REPORT ON THE DETERMINATION OF UNACCEPTABLE RISK TO NATIONAL SECURITY FROM A PROPOSED COMMERCIAL WIND TURBINE PROJECT IN THE VICINITY OF NAVAL AIR STATION PATUXENT RIVER AND THE ATLANTIC TEST RANGE

Pursuant to Section 358(e)(3) of the
Ike Skelton National Defense Authorization Act For Fiscal Year 2011
(Public Law 111-383)

Office of the Under Secretary of Defense
for Acquisition, Technology, and Logistics

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The estimated cost of report or study for the Department of Defense
is approximately $17,000 in Fiscal Year 2015.
This includes $12,000 in expenses and $5,360 in DoD labor. RefID: A-CDA1F8B

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Requirement for This Report

Section 358(e)(3) of the Ike Skelton National Defense Authorization Act for Fiscal Year 2011, as amended (Public Law 111-383), requires the Secretary of Defense to notify the congressional defense committees within 30 days on determination that a renewable energy project would result in an unacceptable risk to the national security of the United States. The report shall include:

- An explanation of the operational impact that led to the determination,
- A discussion of the mitigation options considered, and
- An explanation of why the mitigation options were not feasible or did not resolve the conflict.

Defense Objection Raised

On October 30, 2014, the Deputy Secretary of Defense notified the Secretary of Transportation of the Department's objection to the Great Bay Wind Energy Center (GBWEC) project proposed by Pioneer Green Energy (applicant) to be located in Somerset County, Maryland, and in the vicinity of Naval Air Station Patuxent River (NAS Patuxent River) and the Atlantic Test Range (ATR).

The Deputy Secretary of Defense determined that the proposed project, even as it may have been modified by the applicant after mitigation discussions, would constitute an unacceptable risk to the national security of the United States[1] because it would significantly impair or degrade the capability of the Department of Defense (DoD) to conduct research, development, testing and evaluation (RDT&E) and operations, and to maintain military readiness. This project has an unacceptable impact on the Department's ability to characterize the survivability of DoD's advanced airborne weapons systems. Because the applicant unilaterally requested the Federal Aviation Administration (FAA) issue a determination of no hazard[2] before DoD and the applicant could reach a mutually acceptable mitigation agreement, should the project be constructed it would ultimately place our armed forces at greater risk when they go in harm's way.

The Department strongly supports the development of clean energy projects, and is more than willing to re-open discussions with the applicant. In this case, however, any mitigation agreement must be informed by ongoing technical studies. The formal request by the applicant for a final Determination of No Hazard, without mitigating the unacceptable risk, has put the Department in the position of having to formally object to the project.

[1] As defined in section 358(e)(2) of Public Law 111-383 and further defined in Title 32 Code of Federal Regulations § 211.3 (32 CFR 211).
[2] Letter between the Vice President, Great Bay Wind I, LLC, and the FAA's New England Regional Office, dated August 26, 2014.

Background

NAS Patuxent River is one of the Navy's two hubs for naval aviation and weapons systems RDT&E and in-service aviation systems support and hosts the ATR. The ATR is a fully-instrumented and integrated test range that provides aviation systems testing support from initial research to end-of-service-life. This support includes the RDT&E of aircraft, integrated avionics, and mission systems at NAS Patuxent River, including the ATR. This test infrastructure is a crucial element of DoD's Major Range and Test Facility Base (MRTFB). The MRTFB is the core set of DoD Test and Evaluation (T&E) infrastructure that is maintained as a national asset to provide T&E capabilities to support the DoD acquisition system and other users such as government agencies, state and local governments, allied foreign governments, and commercial entities.

The Advanced Dynamic Aircraft Measurement System (ADAMS), as a capability under the MRTFB, is a unique open-air dynamic Radar Cross Section (RCS) measurement facility used to measure the RCS of airborne aircraft and missiles. ADAMS supports all of the Military Departments, other Federal government agencies, and Coalition partner nations. It cannot be feasibly separated from the other RDT&E capabilities that constitute the ATR. One of the ATR's vital missions is to determine what aircraft and various counter-measures look like to enemy radars while in the air by conducting measurements using the ADAMS facility. These determinations, and the resulting aircraft survivability assessments, have life or death consequences for fleet aviators and all joint service Warfighters.

The ADAMS testing is a critical and well integrated component of the mission at the ATR and is required in order to evaluate the signature characteristics of DoD manned and unmanned aircraft and missiles. The ADAMS operates across a broad frequency spectrum (from 150 MHz to 35 GHz), which enables the measurement of the RCS of targets that range in size from hand-launched unmanned aerial systems (UAS) to large maneuvering aircraft. Unlike tracking radars, whose primary mission is to track an aircraft and missiles in flight, the ADAMS is a high-precision instrumentation radar based system specifically designed to perform calibrated Radio Frequency (RF) signature measurements of targets in-flight. The data collected are used to assess the ability of enemy radars and other threat systems to detect and track DoD and Coalition aircraft. ADAMS capability allows for precise and efficient gathering of flight test information used to assess the survivability of aircraft, and is critical to the development of ingress and egress routes by classified mission planning systems in wartime.

The ADAMS measurement capabilities include:

- Aircraft Radar Cross Section analysis;
- Doppler-based phenomenology, such as jet engine modulation, jet engine rotor blade modulation, and wide band imaging;
- Jammer-to-skin and decoy assessments; and
- Chaff cloud size and bloom rates.

Although indoor RCS facilities exist within DoD, these facilities are not capable of providing the fidelity of in-flight data collected by ADAMS in a dynamic and operationally

realistic environment with platforms using functioning on-board systems. The resulting measurements are critical to aircraft survivability and provide DoD with the decision-quality data needed to assess if major weapon system acquisition programs are meeting defined performance requirements for RCS and to support related system developments. They are essential for the measurement of operational aircraft RCS stability over time, and have been used to evaluate the effects of depot level maintenance on the signature characteristics of F/A-18 E/F aircraft. The ADAMS also provides a flexible facility for testing and measuring other radar phenomenology, benefiting both the Non-Cooperative Target Recognition community, and the Science and Technology community.

Operational Impact

The rotating components of wind turbines induce a Doppler[3] shift to RF energy, which can degrade the operational capabilities of radar based systems. To validate its own in-house findings regarding the Doppler shift impact to the ADAMS radar-based system, the Navy sponsored a study by the Massachusetts Institute of Technology's Lincoln Laboratory (MIT-LL). This study confirmed that the ADAMS radar system would be significantly affected by wind turbines within its line of sight (LOS)[4, 5]. Wind turbines in Somerset County, such as those proposed by the applicant will degrade ADAMS performance to a level where aircraft, and other systems under test, cannot be accurately measured. This means that data to support systems acquisition and operational RF signature assessments would not be able to be obtained using ADAMS.

ADAMS has supported major weapons system acquisition program developmental and operational testing, including:

- U.S. Navy: F-35C, F/A-18E/F, EA-18G, E-2C, E-2D, MH-53, P-3C, and T-38;
- U.S. Air Force: F-15, F-16, A-10, AC-130, KC-135, KC-10, and C-17;
- U.S. Marine Corps: F-35B, AH-1Z, and UH-1Y;
- U.S. UAS: RQ-4A Global Hawk (Air Force), MQ-1C Gray Eagle (Army);
- Royal Australian Air Force: F/A-18E/F;
- Royal Canadian Air Force: CC-130J; and,
- Danish Air Force: F-16.

Demand for the ADAMS has steadily grown in recent years with DoD's increased reliance upon measuring the RCS characteristics of advanced aircraft. For each new production lot of F-35B/C and F/A-18E/F delivered to the government, sample aircraft will be tested by ADAMS to measure and validate signature performance and stability. The Navy has developed

[3] The Doppler shift is the change in frequency observed by a sensor (e.g. a radar receiver) due to movement (e.g. spinning turbine blades) relative to the frequency source (e.g. a radar transmitter).
[4] Wind Energy Impacts to ADAMS Radar, Analysis Summary, Massachusetts Institute of Technology, Lincoln Laboratory, June 18, 2012.
[5] Line of sight: the *line* between two points; specifically, the straight path between a transmitting antenna and a receiving antenna when unobstructed by the horizon.

a signature management plan for these platforms that will monitor RCS stability over time and which will require ADAMS support throughout the weapon system's life cycle. New weapons systems, such as the MH-47 and MH-60M, regularly add to existing workload.

From a strategic perspective, any limits to ADAMS measurement capability or capacity constitute a risk to the national security of the United States. The limits that would be imposed by the proposed Great Bay wind turbine project constitute an unacceptable risk to the national security of the United States.

Mitigation Options Considered

In December 2012, the applicant submitted a proposal for 40 turbines to the FAA for review in accordance with the Obstruction Evaluation/Airport Airspace Analysis process. The 40 turbines presented a vertical height obstruction up to 528 feet Above Ground Level (AGL), as measured to the maximum height of the blade tip. In October 2013, the applicant revised the proposed number of turbines to 29 and increased the blade tip height to 599 feet AGL. In November 2013, the applicant confirmed a height restriction of 600 feet AGL for ongoing mitigation discussions but requested the flexibility in the discussions to explore turbine heights up to 700 feet AGL.

As proposed, all of the 29 turbine locations are in the ADAMS LOS, as shown in Figure 1. The contour lines on the figure at various locations show the maximum tolerable height measured to the maximum sweep of the blade for the turbines to be below the ADAMS LOS. For example, for the turbine location nearest NAS Patuxent River, the maximum height of the turbine would have to be less than 341 feet AGL to be below the radar LOS. For the turbine location farthest from NAS Patuxent River, the maximum height would have to be less than 474 feet AGL. These acceptable heights are well below the GBWEC proposed blade tip heights.

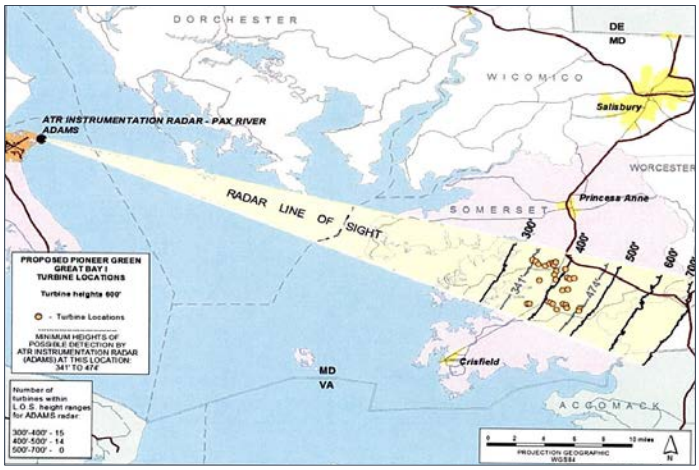

Figure 1: GBWEC Proposed Site

The fact that the GBWEC development would result in wind turbines being within the ADAMS LOS served as the basis for discussions of potential mitigation options between the Navy and the applicant. To fully support the intent of 32 CFR 211, the Navy conducted

extensive studies and analyses with its in-house engineering experts, and independent studies by MIT-LL, to evaluate technical solutions to mitigate the Doppler effects of spinning turbines.

The MIT-LL study conducted in 2012 (the Phase 0 study) confirmed Navy findings that turbines constructed within the ADAMS LOS would significantly degrade ADAMS performance to levels incompatible with supporting mission requirements. The study also provided an assessment of wind turbine impacts to the ADAMS and identified several technical, but as yet un-proven, mitigation options. A subsequent Phase I study by MIT-LL, completed on April 30, 2014, provided a preliminary evaluation of the most promising technical mitigation options identified in the Phase 0 study. Currently, MIT-LL is conducting preliminary design work and fabricating prototype hardware and software solutions associated with the mitigations that showed the highest potential for success in Phase I. The MIT-LL Phase II study is planned to be completed in December 2015.

The following is a brief synopsis of mitigation options that were discussed by the Navy and the applicant:

Modifications to Test Operations:

The Navy analyzed varying aircraft flight profiles so that ADAMS antennas would point away from wind turbines during testing. The analysis found this change would not mitigate data degradation because wind turbines would still be present in the ADAMS sidelobes[6]. Further, there is not sufficient special use airspace to accommodate flight profiles outside of the current area, particularly given aircraft safety and effects on civilian populations. Modifications to ADAMS operations were therefore evaluated as not effective in mitigating wind turbine impacts.

Modification to ADAMS Hardware and Software:

The MIT-LL Phase 0 study identified several potential technical modifications to ADAMS that may, to some degree, mitigate wind turbine impacts. The mitigations identified by MIT-LL include the installation of an RF clutter fence, relocation of the ADAMS radar, RF sidelobe cancellation, waveform modifications, signal processing upgrades, and turbine relocation. The mitigation options are unproven and must be combined in order to reduce wind turbine interference to a level that would allow measurements to take place with wind turbines in the ADAMS LOS. They also carry high technical risk to ADAMS performance and in the case of the RF clutter fence, are potentially fiscally prohibitive, and would require extensive Chesapeake Bay environmental analysis.

[6] Radar RF energy returns are detected in several areas or lobes relative to the direction in which the antenna is facing—the main lobe. Side lobes are those in which the RF energy is less than the RF energy main lobe but still a major contributor to the overall signal detected.

Radio Frequency Clutter Fence:

A RF clutter fence (a physical obstruction to block RF energy from reaching a radar receiver) would theoretically block reflected energy from wind turbines from reaching the ADAMS antennas. This is a high risk proposal given that:

- It would also cause ADAMS to lose surface measurement capability and would require relocation of ADAMS antennae;
- Preliminary study results indicate that this option may not be technically feasible due to multipath effects on RF energy caused by the clutter fence itself; and,
- The cost of constructing the RF clutter fence and relocating ADAMS is estimated to be between $50 million and $100 million, and would require extensive environmental analysis.

Given these factors, further study of RF clutter fence mitigation was suspended.

Relocation of the ADAMS Radar:

ADAMS is a system within a system and is integrated with the other instrumentation systems at the ATR. ADAMS dynamic RCS measurements are supported by precision tracking radars, instrumentation, airspace, and other infrastructure at the ATR. Any location at NAS Patuxent River which would allow for the operation of aircraft systems and ADAMS will be susceptible to radar degradation by the GBWEC turbines; therefore, the only relocation option would be to move ADAMS to another location. Comparable RDT&E-compatible infrastructure elsewhere does not exist. Relocation of ADAMS without the necessary complimentary resources would not be feasible or affordable and would jeopardize the provision of data to both acquisition managers and other range customers.

Relocation of this capability was evaluated as being not feasible or affordable.

RF Sidelobe Cancellation:

The use of RF sidelobe cancellation techniques requires a significant redesign of the ADAMS receiver system and carries the risk of increasing the measurement uncertainty of the ADAMS data product. Further, it increases the complexity of the radar system and significantly increases the annual operations and maintenance costs for the ADAMS system. MIT-LL is currently investigating this mitigation option in its Phase II study. If these technical challenges can be successfully addressed, full implementation of this option will take up to two years and cost approximately $4 to $7 million.

Waveform Modifications and Signal Processing Upgrades:

The effectiveness of modifying the ADAMS radiated RF waveforms (e.g., frequency, pulse characteristics, etc.) is unknown, as are the signal processing impacts that would potentially impair ADAMS real-time and post-mission processing capabilities. MIT-LL is currently investigating this mitigation option in its Phase II study. If these technical challenges

can be successfully addressed, full implementation of this option will take up to five years and cost approximately $20 to $25 million.

Turbine Relocation:

The Department determined that relocating the project an average distance of nine miles from the proposed site would eliminate the Doppler impact to the ADAMS. Placing wind turbines outside the LOS was determined to be the most feasible mitigation option, especially from a technical perspective, and was preferred by DoD. However, during formal mitigation discussions, the applicant stated that this mitigation option was not feasible since their proposed location was chosen based upon proximity to the electric power grid.

Reduction in Turbine Height:

Wind turbine blade tips that are below the ADAMS LOS of the radar system would have negligible impact on ADAMS operation. As stated earlier, the tips of the turbine blades would need to remain below elevations of 341 to 474 feet (dependent upon each turbine's individual LOS distance to ADAMS) to be under the ADAMS LOS. The applicant stated that this mitigation option was not feasible since it would impact its ability to optimize wind resources and, as a result, would have an impact on the project's economics. Reducing the maximum height of the wind turbines to an elevation below the ADAMS LOS profile would mitigate the interference to the ADAMS.

Wind Turbine Project Curtailment:

The Navy has actively engaged in discussions with the applicant ever since becoming aware of the proposed GBWEC project in 2011. The Navy established a formal working group with the applicant in June 2013, and the DoD Siting Clearinghouse established a Mitigation Response Team (MRT) on July 3, 2013. Discussions with the applicant focused largely on curtailment of wind turbine operations.

Why the mitigation options were not feasible or did not resolve the conflict

Mitigating wind turbine impacts to the ADAMS system is a complex challenge. The most feasible and affordable solutions from a DoD perspective are to keep turbines out of the ADAMS LOS by either reducing their height or moving the turbine locations. The applicant has stated that these options are unacceptable as they would have an impact on the project's economics and schedule.

Initially, the Navy considered curtailment as a short-term mitigation measure to bridge the time necessary to study and implement effective, long-term technical mitigation measures. However, in the spring of 2014, the Navy determined that the number of curtailment hours contemplated at that time in discussions with the developer were insufficient to meet the expected workload for FYs 2016 through 2020. Moreover, the Navy recognized that it will not be able to fully assess the feasibility and affordability of long-term technical mitigations until the

completion of the MIT/LL Phase II study. Therefore, the Department concluded that execution of a mitigation agreement based exclusively on curtailment was not viable even as a bridge to development of long-term mitigation measures. The Department's ability to enter into any mitigation agreement with the developer is dependent on completion of the MIT/LL Phase II study.

Technical solutions that are both feasible and affordable and can also be implemented soon enough to meet the GBWEC project schedule while also allowing continuation of ADAMS operation are not available at the current time. MIT-LL has evaluated numerous possible technical solutions, all of which carry significant technical risk and cost. The most promising technical solutions are currently being evaluated by MIT-LL in their Phase II study. The Phase II study is planned to be completed by December 2015 and includes extensive hardware and waveform prototyping and testing to validate system performance.

Conclusion

Absent effective mitigation, wind turbines constructed within the ADAMS LOS will prevent DoD from performing the ADAMS RDT&E mission conducted at NAS Patuxent River. As a result, DoD would be unable to characterize aircraft survivability, causing increased risk to the Warfighter and constraining operational decision makers due to inadequate knowledge of aircraft signatures. The formal request by the applicant to the FAA for a Determination of No Hazard on August 26, 2014, without mitigating the unacceptable risk, has put the Department in the position of having to formally object to the project.

Thus, after extensive deliberation, the Deputy Secretary of Defense determined, on October 30, 2014, that the proposed GBWEC project, as it may have been modified by the applicant after mitigation discussions, would result in an unacceptable risk to the national security of the United States because it would unacceptably impair or degrade the capability of DoD to conduct RDT&E, and to maintain military readiness. Construction of this project in Somerset County, Maryland, would ultimately result in unacceptable risk to national security.