



International Finance Corporation

Environmental, Health and Safety Guidelines for

WIND ENERGY CONVERSION SYSTEMS

These guidelines are for the design, construction and use of wind energy conversion systems. Other guidelines that are applicable to project features associated with wind energy conversion systems, such as construction camps, maintenance facilities, substations and transmission lines, and access roads, are provided in the guidelines for [Electric Power Transmission and Distribution](#), [Roads and Highways](#), [General Health and Safety Guidelines](#) and the [General Environmental Guidelines](#), which include requirements for liquid effluents, air emissions, waste disposal, hazardous materials, and employee health, safety and training.

The guidelines incorporate the provisions of the World Bank policies for biodiversity, cultural properties, indigenous peoples, involuntary resettlement, water resources management and wildlands. Environmental issues that are identified by the project sponsor or other interested parties, but not addressed by World Bank policies or guidelines, must be brought to the immediate attention of IFC for consideration and guidance.

Project Siting

The principal elements of World Bank policy regarding the siting, land acquisition and development of wind energy projects are summarized below. Selection of the development site should be made through a systematic, documented process that includes consideration of alternatives and their environmental impacts.

a) The site must be selected taking environmental factors into consideration in a

manner which will minimize, to the extent possible, impacts to natural resources, sensitive ecosystems, cultural resources and populated areas.

b) Project sponsors should conduct detailed studies to avoid project siting in sensitive avian habitat such as migratory bird corridors, waterfowl nesting areas, or raptor feeding areas.

c) The site should be selected to avoid, where possible, areas susceptible to erosion.

d) Land acquisition must be carried out in accordance with World Bank resettlement policy which requires quantification of impacts on land-based livelihood, and fair compensation to landowners and people relying on the land for their residence and/or livelihood.

e) In locating sites for construction camps and equipment and materials storage areas, project sponsors should take into consideration the same environmental and sociocultural resources considered in selecting the project site.

Project sponsors must provide IFC with a complete record of the process by which the site was selected, including the analysis of alternative sites, and the consultation with government agencies, affected communities and nongovernmental organizations.

Erosion and Sediment Control

Project sponsors should develop an erosion and sediment control plan to minimize erosion in construction areas and along access roads, and provide for long-term maintenance and operation practices that will control erosion and

sedimentation. The plan should include, but should not be limited to, the following measures.

- a) The area cleared of vegetation to accommodate tower construction and access roads should be minimized and slopes should be stabilized to prevent erosion.
- b) Cleared areas should be promptly revegetated with native grasses, shrubs and trees.
- c) Overland drainage should be controlled to prevent channeling and sediment transport by diverting flows from areas where soils are exposed, and/or by providing filter barriers or settling basins to remove sediment before the runoff is discharged to surface waters.
- d) Revegetated areas and areas subject to erosion should be monitored and maintained during project operation.

Ambient Noise

- a) Noise abatement measures should achieve either the following levels or a maximum increase in background levels of 3 dB(A). Measurements are to be taken at noise receptors located outside the project property boundary.

Receptor	Maximum Allowable L_{eq} (hourly), in dB(A)	
	Daytime	Nighttime
	07:00 - 22:00	22:00 - 07:00
Residential; institutional; educational	55	45
Industrial; commercial	70	70

- b) Ambient noise impacts should be mitigated through appropriate wind turbine design and setbacks.
- c) Project sponsors should develop a noise monitoring program in cooperation with local government agencies to determine noise generation, including low frequency sound, and identify additional noise mitigation measures if necessary.

Protection Of Wildlife Habitat

- a) Disturbances to wildlife habitat should be minimized by limiting construction areas, grading requirements and vegetation removal, and by prohibiting the removal of vegetation within or near sensitive biological areas.
- b) The wind energy conversion system should include designed elements that will limit bird collisions and electrocution, such as locating transmission lines underground, using flashing lights or audible deflectors on turbines, and avoiding tower siting near surface waters.
- c) A monitoring program should be developed and implemented in coordination with governmental agencies to evaluate the impacts on bird movement patterns, avoidance behavior and mortality.

Visual Resources

A plan must be developed to mitigate visual impacts resulting from the project. The following measures should be included in the visual mitigation plan.

- a) Provide setbacks for facilities to minimize impacts to visually sensitive areas, such as scenic corridors and recreation areas.
- b) Minimize new road construction; where such construction is necessary, locate the roadways on gentle grades to minimize visible cuts and fills.
- c) Place transmission lines underground where possible, or in low-lying areas.
- d) Paint wind turbines, blades, towers and structures a neutral, non-reflective color so they will blend with surroundings.
- e) Use subdued lighting for project facilities, while providing lighting only as needed for safety purposes.

General Environmental Requirements

- a) Impacts to environmental and sociocultural resources must be minimized to the extent practicable, and all project facilities operated in accordance with World Bank Environment, Health and Safety Guidelines: General Criteria.

- b) Project sponsors must devise a program to: survey, identify and assess cultural resource sites within the project area; train construction personnel in the identification of cultural resources; and mitigate adverse impacts resulting from project development in accordance with host country requirements.
- c) The potential for electromagnetic interference as a result of wind turbine operation should be avoided by proper tower siting, or minimized by filtering and/or shielding the wind turbine generators.

Public Safety

- a) Minimum safety setbacks of 150 meters, or three times the turbine height, whichever is greater, should be established from any property line, public roadway, transmission facility, or railroad.
- b) In designing a site plan for project facilities, project sponsors should comply with the requirements of aviation authorities to avoid electromagnetic interference and other incompatible land uses.
- c) Project sponsors must ensure the safe operation of wind turbine rotors by providing rotational speed controls.
- d) Unauthorized personnel should be prevented from accessing towers and other hazardous or restricted areas.
- e) Project sponsors must develop an operations and public emergency response program for fires and major accidents, including emergency equipment and trained personnel.

Hazards Protection

- a) Wind energy conversion systems should be located, to the extent possible, to minimize potential risks from earthquakes, landslides, floods and fires from surrounding areas.
- b) Wind turbines and towers must be designed to criteria appropriate to the local seismic risk, wind loading, and any other dynamically imposed loads associated with climatic and geological factors inherent at the location; certification of the design criteria used must be provided by the structural engineers or architect.

Training

- a) Personnel involved in the construction and operation of the project must be trained on the hazards, safety procedures and emergency response plan associated with their tasks in accordance with World Bank Environment, Health and Safety Guidelines: General Criteria.
- b) Project sponsors must provide training for monitoring and mitigating the effects of the project on environmental and sociocultural resources.

Record Keeping And Reporting

- a) The sponsor must maintain records of significant environmental matters, including monitoring data, occupational accidents, and fires and other emergencies.
- b) Records of public complaints and accidents involving the general public must be maintained.
- c) The above information must be reviewed and evaluated to improve the effectiveness of the environmental, health and safety program, and an annual summary provided to IFC.