

US EPA ARCHIVE DOCUMENT

**PIONEER VALLEY ENERGY CENTER
1-HOUR NO2 IMPACTS DURING TURBINE STARTUP EVENTS
SUMMARY OF RESULTS**

NAAQS	188.7 ug/m3	100 ppb
Background	62.3 ug/m3	33 ppb

FUEL	SOURCES	IMPACT	MODELING YEAR					Max 5-year H8H Ave		Total	Compliance?
			1991	1992	1993	1994	1995	(NOx)	(NO ₂)		
ULSD Oil	CT & Aux Boiler	Max H8H	86.6	75.6	60.3	60.2	93.1				
			11.92	48.05	28.72	40.49	36.98	33.23	24.92	87.19	yes
Natural Gas	CT & Aux Boiler	Max H8H	58.1	53.3	70.4	62.4	76.5				
			6.8	16.81	14	27.79	33.01	19.68	14.76	77.03	yes

1) Background, provided by Steve Dennis, MADEP, calculated as the 3-year average of the 98th percentile values, 2007-2009 at Anderson Road, AFB, Chicopee

2) Generator and firepump will not be operated during startup

3) ARM 75% conversion applied for Nox to NO2 conversion

4) AERMOD PLOTFILES used to generate the top 10 values at each receptor. In the event the top eight daily maximum 1-hour values did not occur within the top ten values, the 10th high value was used.

PIONEER VALLEY ENERGY CENTER
Description of Modeling to Assess 1-hour NO₂ Impacts
During Startup Events

The new 1-hour NO₂ National Ambient Air Quality Standard (NAAQS) is based on the 3-year average of the 98th percentile of daily maximum 1-hour values. To determine a Project's impacts for comparison against the standard, the maximum 1-hour impact at each receptor is first determined for each day of the year, resulting in 365 concentrations (or 366 in a leap year). The 98th percentile value is then the 8th highest of these concentrations.

At the present time, AERMOD output can be used to determine the overall 8th highest modeled concentration at each receptor. However, the reported 8th highest values do not take the time period into account. Standard AERMOD output and post-processors do not directly handle the 8th highest of the daily maximum 1-hour values at this time. AERMOD output options can be used to generate the information needed to properly process the values.

EPA has recently issued guidance regarding AERMOD application for the 1-hour NO₂ standard (EPA, 2010). The guidance indicates that AERMOD should be applied with the POSTFILE option for each individual year of meteorological data, creating a concentration file containing modeled values for each receptor location and modeled hour. This file can then be read to determine the maximum 1-hour value at each receptor location and modeled day. The 8th highest modeled concentration is averaged at each receptor location over the 5-year modeling period. The highest of these 5-year averages should be added to regional background to determine a total concentration for comparison to the 1-hour NAAQS.

AERMOD modeling for the Project was performed for the 5-year modeling period (1991 – 1995) following the above guidance with one exception. The PLOTFILE option was applied to output the ten highest modeled concentrations for each year at each receptor location. For each year, the highest ten values were evaluated to determine the eight highest values occurring on different days during the year. In some instances, the ten highest concentrations at a receptor may have been modeled to occur on less than eight different days. For those cases, the overall 10th highest 1-hour concentration was used.

Previous modeling documented compliance for typical operations of the turbine, auxiliary boiler, fire pump and emergency generator. Adding the maximum 5-year average of the 98th percentile daily maximum NO₂ values to the background results in a total NO₂ concentration of 148.5 µg/m³; less than 80% of the 1-hour NO₂ NAAQS. The fire pump and emergency generator were the largest contributors to the maximum values.

Neither the fire pump nor the emergency generator will be operating during startup conditions. Turbine startup exhaust parameters are presented in the attached table. As shown in the table, hour 1 of cold and warm starts are identical in emissions, exhaust flow and exhaust temperature. This initial hour represents the worst-case modeling scenario with the highest emissions and lowest exhaust flow rate. This operating scenario was modeled in conjunction with the auxiliary boiler to determine the worst-case 1-hour NO_x concentrations.

IMPACTS DURING STARTUP WHILE FIRING OIL

The maximum 5-year 98th percentile average NO_x concentration from the turbine startup operations and the auxiliary boiler is 33.2 µg/m³, modeled at UTM coordinate 682679.88, 4672192. To assess NO₂ impacts against the 1-hour NAAQS, these impact levels are properly adjusted using the Ambient Ratio Method (ARM) which specifies that NO₂ impacts are reasonable estimated a 75% of the total NO_x impacts. Thus, the Project's predicted 5-year average 98th percentile NO₂ impact is 24.9. µg/m³.

The closest NO₂ monitor to the site is located in Chicopee. With its urban location, Chicopee provides a conservative background estimate compared to the rural locations of the maximum Project impacts. Background values for use in this analysis were provided by MassDEP. Over the 2007-2009 period, the three-year average of the 98th percentile values at Chicopee is 33 ppb (62.3 µg/m³).

Adding the maximum 5-year average of the 98th percentile daily maximum NO₂ values to the conservative background results in a total NO₂ concentration of 87.2 µg/m³; about 46% of the 1-hour NO₂ NAAQS.

IMPACTS DURING STARTUP WHILE FIRING NATURAL GAS

The maximum 5-year 98th percentile average NO_x concentration from the turbine startup operations and the auxiliary boiler is 19.7 µg/m³, modeled at UTM coordinate 682348.4, 4671481. To assess NO₂ impacts against the 1-hour NAAQS, these impact levels are properly adjusted using the Ambient Ratio Method (ARM) which specifies that NO₂ impacts are reasonable estimated a 75% of the total NO_x impacts. Thus, the Project's predicted 5-year average 98th percentile NO₂ impact is 14.8. µg/m³.

Adding the maximum 5-year average of the 98th percentile daily maximum NO₂ values to the background level summarized above for Chicopee monitoring station results in a total NO₂ concentration of 77.0 µg/m³; about 40% of the 1-hour NO₂ NAAQS.

References

MADEP, 2010. Email from Stephen Dennis, MADEP, to Dammon Frecker, ESS Group. April 2, 2010.

PIONEER VALLEY ENERGY CENTER
Assessment of 1-Hour SO₂ Impacts

Modeling performed in support of the original air permit application was sufficient to demonstrate compliance with the 1-hour SO₂ standard. Table 14 contained in the air permit application presents the individual source pollutant impacts. Maximum values from the turbine, auxiliary boiler, emergency generator, fire pump and cooling tower are added together, regardless of modeled location or time period, to provide a conservative estimate of the potential impact from the facility. The table was revised to include a calculation for 1-hour SO₂. The maximum turbine impact is 3.27 µg/m³. Maximum values for the auxiliary boiler, emergency generator, and fire pump are 0.13, 0.35 and 0.57 µg/m³, respectively. The potential total from the Facility is 4.32 µg/m³.

The closest SO₂ monitor to the Facility is located in Springfield. Monitor values for 2006-2008 were determined from EPA's AIRS website. The website presents only the maximum and 2nd highest 1-hour values for each year. The highest of the second-high values is 0.044 ppm (114.4 µg/m³). Adding the modeled 4.32 µg/m³ to this background results in a total concentration of 118.7 µg/m³, well below the 195 µg/m³ (75 ppb) NAAQS.

**PIONEER VALLEY ENERGY CENTER
TURBINE EXHAUST AND EMISSIONS DURING STARTUP PERIODS**

Fuel	Start Type	Hour	Tstk		Mstk	Qstk		E _{NOx}	Comments
			(°C)	(°F)	(tons/hr)	(Ft ³ /hr)	(Ft ³ /min)	(lbs/hr)	
Gas	Cold	1	100	212	1273.2	36,009,697	600,162	57.0	Worst case hour
		2	101	214	1372.3	38,881,833	648,031	43.0	Higher temp and flow, lower emission rate than hour 1
		3	101	214	1372.3	38,881,833	648,031	43.0	Same as hour 2
		4	99	210	1373.3	38,771,449	646,191	43.0	
		5	79	174	1792.4	48,793,111	813,219	27.0	
	Warm	1	100	212	1273.2	36,009,697	600,162	57.0	Same as hour 1 for cold start
		2	89	192	1602.3	44,427,409	740,457	34.0	Lower emission rate, higher flow, nearly same temp as hour 4 cold start
		3	80	176	2151.8	58,685,455	978,091	20.0	Lower emission rate, higher flow, nearly same temp as hour 5 cold start
	Hot	1	88	190	1404.8	38,880,323	648,005	57.0	Same E rate, 22°F lower Tstk, higher stack flow rate
ULSD	Cold	1	109	228.2	1288.4	37,025,232	617,087	100.0	Worst case hour
		2	115	239	1389.9	40,363,258	672,721	86.0	Higher temp and flow, lower emission rate than hour 1
		3	115	239	1389.9	40,363,258	672,721	86.0	Same as hour 2
		4	113	235	1391.8	40,277,848	671,297	82.0	
		5	95	203	1849.9	51,853,258	864,221	52.0	
	Warm	1	109	228	1288.4	37,025,232	617,087	100.0	Same as hour 1 for cold start
		2	104	219	1641.3	46,752,182	779,203	67.0	Lower emission rate, higher flow, nearly same temp as hour 4 cold start
		3	97	207	2237.4	62,941,000	1,049,017	41.0	Lower emission rate, higher flow, nearly same temp as hour 5 cold start
	Hot	1	99	210	1458.8	41,185,313	686,422	98.0	Slightly E rate as hour 1 cold start, 18°F lower Tstk, higher stack flow rate

Table 14
Pioneer Valley Energy Center
Refined Modeling - Individual Source Contributions and Cumulative Impacts¹

Source		Turbine Gas	Turbine Gas	Turbine ULSD	Turbine ULSD	Turbine ULSD	Aux Boiler	Egen	Firepump	Cooling Tower		
Load (%)		100	100	100	75	60	100	100	100			
Amb Temp (F)		10	59	59	59	59						
Hours/Day		24	24	24	24	24	24	24	24	24		
Hours/Year		8760	8760	1440	1440	1440	1100	300	300	8760		
Maximum Emission Rates (g/sec)												
NOx		2.5452	2.268	5.3802	3.7548	3.528	0.07686	4.72	0.40	0.00		
CO		1.5498	1.386	3.9312	2.7468	2.583	0.09828	1.54	0.03	0.00		
SO2		0.5922	0.5292	0.4284	0.3024	0.2898	0.001386	0.010	0.0009	0.0000		
PM10		1.2348	1.1088	3.1248	2.142	2.016	0.0126	0.11	0.011	0.00129		
PM2.5		1.2348	1.1088	3.1248	2.142	2.016	0.0126	0.11	0.011	0.00129		
AERMOD Results @ 1 g/sec Emission Rate												
1-hr	1991	5.46442	5.77111	4.97565	5.82219	6.63447	93.69354	34.7684	619.6059	386.503		
	1992	5.52505	6.04423	4.73867	6.28353	6.68999	84.07355	33.40039	628.2822	376.8898		
	1993	4.41569	4.69391	4.0272	4.77486	6.48149	88.83788	32.70624	586.1635	385.5608		
	1994	4.82673	5.02413	4.64041	5.28705	6.1373	78.72094	34.90324	642.1148	415.4806		
	1995	5.29243	5.26879	5.23679	5.49294	7.21722	78.33467	35.20649	642.6773	453.6638		
	Max	5.53	6.04	5.24	6.28	7.22	93.69	35.21	642.68	453.66		
3-hr	1991	1.82156	1.92376	1.66015	2.00334	2.43237	66.59963	25.05188	324.5877	317.0461		
	1992	1.84168	2.01474	1.57956	2.09451	2.23	63.28343	27.22712	287.2406	321.8655		
	1993	2.05855	2.17	1.82805	2.18918	2.30482	62.56245	22.4845	294.6932	328.6051		
	1994	2.2125	2.38915	1.9231	2.44699	2.65802	63.65082	23.14409	334.2945	351.9251		
	1995	2.69376	2.92485	2.32404	3.01233	3.35695	62.37524	22.46113	318.1642	372.2697		
	Max	2.69	2.92	2.32	3.01	3.36	66.60	27.23	334.29	372.27		
8-hr	1991	0.92244	0.97355	0.83112	1.02324	1.19176	48.46002	17.1293	277.6808	247.6317		
	1992	0.92101	1.00749	0.83781	1.04732	1.27368	53.02006	17.77643	206.9909	248.0765		
	1993	1.06	1.11021	0.95024	1.15581	1.35477	48.9529	17.55244	234.1963	291.889		
	1994	0.94027	1.00855	0.86737	1.03145	1.14519	48.79144	16.53201	193.7455	300.6087		
	1995	1.01024	1.09691	0.89489	1.12972	1.25896	53.04829	16.95941	212.3369	300.2195		
	Max	1.06	1.11	0.95	1.16	1.35	53.05	17.78	277.68	300.61		
24-hr	1991	0.503	0.57234	0.46203	0.65689	0.79771	36.37261	12.52423	167.1321	171.2568		
	1992	0.48324	0.53317	0.45901	0.61012	0.72377	48.33433	12.8867	167.0492	137.0082		
	1993	0.41105	0.49419	0.38449	0.56266	0.66208	43.60943	11.83057	136.2371	183.587		
	1994	0.51462	0.56431	0.47244	0.65298	0.77883	36.18283	14.12568	159.5688	239.3		
	1995	0.54944	0.61175	0.52566	0.69046	0.81389	35.63425	11.80979	116.6792	202.0533		
	Max	0.55	0.61	0.53	0.69	0.81	48.33	14.13	167.13	239.30		
Annual	1991	0.03455	0.03957	0.03034	0.04451	0.05614	6.67739	1.77129	23.95573	10.96702		
	1992	0.0437	0.04957	0.03866	0.05568	0.06895	6.85845	2.05151	25.75367	16.11628		
	1993	0.05049	0.05754	0.04498	0.06458	0.08013	6.98917	2.12075	26.79208	21.42589		
	1994	0.04903	0.05529	0.04352	0.06207	0.07652	6.56065	2.03488	26.30148	22.9563		
	1995	0.0414	0.04721	0.0373	0.05348	0.06563	7.83766	1.70933	25.69106	28.86032		
	Max	0.05	0.06	0.04	0.06	0.08	7.84	2.12	26.79	28.86		
AERMOD Results @ Maximum Emission Rates										Total	SIL	
NOx	Annual		0.13	0.04	0.04	0.05	0.08	0.34	0.37	0.00	0.97	1
CO	1-hr	8.56	8.38	20.59	17.26	18.64	9.21	54.12	20.24	0.00	104.16	2000
CO	8-hr	1.64	1.54	3.74	3.17	3.50	5.21	27.33	8.75	0.00	18.24	500
SO2	1-hr	3.27	3.20	2.24	1.90	2.09	0.13	0.35	0.57	0.00	4.32	
SO2	3-hr	1.60	1.55	1.00	0.91	0.97	0.09	0.27	0.29	0.00	1.99	25
SO2	24-hr	0.33	0.32	0.23	0.21	0.24	0.07	0.14	0.15	0.00	0.46	5
SO2	Annual		0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	1
PM10	1-hr							4.04	6.88			
PM10	24-hr	0.68	0.68	1.64	1.48	1.64	0.61	1.62	1.79	0.31	3.02	5
PM10	Annual		0.06	0.02	0.02	0.03	0.01	0.01	0.01	0.04	0.16	1
PM2.5	1-hr							4.04	6.88			
PM2.5	24-hr	0.68	0.68	1.64	1.48	1.64	0.61	1.62	1.79	0.31	3.02	2
PM2.5	Annual		0.06	0.02	0.02	0.03	0.01	0.01	0.01	0.04	0.16	0.3

Concurrent Operations
Emergency Generator
Firepump

1
1