Stoves (NG)	1.00	1.65	2.49	0.84
B BF Casthouse (Roof Monitor)	B BF Casthouse (Roof Monitor)	0.23	15.53	1.31	-14.22
C BF Casthouse (Roof Monitor)	C BF Casthouse (Roof Monitor)	0.23	27.11	3.27	-23.83
B BF Bleeders	BF bleeder stacks	1.00	0.12	0.12	0.01
C BF Bleeders	BF bleeder stacks	1.00	0.20	0.31	0.10
B BF Taphole Burning	Tapehole burning	1.00	0.14	0.15	0.01
C BF Taphole Burning	Tapehole burning	1.00	0.10	0.15	0.05
BF B Casthouse Baghouse Stack	Blast furnace casthouse*	0.23	0.00	5.63	5.63
BF C Casthouse Baghouse Stack	Blast furnace casthouse*	0.23	0.00	11.25	11.25
Lime Unloading - BOF Receiving	Lime unloading	1.00	2.63	2.63	0.00
Reladling South - STACK	Reladling South - Stack	0.23	3.12	0.00	-3.12
Reladling South - FUGITIVES	Reladling South - Fugatives	0.23	1.08	1.45	0.37
Torch Cutting	Torch Cutting	1.00	1.99	0.00	-1.99
BOF Natural Gas	BOF (NG)	1.00	1.98	2.66	0.68
BOF ESP Stack	BOF ESP Stack	0.73	147.72	162.88	15.16
BOF Secondary Emiss. Baghouse	avg of BOF charge/tap baghouse*	0.19	0.00	6.20	6.20
BOF Tapping (Roof Monitor)	BOF Tapping (Roof Monitor)	0.37	125.27	1.95	-123.32
BOF Slag Tap (Roof Monitor)	Slag*	0.20	8.57	0.13	-8.44
BOF Charging (Roof Monitor)	BOF Charging (Roof Monitor)	0.22	40.79	2.19	-38.59
Desulfurization - STACK	Desulfurization - STACK	0.42	3.84	3.84	0.00
Desulfurization - FUGITIVES	Desulfurization - FUGITIVES	0.11	2.96	3.98	1.02
#1 LRF Stack	#1 LRF Stack	1.00	29.68	29.68	0.00
#2 LRF Stack	#2 LRF Stack	1.00	16.96	16.96	0.00
Vacuum Degasser	EMISSIONS RESTRICTED BY LIMITS IN EXISTING PERMIT				
DD Baghouse - Coke Transfer	DD Baghouse - Coke Transfer	1.00	3.75	3.75	0.00
EE Baghouse - Coke Unloading	assumed same as DD Baghouse	1.00	4.69	4.69	0.00
EE Baghouse - Natural Gas	assumed same as DD Baghouse	1.00	0.02	0.03	0.01
Raw Material Handling	Raw Material Handling	1.00	4.38	4.38	0.00
Annealing Furnaces	Annealing Furnaces (NG)	1.00	4.42	6.08	1.66
Reheat Furnace #1	Reheat Furnace #1 (NG)	1.00	11.84	12.97	1.13
Reheat Furnace #2	Reheat Furnace #2 (NG)	1.00	11.84	12.97	1.13
Reheat Furnace #3	Reheat Furnace #3 (NG)	1.00	11.84	12.97	1.13
Hand Scarfing	Hand Scarfing	1.00	13.14	17.66	4.52
B BF Slag Pit	B BF Slag Pit	0.02	0.01	0.01	0.00
C BF Slag Pit	C BF Slag Pit	0.02	0.02	0.04	0.01
Desulfurization Slag Pit	Desulfurization Slag Pit	0.02	0.07	0.10	0.03
Parts Cleaning			0.00	0.00	0.00
Maintenance Paint Booth			0.00	0.00	0.00
J-9 Dip Tank			0.00	0.00	0.00
Equipment and Emissions from On-Site Coal Pulverization					
Fine Coal Silo Baghouse	assumed same as DD Baghouse	1	0.00	1.16	1.16
Filter #4 (Pulverizer Baghouse)	assumed same as DD Baghouse	1	0.00	3.00	3.00
Rail Unloading Baghouse	assumed same as DD Baghouse	1	0.00	1.88	1.88
Raw Coal Silo Baghouse	assumed same as DD Baghouse	1	0.00	0.34	0.34
Rail Car Building Heater	assumed same as DD Baghouse	1	0.00	0.82	0.82
Pulverizer Hot Gas Generator	assumed same as DD Baghouse	1	0.00	0.82	0.82
Process Fugitives	AP-42, aggregate handling (2006)**	0.15	0.00	1.28	1.28
Totals			553.43	405.81	-147.62

* from Table 5-2 in RTI report (see Table 3 above)

**from revisions to AP-42, 5th edition