PATRICK ENGINEERING

November 3, 2014

Mr. Charles Schopp, Administrator
Livingston County Regional Planning Commission
110 West Water Street, Suite 3
Pontiac, IL 61764

Reference: Pleasant Ridge Wind Energy Project
Summary Review Report

Dear Mr. Schopp:

Patrick Engineering Inc. (Patrick) has prepared this letter report to document our review findings on the Invenergy Pleasant Ridge Wind Energy Project proposal for Livingston County. As stated in our August 29, 2014 proposal letter, Patrick performed the following activities:

- Prepared a checklist to compare application data to Livingston County ordinance (the Ordinance) only as it pertains to Article VIII, Wind Energy;
- Checked setbacks listed in the Ordinance related to dwellings, public roads, transmission lines, property lines and municipality corporate limits[1];
- Checked that appropriate Federal, State, and local agencies were contacted regarding impacts to threatened & endangered species, wetlands, historic preservation, etc.

The remainder of this letter summarizes our review findings.

Review Materials. The following documents were reviewed by Patrick:

- Invenergy "Application for County Siting Approval for Pleasant Ridge Wind Energy Project by Invenergy, Livingston County, Illinois Dated August 20, 2014". (This is the Special Use Application), including all supporting documentation in the Appendices A through I attached to and considered a part of the Special Use Application. It should be noted that Patrick did not review the application for consistency with the General Special Use Application, but only the parts related to Article VIII (Wind Energy) of the Ordinance.
- Appendices included the following:
    - Appendix A – Livingston County Wind Ordinance Checklist – by Invenergy
    - Appendix B – Credit Worthiness Letter – from CoBANK
    - Appendix C – Turbine Information – by General Electric
    - Appendix D – Participating Property Owners Names, Addresses, and Phone Numbers
    - Appendix E – Communications and Interference Information
        - Wind Power GeoPlanner Microwave Study by Comsearch

[1] Note: The accuracy of the setbacks is limited due to the sources of readily available information. Patrick did not perform any field verification.

      - Letter from U.S. Department of Commerce concerning radio frequency interference
  - Appendix F – Safety Plan
  - Appendix G – Noise Modeling
      - Pleasant Ridge Wind Energy Project Sound Study by Stantec
      - Two sub-appendices
          - Appendix A – Sound Study Results
          - Appendix B – Receptor and Turbine Coordinates (UTM Zone 16)
  - Appendix H – Natural and Cultural Resource Studies
      - Letter concerning archeological and architectural sites of historic interest in the project area.
  - Appendix I – Decommissioning Plan
      - Prepared by Stantec for Pleasant Ridge Energy, LLC

Conclusions. Attachment A to this summary report is a checklist prepared by Patrick to confirm evidence that each of the Ordinance requirements was contained in the permit application. The checklist does not indicate whether the permit application is "complete" with respect to the Ordinance, only that data was submitted to address the Ordinance requirements.

Patrick's review concluded the following:

- Data required by Section 56-616 of the Ordinance is included in the application, with the following notes:
  - Part (b)(1): Hub height is noted in Section 2.1 to be 80 meters (262.5 feet) with an overall height including rotor of 131.5 meters (431.4) while Appendix E "Communication and Interference Information" Microwave Study Section 2 shows a hub height of 96 meters (315 feet) giving an overall height including rotor of 147.5 meters (483.9 feet). Although still below the required 500 feet, this difference needs to be reviewed for the microwave impact study. An overall height of 500 feet was utilized by Invenergy in their Application for determining residential setbacks.
  - Part (b)(3): Guying is not required for the turbine towers as they are self-supporting.
  - Part (b)(6): A letter of creditworthiness is included with the application, however, no financial commitment letter is included.
- Design and installation data required by Section 56-618 of the Ordinance is included in the application, with the following notes:
  - Part (a)(1): Compliance certificates will be provided at a later date. None were included in the Application.
  - Part (h)(1), (h)(2), and (h)(3): Patrick has verified compliance with setbacks relative to the available data on receptors, turbines, GIS data of roads, transmission lines, and property boundaries. No field verification was performed.
  - Part (h)(4): The application indicated that Forrest had waived "extraterritorial regulatory authority". Six (6) turbines are within 1.5 miles of Forrest.
  - Part (j)(2)b: The application did not indicate that a pre-construction baseline survey of existing roads will be performed; however, this is required by the

Ordinance as a pre-construction activity and will be a necessary part of any agreement with the relevant roadway authorities.

- Operation data required by Section 56-619 of the Ordinance is included in the application, with the following notes:
  - Part (b)(3): Comsearch stated that "For this project, turbine locations were not provided; thus we could not determine if any potential obstructions exist between the planned wind turbines and the incumbent microwave paths. If the latitude and longitude values for the turbine locations are provided, Comsearch can identify where a potential conflict might exist." The Comsearch "Wind Power GeoPlanner Microwave Study" recommends proper siting of turbines to avoid interference or obstruction with the Fresnel Zones of the calculated microwave paths. Twenty five (25) microwave paths were identified.
    The application does include turbine and receptor coordinates in UTM. The Comsearch study only identified the Microwave paths and Fresnal zones.
  - It was noted that the Figure 3 of the Comsearch study and the Figure 3-2 of the Invenergy Application do not agree with respect to the microwave paths, or fresnal zones. In particular, microwave paths 2 and 3 are missing from Figure 3-2 by Invenergy.
- Noise data required by 56-620 of the Ordinance is included in the application.
  - Noise study prepared by Stantec (Appendix G) concludes "The analysis of potential sound impact from the Pleasant Ridge Project on area homes and other identified sensitive community receptors indicates that the noise impacts from the proposed Project are within the limits set forth by the IPCB regulations."
  - Patrick's noise evaluation at three separate locations (Attachment B to this Summary) confirmed the conclusions of the noise studies provided in the application.
  - Patrick noted that the turbine labeling in Table 5 of the Application Appendix B "Receptor and Turbine Coordinates" is inconsistent with the various exhibits in the Application. In our sound studies we referenced the turbine labels as follows, consistent with Invenergy Figures 1-3, 2, and 3-3:
    - A01–123; A02-124; A03-125; A04-126; A05-127; A06-128; A07-129; A08-130; A09-131; A10-132; A11-133; A12-134; A13-135; A14-136; A15-137.
- Avian (bird) study data required by Section 56-621 of the Ordinance is included in the application.
  - Section 5 of the Application indicates that the results of six different studies performed for the project area relevant to birds and their habitat and prepared by Pleasant Ridge "… indicate that the installation of turbines will not have a substantial adverse impact on birds."
  - A similar set of studies is identified in this section of the Application relevant to bats and their habitat and prepared by Pleasant Ridge with the following commentary "… no direct effects are expected to occur during the winter, spring, or summer months. To avoid impacts to bats during fall, in addition to Project siting and turbine setbacks to avoid potential bat habitat, Pleasant Ridge will raise

  - cut-in speeds to 15.2 mph (6.9 m/s) from August 1 through October 7 from sunset to sunrise."
  - The Application did not identify any terrestrial/plant threatened and endangered species or natural areas. If the County desires, an IDNR EcoCAT study may be performed and it would identify these in addition to bats and birds. This work is not required by the Ordinance.
- Liability insurance data required by Section 56-623 of the Ordinance is included in the application.
- Decommissioning plan data required by Section 56-624 of the Ordinance is included in the application.
  - The County may want to consider the true cost of Decommissioning independently. The decommissioning report by Stantec indicated the net decommissioning cost at approximately $37,000 per turbine after salvage.
- State/Federal Requirements:
  - NPDES permit and SWPPP will be obtained prior to construction. No permits have been applied for at this time.
  - Archeological Assessment
    - No Phase 1 survey was completed.
    - UIUC letter states that "Overall, no known NRHP (National Register of Historic Places) eligible archeological sites and no known eligible architectural resources (are) present in the project area, **but most of the project area has not been surveyed for cultural resources.**" Invenergy states that the results of a "record review (within a two mile radius of the project area) indicate limited cultural resources located within the study area".
  - Threatened & endangered (T&E) species, wetlands, and historic preservation required by Federal, State, and local regulations is referred to in Section 5 of the Application. The referenced studies were summarized only. They were not included with the Application.
- See "Attachment C – Permit Summary Table" for listing of permits, agreements and documentation to be furnished after approval of the Application, but prior to construction.

Please contact me if you have any questions or concerns regarding this summary report.

Sincerely,
PATRICK ENGINEERING INC.

Alan M. Hymans

Alan M. Hymans, P.E..
Senior Engineer, Power and Energy Team

CJB/mem Enclosures: As noted

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ATTACHMENT A

Livingston County Wind Energy Checklist

300 West Edwards Street, Suite 200, Springfield, Illinois 62704 | 800.799.7050 | patrickco.com

Attachment A

Livingston County – Pleasant Ridge Wind Energy Center Checklist			
County Ordinance Requirements			**Location of Required Information**** A = information from Application. **P = comment from Patrick.**
Section 56-616 - Siting Approval Application*			
Part (b)(1)	WECS Project Summary		
a.	General Project Description	√	A: Section 1.3
	Name plate generating capacity	√	A: Section 1.3 – Up to 250mW; depends on turbine size (1.6 – 2.1MW)
	Potential equipment manufacturer	√	A: Section 1.3 – General Electric (GE)
	Types of WECS	√	A: Section 1.3 - GE Model 1.79-100
	Number of WECS	√	A; Section 1.3 – Quantity 136
	Name plate generating capacity of each WECS	√	A: Section 1.3 – Generator capacity as low as 1.6mW and as high as 2.1MW
	Maximum height of the WECS tower – Limit 500 feet	√	A: Section 2.1, 2nd para & Section 3.2 – Hub Ht = 262.5ft; Rotor dia. = 337.9ft; Total Ht = 431.4ft
	Maximum diameter of the WECS rotor	√	A: Section 2.1, 2nd para & Section 3.2 –Rotor dia. = 337.9ft
b.	Location of the project	√	A: Provided in Sections 1.1 and 1.4, Figures 1-1 and 1-2, Table 1-2. Livingston County, Illinois: Townships of Pleasant Ridge, Forrest, Fayette, Eppards, Point, Indian Grove, Chatsworth, Charlotte, Belle Prairie, Avoca
c.	Description of the Applicant, Owner and Operator	√	A: Sections 1.1, 1.5, 1.6, 1.7
Part (b)(2)	Names, addresses, phone numbers of applicants including their respective business structures		
	Applicant	√	A: Section 1.6
	Owner and Operator	√	A: Section 1.6
	Property Owners	√	A: Appendix D
Part (b)(3)	Site Plan for the Installation of WECS	√	A: General Area Map – Figure 1-2
	Planned location for each WECS tower, guy lines & anchor bases	√	A: Appendix B – Coordinates are given in UTM. Locations are shown on Figures 3-1 & 1-3. Typical foundation is shown on drawing S-02. **P: Guying is not required for the towers as they are self-supporting.**
	Primary Structures	√	A: Figure 3-2
	Property lines (identify adjoining property)	√	A: Figure 1-3
	Setback lines	√	A: Figure 3-2 & Section 3.2 – Facility Siting and Setback Requirements
	Public and private access roads and turnouts	√	A: Figure 3-2
	Substations	√	A: Figure 1-3 & Figure 2 for Collection Substation
	Electrical cabling from WECS tower to the substation	√	A: Figure 1-3 includes a detailed map of the proposed cable routes

	Ancillary equipment	√	A: Described in Sections 2.1 and 3.1 (transformers, underground cable, met tower, laydown area)
	Third party transmission lines	√	A: Figures 1-3 and 3-2
	Layout of all structures within geographical boundaries of any setback	√	A: Figures 1-3 and 3-2 show layout of WECS towers, roads, and substations relative to setbacks for non-participating landowners, primary structures (residences), transmission lines, and roads/railroads.
	Location of any construction staging areas.	√	A: Figures 2, 1-3, and 3-2
Part (b)(4)	Studies, reports, certifications and approvals showing compliance with the provisions of this article	√	A: Sections 3, 4, 5, and 6 of the application include information and studies to support the project. **P: Desktop studies have been completed. Further delineation and study is necessary prior to obtaining construction authorization.**
Part (b)(5)	Information required by the County Zoning Ordinance	√	**P: Patrick only reviewed the application as it applies to the Ordinance Article VIII: Wind Energy (Sections 56-614 through 56-624)**
Part (b)(6)	Financial assurance that the project can be developed as proposed	√	A: Letter of Creditworthiness from CoBank is included in the Application (Appendix B) **P: No financial commitment letter is included with the application.**

Section 56-618 – Design and Installation*			
Part (a)(1)	Equipment Manufacturer's Certificate of Design Compliance	√	A/P: Section 3-1-1 – Indicates compliance certificates will be provided. None were included with the Special Use Application.
Part (a)(2)	P.E. Certification of WECS Foundation	√	A: Section 3.1.1 – P.E. sealed foundation design will be provided after Special Use Application and WECS Tower Sites have been approved by the County.
Part (b)(1)	WECS shall be equipped with a redundant braking system ▪ Aerodynamic overspeed controls ▪ And mechanical brakes	√	A: Appendix C under Brake System and Section 3.1.2 – Rotor. **P: Rotors are feathered to provide the main braking system.**
Part (c)	All electrical components shall conform to applicable local, state, and national codes: relevant national and international standards. Utility lines to be underground.	√	A: Section 3.1.1 Design Safety Certification
Part (d)	Color shall be non-reflective and unobtrusive	√	A: Section 3.1.2 – Rotor and Tower. Color white noted.
Part (e)	FAA requirements compliance	√	A: Section 3.5 – Compliance with FAA
Part (f)	Warnings:		
(f)(1)	Voltage warning sign shall be placed at the base of all transformers and substations	√	A: Section 3.1.3
(f)(2)	Anchor points of guy wires and 15 feet up guy wires shall have visible, reflective warning markers.	√	A: Section3.1.2 – Towers are self-supporting, no guying is required.
Part (g)(1)	All WECS must be externally unclimbable	√	A: Section 3.1.4

Attachment A

Part (h)	Setbacks		
(h)(1) (h)(2)	All WECS shall be set back three times the height of the tower or 1200 feet, whichever is greater, from any Primary Structure.	√	A: Section 3.2, Figure 3-2. Setback is 1294.2ft for this project. **P: Patrick has verified compliance based on the primary structure information provided in the Application (Table 4 of Appendix B in Appendix G of Application)** **Invenergy used tower height of 500 ft for residential setbacks of 1500 ft.**
(h)(3)	All WECS shall be set back at least 1.10 times the WECS Tower Height from public roads, third party transmission lines, and communication towers.	√	A: Section 3.2, Figure 3-2. Setback is 474.5ft for this project. **P: Patrick has verified compliance based on the GIS dataset of public roads, third party transmission lines, and communication towers for this area in Livingston County**
(h)(4)	All WECS shall be set back at least 1.10 times the WECS Tower Height from adjacent property lines.	√	A: Section 3.2, Figure 3-2. Setback is 474.5 ft for this project. **P: Patrick has verified compliance based on the GIS dataset of property lines for Livingston County. Participating landowners are listed in Appendix D.**
(h)(5)	Incorporated village or municipality must approve of any tower within 1.5 miles of corporate limits.	√	A: Section 3.2, last paragraph – Forrest entered into a Cooperation and Release Agreement with Pleasant Ridge, providing that the Village waives its "extraterritorial regulatory authority". **P: WECS towers 32 and 123 through 132 are within the 1.5 mile municipal limit of Forrest.**
	No part of a WECS tower shall encroach on a sewage disposal system.	√	A: Section 3.2 (4th paragraph) and Section 3.6
Part (j)	Use of public roads	√	A: Section 3.4
(j)(1)a	Identify all public roads	√	A: Figure 1-3, Figure 3-2, and Figure 2
(j)(1)b	Obtain applicable weight and size permits prior to construction	√	A: Section 3.4. To be furnished after Special Use Application approval.
Part (j)(2) (j)(2)a	Weight or size permit requirements	√	A: Section 3.4. To be furnished after Special Use Application approval.
(j)(2)b	Conduct a pre-construction baseline survey to determine existing road conditions	√	A: Section 3.4 **P: Performance of a pre-construction survey not specifically addressed.**
(j)(2)c	Secure financial assurance for any repair or damage to road	√	A: Section 3.4 – Pleasant Ridge "…will ensure…repairs" per Road Use and Repair Agreements to be negotiated.
	Provide Livingston County Zoning Administrator with agreements pertaining to public road use.	√	A: Section 3.4 **P: Agreements to be negotiated following approval of Special Use Permit.**
Part (k)	Height - Maximum height of 500 feet.	√	A: Section 3.5
(k)(2)	WECS shall be constructed with a tubular tower.	√	A: Section 3.1.2
Part (l)	Lighting Plan approval by the zoning board of appeals		
	Description of all lighting used, including required by FAA	√	A: Section 3.5 FAA

	Planned number and location of lights	√	A: Section 3.5 and Figure 3-3
	Light color	√	A: Figure 3-3
	Where any lights will be flashing	√	A: Figure 3-3
Section 56-619 – Operation*			
Part (a)	Maintenance		
(a)(1)	Annual summary of operation and maintenance reports to the County.	√	A: Section 4.1
(a)(2)	Recertification of application for any physical modification to the WECS	√	A: Section 4.1
Part (b)	Interference		
(b)(1)	Provide copies of project summary and site plan to applicable microwave transmission providers and local emergency service providers.	√	A: Section 4.2 and Figure 3-2. Appendix E – Comsearch Study **P: Does not address whether copies of the study were provided to local microwave transmission or emergency service providers. Some microwave paths (paths 2 and 3) identified in Comsearch study were not located on Figure 3-2.**
(b)(2)	Mitigation of Interference, if required	√	A: Section 4.2 – Mitigation measures
(b)(3)	Interference Study related to interference with local broadcast residential television and wireless internet services.	√	A: Appendix E – Comsearch Study – Recommends proper siting of turbines to avoid microwave paths. 25 microwave paths were identified.
Part (c)	Coordination with Local Fire Department		
(c)(1) (c)(2) (c)(3)	Local fire department submissions ▪ Site Plan ▪ Hazard Plan ▪ Emergency Response Plan (upon request) ▪ Comply with other applicable fire laws	√	A: Section4.3 All items will be provided when meeting with local fire departments. Contact has been made with local fire departments (Section 7.0).
Part (d)	Materials Handling, Storage, and Disposal	√	A: Section 4.4
(d)(2)	List of hazardous materials related to the construction, operation and maintenance	√	A: Section 4.4 - IAC Title 35, Parts 700-739 **P: Does not address fluids in transformers that will be set at base of WECS towers. Does not address fuels, concrete waste, or construction materials (e.g., solvents).**

Section 56-620 – Noise Levels*			
	Comply with applicable IPCB regulations	√	A: Section 5.1 and Appendix G – addresses IPCB noise regulations (35 Ill. Admin. Code, Title 35, Parts 900 and 901).

Section 56-621 – Birds*			
	Avian habitat study to determine if the WECS will have a substantial adverse impact on birds	√	A: Section 5.2 – Covers Birds and Bats

Attachment A

Section 56-623– Liability Insurance*			
	Maintain general liability policy covering bodily injury and property damage ▪ $5 million per occurrence ▪ $10 million in the aggregate ▪ County as additional insured	√	A: Section 1.8

Section 56-624 – Decommissioning Plan*			
	Decommissioning Plan shall include:	√	A: Section 6.0 and Appendix I
Part (1)	Provisions for decommissioning triggering events	√	A: Appendix I, Section 1.2***
Part (2)	Provisions for the removal of structures, debris and cabling	√	A: Appendix I, Section 2***
Part (3)	Provisions for the restoration of the soil and vegetation	√	A: Appendix I, Section 2.9***
Part (4)	An estimate of the decommissioning costs certified by a P.E.	√	A: Appendix I, Section 3***
Part (5)	Financial assurance for the purpose of performing decommissioning	√	A: Appendix I, Section 3.4***
Part (6)	A provision that the terms of the Decommissioning Plan shall be binding upon the owner or operator	√	A: Appendix I, Section 3.4***

State/ Federal Requirements			
	Permit Requirements		**Application**
IEPA	NPDES Construction Stormwater Permit Stormwater Pollution Prevention Plan	√	A: Section 5.6 – Will develop SWPPP and obtain NPDES Permit prior to construction
Corps, IEPA	Clean Water Act	√	A: Section 5.3 – Wetlands and Waterways Section5.4 – Flood Plains Desktop studies have been completed. Permits will be obtained prior to construction. **P: Wetland delineation has not been performed. Some access roads may fall within regulated floodplains, based on Figure 3-2.**
IHPA	Archeological Assessment	√	A: Archeological assessment letter from UIUC is included. It indicates that "most of the project area has not been surveyed for cultural resources. **P: A Phase I archeology study has not been completed.**
IDNR	Threatened & Endangered Species	√	A: Section 5.2.1 – Birds. Section 5.2.2 – Bats – Site characterization studies being performed in accordance with IDNR and USFWS *recommendations*. **P: An IDNR EcoCAT report has not been completed, which would identify potential T&E species (avian, terrestrial, and plants) and nearby natural areas.**

* Heading, Section and Part #'s refer to the Livingston County, Illinois, Code of Ordinances>>Part II – Land Use, Planning and Utilities>>Chapter 56 – Zoning>>Article VIII. Wind Energy

Attachment A

** Section #'s in this column of the checklist refer to section numbers within the "Application for County Siting Approval for Pleasant Ridge Wind Energy Project" as published by Invenergy for Livingston County, Illinois and dated August 20, 2014, unless noted otherwise in notes * and ***.

*** Section #'s refer to sections within the Stantec Decommissioning Report (Appendix I)

ATTACHMENT B

Noise Studies

Pleasant Ridge Wind Energy Project – Livingston County
Noise Assessment Study and Review

Executive Summary

The purpose of this study is to define the regulations applying to the noise assessment for the Pleasant Ridge Wind Energy Project, validate the noise modeling predictions using an independent model and compare the results. The evaluations performed indicate that the turbines, as situated, and given the parameters used under normal conditions, will generate noise levels that are in compliance with state regulations at the 107 receptor locations identified in the Application for Livingston County. The site layout of the Wind Energy Project along with the location of the sound studies, turbines and receptors are shown in Figures PEI-4 and PEI-5 at the end of this review.

Regulation

The primary applicable regulation for this location is defined by the Illinois Pollution Control Board (IPCB) known as Title 35: Environmental Protection, Subtitle H: Noise, Chapter 1: Pollution Control Board, Sections 901.101 Classification of Land According to Use, 901.102 Sound Emitted to Class A Land, and 901.106 Prominent Discrete Tones. This regulation defines the sound levels allowed to be emitted from an agricultural/industrial site and received on a residential site during daylight and nighttime hours. These levels are divided into frequency bands in order to account for noise annoyance that is dependent on frequency. Generally, higher audible frequencies cause greater annoyance than lower frequencies. This is reflected in the regulations that restrict the sound levels at higher frequencies, and is shown graphically in Figure 1.

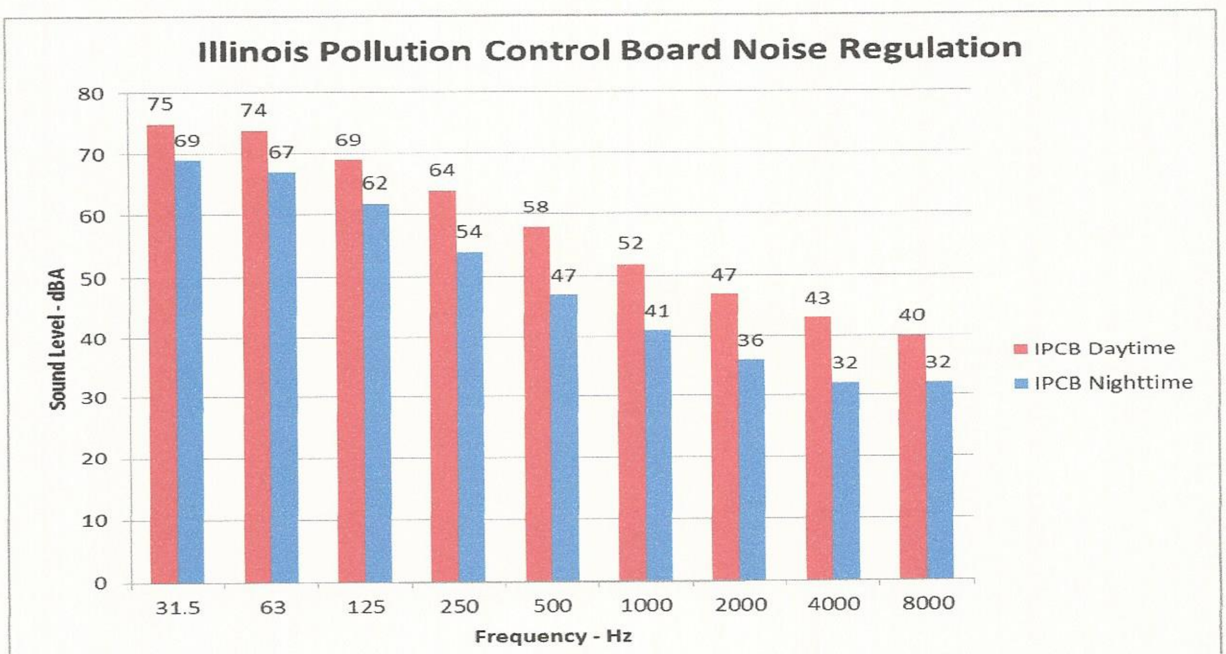


Figure 1. Allowable Daytime and Nighttime sound emitted from Class C land to Class A land.

A source with higher individual or discrete tones can cause more annoyance than a source with equal levels across all frequencies. With measurements broken into frequency bands, if one frequency band is much higher than the others at the source, it is classified as a discrete tone. Section 901.106, Prominent Discrete Tones was determined to apply to the transformers used to step up the voltage at each turbine foundation from the generated voltage to the distribution voltage. Manufacturers' data was used in the specified analysis to determine if discrete tones are present at the turbines. This was accomplished for the GE 1.79-100 turbine. In this case the turbine sources were not classified as having discrete tones or frequencies.

Transformers typically create discrete tones in the lower octave bands. A tonal adjustment factor[1] for each frequency band can be applied to the transformer sound level emissions. However, industry practice has a 5 dB adjustment applied to each frequency band, thereby providing the most conservative approach to tonal adjustment. The tonal adjustment factors for each frequency band is shown in Table 1 with Column 2 showing the individual discrete adjustments and Column 3 showing the typical industry adjustment. The Patrick studies used the final values shown in Column 5.

	Transformer Noise Emissions			
Frequency Band - Hz	Tonal Adjustment - dB (per Reference 1)	Tonal Adjustment Typical - dB	Transformer Sound Levels	Adjusted Transformer Sound Levels Typical
31	-1	5	77	82
63	5	5	72.8	77.8
125	7	5	76	81
250	2	5	76.4	81.4
500	2	5	73.3	78.3
1000	-4	5	61.4	66.4
2000	-9	5	53.4	58.4
4000	-14	5	44.4	49.4
8000	-21	5	34.4	39.4

Table 1: Transformer Noise Emissions

The application source and receptor data (furnished as part of the Invenergy Study) was reviewed for all locations, and a summary of the highest sound levels versus frequency band was created. This summary is plotted below in Figure 2 and shows that all the predicted levels are lower than or equal to the regulation.

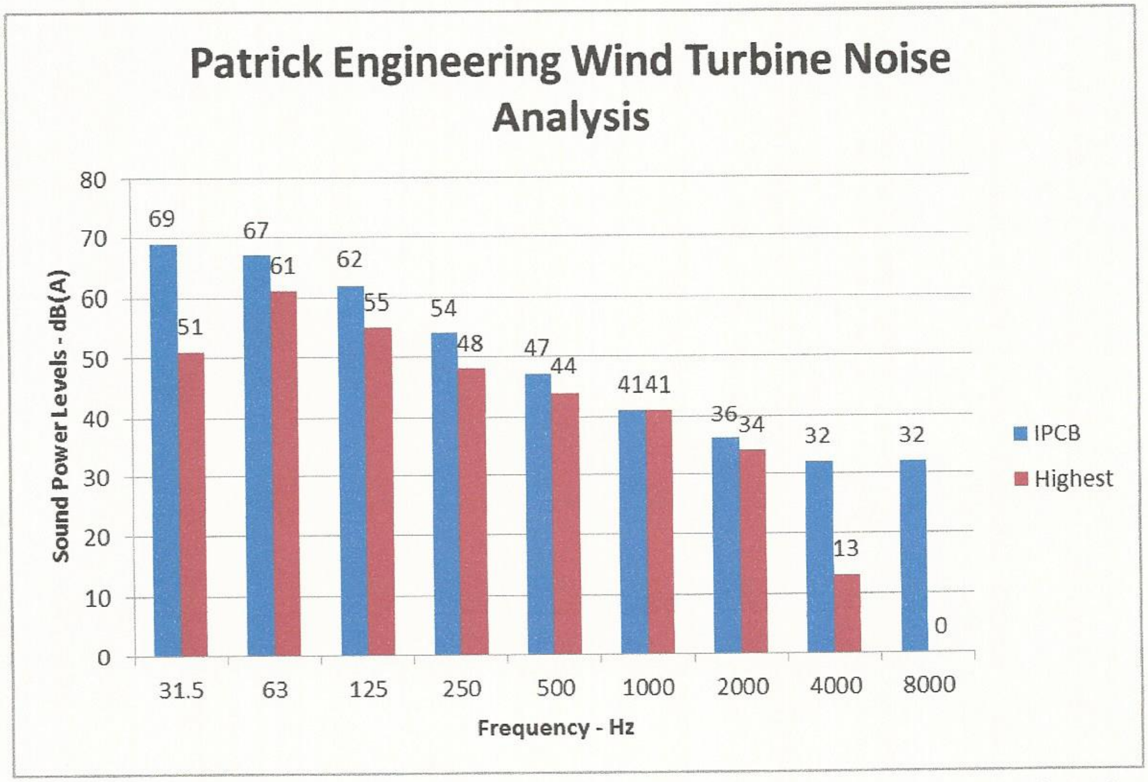


Figure 2. Illinois Pollution Control Board (IPCB) limits at receptors versus anticipated maximum sound power levels within each octave band.

Approach

Patrick identified the applicable State regulations from the Illinois Pollution Control Board (IPCB), and then determined the sound levels that could not be exceeded. Sound Propagation Modeling was used to predict the sound levels at the receivers based on the emitting sources characteristics and locations.

- Sound Propagation Modeling is well studied and a standard has been developed by the International Standards Organization (ISO)[2]. The standard is ISO 9613 and it defines the equations and factors which must be used to predict sound power levels at receivers based on the sound power level of a single source or multiple sources. It takes into account distance between source and receiver and assumes optimal sound propagation, where the receiver is assumed to be downwind of the sound source and the wind speed is under 5 m/s (11mph).
- Commercially available sound propagation software modeling packages use this same basic approach. The standard equations from ISO 9613 show that the sound at a receiver produced by some source is based on the directivity of the source and several attenuation effects. These attenuation effects include the distance from source to receiver, absorption of sound by the atmosphere, absorption of sound due to ground effects, and several other smaller effects such as elevation, walls, barriers, and trees.

Based on this, Patrick was able to model and predict the sound propagation power levels at the receivers at three representative locations. These locations were selected due their proximity to the largest number of turbines within a 2000 meter radius of any given receptor and also were located such that one was in the western area of the project, one was in the eastern area of the project and one was in the southern area of the project. The results of the 3 models should provide a good match to the Stantec data presented in the Invenergy Application if all the key factors are entered in accordance with the ISO standards. This approach would then allow validation of the Invenergy noise studies.

The key factors in the equation for this model include:

- Location, height and sound power output of the sources. The locations of the sources were defined, the height specified as the hub height of 80 meters (262.5 ft) and the sound power from the turbine documented for each of the 136 wind turbines. Additional sources were defined as the transformers with height of 3ft (1m) with their adjusted sound power levels, and the ambient nighttime sound power levels.
- Location and Elevation of the receivers.
  - Receiver locations used were those defined in the Invenergy Application. All receivers were considered to be downwind of the wind turbines (although this would most likely be a physical impossibility).
  - Noise levels at a receiver can vary depending on the elevation of the receiver relative to the source. These elevation differences were taken into account in the model.
- Sound Power and Wind speed
  - The sound power levels of the Wind Turbine is a key factor. These value must be specified for the exact model of wind turbine being proposed. The sound power must be determined for the normal wind speed range (12 to 30 mph) for accurate sound propagation modeling. Turbine hub height cutout wind speed for this turbine model is 14 m/s (31 mph). Information made available by the wind turbine manufacturer shows sound power ratings of a GE Model 1.7-100 wind turbine starting at a hub height wind speed of 7m/s (15.7 mph) up to 12.5 m/s (28 mph). Patrick used the hub height sound power ratings at the higher wind speed in its models. This will predict the highest sound levels at the receivers.
- Atmospheric information. These values were set to 15°C (59°F) and 70% relative humidity.
- Geometry of the sound sources – i.e. point sources or line sources. The wind turbines and transformers are considered as point sources.
- Ground Factor. The ground covering can be included in the calculations. A value of 0 is used for hard ground such as pavement, ice, water and concrete. A value of 1 is used for grassland, trees, vegetation, and farm land. A value between 0 and 1 is used for a mix of hard and porous ground. A Ground Factor setting of 0 was used. It is conservative and will result in the highest predicted values at the receivers.
- The sound level output must also be analyzed to determine if discrete tones are present. This is required by Section 901.106 of the IPCB regulation. Discrete tones were determined not to apply to the turbines in this analysis. Discrete tones were applicable to the turbine power transformers and were included. Other factors can be included, such as screening and barriers, but were not included in order to provide more conservative (higher predicted) results at the receivers.

Results

Results from the Invenergy noise study were validated using a commercially available and proven ISO 9613 modeling package[3]. The modeling package, SPM 9613 v2 by Power Acoustics, Inc., was used to predict the sound levels at the following three (3) receiver residential locations - locations R009, R059, and R240. These locations were independently modeled by Patrick. The results from the Stantec study along with the predicted values from the Patrick model are shown in Figures 3a, 3b, 4a, and 4b.

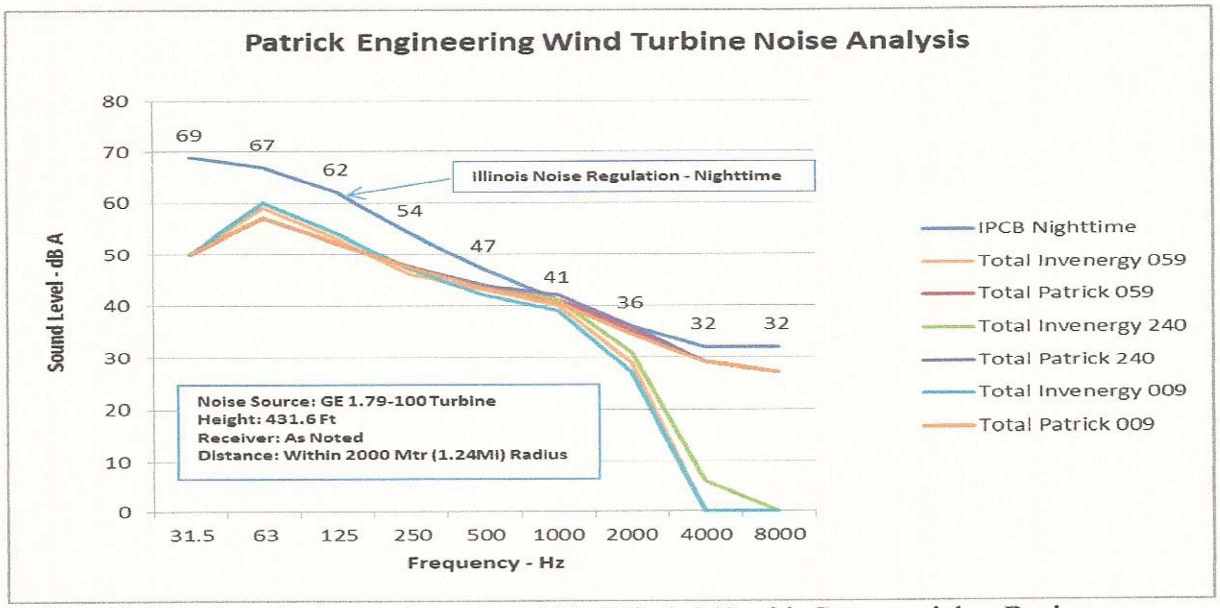


Figure 3a. Sound predictions at Locations 009, 059, & 240 with Commercial or Business ambient sound pressures.

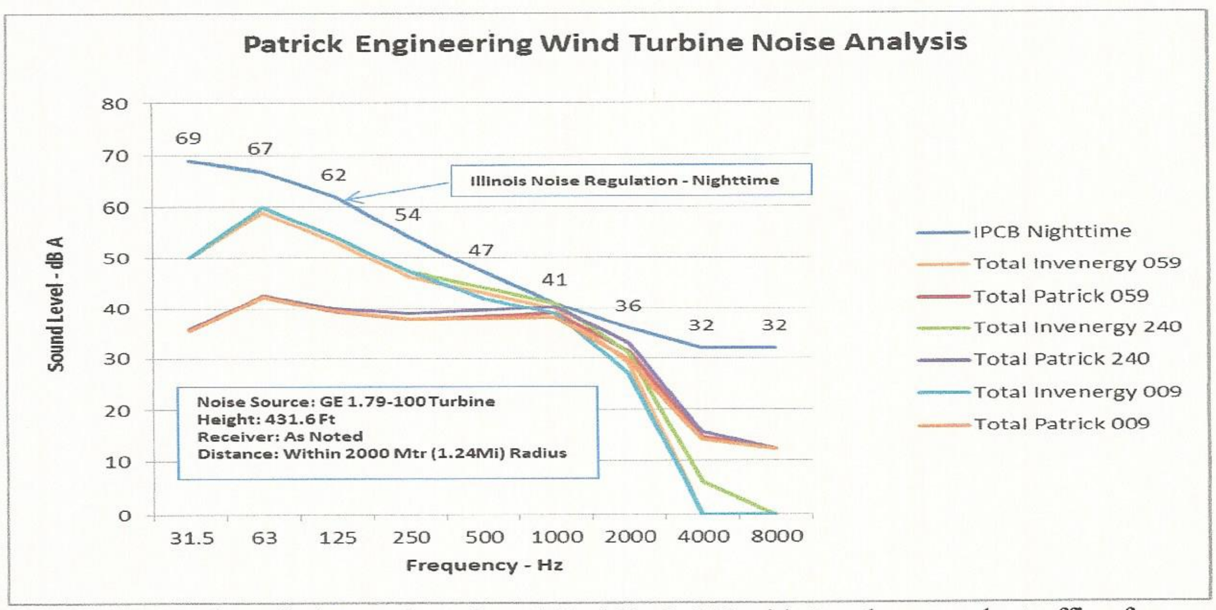


Figure 3b. Sound predictions at Locations 009, 059, & 240 with Rural, no nearby traffic of concern sound pressures.

Patrick Engineering Noise Study Model Results
Business and Commercial Ambient Levels

Frequency Band	31.5	63.0	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0
IPCB Nighttime	69.0	67.0	62.0	54.0	47.0	41.0	36.0	32.0	32.0
Ambient Levels	50.0	57.0	52.0	47.0	42.0	37.0	33.0	29.0	27.0
Total Invenergy 009	50.0	60.0	54.0	47.0	42.0	39.0	27.0	0.0	0.0
Total Patrick 009	50.0	57.0	52.1	47.4	43.4	40.6	34.5	29.0	27.0
Total Invenergy 059	50.0	59.0	53.0	46.0	43.0	40.0	29.0	0.0	0.0
Total Patrick 059	50.0	57.0	52.1	47.4	43.5	41.1	35.2	29.0	27.0
Total Invenergy 240	50.0	60.0	54.0	47.0	44.0	41.0	31.0	6.0	0.0
Total Patrick 240	50.0	57.0	52.1	47.5	43.9	42.0	36.0	29.1	27.0

Figure 4a. Noise model comparison at locations R009, R059, and R240 utilizing Business and commercial area ambient sound pressures.

Patrick Engineering Noise Study Model Results
Rural, No Traffic of Concern Ambient Levels

Frequency Band	31.5	63.0	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0
IPCB Nighttime	69.0	67.0	62.0	54.0	47.0	41.0	36.0	32.0	32.0
Ambient Levels	35.0	42.0	37.0	32.0	27.0	22.0	18.0	14.0	12.0
Total Invenergy 009	50.0	60.0	54.0	47.0	42.0	39.0	27.0	0.0	0.0
Total Patrick 009	35.6	42.4	39.5	37.9	38.1	38.2	29.6	14.2	12.3
Total Invenergy 059	50.0	59.0	53.0	46.0	43.0	40.0	29.0	0.0	0.0
Total Patrick 059	35.5	42.3	39.5	37.9	38.3	39.0	31.3	14.6	12.3
Total Invenergy 240	50.0	60.0	54.0	47.0	44.0	41.0	31.0	6.0	0.0
Total Patrick 240	35.9	42.5	40.1	39.1	39.6	40.4	33.0	15.7	12.3

Figure 4b. Noise model comparisons at locations R009, R059, and R240 utilizing rural, no nearby traffic of concern area ambient sound pressures.

The correlation between the Invenergy studies and the Patrick Engineering models validate that each approach followed the ISO standard correctly. Differences between the two sets of models indicate the use of ambient sound pressure levels for different areas – rural versus business/commercial. When utilizing the Business/commercial ambient nighttime levels, the Patrick and Invenergy models yield the same results except in the 4000 and 8000 Hz bands. Utilizing the Rural, no nearby traffic of concern levels the models yield divergent results in the 500 Hz band and below as well. Input values available for the three studies included sound source (turbine) height, sound power levels for each octave band from 31.5 hz through 8000 hz for each turbine, turbine and receptor location coordinates, receptor and turbine elevations relative to one another, typical values for air quality of 59°F temperature and 70% relative humidity, ground hardness value of 0 (very hard ground). The good agreement in the results between the Invenergy study and the Patrick studies indicate similar modeling approaches were utilized.

It can be seen that all the levels predicted are below the regulation for the modeled locations except for the 1000 Hz band where the ambient levels utilized were for the 'Business and Commercial Areas' (Figure 4a). Location R059 exceeded the regulations by 0.1 dB, while location R240 exceeded by 1 dB. The same band is below the regulation when utilizing the ambient levels for 'Rural, no nearby traffic of concern'. All three sites, by desktop review, would normally be classified as Rural, no nearby traffic of concern areas. Also, very good agreement can be seen between the Invenergy study model predictions at the three receptor locations Patrick reviewed and Patrick's model when utilizing the sound pressures for nighttime business and commercial areas. The Patrick models indicate lower predicted levels in the low frequency range when utilizing the sound pressure levels for Rural, no nearby traffic of concern. The Patrick model included the wind turbine sound power levels at high turbine wind speeds, wind turbine power transformer sound power levels including discrete tonal adjustments, and ambient noise levels for both business/commercial areas and rural/farmland areas. The turbine modeled was the GE series 1.7-100 wind turbine with standard blades.

Conclusion

Wind turbine site noise studies are performed to establish predicted noise levels throughout a project area and to verify compliance with applicable noise regulations. Patrick reviewed the Illinois Pollution Control Board sections which applied to this project site. The specific sound level regulations are in Section 901.102 for night time operation, which is the strictest of requirements. Section 901.106 governing discrete tones was found not to apply to the turbine sound sources by analysis of the published manufacturers' specifications. This section 901.106, however, was found to apply to the power transformers at the base of each wind turbine. As a result, transformer sound power levels were provided with a tonal adjustment within each frequency band.

Ambient noise levels also have an impact on the overall noise levels at any given site. Utilizing the most stringent nighttime sound power levels yielded some excess noise in the 1000 Hz band.

Using ambient noise power levels for rural areas, however, showed full compliance with the IPCB regulations.

Patrick reviewed the ISO standard 9613 which defines the formulas used to predict sound propagation. This standard also identifies the key input and attenuation factors critical to obtaining accurate results. These factors were entered into the Patrick sound model and through the use of a well-established, published, sound propagation software tool Patrick obtained the sound power levels at the three receiver locations studied. The predicted results presented by Invenergy in their Application and provided by the Patrick studies showed good to excellent comparison and validation of the outputs.

References

1. Handbook of Acoustics by Malcolm J. Crocker, Chapter 79, Page 1032, Table 21
2. Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation, International Standard ISO 9613-2: 1996 (International Organization for Standardization, Geneva, Switzerland, 1996)
3. SPM 9613 modeling package, Power Acoustics, Inc. http://poweracoustics.com/

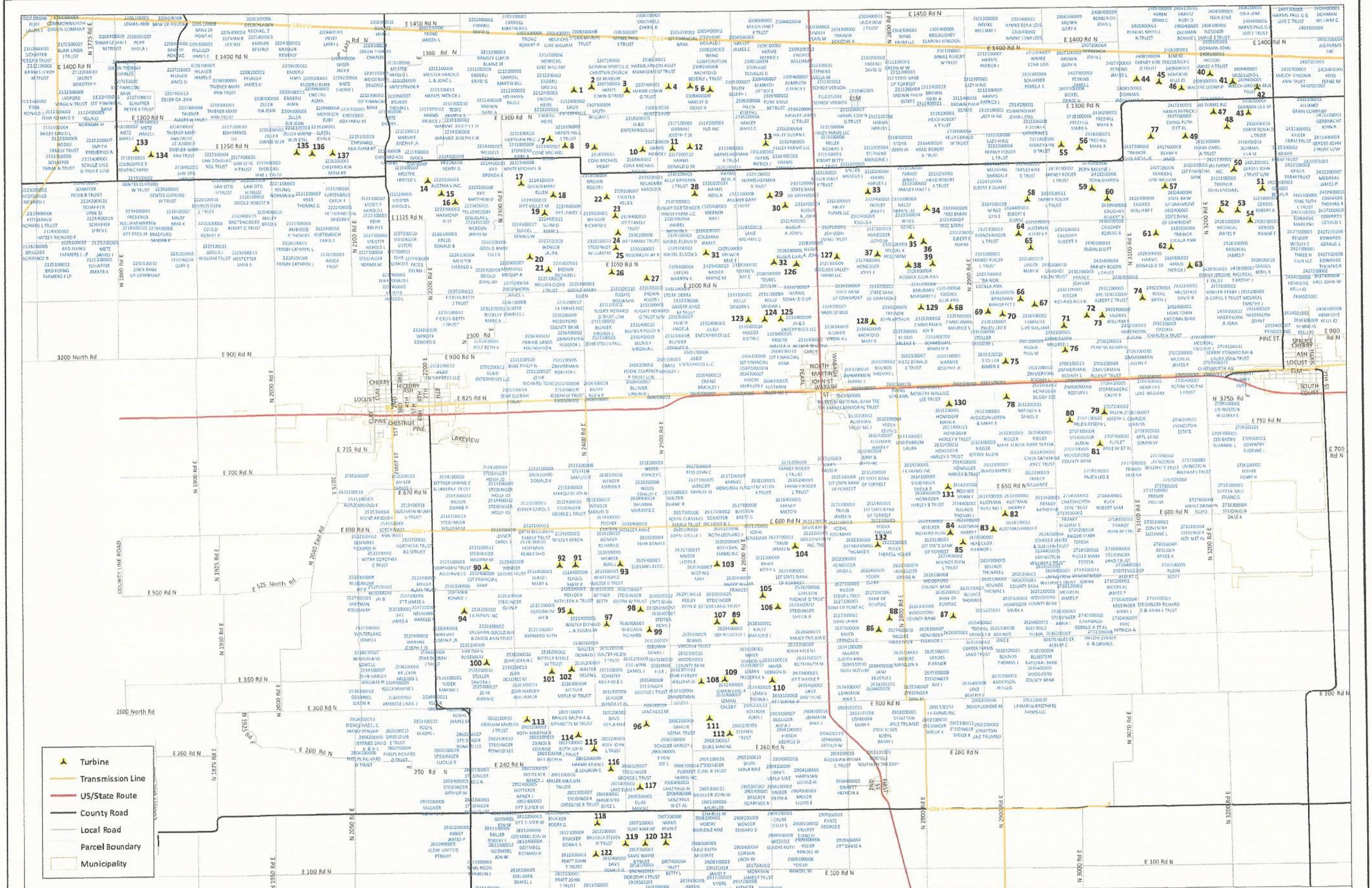
ATTACHMENT C

Permit Summary Table

The following table lists the permits, agreements, and documentation stated by Invenergy to be furnished to the County and other local, state, and federal agencies prior to construction of the Wind Energy Project. These items were noted in the Application to be furnished after Application approval and prior to issuance of building permits or start of construction.

Permit Summary Table

Ordinance Section	Permit, Agreement, Documentation	Comment
56-616 Part (b)(4)	Further delineation and study is necessary prior to obtaining construction authorization	As relates to Sections 3, 4, 5, and 6 of the application.
56-618 Part (a)(1)	Equipment Manufacturer's Certificates of Design Compliance	Section 3.1.1 of Application
56-618 Part (a)(2)	P.E. Certification of WECS foundation	Section 3.1.1 of Application
56-618 Part (j)(1)(b)	Obtain applicable weight and size permits	Section 3.4 of Application
56-618 Part (j)(2)(c)	Provide Livingston County Zoning Administrator with agreements pertaining to public road use	Section 3.4 of Application
56-619 Part (b)(1)	Copies of study to local microwave transmission or emergency service providers.	Not identified as being accomplished
56-619 Part (c)	Site, hazard and emergency response plans	To be provided when meeting with local fire departments
	NPDES Permit	Through IEPA – No application at this time
	SWPPP	Through IEPA – No application at this time

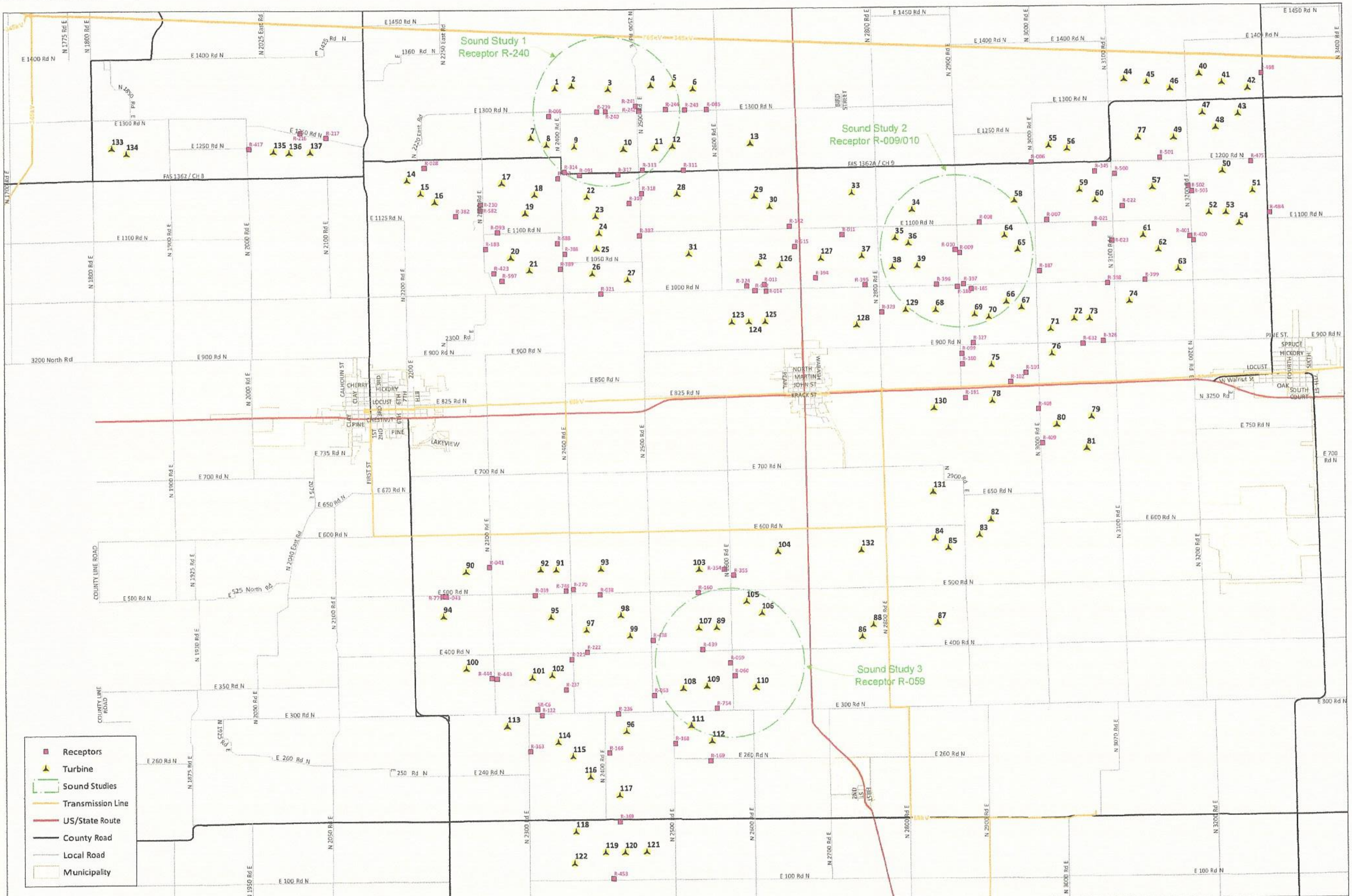


Proposed Project Site Plan - Turbines & Receptors

Pleasant Ridge Wind Energy Project, Livingston County, Illinois

Figure PEI-4

October 31, 2014



Proposed Project Site Plan - Turbines & Receptors
Pleasant Ridge Wind Energy Project, Livingston County, Illinois

Figure PEI-5

October 31, 2014

PATRICK ENGINEERING

March 24, 2015

Mr. Charles Schopp, Administrator
Livingston County Regional Planning Commission
110 West Water Street, Suite 3
Pontiac, IL 61764

Reference: Pleasant Ridge Wind Energy Project
Noise Study Updates with LNTE Turbine Blades

Dear Mr. Schopp:

Patrick Engineering Inc. (Patrick) has prepared this letter to supplement its report of review findings on the Invenergy Pleasant Ridge Wind Energy Project proposal for Livingston County. This supplement provides the following information and updates:

- Adds supplemental information to Attachment A regarding sound levels when substituting the GE 1.7-103 turbine for the original GE 1.7-100 unit. The substituted turbines have Low Noise Trailing Edge Blades (LNTE) that are 103 meters in diameter as opposed to the original 100 meter diameter blades. The substitutions were made only at the locations indicated by Invenergy that impact the three studies performed by Patrick.
- Comments are listed concerning infrasound related to the Pleasant Ridge Wind Energy Project.
- Revisions to the "Critical Review of Decommissioning Costs for Pleasant Ridge Energy Project" report issued by Patrick in February, 2015.

The remainder of this letter summarizes our review findings.

- The Patrick update to the "Attachment B Noise Studies" utilized the GE 1.7-103 LNTE turbine in substitution for WTG's 4, 10, 68, and 109. WTG 4 and 10 are in the turbine group modeled to receptor R240 in the west area of the wind farm. WTG 68 is in the turbine group modeled to receptor R009 in the east area of the wind farm. WTG 109 is in the south turbine group modeled to receptor R059 in the south area of the wind farm. The following chart (Figure Att B-1) compares the sound results presented in the original review with the results with the LNTE turbines. It can be seen that the LNTE units do in fact bring the noise levels down from that utilizing only the standard blades. There is an increase of .1 dB(A) at R240 and .2 dB(A) at R059 at the 2000 Hz band and .3 dB(A) at R059 at the 4000 Hz band. However, the composite dB(A) levels remain the same at R009 and decrease by .3 dB(A) at R240 and by .6 dB(A) at R059.

Patrick Engineering Noise Study Model Results Comparison Standard Blade to LNTE Blade										
Frequency Band - Hz	16	31.5	63	125	250	500	1000	2000	4000	8000 dB(A)
R 240 (WTG 4 & 10)										
Total of Sources w/o LNTE	0	28.4	32.7	37.2	38.1	39.4	40.3	32.9	10.9	0	42.7
Total of Sources w/ LNTE	0	28.2	32.2	36.9	37.7	38.9	40	33	10.9	0	42.4
R 009-010 (WTG 68)											
Total of Sources w/o LNTE	0	26.7	31.5	36	36.6	37.7	38.1	29.3	0.9	0	40.5
Total of Sources w/ LNTE	0	26.7	31.3	35.9	36.5	37.6	38.1	29.3	0.9	0	40.5
R 059 (WTG 109)											
Total of Sources w/o LNTE	0	26.2	31.2	35.8	36.6	38	38.9	31.1	6	0	41.3
Total of Sources w/ LNTE	0	26	30.4	35.2	36.1	37.2	38.4	31.3	6.3	0	40.7

Figure Att B-1

In the original review, Figure 4a showed that the noise at the 1000 Hz band at receptor R059 exceeded the IPCB regulations by .1 dB(A) and at receptor R240 by 1 dB(A). With utilizing the higher Business and Commercial ambient levels and the LNTE blades the sound levels are now as shown in Figure 4a-R.

Patrick Engineering Noise Study Model Results Business and Commercial Ambient Levels									
Frequency Band	31.5	63.0	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0
IPCB Nighttime	69.0	67.0	62.0	54.0	47.0	41.0	36.0	32.0	32.0
Ambient Levels	50.0	57.0	52.0	47.0	42.0	37.0	33.0	29.0	27.0
Total Invenergy 009	50.0	60.0	54.0	47.0	42.0	39.0	27.0	0.0	0.0
Total Patrick 009	50.0	57.0	52.1	47.4	43.3	40.6	34.5	29.0	27.0
Total Invenergy 059	50.0	59.0	53.0	46.0	43.0	40.0	29.0	0.0	0.0
Total Patrick 059	50.0	57.0	52.1	47.3	43.2	40.8	35.2	29.0	27.0
Total Invenergy 240	50.0	60.0	54.0	47.0	44.0	41.0	31.0	6.0	0.0
Total Patrick 240	50.0	57.0	52.1	47.5	43.7	41.8	36.0	29.1	27.0

Figure 4a-R

Figure 4b-R shows the sound levels with the lower rural ambient levels and LNTE blades.

Patrick Engineering Noise Study Model Results Rural, No Traffic of Concern Ambient Levels									
Frequency Band	31.5	63.0	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0
IPCB Nighttime	69.0	67.0	62.0	54.0	47.0	41.0	36.0	32.0	32.0
Ambient Levels	35.0	42.0	37.0	32.0	27.0	22.0	18.0	14.0	12.0
Total Invenergy 009	50.0	60.0	54.0	47.0	42.0	39.0	27.0	0.0	0.0
Total Patrick 009	35.6	42.4	39.5	37.8	38.0	38.2	29.6	14.2	12.3
Total Invenergy 059	50.0	59.0	53.0	46.0	43.0	40.0	29.0	0.0	0.0
Total Patrick 059	35.5	42.3	39.2	37.5	37.6	38.5	31.5	14.7	12.3
Total Invenergy 240	50.0	60.0	54.0	47.0	44.0	41.0	31.0	6.0	0.0
Total Patrick 240	35.8	42.4	40.0	38.7	39.2	40.1	33.1	15.7	12.3

Figure 4b-R

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The model now shows that only one location at 1000 Hz exceeds the IPCB nighttime regulation with Business and Commercial ambient levels. This is at R240. There are no receptors that exceed the IPCB when considering rural ambient levels.

- Patrick was commissioned by Livingston County to review the "Application for County Siting Approval for Pleasant Ridge Wind Energy Project" from Invenergy dated August 20, 2014 including all supporting documentation submitted with the application. This review was to verify that all information required by the County ordinance governing wind farm projects was submitted and that its content complied with the ordinance. Patrick's review of the submitted sound studies and Patrick's performance of sound analyses was to verify that the analysis submitted by Invenergy met the requirements outlined in the ordinance. These requirements reference the need for compliance with applicable sections of the IPCB (Illinois Pollution Control Board) rules put forth in 35 Ill. Admin Code, Title 35, Parts 900 and 901.

  The IPCB rules do not reference infrasound – low frequency sound generally below 20 Hz. The Invenergy analysis reviewed by Patrick did not reference infrasound. The County Wind Farm ordinance does not reference infrasound. Patrick was not commissioned to provide an independent summary or to comment concerning infrasound. Therefore, no comment concerning infrasound was presented for the Pleasant Ridge Wind Energy Project.

- Revisions to the "Critical Review of Decommissioning Costs for Pleasant Ridge Energy Project" report issued by Patrick in February, 2015 are listed in the Attachment A to this supplement. The Attachment A shows revised costs for area demolition by assuming the constructed areas did not utilize geotextile fabrics and, therefore, its removal and disposal costs could be deleted. It is noted that the restoration costs could be greater if geotextile fabrics are encountered.

  The costs for access road removal was revised to reflect only 50% of the roads to be demolished and restored. It is noted that the removal and restoration costs could be greater than indicated if more access roadways are removed during demolition.

Please contact me if you have any questions or concerns regarding this summary report.

Sincerely,
PATRICK ENGINEERING INC.

Alan M. Hymans

Alan M. Hymans, P.E..
Senior Engineer, Power and Energy Team

Enclosures: As noted
P:\Springfield\Livingston County\21476.189 Pleasant Ridge\8.0 Reports-Studies-Audits\Report\Final with Rev - Working

PATRICK ENGINEERING

May 06, 2015

Mr. Charles Schopp, Administrator
Livingston County Regional Planning Commission
110 West Water Street, Suite 3
Pontiac, IL 61764

Reference: Pleasant Ridge Wind Energy Project
Noise Study Review Update

Dear Mr. Schopp:

Patrick Engineering Inc. (Patrick) has prepared this letter to supplement its report of review findings on the Invenergy Pleasant Ridge Wind Energy Project proposal for Livingston County. This supplement provides the following information and updates:

- Provides comments on an additional review of Patrick's sound analysis submitted in prior reports, letters and studies.

Summary review:

- In this Patrick update to the "Attachment B Noise Studies" both the GE WTG model 1.7-100 (the base WTG from the Invenergy proposal) and also the model 1.7-103 LNTE (the GE WTG utilizing the 103 meter blade with low noise trailing edge blades) were utilized. The attached chart shows three basic scenarios – 1a, 2a, and 3a - at locations other than those already submitted to you. These additional scenarios use all the same basic input data as previously shown (temperature at 15C, humidity at 70%, hard ground – value of zero for calculation, no intervening barriers or trees, and all turbines upwind of their respective receptor). In the attached, we showed the noise levels at the receptors (eg: at the wall of the house nearest the turbines). In order to show a more restrictive analysis we also showed the noise levels at a distance of 100 feet from the receptor to simulate a grassy/lawn area surrounding the house. We also showed the noise levels at the receptor when considering ambient levels added directly to the turbine noise. These ambient levels are shown in two separate cases – one for rural, no traffic of concern and one for business/commercial.
- The analysis showed that only when adding in all the factors, utilizing the standard blade, and considering commercial ambient did we have a situation where the nighttime levels exceeded the IPCB noise regulation. This happened at the 1000 and 2000 Hz bands. All other frequency bands were at or under the regulatory limits.
- Scenarios 2dL and 3dL show the effects of the LNTE blades under all of the worst case conditions. Also, these predictions are at the more restrictive location of 100' closer to the turbine/s.
- Noise level predictions greater than those prescribed by the IPCB occurred only with the added ambient noise expected from Business/Commercial areas. When ambient noise is

PATRICK ENGINEERING

of a Rural, No Traffic of Concern nature and these levels are added, there are no scenarios that exceed the IPCB.

This additional summary review confirms Patrick's previous results as valid for the Pleasant Ridge Wind Energy Project as proposed by Invenergy.

Please contact me if you have any questions or concerns regarding this summary report.

Sincerely,
PATRICK ENGINEERING INC.

Alan M. Hymans

Alan M. Hymans, P.E..
Senior Engineer, Power and Energy Team

Enclosures: As noted
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5/6/2015

Follow Up Sound Scenarios
Pleasant Ridge

		31.5	63	125	250	500	1000	2000	4000	8000	
Center Frequency, Hz		31.5	63	125	250	500	1000	2000	4000	8000	
IPCB											
	Nighttime	69	67	62	54	47	41	36	32	32	
	Daytime	75	74	69	64	58	52	47	43	40	
AMBIENT											
	Rural		42	37	32	27	22	18	14	12	
	Commercial		57	52	47	42	37	33	29	27	
Scenario	Receptor										
1a	R409	22.8	27.7	32.4	33.6	35.5	37.0	31.0	10.9	0.0	turbine to receptor only
1aL	R409	21.8	23.2	29.5	30.8	31.0	34.9	31.4	11.5	0.0	1a with LNTE blades
1a-100	R409	23.2	28.1	32.8	34.0	36.0	37.6	31.7	12.2	0.0	1a 100' closer
1b	R409	22.8	42.2	38.3	35.9	36.1	37.1	31.2	15.7	12.3	1a with rural ambient
1c	R409	22.8	57.0	52.0	47.2	42.9	40.0	35.1	29.1	27.0	1a with commercial ambient
1d	R409	23.2	57.0	52.1	47.2	43.0	40.3	35.4	29.1	27.0	1a with commercial ambient 100' closer

Scenario 1a - receptor R409 to WTG 80 with standard blades at a distance of 1909 ft (582 m). Includes transformers.

2a	R028	26.6	31.5	36.2	37.3	39.2	40.7	34.6	15.0	0.0	turbines to receptor only
2aL	R028	25.6	27.1	33.3	34.6	34.7	38.6	35.0	15.6	0.0	2a with LNTE blades
2a-100	R028	27.1	31.9	36.6	37.8	39.7	41.3	35.3	16.3	0.0	2a 100' closer
2b	R028	26.6	42.4	39.6	38.4	39.5	40.8	34.7	17.5	12.3	2a with rural ambient
2c	R028	26.6	57.0	52.1	47.4	43.8	42.2	36.9	29.2	27.0	2a with commercial ambient
2d	R028	27.1	57.0	52.1	47.5	44.0	42.7	37.3	29.2	27.0	2a with commercial ambient 100' closer
2a-100L	R028	26.1	27.5	33.8	35.1	35.2	39.2	35.7	16.9	0.0	2a-100 with LNTE blades
2dL	R028	26.1	57.0	52.1	47.3	42.8	41.2	37.6	29.3	27.0	2a-100L with commercial ambient

Scenario 2a - receptor R028 to WTG's 14, 15, & 16 with standard blades at a distance of 1645 ft(501.5 m) to WTG 14, 2300 ft(701.2 m) to WTG 15 and3114 ft(949.4 m) to WTG 16. Includes transformers.

3a	R237	25.6	30.5	35.2	36.4	38.3	39.9	34.0	14.9	0.0	turbines to receptor only
3aL	R237	24.6	26.1	32.4	33.7	33.8	37.8	34.4	15.5	0.0	3a with LNTE blades
3a-100	R237	26.1	31.0	35.7	36.9	38.9	40.5	34.8	16.3	0.0	3a 100' closer
3b	R237	25.6	42.3	39.2	37.7	38.6	40.0	34.1	17.5	12.3	3a with rural ambient
3c	R237	25.6	57.0	52.1	47.4	43.5	41.7	36.5	29.2	27.0	3a with commercial ambient
3d	R237	26.1	57.0	52.1	47.4	43.7	42.1	37.0	29.2	27.0	3a with commercial ambient 100' closer
3a-100L	R237	25.1	26.6	32.8	34.2	34.4	38.4	35.2	16.9	0.0	3a-100 with LNTE blades
3dL	R237	25.1	57.0	52.1	47.2	42.7	40.8	37.2	29.3	27.0	3a-100L with commercial ambient

Scenario 3a - receptor R237 to WTG's 102 & 101 with standard blades at a distance of 1615 ft(492.4 m) to WTG 102, and 2622 ft(799.4 m) to WTG 101. Includes transformers.

PATRICK ENGINEERING

May 6, 2015

Patrick Engineering
300 West Edwards
Springfield, Illinois

Attn: Mr. Chris Burger
Ref: Noise Study
Pleasant Ridge Wind Energy Project

Dear Mr. Burger:

Please see my attached resume for a review of my background and publications in the areas of noise and vibration.

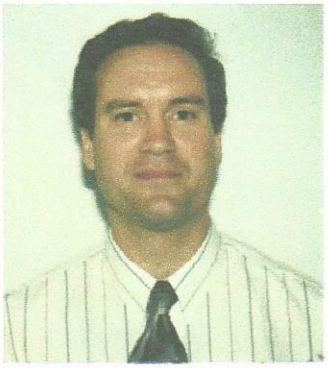
I have reviewed the noise study prepared by Mr. Alan Hymans of Patrick Engineering for the Pleasant Ridge Wind Energy Project being developed by Invenergy. I have provided direct input and reviewed the work performed and find it to comply with the relevant noise standard ISO 9613-2. My review indicated that his assumptions and results were valid. I also confirmed that the results were reviewed against the Illinois Pollution Control Board sound regulations for compliance.

Sincerely;

Timothy J. Copeland, INCE
217-391-4573

TECHNICAL EXPERIENCE

TIM COPELAND



EDUCATION

M.S., Mechanical Engineering, Major: Structural Dynamics University of Cincinnati

B.S., Engineering Mechanics, Major: Acoustics-Vibration University of Illinois

Institude of Noise Control Engineering, Member

AFFILIATIONS

The Acoustical Society of America

Institute of Environmental Sciences

Institute of Noise Control Engineering

PUBLICATIONS

Society for Experimental Mechanics, **Vibration Site Survey Measurements and Combined System Modal Analysis,** International Modal Analysis Conference XXVII.

Society of Experimental Test Engineers,**Combined Acoustic and Vibration Controller,** AeroTest America 2008

Society for Experimental Mechanics, **Vibration Site Survey Measurements and Combined System Modal Analysis,** International Modal Analysis Conference XXVII.

Society of Experimental Test Engineers,**Combined**

Mr. Copeland has over 30 years experience solving the toughest noise and vibration problems in Aerospace, Automotive, Off-Highway and White products markets. Specialized focus on noise and vibration data acquisition, analysis and correlation of experimental data with analytical models.

Recent Vibration and Acoustic Projects

Vibration Site Survey, Perceptron, *Greenville, South Carolina. 2008*
Performed vibration site survey to determine feasibility of locating sensitive non-contact measurement and inspection machinery on factory floor. Developed test plans working with design engineers in Plymouth, MI and the Facilities manager in Greenville, SC. Performed testing onsite and communicated vibration and acoustic results to management team. Developed vibration and noise models for further studies.

Earthquake Simulator, Non-Linear Dynamics Lab, Aerospace Dept., University of Illinois, *Champaign, IL. 2008*
Delivered an earthquake simulator control system to apply measured time history events to structures for design optimization. System also measures noise and vibration allowing general purpose analysis including sound pressure levels and experimental modal analysis.

Automotive Pass By Noise, Cooper Tire, Pearsall Test Track, *Pearsall, TX. 2007.*
Installed Pass By Noise measurement system, which uses GPS for positioning, speed and triggering. System operated by a single driver allows Pass By Noise measurements with 2 microphones when the vehicle passes trigger points set by the differential GPS positioning system. Integrated weather station variables and customized reporting result in quicker test turnaround and more accuracy.

Experimental Noise and Vibration Measurements, Structures and Motions Lab, University of Cincinnati, *Cincinnati, OH 2006*
Implemented six noise and vibration systems for use by students performing experimental dynamics projects in the Structures and Motions Lab. Systems allow acquisition of data, real time processing of data, export to matlab and advanced post processing including modal analysis.

Interior Noise Measurement, Honda Human Factors Group, *Marysville, OH.* 2003
Developed interior noise measurement system for wind tunnel testing of the Pilot new vehicle program. Developed a wireless in-vehicle measurement system which eliminated the need for the running of cabling from the measurement system. Resulted in more accurate noise measurements.

TECHNICAL EXPERIENCE

TIM COPELAND

Acoustic and Vibration Controller, AeroTest America 2008

Professional Work Experience

Patrick Engineering, *Springfield, IL. 2008 – present*
Senior Project Engineer for Noise and Vibration studies. Traffic Noise Modeling including using FHTA TNM 2.5, wind farm noise studies, site noise survey and measurements.

m+p International, *Springfield, IL. 2005 – present*
Sales manager for Midwest including Canada and Mexico. Direct technical sales including support, installation, training and consulting. North American expert for Pass By Noise application, large channel aerospace support, NVH analyzer including modal and vibration control. Consulting experience includes vibration monitoring, modal surveys and site evaluations.

Levi, Ray & Shoup, *Springfield, IL. 2003-2005*
Technical sales for $110 million software company selling mainframe, unix and windows solutions. Developed sales presentation strategy and tools including ROI model. Application engineering support for pre-sales including installations, demonstrations, trade shows and customer visits.

Head Acoustics, *Springfield, IL. 2001-2003*
Account manager for Midwest/South region covering 21 states. Self started a cold region to build the business and generate new sales. Goals to build existing accounts and expand to Vibration market were accomplished. Key account wins included Honda and Mercedes. Developed automated acquisition and analysis applications for customers at Arvin Meritor and Delphi.

MTS Noise & Vibration, *Cincinnati, OH.* 1998-2001
Product manager for Noise and Vibration Product Line. Developed product plans defining the market requirements, competitive positioning and product strategies to revitalize the existing product and develop the next generation of products. Assisted in Sales and Marketing winning in tough competitive situations using honesty and good customer relationships.

Structural Dynamics Research Corp., *Cincinnati, OH.* 1996-1998
Software developer for the I-DEAS TEST product integrating Hewlett-Packard VXI based instruments for data acquisition and analysis. Primary use of instrumentation is for Dynamics Data Acquisition. Performed customer support including onsite integration for complex systems. Completed the transition from Unix product to Windows NT 3.51 in 1996. Demonstrated a 1016 channel VXI based Modal acquisition system in 1998 on Windows for AirBus A380 ground vibration test.

BF Goodrich Aircraft Wheels and Brakes, *Troy, OH* 1994-1996
Implemented a dynamics combined Windows NT and Unix system for the correlation and quantification of Aircraft Brake Dynamics still in operation today. Utilized HP VEE, Astromed Strip Chart, HP VXI, Simulink to create an automated dynamics system used on every dyno brake test.

GE Aircraft Engines, *Cincinnati, OH.* 1987-1994
Technical Product Manager for 150 internal Patran and Unigraphics users. Developed and conducted user seminars on modeling and analysis. Enabled network access for custom applications for engineering analysis.

Boeing Aerospace Co, *Seattle WA.* 1984-1987
Performed Experimental and Analytical Dynamics Analysis on Aircraft components and systems. Performed Modal analysis on components, systems and full scale vehicles. Developed stress screening programs to reduce defect and field failures of Line Replaceable Units. Designed Flight Test hardware for the B-1B bomber to measure tri-axial acceleration and compensate Terrain Following Radar.

University of Illinois, *Champaign, IL.* 1981-1983
Research Assistant to Asst. Prof. RL Weaver for National Science Foundation research. Developed acoustics/vibration laboratory based around the 2 channel Nicolet Analyzer provided by Prof. Bergman.

Fiat-Allis CMI, *Springfield, IL.* 1980-1981
Performed noise and vibration engineering on Construction Machinery – performed pass by noise and developed hush kits for front end loaders for export to Europe. Developed two microphone probe with cross spectral intensity method for sound source localization. Performed bearing load test and analysis. Performed modal analysis on components and systems.

TECHNICAL EXPERIENCE

TIM COPELAND

1979-1983	University of Illinois, Champaign, Illinois, B.S. Engineering Mechanics, Major: Acoustics-Vibration.
1987-1994	University of Cincinnati, Cincinnati, Ohio, M.S. Mechanical Engineering, Major: Structural Dynamics.
1984	Boeing Avionics Course B1-B Avionics
1985	Measurements Group Strain Gage Principles and Applications
1985	Basic Programming for HP-IB IEEE 488 Instruments Hewlett Packard
1990	C146 Programming C Language GE Aircraft Engines
1991	Advanced Surfacing McDonnell Douglas Education & Consulting Services
1992	Patran Plus & Patran Transition Course PDA Institute of Technology
1992	Advanced C Programming Course GE Aircraft Engines
1993	Structural Dynamics Course GE Aircraft Engines
1994	Engine Rotor Dynamics Course GE Aircraft Engines
1997	C++ Programming Course ITDC Open Systems Education
1997	Object Oriented Modeling and Design ITDC Opens Systems Education
1998	Microsoft Certified Professional NT Workstation & Network Essentials
1998	Microsoft 922 Implementing and Supporting Windows NT Server
2000	Effective IT Product Management and Marketing University of St. Thomas
2000	Microsoft 1303 Visual Basic Fundamentals
2001	Microsoft 1560 Support Skills from Windows NT Server to Windows 2000
2002	Microsoft Certified Professional XP
2003	Technical Writing Application Course
2005	Microsoft 2003 Server Support
2007	Fundamentals of Acoustic Control
2008	Institute of Noise Control Engineering Membership accepted
2009	ISO 362-2:2009 updated standard training
2010	Nonlinear Modal Analysis Course

NOISE AND VIBRATION CONSULTING

TIMOTHY J. COPELAND, INCE

Mr. Copeland has over 30 years experience solving the toughest noise and vibration problems working in the Test Laboratories at the Boeing Company, GE Aircraft Engines, BF Goodrich Aircraft Wheels and Brakes. His focus is on noise and vibration data acquisition and specialty in correlation of experimental data with simulation models.

Recent Noise and Vibration Experience with Patrick Engineering

Livingston Wind Farm compared and validated the results of noise propagation studies using Power Acoustics SPM9613 software with Illinois regulations, this included complete modeling of sources and receptors.

Macon County Land Fill project was evaluated for noise impact using sound prediction modeling and the impact of a barrier in the form of an earthen beam was developed.

FutureGen Drill Site Impact Noise and Vibration Study for multiple sites using predictive modeling and comparing against local, state and federal guidelines. Field noise measurements were taken at final site to evaluate impact due to backup alarms at nearest receptors. Day and night ambient levels were captured at one receptor and then a actual backup alarm turned on at the site and the sound levels captured at the receptor. Providing experimental correlation of the modeling results and resulted in strategic placement of site equipment to block the line of site reducing the impact of backup alarms on the residence.

IL-53 (Army Trail Road to Elgin-O'Hare Expressway) Reevaluation Traffic Noise Study of traffic noise impacts on Rohlwing Road (IL 53) along the corridor between Army Trail Road and the Elgin O'Hare Expressway, DuPage County, Illinois using the Federal Highway Administration, FHWA Traffic Noise Model Version 2.5. New roadway geometry was analyzed along with updated traffic patterns and loads. Noise barriers were evaluated for effectiveness and cost compared to Federal standards.

DeKalb Land Fill Project was modeled for noise impact and when determined the impact exceeded state regulation a noise barrier was designed and analyzed which effectively reduced the noise level.

Tenaska Rail Project evaluation of the noise and vibration impact and to compare those levels to applicable Federal and Illinois noise regulations. The impact was evaluated using techniques based on the Federal Transit Administration "Transit Noise and Vibration Assessment" and modified specifically for rail traffic by Harris Miller Miller & Hanson Inc. (HMMH) for the Chicago Rail Efficiency And Transportation Efficiency Program (CREATE Railroad Noise Model).

Development of internal methods and capabilities
Procured Power Acoustics SPM9613 ISO-9613 based program for noise modeling and prediction and updated existing sound measurement capabilities.

EDUCATION

M.S., Mechanical Engineering, Major: Structural Dynamics University of Cincinnati
B.S., Engineering Mechanics, Major: Acoustics-Vibration University of Illinois
Institute of Noise Control Engineering, Member

AFFILIATIONS

Society for Experimental Mechanics
Institute of Environmental Sciences
Institute of Noise Control Engineering

SELECTED PUBLICATIONS

Society for Experimental Mechanics, **Vibration Site Survey Measurements and Combined System Modal Analysis,** International Modal Analysis Conference XXVII.
SAE Noise and Vibration, **Advanced Tire Noise Pass by Noise Solution Meets ISO 13325 and the Recently Updated ISO 362 Standards,** 2011
Society for Experimental Mechanics, **Nonlinear modal identification techniques reveal nonlinearity in a dynamics benchmark system,** International Modal Analysis Conference XXVIII