

Delaware's Experience with SO₂ Sources

NACAA JOINT PERMITTING AND ENFORCEMENT WORKSHOP
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Overview

- Background & purpose of Action
- Sources of SO₂ emissions
- Ambient monitoring data
- 2011 point source inventory
- Modeling
- List of modeled sources
- Modeling methodology
- Modeling Results & Analysis
- Permitting Implications
- Conclusions

Background & Purpose of Action

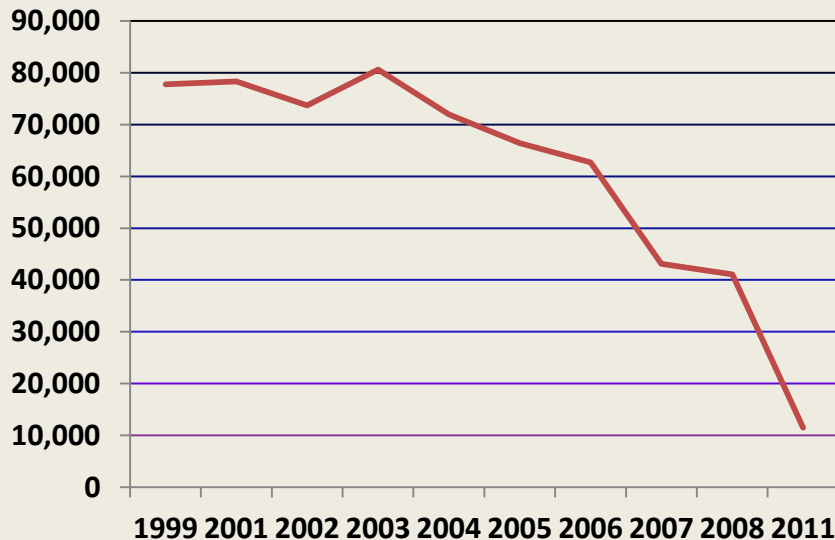
- 6/22/2010 final rule: EPA recommended a hybrid approach for designating areas
 - Combines monitoring and modeling as the most technically appropriate and cost effective method
 - Initial Designations
 - “nonattainment” or “attainment” based on monitoring or/and modeling
 - “unclassifiable”
- 6/13/2011: Delaware submitted a designation recommendation to EPA
 - Delaware proposed that the entire State be designated as unclassifiable
 - SO₂ monitoring network not sufficient to support attainment designation
 - Modeling not complete to support either attainment or nonattainment

Background & Purpose of Action

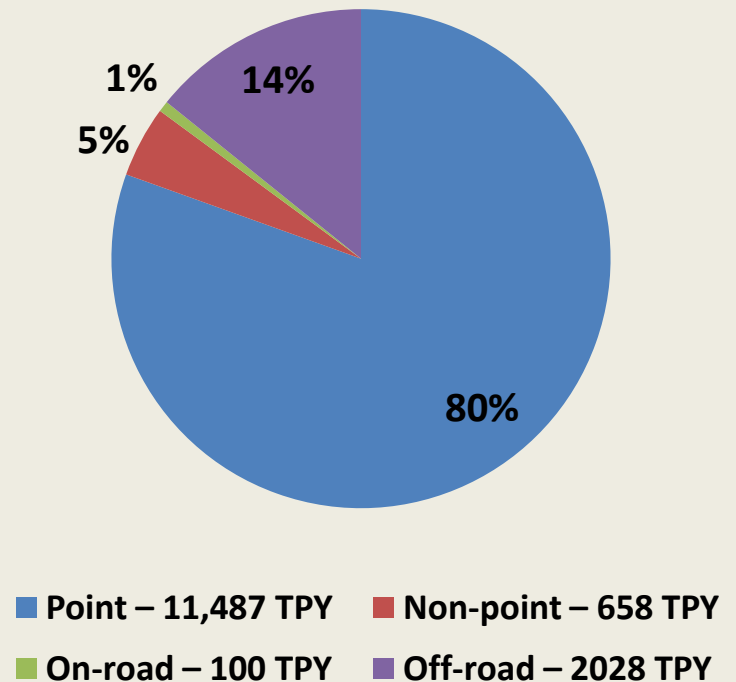
- Conducted modeling analysis to determine compliance with new SO₂ Standard and take corrective action if necessary,
- 6/05/2013: Letter & TSD to EPA to support designation of attainment
 - Delaware now has a complete SO₂ monitoring network
 - Dispersion modeling supports a designation of attainment for the entire state
 - Requested EPA to designate entire state of Delaware into attainment

Sources of SO₂ Emissions

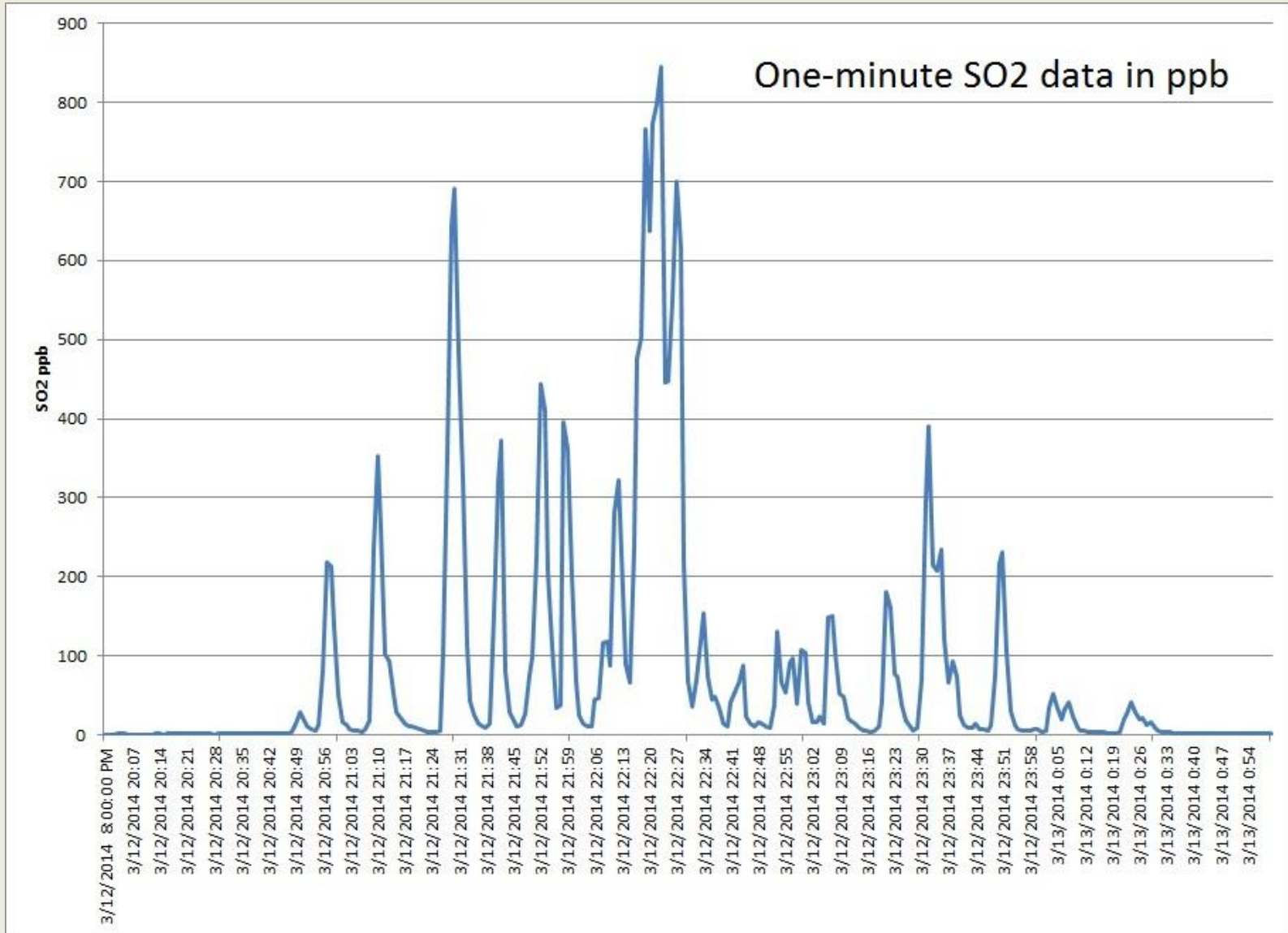
- Delaware reduced its 1970 SO₂ emissions by 95% by 2011



- In 2011, 80% of emissions are from point sources



DAQ's Delaware City Monitor

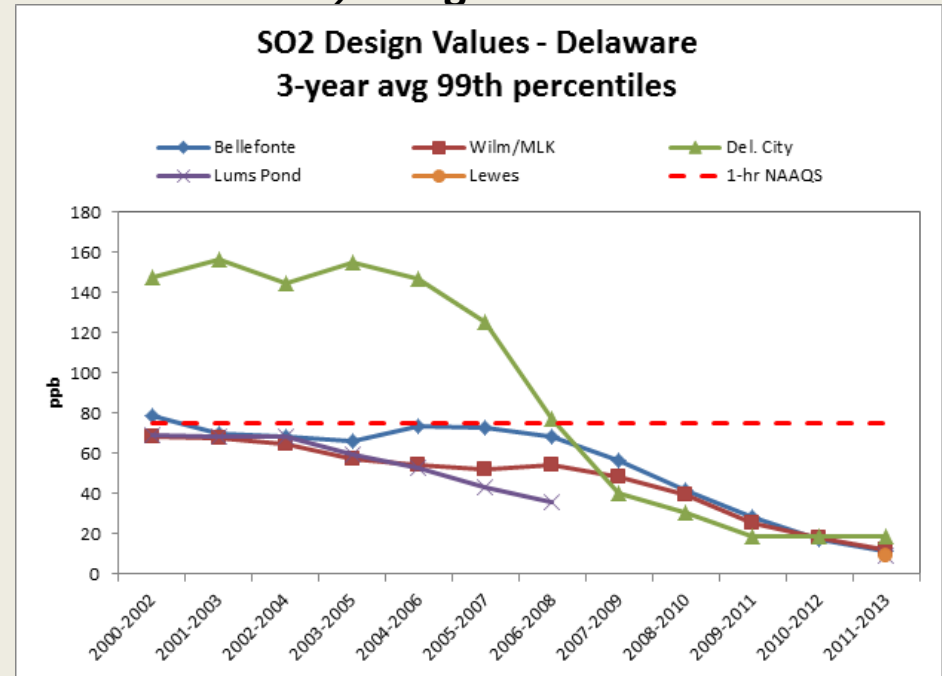


Delaware's SO₂ Ambient Monitoring Data

Air Quality Monitoring Sites in Delaware



1-hour SO₂ Design Value Trends



Annual 99th percentile 1-hour Average in ppb

Site	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Bellefonte	82	77	78	54	72	72	77	69	60	41	25	19	8	7
Wilm.-MLK	61	72	73	57	63	52	47	58	57	30	31.6	14	9	13
Del. Ctiy	136	143	163	164	106	195	139	41	51	28	13.3	15	29	13
Lums Pond	64	58	86	61	58	59	42	29				12		7
Lewes													11	7

2011 Point Source Inventory

- 59 facilities reported SO₂ emissions
- Two facilities account for 91% of the point source emissions
 - These two facilities include Delaware's only coal fired units
- Only four facilities had SO₂ emissions greater than 100 tpy
 - 2 facilities with coal fired units
 - Petroleum refinery
 - 1 facility w/residual oil as primary

Selection of Sources for Modeling

- Sources, regardless of size, fired on a higher sulfur fuel warrant a detailed analysis
 - Coal
 - Residual oil (primary or backup)
- Also included
 - Delaware City petroleum refinery
 - Red Lion sulfuric acid plant
- Modeled 17 facilities at PTE for 44 units
 - All units at their PTEs (conservative approach)
 - List of sources
 - Analysis of 1999-2011 inventory data, permit review, engineers
 - Sorted highest to lowest based on maximum annual emissions

Selection of Sources for Modeling, Cont'd

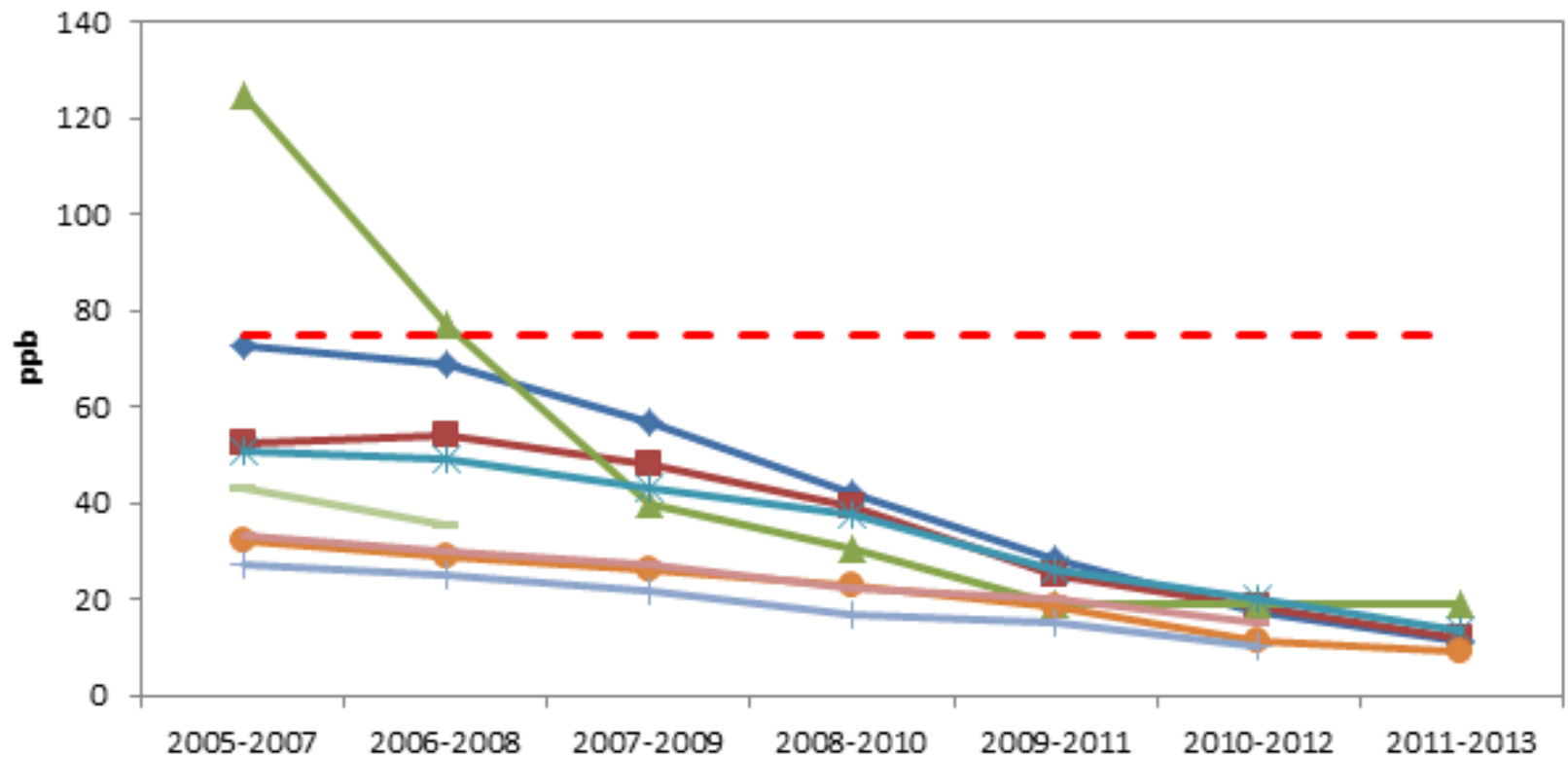
Facility	Highest Annual Emissions (TPY) (1999-2011)	2011 PEI (tpy)	PTE SO2 Rate (lb/hr)	PTE SO2 Rate (g/sec)
Indian River Power LLC Unit 4	24,643.18	9,194.4	1017.5	128.3
Calpine Edge Moor Unit 5	12,315.28	83.1	2455.4	309.6
DuPont Experimental Station (<i>5 boilers</i>)	593.15	247.7	251.0	31.7
Christiana Care - Christiana Hospital (<i>4 boilers – modeled on oil</i>)	142.42	0.1	101.1	12.8
Perdue Farms, Inc - Georgetown (<i>2 boilers - oil fired</i>)	135.66	8.1	21.9	2.8
DuPont Titanium Technologies – Edgemoor	120.87	18.0	23.6	3.0
Fisker Automotive, Inc. (<i>5 boilers - facility not operating</i>) (GM for 2011)	103.10	0.06	225.4	28.4
Amick Farms, LLC (<i>2 boilers - gas primary, oil backup – modeled on oil</i>)	95.20	0.02	19.7	2.5
Perdue Grain & Oilseed LLC - Bridgeville (<i>gas primary - only 1 boiler allowed to fire residual backup – modeled on oil</i>)	76.80	1.5	7.7	1.0
Sea Watch International, Ltd (<i>3 boilers - gas primary, oil backup, modeled on oil</i>)	70.10	70.10	39.5	5.0
Allen Harim Foods, Inc. (<i>2 boilers gas primary, modeled on oil</i>)	65.20	0.01	18.6	2.3
Perdue Farms, Inc. - Milford (<i>2 boilers, gas primary, modeled on oil</i>)	25.88	0.14	18.6	2.3
IKO Production Wilmington Inc (<i>oxidizer and 2 boilers, gas primary, modeled on oil</i>)	25.23	25.23	12.1	1.5
Hanover Foods Corporation (<i>2 gas/residual oil fired boilers, modeled on oil</i>)	16.67	0.46	32.9	4.2
Milford Memorial Hospital (<i>3 boilers – gas primary, only two allowed to fire residual oil</i>)	11.67	11.67	15.2	1.9
Delaware City Refining Co-Delaware City	38,049.58	333.2	434.2	54.8
E. I. DuPont - Red Lion Plant Acid Plant	60.97	45.5	274.8	34.7

Modeling Methodology

- AERMOD
- 2006-2011 meteorology
- For each facility modeling receptors placed
 - At every 100 m up to 2.5 km
 - At every 200 m up to 5 km
- Modeled design values
 - 5-yr average of the highest 99th-percentile (4th-high) modeled concentrations
- Monitored design value
 - 99th-percentile daily max 1-h values across three years
 - Background Concentrations
 - Bellefonte – a conservative site
 - Bellefonte recorded highest SO₂ concentrations since SO₂ emissions are controlled at the Delaware City Refinery in 2008
 - 2010-2012 DV: 17 ppb (44.5 µg/m³)

Local Phila CBSA SO2 Design Values - 3 yr Avg 99th percentile

- ◆ Bellefonte
- Wilmington
- ▲ Del. City
- Lums Pond
- ✱ Chester County PA
- Montgomery County PA
- + Camden County NJ
- Gloucester County NJ



Modeling Results ($\mu\text{g}/\text{m}^3$) for 1-hour SO_2 Max Hourly PTE Emissions

Facility Name	1-h SO_2 (H4H) Modeled Concentrations		Bellefonte Background (2010-2012 DV)	Total Impact	
	Meteorological Years	5-yr Average			
Indian River Power Plant	2006-2010	30.8	44.5	75.3	
	2007-2011	31.0	44.5	75.5	
Dupont Experimental Station Boiler 3 down; 1&2, 4, & 6 up	2006-2010	157.9	44.5	202.4	
	2007-2011	159.3	44.5	203.8	
Calpine Edge Moor Unit 5	2006-2010	88.5	44.5	133.0	
	2007-2011	88.2	44.5	132.7	
Christiana Care	2006-2010	80.6	44.5	125.1	
	2007-2011	80.5	44.5	125.0	
Perdue Georgetown	2006-2010	120.5	44.5	165.0	
	2007-2011	120.2	44.5	164.7	
DuPont Titanium: Boiler RX1	2006-2010	62.0	44.5	106.5	
	2007-2011	61.6	44.5	106.1	
Fisker Automotive: Boilers 1,2,&3 merged, 4 & 5 separate	2006-2010	200.2	44.5	244.7	
	2007-2011	200.9	44.5	245.4	
Amick Farms	2006-2010	465.1	44.5	509.6	
	2007-2011	456.0	44.5	500.5	
Perdue Grain - Bridgeville	2006-2010	118.0	44.5	162.5	
	2007-2011	119.6	44.5	164.1	
Sea Watch International	2006-2010	470.8	44.5	515.3	352.3
	2007-2011	474.8	44.5	519.3	353.8
Allen Harim Foods	2006-2010	117.9	44.5	162.4	
	2007-2011	117.3	44.5	161.8	
Perdue Farms - Milford	2006-2010	184.9	44.5	229.4	
	2007-2011	186.7	44.5	231.2	
IKO Production Wilmington	2006-2010	173.2	44.5	217.7	
	2007-2011	169.8	44.5	221.5	
Hanover Foods	2006-2010	207.6	44.5	252.1	
	2007-2011	207.4	44.5	251.9	
Milford Memorial Hospital	2006-2010	33.9	44.5	78.4	
	2007-2011	33.5	44.5	78.0	
DuPont Red Lion	2006-2010	134.14	44.5	178.64	
	2007-2011	136.42	44.5	180.92	
Delaware City Refinery	2006-2010	54.9	44.5	99.4	
	2007-2011	55.2	44.5	99.7	

Modeling Results Analysis

- 7 facilities have potential to cause exceedance of 1-h NAAQS
- Facility 1:
 - Highest emissions since 1999 - 103 tpy
 - Not been in operation since 2008
 - 5 boilers operating using residual oil at 1% Sulfur

Modeling Results Analysis Cont'd

- Facility 2:
 - Highest emissions since 1999 - 593 tpy
 - 5 boilers rated at 96 mmBtu/hr each.
 - Boiler 3 is now offline and will restart on natural gas, with no residual oil allowed
 - Facility has potential to exceed the 1-hour SO₂ NAAQS when the remaining four boilers simultaneously operate on residual oil at their rated capacity
 - Facility uses up to four boilers simultaneously in the cold of winter; and only one boiler in the summer.
 - Delaware re-modeled the PTE of this facility and winter meteorology.

DUPONT EXP. STATION - WINTER MONTHS ONLY				
Met. Year		1-h SO ₂ (H4H) 5-yr Average	Background (2010-2012 DV) Bellefonte	Total Impact
2006-2010		127.1	44.5	171.6
2007-2011		127.4	44.5	171.9

Modeling Results Analysis Cont'd

- Facility 3:
 - Highest annual emissions since 1999 - 26 tpy
 - Uses natural gas as a primary fuel (2011 SO₂: 0.12 ton)
 - Has the potential to exceed the 1-hour SO₂ NAAQS when its two boilers (21 mmBtu/hr & 15 mmBtu/hr) simultaneously operate on residual oil at their rated capacity
 - Not causing an exceedance of the 1-h SO₂ NAAQS because it operates on natural gas

Modeling Results Analysis Cont'd

- Facility 4:
 - Highest annual emissions since 1999 - 95 tpy
 - Uses natural gas as a primary fuel(2011 SO₂: 0.02 ton)
 - Has the potential to exceed the 1-hour SO₂ NAAQS when its two boilers (21 mmBtu/hr & 17 mmBtu/hr) simultaneously operate on residual oil at their rated capacity
 - Not causing an exceedance of the 1-h SO₂ NAAQS because it operates on natural gas

Modeling Results Analysis Cont'd

- Facility 5:
 - Highest annual emissions since 1999 - 70 tpy
 - Uses natural gas as a primary fuel
 - Has the potential to exceed the 1-hour SO₂ NAAQS when its three boilers (25 mmbtu/hr each) simultaneously operate on residual oil at their rated capacity
 - Not causing an exceedance of the 1-h SO₂ NAAQS because it operates on natural gas

Modeling Results Analysis Cont'd

- Facility 6:
 - Highest annual emissions since 1999 - 25 tpy
 - Uses natural gas as a primary fuel
 - Operates an asphalt oxidizer (11 mmBtu/hr) and two boilers (6 mmBtu/hr)
 - Has the potential to marginally exceed the 1-hour SO₂ NAAQS when all three units simultaneously operate on residual oil at their rated capacity
 - Not causing an exceedance of the 1-h SO₂ NAAQS because it operates on natural gas

Modeling Results Analysis Cont'd

- Facility 7:
 - Highest annual emissions since 1999 - 17 tpy
 - Uses natural gas as a primary fuel(2011 SO₂: 0.46 ton)
 - Operates an two boilers (34 & 30 mmbtu/hr)
 - Has the potential to marginally exceed the 1-hour SO₂ NAAQS when the two boilers simultaneously operate on residual oil at their rated capacity
 - Not causing an exceedance of the 1-h SO₂ NAAQS because it operates on natural gas

Permitting Implications

- Each of the seven facilities were notified that:
 - Delaware’s air regulations prohibit emissions that cause an exceedance of any NAAQS,
 - Delaware has conducted screening modeling that indicates operations at their facility may under certain operational conditions cause a violation of the 1-hour SO₂ NAAQS,
 - prior to utilizing residual oil the facility shall ensure its operations do not cause an exceedance of the 1-hour SO₂ NAAQS, and
- follow-on steps were taken to clarify the conditions under which residual oil may be used by the facility in the future.
 - Reduction in sulfur in fuel
 - Restriction in number of units operating at the same time
 - Permit cancellation

Conclusion

- Small sources with short stacks have more adverse impact on NAAQS than large sources locally,
- Controls are effective in addressing SO₂ NAAQS exceedances,
- Emissions during start-up, shut-down and malfunction can cause an exceedance of the NAAQS,
- Sulfur-in-fuel strategies are effective,
- Administrative controls in permits can address some violations.
- The entire State of Delaware is in attainment with the 2010 1-hour SO₂ NAAQS.