COMMONWEALTH of VIRGINIA

Office of the Governor
P.O. Box 1475
Richmond, Virginia 23218

July 14, 2010

Mr. Jacques Beaudry-Losique
Program Manager, Wind and Power Program
Offices of Energy Efficiency and Renewable Energy
U.S. Department of Energy
1000 Independence Ave., SW
Washington, DC 20585

RE: Request for Information DE-FOA-EE0000385

Dear Mr. Beaudry-Losique:

On behalf of Governor McDonnell, thank you for the opportunity to respond to the Department of Energy's offshore wind Advanced Technology Demonstration Projects Request for Information. A broad group of public and private offshore wind stakeholders in Virginia are working to develop a new offshore wind power industry in Virginia and elsewhere along the Atlantic Coast.

Virginia stakeholders are engaged in a number of efforts that, in partnership with the Department of Energy's offshore wind program, can support establishment of this new industry.

- Virginia is working with the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEM) to start the leasing process for offshore wind development off of our coast.
- Industry and public stakeholders, under leadership of the Virginia Offshore Wind Coalition, are working to develop a National Offshore Wind Test Center and Advanced Technology Demonstration Program.

- The Commonwealth, under legislation enacted this year, has formed the Virginia Offshore Wind Development Authority to support development of offshore wind power in the state.
- Virginia has joined with nine other Atlantic states and the BOEM to form the Atlantic Offshore Wind Energy Consortium.
- The Virginia Coastal Energy Research Consortium has completed substantial study of the offshore wind energy potential, finding that we have a strong potential with Class 6 winds, water depths under 30 meters, and ready access to the high-voltage electric transmission grid.
- The Virginia Marine Resources Commission has completed a study of the potential of state waters for offshore energy development.

Virginia's offshore wind stakeholders have developed the enclosed response to your Request for Information outlining how the Department of Energy can work with us to substantially expand the industry in the mid Atlantic. The comments provide some specific examples of where the Department of Energy could prioritize its resources to hasten the development of this industry. Virginia stakeholders will also be submitting individual comments.

I encourage the Department of Energy to consider these comments carefully and to work with Virginia's offshore wind stakeholders to advance this industry.

Sincerely,

Maureen Riley Matsen
Deputy Secretary of Natural Resources
Senior Advisor to the Governor on Energy

cc: The Honorable Bill Bolling, Lieutenant Governor of Virginia
Ms. Ann Flandermeyer, Virginia Offshore Wind Coalition

National Offshore Wind Test Center and Advanced Technology Demonstration Program

Virginia's Capstone Response to Request for Information DE-FOA-EE0000385
"DOE Offshore Wind Program – Input Requested for Demonstration Projects"

July 14, 2010

There is an urgent need for a full-scale advanced technology demonstration program focused on offshore wind engineering and operational issues associated with fixed turbines designed for shallow and intermediate water depths in the Atlantic Ocean and Gulf of Mexico. With the U.S. Department of Defense as a large potential customer and intensive ocean user in these waters, there should be a particular focus on advanced technologies that will ensure the compatibility of offshore wind development with national security and military preparedness.

Virginia is well positioned to leverage the activities of ongoing and future complementary programs, resources, and diverse funding opportunities and to join with the Department of Energy and neighboring states in leading the development and operation of an Advanced Technology Demonstration Program with such a focus, ultimately leading to establishment of an accredited National Offshore Wind Test Center (NOWTC). The Department of Energy should support such a comprehensive effort with technical and financial resources.

This document is Virginia's capstone response to the Department's Request for Information and has been collectively developed by representatives from our diverse offshore wind community. Many stakeholders in Virginia and outside our state have reviewed and agreed to be associated with this response. Some have contributed comments to this capstone document and others are submitting their own individual responses to the RFI. A list of stakeholders who support Virginia's submittal is provided at the end of this document.

Why an Offshore Focus on Shallow and Intermediate Water Depths is Needed

To date, the Department of Energy (DOE) has committed nearly $40 million to the development of a deep-water ocean test center for floating offshore wind turbines in the Gulf of Maine. The National Renewable Energy Laboratory has estimated a total offshore wind potential installed capacity of 237 gigawatts (GW) in water depths greater than 60 m among the three states that border the Gulf of Maine (ME, NH, and MA). These three states account for just 3.5% of the U.S. Gross Domestic Product (USGDP).

By comparison, nine coastal states (NC, VA, MD, DE, NJ, NY, CT, RI, and MA) bordering the Mid-Atlantic Bight from Cape Hatteras to Cape Cod, produce 24.4% of the USGDP and have cable's length access to an aggregate offshore wind potential of 489 GW in water depths of 60 m or less. With fixed offshore wind turbines much closer to maturity for commercial application in the U.S., and with more than twice the potential as compared with the Gulf of Maine deep water resource, DOE should commit at least comparable funding to a demonstration program and test center for fixed offshore wind turbines suited to the shallower-water resources of the Atlantic Ocean and Gulf of Mexico. Hampton Roads is uniquely positioned to host such a facility.

There are at least six major issues faced by shallow- and intermediate-depth fixed offshore wind turbines in the Atlantic Ocean and Gulf of Mexico, and these are briefly described in the six paragraphs below. Full-scale demonstration of advanced technologies that resolve these issues would eliminate real barriers to commercial development and lead to cost-effective projects in several nationally important markets, including Texas, the Southeast, and the Mid-Atlantic.

(1) Increasing Rotor Swept Area per Unit Generator Capacity: While 3- to 5-MW offshore wind turbines and fixed foundation types suitable for water depths of 60 m or less have been commercially deployed or demonstrated at full scale in Europe, their rotors are undersized for optimal cost-effectiveness in the Mid-Atlantic and Southeast, where annual average offshore wind speeds are 8 to 8.5 m/sec at hub height, as compared with 9 to 9.5 m/sec in the North Sea.

(2) Safe Operation and Survivability in Tropical Storms: European offshore wind turbine design standards have not needed to consider the structural and operating safety impacts of encountering tropical storms and hurricanes, with rapidly reversing wind directions and the associated high probability that grid power will not be available to control rotor yaw under these conditions. This issue is particularly important when considering the above requirement for larger-diameter rotors. While testing of longer blades can occur at a soon-to-be-completed facility in Massachusetts, measurement *and accurate design simulation* of overall rotor response to combined wind and wave loading under a variety of scenarios (including loss of grid power) requires a complete grid-interconnected, operational turbine and foundation system.

(3) Qualification of New Technologies in Staged Demonstration Test Pads: Cost modeling by the Virginia Coastal Energy Research Consortium indicates that having a domestic source of turbine supply would decrease the cost of offshore wind energy by 1.5 cents per kilowatt-hour. Ideally, an advanced technology demonstration program would qualify full-scale components to be supplied by U.S. companies by testing them in a staged series of test pads graduating from land-based access close to industrial infrastructure in mild wind and wave conditions all the way to remote access in truly oceanic conditions and water depths at farther offshore distances.

(4) Innovative Installation Procedures and Foundations: European offshore wind projects have been installed using methods directly derived from their land-based predecessors, whereby tower sections and rotor-nacelle assemblies are bolted together in sequential crane lifts onto an above-water foundation. High levels of European government subsidy enable such support structures and installation methods to remain commercially viable, and so provide little incentive for offshore-specific innovations. European-scale financial incentives are unlikely in the U.S., which must lower capital costs by demonstrating fixed turbine designs, support structures, and installation methods specifically developed for shallow and intermediate water depths.

(5) Avian Interaction with Large Oceanic Wind Turbines: Of all the world's avian migratory corridors, the Atlantic Flyway supports one of the largest near shore movement corridors of birds in the world including many declining species of conservation concern. Monitoring of flight and foraging behavior before and after large turbine installation is needed in oceanic settings.

(6) Compatibility with National Security and Military Preparedness: Eastern states must demonstrate the compatibility of commercial offshore wind development with national security and military preparedness. This is of particular concern in the vast complex of offshore training and testing ranges known as the Virginia Capes Operating Area (VACAPES), which extends from Cape Henlopen, Delaware to Cape Hatteras, North Carolina.

When considering potential benefits to national security, offshore wind power represents the single largest renewable energy resource available to Department of Defense (DOD) facilities on the U.S. Eastern Seaboard, and has particularly great potential for the U.S. Navy to meet DOD's goal of 25% renewable energy by 2025 and the Secretary of the Navy's even more ambitious renewable energy target for shore installations of 50% by 2020.

In considering potential risks to national security, the DOD, Coast Guard, and Federal Aviation Administration have significant concerns about radar interference, and this is proving to be a market barrier to large land-based wind projects as well. *Although a variety of mitigation measures have been proposed, these have not yet been demonstrated with full-scale turbines in an operational multi-radar environment*. Related to Issues (2) and (3), above, excessive repair activities (such as wholesale gearbox replacement as has occurred in several European offshore wind projects) or unscheduled maintenance (due to failure of remote condition-monitoring systems) could create conflict with the scheduling of military testing and training activities in VACAPES and other Atlantic training ranges.

What a National Offshore Wind Test Center (NOWTC) Should Do

In conjunction with an Advanced Technology Demonstration Program, the United States needs a National Offshore Wind Test Center ("NOWTC") similar to the National Wind Test Center for land-based wind turbines in Boulder, Colorado (www.nrel.gov/wind/facilities_test_pads.html). In addition to offshore wind turbine certification, the NOWTC also would support advanced technology demonstration projects to address the issues described above.

The NOWTC would perform accredited testing of the following technologies:

- Hydrodynamic and aerodynamic response measurements and to validate coupled numerical models for "wind to wire" simulations, encompassing:
    - Turbine performance verification (output vs. wind speed curve), as required for project financing
    - Electric power quality verification, as required for project interconnection to the utility transmission system
    - Rotor structural response verification and turbine survival in hurricane-dominated extreme wind and wave conditions, as required for project insurance underwriting
- Structural stress and strain measurement and monitoring fatigue of rotor blades
- Measuring structural vibration and dynamic response behavior, including soil-structure-interaction effects, long-term foundation stability monitoring and remediation
- Drive train reliability and corrosion control
- Safety and accessibility for offshore inspection, maintenance, and repair
- Underwater acoustic and electro-magnetic emissions
- Turbine control and survivability in rapidly reversing wind fields associated with tropical storms and hurricanes
- Full-scale Doppler and radar signature measurements for input to offshore project radar interaction simulation models, to determine appropriate mitigation measures for air traffic control and strategic defense radars, such as exists at NAS Oceana in Virginia Beach
- Turbine interactions with tactical radars on aircraft and surface vessels, to determine effects on navigation, hazard avoidance, search and rescue, weapons targeting, etc.
- Before and after monitoring of bird and bat behavior in vicinity of turbine test pads, using marine radar, acoustic, and thermal imaging technologies
- Low-stress warning systems for redirecting birds and bats away from turbine rotors

Advanced technology demonstration projects should leverage the substantial funds that DOE has committed for a full-scale drive train test facility of 5- to 15-megawatt capacity in Charleston, South Carolina, and a blade test facility in Massachusetts capable of statically and dynamically loading individual blades up to 90 meters in length. Full-turbine demonstrations of advanced technologies should be accomplished using blades and drive trains that have been previously certified by these facilities, but which remain to be proven in a complete grid-interconnected, operational turbine and foundation system when subjected to combined wind and wave loading under a variety of scenarios (including loss of grid power). Advanced technology demonstration projects must have the same third-party accreditation as these DOE-funded facilities in South Carolina and Massachusetts. Such accredited testing would provide the basis for type-certifying offshore wind turbines in a full range of meteorological, oceanographic, and soils conditions. DOE should prioritize its resources to support such *total turbine testing in actual offshore sites*.

Potential NOWTC Facilities in the Hampton Roads Region of Virginia

The NOWTC would consist of three stages of testing facilities: inshore, nearshore, and offshore. Each stage would enable full-scale field trials in areas that offer, progressively more energetic wind climates, and more challenging conditions for turbine access, as described below.

> <u>Stage I: Inshore</u>
> This stage would have test pads for offshore wind turbines in Class 3 and Class 4 wind regimes that would be in relatively shallow waters (<10 m deep) accessible by land, for ready access close to potential manufacturing locations, via vehicle or pedestrian bridge. Extreme wave conditions would be relatively mild. Our initial screening has identified two promising sites for these inshore test pads, as shown in Figure 1 on the next page.
>
> <u>Stage II: Nearshore</u>
> The NOWTC second stage would have nearshore test pads to be installed in Class 4 and Class 5 wind regimes, also in relatively shallow (<10 m deep) waters, but in a much more oceanic environment in terms of extreme wave exposure. A promising region for these test pads is in the vicinity of the Chesapeake Bay Bridge Tunnel, between the fourth island and the North Channel bridge span, as is shown in Figure 2. One pad might be accessible by vehicle and pedestrian bridge and the other pad(s) would be accessible by boat or helicopter, enabling demonstration of advanced offshore access systems. Before any fixed test pads would be developed, a mobile test turbine would be deployed, which can be readily relocated in the event any unacceptable avian interactions are observed.
>
> <u>Stage III: Offshore</u>
> The NOWTC third stage would be located in a Class 6 wind regime, in federal waters, installed under a Section 238 research lease within LIDAR range of the Chesapeake Light Tower, in water depths of 20 m. Test turbines in these locations could involve innovative “float and flip” installation on pre-installed pads that enable pre-assembled turbine-tower units to be rapidly replaced. This is an important advanced technology to demonstrate for minimizing turbine downtime due to major forced outages that require the recovery of failed turbines to shore and repowering or decommissioning of projects.

The NOWTC would provide all required infrastructure including fixed test pad foundations and moveable fixed platforms, utility grid-interconnection, test equipment and SCADA systems, and land-based support services. Each turbine certification and advanced technology demonstration activity would be organized under a private-public partnership between the NOWTC and the turbine supplier or advanced technology developer.

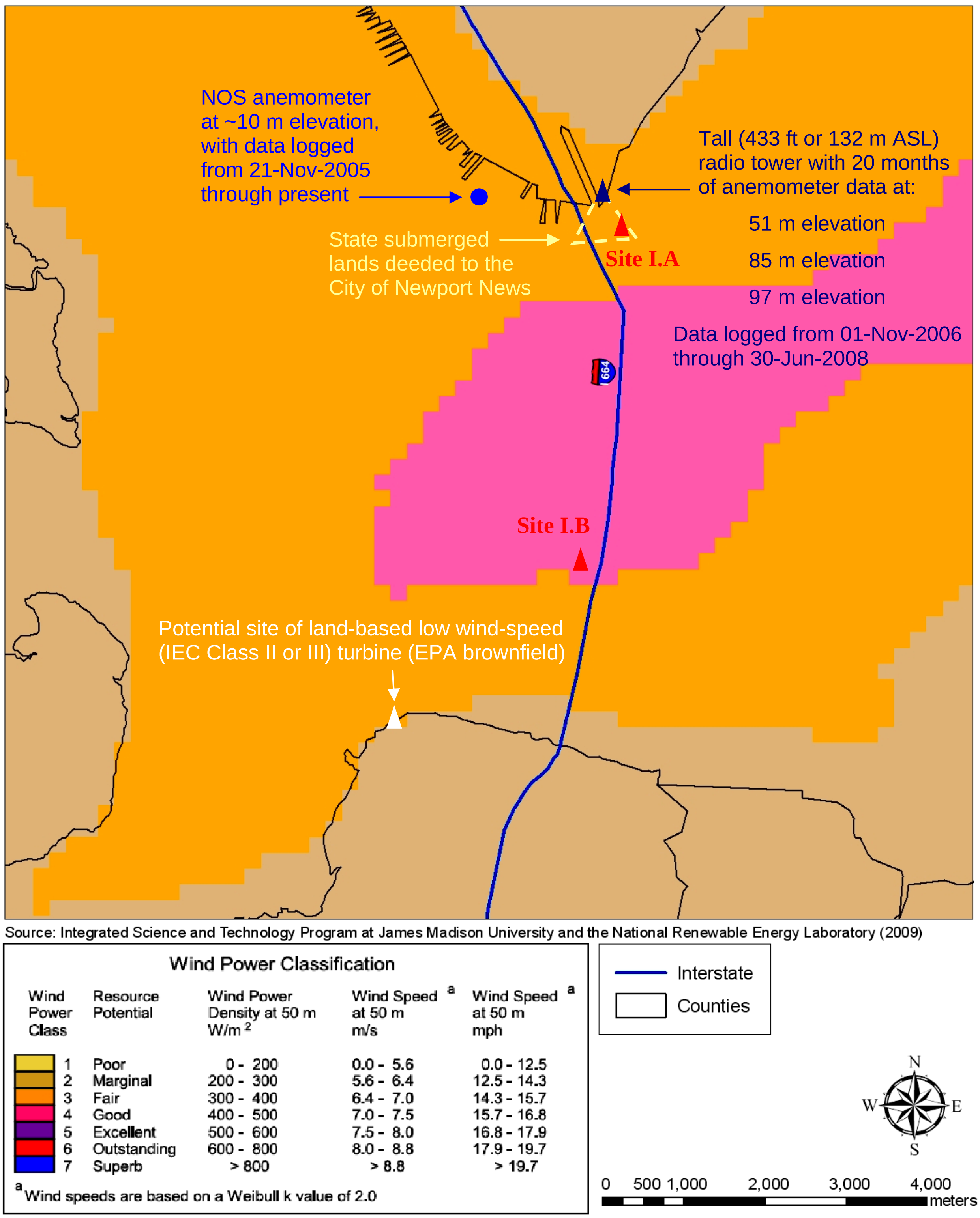

FIGURE 1. Virginia Wind Map view of potential Stage I test pad sites by the Monitor-Merrimac Memorial Bridge-Tunnel crossing of the James River. Site I.A has Class 3 winds and may be accessed by walkway along the Newport News Harbor wave screen. Site I.B has Class 4 winds and may involve Virginia Department of Transportation construction of a “turn-out” off the southbound bridge span. A potential land-based “Stage 0” test pad could be sited between Class 2 and Class 3 winds at the shoreline of the former Nansemond Ordnance Depot, and might be able to attract “brownfield” development funding from the Environmental Protection Agency.

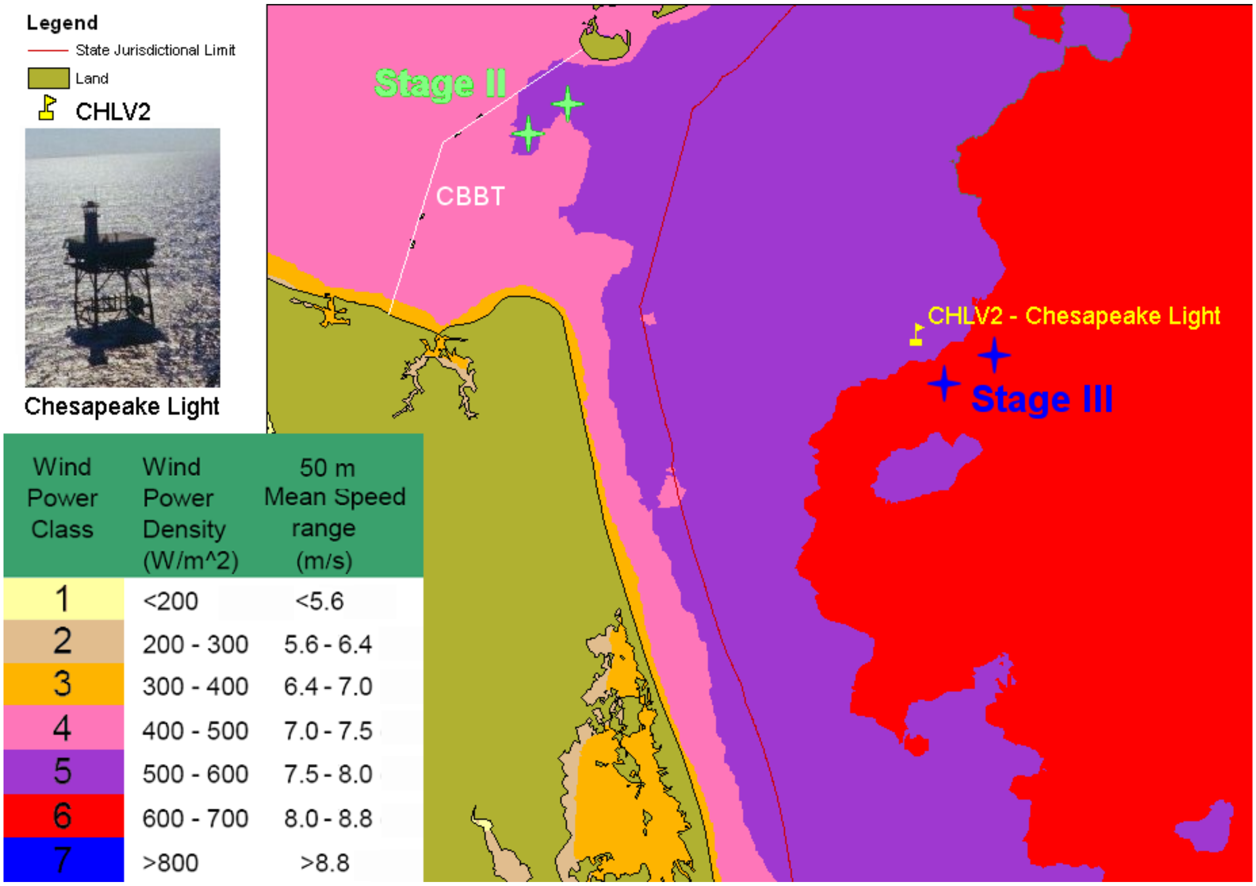

FIGURE 2. Potential Stage II test pad sites are indicated by light green cross symbols due east of the northern span of the Chesapeake Bay Bridge Tunnel (CBBT). Development at this stage would be subject to preliminary and temporary installation of a mobile test turbine to optimize fixed pad locations relative to avian flight paths along the CBBT. Potential Stage III test pad sites are indicated by blue cross symbols by the Chesapeake Light (CHLV2) and would also be subject to preliminary trials of a mobile test turbine before any fixed pads would be developed. VCERC already has held screening meetings with air operations teams from Naval Air Station Norfolk (Chambers Field) and Norfolk International Airport, which suggest that the potential test pad sites mapped above do not appear to have any aviation safety conflicts with their operations, pending formal review by the FAA and a more detailed development plan, and provided that the top rotation of rotor blade tips remains below 500 feet (153 m) above sea level (ASL). Thus, a turbine with a 120-meter diameter rotor could be safely installed at a hub height of 90 m ASL.

In addition to its stable and robust shipbuilding and ship repair industrial base from which to grow and retool the fabrication of offshore wind foundation structures and towers, as well as large steel parts for the rotor-nacelle-assembly, the Hampton Roads region of Virginia has many commercially available large-area sites with railhead access and deep-draft quays on protected waters with close ocean access for turbine assembly and staging of support structures, which are well suited to wind turbine companies for establishing manufacturing facilities. They would well benefit from being able to qualify their first- and second-tier supply chain vendors on nearby Stage I turbines that can be readily accessed by land under the same state legal regime as governs their manufacturing operations. This ultimately provides an ideal setting for private-public partnership to create sustainable financing of the NOWTC.

Cost sharing requirements will be a key factor in financing advanced technology demonstration projects. We estimate that the total cost for the NOWTC as described herein might be in the range of $12 million to $16 million per year over a five-year period, for a total of $60-80 million. For advanced technology demonstration projects with nationwide scope, such as outlined herein, we believe that a non-federal cost share requirement of 30% to 50% might be appropriate. For awards that would simply subsidize a small commercial project (*e.g.*, the Deepwater Wind array off Block Island, RI), with limited nationwide benefit, a non-federal cost-share requirement of 80% to 85% would be more appropriate.

Virginia's Collaborative Organizations for Ensuring that all Stakeholders Benefit

Virginia already has in place three organizations that represent all four stakeholder groups to which this RFI is directed:

- The Virginia Offshore Wind Coalition represents project developers (Group 1); economic development agencies, public non-government organizations (NGOs), local governments, and environmental consultants (Group 2); manufacturers and developers of advanced technology (Group 3).
- The Virginia Offshore Wind Development Authority represents state government interests and the U.S. Navy and its training range interests (Group 2).
- The Virginia Coastal Energy Research Consortium (VCERC) represents a variety of state regulatory and resource agencies (Group 2), industry trade associations (Group 3); and technical research organizations (Group 4).

These three organizations thus provide the means by which Virginia can ensure that the needs of all four stakeholder groups are incorporated into the planning, implementation, and operation of the NOWTC and Advanced Technology Demonstration Program.

Virginia's Position to Lead a Regional Effort having Nationwide Impact

As indicated by Virginia's coordinated responses to this RFI, each of the three organizations described above represent their particular stakeholder groups in a truly collaborative fashion. This can provide a model for extending the NOWTC to include our organizations' counterparts in the states of Delaware, Maryland, and North Carolina, as well as the District of Columbia. We also believe that our staged test pads for advanced technology demonstration and turbine certification would complement the onshore 2 MW turbine recently commissioned on the Lewes campus of the University of Delaware given its focus on education and training, as well as the shallow-water array of one to three turbines planned for installation by Duke Energy in Pamlico Sound, North Carolina with its focus on utility integration and environmental effects. The short time available to respond to this RFI has required that we focus within Virginia to ensure that all four stakeholder groups in our state are well represented, but we anticipate that in responding to any DOE request for proposal subsequent to this RFI, Virginia will explore partnering with our three neighboring states and the District of Columbia to propose a regionally supported program.

In conclusion, *Virginia is well able to leverage existing academic and industrial capabilities, together with ongoing and future complementary programs, resources, and diverse funding opportunities to stand up the NOWTC and Advanced Technology Demonstration Program with assistance from the U.S. Department of Energy under the subject RFI.*

Alphabetical Listing of Offshore Wind Stakeholders Supporting Virginia's Submittal

Group 1: Offshore Wind Project Developers
Apex Wind Energy, Inc., *Charlottesville, VA*
Dominion, *Richmond, VA*
Fishermen's Energy, *Cape May, NJ*
Seawind Renewable Energy Corporation, *Richmond, VA*

Group 2: Economic Development Agencies, Public NGOs, and Environmental Stakeholders
Chesapeake Crescent Initiative, *Washington, DC*
Ecology & Environment, Inc., *Lancaster, NY and Virginia Beach, VA*
Green Jobs Alliance, *Hampton, VA*
Hampton Roads Economic Development Alliance, *Norfolk, VA*
Hampton Roads Military and Federal Facilities Alliance, *Norfolk, VA*
Sierra Club – Virginia Chapter, *Richmond, VA*
Virginia Conservation Network, *Richmond, VA*
Virginia Department of Mines, Minerals and Energy, *Richmond, VA*
Virginia Economic Development Partnership, *Richmond, VA*
Virginia Port Authority, *Norfolk, VA*

Group 3: Manufacturers and Developers of Advanced Technology
Alstom Power, *Richmond, VA*
BAE Systems, *Arlington, VA and Norfolk, VA*
Catch the Wind, Inc., *Manassas, VA*
Colonna's Shipyard, Inc., *Norfolk, VA*
Earl Industries, LLC, *Portsmouth, VA*
Fugro Atlantic, *Norfolk, VA*
LS Cable, *Gyeonggi-do, Korea*
Luna Innovations, *Roanoke, VA*
Science Applications International Corporation, *McLean, VA and Virginia Beach, VA*
Ventower Industries, *Monroe, MI*
WeatherFlow, Inc., *Poquoson, VA*
Weeks Marine, Inc., *Portsmouth, VA*

Group 4: Technical Research Organizations
Center for Innovative Technology, *Herndon, VA*
College of William and Mary, Center for Conservation Biology, *Williamsburg, VA*
George Mason University, *Fairfax, VA*
James Madison University, *Harrisonburg, VA*
NASA Langley Research Center, *Hampton, VA*
National Institute of Aerospace, *Hampton, VA*
Norfolk State University, *Norfolk, VA*
Old Dominion University, *Norfolk, VA*
Princeton Energy Resources International, LLC, *Rockville, MD*
SRI International, *Harrisonburg, VA*
Virginia Aquarium & Marine Science Center, *Virginia Beach, VA*
Virginia Tech Advanced Research Institute, *Arlington, VA*
Virginia Tech Department of Fisheries and Wildlife Sciences, *Blacksburg, VA*
University of Virginia, *Charlottesville, VA*