

CALPUFF MODELING RESULTS ADDENDUM FOR THE



MARTIN DRAKE POWER PLANT'S SYNTHETIC MINOR PERMIT APPLICATION

By: Jenny A. Gray, E.I.

Reviewed By: Dale H. Adams, P.E.

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CALPUFF MODELING RESULTS ADDENDUM FOR THE MARTIN DRAKE POWER PLANT

Shortly after the CALPUFF Modeling Results for the Martin Drake Power Plant report (dated August 17, 2007) was submitted, an error involving the modeled SOA emission rate for both Units #6 and #7 was discovered. This addendum to the report is being submitted to demonstrate that the error has essentially no impact on the modeled visibility impact, and does not alter the BART synthetic minor determination.

Description of Error

A data entry error was made on the SOA emission rate of Unit #7. Since Unit #6 SOA emissions were scaled from Unit #7, Unit #6 SOA emissions were also incorrect. The SOA emissions for Unit #7 were originally modeled as 0.616 lb/hr (0.078 g/s), but should have been modeled as 0.904 lb/hr (0.114 g/s). In addition, the SOA emissions for Unit #6 were originally modeled as 0.403 lb/hr (0.051 g/s), but should have been modeled as 0.592 lb/hr (0.075 g/s). Shown below in Table 1 are the initially submitted SOA emissions rates as well as the corrected emissions rates.

Table 1: Modeled Emissions

	SOA emission rate as initially submitted		SOA emission rate - Corrected	
	(lb/hr)	(g/s)	(lb/hr)	(g/s)
Drake Unit #5	0.474	0.060	No change	No change
Drake Unit #6	0.403	0.051	0.592	0.075
Drake Unit #7	0.616	0.078	0.904	0.114

The correction of the SOA emission rate is an increase (plantwide) of 0.477 lb/hr (0.060 g/s) compared to the previously modeled emission rate. This correction corresponds to a 31.9% increase in the plantwide SOA emission rate. Note, the corrected SOA emission rate for Unit #7 matches the stack test results submitted in the initial report.

Estimated Impact of Corrected Emission Rate

Based on the total modeled visibility impact, the percent of the impact attributable to SOA (%OC in the CalPuff model), and the small increase to the emission rate of SOA, an estimate of the

“corrected” impact can be made. Inspection of Table 32 of the initial report, which shows the 8 highest days of impact for each scenario, reveals that the 2002 “Base Case” scenario is the closest to exceeding the BART exemption threshold, and will therefore be the most likely to exceed the threshold due to the increase in modeled SOA emissions. (This assertion will be tested later in this section) Similarly, by inspection, it can be seen that the Rocky Mountain National Park (RMNP) is the Class I Area with the largest modeled visibility impact, and will be the most likely to exceed the BART exemption threshold due to an increase in modeled emissions. Data from the standard CalPost output file for the “2002 Base Case” scenario (submitted on DVD with the initial report) shows that SOA (called OC in the CalPost table) contributes 0.12% of the 0.496 dV impact on day 275 at RMNP. See Table 2 below. Multiplying the OC contribution by the overall visibility impact will give the impairment due to OC alone:

$$0.12\% \times (1/100\%) \times 0.496\text{dV} = 0.0005952 \text{ dV (initial OC contribution)}$$

Table 2: 8 Highest Impact Days at Rocky Mountain National Park

Year 2002 Day	“Base Case” scenario as initially submitted	
	Delta dV	%OC (SOA)
305	1.906	0.08
297	1.55	0.08
93	0.855	0.12
304	0.836	0.09
30	0.672	0.15
84	0.617	0.08
129	0.568	0.11
275	0.496	0.12

The increase in the plantwide SOA emission rate has been previously determined to be 31.9%. This increase of emissions is assumed to linearly increase the impairment attributable to OC, which even in non-linear systems, is a reasonable approximation for incremental changes. The validity of this assumption will be verified using actual modeling results in a later section. The increased OC impairment is calculated to be:

$$31.9\% \times (1/100\%) \times 0.0005952 \text{ dV} = 0.0001899 \text{ dV (increased OC contribution)}$$

Therefore the total impairment at RMNP in 2002 on the 98th percentile day (day 275) is estimated to be:

$$0.496 \text{ dV} + 0.0001899 \text{ dV} = 0.4961899 \text{ dV (estimated total impairment)}$$

Note that the CalPuff model (and the CDPHE's BART modeling guidance) rounds the visibility impairment off at the third decimal place. This being the case, the estimated visibility impact using the corrected emission rate would be the same as the value initially submitted (0.496 dV). In the event that the initially reported emission rate was already rounded down, say from 0.4964999 dV, the result of this correction would be (in the very worst case):

$$0.4964999 \text{ dV} + 0.0001899 \text{ dV} = 0.4966898 \text{ dV (estimated worst case impairment)}$$

which would round to 0.497dV, which is still below the BART exemption threshold. This is just an estimate of the impact that the corrected emission rate will have in the visibility impairment modeling. This estimate can be similarly calculated for the remaining scenarios of the initial report to demonstrate that the increased impairment due to the increased SOA emission rate is extremely small, and does not change the synthetic minor conclusion in the initial report. These estimates have been calculated and are shown below in Table 3. By inspection of Table 3, it can be seen that the assertion made in the first paragraph of this section is true; the estimated increase in impairment due to the increased SOA emissions is of such a small magnitude that if the 2002 "Base Case" scenario does not exceed the exemption threshold, then no scenario will exceed the threshold.

Table 3: Estimated Impact Increase on 8th High Day at RMNP

Initial Report Results						Estimated Impacts due to increased SOA	
Scenario	Year	8th High Day	Total Impact (dV)	%OC	OC Impact (dV)	Increased SOA Impact* (dV)	Calculated Total Impact (dV)
Base Case	2002	275	0.496	0.12	0.000595	0.000190	0.496
Typical Emissions	2002	275	0.495	0.12	0.000594	0.000189	0.495
NOx Variation 1	2002	275	0.496	0.12	0.000595	0.000190	0.496
NOx Variation 2	2002	275	0.496	0.12	0.000595	0.000190	0.496
SO2 Variation 1	2002	275	0.478	0.09	0.000430	0.000137	0.478
SO2 Variation 2	2002	275	0.484	0.09	0.000436	0.000139	0.484
SO2 Variation 3	2002	275	0.446	0.05	0.000223	0.000071	0.446
SO2 Variation 4	2002	275	0.488	0.09	0.000439	0.000140	0.488
Base Case	1996	321	0.473	0.13	0.000615	0.000196	0.473
Base Case	2001	58	0.295	0.11	0.000325	0.000104	0.295

Verification of Impact from Increased Emission Rate

The increase in visibility impairment at RMNP on the 8th high day (the 98th percentile day) in the 2002 “Base Case” scenario was estimated in the previous section to be 0.0001899 dV, or essentially from 0.000 dV to 0.001 dV change in impact when rounding is applied. The CalPuff model was re-run for the 2002 Base Case scenario to verify this estimate. The results of this verification run are presented in Table 4 below. As can be seen in the table, the modeled impairment did not increase, which is what was predicted by the estimate above. Inspection of the data shows that the increased SOA emissions do cause a very small increase in the magnitude of the visibility impact (on days above the 98th percentile), but even on the days with the very largest magnitude of total impact, the proportional impact of SOA along with the very small increase to the SOA emission rate will yield a very small increase in visibility impact. This very small increase in the visibility impact will not cause the plant to exceed the BART exemption threshold on the 98th percentile day in any of the scenarios modeled previously.

Table 4: 8 Highest Impact Days at Rocky Mountain National Park

Year 2002 Days*	“Base Case” scenario as initially submitted		“Base Case” scenario – Corrected	
	Delta dV	%OC (SOA)	Delta dV	%OC (SOA)
305	1.906	0.08	1.907	0.11
297	1.55	0.08	1.55	0.10
93	0.855	0.12	0.856	0.15
304	0.836	0.09	0.837	0.12
30	0.672	0.15	0.673	0.20
84	0.617	0.08	0.618	0.11
129	0.568	0.11	0.569	0.15
275	0.496	0.12	0.496	0.16

*Note: The eight highest days were the same for both the initially submitted and the corrected modeling runs.

Summary

An error in the modeled emissions was discovered; the SOA emission rate for Unit #6 and Unit #7 was set too low in the initial report. The correct SOA emission rates were determined. The potential impact of the corrected emission rates was estimated assuming that an increase in emissions will be linearly reflected in the visibility impact. The estimates showed that the increased SOA emission rates will not materially increase the modeled visibility impairment. The worst case scenario, the 2002 Base Case, was modeled to confirm the estimate of the impact of the increased SOA emission rates. The modeling confirmed that the increased SOA emissions did not have a material impact on the modeled visibility impact. Using both the estimate of the

increase in visibility impairment as well as the confirmation modeling, it has been demonstrated that the corrected SOA emission rates do not alter the previous report's conclusion that the synthetic minor emission rates will allow the Martin Drake Power Plant to fall below the "subject to BART" threshold.

APPENDIX A

Title from CALPOST:
DRAKE - Eagles Nest WA (EAG);Pass_5_2 ; spec PM emiss.
MVISBK=6; EPA2003 centroid monthly $\bar{f}$ (RH); EPA2003 20%bestdays natural backgrd
2002 12km MM5, 0.5km CALMET, hourly ozone; DRAKE

Days processed: 364
Receptors processed: 213
CALPOST species: ALL
Contribution threshold (or user-specified threshold): 0.5

Summary of delta-deciview results:

The largest delta-deciview change is: 0.887 dv
Number of days with delta-deciview => 0.5: 2
Number of days with delta-deciview => 1.00: 0

98th Percentile Results:

Method 1. DAY-SPECIFIC - closest modeled value:
The ' 8 High' value from the model is: 0.209 dv
at receptor 666 on day 200(2002)

Method 2a. RECEPTOR-SPECIFIC - closest modeled value:
The 'High 8 High' value from the model is: 0.175 dv
at receptor 786 on day 74(2002)
Number of days with delta-deciview => 0.5: 0
Number of days with delta-deciview => 1.00: 0

Method 2b. RECEPTOR-SPECIFIC - Weighted Average at X[(n+1)p]:
The calculated 98th percentile value
using a weighted averaging method is: 0.189 dv
at receptor 666
using days 200(2002) and 197(2002)

Title from CALPOST:
DRAKE - Great Sand Dune NP (GSD; Pass_5_2; spec PM emiss.
MVISBK=6; EPA2003 centroid monthly f(RH); EPA2003 20%bestdays natural backgrd
2002 12km MM5, 0.5km CALMET, hourly ozone; DRAKE

Days processed: 364
Receptors processed: 195
CALPOST species: ALL
Contribution threshold (or user-specified threshold): 0.5

Summary of delta-deciview results:

The largest delta-deciview change is: 1.033 dv
Number of days with delta-deciview => 0.5: 4
Number of days with delta-deciview => 1.00: 1

98th Percentile Results:

Method 1. DAY-SPECIFIC - closest modeled value:
The ' 8 High' value from the model is: 0.392 dv
at receptor 150 on day 10(2002)

Method 2a. RECEPTOR-SPECIFIC - closest modeled value:
The 'High 8 High' value from the model is: 0.374 dv
at receptor 192 on day 10(2002)
Number of days with delta-deciview => 0.5: 0
Number of days with delta-deciview => 1.00: 0

Method 2b. RECEPTOR-SPECIFIC - Weighted Average at X[(n+1)p]:
The calculated 98th percentile value
using a weighted averaging method is: 0.380 dv
at receptor 193
using days 4(2002) and 10(2002)

Title from CALPOST:
BART- Rawah (RAW); Pass_5_2 ;spec PM emiss
MVISBK = 6; EPA2003 centroid monthly f(RH); EPA2003 20%bestdays natural backgrd
2002 36km MM5, 0.5km CALMET, hourly ozone; DRAKE

Days processed: 364
Receptors processed: 116
CALPOST species: ALL
Contribution threshold (or user-specified threshold): 0.5

Summary of delta-deciview results:

The largest delta-deciview change is: 1.189 dv
Number of days with delta-deciview => 0.5: 3
Number of days with delta-deciview => 1.00: 1

98th Percentile Results:

Method 1. DAY-SPECIFIC - closest modeled value:
The ' 8 High' value from the model is: 0.228 dv
at receptor 819 on day 200(2002)

Method 2a. RECEPTOR-SPECIFIC - closest modeled value:
The 'High 8 High' value from the model is: 0.225 dv
at receptor 830 on day 200(2002)
Number of days with delta-deciview => 0.5: 0
Number of days with delta-deciview => 1.00: 0

Method 2b. RECEPTOR-SPECIFIC - Weighted Average at X[(n+1)p]:
The calculated 98th percentile value
using a weighted averaging method is: 0.229 dv
at receptor 840
using days 75(2002) and 200(2002)

Title from CALPOST:
DRAKE - Rocky Mtn NP (ROM); Pass 5_2 ; spec PM emiss.
MVISBK=6; EPA2003 centroid monthly f(RH); EPA2003 20%bestdays natural backgrd
2002 12km MM5, 0.5km CALMET, hourly ozone; DRAKE

Days processed: 364
Receptors processed: 407
CALPOST species: ALL
Contribution threshold (or user-specified threshold): 0.5

Summary of delta-deciview results:

The largest delta-deciview change is: 1.907 dv
Number of days with delta-deciview => 0.5: 7
Number of days with delta-deciview => 1.00: 2

98th Percentile Results:

Method 1. DAY-SPECIFIC - closest modeled value:
The ' 8 High' value from the model is: 0.496 dv
at receptor 222 on day 275(2002)

Method 2a. RECEPTOR-SPECIFIC - closest modeled value:
The 'High 8 High' value from the model is: 0.496 dv
at receptor 222 on day 275(2002)
Number of days with delta-deciview => 0.5: 0
Number of days with delta-deciview => 1.00: 0

Method 2b. RECEPTOR-SPECIFIC - Weighted Average at X[(n+1)p]:
The calculated 98th percentile value
using a weighted averaging method is: 0.534 dv
at receptor 323
using days 129(2002) and 275(2002)
