

Virginia Offshore Wind Technology Advancement Project (VOWTAP) Overview

Introductory Briefing

Virginia Tech Hampton Roads Showcase

Newport News, VA

06 Mayt 2015



George Hagerman

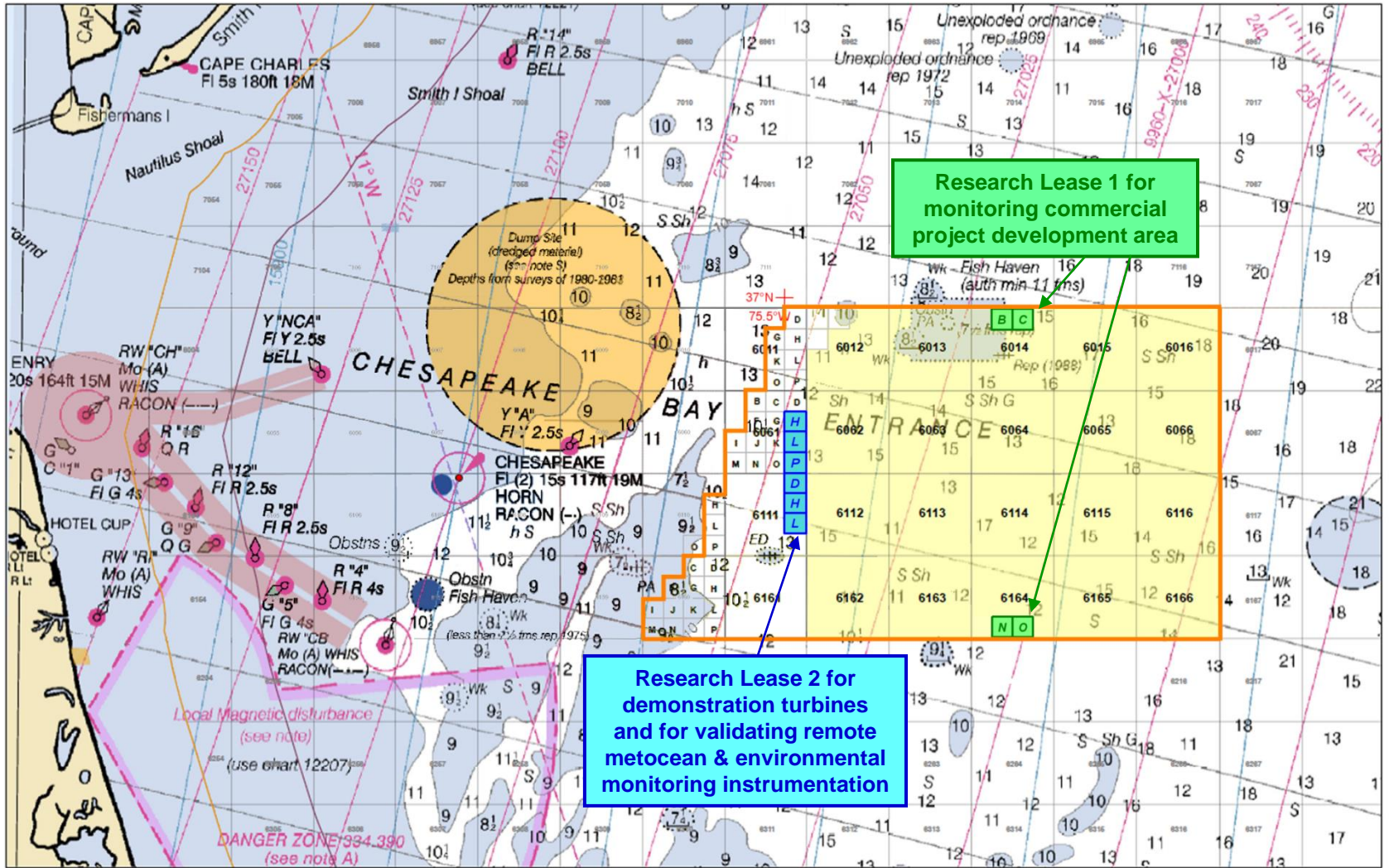
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VT-ARI Contributions to Virginia Offshore Wind Activities

- Coordination of three VCERC offshore wind projects and primary authorship of the *VCERC Offshore Wind Studies Final Report*
- State technical lead on the BOEM Virginia Intergovernmental Offshore Renewable Energy Task Force
- Site selection and technical support of two offshore wind research lease applications for Virginia DMME submittal to BOEM
- Metocean extreme event climatology for Mid-Atlantic offshore wind energy areas, \$250K study funded by BOEM
- Key elements of the Applied Research Roadmap in the *VCERC Offshore Wind Studies Final Report* are now being implemented by others with funding from the U.S. Department of Energy (DOE)
 - **Sep 2011:** DOE awards Dominion \$0.5 million for Virginia Offshore Wind Cost Reduction through Innovation Study (VOWCRIS)
 - **Dec 2012:** DOE awards Dominion \$4 million for Virginia Offshore Wind Technology Advancement Project (VOWTAP) Phase I (one of seven U.S. projects)
 - **May 2014:** DOE awards Dominion \$47 million for VOWTAP Phases II – V (one of three U.S. projects to advance beyond Phase I)

Nautical Chart Showing Commercial Wind Energy Area (WEA) and two Research Leases



- 8g Line
- Fed/State Boundary
- Chesapeake Light
- Fish Haven
- Dredge Disposal Area
- Traffic Separation Scheme
- Virginia RFI with Exclusions
- OCS Lease Blocks
- Alternative A for which BOEM Mid-Atlantic Final EA has a Finding of No Significant Impact for lease issuance and site characterization
- Virginia DMME Section 238 Research Lease Number 1
- Virginia DMME Section 238 Research Lease Number 2

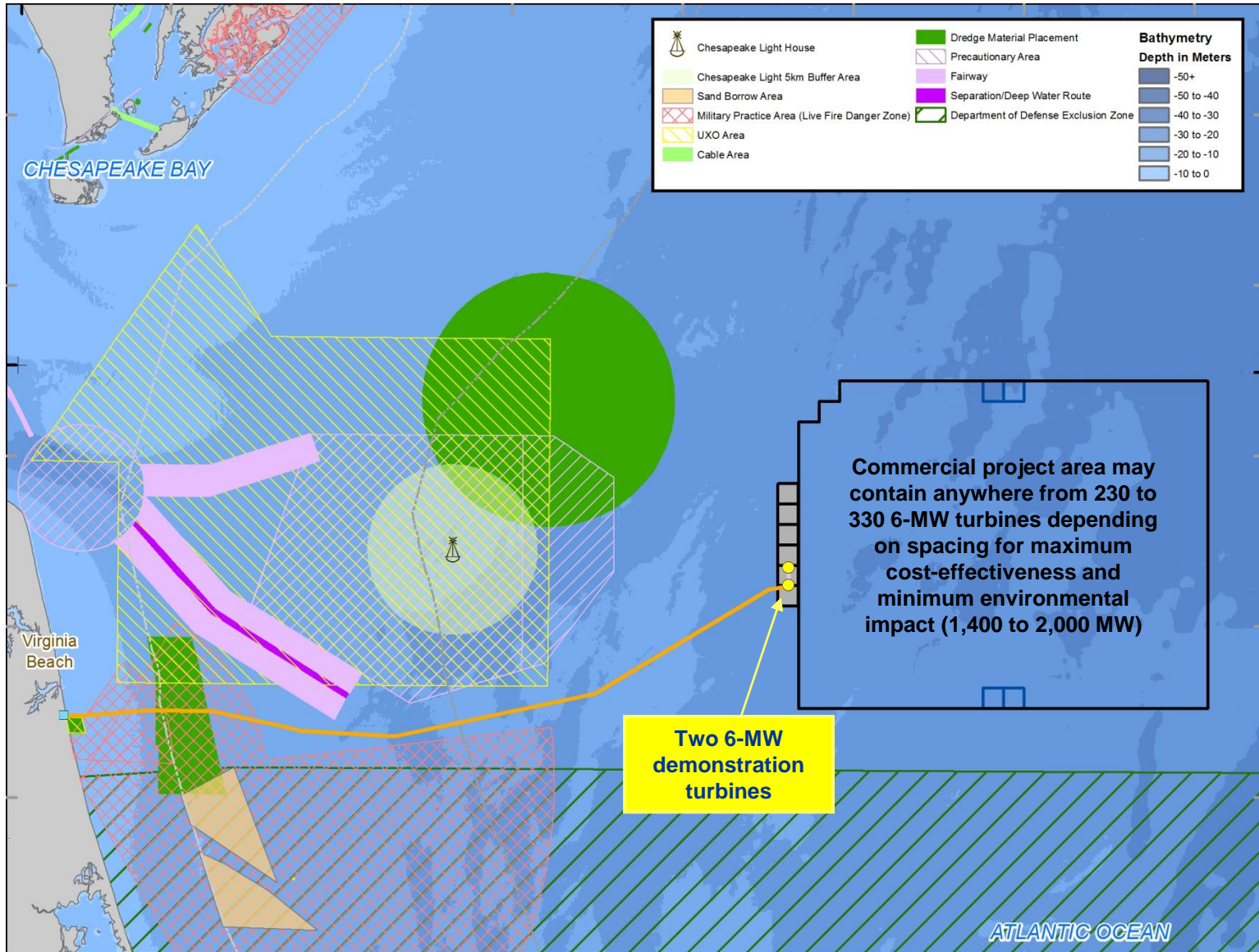
0 2 4 6 8 10 12 Nautical Miles

0 5 10 15 20 25 30 Kilometers

Virginia WEA Leased One Month after RI-MA AMI



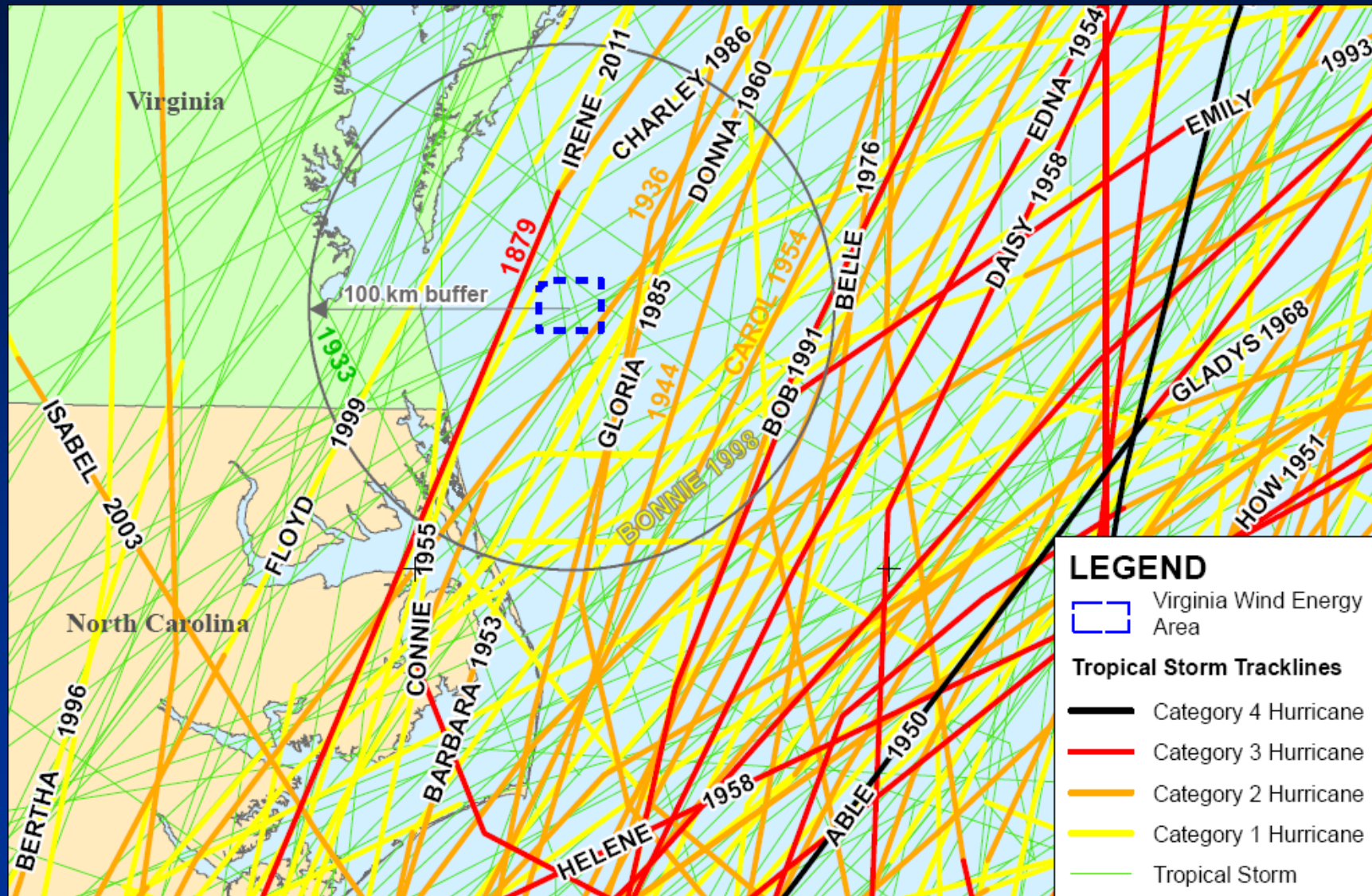
Dominion's Virginia Offshore Wind Demonstration and Commercial Project Footprints



Metocean Measurement and Modeling



Historical Hurricane Tracks within 100 km of Virginia Offshore Wind Energy Area



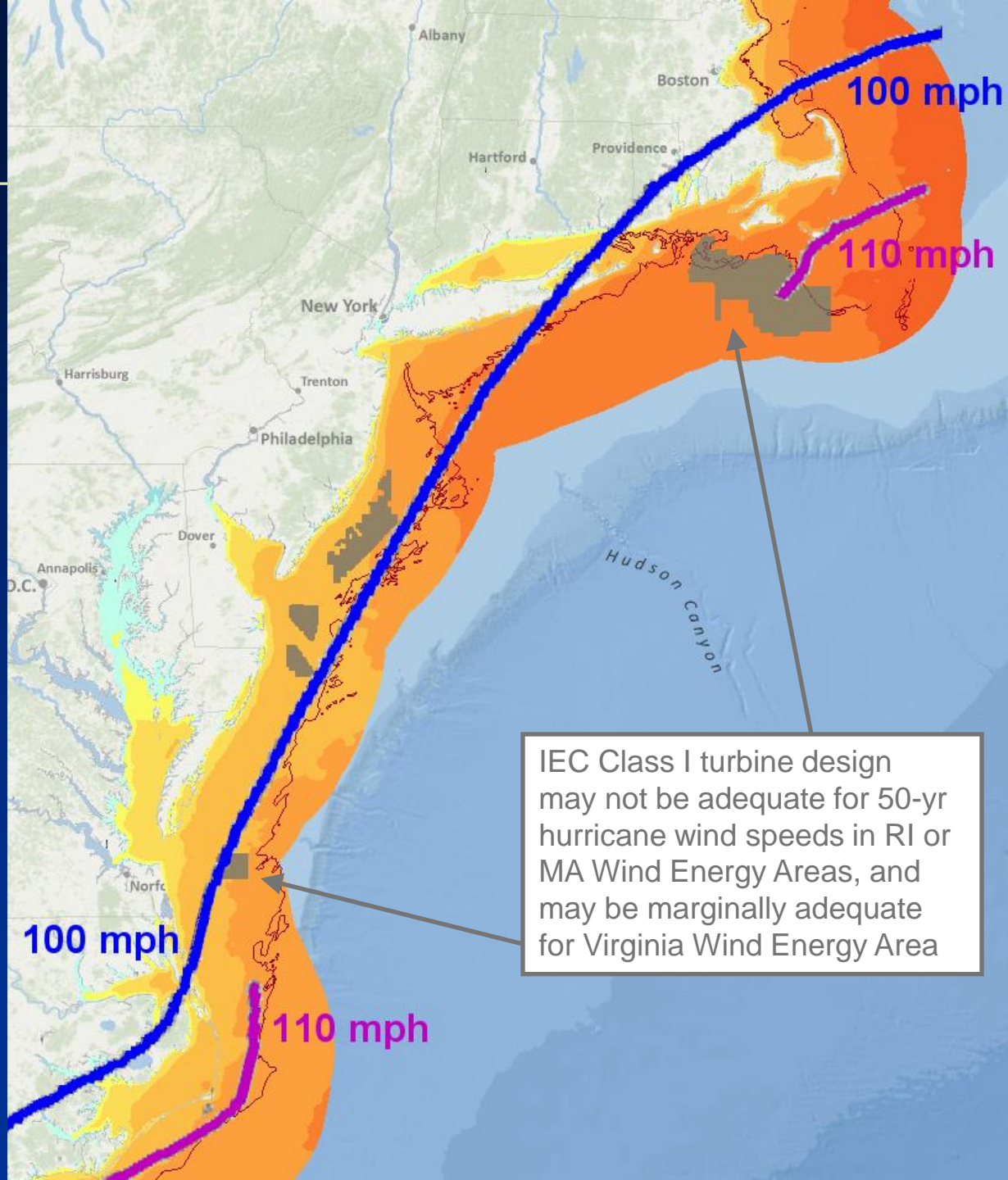
Comparison of Relevant Reference Wind Speeds

Parameter	IEC Class I Turbine Design	IEC Class II Turbine Design	Category 2 Hurricane Range	ASCE 7-10 Building Standard
Reference Wind Speed native units (derived units)	50 m/s (112 mph) (97 kt)	42.5 m/s (95 mph) (83 kt)	96 – 110 mph (43 – 49 m/s) (83 – 96 kt)	100 – 110 mph (44 – 49 m/s) (87 – 96 kt)
Reference Wind Speed Averaging Period	10-minute mean	10-minute mean	1-minute sustained	3-sec gust
Multiplier to Estimate 10-minute Mean *	50 m/s	42.5 m/s	0.93 <i>yields 40 to 46 m/s</i>	(1.11/1.23 = 0.90) <i>yields 40 to 46 m/s</i>
Reference Wind Speed Height Above Ground	Turbine hub height	Turbine hub height	10 m	10 m
Extrapolated 10-Minute Mean Wind Speed at 100m Turbine Hub Height **	50 m/s	42.5 m/s	48 – 55 m/s	48 – 55 m/s

* Based on WMO tropical cyclone gust factors at 10 m height above ground.

** Based on power law with 0.081 exponent (Giammanco, I.M., J.L. Schroeder, and M.D. Powell, 2012. Observed characteristics of tropical cyclone vertical wind profiles. *Wind and Structures, Vol. 15, No. 1*, pp. 65-86).

**Offshore
Extrapolation of
ASCE 7-10
Building
Standard 50-Year
Return Period
3-sec Gust Speed**



Dominion-led, DOE-funded Virginia Offshore Wind Demonstration



December 2012: \$4 million Phase I Award for Offshore Wind Demonstration Project



Dominion

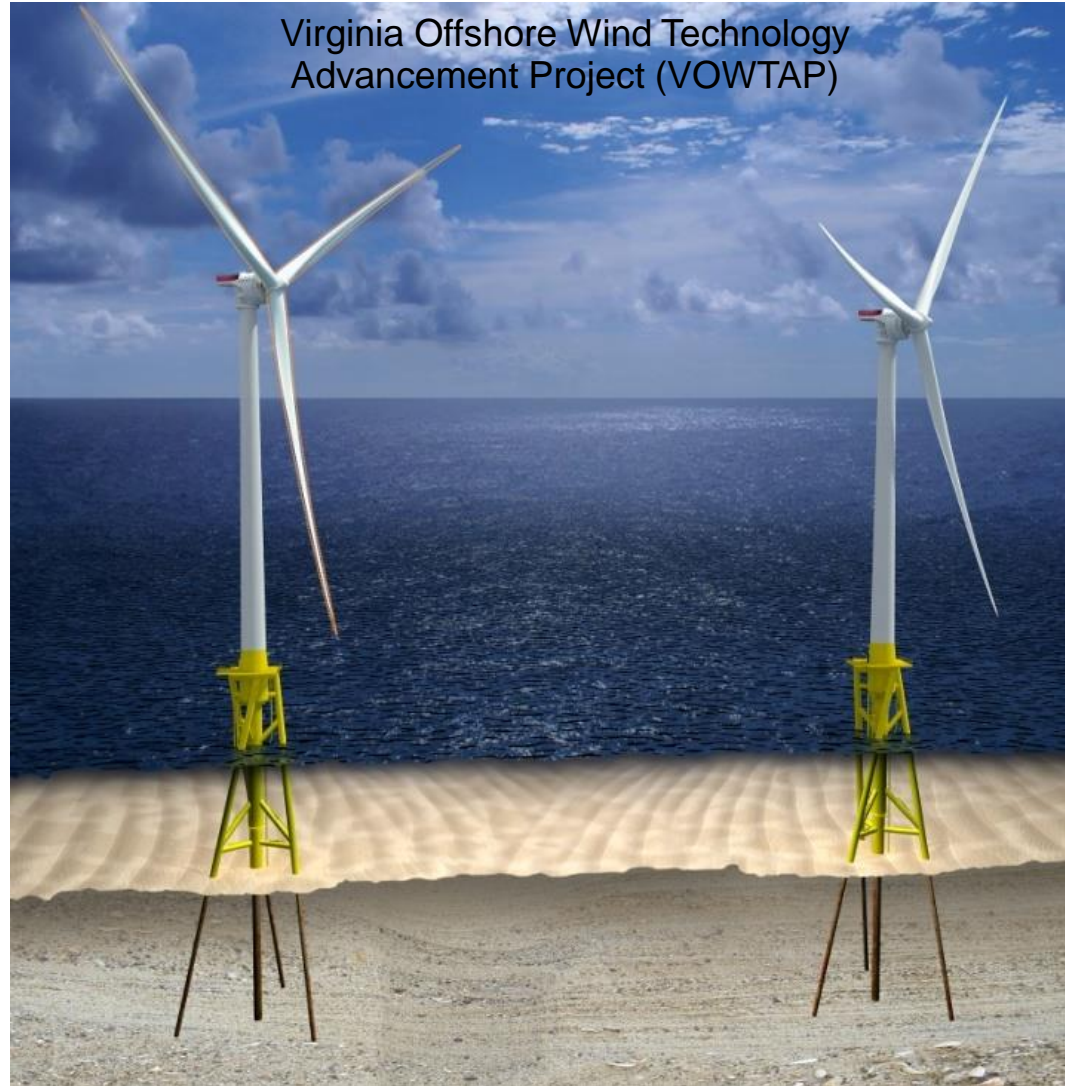
KBR

ALSTOM



**Newport News
Shipbuilding**

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Virginia Offshore Wind Technology Advancement Project (VOWTAP)

VOWTAP is the Only Fixed Foundation Project in Federal Waters

UNIVERSITY OF MAINE
2 x 6MW, Floating semi-sub,
Maine State waters

STATOIL NA
4 x 3MW, Floating spar,
Federal waters off Maine

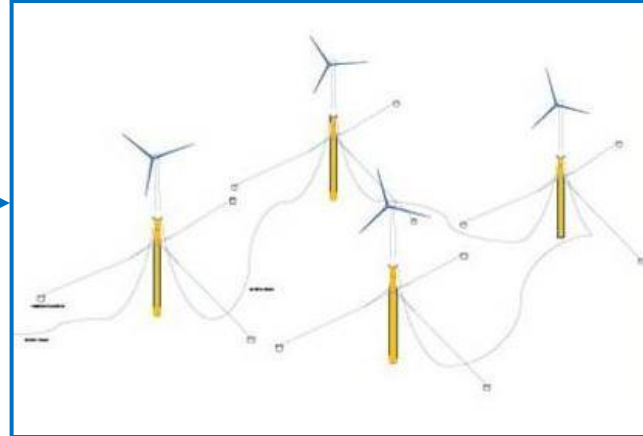
FISHERMEN'S ENERGY
5 x 5MW, Monopiles,
New Jersey State waters

DOMINION
2 x 6MW, IBGS foundations,
Federal waters off Virginia

BARYONYX
3 x 6MW, Jacket foundations,
Texas State waters

PRINCIPLE POWER
5 x 6MW, Floating semi-sub,
Federal waters off Oregon

LEEDCO
9 x 3MW, Icebreaking foundations,
Great Lakes (Erie) off Ohio



Nov 2013: Alstom's Second Prototype Installed Offshore (First Prototype Built on Land, May 2012)

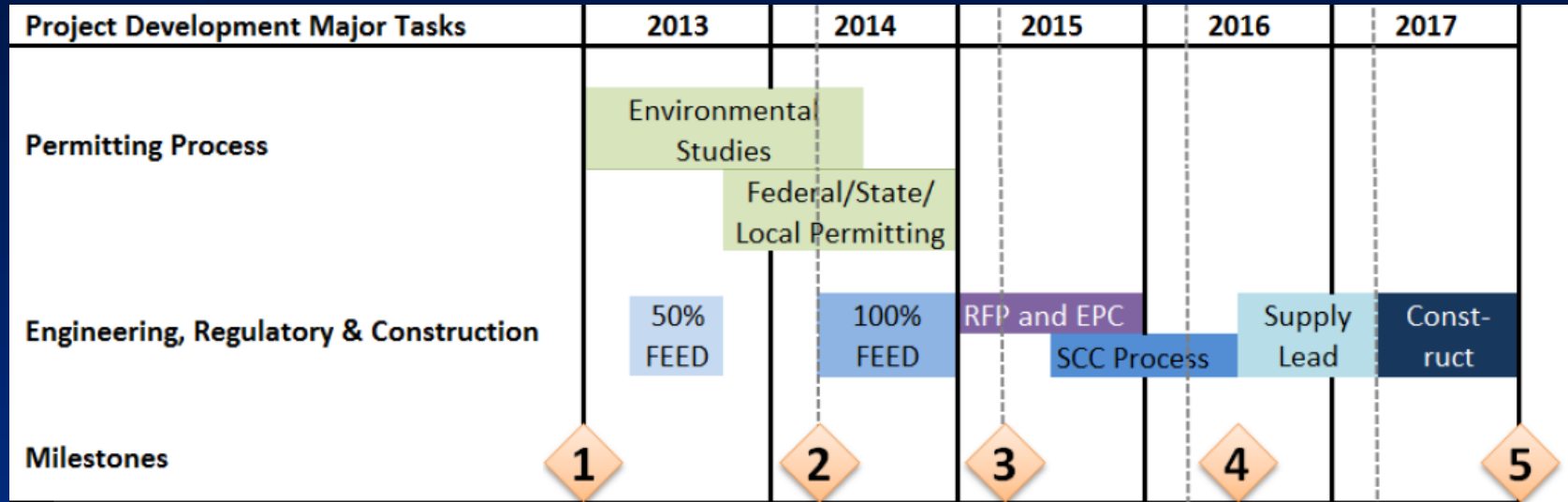
Alstom 6 MW Haliade-150
installed in 34 m water depth,
45 km off the coast of Belgium.



Installation video:

www.youtube.com/watch?v=XI590hoGENc

May 2014: VOWTAP \$47 Million Phase II Award



Milestone 1: Dominion-led VOWTAP team begins 50% Front-End Engineering Design (FEED), with final reports submitted Feb 2014

Milestone 2: *DOE announces three awards for completion*

Milestone 3: Request for Proposal (RFP) and selection of Engineering, Procurement, and Construction (EPC) contractor

Milestone 4: SCC approval triggers project procurement

Milestone 5: Commission project and start operation

April 2015: EPC Contractor Bid Price Announced

Richmond Times-Dispatch

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Dominion says off-shore wind project could cost far more than expected

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Dominion Virginia Power

Installing two wind turbines about 24 miles off the coast of Virginia Beach could cost far more than expected.

Posted: Thursday, April 23, 2015 10:31

By JACOB GEIGER Richmond Times-

[Dominion Resources Inc.'s](#) two wind turbines about 24 miles off the coast of Virginia Beach could cost twice what the company originally expected, and the price tag could delay the project.

Dominion originally had estimated the project would cost about \$230 million. A pair of six-megawatt turbine project to determine what wind power was economic. A \$47 million grant from the Department of Energy would cover some costs.

Public stakeholder group now being assembled; expecting to meet over the summer and report back to the Virginia Offshore Wind Development Authority in early September

But Mary Doswell, Dominion's senior vice president for retail and alternative energy solutions, said the only complete bid the company received quoted a price of \$375 million to \$400 million, with no price cap, which means costs could escalate due to bad weather or construction delays.

On Thursday, Doswell told the Virginia Offshore Wind Development Authority, a group of state officials and private industry executives, that Dominion wants to hold meetings with state and federal officials, shipping companies, other electric utilities and turbine manufacturers to discuss ways to reduce or share the project's costs before signing any contracts. Doswell is a member of the authority's board.

If the project's costs do not end up closer to the \$230 million estimate, Doswell said, Dominion may struggle to win approval from the State Corporation Commission, which regulates the company.

[Dominion plans to build natural gas power plant in Southside](#)

"We were comfortable with the \$230 million figure and thought it was doable," Doswell said. "We need to figure out where the pressure point or tradeoff is. We haven't asked the SCC about the \$400 million price."

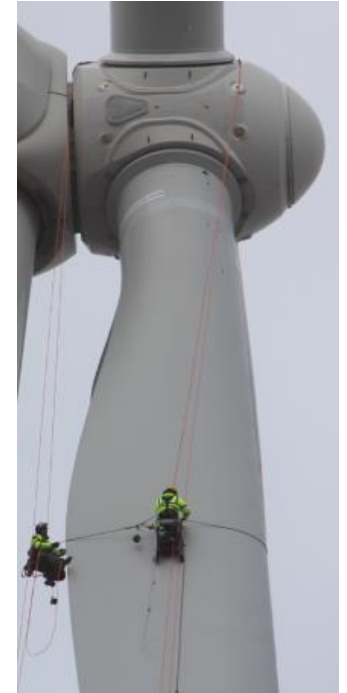
Innovative UAV Blade Inspection



Piloted UAV inspection of land-based turbine (left) and offshore oil & gas platform (right)

BENEFITS OF UAV SYSTEM

- Autonomous quad-rotors charged by service power circuit, remotely actuated
- Can afford much more frequent scheduled and “as needed” inspections
- Earlier detection of damage enables timely repair rather than costly replacement
- Eliminates riskiest offshore operation for personnel



Visual inspection by rope technicians will provide commercial standard of service for blades and will be used to benchmark UAV performance

BP2 | *Plan BP3 – BP5 activities; refine LCOE reduction estimates*

BP3 | *Test components; validate visual & IR image interpretation*


BP4 | *Integrate components and test on gantry at NASA-WFF*

BP5 | *Install and operate a 3-quad system & charging garage on one turbine*

Thank You!

VCERC Offshore Wind Studies Final Report, April 2010:

www.vcerc.org/report.htm



Any questions?

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