


Shadow Flicker Regulations and Guidance: New England and Beyond



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Webinar #5: Understanding the Current Science,
Regulation and Mitigation of Shadow Flicker

February 10, 2011

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

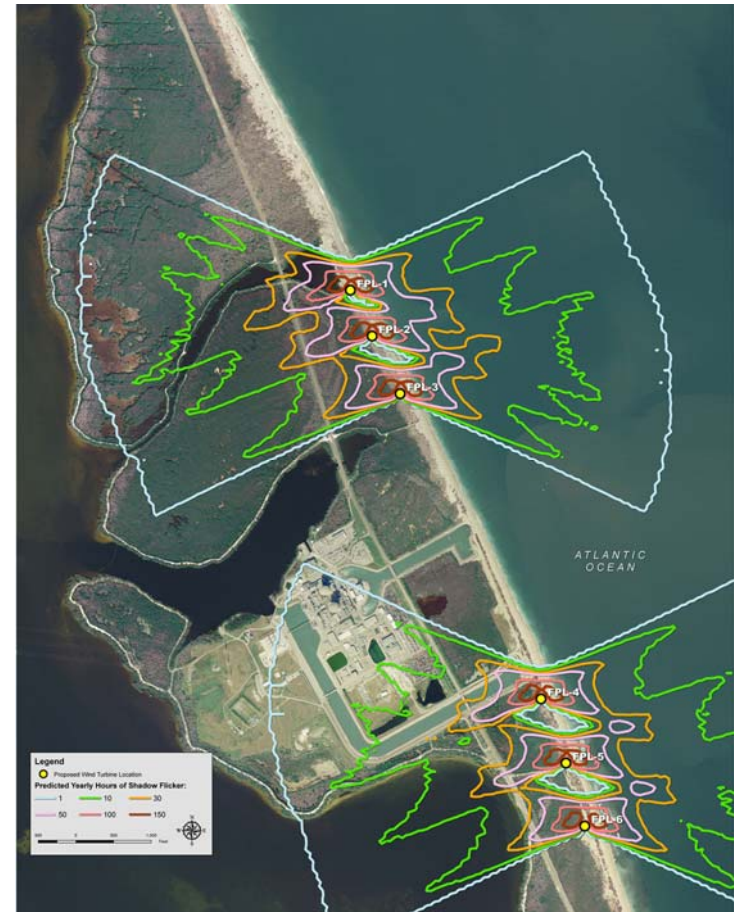
Conclusions



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.

