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July 12, 2011

Ms. Ida E. McDonnell
Manager, Air Permits, Toxic and Indoor Air Program Unit
US Environmental Protection Agency - Region 1
5 Post Office Square, Suite 100
Boston, MA 02109-3912

Re: Pioneer Valley Energy Center, Westfield, Massachusetts
Prevention of Significant Deterioration Air Permit Application
Information Request Response
ESS Project Number E402-007.01

Dear Ms. McDonnell:

On behalf of Pioneer Valley Energy Center, LLC (PVEC), ESS Group Inc (ESS) is providing the following supplemental information to the above referenced application in response to your request for additional information dated May 17, 2011.

BACT Analysis for Nitrogen Oxides (NO_X) Emissions

1. Dry low NO_X (DLN) combustion technology utilizes premixed and staged combustion to significantly lower the combustion temperature and residence time to reduce the formation of thermal NO_X in the combustor. DLN, also referred to as "lean pre-mix," is a dry process where air and fuel are mixed prior to combustion creating a leaner fuel/air mixture and consequently a lower temperature combustion zone to minimize thermal NO_X formation. The combustion process is adjusted through the turbine control system to achieve the leanest possible mixture without creating flame instability. Further reduction of the combustion temperature, for example through water or steam injection, is impractical because of the risk of flame instability and the resulting damage it can cause in the combustion hardware. The use of DLN technology to minimize NO_X formation in the combustor and selective catalytic reduction (SCR) to convert NO_X in the exhaust gas to nitrogen and water is the most effective method commercially available to control NO_X emissions from a natural gas fired combustion turbine.

   Virtually all DLN combustors in commercial operation are designed for use with gaseous fuels. DLN operation on liquid fuels is problematic due to liquid evaporation and auto-ignition issues. Because of these issues, injecting water or steam into the flame area is typically used to lower the combustion temperature and the formation of thermal NO_X from a liquid fuel fired combustor. The use of water or steam injection to minimize thermal NO_X formation and SCR in the exhaust is the most effective method commercially available to control NO_X emissions from an oil-fired combustion turbine.

   DLN and water/steam injection are not control technologies that can be used in tandem because they utilize alternative methodologies to achieve lower combustion temperatures which in turn minimizes the formation of thermal NO_X emissions from a

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combustion turbine. Consistent with the information provided above and in the PSD application, PVEC asserts that the use of DLN and SCR while firing natural gas and the use of water injection and SCR while firing ultra low sulfur diesel (ULSD) represent the Best Available Control Technology (BACT) for the combustion turbine for the project.

2. PVEC asserted in its PSD application that $SCONO_X$ is not a technically feasible control technology for the project because it has not been applied to a combustion turbine of a similar size. The application of this technology to date has been limited to natural gas combined cycle combustion turbines under 40 MW in capacity. In its information request, the EPA stated that although it agrees that this technology has not been applied to a turbine of similar size, EPA understands, based on discussions with the vendor, that the technology is scalable, and is therefore not technically infeasible for the project. Therefore it cannot be eliminated in Step 2 of the BACT analysis.

   PVEC reasserts that $SCONO_X$ is technically infeasible for the project because it has not been demonstrated to be "available" for the project. Despite the claims of the vendor, the scalability of the technology has yet to be demonstrated in practice. It would be problematic for a project developer to obtain financing for a project utilizing a control technology that has not been demonstrated to be effective and reliable at the scale necessary for the PVEC project. However, to be complete, PVEC offers the following supplemental information for the NO_X BACT determination for the project.

   Step 3 of the BACT analysis is to rank the control technologies which have not been eliminated due to technical infeasibility by their control effectiveness. According to the available information, with the use of $SCONO_X$, if it could be scaled to a project this size, PVEC could achieve equivalent NO_X stack concentrations and emission rates as have been proposed. Therefore $SCONO_X$, if scalable, cannot be eliminated from BACT consideration for the project based on its control effectiveness.

   Step 4 of the BACT analysis considers the remaining control technologies with respect to their energy, environmental, and economic impacts. There are energy and environmental impacts associated with the use of both $SCONO_X$ and SCR which are considered to be relatively equal. However, the difference in capital costs associated with the use of $SCONO_X$ and SCR are significant.

   Estimating the capital and operational costs associated with the use of $SCONO_X$ at a facility such as PVEC is problematic, as the technology has never been applied at such a scale. However, according to published information, the total capital costs associated with $SCONO_X$ are projected to be more than five times the capital costs associated with SCR, a well established "off the shelf" control technology. The annualized operating costs associated with $SCONO_X$ are projected to be more than three times the annualized operating costs associated with SCR. One of the primary reasons for these cost differentials is that $SCONO_X$ requires platinum for its catalyst, which is significantly more expensive than the base metals typically used in SCR catalysts. Because the $SCONO_X$ system would be a first of its kind at this scale, these cost differentials are most likely conservative. The actual differential in costs between $SCONO_X$ and SCR at PVEC would be expected to be greater than the ratios cited.

There are numerous examples in the public domain of BACT analyses conducted for projects similar to PVEC where the cost effectiveness of $SCONO_X$ as a control technology for NO_X from large combustion turbines has been evaluated. As an example, such an analysis was conducted in September 2008 for the Greenland Energy Center project in Duval County, Florida. This project included the conversion of two simple cycle combustion turbines into combined-cycle units each with a nominal 550 MW output capacity.

The BACT analysis conducted for the Greenland Energy Project (http://www.dep.state.fl.us/air/emission/construction/grreenland/bact.pdf) included a detailed comparison of the capital costs and annual direct and indirect costs associated with SCR and $SCONO_X$, using cost estimates provided by equipment vendors. This analysis concluded that the total annualized costs associated with $SCONO_X$ would be more than three times the total annualized costs associated with SCR to achieve the same level of emission reductions. The cost effectiveness of the use of $SCONO_X$ as a NO_X control technology for this project was estimated to be more than $23,000 per ton, which is significantly higher than what has been considered to be a cost effective control option for NO_X emissions from a large combustion turbine in previous BACT determinations.

The use of $SCONO_X$ or SCR for the PVEC project would result in equally stringent NO_X emissions control. There is ample information in the public domain to conclude that the use of $SCONO_X$, if it were scalable, would not be a cost effective NO_X control technology for PVEC, and its economic costs would be significantly higher than the costs associated with SCR. The use of SCR, the most stringent and cost effective control technology available, is therefore the NO_X BACT determination for the PVEC combustion turbine.

BACT Analysis for Carbon Monoxide (CO) Emissions

1. The EPA has also requested additional information to demonstrate why $SCONO_X$ does not represent the BACT determination for the project if it is not deemed to be technically infeasible. The CO emission rates currently proposed for the PVEC project are the lowest emission rates achieved in practice for such a source type and size. Based on the available information, $SCONO_X$ could achieve the same level of CO emissions reduction as the oxidation catalyst proposed for the PVEC project.

   However, the capital costs and operating costs associated with the use of $SCONO_X$ for the PVEC project, if it were to be scalable, would be significantly higher than the costs associated with an oxidation catalyst, a well established “off the shelf” control technology. The ratios of the capital and operating costs between $SCONO_X$ and oxidation catalyst would be expected to be significantly larger than the ratios between $SCONO_X$ and SCR, as described above, because oxidation catalyst systems are significantly less expensive than SCR systems on an annualized cost basis.

There are numerous examples in the public domain of BACT analyses conducted for projects similar to PVEC where the cost effectiveness of $SCONO_X$ as a control technology for CO from large combustion turbines has been evaluated. The BACT analysis conducted for the Greenland Energy Project cited above included a detailed comparison of the capital costs and annual direct and indirect costs associated with oxidation catalyst and $SCONO_X$, using cost estimates provided by equipment vendors. This analysis concluded that the total annualized cost associated with $SCONO_X$ would be nearly thirty times greater than the total annualized cost associated with an oxidation catalyst to achieve the same CO emissions reductions. The cost effectiveness of the use of $SCONO_X$ as a CO control technology for this project was estimated to be more than $60,000 per ton, which is significantly higher than what has been considered to be a cost effective control option for CO emissions from a large combustion turbine in previous BACT determinations.

The use of $SCONO_X$ to control the CO emissions from the PVEC combustion turbine would be equally effective as the use of an oxidation catalyst. There is ample information in the public domain to conclude that the use of $SCONO_X$, if it were scalable, would not be a cost effective CO control technology for PVEC, and its economic costs would be significantly higher than the costs associated with an oxidation catalyst. Therefore, the use of an oxidation catalyst, the most stringent and cost effective available control technology, is the CO BACT determination for the PVEC combustion turbine.

BACT Analysis for Greenhouse Gas (GHG) Emissions from the Combustion Turbine

1. The EPA has requested additional information to support PVEC's conclusion that carbon capture and storage (CCS) is technically infeasible or to otherwise demonstrate that that it can be eliminated from BACT consideration for the project.

   According to the EPA's "PSD and Title V Permitting Guidance for Greenhouse Gases", November 2010, the EPA classifies CCS as an add-on control technology that is available for large CO_2 emitting facilities including fossil fuel-fired power plants. It further states that CCS can be eliminated from a BACT determination on the basis of technical infeasibility if it can be shown that there are significant differences pertinent to its successful operation from what has already been applied to a differing source type or that it is technically infeasible to integrate its components (capture, compression, transport, and storage) into the source due to site-specific considerations.

   The EPA guidance states that the level of detail required to support the justification for the removal of CCS in Step 2 of the BACT analysis will vary depending on the nature of the source and the CCS opportunities available. In cases where CCS opportunities already exist in the area of the source, a comprehensive consideration of CCS is required. According to the EPA guidance, in cases where it is clear that there are significant and overwhelming technical (including logistical) issues associated with the application of CCS to the source under review, a much less detailed justification may be appropriate and acceptable for the source.

PVEC reasserts that the implementation of CSS is technically infeasible for this project. There is inadequate space within the available site footprint to accommodate the CO_2 capture and compression equipment which would be required. The PVEC facility layout has already been optimized for the available footprint to the greatest extent practicable to avoid habitat and wetland impacts resulting from the project's construction.

The parasitic load requirements for such equipment would significantly reduce the net power output of the facility, undermining PVEC's business goals and fundamentally redefining the nature and purpose of the project. Sequestration of the captured CO_2 would require the development of a high pressure pipeline several hundred miles long to transport the material to a location with viable geologic formations, which are not present in the area of the project.

These issues and the logistical hurdles involved in the development of such a pipeline, such as the engineering and the securing of the rights of way, should be sufficient to meet the EPA's requirement for significant and overwhelming technical issues required to demonstrate technical infeasibility of CCS for a source. However, at the EPA's request, PVEC has also considered cost in its evaluation of CSS as BACT.

The EPA guidance states that when evaluating the economic impacts of GHG controls, it may be appropriate in some cases to assess the cost effectiveness of a control option in a less detailed quantitative (or even qualitative) manner. It further states that if the cost of building a new pipeline to transport the CO_2 for CCS is extraordinarily high and by itself would be considered cost infeasible, it would not be necessary to for the applicant to obtain a vendor quote and evaluate the cost effectiveness of a CO_2 capture system.

The EPA guidance acknowledges that at present CCS is an expensive technology whose costs will generally make the price of electricity from power plants with CCS uncompetitive compared to the electricity from plants with other GHG controls. The final decision regarding the reasonableness of the cost effectiveness of CCS is at the discretion of the permitting authority until such time as more data is obtained and more BACT determinations are made.

There are several IGCC and coal based projects in the U.S. that have proposed the use of CCS, such as the AEP Mountaineer project in West Virginia and the PurGen One IGCC project in New Jersey. However, for coal based projects such as these, CCS has not been proposed exclusively as an add-on control technology, it has been proposed to demonstrate the viability of coal-based generation technology in the current regulatory environment. CCC is inherent to the purpose and design and is built into the economic viability of these projects, which would not otherwise be technically or economically feasible without the use of CCS. Therefore, any comparison of the cost effectiveness of CCS for such a project to the PVEC facility, for which the use of CCS would completely change the project's economic viability and purpose, is not a valid or pertinent comparison.

A valid benchmark for cost effectiveness would be to compare the cost of implementing CCS at PVEC with implementing it at another natural gas fired combined-cycle combustion turbine based electric generating facility not located near a viable sequestration site. No such facility has been proposed to date in the U.S., providing further evidence that CCS is not a viable or cost effective control technology for such a source, and that its implementation would ultimately redefine the source, which is beyond the scope and purpose of the BACT determination.

PVEC estimates the cost of the pipeline needed to transport captured CO_2 to a sequestration site to be one to three million dollars per mile. Because there are no viable sequestration sites within the project area, it would cost several hundred million dollars to design, permit, and build such a pipeline. Such costs would severely undermine the economic viability of a project such as PVEC.

Consistent with the EPA guidance, the pipeline costs alone, without consideration of the additional costs associated with the required CO_2 capture and compression systems, should be sufficient to demonstrate that CCS is not a cost effective GHG control technology for PVEC.

PVEC asserts that the information provided above substantiates the conclusion that CCS is not a technically viable or cost effective means of controlling the GHG emissions from the facility, and that its implementation would redefine the project, and can therefore, consistent with the EPA guidance, be eliminated from consideration as BACT.

2. In the March 9, 2011 application supplement, PVEC provided the EPA with a comparison of the project's design net heat rate with the heat rates of other turbines manufactured by General Electric (GE) and Siemens. The EPA has requested additional information, as part of the GHG BACT analysis for the project, that demonstrates that the combined-cycle turbines being evaluated are the most efficient available for this facility.

   There are only four companies that manufacture turbines of a size suitable for the PVEC facility: GE, Siemens, Alstom, and Mitsubishi (MHI). GE offers the 7FA and 7FB turbines only, which were represented in the supplement. Siemens offers the 5000F turbine which was included in the supplement. Siemens is developing a 5000H turbine, but none have been installed in the US to date. Alstom offers the GT24 and GT26 combined-cycle combustion turbines, which, according to their technical specifications, have higher heat rates and lower efficiencies than the MHI 501G. MHI also offers the 501F turbine, which has a higher heat rate than the 501G. The MHI 501J turbine is in development, and has not been installed in the U.S. to date. There is no other similarly sized combustion turbine model commercially available in the U.S., as substantiated in the PVEC PSD application supplement and above, which has a lower heat rate than the MHI 501G.

The information provided above and in the March 9, 2011 supplement demonstrates that the MHI 501G combined-cycle combustion turbine is the most efficient commercially available for the PVEC facility, and thus represents BACT for GHG.

GHG BACT Analysis for Other Equipment

1. The EPA has requested that PVEC consider improvements in the utilization of thermal energy and electricity generated and used on-site that will have the most significant impact in reducing the facility's emissions as part of the BACT analysis for the facility. According to the EPA guidance, the evaluation of options in this category need not include an assessment of each and every conceivable improvement that could marginally improve the energy efficiency of the facility as a whole, since the burden of this level of review would likely outweigh any emissions reductions achieved. Rather, the EPA recommends that the BACT analysis for units at a new facility concentrate on the efficiency of equipment that uses the largest amounts of energy, since energy efficient options for such units and equipment will have a larger impact on reducing the facility's emissions.

   For a combined-cycle power plant such as PVEC, the power block uses the largest amount of energy and is responsible for the vast majority of the facility emissions. Consistent with the EPA guidance, any power block efficiency improvements which can be achieved at such a facility will have a much more significant impact on the facility's energy efficiency and emissions that any marginal improvements that may be achieved from optimizing the other equipment. The burden of the level of review required to achieve any potential efficiency improvements from the other equipment at the facility would outweigh any emissions reductions achieved.

   PVEC will utilize the most efficient combined-cycle combustion turbine generating technology commercially available. PVEC also proposed several additional GHG mitigation measures in the March 9, 2011 application supplement. In combination, these measures represent GHG BACT for the PVEC facility, as determined in accordance with the EPA guidance for such a determination.

2. The EPA has requested that PVEC provide information regarding the energy efficiency of the proposed auxiliary boiler, emergency generator, and fire pump, as well as any actions that will be taken to optimize the efficiency of this equipment.

The March 9, 2011 application supplement detailed the GHG mitigation measures to be employed by PVEC for this equipment including limited operation and the use of clean fuels and efficient combustion technology. The auxiliary boiler will fire natural gas fuel only and be limited in operation to 1,100 hours per year. The auxiliary boiler will only be used during startups of the combustion turbine and then only for brief periods until the HRSG begins to produce steam. The operation of the auxiliary boiler will be too intermittent and of short duration for the effective implementation of additional energy efficiency measures which are designed for extended steady-state boiler operation, such as an air preheater. By the time the air preheater reached its effective temperature, the auxiliary boiler would already be shut down. The auxiliary boiler will be equipped with efficient combustion controls commensurate with its size and proposed use, and in combination with the use of natural gas fuel and limited operation, represent GHG BACT for the project.

The diesel emergency generator and fire pump will each be limited in operation to 300 hours per year. Compliance with the EPA's non-road engine emission standards will require PVEC to install the lowest emitting and most efficient engines commercially available at the time of construction. Limiting operation and utilizing diesel equipment with engines that meet the EPA's strictest non-road emission standards are the only means available for controlling the GHG emissions from such equipment, and therefore represent the BACT determination for the project.

As noted above, the EPA guidance recommends that facility energy efficiency improvement efforts be focused on equipment from which significant GHG emission reductions can be achieved. As detailed in Table 1 of the application supplement, the total GHG emissions from the auxiliary boiler, emergency generator, and fire pump represent approximately 0.1% of the total annual GHG emissions from the PVEC facility. PVEC asserts that any efforts to achieve additional energy efficiency improvements or emissions reductions beyond those already proposed for this equipment, consistent with EPA guidance, would outweigh the minimal facility emission reductions which could be achieved.

3. The EPA has requested that PVEC provide additional information substantiating the need to use sulfur hexafluoride (SF_6) in the circuit breakers at the facility. The EPA has also requested an estimate of the potential SF_6 emissions from the PVEC facility due to leaks from the circuit breakers.

For clarification, although the switchyard equipment has been included in the permitting of the PVEC facility, this equipment will be owned, operated, and maintained by Northeast Utilities (NU). NU has been an active participant in the SF_6 Emission Reduction Partnership, led by EPA, investigating the most cost effective technologies and industry practices for the reduction of SF_6 emissions. Through its participation in the Partnership, NU has developed the recommended practices for handling and storing SF_6 gas. The equipment installed in the PVEC switchyard will be included in NU's program.

In the March 9, 2011 application supplement, PVEC asserted that while the use of circuit breakers containing dielectric oil or compressed air could be technically feasible, their use would require significantly larger equipment to achieve comparable performance as SF_6 circuit breakers, and space constraints on the site would preclude their use for the project.

PVEC has done some additional due diligence on the requirements for the facility circuit breakers and determined that SF_6 is in fact the only chemical that has the adequate insulating properties for the facility circuit breakers that is commercially available. The advantages of the use of SF_6 in circuit breakers over other possible materials include low operating energy requirements, no fire risk, no toxic hazards, corrosion protection, limited space requirements, extremely low failure rate, low maintenance costs, and long service life. The use of SF_6 is the safest and most reliable means commercially available to insulate high-voltage circuit breakers.

Although there are ongoing industry efforts to identify alternative materials and technologies to replace the properties of SF_6 in circuit breakers without the potential for GHG emissions, no such material or technology is commercially available at this time. PVEC will continue to monitor such efforts and will consider the use of alternative materials with less potential for GHG emissions should they become commercially available for the facility.

As described in the application supplement, the PVEC switchyard will utilize state-of-the-art, totally enclosed-pressure circuit breakers equipped with leak detection systems. These systems will be guaranteed for a leakage rate less than 0.5% by weight per year. Density alarms will be used to identify SF_6 leaks immediately so that corrective actions can be taken in time to limit releases. The use of enclosed-pressure SF_6 circuit breakers equipped with leak detection represents BACT for GHG for the project.

PVEC estimates the circuit breakers at the facility will have a total SF_6 capacity of approximately 64 pounds. With a maximum leak rate of 0.5% by weight per year, the potential SF_6 emissions from circuit breaker leaks at the facility will be a maximum of 0.32 pounds per year. The global warming potential of SF_6 is 23,900. Therefore, the potential SF_6 emissions from the PVEC facility, expressed as CO_2 equivalents (CO_{2e}), will be up to 3.8 tons per year.

This maximum SF_6 leak rate of 3.8 tons per year as CO_{2e} represents less than 0.00025% of the total potential annual GHG emissions from the PVEC facility. PVEC asserts that any efforts to achieve additional emissions reductions beyond those already proposed for this equipment, consistent with EPA guidance, would outweigh the minimal facility emission reductions which could be achieved.

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Environmental Justice Analysis

1. The EPA has requested that PVEC provide figures which magnify the significant impact areas (SIA) for annual and 24-hour $PM_{2.5}$. The attached figures (Figures 1A and 2A) provide such detail. As shown on Figures 1A and 2A, neither the SIA for annual nor 24-hour $PM_{2.5}$ include any identified environmental justice areas.

   The EPA also requested that PVEC quantify the contribution of the SCR emissions control system to the combustion turbine's $PM/PM_{10}/PM_{2.5}$ emissions from the formation of ammonium nitrates and ammonium sulfates from the injection of ammonia for NO_X control. According to MHI, the contribution to the $PM/PM_{10}/PM_{2.5}$ emission rate from the combustion turbine resulting from ammonia injection in the SCR will be approximately 57.3 percent of the total emission rate while firing natural gas and approximately 15.4 percent of the toal emission rate while firing ULSD. The PVEC PSD Permit Application included a demonstration that the maximum PM_{10} and $PM_{2.5}$ emission rates from the facility, including the emissions resulting from ammonia injection in the SCR, will not cause or contribute to an exceedance of the NAAQS or any PSD increment.

We trust that the above information is a complete response to your information request. Please feel free to contact me by phone at (781) 489-1149 or via e-mail at mfeinblatt@essgroup.com if you have any questions on this response.

Sincerely,

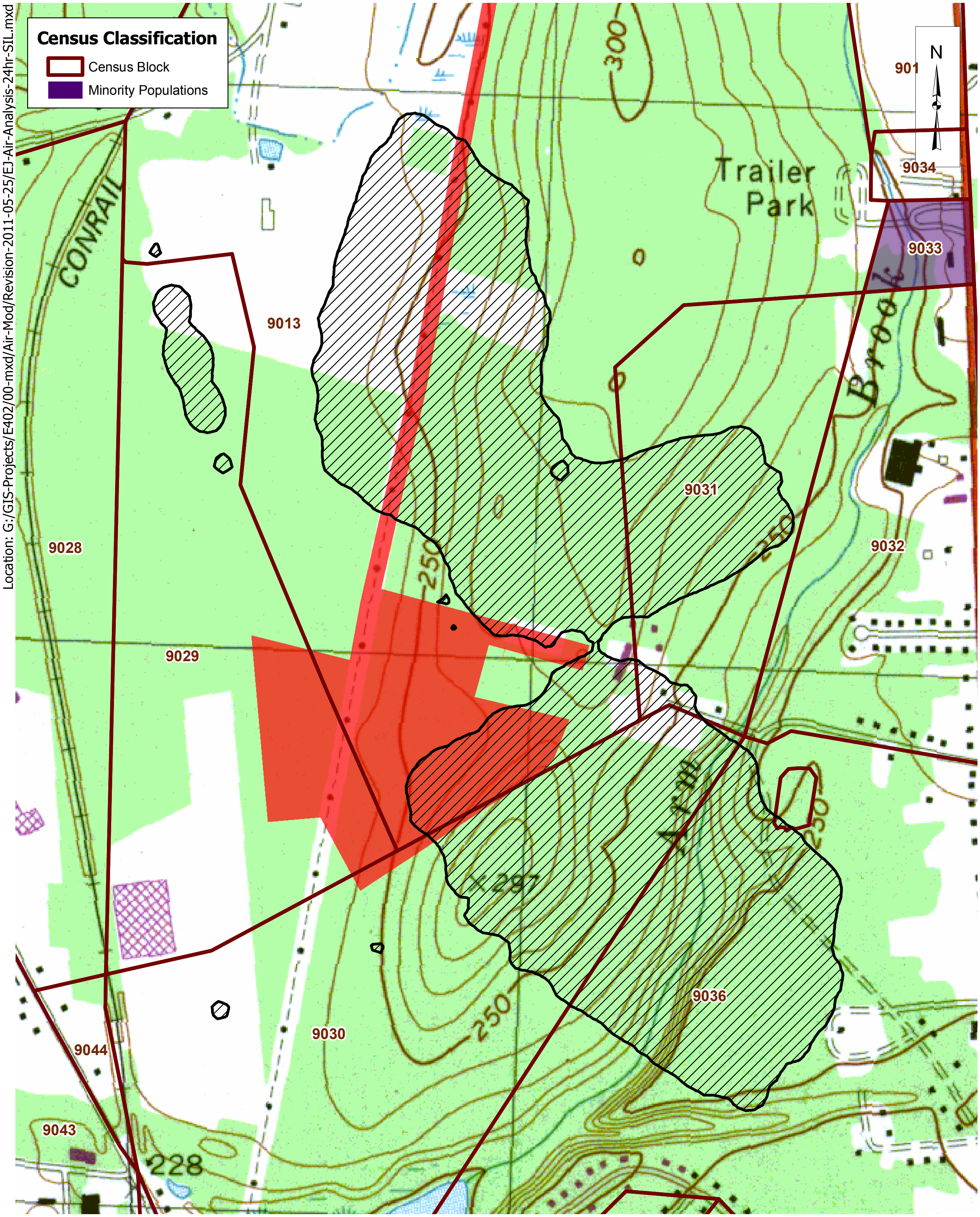
ESS GROUP, INC.

Michael E. Feinblatt
Practice Leader
Energy & Industrial Services

Attachments

C: Matthew Palmer, PVEC
Jack Arruda, PVEC

Location: G:/GIS-Projects/E402/00-mxd/Air-Mod/Revision-2011-05-25/EJ-Air-Analysis-24hr-SIL.mxd



EMI WESTFIELD
Westfield, Massachusetts

Scale: 1" = 800'

0 800 Feet

Source: 1) MassGIS, USGS DRG, 1987
2) ESS, Contours 24hr, 2008

Legend

$PM_{2.5}$ SIL Isopleth (1.2 µg/m³)

Site Boundary

Values shown are the modeled $PM_{2.5}/PM_{10}$ ambient air impacts in µg/m³ from the PVEC Facility during normal operation.

PVEC 24-hr $PM_{2.5}$
Significant Impact Area

Figure 1A

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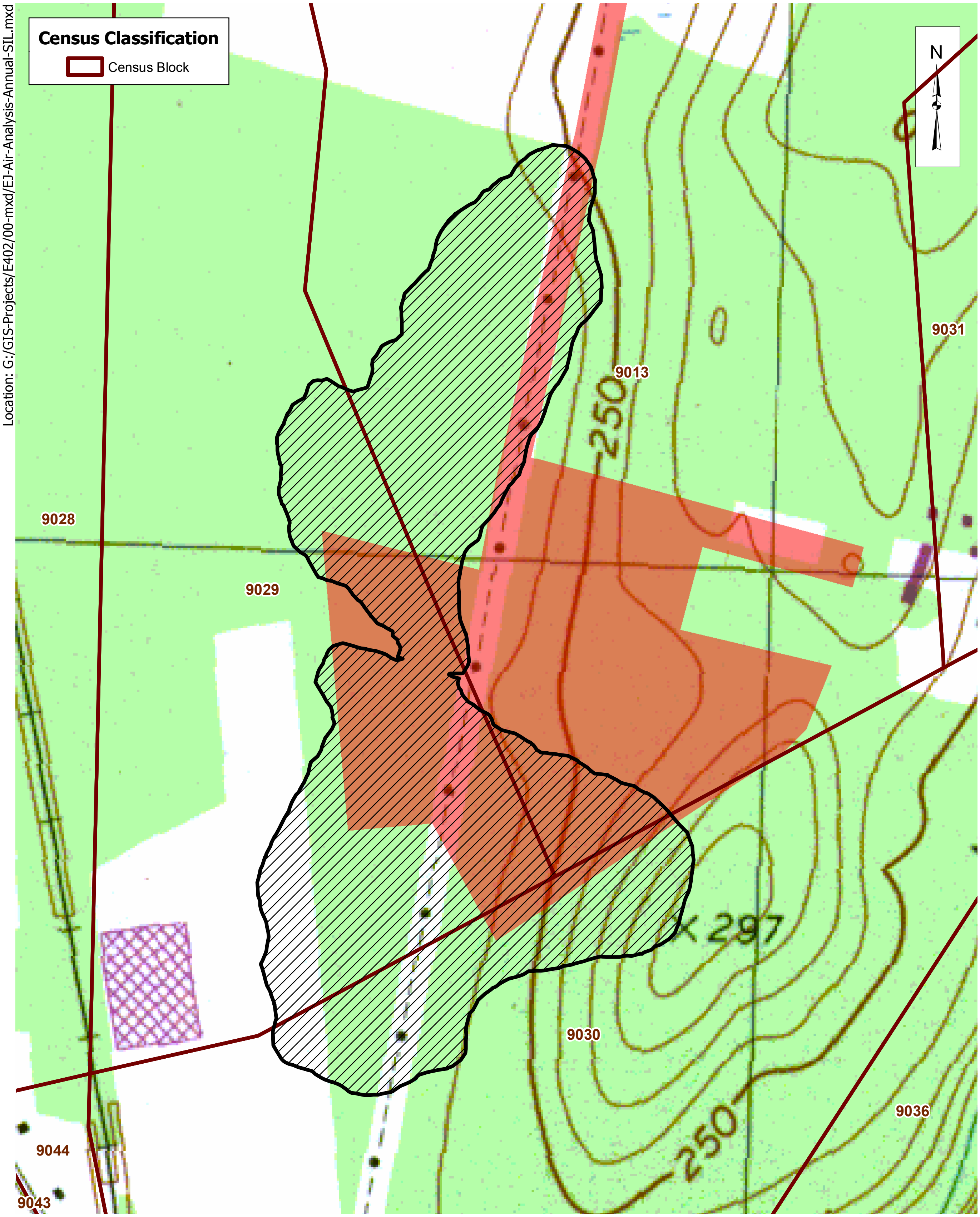
Location: G:/GIS-Projects/E402/00-mxd/EJ-Air-Analysis-Annual-SIL.mxd



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EMI WESTFIELD
Westfield, Massachusetts

Scale: 1" = 500'

0 500 Feet

Source: 1) MassGIS, USGS DRG, 1987
2) ESS, Contours 24hr, 2008

Legend

$PM_{2.5}$ SIL Isopleth (0.3 µg/m³)

Site Boundary

Values shown are the modeled $PM_{2.5}$/PM_{10} ambient air impacts in µg/m³ from the PVEC Facility during normal operation.

PVEC Annual $PM_{2.5}$ Significant Impact Area

Figure 2A