Appendix 3-K

Photo Rendering Methodology

Photo Rendering Methodology

Cape Wind Project – Alternatives Analysis

Cape Cod, Martha's Vineyard and Nantucket

Massachusetts

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Date: February 2004

TABLE OF CONTENTS

Introduction 1
Alternative Project Sites and Layouts 1
Viewpoint Selection 1
Methodology 2
Computer Model 2
Viewpoint Photos 2
Photo Renderings 3

TABLES AND FIGURES

Table 1. Selected Viewpoints
Table 2. Viewpoint Data

Figure 1. Alternative Project Sites and Layouts
Figure 2. Computer Models
Figure 3. Photo Renderings
Day Time – See Figures in Section 3.0 of DEIR/DEIS
Night Time – See Figures in Section 3.0 of DEIR/DEIS

INTRODUCTION

Environmental Design & Research, P.C. (EDR) prepared the following report describing the methodology used to prepare daytime and night time photo renderings of alternate sites and layouts for the proposed Cape Wind Project. The proposed Cape Wind Project is a wind-powered electric generating facility, with associated transmission lines. The alternative sites considered in this evaluation sites are off or near the coast of southeastern Massachusetts.

Alternative Project Sites and Layouts

Six alternative sites/layouts were evaluated as part of this analysis. These are referred to as 1) Tuckernuck Shoal, 2) South of Tuckernuck Island, 3) Handkerchief Shoal, 4) 130 turbine Horseshoe Shoal alternative, and Reduced Horseshoe Shoal, in combination with 5) New Bedford, and 6) Massachusetts Military Reservation (MMR). The Tuckernuck Shoal alternative is a 130 turbine array located approximately 3.9 miles east of Martha's Vineyard, 5.0 miles northwest of Nantucket, and 9.8 miles southeast of the nearest point on Cape Cod (Great Neck, Falmouth). The South of Tuckernuck Island alternative is a 130 turbine array located approximately 3.6 miles southwest of Nantucket and 5.8 miles southeast of Martha's Vineyard. The Handkerchief Shoal alternative is a triangular, 92 turbine array located approximately 4.3 miles south of Dennisport/West Harwich and 6.4 miles west of Monomoy Island. The Horseshoe Shoal alternative is a 130 turbine array with the nearest project components located approximately 4.7 miles from Cape Cod (Point Gammon), 5.4 miles from Martha's Vineyard (Cape Poge), and 11.2 miles from Nantucket (Great Point). The Reduced Horseshoe Shoal alternative is an irregularly-shaped 114 turbine array that is located in the same area proposed for the Horseshoe Shoal alternative. This reduced alternative moves the closest turbines to approximately 5.4 miles from Point Gammon and 6.0 miles from Cape Poge. The Reduced Horseshoe Shoal alternative is proposed in combination with the 25 turbine New Bedford alternative. This alternative site is located approximately 0.9 mile southeast of Ricketson Point, South Dartmouth, 1.6 miles southwest of Wilbur Point (Sconticut Neck), and 1.4 miles east of Smith Neck.

The final alternative is the MMR alternative, which is the only land-based alternative under consideration. This alternative involves 132 turbines located between the Mid-Cape Highway (Route 6) and Route 28 south of the Cape Cod Canal in the Town of Bourne. The larger number of turbines proposed in this alternative is due to the fact that smaller 1.5 MW turbines are proposed rather than the 3.6 MW off-shore units.

The location and layout of all the alternatives described above are illustrated in Figure 1.

Viewpoint Selection

In accordance with guidance provided by the U.S. Army Corps of Engineers (USACE) it was decided that photo renderings of the alternate off-shore sites/layouts described above would be prepared using a "generic" seascape photo from EDR's photo library. However, the distance and direction of views is based on the location of the nearest designated historic properties and districts on Cape Cod, Nantucket and Martha's Vineyard (even though the photo was not obtained from those locations), with the concurrence of USACE. Only in the case of the land-based MMR alternative was a site-specific photograph utilized. The six locations selected to illustrate the proposed alternatives are listed in Table 1 and shown on Figure 1. The USACE determined that preparation of photo renderings from these viewpoints would adequately illustrate potential visibility and visual impact of project alternatives from Cape Cod, Nantucket and Martha's Vineyard.

Table 1. Proposed Viewpoint Locations.

Alternative	Viewpoint Number	Viewpoint Location	Distance/Direction to Wind Park	Photo
Tuckernuck Shoals	A1	Cape Poge	3.9 mi. East	Generic Seascape
South of Tuckernuck Is.	A2	Madaket	3.8 mi. Southwest	Generic Seascape
Handkerchief Shoals	A3	Monomoy	6.4 mi. West	Generic Seascape
130 WTG Horseshoe Shoal Alternative	A4	Wianno	6.2 mi. Southeast	Generic Seascape
New Bedford	A5	S. Dartmouth	1.0 mi. Southeast	Generic Seascape
MMR	A6	Sagamore Bridge	0.8 mi. South	Site Photo
Reduced Horseshoe Shoal Alternative	A4	Wianno	5.7 mi. Southeast	Generic Seascape

METHODOLOGY

Computer Model

To develop a computer model of the various alternatives, EDR obtained layout plans from ESS Group, Inc. (ESS). As currently proposed, the offshore alternatives utilize 3.6 MW General Electric (GE) wind turbines, each mounted on 246 foot/75 meter-tall tubular steel monopole towers. The 3-bladed rotors have a diameter of approximately 341 feet/104 meters and will reach a maximum height of approximately 417 feet/127 meters above sea level. Each tower has a service platform located approximately 30 feet/10 meters above the water surface. The turbines are arranged in a grid pattern with an approximate separation distance of 0.3 to 0.5 mile. All built components of the facility are proposed to be painted a marine gray color.

For the purposes of this study it was assumed that every other offshore wind turbine on the project perimeter would be illuminated with dual aviation warning lights (white strobes [FAA L865] during the day and flashing medium intensity red lights [FAA L864] at night) mounted on the nacelle. The remaining perimeter turbines would be marked day and night with two flashing low intensity red lights (FAA L810). Interior turbines would each have two flashing low intensity red lights (L810) at night and during the day time. Coast Guard amber navigation warning lights will be installed on each tower approximately 35 feet above the water's surface.

For the land-based MMR alternative, EDR used layout plans provided by ESS and a turbine model equivalent to a GE 1.5 MW unit. This unit has a 254-foot diameter rotor mounted on a 267 foot-tall tubular steel tower. The nacelle is approximately 27 feet long by 11 feet tall and is topped with an aviation warning light. Land turbines would be illuminated with the FAA lights described above. These land-based machines have no service platforms or Coast Guard warning lights, and are assumed to be white in color, similar to most land-based wind turbines.

This data was used to construct to-scale computer models of the alternate arrays evaluated in this analysis. All visible facilities were modeled to scale and in the proper geographic location and elevation using 3D Studio Max 6.0® software. Appropriate structural materials and finishes were applied based on information provided by Cape Wind Associates.

Viewpoint Photos

Because five out of the six alternative project sites and turbine arrays are in off-shore settings, and because direct comparison was desired, a “generic” seascape photo was used as the background for each offshore rendering. This photo shows a section of beach, an expanse of open water, and a horizon line that essentially could represent a shoreline view at any of the selected viewpoints. Consequently, this single photograph was used to illustrate the potential view of the Tuckernuck Shoal alternative from Cape Poge, the South of Tuckernuck Island alternative from Madaket, the Handkerchief Shoal alternative from Monomoy, the Reduced and Horseshoe Shoal alternatives from Wianno, and the New Bedford alternative from South Dartmouth.

Site-specific day time photos toward the MMR alternative were obtained from one selected viewpoint. This viewpoint, on the Sagamore Bridge over the Cape Cod Canal, was identified by the USACE as the best location to illustrate the land-based MMR alternative. Photos from the Sagamore Bridge were taken by an ESS field crew on January 23, 2004 with a 35 mm Olympus OM-10 camera and a 50 mm lens to simulate normal human eyesight relative to scale. Photos were taken from various locations on the bridge to document different views/visibility of the MMR site. GPS coordinates were obtained at each photo location and at the location of visible reference points (buildings) in the photos. The time and location of each photo was documented on cameras, GPS units, field maps and data sheets. After reviewing the Sagamore Bridge photos, the viewpoint selected was the most open, unobstructed, publicly-accessible view toward the MMR site.

Photo Renderings

To show anticipated visual changes associated with the various alternate sites/layouts, high-resolution computer-enhanced image processing was used to create realistic photographic renderings of the alternates from each of the selected viewpoints. The term photo rendering, rather than visual simulation, is used because a generic photo was used for illustration of the off-shore alternatives, the sun angle used in the renderings lighting may not match that of the original photograph, and precise, surveyed locations of visible reference points were not obtained or utilized in developing the camera alignments. The photo renderings were prepared by adding three-dimensional computer models of the proposed alternatives to the photos. The first step in this process involved incorporating the alternate layout plans for each wind park into an AutoCAD drawing in a common datum (Massachusetts State Plane, NAD 83, Massachusetts Island 2002). The two dimensional AutoCAD data was then imported into 3D Studio Max 6.0® and three-dimensional components (cameras, modeled turbines, lights, etc.) were added. This data was superimposed over the photographs and minor camera changes (target height, roll,) made to align with the horizon line in the view. This process ensured that, to the extent possible, project elements were shown in proportion, perspective, and proper relation to viewer location and direction of view. Consequently, the alignment, elevations, dimensions and locations of the alternatives are accurate and true to the proposed design.

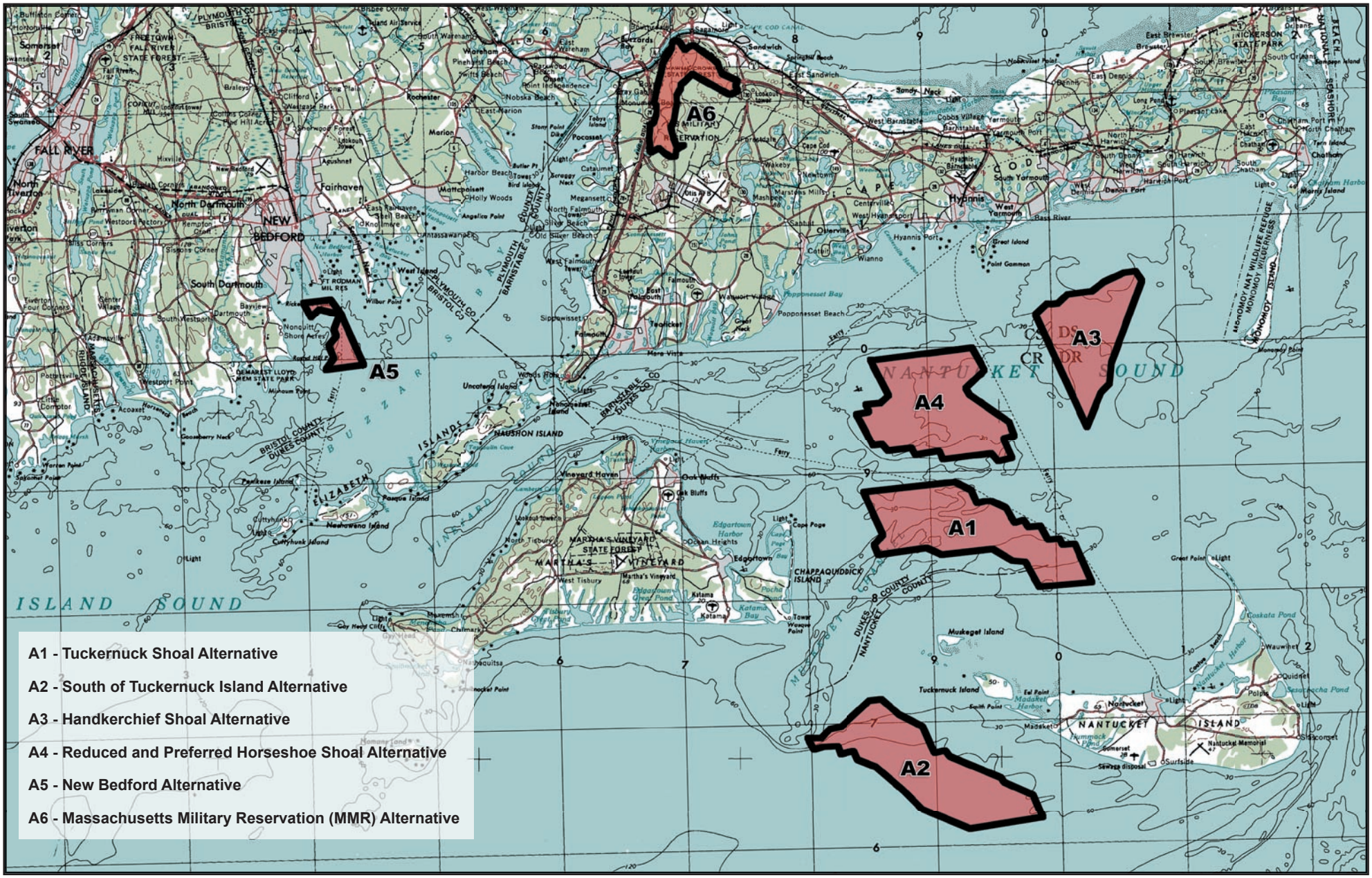
At this point, a “wire frame” model of each alternative, and any reference points, was added to the photographs. Based on previously reviewed studies and data sources it was determined that the visible horizon is approximately 3-4 miles from a viewer standing at sea level. EDR’s research, coupled with our evaluation of the visibility of the constructed met. tower, led us to the conclusion that curvature of the earth would obscure the bases of all the turbines from all of the selected viewpoints, with the exception of the New Bedford alternative as viewed from South Dartmouth. However, variables associated with light refraction, wave height and the effect of atmospheric conditions make it impossible to determine exactly how

much of each turbine will fall in front or beyond the visible horizon line. Consequently, in views where the turbines are over 3 miles from the viewer, the renderings were created by placing the project on the visible horizon.

The proposed exterior color/finish of the wind turbines was added to the model. The software simulated the appropriate sun angle based on the location (latitude and longitude) of each viewpoint and the assumption that the photo was taken at 11:00 a.m. on June 21, 2004. A consistent lighting scenario was used for all the offshore renderings to allow for direct comparison of the alternatives. In the case of the rendering of the MMR alternative, the actual time and date of the photo from the Sagamore Bridge was used to simulate the sun angle/lighting conditions. This information allowed the computer to accurately illustrate highlights, shading and shadows for each individual turbine shown in the view. The effects of distance (hazing, bluing, loss of detail) were not added to these simulations. In addition, illuminated white aviation warning lights were not shown in the simulations, because in EDR's experience, these lights are generally not visible/noticeable under clear day time conditions. The day time renderings of the proposed alternatives are presented as Figures in Section 3.0 of the DEIR/DEIS.

Data on the proposed lighting system was provided by ESS to assist with preparation of the night time simulations. In addition, night time field notes and photos of the constructed met. tower were obtained from various night time viewpoints on Cape Cod and Martha's Vineyard. Night time renderings were prepared using a "generic" night time photo. To allow for a "worst case" evaluation, a dark photo was chosen, which may not accurately illustrate any existing light sources that could be visible from the selected location and direction of view. To simulate the appearance of the proposed FAA warning lights, night time photos of the constructed met. tower (which includes an L810 light fixture) and the constructed Fenner (New York) Wind Power Project (which includes L810 and L864 lights on the turbines) were obtained under clear sky conditions. Photos were obtained at distances ranging from 1 to 16 miles. The lights as they appeared in these photos were then used to create comparable lights in the computer model of the alternate sites/layouts and aligned to the night time photo in the same manner as described for the day time simulations.

The night time renderings are presented as Figures in Section 3.0 in the DEIR/DEIS. Because the FAA warning lights will be flashing, the proposed flashing rate (20 FPM) was used to animate the computer model lights, with each interior turbine flashing randomly (rather than synchronized). Each simulation is essentially a snap shot that shows the project at one moment in time (i.e. $1/30^{th}$ of a second) with some portion (in the range of 50-65%) of the interior lights on. All of the perimeter lights are illuminated, as the flashing of these lights is proposed to be synchronized. Due to the effects of distance, no visible lighting from the Coast Guard navigation warning lights was shown in the night time renderings, except in the view of the New Bedford alternative from South Dartmouth.



Alternate Project Sites and Layouts

February 2004

Figure 1

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Prepared For: Cape Wind™ Energy for Life.

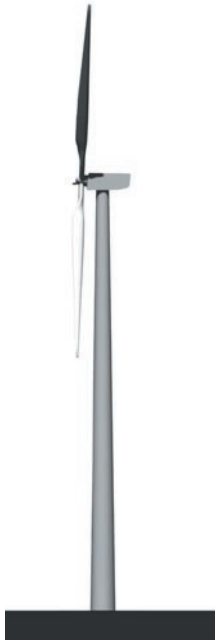
Offshore Turbine 3.6 MW

Side Elevation

Front Elevation

Proposed Color of Turbine	Blue Gray (R=77 G=194 B=215)
Height to Hub	240'
Hub Diameter	13.3'
Bounding Dimensions of Nacel (LxWxH)	48' X 40 X 27'
Maximum Width of Tower	16' dia
Minimum Width of Tower	11' dia
Rotor Diameter	341'
Maximum Rotor Blade Width	12'
Maximum Height above Sea Level	417'
Wind Direction	SW
Height of Turbine Platform above Sea Level	30'
Bounding Dim. of ESP (LxWxH)	100' X 200' X 100'
Aviation Warning Lights	FAA L864/L865 L810
Coast Guard Warning Lights	Dual Amber USCG Lights

Land Based Turbine 1.5 MW



Side Elevation

Front Elevation

Proposed Color of Turbine	White (R=255 G=255 B=255)
Height to Hub	267'
Hub Diameter	7.6'
Bounding Dimensions of Nacel (LxWxH)	27' X 10' X 11'
Maximum Width of Tower	8" dia
Minimum Width of Tower	15.6' dia
Rotor Diameter	254"
Maximum Rotor Blade Width	6"
Maximum Height	391'
Wind Direction	SW
Height of Turbine Platform above Sea Level	NA
Bounding Dim. of ESP (LxWxH)	NA
Aviation Warning Lights	FAA L864/L865 L810
Coast Guard Warning Lights	NA

Computer Models

February 2004

Figure 2

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