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176 Wind Turbines in the Balance: How the APA and Evidence-Based Law Resurrected Wind Farms in Coastal Virginia

Ethics * Energy * Economics

Abstract

In the annals of American renewable energy development, few weeks have been as consequential as the second week of January 2026. The abrupt suspension of the Coastal Virginia Offshore Wind (CVOW) project -- the largest infrastructure undertaking in the history of the Commonwealth of Virginia and the flagship of the United States' offshore wind ambitions -- plunged the sector into a crisis of existential proportions. Citing "national security risks" and "radar clutter" purportedly identified by the "Department of War," the executive branch issued a stop-work order on December 22, 2025, that threatened to strand nearly \$10 billion in capital investment and thousands of jobs in the Hampton Roads region.

This special report provides an exhaustive dissection of the events leading to the landmark preliminary injunction granted by U.S. District Judge Jamar Walker on January 16, 2026. We move beyond the headlines to explore the jurisprudential mechanics of the Administrative Procedure Act that underpinned the court's decision, the advanced aerodynamic and electrical engineering of the 2.6-gigawatt facility, the physics of electromagnetic interference that formed the crux of the government's defense, and the intricate biological safeguards designed to protect the North Atlantic Right Whale. By synthesizing legal filings, technical schematics, and environmental impact statements, this article aims to provide students and industry observers with a definitive account of how the CVOW project survived its most significant challenge to date.

1. The Legal Precipice: Dominion Energy v. Bureau of Ocean Energy Management

1.1 The December Decree: Anatomy of a Suspension

The conflict began not with a bang, but with a bureaucratic memorandum. On December 22, 2025, just days before the Christmas holiday, the Department of the Interior (DOI) and the Bureau of Ocean Energy Management (BOEM) issued a blanket suspension order halting operations on five major East Coast offshore wind projects.[1] The order, signed by administrative officials but clearly emanating from the highest levels of the Trump White House, cited "emerging national security risks" related to radar interference.[2]

For Dominion Energy, the developer of the Coastal Virginia Offshore Wind (CVOW) project, the order was catastrophic. Unlike other developers who utilize project-specific LLCs to ring-fence liability, Dominion is a regulated utility; the project's costs are recovered directly from Virginia ratepayers.[3] The project,

located 27 miles off the coast of Virginia Beach, was approximately 50% complete at the time of the order, with massive monopile foundations already driven into the seabed and specialized vessels traversing the Atlantic.[5]

The government's justification rested on classified reports allegedly detailing how the "movement of massive turbine blades" and "highly reflective towers" created radar clutter that could obscure incoming aerial threats or generate false targets.[1] However, the text of the order contained a glaring anachronism that would become a focal point of the subsequent litigation: it attributed the national security findings to the "Department of War".[1] The Department of War was dissolved in 1947 and reorganized into the Department of Defense (DoD).[6] This error, seemingly trivial to a layperson, signaled to legal scholars a potential lack of rigorous interagency review, suggesting the order was drafted hastily by political appointees rather than career defense officials.

1.2 The Administrative Procedure Act and the "Arbitrary and Capricious" Standard

Dominion Energy, along with developers for the Revolution Wind and Empire Wind projects, immediately filed suit in federal court. The legal battleground was the Administrative Procedure Act (APA), the federal statute that governs the process by which federal agencies develop and issue regulations. Under the APA, courts must set aside agency actions that are "arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law".[7]

In the case of *Dominion Energy v. Bureau of Ocean Energy Management*, heard in the U.S. District Court for the Eastern District of Virginia, the plaintiffs argued that the suspension failed this rationality test on several grounds:

- * **Lack of Specificity:** The order was a blanket ban affecting projects from Massachusetts to Virginia, regardless of their specific proximity to sensitive radar installations or their completion status. Judge Jamar Walker, presiding over the case, noted during oral arguments that the order appeared "too broad" and failed to articulate a project-specific security threat for CVOW.[3]
- * **Contradiction of Prior Findings:** The CVOW project had undergone years of rigorous review, including a comprehensive Environmental Impact Statement (EIS) and consultation with the DoD Clearinghouse.[9] The government had previously determined that the project, with appropriate mitigation, posed no significant threat to national security. The sudden reversal, without a detailed explanation of what had changed in the threat landscape, smacked of arbitrary decision-making.[10]
- * **The Pilot Project Precedent:** Perhaps the most damaging fact for the government's case was the existence of the CVOW Pilot Project. Two Siemens Gamesa turbines had been operating in the lease area since 2020.[9] These turbines, while smaller than the commercial units, had been spinning for five years without triggering a national security crisis. Dominion argued that if wind turbines in that specific location were an intolerable threat, the military would have intervened years ago.[11]

1.3 The "Department of War" Error: A procedural "Smoking Gun"?

The reference to the "Department of War" in the suspension order became a symbol of

the administration's chaotic approach. In the parallel lawsuit filed by Vineyard Wind, the complaint highlighted this error as evidence that the "DoD" had not actually been consulted in the drafting of the order, or else such a fundamental nomenclature error would have been caught.[6]

Judge Walker's ruling implicitly acknowledged this lack of rigor. By failing to correct the record or explain the discrepancy, the government undermined its own claim to "expert deference." Courts generally defer to the executive branch on matters of national security, but that deference is not absolute; it requires the government to show that it actually deliberated on the specific facts at hand. The "Department of War" slip suggested a cut-and-paste political directive rather than a reasoned security assessment.[12]

1.4 The Preliminary Injunction: A Three-Pronged Victory

On January 16, 2026, Judge Walker issued a preliminary injunction from the bench.[13] To obtain this relief, Dominion had to demonstrate:

* Likelihood of Success on the Merits: The court found a strong probability that the suspension would be found unlawful under the APA.[15]

* Irreparable Harm: This was the economic crux of the case. Dominion demonstrated that the "tightly choreographed construction schedule" relied on specialized foreign-flagged vessels that were booked years in advance.[16] A 90-day delay would not merely push the project back by three months; it could cause the project to miss its weather windows and lose vessel slots, potentially delaying completion by a full year and adding hundreds of millions in costs.[17]

* Public Interest: The court recognized the project's critical role in Virginia's energy transition and the economic damage a halt would cause to the state.[18]

The ruling allowed construction to resume immediately, placing CVOW back on track for its late 2026 completion date.[19]

2. Project Anatomy: The Scale of Coastal Virginia Offshore Wind Farms

To understand why the CVOW suspension was so contentious, one must grasp the sheer scale of the undertaking. This is not merely a collection of windmills; it is a utility-scale power plant located in the hostile environment of the North Atlantic.

2.1 The Lease Area and Site Characteristics

The project is located in federal lease area OCS-A 0483, covering 112,799 acres (approximately 176 square miles).[20] The site lies 27 statute miles (43.5 km) east of Virginia Beach.[9] This distance is strategic: it places the turbines beyond the visual horizon for most beachgoers, mitigating the "viewshed" complaints that doomed earlier projects like Cape Wind, while tapping into the stronger, more consistent winds of the Outer Continental Shelf (OCS).

Table 1: Site Characteristics of OCS-A 0483

Parameter	Value	Implications	Source
Distance from Shore	27 miles (43.5 km)	Minimal visual impact; higher	

transmission costs || [9] |

| Water Depth || 25 - 40 meters || Ideal for Monopile foundations || [21] |

| Total Area || 112,799 acres || Sufficient for 176 turbines + 3 substations || [20] |

| Seabed Composition || Sandy/Sediment || Suitable for pile driving; requires scour protection || [22] |

| Grid Connection || Fentress Substation || Robust onshore interconnection point || [23] |

2.2 From Pilot to Commercial Powerhouse

The CVOW project is unique in U.S. history because it was preceded by a distinct "Pilot Project." Completed in 2020, this two-turbine demonstrator (12 MW total capacity) was the first offshore wind project installed in U.S. federal waters.[9]

The Pilot Project served as a critical "de-risking" mechanism. It allowed Dominion and its contractors to test:

- * The Regulatory Pathway: Navigating the BOEM approval process for the first time.

- * Logistics: Testing the hypothesis that the Port of Virginia could handle offshore wind components.

- * Environmental Impact: Gathering real-world data on acoustic impacts and marine mammal interactions in this specific lease area.[24]

The success of the Pilot Project gave Dominion the confidence to proceed with the commercial phase: a massive expansion to 176 turbines with a total nameplate capacity of 2.6 GW.[14] This capacity is sufficient to power 660,000 homes, making it a baseload-scale contributor to the PJM grid.[24]

2.3 The Economics of Scale

The jump from 12 MW to 2,600 MW represents a scaling factor of over 200x. The commercial project represents an investment of approximately \$9.8 billion.[4] This cost includes not just the offshore hardware, but significant onshore transmission upgrades.

The economic logic of the project relies on the "Levelized Cost of Energy" (LCOE). By deploying massive turbines (14.7 MW each) in a large array, the project reduces the per-megawatt cost of installation and maintenance. Fewer turbine positions mean fewer foundations to drive and fewer cables to lay per unit of energy generated.

3. Engineering Titans: The Siemens Gamesa SG 14-222 DD

At the heart of the CVOW project -- and the center of the radar clutter controversy -- is the wind turbine generator (WTG) itself. Dominion Energy selected the Siemens Gamesa SG 14-222 DD, a machine that pushes the boundaries of materials science and mechanical engineering.

3.1 Direct Drive Technology: Eliminating the Gearbox

The "DD" in the model name stands for Direct Drive. In traditional wind turbines, a gearbox is used to step up the slow rotation of the blades (10-15 rpm) to the high speed required by a standard induction generator (1000+ rpm). However, gearboxes are heavy, contain thousands of moving parts, and are prone to failure -- a nightmare scenario when maintenance requires a jack-up vessel costing \$200,000 per day.

The SG 14-222 DD eliminates the gearbox entirely. The rotor hub is connected directly to a massive, low-speed synchronous generator.[25]

* Permanent Magnets: The generator uses permanent magnets rather than electromagnets for excitation. This eliminates the need for slip rings and external power supplies for the rotor field, increasing efficiency and reliability.[26]

* The Trade-off: To generate sufficient voltage at low rotational speeds (max 12.7 rpm), the generator diameter must be enormous to achieve a high "tip speed" relative to the stator coils. This results in a heavier nacelle (500 tons) compared to geared equivalents, but Siemens Gamesa has optimized the structural design to keep this weight manageable for installation vessels.[27]

3.2 Aerodynamics of the B108 Blades

The most visually striking feature of the turbine is the rotor. With a diameter of 222 meters, the swept area is 39,000 square meters -- roughly equivalent to 5.5 standard soccer fields.[28]

The blades, designated B108 (indicating a length of 108 meters), are marvels of composite engineering.[26]

* IntegralBlade Technology: The blades are cast in a single piece using fiberglass-reinforced epoxy, with a spar cap made of pultruded carbon fiber for stiffness.[26] This eliminates glue joints, which are common failure points in segmented blades.

* Tip Speed and Reynolds Numbers: At the maximum rotational speed of 12.7 rpm, the tip of the blade travels at approximately 148 meters per second (331 mph).[26] This high tip speed places the airflow into extremely high Reynolds number regimes, requiring specialized airfoil profiles to maintain lift and prevent flow separation.

* Leading Edge Protection: At 330 mph, rain droplets hit the blade like bullets. The blades feature advanced Leading Edge Protection (LEP) materials to prevent erosion, which can degrade aerodynamic performance over the 25-year lifespan of the turbine.[29]

Table 2: Technical Specifications of the SG 14-222 DD

Component	Specification	Details	Source
Nominal Capacity	14 MW (15 MW with Power Boost)	World-class output	[27]
Rotor Diameter	222 meters	Larger than the Washington Monument height	[27]
Blade Length	108 meters	Type B108 IntegralBlade	[27]

Swept Area		39,000 m		~5.5 Football Fields		[28]
Nacelle Weight		500 tons		Lightweight for Direct Drive class		[27]
Rotational Speed		Max 12.7 rpm		Variable speed, pitch regulated		[26]
Voltage		66 kV (Transformer in Nacelle)		Inter-array voltage		[30]

3.3 Foundation Engineering: The Monopile

Supporting this massive rotating structure is the monopile foundation. These are steel tubes up to 272 feet long and 31 feet in diameter, weighing nearly 1,500 tons.[4]

The installation process is violent and complex. A specialized vessel (like the Orion or Charybdis) positions the pile vertically. A massive hydraulic hammer then drives the pile deep into the seabed. The interaction between the steel pile and the sediment provides the lateral stiffness required to resist the immense overturning moments generated by wind and wave loads on the tower.[31]

A Transition Piece (TP) is then installed on top of the monopile. The TP contains the boat landing, ladders, and electrical switchgear, serving as the interface between the subsea foundation and the wind turbine tower.[5]

4. The Physics of Interference: Radar Clutter and National Security

The central technical argument of the Trump administration's suspension order was that these massive turbines interfere with national security radars. To understand the validity of this claim -- and the court's rejection of it as a basis for immediate suspension -- we must examine the physics of Wind Turbine Radar Interference (WTRI).

4.1 The Doppler Effect and Moving Target Indication (MTI)

Modern air surveillance radars use the Doppler effect to distinguish moving targets (aircraft, missiles) from stationary background objects (buildings, mountains, water). When a radar pulse hits a moving object, the frequency of the reflected signal shifts slightly. This is known as the Doppler shift.

Radars use Moving Target Indication (MTI) processing to filter out signals with zero Doppler shift (stationary clutter). This allows the radar operator to see an aircraft flying over a mountain range without the mountain obscuring the plane.[32]

4.2 The "Doppler-Spread Clutter" Problem

Wind turbines present a unique pathological case for MTI radars.

- * Huge Static Cross-Section: The tower and nacelle are massive steel structures that create a large static radar return.
- * High-Velocity Motion: The blades are moving. However, unlike an aircraft which moves as a single point, a wind turbine blade has a velocity gradient. The root is moving slowly, while the tip is moving at 330 mph (148 m/s).
- * Periodic Flashes: As the blades rotate, they present different aspects to the radar. When the blade is perpendicular to the radar beam, it creates a massive

"flash" of reflectivity.[33]

This creates what engineers call Doppler-spread clutter. The radar receives a signal that has a broad spectrum of Doppler frequencies. This can confuse the radar's processor, causing it to:

- * Drop Tracks: The clutter effectively raises the noise floor, causing the radar to lose the lock on a real aircraft passing through the area.
- * Generate False Targets: The moving blades can trick the radar into thinking there are multiple aircraft in the area (ghost targets).[34]
- * Shadowing: The physical structure of the turbine can block the radar beam, creating a blind spot behind the wind farm.[35]

4.3 The "Department of War" Claims vs. Operational Reality

The administration's suspension order claimed that the CVOW turbines created "emerging national security risks" that required a total halt.[1] The "Department of War" report ostensibly argued that the 222-meter rotors created a level of clutter that current algorithms could not handle.

However, the Department of Defense (DoD) has been studying this issue for nearly two decades. The DoD Energy Siting Clearinghouse was established specifically to review such projects. Technical mitigations exist and were part of the CVOW approval process:

- * In-Fill Radar: Installing smaller, localized radars to cover the blind spots created by the wind farm.
- * Gating: Creating "Non-Automatic Initiation Zones" (NAIZ) over the wind farm coordinates, where the radar requires more consistent returns to establish a track.
- * Advanced Signal Processing: Modern Active Electronically Scanned Array (AESA) radars have sophisticated software that can distinguish the periodic "beat" of a wind turbine blade from the linear trajectory of an aircraft.[36]

Judge Walker's finding that the suspension was "arbitrary" was likely rooted in the fact that Dominion had already agreed to mitigation measures. The sudden invocation of a "new" threat, without explaining why the existing mitigations were insufficient, failed to meet the legal standard for rational agency action.

5. The Nervous System of the Grid: High Voltage Transmission

Generating power is only half the battle; delivering it to the consumer is the other. The CVOW project involves a massive electrical infrastructure project that rivals the complexity of the turbines themselves.

5.1 The Architecture: Strings, Collectors, and Exports

The electrical system is hierarchical:

- * Inter-Array Cables (66 kV): The 176 turbines are connected in "daisy chains" or strings. Power flows from one turbine to the next, accumulating until it reaches the end of the string. These cables operate at 66 kV (AC). The project uses approximately 231 miles (372 km) of inter-array cabling.[37]

* Offshore Substations (OSS): The strings terminate at one of three massive Offshore Substations. These 4,000-ton structures are essentially multi-story buildings on stilts in the middle of the ocean.[4] Inside, massive transformers step up the voltage from 66 kV to 220 kV for export to shore.

* Export Cables (220 kV): Power is sent to shore via nine (9) independent export cables. This is a massive number of cables, necessitating a wide cable corridor. The total length of export cabling is approximately 350 miles (563 km).[37]

5.2 The Great Debate: HVAC vs. HVDC

A critical engineering decision for any offshore wind farm is the choice between High Voltage Alternating Current (HVAC) and High Voltage Direct Current (HVDC).

* HVAC (CVOW's Choice): AC is standard for terrestrial grids. It is cheaper for short distances because the converter stations (AC-to-AC transformers) are relatively simple. However, AC cables suffer from high capacitive losses over long distances. The insulation of the submarine cable acts like a capacitor, charging and discharging 60 times a second (60 Hz). This "reactive power" consumes the cable's capacity, leaving less room for real power delivery.

* HVDC (Sunrise Wind's Choice): DC does not suffer from reactive power losses. It is far more efficient for long distances (typically >50 miles). However, the converter stations (AC-to-DC onshore and offshore) are massive, complex, and expensive.[38]

Dominion chose HVAC for CVOW. At 27 miles offshore, the project is in the "Goldilocks zone" where HVAC is still technically feasible but pushing the limits. To manage the reactive power, the project likely employs massive STATCOMs (Static Synchronous Compensators) or shunt reactors at the onshore substation to stabilize the voltage. The decision to use nine export cables (3 cables per substation) suggests a need to distribute the massive 2.6 GW load across multiple conductors to manage thermal limits and redundancy.[37]

6. Environmental Acoustics: The North Atlantic Right Whale

While radar interference was the political weapon used against the project, the biological constraint is the North Atlantic Right Whale (NARW). With fewer than 340 individuals remaining, the death of a single reproductive female could drive the species to extinction.

6.1 The Acoustic Threat of Pile Driving

The primary environmental threat from CVOW is underwater noise. Driving a 31-foot diameter steel pile into the seabed generates intense pressure waves.

* Peak Sound Pressure Level (SPL): Can exceed 200 dB re 1 Pa.

* Impact: This noise can cause permanent hearing loss (Permanent Threshold Shift, or PTS) or temporary hearing loss (TTS) in whales. It can also mask their communication calls (Level B Harassment).[40]

6.2 The Mitigation Engineering: Bubble Curtains

To operate legally under the Marine Mammal Protection Act (MMPA) and the Endangered

Species Act (ESA), Dominion employs a Double Big Bubble Curtain (DBBC).[42]

- * Mechanism: A perforated hose is laid in a ring around the pile driving site. Compressed air is pumped through the hose, creating a dense wall of bubbles rising to the surface.

- * Physics: Sound travels efficiently through water (an incompressible fluid) but poorly through air. The air bubbles create an impedance mismatch. When the sound wave hits the bubble curtain, much of the energy is reflected or absorbed rather than transmitted into the surrounding ocean.

- * Effectiveness: A properly functioning DBBC can reduce noise levels by 10-20 dB, significantly shrinking the "harassment zone" where whales could be injured.

6.3 Monitoring and Shutdowns

In addition to noise damping, the project uses a "defense in depth" strategy:

- * Passive Acoustic Monitoring (PAM): Hydrophones listen for whale calls 24/7. If a NARW is heard within a 10 km clearance zone, pile driving cannot start.[43]

- * Protected Species Observers (PSOs): Trained biologists on vessels scan the horizon.

- * Vessel Speed Limits: All project vessels must travel at 10 knots or less in NARW zones to prevent ship strikes -- the leading cause of whale mortality.[44]

Despite these measures, environmental groups have sued, arguing that the cumulative impact of CVOW plus all other East Coast projects creates a "gauntlet" of noise and vessel traffic that could displace the whales from their migration corridors.[45]

While Judge Walker's ruling addressed the national security suspension, this environmental litigation remains a parallel risk to the project's long-term timeline.

7. The Economic Ecosystem: Virginia's Offshore Ambitions

For the Commonwealth of Virginia, CVOW is not just an energy project; it is an industrial strategy. The state has positioned the Hampton Roads region as the supply chain hub for the entire U.S. East Coast offshore wind industry.

7.1 The Portsmouth Marine Terminal (PMT)

The epicenter of this strategy is the Portsmouth Marine Terminal (PMT). Once a container terminal, PMT has been transformed into a specialized staging ground for offshore wind.

- * Investment: Dominion and the Port of Virginia invested over \$200 million to upgrade the facility.[46]

- * Load Bearing: The wharves were reinforced to handle the extreme weight of the wind turbine components. A single nacelle weighs 500 tons; a monopile weighs 1,500 tons. Standard shipping terminals would crumble under these loads.[47]

- * Jobs: The project supports approximately 900-1,100 jobs annually during construction. These are high-wage roles for longshoremen, crane operators, welders, and stevedores.[48]

7.2 The Jones Act Challenge

A unique constraint on U.S. offshore wind is the Jones Act (Merchant Marine Act of 1920). This law requires that any vessel transporting merchandise between two U.S. points (e.g., from PMT to the lease area) must be:

- * Built in the U.S.
- * Owned by U.S. citizens.
- * Crewed by U.S. citizens.

At the start of the CVOW project, there were zero Jones Act-compliant wind turbine installation vessels (WTIVs) capable of handling the massive 14 MW turbines.

* The Solution: Dominion commissioned the Charybdis, the first U.S.-built WTIV, constructed at the Keppel AmFELS shipyard in Brownsville, Texas. This vessel represents a \$500 million bet on the U.S. market.[46]

* The Workaround: Until Charybdis is fully operational and for other tasks, the project uses a "feeder barge" solution. U.S.-flagged tugs and barges transport components from Portsmouth to the site. There, a foreign-flagged installation vessel (which stays stationary and thus does not "transport" goods) lifts the components from the barge and installs them. This complex logistical dance increases costs and scheduling risks -- risks that were exacerbated by the Trump suspension order.[17]

8. Conclusion: The Resilience of Steel and Law

The resumption of construction on the Coastal Virginia Offshore Wind project is a watershed moment for the U.S. energy transition. It demonstrates that the sector has matured to a point where it can withstand significant political headwinds.

Legally, the case of Dominion Energy v. BOEM reaffirms the power of the Administrative Procedure Act as a bulwark against executive overreach. Judge Walker's ruling sends a clear signal: national security cannot be used as a "get out of jail free" card to cancel permitted infrastructure without rigorous, specific evidence. The "Department of War" error will likely be studied in law schools as a cautionary tale of procedural incompetence.

Technically, the project is a testament to the scale of modern engineering. The Siemens Gamesa SG 14-222 DD turbines are pushing the limits of aerodynamics and materials science. The successful integration of these machines into the grid, despite the challenges of HVAC transmission and radar clutter, showcases the adaptability of the industry.

However, the 90-day suspension -- though lifted -- has introduced a new variable into the equation: Political Risk. Investors now know that a change in administration can lead to existential threats to permitted projects. While CVOW has survived, the cost of capital for future projects may rise to account for this uncertainty.

As the heavy lift vessels return to the waters off Virginia Beach, they carry more than just steel monopiles; they carry the aspirations of a state seeking to reinvent its maritime economy and a nation struggling to balance energy security, environmental protection, and political polarization. For now, the turbines will

rise.

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