Minnesota Department of Natural Resources

500 Lafayette Road • St. Paul, MN • 55155-40

December 16, 2009

Scott Ek
Minnesota Office of Energy Security
85 7th Place, Suite 500
St. Paul, MN 55101-2198

RE: Draft Site Permit for the 20 Megawatt Large Wind Energy Conversion System, West Stevens Wind
(PUC Docket Number: IP-6824/WS-09-830)

Dear Mr. Ek:

The DNR has reviewed the draft site permit for the 20 Megawatt Large Wind Energy Conversion System, West Stevens Wind. Thank-you for your responses to previous recommendations related to the site permit application. The following additional information is provided concerning West Central Trail Blazers Snowmobile Trail, which passes through the proposed project area.

The Office of Energy Security response to DNR recommendations, included with the draft site permit, regarding an appropriate turbine setback from the West Central Trail Blazers Snowmobile Trail, noted the need for a map and further explanation of safety concerns. A map is enclosed showing the location of the West Central Trail Blazers Snowmobile Trail in relation to sections where turbines are proposed to be located. These sections are marked green. Trail maps can also be accessed at the DNR website through the "Data Deli". The webpage for snowmobile trails is: http://deli.dnr.state.mn.us/metadata.html?id=L390002190202.

Risks associated with placement of wind turbines adjacent to this snowmobile trail may include the possibility of ice shedding or equipment failure resulting in injury of trail users. The attached document from GE Energy summarizes risks associated with ice shedding, suggested setbacks, and includes references to other informative papers related to this topic.

Currently, proposed turbine placement appears to be a sufficient distance from the West Central Trail Blazers Snowmobile Trail to mitigate ice shedding or equipment failure risks. However, it is recommended that the permit include a requirement for at least a 250 foot setback from the snowmobile trail. Please also contact the DNR regarding any changes in the turbine layout that result in a turbine being located closer to the West Central Trail Blazers Snowmobile Trail than is currently proposed.

Thank-you for reviewing these recommendations and please contact me if additional information is needed or if you have questions.

Sincerely,

Jamie Schrenzel

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Planner Principal
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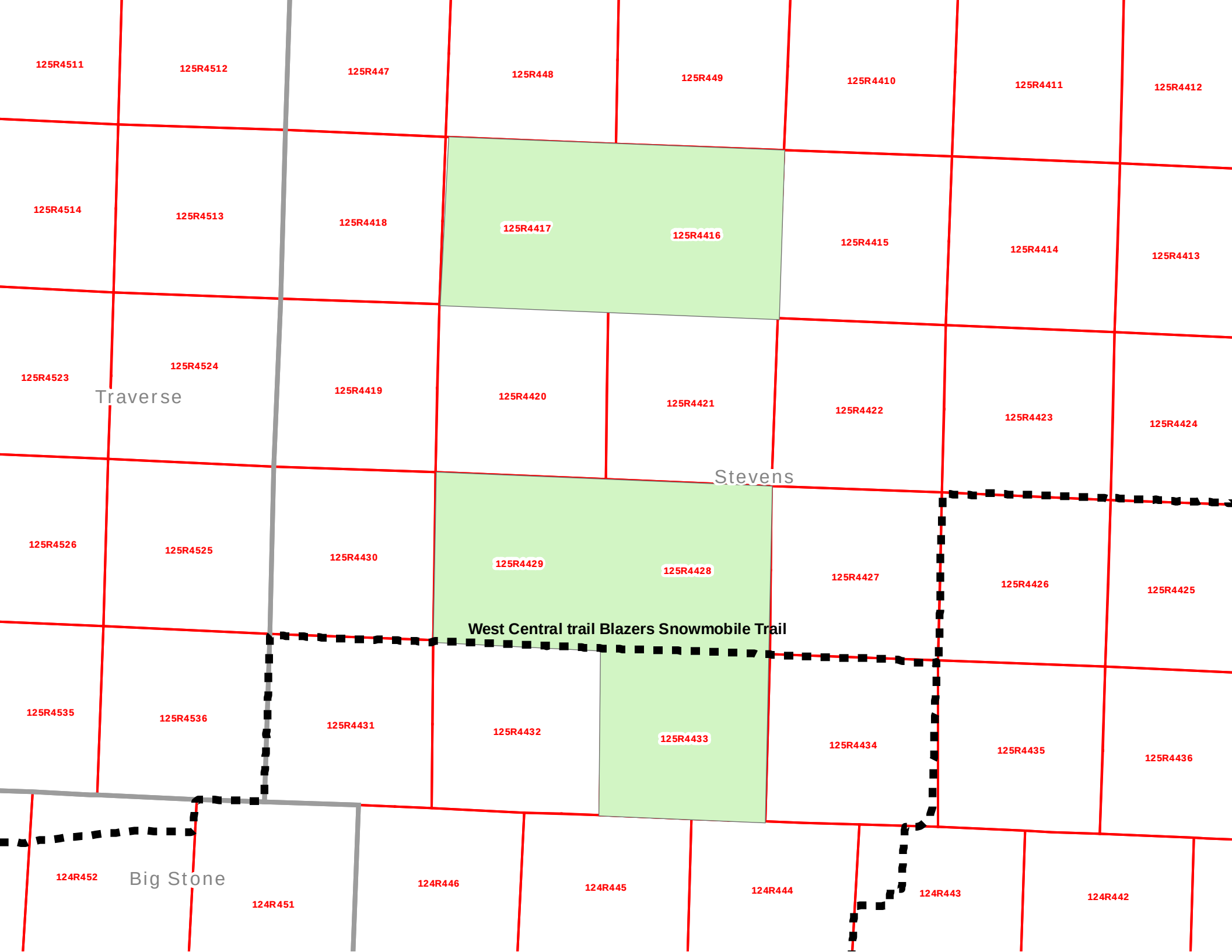
Enclosures: 2

ERDB# 20090903-0004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GE
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Ice Shedding and Ice Throw – Risk and Mitigation

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Ice Shedding and Ice Throw – Risk and Mitigation

Introduction

As with any structure, wind turbines can accumulate ice under certain atmospheric conditions, such as ambient temperatures near freezing (0°C) combined with high relative humidity, freezing rain, or sleet. Since weather conditions may then cause this ice to be shed, there are safety concerns that must be considered during project development and operation. The intent of this paper is to share knowledge and recommendations in order to mitigate risk.

The Risk

The accumulation of ice is highly dependent on local weather conditions and the turbine's operational state.[2,4] Any ice that is accumulated may be shed from the turbine due to both gravity and the mechanical forces of the rotating blades. An increase in ambient temperature, wind, or solar radiation may cause sheets or fragments of ice to loosen and fall, making the area directly under the rotor subject to the greatest risks[1]. In addition, rotating turbine blades may propel ice fragments some distance from the turbine—up to several hundred meters if conditions are right.[1,2,3] Falling ice may cause damage to structures and vehicles, and injury to site personnel and the general public, unless adequate measures are put in place for protection.

Risk Mitigation

The risk of ice throw must be taken into account during both project planning and wind farm operation. GE suggests that the following actions, which are based on recognized industry practices, be considered when siting turbines to mitigate risk for ice-prone project locations:

- **Turbine Siting:** Locating turbines a safe distance from any occupied structure, road, or public use area. Some consultant groups have the capability to provide risk assessment based on site-specific conditions that will lead to suggestions for turbine locations. In the absence of such an assessment, other guidelines may be used. Wind Energy Production in Cold Climate[6] provides the following formula for calculating a safe distance:

  1.5 * (hub height + rotor diameter)

  While this guideline is recommended by the certifying agency Germanischer Lloyd as well as the Deutsches Windenergie-Institut (DEWI), it should be noted that the actual distance is dependant upon turbine dimensions, rotational speed and many other potential factors. Please refer to the *References* for more resources.

- **Physical and Visual Warnings:** Placing fences and warning signs as appropriate for the protection of site personnel and the public.[4]

- **Turbine Deactivation:** Remotely switching off the turbine when site personnel detect ice accumulation. Additionally there are several scenarios which could lead to an automatic shutdown of the turbine:

  - Detection of ice by a nacelle-mounted ice sensor which is available for some models (with current sensor technology, ice detection is not highly reliable)
  - Detection of rotor imbalance caused by blade ice formation by a shaft vibration sensor; note, however, that it is possible for ice to build in a symmetric manner on all blades and not trigger the sensor[2]
  - Anemometer icing that leads to a measured wind speed below cut-in

- **Operator Safety:** Restricting access to turbines by site personnel while ice remains on the turbine structure. If site personnel absolutely must access the turbine while iced, safety precautions may include remotely shutting down the turbine, yawing to place the rotor on the opposite side of the tower door, parking vehicles at a distance of at least 100 m from the tower, and restarting the turbine remotely when work is complete. As always, standard protective gear should be worn.

References

The following are informative papers that address the topic of wind turbine icing and safety. These papers are created and maintained by other public and private organizations. GE does not control or guarantee the accuracy, relevance, timeliness, or completeness of this outside information. Further, the order of the references is not intended to reflect their importance, nor is it intended to endorse any views expressed or products or services offered by the authors of the references.

[1] *Wind Turbine Icing and Public Safety – a Quantifiable Risk?:* Colin Morgan and Ervin Bossanyi of Garrad Hassan, 1996.

[2] *Assessment of Safety Risks Arising From Wind Turbine Icing:* Colin Morgan and Ervin Bossanyi of Garrad Hassan, and Henry Seifert of DEWI, 1998.

[3] *Risk Analysis of Ice Throw From Wind Turbines:* Henry Seifert, Annette Westerhellweg, and Jürgen Kröning of DEWI, 2003.

[4] *State-of-the-Art of Wind Energy in Cold Climates:* produced by the International Energy Agency, IEA, 2003.

[5] *On-Site Cold Climate Problems:* Michael Durstewitz, Institut fur Solare Energieversorgungstechnik e.V. (ISET), 2003.

[6] *Wind Energy Production in Cold Climate:* Tammelin, Cavaliere, Holttinen, Hannele, Morgan, Seifert, and Säntti, 1997.

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