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April 23, 2010

Ida McDonnell
U.S. Environmental Protection Agency
Region I – New England
Air Permits Program
1 Congress Street – Suite 1100
Boston, Massachusetts 02114-2023

Re: OCS Permit Application
Cape Wind Energy Project
ESS Project No. E159-504.1

Dear Ms. McDonnell:

A Permit Application for the proposed Cape Wind Offshore Renewable Energy Project (the Project) was submitted by ESS Group (ESS) on December 17, 2008 to fulfill the regulatory requirements of the United States Environmental Protection Agency's (EPA) Outer Continental Shelf (OCS) Air Regulations, codified under Title 40 Code of Federal Regulations, Part 55 (40 CFR § 55). The Project, as proposed by Cape Wind Associates, LLC (Cape Wind), will be located at Horseshoe Shoal, Nantucket Sound, Massachusetts, and will utilize emission free offshore wind energy as its renewable fuel to generate electricity for sale.

In a letter dated April 20, 2010, the EPA requested additional information to complete their review of the Cape Wind OCS Permit Application. The following information is being provided on behalf of Cape Wind to supplement the application, in direct response to the EPA's information request. The technical information provided on the Project equipment and construction sequencing is referenced directly from the Final Environmental Impact Statement (FEIS) prepared for the Project by the U.S. Minerals Management Service (MMS) in January 2009.

EPA Item #1

For each of the following pieces of equipment, please provide the function, installation sequence, and the final configuration of the WTG platform:

a. "wind turbine generator,"

b. "monopile" and

c. "scour protection equipment."

Cape Wind Response #1

Section 2.0 of the MMS FEIS for the Project provided detailed descriptions of this equipment, including their function and installation sequence, and the final configuration of the WTG platform, as follows:

www.essgroup.com

a. The Project will consist of 130 wind turbine generators (WTGs) located in a grid pattern, which are described in detail in Section 2.1.1 of the FEIS. The main components of the WTG will be the rotor, transmission system, generator, yaw system, and the control and electrical systems, which will be located within the nacelle. The nacelle is the portion of the WTG that encompasses the drive train and supporting electromotive generating systems that will produce the wind-generated power. Each WTG will have an energy generating capacity of 3.6 ± megawatts (MW).

b. The WTG nacelles will be mounted on a manufactured tubular conical steel tower, supported by a monopile foundation system.

c. As described in Section 2.3.2.3 of the FEIS, a seabed scour control system will be installed on the seabed around each monopile, to help to prevent underwater currents from eroding the substrate adjacent to the WTG foundation. The scour protection system will consist of either a set of six scour control mats arranged to surround the monopile, or rock armor.

The installation sequence for the WTGs is described in detail in Section 2.3.2 of the FEIS. It is anticipated that the installation of the WTGs will include the following sequence of activities:

1. Installation of the foundation monopiles;

    i. A crane on a jack-up barge will lift the monopiles from the transport barge and place them into position.

    ii. The monopiles will be installed into the seabed using a pile driving ram or vibratory hammer to an approximate depth of 85 feet.

2. Erection of the WTGs;

    i. A specialized WTG installation vessel will be stabilized at the correct location and elevation using a jacking system.

    ii. A transition piece unique to the WTG will be placed by the vessel's crane onto the monopile, leveled, set at the precise elevation for the tower, and grouted in place. The transition piece will include a pre-fabricated access platform and service vessel landing (approximately 32 feet from mean lower low water).

    iii. The crane will then place the lower half of the tower onto the deck of the transition piece.

    iv. The upper tower section will then be raised and bolted to the lower half.

v. In order, the nacelle, hub and blades will then be raised to the tower and secured.

3. Installation of the inner-array cables; and

4. Installation of the scour protection mats or rock armor.

   i. The scour mats will be placed on the seabed by a crane or davit onboard the support vessel. Final positioning will be performed with the assistance of divers.

   ii. Divers will use a hydraulic spigot gun fitted with an anchor drive spigot to drive the anchors into the seabed.

   iii. Alternatively, the rock armor and filter layer material will be placed on the seabed using a clamshell bucket or a chute. The armor stones would be sized so that they are large enough not to be removed by the effects of the waves and currents, while being small enough to prevent the stone fill material placed underneath it from being removed.

EPA Item #2

Are the monopoles driven into the seafloor?

Cape Wind Response #2

As described in Section 2.3.2.2 of the FEIS, Cape Wind plans to use a jack-up barge with a crane for the installation of the monopiles. The crane would lift the monopiles from the transport barge and place them into position. The monopiles would be installed into the seabed by means of a pile driving ram or vibratory hammer to an approximate depth of 85 feet.

EPA Item #3

Does the WTG attached to the top of the monopoles?

Cape Wind Response #3

As described in Section 2.3.2.3 of the FEIS, a transition piece unique to each specific WTG will be placed by a crane onto the monopile. The crane will then place the lower half of the tower onto the deck of the transition piece. Once this piece is secured, the upper section will be raised and bolted to the lower half. In order, the nacelle, hub and blades will then be raised to the top of the tower and secured.

EPA Item #4

Does the scour equipment protect the monopoles from the ocean current by scouring out the sand surrounding the monopoles?

Cape Wind Response #4

As described in Section 2.3.2.3 of the FEIS, a seabed scour control system will be installed on the seabed around each monopile, to help to prevent underwater currents from eroding the substrate adjacent to the WTG foundation. For additional detailed information on scouring please refer to Report No. 4.1.1-5 of the FEIS (Revised Scour Report, ESS 2006).

EPA Item #5

A schematic of the final installation with the equipment identified.

Cape Wind Response #5

Figure 2.1.1-1 of the FEIS (copy attached) provides a schematic of an installed WTG. The scour control system will be installed on the seabed around the monopile.

EPA Item #6

For the three diesel cranes, two hydraulic rams and one jacking system with 6 legs answer the following questions:

a. Will Cape Wind use only compression-ignition engines?

b. What is the current emission rate for each engine?

c. Who owns and maintains the equipment?

Cape Wind Response #6

a. Cape Wind expects to use only compression-ignition engines for this equipment.

b. The attached table, which was previously provided to the EPA in a letter dated September 23, 2009, summarizes the current emission rates for each engine.

c. The EPC Contractor that will be hired by Cape Wind will be responsible for procuring the equipment and for its maintenance. Although under the control of the EPC Contractor, some of the equipment may be owned by a third-party. Cape Wind will obligate the EPC Contractor to maintain the equipment in accordance with the EPA Permit.

EPA Item #7

Will Cape Wind install the equipment on barges and tow the equipment out to the site or install the equipment on self-propelled vessels?

Cape Wind Response #7

As described in Section 2.3.2 of the FEIS, the plan for the WTG installation is to use a specialized self-propelled vessel equipped with a jacking system and a crane. All of the other construction equipment is expected to be installed on barges which would be towed out to the site by tugs.

EPA Item #8

Will the equipment remain on site or return to port periodically for maintenance?

Cape Wind Response #8

The construction equipment is expected to remain on site until job completion.

EPA Item #9

Does the vessel or barge use one or more anchors to attach to the seafloor?

Cape Wind Response #9

As described in Section 2.3 of the FEIS, Cape Wind plans to use a jack-up barge for the installation of the monopiles. A jacking system would then be used to stabilize the specialized vessel used for the WTG installation activities. The legs of these jacking systems would ultimately rest on the seafloor. Other vessels may use anchors that rest on the seafloor, but would not be "attached to the seabed and erected thereon" within the meaning of the EPA's regulations.

EPA Item #10

Does the vessel or barge need to anchor before the construction equipment can operate?

Cape Wind Response #10

It is anticipated that all construction equipment will be positioned on vessels or barges with jack-up capability. No anchoring is anticipated for these jack-up vessels.

EPA Item #11

For each vessel, what is the minimum number, type, and sequence of seafloor attachments before the construction vessel can operate?

Cape Wind Response #11

The jack-up vessels will likely be equipped with 3-6 legs equipped with spuds that will rest on the seafloor. The vessel will be stabilized into position by the jacking system, and then construction activities will begin. Other vessels may use anchors that rest on the seafloor, but will not be "attached to the seabed and erected thereon" within the meaning of EPA's regulations.

EPA Item #12

For each vessel, what is the minimum number, type, and sequence of seafloor detachments after which the construction equipment no longer operates?

Cape Wind Response #12

The jack-up vessels will likely be equipped with 3-6 legs equipped with spuds that will rest on the seafloor. The construction activities will be completed, and then the jacking system will detach from the seafloor so that the vessel can move to the next installation location. Other vessels may use anchors that rest on the seafloor, but will not be "attached to the seabed and erected thereon".

EPA Item #13

Can (and will) the barge or vessel tether to a platform that is already attached to the seafloor?

Cape Wind Response #13

Installation vessels are not expected to attach to monopiles / tower structures, but crew vessels may tether to a jack-up barge. Such vessels are not anticipated to include any stationary emission sources. Smaller crew vessels may use the docking structures provided on the towers' transition piece for operations and maintenance activities, but such vessels are not anticipated to include any stationary emission sources.

EPA Item #14

For each vessel, will the vessel's propulsion engine(s) be operating at all or part of the time while the vessel is in the process of attaching to the seafloor, after attachment to the seafloor but before construction equipment is operating, and while construction equipment is operating?

Cape Wind Response #14

The propulsion engines of the jack-up vessels will only be in operation during the jack-up process as may be required to stabilize and maintain the position of the vessel. Once the jack-up process is completed, the propulsion engines are expected to shut down prior to, and for the duration of the operation of construction equipment.

EPA Item #15

Is the jacking system a separate vessel that is self propelled?

Cape Wind Response #15

No. As described in Section 2.3.2.3 of the FEIS, Cape Wind expects to use a specialized vessel for the WTG installation that is self propelled, and is equipped with a jacking system to stabilize the vessel in the correct location, and to raise the vessel to a suitable working elevation.

EPA Item #16

Cape Wind stated in its application that the construction equipment will have transient and highly variable load operating characteristics. Cape Wind should provide additional information to support this statement. Cape Wind should provide this information for each engine and for each construction activity. The information should include the load characteristics for each engine and for each task and answer the following:

a. Does the construction equipment operate for several hours and then shut down for an extended period once the task is completed?

b. During operation, is the engine operating within a certain load range (i.e., 60-80%) or does the engine throttle from full load to idle then back to full load?

c. How does the jacking system operate? Does the engine installed on the system operate the legs? Does the engine shut off once the WTGs are stabilized?

Cape Wind Response #16

The attached table summarizes the load characteristics for each engine and for each task, including the jacking system.

EPA Item #17

Cape Wind concluded that selective catalytic reduction (SCR) systems were not feasible for the control of NOx due to the transient load operations of the engines. The assumption is that transient load operations will not maintain the exhaust temperature above the minimal temperature requirements of the SCR systems. However, EPA Region 10 recently concluded that SCR was technically feasible for the control of diesel engines used on oil exploration vessels. The engines used in the Region 10 projects have similar power outputs as the Cape Wind project. Cape Wind should investigate the Region 10 projects to determine if SCR systems used in those projects could be used on any of the engines in the Cape Wind project.

Cape Wind Response #17

Cape Wind has reviewed the following OCS Permits recently issued by EPA Region 10:

- Frontier Discovery Drillship – Beaufort Sea Exploration Drilling Program
- Frontier Discovery Drillship – Chukchi Sea Exploration Drilling Program

The drillship associated with these projects includes numerous emission sources which are not source types associated with the Cape Wind Project. These sources include large diesel generators, heat boilers, incinerators, ice breakers, and drilling equipment. The only emissions sources associated with the drillship for which SCR systems were required for NOx emissions control were the six 1,325 horsepower diesel generator engines used to power the drillship non-propulsion systems. These engines serve as a floating power plant, and are used as stationary sources, in operation at all times to provide auxiliary power for ship systems. SCR is a proven NOx emissions control technology for diesel generator engines at stationary source installations used to provide power.

The diesel engine emission sources associated with the construction of the Cape Wind Project are non-road mobile sources, as defined by the EPA. Unlike diesel generators, the source types to be used for the Project are not regulated as stationary sources by EPA or MassDEP. Although the Cape Wind sources may use diesel engines that have similar output ratings as the Region 10 sources, the Cape Wind sources are of a different class or category of source than the sources in Region 10 where SCR was required. There are many different types of stationary and mobile emission sources which utilize diesel engines. The manner in which these sources are defined and regulated by the EPA and MassDEP are based on their use, not on their power output. Although a crane and generator may both utilize a diesel engine of similar power output, their use and configuration are significantly different. This difference has been recognized by the EPA and MassDEP, as they regulate these sources as separate source categories, with significantly different requirements for their use.

A review of the EPA's RACT/BACT/LAER Clearinghouse (RBLC) identified SCR as a proven NOx control technology for diesel engines used as stationary sources for the generation of power. A review of the RBLC database did not identify a project where SCR has been applied to any non-road mobile sources, such as the construction equipment proposed for the Project. The EPA maintains a list of diesel retrofit technologies that have been approved in engine retrofit programs (http://www.epa.gov/oms/retrofit/verif-list.htm). The California Air Resources Board (CARB) also maintains a similar list (http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm). Neither of these lists of verified diesel retrofit technologies includes SCR systems that have been installed on mobile non-road construction equipment of the same type as those proposed for the Project. A review of recent large construction projects, such as the World Trade Center and Central Artery projects, has determined that SCR has not been applied to any non-road mobile construction equipment of the same type as the equipment proposed for the Project.

The Project must apply the Lowest Achievable Emission Rate (LAER) for its NOx emissions. LAER is defined as the most stringent emission limitation which has been achieved in practice for a class or category of source. According to the available information, SCR has not been implemented on any non-road mobile construction equipment such as the equipment proposed for the Project. SCR has been successfully implemented on diesel generators used to generate power, which are stationary sources, and are of a different source class or category than the Cape Wind construction emission sources. Because SCR has not been applied to the source types associated with the Project, it has not been demonstrated to be achievable in practice, and is therefore not the LAER determination for the Project sources.

EPA Item #18

Cape Wind concluded that Active Diesel Particulate Filter (DPF), Catalyzed Diesel Particulate Filters (CDPF), and Flow-through-Filter (FTF) were not cost effective. To verify these cost estimates, Cape Wind should investigate the use of these controls on various pieces of construction equipment used in New York City. Cape Wind should identify the project where these controls were used and document the actual cost estimates for these control applications.

Cape Wind Response #18

The "Cleaner Diesel Handbook" (April 2005) provides details of efforts in New York City to reduce pollution from diesel engines. It provides a case study of the 7 World Trade Center (WTC) Emission Reduction project. According to the study, in October of 2002, the site converted to ultra-low sulfur diesel (ULSD) for all equipment, and subsequently retrofitted six pieces of construction equipment with add-on emission controls. Five pieces of equipment were retrofitted with diesel oxidation catalysts (DOC), the control type proposed by Cape Wind for its diesel construction equipment. A single stationary generator was equipped with active DPF in 2004.

As discussed above in Cape Wind Response #17, a stationary generator is a different source type than the construction equipment associated with the Project. The fact that DPF was only applied to a stationary generator for the WTC project, and not to any of the mobile off-road construction equipment, reinforces Cape Wind's contention that DPF are not technically feasible or cost effective for the Project sources. If that were not the case, DPF would have presumably been more universally applied for the WTC project.

For a control technology to be considered cost effective, the ratio of the emissions reductions associated with its use over the duration of the project to its total capital and operating cost must be consistent with previous BACT determinations. The difference between Cape Wind and other projects for which DPF have been applied is the short duration of the period during which PM emissions will occur, and the relatively small amount of uncontrolled PM emissions. For example, the Chukchi drillship project, which will utilize DPF for some of its equipment, has potential PM emissions of more than 35 tons per year for the life of the multi-year drilling operation. The WTC project has estimated total PM emissions from its construction equipment of nearly 8 tons over the life of the project.

According to the emissions estimates provided to EPA in the September 19, 2009 letter, the construction of the Cape Wind project will result in approximately 0.5 tons of PM emissions from the sources subject to OCS permitting, over the 1-2 year construction period. A cost effectiveness analysis was submitted by Cape Wind to the EPA on March 12, 2010 for the Project sources subject to OCS permitting.

According to this analysis, the Project source with the highest PM emission rate, the hydraulic ram used for pile driving the monopiles, will emit approximately 272 pounds of PM during the construction period. The least cost PM control option for this equipment would be an FTF. The cost effectiveness of FTF would be approximately $79,000 per ton reduced over the 2-year construction period. This value is more than 10 times the values which have been typically used in previous PM BACT determinations. For the other Project equipment, the cost effectiveness ratio is even higher, with values in many cases in exceedance of $1 million dollars per ton reduced over the 2-year construction period.

The BACT guidelines require a proponent to determine the cost effectiveness of a control technology for its sources, and then compare the results to previous BACT determinations. Cape Wind has conducted a rigorous analysis of the cost effectiveness of the installation of DPF, CDPF, and FTF on its construction equipment subject to OCS permitting. The use of these technologies may be cost effective for other projects, which are of longer duration, and require more equipment usage, resulting in higher levels of uncontrolled PM emissions. The results of this analysis clearly demonstrate that it would not be cost effective for Cape Wind to use these technologies on any of its sources, and they are therefore not BACT for the Project.

<u>EPA Item #19</u>

In the economic impact analysis portion of the BACT evaluation, Cape Wind annualized the cost of the various control over 2, 5 and 10 year periods. Typically, control costs are annualized over a 20 year period but this time frame may not be applicable to this project. An additional methodology for deriving a period of cost estimates would be to estimate the total percentage over the project's expected 20-year life span during which the project will constitute and OCS source, then multiplying that percentage by 20 years to derive a time period in years during which the project is an OCS source, and using that for annualized cost estimates. Cape Wind should determine the applicable timeframe to annualize costs over and provide justification for such timeframe.

<u>Cape Wind Response #19</u>

There will be no OCS emission sources which are subject to a BACT determination during the operational phase of the Cape Wind facility. All of the Project emissions during the operating period, excluding unplanned equipment repairs, will be from vessels, which are not servicing or associated with an OCS emissions source or subject to the BACT requirement. The only BACT determination required for the Project is for the OCS emissions sources existing during the 1-2 year construction period at the site.

According to the EPA Air Pollution Control Cost Manual, the cost effectiveness of control equipment must be determined over the remaining useful life of the equipment. The assumption is that the entity that makes the investment in the control technology and retains operational control of it will benefit from the resulting reduction in emissions until the equipment is retired.

In the case of Cape Wind, the equipment used during construction will not be new equipment; it will be equipment that has already run for some amount of its useful life. There are no means to determine the remaining useful life of any of the equipment to be used during the construction of the Project. The retrofitted equipment will only operate under Cape Wind's control for the 1-2 year construction period, during which the emission reductions will take place.

Following the construction period, there are no means to determine the additional useful life or emission reductions to be achieved for any of this equipment. All of this equipment could be retired immediately following construction and never be used again. In that case, Cape Wind's capital expense for the retrofit would provide no further emission reduction benefit for any entity, and the cost effectiveness of the retrofit would be the ratio of the initial capital costs and operating costs during construction to the emission reductions achieved during the construction period. This is an extreme example, but it demonstrates the inability of Cape Wind to control the operation of the retrofitted equipment following the construction period.

As a result, Cape Wind reasserts that the cost effectiveness of the construction equipment subject to OCS Permitting be determined for the 1-2 year construction period only. Assigning a remaining useful life to the equipment in the cost effectiveness determination for Cape Wind beyond the construction period would be arbitrary at best and inconsistent with the BACT guidelines, as Cape Wind will not retain any operational control of the equipment beyond that time period, nor is there any guarantee that additional emission reductions will occur.

EPA Item #20

Cape Wind concluded that ultralow sulfur diesel is BACT for SO_2. EPA does not disagree with this conclusion. However, Cape Wind's analysis should provide additional information to support this conclusion and to show how controls would not be technically feasible for this application.

Cape Wind Response #20

The SO_2 emissions from the Project will result from the combustion of diesel fuel, which contains sulfur, in diesel internal combustion (IC) engines. A review of the RBLC identified low sulfur fuel as the only means to controlling SO_2 emissions from diesel IC engines of a similar size. There are flue gas desulfurization control technologies which have been developed and are in use on larger SO_2 emission sources, such as coal fired power plants, petroleum refineries, pulp mills, and large incinerators. However, as confirmed by the RBLC, these systems have not been applied to smaller diesel IC engines, such as those proposed for the Project. Neither the EPA nor CARB lists of verified diesel retrofit technologies include any add-on emissions control systems for the control of SO_2 emissions from a diesel IC engine.

A review of recent OCS permits issued by EPA, including the recent Region 10 OCS permits, determined that the use of ULSD fuel has been applied uniformly as the BACT determination to control the SO_2 emissions from diesel IC engines. Similarly, a review of recent large construction projects, such as the World Trade Center and Central Artery projects, has indicated that the use of ULSD for diesel construction engines has been universally applied to equipment using diesel engines, without additional SO_2 emissions controls.

Based on all of the available information, and on precedent, Cape Wind reasserts that the use of ULSD fuel for the control of SO_2 emissions from the Project's diesel IC engines is the only technically feasible control option, and is therefore the BACT determination for the Project.

I hope that this letter adequately responds to your information request. If you have any questions regarding this submittal, do not hesitate to call me at (781) 489-1149.

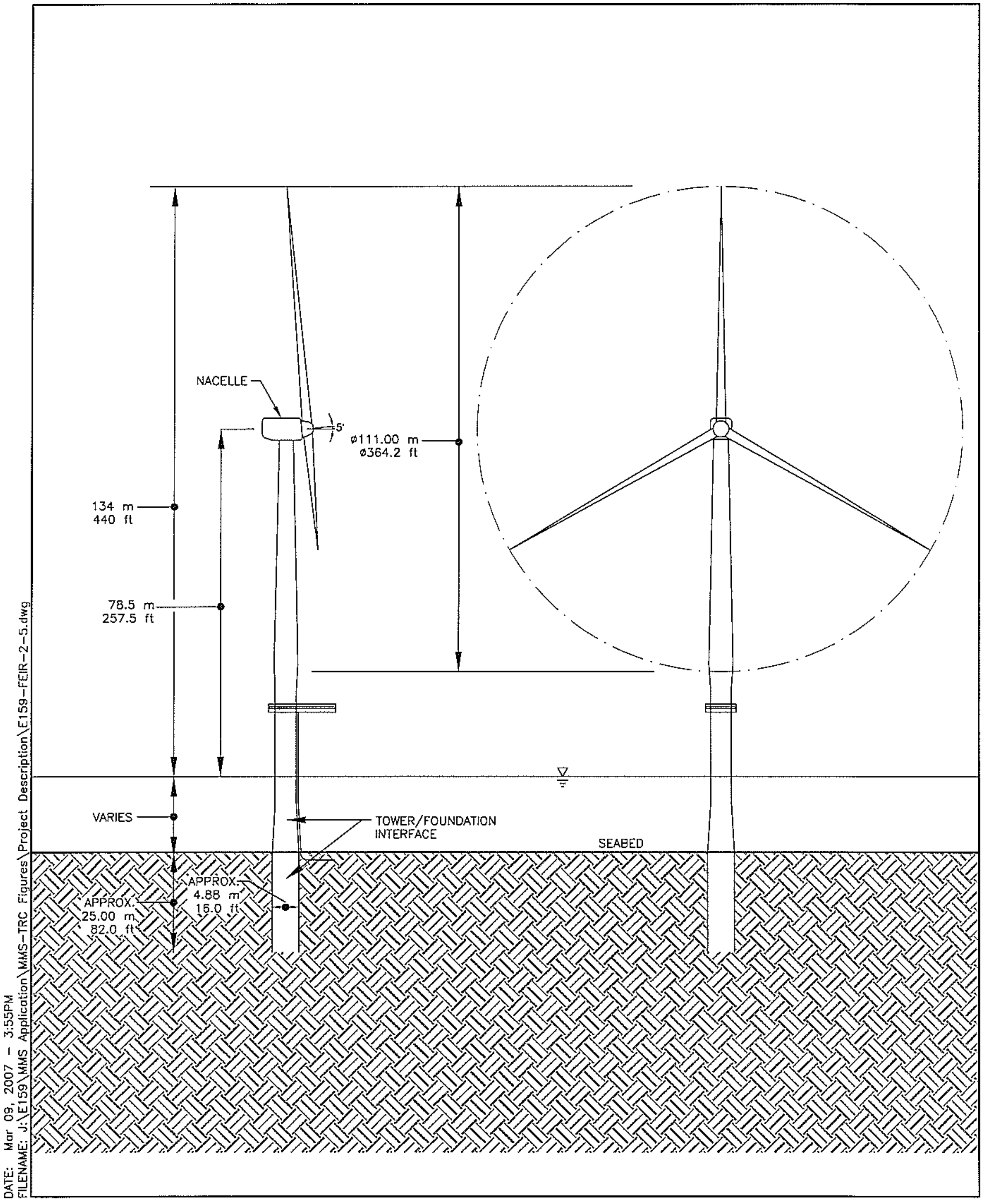
Sincerely,

ESS GROUP, INC.

Michael E. Feinblatt
Project Manager

Attachments

C: Donald Dahl, EPA Region I
Brendan McCahill, EPA Region I
Dave Conroy, EPA Region 1
Ronald Fein, EPA Region I
Craig Olmsted, Cape Wind Associates
Rachel Pachter, Cape Wind Associates
Chris Rein, ESS
Terry Orr, ESS



CAPE WIND ENERGY PROJECT

Proposed Wind Turbine Generator

Profile Detail

Figure 2.1.1-1

Revised July 2009 as directed by EPA & MMS

Cape Wind Energy Project
Construction Emissions Inside of 25 miles - Stationary Activities

Note: All trips are one-way (not round trips).

Emission Factors (g/hp-hr)Diesel Recip. >600 hp Based on AP-42 Vol.1 , Tables 3.4-1 - 3.4-4							
NOx	VOC	SO_2	CO	PM_{10}	$PM_{2.5}$	CO_2	HAPs
	0.33	0.01				526.16	0.00474
Emission Factors (g/hp-hr) Diesel Recip. <600 hp Based on AP-42 Vol.1 , Tables 3.3-1 - 3.3-2							
NOx	TOC*	SO_2	CO	PM_{10}	$PM_{2.5}$	CO_2	HAPs
	1.14	0.01				521.63	0.012

Diesel Fuel Sulfur Content:	15 ppm

* Emission factor for VOC was not available; TOC emission factor is used instead, which will result in a very conservative estimation of VOC emissions.

	EPA Nonroad Diesel Engine Emission Standard (Tier 2 or Tier 3 if available), g/KW-hr							
Engine Size	NOx *	VOC	SO_2	CO	PM_{10}	$PM_{2.5}$	CO_2	HAPs
75≤kW<130	4.0			5.0	0.30	0.30		
225≤kW<450	4.0			3.5	0.20	0.20		
kW>560	6.4			3.5	0.20	0.20		

* EPA emission standard is for NOx+NMHC. It has been assumed that all emissions are NOx to be conservative.

Activity Type	Vessel Type/ Emission Source	Number of Sources	Equipment Size (HP)	Equipment Size (kW)	Activity	Count	Duration	Operating Hours (per unit)	Assumptions	Emissions (tons) NOx	VOC	SO_2	CO	PM_{10}	$PM_{2.5}$	CO_2	HAPs
Construction Period - Stationary Activities within 25 Miles of the Project																	
Pile Installation																	
Put piles in place	primary 500 ton crane	1			Set piles	130 days	4 hrs/day	520		2.2	0.2	0.0	1.2	0.1	0.1	241.1	0.0
Pile driving	Hydraulic ram	1	800	597	Set piles	130 piles	4 hrs/pile	520	IHC S-1200 hydrohammer	4.4	0.3	0.0	2.4	0.1	0.1	482.1	0.0
Set transition pieces	primary 500 ton crane	1	1,600	1,193	Set Pieces	130 days	4 hrs/day	520		2.2	0.2	0.0	1.2	0.1	0.1	241.1	0.0
Installation of scour protection																0.0	0.0
Install rock armor	crane	1	800	597	Daily activity	65 days	8 hrs/day	520	2 towers per day	0.7	0.3	0.0	0.6	0.0	0.0	119.5	0.0
Install filler material	crane	1			Daily activity	65 days	8 hrs/day	520	2 towers per day	0.7	0.3	0.0	0.6	0.0	0.0	119.5	0.0
Subtotal										**10.1**	**1.1**	**0.0**	**6.0**	**0.3**	**0.3**	**1,203**	**0.0**
Cable laying			400 400	298 298													
Sheet Pile Driving for cofferdam		1				2 days	10 hrs/day	20	2 day @10 hrs/day	0.0	0.0	0.0	0.0	0.0	0.0	4.6	0.0
Compressor Drive		1				2 days	8 hrs/day	16	2 day @8 hrs/day	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0
Sheet Pile Removal		1				2 days	10 hrs/day	20	2 day @10 hrs/day	0.0	0.0	0.0	0.0	0.0	0.0	4.6	0.0
Cofferdam Backfill	crane barge	1	400	298	Backfill	2 days	10 hrs/day	20	2 day @10 hrs/day	0.0	0.0	0.0	0.0	0.0	0.0	4.6	0.0
Subtotal			100	75						**0.1**	**0.0**	**0.0**	**0.1**	**0.0**	**0.0**	**15**	**0.0**
Turbine installation			400 400	298 298													
Stabilizing the the WTG vessel in correct location and elevation	jacking system with 6 legs	1				130 days	2 hrs/day	260		0.4	0.2	0.0	0.4	0.0	0.0	71.1	0.0
Tower Installation	primary 500 ton crane	1	476	355		130 days	2 hrs/day	260		1.1	0.1	0.0	0.6	0.0	0.0	120.5	0.0
Nacelle installation	primary 500 ton crane	1	800	597		130 days	2 hrs/day	260		1.1	0.1	0.0	0.6	0.0	0.0	120.5	0.0
Rotor installation	primary 500 ton crane	1	800	597		130 days	2 hrs/day	260		1.1	0.1	0.0	0.6	0.0	0.0	120.5	0.0
Subtotal										**3.7**	**0.4**	**0.0**	**2.1**	**0.1**	**0.1**	**433**	**0.0**
ESP Installation			800	597													
Setting template for ESP installation	crane	1				1	16 hrs.	16		0.3	0.0	0.0	0.1	0.0	0.0	27.8	0.0
Pile setting	crane	1				6	3 hrs.	18		0.3	0.0	0.0	0.2	0.0	0.0	31.3	0.0
Pile driving	Hydraulic ram	1	3,000 3,000 3,200	2,237 2,237 2,386		6	2 hrs.	12	IHC S-500 hydrohammer	0.2	0.0	0.0	0.1	0.0	0.0	22.3	0.0
Subtotal										**0.7**	**0.1**	**0.0**	**0.4**	**0.0**	**0.0**	**81**	**0.0**
TOTAL Construction Emissions Over 1 to 2-Year Construction Duration										**14.6**	**1.6**	**0.0**	**8.6**	**0.5**	**0.5**	**1,732**	**0.0**

All operating hours will be metered to track actual emissions.

Construction Equipment Operational Summary
Cape Wind Energy Project

Construction Activity	Construction Equipment	Equipment Size (Hp)	Activity	Equipment Use			Description of Equipment Operation
				Days	Hrs/Day	Hours	
Monopile Installation	Primary 500 ton crane	800	Put piles in place	130	4	520	The crane engine will be operated at a moderate load to position itself to the monopile, be operated at a high load to lift the monopile from the barge and then throttle back to a moderate load to move it into position.
	Hydraulic ram	1,600	Pile driving	130	4	520	The hydraulic ram engine will be started, and will idle until the monopile is in position. It will then alternate between idle and a high load until the monopile is installed into the seabed. It will then be shut down to be moved to the next location.
	Primary 500 ton crane	800	Set transition pieces	130	4	520	The crane engine will be operated at a moderate load to position itself to the transition piece, be operated at a high load to lift the transition piece from the barge and place it over the monopile and then throttle back to a moderate load to move it into position. The crane engine will then idle until it is time to install the tower.
WTG Installation	Jacking system	476	Vessel stabilization	130	2	260	The jacking system engine will be started and operated at a high load until the vessel is stabilized in position. It will then be shut off until WTG installation is complete, then started up and operated at a high load to retract the jacking legs. The jacking system engine will then be shut down until the vessel moves to the next location.
	Primary 500 ton crane	800	Tower installation	130	2	260	The crane engine will be operated at a moderate load to position itself to the lower half of the tower, be operated at a high load to lift the tower from the barge and place it on the transition piece and then be throttled back to a moderate load to move it into position. The crane engine will then idle until it is time to set the upper tower section, and then the process will be repeated. Once the upper tower section is set, the crane engine will then idle until it is time to install the nacelle.
	Primary 500 ton crane	800	Nacelle installation	130	2	260	The crane engine will be operated at a moderate load to position itself to the nacelle, be operated at a high load to lift the nacelle from the barge and place it on the tower and then be throttled back to a moderate load to move it into position. The crane engine will then idle until it is time to install the rotor.
	Primary 500 ton crane	800	Rotor installation	130	2	260	The crane engine will be operated at a moderate load to position itself to the rotor components, continue at a moderate load to lift the rotor components to the nacelle and then be throttled back to a moderate load to move them into position. The crane engine will then be shut down to be moved to the next location.
Cable Laying	Hydraulic ram	400	Sheet pile driving for cofferdam	2	10	20	The hydraulic ram engine will be started, and will idle until the sheet pile is in position. It will then alternate between idle and a high load until the pile is installed into the sediments. This process will be repeated until all cofferdam sheet piles are installed and then the engine will be shut down.
	Compressor drive	100	Cable laying	2	8	16	The compressor would be started and operated at a moderate level while the cable barge and jet plow are positioned. The compressor would operate at a high load while the jet plow advances and the cable embedment takes place. As the jet plow reaches the cable barge the compressor would be reduced to a moderate load while the cable barge is repositioned, after which the jet plowing would resume and the compressor would operate once again at a high load. This cycling would continue until the cable installation is completed, at which time the compressor would be shut off.
	Crane	400	Sheet pile removal	2	10	20	The crane engine will be operated at a moderate load to position itself to the cofferdam, be operated at a high load to lift the sheet pile from the sediments and then be throttled back to a moderate load to re-position if necessary. The crane engine will then idle until it is time to remove the next sheet pile.
	Crane barge	400	Cofferdam backfill	2	10	20	The crane engine will be operated at a moderate load to position itself to the cofferdam, be operated at a high load to lift and place the clean fill into the cofferdam and then be throttled back to a moderate load to reposition if necessary. The crane engine will then idle until it is time to install additional fill, after which it would be shut down.
Scour Protection Installation	Crane	400	Install rock armor	65	8	520	The crane engine will be operated at a moderate load to position itself to the rock armor, be operated at a high load to lift the rock armor from the barge and then be throttled back to a moderate load to move it into position. The crane engine will then idle until it is time to install additional rock armor. The crane engine will then be shut down to be moved to the next location.
	Crane	400	Install filler material	65	8	520	The crane engine will be operated at a moderate load to position itself to the filler material, be operated at a high load to lift the filler material from the barge and then be throttled back to a moderate load to move it into position. This process will be repeated until completion. Upon completion, the crane will idle until it is time to install the rock armor material.
ESP Installation	Crane	3,000	Setting template	1	16	16	The crane engine will be operated at a moderate load to position itself to the platform jacket assembly, be operated at a high load to lift the platform jacket assembly from the barge and then be throttled back to a moderate load to move it into position. The crane engine will then idle until it is time to set the piles. The process will then be repeated for the superstructure installation and then the crane engine will be shut down.
	Crane	3,000	Pile setting	6	3	18	The crane engine will be operated at a moderate load to position itself to the pile, be operated at a high load to lift the pile from the barge and then throttle back to a moderate load to move it into position. The crane engine will then idle until it is time to set the next pile. This process will be repeated until all six piles are set. The crane will then idle until it is time to install the superstructure.
	Hydraulic ram	3,000	Pile driving	6	2	12	The hydraulic ram engine will be started, and will idle until the pile is in position. It will then alternate between idle and a high load until the pile is installed into the pile sleeve. This process will be repeated until all six piles are installed and then the engine will be shut down.