Attachment to Statement of Basis

Revised CAM Plan

Duke Energy Florida, Inc. (DEF) provided the following comments regarding the excursion level indication found in the revised PM CAM Plan for Crystal River Units 1 and 2 associated with the recently issued draft Title V permit revision (0170004-043-AV). DEF requested that the currently proposed method of determination of a PM CAM excursion found in the draft permit be revised per the follow discussion.

Golder Associates Analysis

Golder Associates staff reviewed the PM, Opacity, and Power Level data available to determine the best statistical approach for the revised PM CAM Plan. The results are as follows:

Unit 1: Multiple regression using dependent variable Log10 PM, and independent variables Log10 ESP Power and Log10 Opacity

Unit 2: Multiple regression using dependent variable Log10 PM, and independent variables ESP Power and Opacity

The **Table 1** below shows an example regression run utilizing the specified independent variables of opacity and ESP power level for unit 1 and 2. As seen the predicted PM level (dependent variable) is 0.060 lb/MMBtu for unit 1 and 0.030 lb/MMBtu for unit 2.

TABLE 1. GOLDER ASSOCIATES ANALYSIS (EXAMPLE REGRESSION RUN).

Unit 1 Heat Input =	3750.00
Unit 1 Opacity =	17.00
Unit 1 ESP Power =	100.00
Unit 2 Heat Input =	4795.00
Unit 2 Opacity =	10.00
Unit 2 ESP Power =	570.00
Unit 1 PM=	0.060
Unit 2 PM =	0.030
Wt. Avg=	0.043

Notes:

For Unit 2, the best fitting model was determined to include ESP Power as the only significant independent variable, but Opacity was added to the model since it was requested to be included in the CAM Plan.

Using a multiple regression approach, it is not possible to say that both variables must be out of their acceptable ranges for an excursion to occur. The PM value is now dependent on both Opacity and Power Levels, so both are used to determine excursions. In the attached excel spreadsheet, tables have been created to show this. A table has also been created that can be used to plug in operating data and calculate the weighted average using the regression models. Using this, there is no set “trigger level” for opacity or power level to determine an excursion. If opacity is lower, then a higher power level is allowed, and vice versa. This offers a more flexible solution. Note that when using the tool, the values in light green are those that can be changed based on operating conditions. This can be interfaced with the existing

monitoring equipment in order to calculate real time weighted averages for the plant; however, DEF is requesting that once the curves (noted below) are established for the two units average that each unit be allowed to operate on its curve independent of the other unit's operation. This will address issues when one unit is off line, but not affect the overall intent of this requirement.

The initial target level to meet the two unit weighted average of 0.04 lb/MMBtu is 0.060 lb/MMBtu or less for Unit 1, and 0.030 lb/MMBtu or less for Unit 2 (see **Table 1**). Each unit would meet its target independently.

Table 2 and **Table 3** below are graphical displays of the three dimensional relationship between PM emissions (dependent variable) and opacity and ESP power (independent variables). The green region of the tables represents operation in an acceptable range. The yellow region is the transition from acceptable to possible excursion. The red region indicates a possible excursion warranting an investigation.

TABLE 2. UNIT 1 REGRESSION DATA.

UNIT 1											
OPACITY (%)	ESP POWER LEVEL (KW)										
	0	50	100	150	200	250	300	350	400	450	500
0											
1		0.006	0.005	0.004	0.004	0.004	0.003	0.003	0.003	0.003	0.003
2		0.011	0.009	0.008	0.007	0.007	0.006	0.006	0.006	0.006	0.006
3		0.016	0.013	0.011	0.010	0.010	0.009	0.009	0.008	0.008	0.008
4		0.020	0.017	0.015	0.013	0.013	0.012	0.011	0.011	0.011	0.010
5		0.025	0.020	0.018	0.016	0.015	0.015	0.014	0.013	0.013	0.012
6		0.029	0.024	0.021	0.019	0.018	0.017	0.016	0.016	0.015	0.015
7		0.033	0.027	0.024	0.022	0.021	0.020	0.019	0.018	0.017	0.017
8		0.038	0.031	0.027	0.025	0.023	0.022	0.021	0.020	0.019	0.019
9		0.042	0.034	0.030	0.028	0.026	0.024	0.023	0.022	0.022	0.021
10		0.046	0.037	0.033	0.030	0.028	0.027	0.026	0.025	0.024	0.023
11		0.050	0.041	0.036	0.033	0.031	0.029	0.028	0.027	0.026	0.025
12		0.054	0.044	0.039	0.036	0.033	0.032	0.030	0.029	0.028	0.027
13		0.058	0.047	0.042	0.038	0.036	0.034	0.032	0.031	0.030	0.029
14		0.062	0.050	0.044	0.041	0.038	0.036	0.034	0.033	0.032	0.031
15		0.066	0.053	0.047	0.043	0.041	0.038	0.037	0.035	0.034	0.033
16		0.070	0.057	0.050	0.046	0.043	0.041	0.039	0.037	0.036	0.035
17		0.073	0.060	0.053	0.048	0.045	0.043	0.041	0.039	0.038	0.037
18		0.077	0.063	0.056	0.051	0.048	0.045	0.043	0.041	0.040	0.039
19		0.081	0.066	0.058	0.053	0.050	0.047	0.045	0.043	0.042	0.041
20		0.085	0.069	0.061	0.056	0.052	0.050	0.047	0.045	0.044	0.042
21		0.089	0.072	0.064	0.058	0.055	0.052	0.049	0.047	0.046	0.044
22		0.092	0.075	0.066	0.061	0.057	0.054	0.051	0.049	0.048	0.046
23		0.096	0.078	0.069	0.063	0.059	0.056	0.054	0.051	0.050	0.048
24		0.100	0.081	0.072	0.066	0.061	0.058	0.056	0.053	0.052	0.050
25		0.103	0.084	0.074	0.068	0.064	0.060	0.058	0.055	0.053	0.052

TABLE 3. UNIT 2 REGRESSION DATA.

UNIT 2												
OPACITY (%)	ESP POWER LEVEL (KW)											
	0	100	200	300	400	500	600	700	800	900	1000	1100
0	0.113	0.081	0.058	0.042	0.030	0.021	0.015	0.011	0.008	0.006	0.004	0.003
1	0.120	0.086	0.062	0.044	0.032	0.023	0.016	0.012	0.008	0.006	0.004	0.003
2	0.127	0.091	0.065	0.047	0.033	0.024	0.017	0.012	0.009	0.006	0.005	0.003
3	0.134	0.096	0.069	0.049	0.035	0.025	0.018	0.013	0.009	0.007	0.005	0.003
4	0.142	0.102	0.073	0.052	0.037	0.027	0.019	0.014	0.010	0.007	0.005	0.004
5	0.150	0.108	0.077	0.055	0.040	0.028	0.020	0.015	0.010	0.007	0.005	0.004
6	0.159	0.114	0.082	0.059	0.042	0.030	0.022	0.015	0.011	0.008	0.006	0.004
7	0.168	0.121	0.086	0.062	0.044	0.032	0.023	0.016	0.012	0.008	0.006	0.004
8	0.178	0.128	0.092	0.066	0.047	0.034	0.024	0.017	0.012	0.009	0.006	0.005
9	0.189	0.135	0.097	0.069	0.050	0.036	0.026	0.018	0.013	0.009	0.007	0.005
10	0.200	0.143	0.103	0.074	0.053	0.038	0.027	0.019	0.014	0.010	0.007	0.005
11	0.211	0.152	0.109	0.078	0.056	0.040	0.029	0.021	0.015	0.011	0.008	0.005
12	0.224	0.160	0.115	0.082	0.059	0.042	0.030	0.022	0.016	0.011	0.008	0.006
13	0.237	0.170	0.122	0.087	0.062	0.045	0.032	0.023	0.016	0.012	0.008	0.006
14	0.251	0.180	0.129	0.092	0.066	0.047	0.034	0.024	0.017	0.012	0.009	0.006
15	0.265	0.190	0.136	0.098	0.070	0.050	0.036	0.026	0.018	0.013	0.009	0.007
16	0.281	0.201	0.144	0.103	0.074	0.053	0.038	0.027	0.020	0.014	0.010	0.007
17	0.297	0.213	0.153	0.109	0.078	0.056	0.040	0.029	0.021	0.015	0.011	0.008
18	0.315	0.226	0.162	0.116	0.083	0.059	0.043	0.031	0.022	0.016	0.011	0.008
19	0.333	0.239	0.171	0.123	0.088	0.063	0.045	0.032	0.023	0.017	0.012	0.009
20	0.353	0.253	0.181	0.130	0.093	0.067	0.048	0.034	0.025	0.018	0.013	0.009

Department Review

The Department reviewed the above analysis and is in agreement that the approach is valid in developing an effective CAM plan for PM emissions using opacity and ESP power as independent variables.

Golder Associates used a data set of size 36 for Unit 1 and 38 for Unit 2. Using these data sets, the Department calculated the accuracy of predicting exceedances using the two color coded charts given in **Figure 1** (Unit 1) and **Figure 2** (Unit 2) below. For Unit 1 the probability of a "correct" prediction was 0.89. For Unit 2 the corresponding value was 0.92. These numbers are high enough to give the Department reasonable assurance that the approach is sound.

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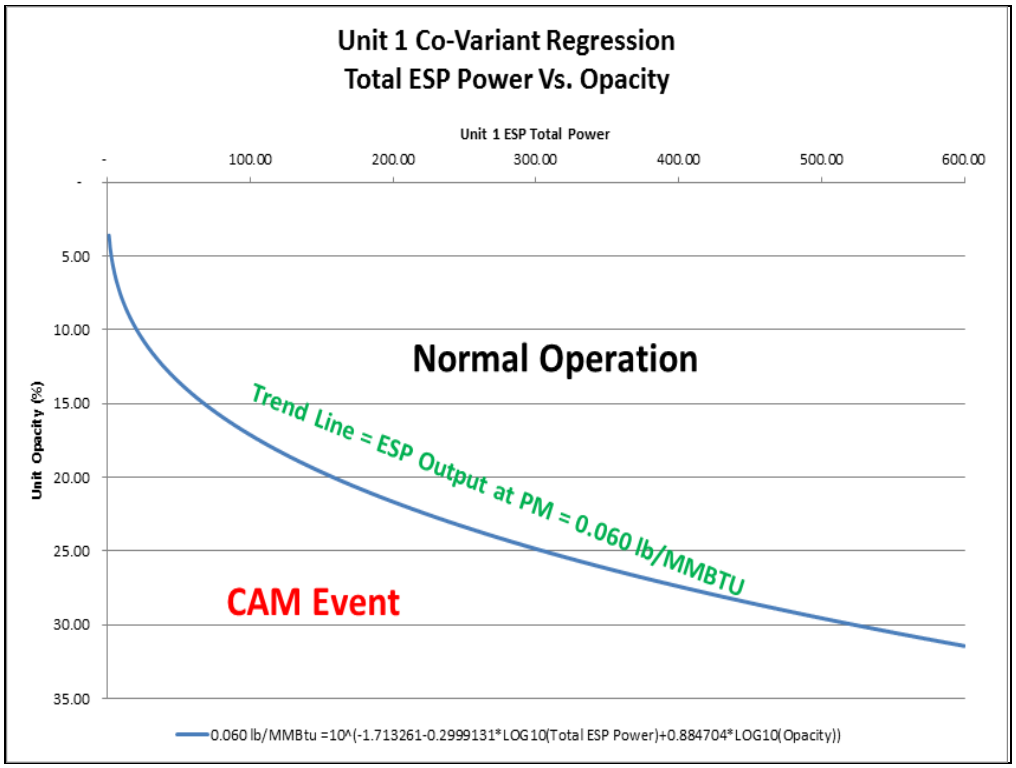

Figure 1 – Unit 1 Regression Curves.

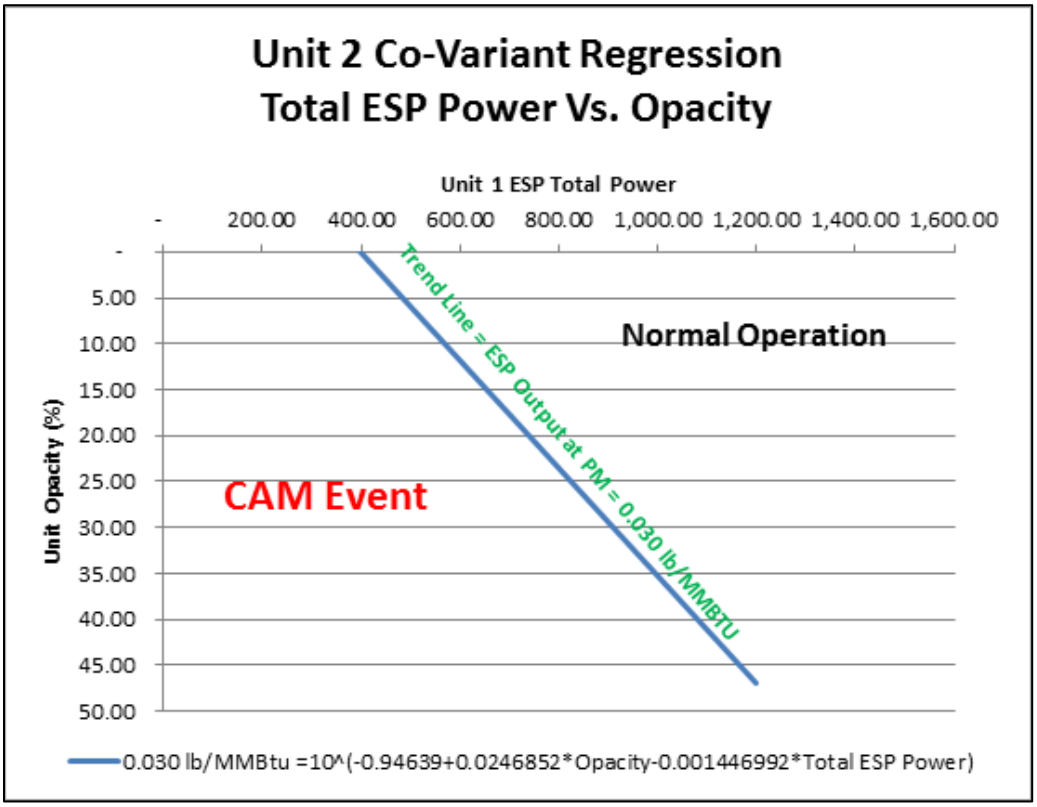

Figure 2 – Unit 2 Regression Curves.