Appendix E. Project Design Envelope and Maximum-Case Scenario

Dominion Energy would implement a Project Design Envelope (PDE) concept. This concept allows Dominion Energy to define and bracket proposed Project characteristics for environmental review and permitting while maintaining a reasonable degree of flexibility for selection and purchase of Project components, such as wind turbine generators (WTGs), foundations, submarine cables, and offshore substation (OSS).[1]

The Bureau of Ocean Energy Management (BOEM) invited Dominion Energy and other lessees to submit Construction and Operations Plans (COPs) using the PDE concept—providing sufficiently detailed information within a reasonable range of parameters to analyze a "maximum-case scenario" within those parameters for each affected environmental resource. BOEM identified and verified that the maximum-case scenario based on the PDE provided by Dominion Energy and analyzed in this Draft Environmental Impact Statement (EIS) could reasonably occur if approved. This approach is intended to provide flexibility for lessees and allow BOEM to analyze environmental impacts in a manner that minimizes the need for subsequent environmental and technical reviews. In addition, the PDE approach may enable BOEM to expedite review by beginning National Environmental Policy Act (NEPA) evaluations of COPs before a lessee has finalized all of its design decisions.

This Draft EIS assesses the impacts of the reasonable range of Project designs that are described in the Dominion Energy COP by using the maximum-case scenario process. The maximum-case scenario analyzes the aspects of each design parameter that would result in the greatest impact for each physical, biological, and socioeconomic resource. This Draft EIS considers the interrelationship between aspects of the PDE rather than simply viewing each design parameter independently. This Draft EIS also analyzes the cumulative impacts of the maximum case scenario alongside other reasonably foreseeable past, present, and future actions.

A summary of Dominion Energy's PDE parameters is provided in Table E-1. Table E-2 details the full range of maximum-case design parameters for the proposed Project and which parameters are relevant to the analysis for each EIS section in Chapter 3, *Affected Environment and Environmental Consequences.*

Table E-1. Summary of PDE Parameters

Project Parameter Details
General (Layout and Project Size)
• 176 to 205 WTGs • Wind farm nameplate capacity ranging from 2,500 to 3,000 MW • Anticipated to begin offshore construction in 2023 (scour protection, offshore cables) and 2025 (WTGs) • Construction of the Project is expected to be complete within approximately 3 years
WTGs and Foundations
• Siemens Gamesa Renewable Energy SG 14-222 DD WTG with power boost technology • 14- to 16-MW WTGs characterized as "minimum" and "maximum" capacity

[1] Additional information and guidance related to the PDE concept can be found here: https://www.boem.gov/Draft-Design-Envelope-Guidance/.

Project Parameter Details
• Rotor diameter ranging from 725 to 761 feet (221 to 232 meters) • Hub height from MSL ranging from 446 to 489 feet (136 to 149 meters) • Turbine tip height from MSL ranging from 804 to 869 feet (245 to 265 meters) • Installation of monopiles through pile-driving • Scour protection installed around WTG monopile foundation installation vessels to include jack-up, platform support, crew transfer, tugs, crew transfer, barges, heavy-lift vessels, fall pipe vessels, walk-to-work, and other support vessel types as necessary
Inter-Array Cables
• Up to 66- kV cables buried 3.3 to 9.8 feet (1 to 3 meters) beneath the seabed • Up to 300 miles (484 kilometers) total length of Inter-Array Cables (average inter-array cable length of 5,868 feet [1,789 meters] between turbines) • Installation by jet trenching, chain cutting, trench former, and/or other available technologies • Installation vessels to include deep draft cable lay, walk-to-work, crew transfer, trenching support, burial tool, survey, multipurpose support vessels, and other support vessel types as necessary
Offshore Export Cables
• Up to nine 230-kV export cables buried 3.3 to 16.4 feet (1 to 5 miles) beneath the seabed; with additional cover in some sections, total burial depth may be up to 24.6 feet (7.5 meters) • Nine export cables (in a single corridor), with alternatives • Up to 416.9 miles (671 kilometers) total length of offshore export cable • Installation by jet trenching, plowing, chain cutting, trench former, direct steerable pipe thrusting, and/or other available technologies • Installation vessels to include pull-in support barge, tug, multipurpose support, survey, shallow draft cable lay, hydroplow, crew transfer, deep-draft, walk-to-work, trenching support, burial tool vessels, and other support vessel types, as necessary • Cable protection at the cable crossings
Offshore Substations and Foundations
• Two to three OSS • OSS installed atop piled jacket foundations • Scour protection installed at all foundation locations • Installation vessels to include barge, tug, transport, heavy lift, anchor handling, jack-up vessels, platform support, and other support vessel types, as necessary
Onshore Facilities
• Landfall of offshore export cable(s) would be completed via Trenchless Installation • Maximum area of temporary disturbance for cable landing location: 2.8 acres (1.1 hectares maximum temporary workspace at the Nearshore Trenchless Installation Area approximately 8.8 acres [3.6 hectares]). • Construction work area for the switching station: maximum of approximately 45.4 acres (18.4 hectares) • Construction work area for the upgrades at the onshore substation (existing Dominion Energy Fentress substation): maximum of approximately 18.5 acres (7.5 hectares) • Maximum onshore export cable length of approximately 4.41 miles (7.10 kilometers) • Maximum interconnection cable length of approximately 14.2miles (22.9 kilometers) • Maximum area of temporary disturbance for onshore export cable route of approximately 26.6 acres (10.8 hectares) acres (27.6 hectares)[1] • Maximum area of permanent disturbance for onshore export cable route of approximately 1.0 acres

Project Parameter Details
(0.4 hectares)[2] • Maximum area of temporary disturbance for Interconnection Cable Route Option 1 of approximately 0 acres (0 hectares)[2] • Maximum area of permanent disturbance for Interconnection Cable Route Option 1 of approximately 1 acre (0.4 hectare)[3] • Maximum area of temporary disturbance for Hybrid Interconnection Cable Route Option 6 of approximately 29.0 acres (11.7 hectares)[4] • Maximum area of permanent disturbance for Hybrid Interconnection Cable Route Option 6 of approximately 4.2 acres (1.7 hectares)[5]

MSL = mean sea level; kV = kilovolt; MW = megawatt; WTG = wind turbine generator; OSS = offshore substation

[1]For the purposes of this analysis, the estimated temporary disturbance for the Onshore Export Cable Route is associated with the areas of the route that are surface trenched (60-foot-wide trench for ~3.7 miles).
[2]For the purposes of this analysis, the estimated permanent disturbance for the Onshore Export Cable Route is associated with the permanent structures (i.e., manhole vaults).
[3]For the purposes of this analysis, the total permanent disturbance for Interconnection Cable Route Option 1 is associated with the new permanent structures (i.e., transmission towers) to be installed within the new/proposed right-of-way. For the purposes of this analysis, it is assumed that no other land disturbance will occur within the Interconnection Cable Route.
[4]For the purposes of this analysis, the estimated temporary disturbance for Hybrid Interconnection Cable Route Option 6 is associated with the area of the underground portion of the route that is surface trenched.
[5]For the purposes of this analysis, the estimated permanent disturbance for Hybrid Interconnection Cable Route Option 6 is associated with the permanent structures (i.e., manhole vaults for the underground portion of the route and transmission towers for the overhead portion of the route).

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Table E-2. Maximum-Case Design Parameters for the Coastal Virginia Offshore Wind Commercial Project (an "X" indicates that the parameter is relevant to an EIS resource analysis)

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
WIND FARM																				
Wind farm nameplate capacity (MW)	3,000	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
WIND TURBINES																				
Parameters per Turbine																				
Number of WTGs	205	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	
WTG generating capacity (MW)	16	X	X		X								X	X			X	X		
Cut-in wind speed (miles per hour)	11.2		X		X															
Cut-out wind speed (miles per hour)	67.1		X		X															
Turbine tip height from MSL (feet)	869		X		X		X	X				X		X	X	X		X		
Hub height from MSL (feet)	489		X		X		X	X				X		X	X	X		X		
Rotor diameter (feet)	761		X		X		X	X				X		X	X	X		X		
Distance from bottom of turbine tip to HAT (feet)	115		X		X		X	X				X		X	X	X		X		
Parameters per Turbine Foundation (Monopile)																				
Monopile diameter per foundation (feet)	31			X			X	X			X		X	X			X		X	
Base diameter with scour protection (feet)	230			X	X		X				X		X	X			X		X	
Seabed penetration (feet)	197			X			X	X			X		X	X			X		X	
Diameter at HAT (feet)	36			X			X	X			X		X	X			X	X		
Maximum hammer energy (kilojoule)	4,000		X	X	X		X				X		X	X			X		X	
Maximum Total Impacts for Turbine Foundations (Monopile)																				
Number of monopiles	205	X	X	X	X		X	X				X	X	X	X	X	X	X	X	
Number of transition pieces	205		X		X		X	X								X		X		
Platform supply vessel: Bubble curtain installation (noise mitigation) temporary impacts (acres)	148.1			X			X				X		X	X			X			
Noise monitoring buoys temporary impacts (acres)	0.8			X			X				X		X	X			X			
Heavy lift vessel (HLV) monopile construction and installation	0.0																			
Feeder spread – monopile feeder	0.0																			
JUV WTG loading temporary impacts (acres) [1]	16.19			X	X		X				X		X	X	X		X		X	
JUV WTG construction and installation temporary impacts (acres) [1]	48.7			X	X		X				X		X	X	X		X		X	
W2W WTG commissioning temporary impacts (acres)	0.0														X					
WTG foundation permanent impacts (acres)	4.39			X	X		X	X			X		X	X	X		X		X	

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
WTG scour protection permanent impacts (acres)	179.3			X	X		X				X		X	X			X		X	
OFFSHORE SUBSTATIONS																				
Topside Offshore Substations																				
Number of substations	3	X	X	X	X		X	X			X	X	X	X	X	X	X	X	X	
Width of topside main structure (feet)	203		X	X	X		X	X			X	X	X	X			X	X		
Length of topside main structure (feet)	242		X	X	X		X	X			X	X	X	X			X	X		
Height (feet)	177		X		X		X	X				X		X	X					
Base height above HAT (feet) (air gap)	151		X		X		X	X				X		X	X			X		
Offshore Substation Foundations (Piled Jackets)																				
Number of structures	3	X	X	X	X		X	X			X	X	X	X	X	X	X	X	X	
Number of piles per offshore substation	4		X	X	X		X	X			X		X	X			X		X	
Pile diameter (feet)	9.0			X	X		X	X			X		X	X			X		X	
Base dimensions (feet)	306.8 x 283.8			X			X	X			X		X	X			X		X	
Scour protection diameter per leg (feet)	230			X			X	X			X		X	X			X		X	
Seabed penetration (feet)	269			X			X	X			X		X	X			X		X	
Seabed footprint without scour protection per offshore substation foundation (square feet)	87,070			X			X	X			X		X	X			X		X	
Seabed footprint with scour protection per offshore substation foundation (square feet)	497,092			X			X	X			X		X	X			X		X	
Dimensions at lowest astronomical tide (feet)	98.4 x 131.2			X			X	X			X		X	X			X	X		
Maximum Total Impacts for OSS Foundations																				
Maximum temporary construction footprint per OSS (acres)	3.74			X	X		X	X			X		X	X			X		X	
OSS jacket footprint permanent impact (acres)	0.41			X							X		X	X			X			
Vessels Associated with OSS																				
Fallpipe vessel scour protection temporary impact (acres) [2]	0		X	X	X		X				X		X	X	X		X		X	
Pin pile template temporary impact (acres)	1.9		X	X	X		X				X		X	X	X		X		X	
HLV OSS pre-piling temporary impact (acres) [2]	0		X		X		X				X		X	X	X		X		X	
HLV OSS jacket construction and installation temporary impact (acres) [2]	0		X		X		X				X		X	X	X		X		X	
Feeder spread OSS jacket supply temporary impact (acres) [2]	0		X		X		X				X		X	X	X		X		X	
HLV offshore substation topside construction and installation temporary impact (acres) [2]	0		X		X		X				X		X	X	X		X		X	

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
Feeder spread offshore substation topside supply temporary impact (acres) [2]	0		X		X		X				X		X	X	X		X		X	
CTV/JUV offshore substation commissioning temporary impact (acres)	3.6		X	X	X	X	X				X		X	X	X		X		X	
OFFSHORE CABLES																				
Inter-Array Cable Parameters																				
Number of cables	230			X			X	X			X	X	X	X	X		X		X	
Length per cable (feet)	31,804	X		X			X	X			X	X	X	X	X		X		X	
Total length of cable (miles)	300.7	X		X			X	X			X	X	X	X	X		X		X	
Operating voltage (kV)	66			X			X				X	X	X	X			X			
Cable diameter (inches)	7.9			X			X	X			X	X	X	X	X		X		X	
Target burial depth (feet)	9.8			X			X	X			X	X	X	X	X		X		X	
Trench width – temporary (feet)	16.4			X			X	X			X	X	X	X	X		X		X	
Seabed footprint (cable) – temporary (acres)	48			X			X	X			X	X	X	X	X		X		X	
Seabed footprint (UXO Survey/Removal) (temporary) (acres)	5			X			X	X			X	X	X	X	X		X		X	
Temporary impact footprint (acres)	1,781.8			X			X	X			X		X	X			X		X	
Pre-lay grapnel run temporary impact (acres)	2,385.5			X			X	X			X		X	X			X		X	
Offshore Export Cable Parameters																				
Number of cables	9			X			X	X			X		X	X			X		X	
Total length of cable (miles)	416.9	X		X			X	X			X		X	X	X	X	X		X	
Operating voltage (kV)	230			X			X				X		X	X			X		X	
Cable diameter (inches)	11.4			X			X	X			X		X	X			X		X	
Burial depth (feet)	16.4			X			X	X			X		X	X			X		X	
Trench width – temporary (feet)	32.8			X			X	X			X		X	X			X		X	
Total corridor length from the lease area to the cable landing location (miles)	49.01	X		X			X	X			X		X	X	X	X	X		X	
Area of construction corridor (offshore work area to offshore substations) (acres)	2,635.37			X			X	X			X		X	X	X	X	X		X	
Requested operational right-of-way (feet)	2,953			X			X				X		X	X			X			

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
Maximum Total Temporary Impacts for Vessels Associated with Inter-Array Cables and Offshore Export Cables																				
Pontoon - nearshore export cable installation anchor handling (acres)	355																			
Cable lay vessel (cable laying and wet end storage) (acres)	131.7			X			X	X			X	X	X	X	X	x	X		X	
Cable lay vessel (affects same area as pre-lay grapnel run) (acres)	131.5		X	X	X		X				X		X	X	X		X	X	X	
Cable trenching jetting vessel (multiple burial passes would impact same area and are thus counted a single time) (acres)	2,892.4		X	X	X		X				X		X	X	X		X	X	X	
Cable joining vessel for joining offshore export cable and interarray cable (acres) [2]	3		X		X		X				X		X	X	X		X	X	X	
Cable lay vessel for wet end storage (acres)	0.2		X	X	X		X				X		X	X	X		X	X	X	
Support vessel for pre-lay grapnel run (acres)	1,393		X	X	X		X				X		X	X	X		X	X	X	
ONSHORE COMPONENT CONSTRUCTION IMPACTS																				
Length of onshore trenchless installation work area at cable landing location area (feet)	2,500			X		X			X	X		X			X	X		X	X	X
Maximum area of temporary disturbance for cable landing location offshore trenches installation punch-out (acres)	80	X	X		X	X		X	X			X				X		X	X	X
Construction work area for switching station (acres)	45.4	X	X		X	X		X	X			X						X	X	X
Construction work area for the upgrades at existing Fentress onshore substation (acres)	26.9	X	X		X	X		X	X			X						X	X	X
Maximum onshore export cable length (miles)	4.1	X	X		X	X		X	X			X						X	X	X
Maximum interconnection cable length (miles)	14.2	X	X		X	X		X	X	X		X			X	X			X	X
Maximum area of temporary disturbance for onshore export cable route (acres)	26.6	X	X		X	X		X	X			X						X	X	X
Maximum area of temporary disturbance for interconnection cable route (acres)	0	X	X		X	X		X	X	X		X			X	X			X	X
Duration of onshore export cable installation (months)	24	X	X		X	X		X	X			X				X		X	X	X
Duration of onshore interconnection cable installation (months)	15	X	X		X	X		X	X			X				X		X	X	X
Duration of switching station construction (months)	24	X	X		X	X		X	X			X				X		X	X	X
Duration of onshore substation upgrade construction (months)	24	X	X		X	X		X	X			X				X		X	X	X

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
OPERATIONS AND MAINTENANCE																				
Commercial project lifespan (years)	33	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Number of offshore emergency generators	3	X																	X	
Offshore emergency generator capacity (kW)	500 each	X																	X	
Number of onshore switching station emergency generators	3	X	X		X	X		X				X							X	
Onshore switching station emergency generator capacity (kW)	260 each	X	X		X	X		X				X							X	
Number of onshore substation emergency generators	3	X	X		X	X		X				X							X	
Onshore substation emergency generator capacity (kW)	150, 310, and 410	X	X		X	X		X				X							X	
Onshore substation electric switchgear sulfur hexafluoride quantity (pounds)	35,137	X																	X	
Switching station electric switchgear sulfur hexafluoride quantity (pounds)	26,000	X																	X	
Offshore substation sulfur hexafluoride quantity 66 kV gas insulated switchgear (pounds)	13,227	X																	X	
Offshore substation sulfur hexafluoride quantity 235 kV gas insulated switchgear (pounds)	15,210	X																	X	

[1] Adjusted for 205 WTG positions. COP Table 3.4-1 (Dominion Energy 2022) provides acreage for 176 WTG positions.
[2] Floating marine spread (COP Table 3.4-3; Dominion Energy 2022).
CVT = Crew Vessel Transfer; HAT = Highest Astronomical Tide; HLV = heavy lift vessel; JUV = jack-up vessel; kV = kilovolt; kW = kilowatt; MW = megawatt; WTG = wind turbine generator; W2W = Multirole Subsea Support Vessel with Walk to Work.

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