



ARC ENGINEERING & CONSTRUCTION, P.C.

February 5, 2010

Planning Board
Town of Wawayanda
80 Ridgebury Hill Road
P.O. Box 296
Slate Hill, New York 10973

**RE: CPV Valley Energy Center
Air Emissions / Air Quality Technical Memorandum
Completeness Recommendation**

Dear Chairperson Parsons and Planning Board Members:

ARC Engineering & Construction, P.C. (ARC) reviewed the air emissions / air quality technical memorandum, dated December 2, 2009; which was prepared by the applicant's consultant. Consistent with our presentation to the Planning Board, ARC's prior comments were satisfactorily addressed by this memorandum.

Accordingly, the December 2nd memorandum was recommended by ARC for Planning Board acceptance as **complete and ready for public review and comment**. This recommendation was presented to the Planning Board at their meeting on January 27, 2010.

If you have any questions or comments, please feel free to contact me at the telephone number listed below, or by cell phone at (609) 575-8875. Thank you for the opportunity to be of service.

Very truly yours,

ARC ENGINEERING & CONSTRUCTION, P.C.

A handwritten signature in black ink, appearing to read 'Stephen J. Fleischacker', written in a cursive style.

Stephen J. Fleischacker, P.E., BCEE
Principal

SJF/wp

cc: W. Bavosa, Esq.; Planning Board Attorney
P. Hines, Planning Board Engineer

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Memorandum

To: Patrick J. Hines, McGoey, Hauser & Edsall
Consulting Engineers, PC

From: Laura Lefebvre and Glenn Harkness, TRC

Subject: CPV Valley - Response to Comments from Steve Fleischacker of ARC Engineering and Construction, dated July 14, 2009 and September 23, 2009

Date: December 2, 2009

CC: Patt Battiato, Steve Fleischacker, Steve Remillard

This memorandum provides responses to comments from ARC Engineering and Construction dated July 14, 2009; September 23, 2009; and November 17, 2009 on the following technical memoranda that were submitted to Mr. Patrick J. Hines in response to comments received on the DEIS:

- Response to George M. Janes & Associates Comments on the CPV Valley DEIS regarding Visibility of Plumes (Memorandum to Patrick Hines from TRC Environmental Laura Lefebvre and Glenn Harkness, dated June 9, 2009, Exhibit A)
- CPV Valley, Draft Environmental Impact Statement Secondary Formation of Fine Particulate Matter (PM_{2.5}) (Memorandum to Patrick Hines from TRC Environmental Laura Lefebvre and Glenn Harkness, dated June 23, 2009, Exhibit B)

In an email communication to Mr. Steve Remillard of CPV Valley, Mr. Steve Fleischacker of ARC stated that ARC had reviewed the above referenced visual plume and PM_{2.5} memoranda prepared by TRC and offered the following comments:

- 1) **PM_{2.5}:** ARC recommends applying the projected PM_{2.5} secondary formation increase to more recent (e.g., 2008) PM_{2.5}-monitored concentrations. The data used in the TRC analysis was for the year 2001.
- 2) **PM_{2.5}:** Emission offsets of 1.15 to 1 for NO_x and VOC are discussed in TRC's memo. The emissions offsets were obtained from another source in an area of similar nonattainment to that of Orange County. Questions: How far is the source located from the proposed CPV site? Could you identify the source?

- 3) **Visual:** The inherent limitations of the model have clearly caused confusion on predicting the actual visible plume model. The TRC memo is well-written in terms of it being educational (i.e., explaining the condition), and we recommend including it as part of the public record. To "close-the-loop" on this issue, we also recommend TRC query the NYSDEC and determine if similar plants (there are several in the State) have received any public concern over plume visibility during operation in the described scenario. If this answer in no, we believe the concern will have been adequately addressed.

Each comment is provided below followed by TRC's response in italics.

COMMENT NUMBER 1:

ARC recommends applying the projected PM_{2.5} secondary formation increase to more recent (e.g., 2008) PM_{2.5}-monitored concentrations. The data used in the TRC analysis was for the year 2001.

RESPONSE:

In response to ARC's recommendation as clarified in subsequent comments, TRC has incorporated the use of ambient PM_{2.5} data from the most recent 3-year period (2006-2008) in the analysis of projected PM_{2.5} secondary formation. Secondary PM_{2.5} refers to PM_{2.5} that may form as a result of various chemical reactions in the atmosphere involving other substances (precursors) that the Project may emit in gaseous form.

The annual, peak (maximum) 24-hour and near-peak (98th percentile) 24-hour PM_{2.5} ambient concentrations used in the analysis change as follows:

- *Annual value in µg/m³ changes from 11.58 to 10.01 and is now based on the average of the annual average concentrations over the last three years (2006, 2007, and 2008).*
- *Peak (maximum) 24-hour value in µg/m³ changes from 33.6 to 41.8 and now represents the maximum monitored 24-hour PM_{2.5} value over the last three years.*
- *Near-peak (98th percentile) 24-hour value in µg/m³ changes from 27.8 to 26.9 and now represents the average of the 98th percentile 24-hour PM_{2.5} value in each of the last three years.*

Tables 6 and 7 change as follows:

Table 6 –Maximum Projected Annual Ambient PM_{2.5} Increases				
Pollutant	Potential Emissions Increase in Orange County (%)	Potential PM_{2.5} Increase (%)	Annual Average Ambient PM_{2.5} Concentration (2006-2008) (µg/m³)	Potential Ambient PM_{2.5} Increase (µg/m³)
SO ₂	0.136	0.5	10.01	0.0068
NH ₃	6.371	0.2	10.01	0.128
NO _x	0.814	0.14	10.01	0.011
VOC	0.392	0.18	10.01	0.0071
Total Potential Ambient PM_{2.5} Increase (µg/m³) through Secondary Formation				0.15

Table 7 – Peak (Maximum) Projected 24-hour Ambient PM_{2.5} Increases				
Pollutant	Potential Emissions Increase in Orange County (%)	Potential PM_{2.5} Increase (%)	Maximum 24-Hour Ambient PM_{2.5} Concentration (2006-2008) (µg/m³)	Potential Ambient PM_{2.5} Increase (µg/m³)
SO ₂	0.136	0.5	41.8	0.028
NH ₃	6.371	0.2	41.8	0.53
NO _x	0.814	0.14	41.8	0.048
VOC	0.392	0.18	41.8	0.029
Total Potential Ambient PM_{2.5} Increase (µg/m³) through Secondary Formation				0.64

The maximum projected annual increase in ambient PM_{2.5} concentrations due to secondary PM_{2.5} formation is less than 0.2 µg/m³. The peak (maximum) projected 24-hour increase in PM_{2.5} concentrations due to secondary PM_{2.5} formation is approximately 0.6 µg/m³. To put these projected increases into some context, we can compare them to significant impact levels (SILs) for PM_{2.5} that are under consideration by EPA for use in PM_{2.5} attainment areas, to significance thresholds used by NYSDEC for PM_{2.5}, and to the National Ambient Air Quality Standards (NAAQS) for PM_{2.5}. Note that maximum predicted impacts of sources in attainment areas are compared to SILs when determining whether source impacts are significant. Similarly, maximum predicted impacts are compared to the NYSDEC significance thresholds. However, compliance with the 24-hour NAAQS for PM_{2.5} is based on the average of the 98th percentile 24-hour concentrations over three years, not on the peak 24-hour concentration.

The nearest ambient monitor for PM_{2.5} is located approximately 37 km east-northeast of the Project site in Newburgh, New York. This monitor, which is located in an urban, city center setting, began operating in February 2000 and continues to operate. The Newburgh monitor is the only PM_{2.5} monitor in Orange County and has never recorded a violation of either the short-term or annual NAAQS for PM_{2.5}. However, Orange County was included as part of the 10-county New York City Metropolitan Nonattainment Area for PM_{2.5} primarily due to EPA guidance recommending the use of Metropolitan Statistical Area boundaries for defining PM_{2.5} nonattainment area boundaries. Therefore, Orange County is currently designated as nonattainment for PM_{2.5} even though the only PM_{2.5} monitor within the county has always shown compliance with the NAAQS.

Although SILs are not currently applicable to PM_{2.5} permitting actions in Orange County given its nonattainment designation, they still provide a reasonable comparative reference within the context of the SEQR EIS for describing the relative environmental significance of PM_{2.5} impacts from a facility.

Although neither EPA nor NYSDEC has formally established SILs for PM_{2.5}, EPA has proposed ranges of possible SILs for PM_{2.5}. The proposed annual SILs for PM_{2.5} range from 0.3 µg/m³ to 1.0 µg/m³. The proposed 24-hour SILs for PM_{2.5} range from 1.2 µg/m³ to 5.0 µg/m³. As explained previously, maximum predicted source impacts are compared to SILs to determine whether those impacts are significant in attainment areas. The maximum projected PM_{2.5} increases due to secondary PM_{2.5} formation from the Project are less than the most stringent SILs under consideration by EPA, but not directly applicable because Orange County is currently designated as non-attainment for PM-2.5. The Project is located in Orange County, New York. Nevertheless, for discussion purposes, the projected increases due to secondary PM_{2.5} formation may be considered insignificant relative to EPA's proposed ranges of possible SILs for PM_{2.5} attainment areas. EPA considers predicted impacts below SILs to be negligible or "de minimis".

NYSDEC Commissioner's Policy CP 33 ("Assessing and Mitigating Impacts of Fine Particulate Matter Emissions"), which applies to projects for which NYSDEC is the lead agency under SEQRA, uses peak (maximum) Project impact thresholds of $0.3 \mu\text{g}/\text{m}^3$ (annual) and $5 \mu\text{g}/\text{m}^3$ (24-hour) to determine if there is a potentially significant adverse impact. The projected maximum secondary $\text{PM}_{2.5}$ impacts attributable to the Project are less than these levels.

The projected increases in ambient $\text{PM}_{2.5}$ concentrations due to secondary $\text{PM}_{2.5}$ formation attributable to potential Project emissions represent small fractions of the associated NAAQS. The potential increase in annual $\text{PM}_{2.5}$ concentration ($0.15 \mu\text{g}/\text{m}^3$) represents only 1% of the annual NAAQS ($15 \mu\text{g}/\text{m}^3$). The peak (maximum) projected increase in 24-hour $\text{PM}_{2.5}$ concentrations ($0.64 \mu\text{g}/\text{m}^3$) represents only 1.8% of the 24-hour NAAQS ($35 \mu\text{g}/\text{m}^3$).

As noted before, compliance with the 24-hour NAAQS for $\text{PM}_{2.5}$ is based on the average of the 98th percentile 24-hour concentrations in the last three years. An analysis of projected $\text{PM}_{2.5}$ increases based on the use of the average of the near-peak (98th percentile) 24-hour ambient $\text{PM}_{2.5}$ concentrations over the last three years ($26.9 \mu\text{g}/\text{m}^3$) rather than the maximum 24-hour ambient $\text{PM}_{2.5}$ concentration of the last three years ($41.8 \mu\text{g}/\text{m}^3$) yields a corresponding lower estimate of secondary $\text{PM}_{2.5}$ formation ($0.41 \mu\text{g}/\text{m}^3$) that represents about 1.2 percent of the corresponding 24-hour NAAQS ($35 \mu\text{g}/\text{m}^3$).

The following table provides a summary of the compliance demonstration for the Project with respect to the NAAQS for $\text{PM}_{2.5}$. The compliance summary explicitly includes contributions representing the potential secondary $\text{PM}_{2.5}$ formation attributable to the Project. Note that the resulting total ambient concentrations are likely overestimated for many reasons, including the following:

- The summary does not account for the effect of the VOC and NO_x emissions offsets that will be required for the Project. These emission offsets would likely decrease the secondary (indirect) $\text{PM}_{2.5}$ impacts relative to those presented in the table.
- The total concentration is based on the sum of peak (maximum) annual or near-peak (98th percentile) 24-hour values of background, direct Project impacts, and indirect Project impacts attributable to secondary $\text{PM}_{2.5}$ formation. Peak (maximum) or near-peak (98th percentile) impacts of these separate components (i.e., background values, direct Project impacts, and indirect Project impacts) are unlikely to occur at the same place or at the same time.

Averaging Period	Rank	Background ($\mu\text{g}/\text{m}^3$)	Direct Impact ($\mu\text{g}/\text{m}^3$)	Indirect Impact ($\mu\text{g}/\text{m}^3$)	Total ($\mu\text{g}/\text{m}^3$)	NAAQS ($\mu\text{g}/\text{m}^3$)
24-hour	98 th percentile	26.9	2.85	0.41	30.2	35
Annual	Maximum	10.0	0.14	0.15	10.3	15.0

Thus, the projected estimates of secondary $\text{PM}_{2.5}$ attributable to the Project are below the National Ambient Air Quality Standards for $\text{PM}_{2.5}$ established by EPA to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly (see <http://www.epa.gov/ttn/naaqs/> and 40 CFR § 50.13). The projected estimates of secondary $\text{PM}_{2.5}$ attributable to the Project are also below other regulatory thresholds ($\text{PM}_{2.5}$ SILs proposed by EPA for $\text{PM}_{2.5}$ attainment areas and the NYSDEC significance thresholds for $\text{PM}_{2.5}$).

The analysis of potential secondary $\text{PM}_{2.5}$ formation was conducted to address questions raised by ARC. As discussed previously (see Exhibit B - June 23, 2009 memorandum), consultation with both EPA and

NYSDEC confirmed that neither agency currently has a recommended procedure for estimating potential secondary PM_{2.5} formation from an individual source.

COMMENT NUMBER 2:

Emission offsets of 1.15 to 1 for NO_x and VOC are discussed in TRC's memo. The emissions offsets were obtained from another source in an area of similar nonattainment to that of Orange County. Questions: How far is the source located from the proposed CPV site? Could you identify the source?

RESPONSE:

As a major new source of NO_x and VOC emissions located in an ozone nonattainment area, the CPV Valley Energy Center by regulation will need to obtain offsets for these two pollutants. Potential emissions of these pollutants must be offset in at least a 1.15 to 1 ratio, thus ensuring that there will be an actual reduction of regional emissions of these pollutants. Ozone is formed in the atmosphere as a result of photochemical reactions among NO_x and VOC precursor pollutants. Ozone is created over a time scale of many hours to days and generally forms tens to hundreds of miles downwind of the sources of its precursors. Due to the nature of its formation, ozone is a regional scale pollutant and is appropriately regulated on a regional basis.

There is no requirement that emission offsets of NO_x or VOC lead to "local" decreases in impacts of these pollutants. The Project site is an area currently designated as attainment for NO₂. The Prevention of Significant Deterioration (PSD) permitting program requires that any increases in impacts remain below established limits, referred to as PSD increments. The maximum predicted impact of Project emissions of NO₂ is 0.85 µg/m³. This is well below the corresponding PSD increment limit of 25 µg/m³. This maximum predicted increase is also below the corresponding SIL of 1 µg/m³ and is regarded as negligible or "de minimis" by EPA.

The source or sources of NO_x and VOC offsets for the Project have not yet been identified. All offsets used for permitting the Project will satisfy applicable NYSDEC requirements from 6NYCRR Part 231, including those related to location.

Emission offsets of NO_x and VOC for sources located in an ozone nonattainment area in New York State must meet certain requirements related to location. If the emission offsets are obtained from within New York State, then the offsets must either come from the same ozone nonattainment area or from some other ozone nonattainment area with the same or a higher degree of nonattainment (provided that emissions from the other nonattainment area contribute to a violation of the ozone NAAQS in the nonattainment area in which the source needing offsets will be located). Emission offsets may also be obtained from some other ozone nonattainment area with the same or higher degree of nonattainment in another state, provided that the emissions from the other nonattainment area contribute to a violation of the ozone NAAQS in the nonattainment area in which the source needing offsets will be located and provided that an interstate reciprocal trading agreement is in place.

CPV Valley will provide additional information to the Planning Board concerning the source of emission offsets for NO_x and VOC once the offsets have been procured contractually.

COMMENT NUMBER 3:

The inherent limitations of the model have clearly caused confusion on predicting the actual visible plume model. The TRC memo is well-written in terms of it being educational (i.e., explaining the condition), and we recommend including it as part of the public record. To "close-the-loop" on this issue, we also recommend TRC query the NYSDEC and determine if similar plants (there are several in the State) have received any public concern over plume visibility during operation in the described scenario. If this answer is no, we believe the concern will have been adequately addressed.

RESPONSE:

As recommended by ARC, TRC consulted with NYSDEC regarding the visible plume issue. Mr. Leon Sedefian, the Chief of Impact Assessment and Meteorology in the Division of Air Resources at NYSDEC, was called and asked whether NYSDEC was aware of any complaints or reports of unusually long visible steam plumes from gas-fired or oil-fired combustion turbine stacks during hours with fog or precipitation.

Mr. Sedefian stated that he was aware of only two cases in which visible steam plumes from power plants had been an issue. In one case, the issue was related to emissions from a wet cooling tower that was causing visible plumes and icing on nearby roads. CPV Valley Energy Center will not have wet cooling towers, so that case is not relevant to our inquiry. The other case was for the Athens Generating Plant. In that case, visible plumes from their combustion turbine stacks were reported for other ambient conditions, not for the conditions of fog or precipitation that are the subject of the inquiry. Mr. Sedefian was not aware of any reports of long visible plumes under conditions associated with fog or precipitation.

Mr. Sedefian indicated that the visible steam plumes at the Athens facility had initially attracted some local attention because they occurred in an area in which the resident population had not previously observed steam plumes and had not understood that what they were observing was condensed water vapor. Pursuant to conditions imposed on the facility by the Article X proceedings which were in force at the time of project approval, Athens Generating is required to file reports of visible steam plumes. The reporting of visible steam plumes is not a condition of the NYSDEC air permit for the Facility.

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Memorandum

To: Patrick J. Hines

From: Laura Lefebvre and Glenn Harkness, TRC

Subject: Response to George M. Janes & Associates Comments on the CPV Valley DEIS regarding Visibility of Plumes (letter dated April 22, 2009)

Date: June 9, 2009

CC: Patt Battiato, Steve Fleischacker, Steve Remillard

Mr. George M. Janes submitted a letter dated April 22, 2009, commenting on the CPV Valley DEIS. CPV committed to addressing Mr. Janes' concerns regarding visible vapor plumes (see comment below) prior to responding to other public comments during a May 20, 2009 conference call (summarized in a Memo dated May 22, 2009). This memo provides responses to Mr. Janes' comments regarding the visible vapor plumes as presented in the DEIS and also recounts prior discussions concerning this topic. Mr. Janes' comments are provided below followed by TRC's responses:

MR. JANES' COMMENTS:

"Chapter 9, Air Quality, discloses in Table 9-29¹ that the plume for the action can be over 10,000 meters long. This very long plume is not discussed in the Visual Resources section and the plumes simulated in photosimulation are 50 meters. Chapter 9 states:

"The apparent prediction of very long visible plumes [over six miles] for 3 to 4 percent of daylight hours is merely a reflection of the number of day light hours during the modeling period with ambient saturated conditions. . . . These long plumes should be considered an artifact of the modeling assumptions particularly the inclusion of hours with very high relative humidity when natural fogging would be expected to occur, thus obscuring any visible combustion plume." (Pg 9-74.) [Bracketed text added]

¹ Page 9-75

Further, Chapter 9 also discloses that the plume can rise over 500 meters vertically from the stack, and should be over 200 meters (about 655 feet) from the stack height (a total of about 940 feet) between eight and nine percent of day light hours. For comparative purposes, the Empire State Building is 381 meters tall. A longer plume is shown as Figure 5-20, but this example is still fraction of the size of these much longer plumes described in the Air Quality chapter.

Because of the materiality of a six mile long plume, extending more than three times higher than the proposed action additional discussion of the visual impact of the plume needs to be studied, analyzed and disclosed as a part of the FEIS.

The expression “artifact of modeling assumptions” needs to be fully explained. Will the plume actually be visible for six miles, or will such plumes only occur when they are obscured, partially or completely, by fog? Will there even be a six mile long plume in reality or is it simply a glitch in the modeling system?”

RESPONSE:

Model Methodology and Overview

Water vapor in the combined cycle stack plumes may condense to form visible plumes under certain atmospheric conditions. If the ambient air is cold and moist, a portion of the emitted water vapor will condense to form water droplets. This may produce a visible, white plume. Visible plumes would be expected to be more prevalent in the winter when the air is cold or during the spring and fall if the air is moist. Visible plumes would be expected to occur much less frequently during the warm summer months. As plumes travel downwind and mix with drier ambient air, water droplets would evaporate and the plume would no longer be visible.

As described in Sections 5.4.2.8 and 9.6.5 of the DEIS, the CALPUFF model was used with a 5-year period of hourly meteorological data to assess the potential frequency of visible water vapor plumes due to emissions from the combustion turbines. The temperature and water vapor content of the plumes from the combustion turbine stacks were modeled as they mixed with the ambient air for each hour simulated.

The mixing of cooler and drier ambient air with the plume causes the plume to cool and reduces its water vapor concentration so that plume temperature and water vapor concentrations eventually approach ambient values. Visible plume dimensions (length and height) were estimated by the model for each hour by comparing the calculated water vapor concentrations along the plume trajectory with saturation values. The

model considered the plume to be visible if the saturation vapor concentration was exceeded. The model considered the plume to no longer be visible once the water vapor concentration in the plume dropped below the saturation value. This mechanism for determining visible vapor plume length and height relies upon the dilution of moist plume air with drier ambient air.

Explanation of “artifact of modeling”

The visible plume statistics summarized in Table 9-29 of the DEIS are based on all the hours that were modeled over a 5-year period of meteorological data. Because of known limitations of predicting visible plumes during hours with naturally occurring fog and/or hours with saturated or near saturated ambient conditions, hours with these conditions were originally excluded from the analysis. The mechanism used by the model to determine plume length and height does not apply under such conditions. TRC raised this concern with ARC and Mr. Janes during the preparation of the DEIS; however, it was requested that TRC include such hours for the plume modeling. If the ambient air is saturated, then no amount of mixing of saturated ambient air with the saturated water vapor plume will yield plume water vapor concentrations that are less than the saturation values. Under these conditions, the model will continue to predict visible plumes at all downwind distances considered along the plume trajectory.

The prediction of very long (“six mile”) and high visible plumes for approximately 3 to 4 percent of daylight hours was associated with hours with saturated and near saturated ambient conditions and results from the model assumptions and the inclusion of hours with these conditions. This is what was meant by the phrase “an artifact of the modeling assumptions” in the DEIS. The results for these hours were only added to Section 9 of the DEIS at the insistence of Mr. Janes and were never intended to imply or “disclose” that visible plumes of these lengths and heights would actually occur this often.

Will the plume actually be visible for six miles or will such plumes only occur when they are obscured, partially or completely, by fogs?

As mentioned previously, hours with naturally occurring fog or with ambient conditions at or near saturation were included in the visible plume modeling analysis at the direction of the Town’s consultants, with reservations by the Applicant, and with the knowledge that including these hours would yield results that would not be physically meaningful or realistic given the model assumptions and limitations. Although these issues were discussed with the Town’s consultants, the Applicant was nevertheless requested to include these hours in the visible plume analysis and the predictions for these hours in summary statistics in the DEIS.

In reality, natural fogging would be expected to occur during hours with saturated ambient conditions. This fogging would typically have an appearance that would reduce visibility and tend to obscure any visible vapor plume that might result due to emissions from the combustion turbine stacks. Under these conditions, it is likely that any vapor plume would be virtually indistinguishable from the typically grayish background or from fog, so that a visible plume would not be easily discernable by a potential observer.

Will there even be a six mile long plume in reality or is it simply a glitch in the modeling system?

As discussed above, during hours with naturally occurring fog or hours with saturated conditions, the model lacks a mechanism to reduce the vapor concentration in the saturated plume from the stack to levels below saturation, with the result that the plume will be predicted to be visible for all downwind distances considered in the modeling domain.

In order to provide a more meaningful set of results concerning the expected frequency of visible plumes, a new summary has been provided in the following table that excludes the hours for which natural occurring fog would be expected to occur (relative humidity \geq 99%). As expected, the predicted frequency of relatively long or high visible plumes is greatly diminished, and the “six mile” long plumes no longer are predicted to occur. This summary should be regarded as a more representative estimate of likely visible plume effects.

Note that the plume heights mentioned in the comment from Mr. Janes are not accurate. For clarity, the plume heights listed in Table 9-29 and in the following table are heights above ground, not above stack top (i.e., they represent plume height, not plume rise). The comment by Mr. Janes implies significantly higher plume heights than those that are predicted in the modeling.

CPV Valley Visible Plume Analysis Summary					
	Daylight Hours Over 5 Years				
	Total Daylight Hours	With Plume Length > 50 meters			
Total Number of Hours:	25587	3368			
Winter Hours	5322	1557			
Spring Hours	6915	974			
Summer Hours	7470	337			
Fall Hours	5880	500			
Visible Plume Length	Percentage of Modeled Winter Hours	Percentage of Modeled Spring Hours	Percentage of Modeled Summer Hours	Percentage of Modeled Fall Hours	Percentage of Modeled Hours (5 Years)
No visible plume or less than 50 meters	67.17%	81.92%	91.38%	87.47%	82.89%
Between 50 and 250 meters	15.16%	6.59%	2.18%	3.42%	6.36%
Between 250 and 500 meters	6.16%	3.54%	0.91%	1.80%	2.92%
Between 500 and 1000 meters	3.29%	1.58%	0.41%	0.88%	1.43%
Between 1000 and 2500 meters	2.29%	1.32%	0.82%	1.36%	1.38%
Between 2500 and 5000 meters	1.32%	0.91%	0.19%	0.87%	0.77%
Between 5000 meters and 9999 meters	1.03%	0.14%	0.00%	0.17%	0.29%
Greater than 9999 meters	0.00%	0.00%	0.00%	0.00%	0.00%
Visible plumes > 50 meters in length	29.3%	14.1%	4.5%	8.5%	13.2%
Plume Height	Percentage of Modeled Winter Hours	Percentage of Modeled Spring Hours	Percentage of Modeled Summer Hours	Percentage of Modeled Fall Hours	Percentage of Modeled Hours (5 Years)
Between Stack Height and 200 meters	16.08%	7.17%	3.11%	3.64%	7.03%
Between 200 and 300 meters	10.45%	5.39%	1.26%	4.35%	5.00%
Between 300 and 500 meters	2.37%	1.23%	0.15%	0.49%	0.98%
Greater than 500 meters	0.36%	0.29%	0.00%	0.02%	0.16%

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Memorandum

To: Patrick J. Hines
From: Laura Lefebvre and Glenn Harkness, TRC
Subject: CPV Valley, Draft Environmental Impact Statement
Secondary Formation of Fine Particulate Matter (PM_{2.5})
Date: June 23, 2009
CC: Patt Battiato, Steve Fleischacker, Steve Remillard, Rich Cogen

In its April 22, 2009 comment letter to the Town of Wawayanda Planning Board regarding the Draft Environmental Impact Statement (DEIS) for the CPV Valley Energy Center (the Project), Allegiance Resources Corporation (ARC) recommended that the potential secondary formation of PM_{2.5} due to Project emissions be evaluated. ARC stated that the evaluation would require scientific approaches using practical assumptions and that it would probably include a review of analytical and computational methodologies used by others.

In developing this response to the ARC comment letter, the scientific literature and the regulatory policies of several agencies were reviewed regarding accepted methodologies for assessing secondary formation of PM_{2.5}. To facilitate the review of the detailed response below, some background on this topic is provided. This response examines the recent scientific literature and provides estimates based on practical assumptions of the extent to which potential emissions from the Project could lead to impacts on ambient levels of PM_{2.5} due to secondary PM_{2.5} formation.

1.0 BACKGROUND

The Project will emit fine particulate matter directly to the air in solid or liquid form. In addition, some particles (“condensable” particulate) will form due to condensation processes in the atmosphere shortly after leaving the stack. These particulates emitted directly or formed nearby by condensation are referred to as “primary” particulates. The potential emissions of primary particulates, including condensable particulates, were presented in the DEIS along with predictions of their impacts.

Additional particulates, referred to as “secondary” particulates, may form in the atmosphere as a result of numerous chemical reactions involving various gaseous substances, some of which may be emitted by the Project. These reactions produce condensable vapors in the atmosphere that either form new particles or condense onto other particles already in the air. Secondary particulate matter with a diameter of 2.5 microns or smaller is referred to as secondary PM_{2.5}. The gases that can lead to the formation of secondary PM_{2.5} are referred to as “PM_{2.5} precursors.” The reactions that can lead to secondary PM_{2.5} associated with emissions of PM_{2.5} precursors from the Project would occur in the atmosphere over the course of many hours or days, and the resulting secondary PM_{2.5} would occur well beyond the Project location.

The degree of this formation of secondary PM_{2.5} depends on many factors, including the ambient concentrations of PM_{2.5} precursors and other gases that may participate in the chemical reactions that may result in secondary PM_{2.5}, various atmospheric properties including solar radiation, temperature, and relative humidity, and the interactions of PM_{2.5} precursors with ambient atmospheric particles and with cloud or fog droplets.

As part of rulemaking for implementing a New Source Review (NSR) major source permitting program for PM_{2.5}, the EPA identified the following four substances as potential precursors for PM_{2.5}:

- Sulfur dioxide (SO₂);
- Nitrogen oxides (NO_x);
- Volatile organic compounds (VOC); and
- Ammonia (NH₃).

In its final action regarding the regulation of potential PM_{2.5} precursor pollutants for major NSR permitting purposes, EPA decided that:

- SO₂ must be regulated as a PM_{2.5} precursor;
- NO_x is presumptively required to be regulated as a PM_{2.5} precursor; and
- VOC and NH₃ are not required to be regulated as PM_{2.5} precursors.

The extent to which secondary PM_{2.5} may form due to precursor pollutant emissions varies from area to area and depends on numerous factors (such as those mentioned above) that vary with time and location. Therefore, it is not possible to specify with a high degree of certainty the quantity of secondary PM_{2.5} that might form due to Project emissions of these PM_{2.5} precursors. The transformation of precursor emissions to secondary PM_{2.5} would occur slowly, with the result that secondary PM_{2.5} formation due to Project emissions of precursors would likely occur well beyond the Project area.

2.0 CONSULTATION AND REVIEW OF AGENCY POLICIES

Based on discussion with both NYSDEC and EPA and a review of their policies, it is clear that neither agency has approved a method to quantify the extent of potential secondary formation of PM_{2.5} in the context of permitting an individual project. In recognition that there is no recommended methodology for determining secondary formation of PM_{2.5} from an individual project, the EPA and NYDEC have chosen to focus on utilizing offset ratios for two PM_{2.5} precursor emissions (NO_x and SO₂) in the context of permitting new major PM_{2.5} sources and major modifications for PM_{2.5} in PM_{2.5} nonattainment areas. These precursor emissions create the opportunity for the formation of “secondary” PM_{2.5} (i.e., PM_{2.5} not directly emitted by the Project) due to additional chemical reactions that can occur in the air. Therefore, it is logical to conclude that the best method of minimizing secondary formation of PM_{2.5} is to reduce or minimize the precursor emissions that can lead to this secondary formation of PM_{2.5}. The offset requirements discussed below along with the use of stringent emissions controls currently represent the most proven and effective method for mitigating the potential for secondary formation of PM_{2.5}.

The Project will not be a major source for PM_{2.5}, and, therefore, is not subject to these specific requirements for emission offsets. However, the Project will be subject to other emission offset requirements associated with permitting a major source of NO_x and VOC. The Project will be offsetting its potential emissions of NO_x and VOC by a ratio of 1.15 to 1, which means that the Project will need to remove actual emissions of NO_x and VOC permanently from other facilities in an amount equal to 115% of the Project’s potential to emit for NO_x

and VOC. The net effect will be a permanent reduction of regional emissions of NO_x and VOC (both PM_{2.5} precursors) as a result of the Project's procurement of these emission offsets.

3.0 REVIEW OF SCIENTIFIC LITERATURE

In an effort to identify a possible methodology for assessing secondary formation of PM_{2.5}, a literature search was performed. The results of the literature indicate that most information available today addresses secondary formation of PM_{2.5} on a large-scale (regional basis) and is not oriented towards project specific applications. However, in an effort to provide some quantification of the potential secondary formation of PM_{2.5} that may be associated with emissions from the Project, the information from the literature searches were applied to the emissions profile of the Project. While this method is not adopted or recommended by any agencies, it was developed in an attempt to respond to the ARC comment letter.

Two recent technical papers by Alexandra P. Tsimpidi, Vlassis A. Karydis, and Spyros N. Pandis that appeared in the Journal of the Air & Waster Management Association examine the sensitivity of PM_{2.5} ambient concentrations to changes in emissions of various PM_{2.5} precursors. The two articles are:

- Tsimpidi, A.P.; Karydis, V.A.; Pandis, S.N. Response of Inorganic Fine Particulate Matter to Emission Changes of SO₂ and NH₃: The Eastern United States as a Case Study; J. Air & Waste Manage. Assoc. 2007, 57, 1489-1498.
- Tsimpidi, A.P. Karydis, V.A./ Pandis, S.N. Response of Fine Particulate Matter to Emission Changes of Oxides of Nitrogen and Anthropogenic Volatile Organic Compounds in the Eastern United States. J. Air & Waste Manage. Assoc., 2008, 58, 1463-1473.

These studies were supported by the U. S. Department of Energy and by the U. S. Environmental Protection Agency. The studies used a three-dimensional chemical transport model to predict changes in PM_{2.5} concentrations that would result from 50% reductions in emissions of various PM_{2.5} precursors over the eastern U.S. during periods in July 2001 and January 2002.

The first study investigated the effect of reducing SO₂ and NH₃ (which are PM_{2.5} precursors) emissions individually by 50% from the eastern U.S. The resulting changes in ambient PM_{2.5} concentrations were predicted for different regions. The results varied by season and by area. The results for the northeast U.S. are summarized in Table 1.

Table 1 – Predicted PM_{2.5} Changes Due to 50% Reduction in SO₂ or NH₃ Emissions		
Control Strategy	Season	Predicted Change in PM_{2.5}
50% reduction in SO ₂	July	Decrease of 25%
50% reduction in NH ₃	July	Decrease of 4%
50% reduction in SO ₂	January	Decrease of 4%
50% reduction in NH ₃	January	Decrease of 10%

The second study investigated the effect of reducing NO_x and VOC (which are PM_{2.5} precursors) emissions individually by 50% from the eastern U.S. The resulting changes in ambient PM_{2.5} concentrations were predicted for different regions. The results varied by season and by area. The results for the northeast U.S. are summarized in Table 2.

Table 2 – Predicted PM_{2.5} Changes Due to 50% Reduction in NO_x or VOC Emissions		
Control Strategy	Season	Predicted Change in PM_{2.5}
50% reduction in NO _x	July	Decrease of 7%
50% reduction in VOC	July	Increase of 3%
50% reduction in NO _x	January	Increase of 3%
50% reduction in VOC	January	Decrease of 9%

4.0 APPLICATION OF THE LITERATURE RESULTS TO THE PROPOSED MAXIMUM PROJECT EMISSIONS

Step 1) The results from the two technical papers by Tsimpildi, Karydis, and Pandis (Tsimpildi et al.) were used to estimate changes in ambient PM_{2.5} that might result due to emissions from the proposed Project. In order to assure that the effect of the Project PM_{2.5} precursor emissions would not be underestimated, the maximum potential to emit (i.e., the proposed maximum allowable emissions) for SO₂, NH₃, NO_x, and VOC was considered, even though actual emissions from the Project could be considerably smaller.

Step 2) Next, it was assumed that the magnitude and direction of predicted changes in ambient PM_{2.5} concentrations associated with the 50% decrease in precursor emissions considered in the studies by Tsimpildi et al. could be scaled to obtain PM_{2.5} changes representative of those that would result from smaller changes in regional emissions of precursor emissions. This is equivalent to assuming a linear relationship between PM_{2.5} precursor emissions and secondary PM_{2.5} formation downwind. Although some of the many and varied chemical reactions involved in the formation of secondary PM_{2.5} may not proceed in a linear fashion, it is not unreasonable to assume that relatively smaller changes in regional PM_{2.5} precursor emissions, such as those proposed as part of the Project, would yield changes in PM_{2.5} levels that could be scaled in this fashion. With this assumption, the results summarized in Table 1 and Table 2 for the northeast U.S. were scaled to provide predicted changes in ambient PM_{2.5} levels (i.e., the extent of secondary PM_{2.5} formation) that could be attributed to a 1% increase in emissions for each of the four listed PM_{2.5} precursors. The maximum predicted relative increase in ambient PM_{2.5} in either season was then identified (noted by bold font in Table 3) for each PM_{2.5} precursor pollutant by comparing the scaled changes in each season.

Table 3 – Predicted PM_{2.5} Changes Due to 1% Increase in Precursor Emissions		
Emission Change	Season	Estimated Change in PM_{2.5}
1% increase in SO ₂	July	Increase of 0.5%
1% increase in NH ₃	July	Increase of 0.08%
1% increase in NO _x	July	Increase of 0.14%
1% increase in VOC	July	Decrease of 0.06%
1% increase in SO ₂	January	Increase of 0.08%
1% increase in NH ₃	January	Increase of 0.2%
1% increase in NO _x	January	Decrease of 0.06%
1% increase in VOC	January	Increase of 0.18%

These maximum relative increases in ambient PM_{2.5} were then incorporated later in the analysis.

Step 3) Next, it was assumed that the relationships predicted in PM_{2.5} concentrations due to modeled emissions changes over the eastern U.S. could be applied to precursor emissions changes over a smaller region, such as Orange County. It is important to note that this approach would be expected to overestimate the degree of secondary PM_{2.5} impacts within Orange County for the following reason. Since many of the chemical reactions that can produce secondary PM_{2.5} formation (and which were modeled in the studies by Tsimpildi et al.) take place on a time scale of many hours to a few days, it is likely that over such time period, the emissions from the Project would have been transported outside the primary region of interest (Orange County) and therefore would not increase PM_{2.5} levels to the predicted extent within Orange County.

Step 4) In order to determine the maximum potential percentage change in PM_{2.5} precursor emissions within Orange County that might result due to emissions from the Project, information concerning existing anthropogenic emissions from within the county was obtained from data available from EPA's AIRDATA website (<http://www.epa.gov/oar/data/>). The modeling conducted by Tsimpildi et al. was for periods in July 2001 and January 2002 and predicted changes relative to ambient PM_{2.5} levels for corresponding periods. Therefore, emissions data for PM_{2.5} precursor pollutants for 2001 for Orange County were obtained to be representative of the period of analysis in the study by Tsimpildi et al. The emissions data in tons per year (tpy) for 2001 are summarized in Table 4.

Pollutant	Year	Orange County Emissions (tpy)
SO ₂	2001	30,874
NH ₃	2001	1,465
NO _x	2001	22,978
VOC	2001	16,582

Step 5) Next, the potential percentage increase in PM_{2.5} county-wide precursor emissions attributable to potential emissions from the Project was calculated by dividing the Project potential to emit for each precursor pollutant by the emissions in 2001. The results are presented in Table 5.

Pollutant	2001 Orange County Emissions (tpy)	Project Potential to Emit (tpy)	Potential Increase (%)
SO ₂	30,874	42	0.136
NH ₃	1,465	104.8	6.371
NO _x	22,978	187	0.814
VOC	16,582	65	0.392

Step 6) Next, the potential increase in county-wide anthropogenic emissions of each PM_{2.5} precursor pollutant was used to project potential increases in ambient PM_{2.5} concentrations (i.e., secondary PM_{2.5} formation) using the relationships from Tsimpildi et al. Ambient PM_{2.5} monitoring data for Orange County for 2001 was obtained from EPA's AIRDATA website. Data from 2001 were selected to be consistent with the associated emissions data and with the period of the study by Tsimpildi et al.

Data were selected for the Newburgh, New York PM_{2.5} monitor (site ID 350204, AIRS #36-071-0002), the only ambient PM_{2.5} monitoring site in Orange County. This monitor began operating in February 2000 and has remained in use since then. This monitor was sited with the objective of assessing population exposure to ambient PM_{2.5} and is in a location characterized as “urban and center city” with commercial land use. It is expected that the ambient PM_{2.5} levels measured at the Newburgh monitor are higher than those that would be measured in the vicinity of the Project location, which is more rural in nature. Nonetheless, the concentrations measured at the Newburgh monitor were used for this analysis, even though the resulting projected increases in PM_{2.5} might be overestimated as a result. The annual average PM_{2.5} concentration at this monitor in 2001 was 11.58 µg/m³. The maximum and 98th percentile 24-hour values measured in 2001 were 33.6 µg/m³ and 27.8 µg/m³, respectively. Note that compliance with the 24-hour National Ambient Air Quality Standard (NAAQS) for PM_{2.5} is related to the average of the 98th percentile value over three years, not to the maximum value.

The potential increase in county-wide emissions of each PM_{2.5} precursor, as listed in Table 5, was multiplied by the maximum percentage increases in Table 3 to obtain estimates of the maximum percentage increase in ambient PM_{2.5} concentrations that might result from the potential Project emissions. These percentage increases were then applied to the ambient PM_{2.5} concentrations in 2001 to project the ambient increases in secondary PM_{2.5} due to Project emissions of precursor pollutants.

5.0 RESULTS

The results are summarized in Table 6 and Table 7 for annual and 24-hour averaging periods, respectively.

Pollutant	Potential Emissions Increase in Orange County (%)	Potential PM_{2.5} Increase (%)	2001 Ambient PM_{2.5} Concentration (µg/m³)	Potential Ambient PM_{2.5} Increase (µg/m³)
SO ₂	0.136	0.5	11.58	0.0079
NH ₃	6.371	0.2	11.58	0.15
NO _x	0.814	0.14	11.58	0.013
VOC	0.392	0.18	11.58	0.0082
Total Increase				0.18

Pollutant	Potential Emissions Increase in Orange County (%)	Potential PM_{2.5} Increase (%)	2001 Ambient PM_{2.5} Concentration (µg/m³)	Potential Ambient PM_{2.5} Increase (µg/m³)
SO ₂	0.136	0.5	33.6	0.023
NH ₃	6.371	0.2	33.6	0.43
NO _x	0.814	0.14	33.6	0.038
VOC	0.392	0.18	33.6	0.024
Total Increase				0.51

The maximum projected annual increase in ambient PM_{2.5} concentrations due to secondary PM_{2.5} formation is less than 0.2 µg/m³. The maximum projected 24-hour increase in PM_{2.5} concentrations due to secondary PM_{2.5} formation is about 0.5 µg/m³. To put these projected increases in some context, we can compare them to significant impact levels (SILs) for PM_{2.5} that are under consideration by EPA and to significance thresholds used by NYSDEC for PM_{2.5}.

Although neither EPA nor NYSDEC has formally established SILs for PM_{2.5}, EPA has proposed ranges of possible SILs for PM_{2.5}. The proposed annual SILs for PM_{2.5} range from between 0.3 µg/m³ to 1.0 µg/m³. The proposed 24-hour SILs for PM_{2.5} range from 1.2 µg/m³ to 5.0 µg/m³. The projected PM_{2.5} increases due to secondary PM_{2.5} formation due to the Project are less than the lowest SILs under consideration by EPA. Therefore, the projected increases due to secondary PM_{2.5} formation should be considered insignificant.

NYSDEC Commissioner's Policy CP 33 ("Assessing and Mitigating Impacts of Fine Particulate Matter Emissions"), which applies to projects for which NYSDEC is the lead agency under SEQRA, uses 24-hour and annual Project impact thresholds of 0.3 µg/m³ (annual) and 5 µg/m³ (24-hour) to determine if there is a potentially significant adverse impact. The projected maximum secondary PM_{2.5} impacts attributable to the Project are less than these levels.