Shadow Flicker Regulations and Guidance: New England and Beyond

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Overview

Shadow Flicker Limits

- Types
- Where do the Limits Apply
- New England Regulations – State and Local
- Regulations Outside New England
- Guidelines

Modeling Requirements / Guidance

- Modeling Domain
- Worst-case vs. Expected

Compliance

Conclusions
Shadow Flicker Limits

Types of Limits Applied to Shadow Flicker

• Duration

• Hours per year
  ▪ Typical presentation of impacts

• Minutes or Hours per day
Shadow Flicker Limits

Where do Regulations / Limits Apply?

• Residence

• Occupied Building

• Property

• Public Road
Shadow Flicker Limits

State Regulations
Lack of shadow flicker regulations in MA, ME, NH, VT, RI, and CT

Statewide Guidance
Massachusetts Model Zoning Ordinance / Bylaw

- Prepared by Department of Energy Resources
- March 2009
- “…shall be sited in a manner that minimizes shadowing or flicker impacts.”
- “The applicant has the burden of proving that this effect does not have significant adverse impact on neighboring or adjacent uses.”
- No specific limits
Shadow Flicker Limits

Statewide Guidance

Maine Model Wind Energy Facility Ordinance

- Provided by the Maine State Planning Office
- August 2009
- “…avoid unreasonable adverse shadow flicker effect at any Occupied Building located on a Non-Participating Landowner’s property.”
- No specific limits
Shadow Flicker Limits

Statewide Guidance

New Hampshire Model Small Wind Energy Systems Ordinance

- Developed by the New Hampshire Office of Energy and Planning
- September 2008
- “…shall be sited in a manner that does not result in significant shadow flicker impacts.”
- “Significant shadow flicker is defined as more than 30 hours per year on abutting occupied buildings.”
Shadow Flicker Limits

Local Regulations
Worcester, MA

- Zoning ordinance

  “The facility owner and operator shall make reasonable efforts to minimize shadow flicker to any occupied building on a non-participating landowner’s property.”

- Shadow flicker assessment report required

- Plan showing the, “area of estimated wind turbine shadow flicker” required

- No limits specified
Shadow Flicker Limits

Local Regulations
Goffstown, NH

- Small wind energy systems

- “…shall be sited in a manner that does not result in significant shadow flicker impacts.”

- “Significant shadow flicker is defined as more than 30 hours per year on abutting occupied buildings.”
Shadow Flicker Limits

Local Regulations

Newburyport, MA

- “… does not result in significant shadowing or flicker impacts.”

- No specific limits

- Analysis required
Shadow Flicker Limits

Outside New England

Wisconsin Wind Siting Rules

- Public Service Commission of Wisconsin
- Currently scheduled to go into effect March 1, 2011
- Limits applicable at nonparticipating residences, occupied community buildings, or for buildings planned to be built (plans for construction on file)
- “An owner shall design the proposed wind energy system to minimize shadow flicker at a residence or occupied community building to the extent reasonably practicable.”
- Limit is 30 hours per year
- Mitigation if impacts are above 20 hours per year
Shadow Flicker Limits

Outside New England

Ohio Power Siting Board

- Requires shadow flicker to be evaluated

- Although not specifically stated under their Application for Certificates for Electric Generating Wind Facilities, impacts at a residence should be no more than 30 hours per year
Shadow Flicker Limits

Outside New England

Ottawa County, MI
- Requires an analysis
- Limits shadow flicker to 30 hours per year at a building

Hutchinson, MN
- Requires an analysis
- No shadow flicker at an existing residential structure
- Up to 30 hours per year of shadow flicker on a roadway or residentially zoned property
Shadow Flicker Limits

Guidelines

German Guideline (WEA-Schattenwurf-Hinweise)
- Maximum of 30 hours per year
- Maximum of 30 minutes per day
- Worst-case calculations (maximum astronomical shadow)

German Court Case
- Court ruled 30 hours per year was acceptable (Danish Wind Industry Association)
- Applied as a guideline when evaluating expected shadow flicker
- Typically referenced in shadow flicker analyses
Modeling Requirements / Guidance

Modeling Domain

• 10 times the rotor diameter
  ▪ 90 meter diameter = 900 meter impact area

• When at least 20% of the sun is covered by the blade
  ▪ German guideline
  ▪ Incorporates blade width

• 2000 meters
  ▪ WindPRO default distance
Modeling Requirements / Guidance

Worst-case vs. Expected / Real Shadow Flicker

Worst-case

- Sun is always shining during the day
- Wind is always blowing, i.e. blades are always spinning
- Wind direction is always favorable for generating shadow flicker at the receiver
Modeling Requirements / Guidance

Worst-case vs. Expected / Real Shadow Flicker

Expected / Real Shadow Flicker

Sun not always shining: Incorporate sunshine probabilities
- % of sunshine during daylight hours
- Monthly values

Wind not always blowing in worst-case direction: Incorporate meteorological data
- Amount of time when winds are between cut-in and cut-out wind speed
- Hours are per wind direction sector
Compliance

Post-construction Evaluation

- Not aware of any post-construction measurement programs
  - Typically shadow flicker is addressed through pre-construction modeling
- Post-construction evaluation not a condition in project approvals
- Complaints handled on an individual basis
Conclusions

- Lack of statewide regulations or specific guidance with respect to shadow flicker
- Local regulations do exist but are generally rare
  - Do not always include specific limits
- 30 hours per year of expected or real shadow flicker is generally the guideline applied by consultants when evaluating shadow flicker impacts.