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Construction and Operations Plan

Coastal Virginia Offshore Wind Commercial Project

Introduction, Project Siting and Design Development, Description of Proposed Activity

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1 INTRODUCTION

1.1 Project Overview

The Virginia Electric and Power Company, doing business as Dominion Energy Virginia (hereafter referred to as Dominion Energy), is proposing to construct, own, and operate the Coastal Virginia Offshore Wind (CVOW) Commercial Project (hereinafter referred to as the Project). The Project will be located in the Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf (OCS) Offshore Virginia (Lease No. OCS-A-0483) (Lease Area), which was awarded to Dominion Energy (Lessee) through the Bureau of Ocean Energy Management (BOEM) competitive renewable energy lease auction of the Wind Energy Area (WEA) offshore of Virginia in 2013. The Lease Area covers approximately 112,799 acres (ac; 45,658 hectares [ha]) and is approximately 27 statute miles (mi; 23.75 nautical miles [nm], 43.99 kilometers [km]) off the Virginia Beach coastline (Figure 1.1-1).

The purpose of this Project is to provide between 2,500 and 3,000 megawatts (MW) of clean, reliable offshore wind energy; to increase the amount and availability of renewable energy to Virginia consumers; to create the opportunity to displace electricity generated by fossil fuel-powered plants, and to offer substantial economic and environmental benefits to the Commonwealth of Virginia. This Project represents a viable and needed opportunity for Virginia to obtain clean renewable energy and realize its economic and environmental goals.

Dominion Energy has adopted a Project Design Envelope (PDE) approach to describe Project facilities and activities. A PDE is defined as "a reasonable range of project designs" associated with various components of the project (e.g., foundation and wind turbine generator (WTG) [or wind turbine] options) (BOEM 2018). The PDE is then used to assess the potential impacts on key environmental and human use resources (e.g., marine mammals, fish, benthic habitats, commercial fisheries, navigation, etc.) focusing on the design parameter (within the defined range) that represents the greatest potential impact (i.e., the "maximum design scenario") for each unique resource (Rowe et al. 2017). The primary goal of applying a design envelope is to allow for meaningful assessments by the jurisdictional agencies of the proposed project elements and activities while concurrently providing the Lessee reasonable flexibility to make prudent development and design decisions prior to construction. This conservative approach likely overstates the actual impact to environmental and human use resources from the ultimate Project following alternatives refinement and implementation of any selected avoidance, minimization, and mitigation measures.

This Construction and Operations Plan (COP) covers the entire Lease Area, Offshore Export Cable Route Corridor, and associated Onshore Project Components and therefore addresses the proposed Project elements and the means and methods used for constructing, installing and operating the facilities as well as the potential positive and adverse effects of the Project.

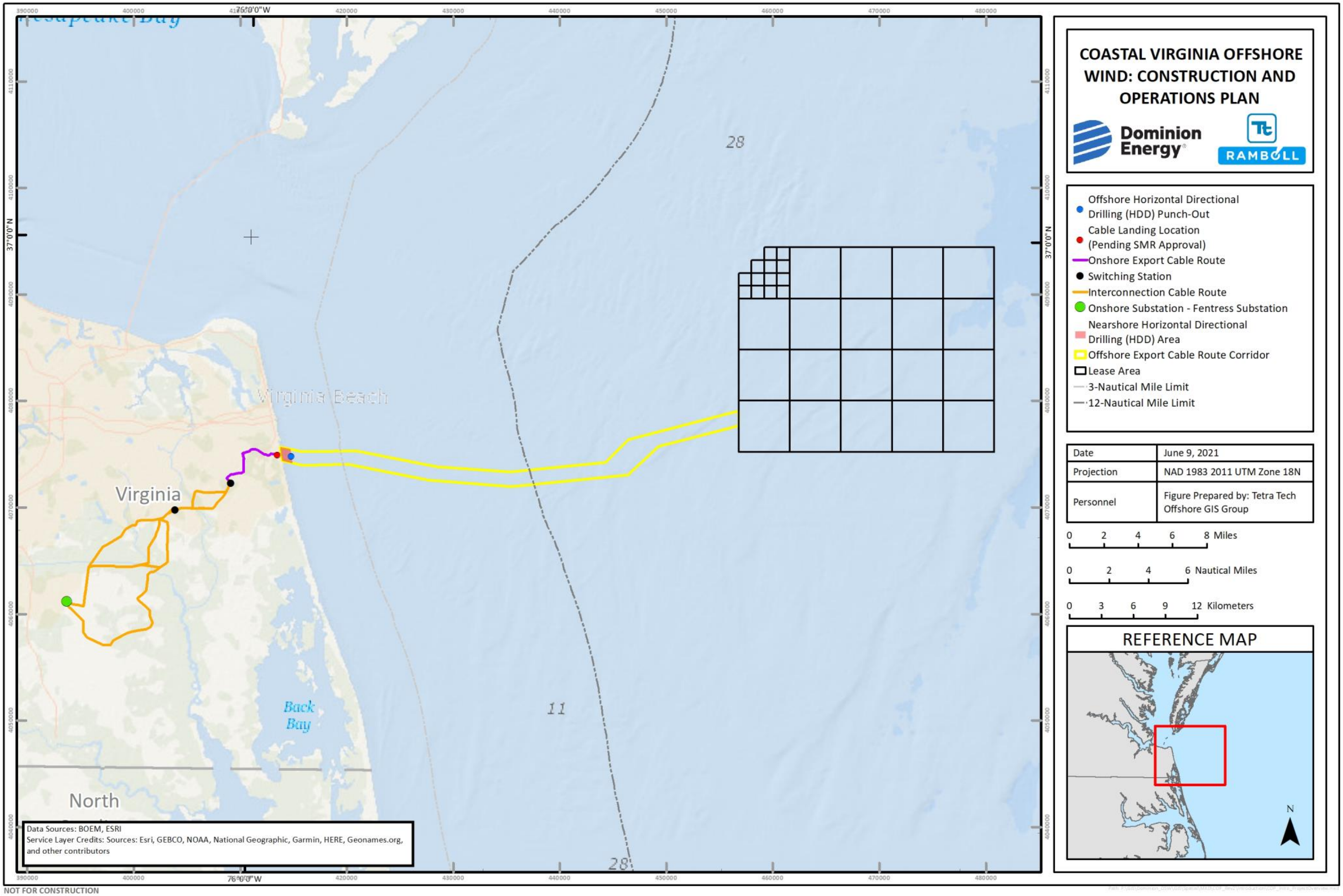


Figure 1.1-1. Project Overview

Offshore components of the Project will consist of the following, as further described in Section 3, Description of Proposed Activity:

- Up to 205 WTGs and associated WTG Foundations;
- Between two and three Offshore Substations and associated Offshore Substation Foundations;
- Up to 300 mi (484 km) total length of Inter-Array Cables (average Inter-Array Cable length of 6,922.6 feet [ft; 2,110 meters [m]) between turbines; and
- Up to nine buried submarine high-voltage alternating-current (HVAC) Offshore Export Cables.

The Offshore Project Components, including the Offshore Substations, Inter-Array Cables, and WTGs, will be located in federal waters in the Lease Area, while the Offshore Export Cable Route Corridor will traverse both federal and state territorial waters of Virginia. The construction stage of the Project will include a temporary construction laydown area(s) and construction port(s). The operations and maintenance (O&M) stage of the Project will include an onshore O&M facility with an associated Base Port.

Onshore components of the Project will consist of the following as further detailed in Section 3, Description of Proposed Activity:

- One Cable Landing Location;
- Up to 27 Onshore Export Cables along one route from the Cable Landing Location to Harpers Road;
- A Switching Station to be located either south of Harpers Road or north of Princess Anne Road;
- Triple-circuit Interconnection Cables from the Switching Station to be located either south of Harpers Road or north of Princess Anne Road to the Onshore Substation; and
- An existing Onshore Substation that will require facility expansion/upgrades to accommodate the power generated by the Project.

The Onshore Substation is an existing substation currently owned by Dominion Energy called the Fentress Substation. Onshore Export Cables are anticipated to be constructed as underground transmission lines from the Cable Landing Location to Harpers Road, while the Interconnection Cables are expected to be constructed as overhead transmission lines or as a combination of overhead and underground (hybrid) transmission lines from Harpers Road to the Onshore Substation. The onshore components of the Project, including the Onshore Substation, Interconnection Cables, Switching Station, Onshore Export Cables, and the Cable Landing Location will be located in the area of Hampton Roads in Virginia.

The proposed facility locations for development of the Project have been selected based upon the preliminary environmental and engineering site characterization studies that have been completed to date. The location of Project facilities will be further refined by the final engineering design as well as ongoing and continuing discussions, agency reviews, public input, and the National Environmental Policy Act (NEPA) and National Historic Preservation Act (NHPA) review processes.

Construction and O&M of the Project will require federal, state, and local permit and environmental reviews. Dominion Energy prepared this COP in accordance with BOEM's renewable energy regulations (30 Code of Federal Regulations [CFR] Part 585) (see Table 1.1-1). The COP is intended to support the environmental impact assessment under NEPA, as amended (42 United States Code [U.S.C.] §§ 4321 *et seq.*), as well as the environmental analysis required as part of other federal, state, and local approvals and consultations for the Project, which are discussed in Section 1.4, Regulatory Framework. Supplemental filings will be provided at a future date for any surveys and studies not completed at the time of submission of this COP (See Table 1.1-2).

Table 1.1-1. BOEM Requirements

BOEM Requirement	Location in COP
30 CFR § 585.105(a)	
(1) Design your projects and conduct all activities in a manner that ensures safety and will not cause undue harm or damage to natural resources, including their physical, atmospheric, and biological components to the extent practicable; and take measures to prevent unauthorized discharge of pollutants including marine trash and debris into the offshore environment.	Section 4, Site Characterization and Assessment of Impact Producing Factors Appendix A, Safety Management System
30 CFR § 585.621(a-g)	
(a) The project will conform to all applicable laws, implementing regulations, lease provisions, and stipulations or conditions of the lease.	Section 1.4, Regulatory Framework
(b) The project will be safe.	Appendix A, Safety Management System
(c) The project will not unreasonably interfere with other uses of the OCS, including those involved with National security or defense.	Section 4.4.8, Department of Defense and Outer Continental Shelf National Security Maritime Uses,
(d) The project will not cause undue harm or damage to natural resources; life (including human and wildlife); property; the marine, coastal, or human environment; or sites, structures, or objects of historical or archaeological significance.	Section 4, Site Characterization and Assessment of Impact Producing Factors
(e) The project will use the best available and safest technology.	Section 1.10, Design Standards Section 3, Description of Proposed Activity Appendix B, Preliminary Hierarchy of Standards
(f) The project will use best management practices.	Section 4, Site Characterization and Assessment of Impact Producing Factors
(g) The project will use properly trained personnel.	Appendix A, Safety Management System
30 CFR § 585.626(a)	
(1) Shallow Hazards	
(1)(ii) Gas Seeps or shallow gas;	Section 4.1, Physical Resources Appendix C, Marine Site Investigation Report
(1)(iii) Slump blocks or slump sediments;	Section 4.1, Physical Resources Appendix C, Marine Site Investigation Report
(1)(iv) Hydrates;	Section 4.1, Physical Resources Appendix C, Marine Site Investigation Report
(1)(v) Ice Scour of seabed sediments;	Section 4.1, Physical Resources Appendix C, Marine Site Investigation Report
(2) Geological survey relevant to the design and siting of facility	Section 4.1, Physical Resources Appendix C, Marine Site Investigation Report
(2)(i) Seismic activity at your proposed site;	Section 4.1, Physical Resources Appendix C, Marine Site Investigation Report
(2)(ii) Fault zones;	Section 4.1, Physical Resources Appendix C, Marine Site Investigation Report

BOEM Requirement	Location in COP
(2)(iii) The possibility and effects of seabed subsidence; and	Section 4.1, Physical Resources Appendix C, Marine Site Investigation Report
(2)(iv) The extent and geometry of faulting attenuation effects of geological conditions near your site.	Section 4.1, Physical Resources Appendix C, Marine Site Investigation Report
(3) Biological	
(3)(i) A description of the results of biological surveys used to determine the presence of live bottoms, hard bottoms, and topographic features, and surveys of other marine resources such as fish populations (including migratory populations), marine mammals, sea turtles, and sea birds.	Section 4.2, Biological Resources Appendix D, Benthic Resource Characterization Report Appendix E, Essential Fish Habitat Assessment
(4) Geotechnical Survey	
(4)(i) The results of a testing program used to investigate the stratigraphic and engineering properties of the sediment that may affect the foundations or anchoring systems for your facility.	Section 4.1, Physical Resources Appendix C, Marine Site Investigation Report
(4)(ii) The results of adequate in situ testing, boring, and sampling at each foundation location, to examine all important sediment and rock strata to determine its strength classification, deformation properties, and dynamic characteristics.	Section 4.1, Physical Resources Appendix C, Marine Site Investigation Report
(4)(iii) The results of a minimum of one deep boring (with soil sampling and testing) at each edge of the project area and within the project area as needed to determine the vertical and lateral variation in seabed conditions and to provide the relevant geotechnical data required for design.	Section 4.1, Physical Resources Appendix C, Marine Site Investigation Report
(5) Archaeological Resources	
(5)(i) A description of the historic and prehistoric archaeological resources, as required by the National Historic Preservation Act of 1966 (NHPA) (16 U.S.C. §§ 470 *et seq.*), as amended.	Section 4.3, Cultural Resources Appendix F, Marine Archaeological Resource Assessment Appendix G, Terrestrial Archaeological Resource Assessment Appendix H, Historic Properties Assessment Appendix I, Visual Impact Assessment
(6) Overall Site Investigation	
(6) (i) Scouring of the seabed;	Appendix C, Marine Site Investigation Report
(6) (ii) Hydraulic instability;	Appendix C, Marine Site Investigation Report
(6) (iii) The occurrence of sand waves;	Appendix C, Marine Site Investigation Report
(6) (iv) Instability of slopes at the facility location;	Appendix C, Marine Site Investigation Report
(6) (v) Liquefaction, or possible reduction of sediment strength due to increased pore pressures;	Appendix C, Marine Site Investigation Report Appendix J, Sediment Transport Analysis
(6) (vi) Degradation of subsea permafrost layers;	Appendix C, Marine Site Investigation Report
(6) (vii) Cyclic loading;	Appendix C, Marine Site Investigation Report
(6) (viii) Lateral loading;	Appendix C, Marine Site Investigation Report
(6) (ix) Dynamic loading;	Appendix C, Marine Site Investigation Report
(6) (x) Settlements and displacements;	Appendix C, Marine Site Investigation Report Appendix J, Sediment Transport Analysis

BOEM Requirement	Location in COP
(6) (xi) Plastic deformation and formation collapse mechanisms; and	Appendix C, Marine Site Investigation Report
(6) (xii) Sediment reactions on the facility foundations or anchoring systems.	Appendix J, Sediment Transport Analysis
30 CFR § 585.626(b)	
(1) Contact information	Section 1.7, Authorized Representative and Designated Operator
(2) Designation of operator, if applicable	Section 1.7, Authorized Representative and Designated Operator
(3) The construction and operation concept	Section 3, Description of Proposed Activity
(4) Commercial lease stipulations and compliance	Section 1.4, Regulatory Framework
(5) A location plat	Appendix K, Conceptual Project Design Drawings
(6) General structural and project design, fabrication, and installation	Section 3, Description of Proposed Activity Appendix K, Conceptual Project Design Drawings
(7) All cables and pipelines, including cables on project easements	Section 3, Description of Proposed Activity
(8) A description of the deployment activities	Section 3, Description of Proposed Activity
(9) A list of solid and liquid wastes generated	Section 3, Description of Proposed Activity
(10) A listing of chemical products used (if stored volume exceeds U.S. Environmental Protection Agency [EPA] Reportable Quantities)	Section 3, Description of Proposed Activity
(11) A description of any vessels, vehicles, and aircraft you will use to support your activities	Section 3, Description of Proposed Activity
(12)(i) A general description of the operating procedures and systems under normal conditions	Section 3, Description of Proposed Activity
(12)(ii) A general description of the operating procedures and systems in the case of accidents or emergencies, including those that are natural or manmade	Appendix A, Safety Management System
(13) Decommissioning and site clearance procedures	Section 3, Description of Proposed Activity
(14)(i) A listing of all Federal, State, and local authorizations, approvals, or permits that are required to conduct the proposed activities, including commercial operations. The U.S. Coast Guard (USCG), U.S. Army Corps of Engineers (USACE), and any other applicable authorizations, approvals, or permits, including any federal, state, or local authorizations pertaining to energy gathering, transmission or distribution (e.g., interconnection authorizations)	Section 1.4, Regulatory Framework
(14)(ii) A statement indicating whether you have applied for or obtained such authorization, approval, or permit	Section 1.4, Regulatory Framework
(15) Your proposed measures for avoiding, minimizing, reducing, eliminating, and monitoring environmental impacts	Section 4, Site Characterization and Assessment of Impact Producing Factors
(16) Information you incorporate by reference	Section 5, References
(17) A list of agencies and persons with whom you have communicated, or with whom you will communicate, regarding potential impacts associated with your proposed activities	Appendix L, Summary of Agency and Stakeholder Engagement

BOEM Requirement	Location in COP
(18) Reference	Section 5, References
(19) Financial assurance	Section 1.9, Financial Assurance
(20) Certified Verification Agent (CVA) nominations for reports required in subpart G of this part	Appendix M, Certified Verification Agency Nomination
(21) Construction schedule	Section 1.1.1, Indicative Construction Schedule
(22) Air quality information	Section 4.1.3, Air Quality Appendix N, Air Emissions Calculations and Methodology
(23) Other information	Various locations, throughout COP
30 CFR § 585.627(a)	
(1) Hazard information	Section 4.1.1, Physical and Oceanographic Conditions
(2) Water quality	Section 4.1.2, Water Quality Appendix J, Sediment Transport Analysis
(3) Biological Resources, including benthic communities, marine mammals, sea turtles, coastal and marine birds, fish and shellfish, plankton, seagrasses, and plant life	Section 4.2.4, Benthic Resources, Fishes, Invertebrates, and Essential Fish Habitat Appendix D, Benthic Resource Characterization Reports, Section 4.2.5, Marine Mammals, Section 4.2.6, Sea Turtles, Section 4.2.3, Avian and Bat Species, Appendix O, Avian and Bat Impact Assessment
(4) Threatened or endangered species	Section 4.2, Biological Resources
(5) Sensitive biological resources or habitats	Section 4.2, Biological Resources
(6) Archaeological resources	Section 4.3, Cultural Resources
(7) Social and economic resources	Section 4.4, Socioeconomic Resources
(8) Coastal and marine uses	Section 4.4.11, Other Coastal and Marine Uses
(9) Consistency Certification	Appendix P, Coastal Zone Management Act Consistency Certifications
(10) Other resources, conditions, and activities	Section 4.4.11, Other Coastal and Marine Uses
30 CFR § 585.627(b)	
Consistency certification	Appendix P, Coastal Zone Management Act Consistency Certifications
30 CFR § 585.627(c)	
Oil Spill Response Plan	Appendix Q, Oil Spill Response Plan
30 CFR § 585.627(d)	
Safety Management System	Appendix A, Safety Management System

Table 1.1-2. Supplemental Filings

Appendix	Description	Regulatory Requirement	Submittal Date
Appendix C Marine Site Investigation Report	Geophysical and Geotechnical surveys and data analysis to support preparation of the Marine Site Investigation Report are ongoing and will be completed in the second or third quarter of 2021. Preliminary information from G&G surveys can be found in the Initial Site Characterization Report submitted in support of the Geotechnical Departure Request.	585.626(a)(1) 585.626(a)(2) 585.626(a)(4)(i) 585.626(a)(4)(iii) 585.626(a)(6) 585.627(a)(1) 585.627(a)(5)	October 31, 2021

Appendix	Description	Regulatory Requirement	Submittal Date
Appendix D Benthic Resource Characterization Report	Benthic survey was completed in August of 2020. Due to shutdowns related to the ongoing pandemic, results of infauna analysis are still pending, but expected in the first quarter of 2021	585.626(a)(3) 585.627(a)(3) 585.627(a)(4) 585.627(a)(5)	Submitted March 23, 2021
Appendix E Essential Fish Habitat Assessment	Geophysical and geotechnical surveys and data analysis to support the Essential Fish Habitat Assessment are ongoing and will be completed in the second or third quarter of 2021.	585.626(a)(3) 585.627(a)(3) 585.627(a)(4) 585.627(a)(5)	October 31, 2021
Appendix F Marine Archaeological Resource Assessment	Geophysical and geotechnical surveys and data analysis to support the Marine Archaeological Resource Assessment are ongoing and will be completed in the second or third quarter of 2021.	585.626(a)(5) 585.627(a)(6)	October 31, 2021
Appendix G Terrestrial Archaeological Resource Assessment	Dominion Energy is in the process of coordinating property access for the Onshore Project Area so that field surveys can be completed. In support of the terrestrial archaeological resources survey, which is currently ongoing, Dominion Energy developed a survey plan that was submitted to the Bureau of Ocean Energy Management (BOEM) and Virginia Department of Historic Resources (VDHR) for review. Dominion Energy is currently revising the survey plan to address comments received from BOEM and VDHR, and anticipates submittal of the revised survey plan to BOEM and VDHR mid-June 2021. To date, the Phase IA portion of the Terrestrial Archaeological Resources Assessment (TARA) has been initiated including reconnaissance survey of properties which Dominion Energy has access permission and associated reporting will be completed in June 2021 (see Appendix G). The Phase IB portion of the TARA is anticipated to begin in July 2021 for properties which Dominion Energy has access permission, and associated reporting will be completed by October 2021.	585.626(a)(5) 585.627(a)(6)	June 30, 2021 October 31, 2021
Appendix H Historic Properties Assessment	In support of the Historic Properties Assessment, which is currently ongoing, Dominion Energy developed onshore and offshore survey plans that were submitted to the Bureau of Ocean Energy Management (BOEM) for review. Dominion Energy is currently revising the survey plans to address comments received from BOEM and anticipates submittal of the revised survey plans to BOEM, VDHR, and NCHPO mid-June 2021. The surveys, reporting, and analysis for the Historic Properties Assessment completed to date will be submitted in June 2021. Any additional surveys, reporting and analysis completed after this filing will be submitted by October 2021.	585.626(a)(5) 585.627(a)(6)	June 30, 2021 October 31, 2021

Appendix	Description	Regulatory Requirement	Submittal Date
Appendix I Visual Impact Assessment	In support of the Visual Impact Assessment, which is currently ongoing, Dominion Energy developed onshore and offshore survey plan that were submitted to the Bureau of Ocean Energy Management (BOEM) for review. Dominion Energy is currently revising the survey plans to address comments received from BOEM and anticipates submittal of the revised survey plans to BOEM mid-June 2021. The surveys, reporting, and analysis for the Visual Impact Assessment completed to date will be submitted in June 2021. Any additional surveys, reporting and analysis completed after this filing will be submitted by October 2021.	585.626(a)(5)	June 30, 2021 October 31, 2021
Appendix R Threatened and Endangered Species Review	Dominion Energy is in the process of coordinating property access for the Onshore Project Area so that field surveys can be conducted. To the extent possible, property access will be obtained in the second quarter of 2021.	585.627(a)(4)	June 30, 2021
Appendix T Obstruction Evaluation and Additional Analysis: • Air Traffic Flow Analysis; and, • Aircraft Detection Lighting System Efficacy Analysis	The Obstruction Evaluation and Radar Line of Site Screening were submitted with the COP in December, 2020. Due to shutdowns related to the ongoing pandemic, information from the Freedom of Information Act request to the Federal Aviation Administration was not received until the first quarter of 2021	14 CFR Part 77, as applicable 14 CFR § 77.9	Submitted March 23, 2021
Appendix U Wetland Delineation Report	Dominion Energy is in the process of coordinating property access for the Onshore Project Area so that field surveys can be completed. To date, wetland delineations have been completed on properties where access has been granted and associated reporting on delineations performed to date will be completed in June 2021 (see Appendix G). Wetland delineations and associated reporting for properties for which Dominion Energy gains access permission following this submittal, will be completed by October 2021.	585.627(a)(5)	June 30, 2021
Appendix CC Seabed Morphology	The Seabed Morphology assessment will incorporate information from the ongoing geophysical and geotechnical surveys upon completion of survey data analysis.	585.626(a)(6)	June 16, 2021

Dominion Energy submitted a Site Assessment Plan and Construction and Operations Plan Survey Plan to BOEM on February 14, 2020 (modifications submitted on March 26, April 10, May 20, and September 8, 2020, and February and March 2021) to conduct high-resolution geophysical (HRG), geotechnical, benthic, and other survey activities in the Lease Area, Offshore Export Cable Route Corridor, and Onshore Project Area, including the Onshore Export Cable Route, Switching Station, Interconnection Cable Routes, and Onshore Substation (hereinafter called the "Project Area"). On June 12 and September 25, 2020 and April 13, 2021, BOEM acknowledged that all comments on the Construction and Operations Survey Plan had been addressed, and survey work commenced in Spring 2020 and will continue through approximately August 2021. These surveys will inform overall Project design and engineering and allow for siting flexibility. Data acquired through this field program will be provided in the Facility Design Report/Fabrication Installation Report (FDR/FIR) or as COP supplemental filings as required for the Project.

1.1.1 Indicative Construction Schedule

An indicative construction schedule for the construction and development of the Lease Area is provided in Table 1.1-3. The schedule assumes that all permits and authorizations will be received by the start of onshore construction in Q2 2023 and offshore construction in Q2 2024. Start of operations is anticipated to be conducted in groups of up to eight turbines beginning in Q2 2025. Construction schedules are subject to various factors, for example, state and federal permitting, financial investment decisions, supply chain considerations, and weather conditions. Therefore, flexibility on construction schedules is important. As such, the PDE covers reasonably foreseeable schedule scenarios, from which maximum design scenarios are conservatively selected as part of the assessment process.

1.2 Project Design Envelope

Development of an offshore wind facility is an extensive and complex process spanning several years. As such, it is not possible to establish a final form of development at the time of the COP submittal. In Europe, it is an accepted practice for offshore wind farm projects to present a range of potential final design parameters through a realistic maximum design scenario approach to the assessment. This is achieved by assessing the maximum parameters for key components (e.g., WTGs, foundations, and installation methodologies) within which the Project will be limited. By assessing the realistic maximum design scenario for each component, the environmental, cultural, and social impact assessment can be robust while allowing for flexibility further on in the development process. The term used to describe the process and set of parameters adopted for a specific project is sometimes referred to as a PDE.

Table 1.1-3. Indicative Construction Schedule

Activity	2023		2024				2025				2026				2027	
	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Scour Protection Pre-Installation																
Monopile Installation																
Scour Protection Post-Installation																
Transition Piece Installation																
WTG Installation																
Inter-Array Cable Installation																
Offshore Substation Installation (piling between May 1 and October 31)																
Offshore Export Cable Installation																
Onshore Export and Interconnection Cable Installation																
Switching Station Construction																
Onshore Substation Upgrade Construction																
Commissioning																

The primary goal of applying a design envelope is to allow for meaningful assessments by the jurisdictional agencies of the proposed project activities while concurrently providing the Lessee reasonable flexibility to make prudent development and design decisions prior to construction. Offshore wind technologies are rapidly advancing and evolving, and the flexibility to take advantage of industry advancements and innovative technologies as a project progresses through development is critical to ensuring that the most technologically sound, environmentally appropriate, and cost-effective project is constructed. In addition, as projects progress through the permitting process and ongoing consultations, flexibility is needed to be able to effectively apply feedback, new design data, and permitting conditions placed on the project.

In an effort to analyze and apply industry-wide best practices in the U.S., BOEM funded a study titled *Phased Approaches to Offshore Wind Developments and Use of the Project Design Envelope, Final Technical Report* (Rowe et al. 2017). The study provided the foundation for BOEM's guidance document entitled *Draft Guidance Regarding the Use of a Project Design Envelope in a Construction and Operations Plan* (BOEM 2018). Within this guidance, BOEM defines a design envelope as "a reasonable range of project designs" associated with various components of the project (e.g., WTGs, foundations, and installation methodologies) (BOEM 2018). The design envelope is used to assess the potential impacts on key environmental and human use resources (e.g., marine mammals, fish, benthic habitats, commercial fisheries, navigation, etc.) focusing on the design parameter (within the defined range) that represents the realistic maximum design scenario for each unique resource (Rowe et al. 2017).

The definition of what is considered the realistic maximum design scenario varies based on the potentially impacted resource and is provided at the beginning of each subsection within Section 4, Site Characterization and Assessment of Impact-Producing Factors. The Maximum Project Design Scenario, a full Lease Area buildout, is also detailed in Section 3, Description of Proposed Activity. Dominion Energy has ensured that only "realistic" development scenarios are considered when defining these. For example, while different sizes of foundation are included in the application, the largest foundations may not be required to support the smallest WTG. In this case, the assessment would identify and describe the greatest impact associated with the foundation type that would be installed with that size WTG. The range of options in the PDE applies for all of the Lease Area.

Dominion Energy will continue to evaluate detailed design and engineering studies to identify conditions and the Project components that would be best suited to the Lease Area. Dominion Energy also plans to commence fabrication of certain Project components in advance of BOEM approval of the COP and Nominated Certified Verification Agent (CVA) and BOEM No Objection to the FDR/FIR.

On November 13, 2020, Dominion Energy submitted a request to BOEM to depart from the requirements of 30 CFR § 585.700(b). Additionally, Dominion Energy submitted a separate request, concurrent with the December 2020 COP, to depart from 30 CFR §§ 585.626(a)(4)(ii) and (iii) as the regulations pertain to the submittal of geotechnical survey results with the COP. Dominion Energy will submit any future requests to BOEM to depart from 30 CFR § 585.700(b), as applicable.

Based on discussions with BOEM conducted in 2020, Dominion Energy has applied a PDE approach to describe Project facilities and activities. Details regarding the PDE for the Project Area are provided in Section 3, Description of Proposed Activity. A summary of PDE parameters is provided in Table 1.2-1.

Table 1.2-1. Summary of PDE Parameters

Project Parameter Details
General (Layout and Project Size)
• 179 to 205 WTGs • Anticipated to begin offshore construction in 2024 (foundations) 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 • 14- to 16-MW WTGs characterized as "minimum" and "maximum" capacity • Rotor diameter ranging from 725 to 761 ft (221 to 232 m) • Hub height from mean sea level (MSL) ranging from 446 to 489 ft (136 to 149 m) • Turbine tip height from MSL ranging from 804 to 869 ft (245 to 265 m) • Installation of monopiles through pile-driving • Scour protection is proposed to be installed around WTG Foundations 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-kilovolt (kV) cables buried 3.3 to 16.4 ft (1 to 5 m) beneath the seabed • Up to 300 miles (484 km) total length of Inter-Array Cables (average Inter-Array Cable length of 6,922.6 ft [2,110 m] 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 ft (1 to 5 m) beneath the seabed • Nine export cables (in a single corridor), with alternatives • Up to 416.9 mi (671 km) total length of Offshore Export Cable • Installation by jet trenching, plowing, chain cutting, trench former, 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 Offshore Substations • Offshore Substations installed atop piled jacket foundations • Scour protection installed at all foundation locations • Installation vessels to include deck carrier, heavy lift, semi-submersible, jack-up vessels, and other support vessel types as necessary
Onshore Facilities
• Landfall of Offshore Export Cable(s) will be completed via horizontal directional drill • Maximum area of temporary disturbance for Cable Landing Location 6 ac (2.42 ha) • Construction work area for the Switching Station, maximum of approximately 26 ac (10.5 ha) • Construction work area for the Upgrades at the Onshore Substation (existing Dominion Energy Fentress substation), maximum of approximately 46.2 ac (18.7 ha) • Maximum Onshore Export Cable length of approximately 4.8 mi (7.72 km) • Maximum Interconnection Cable length of approximately 19.7 mi (31.71 km) • Maximum area of temporary disturbance for Onshore Export Cable Route of approximately 63 ac (25.5 ha) • Maximum area of temporary disturbance for Interconnection Cable Route of approximately 374 ac (151 ha)

1.3 Purpose and Need

Under the Outer Continental Shelf Lands Act (OCSLA), the Secretary of the Interior is responsible for the administration of mineral and wind exploration and development of the OCS. For wind development, the Act empowers the Secretary to grant leases, easements, and rights-of-way and to formulate regulations as necessary to carry out the provisions of the Act. BOEM is responsible for offshore renewable energy development in federal waters. BOEM's renewable energy program occurs in four distinct stages[1] planning, leasing, site assessment, and construction and operations. BOEM engages key stakeholders throughout this process, as early communication with interested and potentially affected parties is critical to managing potential conflicts.

BOEM prepared a final Programmatic Environmental Impact Statement (PEIS)[2] in support of establishing its program for authorizing renewable energy and alternate use activities on the OCS. The final PEIS examines the potential environmental effects of the program on the OCS and identifies policies and best management practices that may be adopted for the program.

As stated above, the purpose of this Project is to provide clean, reliable offshore wind energy; to increase the amount and availability of renewable energy to Virginia consumers; to create the opportunity to displace electricity generated by fossil fuel-powered plants, and to offer substantial economic and environmental benefits to the Commonwealth of Virginia. The Project also directly supports the goals of the 2020 law passed by the Virginia General Assembly, the Virginia Clean Economy Act (VCEA), which supports development of 2,500 to 3,000 MW of clean, reliable offshore wind energy to be in service by 2028. The VCEA is intended to build a clean energy future for the Commonwealth of Virginia that reduces carbon emissions and creates significant economic improvement through local job creation and supply chain formation in both the Commonwealth of Virginia and neighboring states. The Project would increase the amount and availability of renewable energy to Virginia consumers while creating the opportunity to displace electricity generated by fossil fuel-powered plants and offering substantial economic and environmental benefits to the Commonwealth of Virginia. This Project, as designed, should provide approximately 8.8 million megawatt-hours of carbon-free power to the grid on an annual basis. This equates to over 5.3 million metric tons of carbon dioxide that will be reduced from the power generating fleet to meet the needs of Dominion Energy's customers. The onshore electrical portion will connect to the Pennsylvania-New Jersey-Maryland (PJM) regional electric transmission grid, and at peak output the project will power approximately 660,000 homes.

Wind, along with solar, are the least-cost generation options, so they will–by default–be dispatched first to offset production from fossil-fueled units in order to keep the price of electricity as low as reasonably possible.

This Project is not only an important steppingstone toward commercial-scale offshore wind development, but also it will further Dominion Energy's commitment to 3,000 MW of solar and wind energy under development or in operation by the beginning of 2022. The VCEA supports this Project by deeming it in the public interest subject to several conditions, such as competitive procurement and a cost cap. This

[1] https://www.boem.gov/Commercial-Leasing-Process-Fact-Sheet/
[2] https://www.boem.gov/Renewable-Energy-Program/Regulatory-Information/Guide-To-EIS.aspx

Project will be the largest offshore renewable wind energy initiative undertaken in federal waters and the first of its kind owned by an electric utility company.

The Project will directly respond in a cost-effective manner to this expressed need and demand and help achieve significant reductions of greenhouse gas emissions across the region. To meet this need and demand in a timely and efficient manner, it is imperative that the design and permitting for the Project proceed as expeditiously as possible so that the Project can be constructed and commence operations in advance of these State-mandated deadlines.

1.4 Regulatory Framework

1.4.1 Federal Permits, Approvals, and Consultations

Under the OCSLA, the Secretary of the Interior was charged with the administration of mineral exploration and development of the OCS (Title 43, Chapter 29, Subchapter I, § 1301). In 2005, the OCSLA was amended to authorize the Department of the Interior (DOI) to issue leases, easements, and rights-of-way for alternate uses and alternative energy development on the OCS (Section 388 of the Energy Policy Act of 2005). Through this amendment and subsequent delegation by the Secretary of the Interior, BOEM has the authority to issue these leases and regulate activities that occur within them, including the authorization of a COP.

As the federal agency charged with issuing the OCS Lease and reviewing and approving the COP, BOEM will serve as the lead federal agency for the entire Project throughout the permitting process. BOEM will also authorize an easement that will be necessary for the portion of the Offshore Export Cables that are located in federal waters outside of the Lease Area.

As part of the COP approval process, BOEM must ensure that any activities approved are safe, conserve natural resources on the OCS, are undertaken in coordination with relevant federal agencies, provide a fair return to the U.S., and are compliant with all applicable laws and regulations (30 CFR § 585.102). NEPA, also requires the preparation of an Environmental Impact Statement (EIS) for any major federal action significantly affecting the quality of the human environment.

While BOEM is the primary federal agency governing the development of a renewable energy facility within the Lease Area, given the locations of the Project components, several other federal, state, and local agencies also have regulatory authority over the Project. A list of the required approvals and consultations and their current status is provided in Table 1.4-1. At this time, Dominion Energy has not applied for other federal or state permits associated with construction and O&M of the Project, but plans to begin submitting permit applications in the second half of 2021.

A crossing agreement is a form of Joint Use Agreement used for the common usage of intersecting utilities. The Offshore Export Cables will cross several fiber optic communications cables, resulting in required cable crossings. The Interconnection Cables will also require several cable crossings. Dominion Energy has begun coordination with the owners of the fiber optic cables to ensure that crossing agreements are in place as early as practicable in the Project planning process, and will continue to coordinate with the owners of any additional fiber optic cables that are installed. An agreement will also need to be established with

Chesapeake and Albemarle Railroad to run onshore transmission lines across or under railways and work within any rights-of-way (ROWs).

The Fixing America's Surface Transportation (FAST) Act (December 2015), which is a federal streamlining directive that applies to all COPs, is optional for applicants. Title 41 of the FAST Act (FAST-41) (42 U.S.C. § 4370m) was designed to improve the timeliness, predictability, and transparency of the Federal environmental review and authorization process for covered infrastructure projects. FAST-41 created a new entity – the Federal Permitting Improvement Steering Council (FPISC), composed of agency Deputy Secretary-level members and chaired by an Executive Director appointed by the President. FAST-41 establishes new procedures that standardize interagency consultation and coordination practices. Importantly, FAST-41 creates a new authority for agencies to issue regulations for the collection of fees, which, if implemented, will allow the Council to direct resources to critical functions within the interagency review process. FAST-41 codifies into law the use of the Permitting Dashboard to track project timelines. Dominion Energy is pursuing the FAST-41 directive in support of the COP.

Dominion Energy submitted a FAST-41 Initiation Notice (FIN) to the FPISC on February 1, 2021, which resulted in a determination that the Project was covered under FAST-41. FPISC hosted an interagency Coordinated Project Plan (CPP) workshop on April 4, 2021 and the permitting timetable for the Project was posted to the Permitting Dashboard on April 13, 2021.[3] Dominion Energy continues to work closely with FPISC and BOEM to address any data requests in a timely manner to ensure that timeframes indicated on the Permitting Dashboard are maintained.

1.4.2 State and Local Permits, Approvals, and Consultations

As Project components are proposed in the Commonwealth of Virginia, approvals from the applicable state and local agencies will also be required. At the state level, the Virginia Marine Resources Commission (VMRC) will issue a VMRC Permit for the portions of the Project located over, under or on certain state waters under the Virginia Code and regulations (Section 10 Waters, tidal waters, and non-tidal waterways). The Virginia Department of Environmental Quality (VDEQ) will issue a Virginia Water Protection (VWP) Individual Permit pursuant to the Code of Virginia and the Section 401 Water Quality Certification requirements of the federal Clean Water Act (CWA). The U.S. Environmental Protection Agency (EPA) also requires that the Project submit air permit applications under the Clean Air Act (CAA) for marine vessels or other equipment used to construct and/or operate the Project; Dominion Energy anticipates the authority for this permit will be delegated by the EPA to the VDEQ.

Coastal Zone Management Act Consistency

The Coastal Zone Management Act of 1972 (CZMA) requires that federal actions likely to affect any land or water use, or natural resource of a state's coastal zone, be conducted in a manner that is consistent with the state's federally approved Coastal Zone Management Program (CZMP). The Virginia CZMP was established in 1986 and is administered by VDEQ, which serves as the lead agency for the network of

[3] See https://www.permits.performance.gov/permitting-project/coastal-virginia-offshore-wind-commercial-project for more information

Virginia state agencies and local governments that administer the CZMP. The enforceable policies that make up the CZMP include:

- Fisheries Management (Virginia Administrative Code [VAC] §28.2-200 through §28.2-713 and VAC §29.1-100 through §29.1-570);
- Subaqueous Lands (VAC §28.2-1200 through §28.2-1213);
- Wetlands Management (VAC §28.2-1300 through §28.2-1320 and §62.1-44.15.5);
- Dunes Management (VAC §28.2-1400 through §28.2-1420);
- Point and Nonpoint Source Pollution Control (VAC §10.1-560 *et seq*. and §62.1-44.15);
- Shoreline Sanitation (VAC §32.1-164 through §32.1-165;
- Air Pollution Control (VAC §10-1.1300); and
- Coastal Lands Management (Chesapeake Bay Preservation Act, VAC §10.1-2117 through §10.1-2134 and regulations 4 VAC 50-90).

Given the distance of the Lease Area to the shoreline in the State of North Carolina, the North Carolina CZMA has also been considered. The North Carolina Coastal Area Management Act (CAMA) establishes a cooperative coastal area management program between local and state governments. CAMA is the overarching statutory authority for: (1) the state guidelines adopted by regulations in Chapter 7 of Title 15A of the North Carolina Administrative Code (NCAC), (2) local land use plans, and (3) the state permitting process for major development actions. The intention of the program is to provide a management system through policies and standards to protect, preserve, and conserve coastal natural resources while providing a balanced opportunity to use coastal resources for the purposes of economic development, recreation and tourist facilities, transportation, and historic, cultural, and scientific resources.

The North Carolina CZMP was established in 1978 and is administered by the North Carolina Division of Coastal Management (DCM), which serves as the lead agency for the network of North Carolina state agencies and local governments that administer the CZMP. Projects within North Carolina’s coastal waters must comply with the key elements of North Carolina's Coastal Management Program, which include:

- The Coastal Area Management Act;
- the State's Dredge and Fill Law;
- Chapter 7 of Title 15A of the NCAC;
- regulations passed by the Coastal Resources Commission (CRC);
- local land-use plans certified by the CRC; and
- a network of other state agencies’ laws and regulations.

Appendix P Coastal Zone Management Act Consistency Certifications has been prepared pursuant to 15 CFR § 930.39 and provides the data and information necessary to certify that the construction and O&M of the CVOW Commercial Project will be consistent with the CZMP(s), in accordance with CZMA § 307(c)(3)(A), 16 U.S.C. § 1456(c)(3)(A), and 15 CFR § 930, subpart D. Appendix P presents a summary of each enforceable policy under the CZMP and how the CVOW Commercial Project will be consistent with each policy, including a reference to specific sections of the COP that address each policy.

A summary of all required permits and their status is provided in Table 1.4-1.

Table 1.4-1. Required Approvals and Consultations

Regulatory Agency	Permit or Approval	Statutory Basis	Status
BOEM	Outer Continental Shelf Lands Commercial Lease, Site Assessment Plan, and COP	OCSLA 43 U.S.C. § 1337(p)	BOEM published request for competitive interest in Federal Register on December 3, 2012. On November 1, 2013, BOEM issued the Commercial Lease OCS-A 0483. Per BOEM direction issued on December 3, 2013 this COP is submitted to BOEM in accordance with 30 CFR §§ 585.626 and 627.
BOEM	Facility Design Report and Fabrication and Installation Report	30 CFR § 585.700	These reports will be submitted prior to installation of facilities as described in this COP.
USACE Norfolk District	Individual Permit Section 10 Permit for structure in navigable U.S. waters Section 404 Dredge Discharge Permit in navigable U.S. waters Section 408 Permit for activities in a Civil Works Project	Rivers and Harbors Act—Section 10 33 U.S.C. §§ 333(e), 403, and CWA Section 404 33 U.S.C. § 1344	Pre-application consultation was initiated on November 17, 2020. Information required to support the acquisition of these permits is provided in this COP.
BOEM, USACE, and Cooperating Agencies	NEPA Compliance (Categorical Exclusion, Environmental Assessment and Finding of No Significant Impact or Environmental Impact Statement and Record of Decision)	NEPA 42 U.S.C §§ 4321 *et seq.* Energy Policy Act of 2005	An Environmental Impact Statement and Finding of No Significant Impact for the commercial wind lease issuance and site assessment activities on the Atlantic OCS offshore New Jersey, Delaware, Maryland, and Virginia was published on February 2, 2012. Scoping related to the construction and O&M of the Project with primary federal permitting agencies will be conducted during the COP review process. Information required to support NEPA review has been provided in this COP.

Regulatory Agency	Permit or Approval	Statutory Basis	Status
National Oceanic and Atmospheric Administration's (NOAA's) National Marine Fisheries Service (NOAA Fisheries)	Section 7 Consultation under the Endangered Species Act of 1973 (ESA) ESA Incidental Take Permit (ITP)	ESA 16 U.S.C. § 660 16 U.S.C. §§ 1531 *et seq.*	Information to support consultation between federal permitting agencies and federal wildlife resource agencies has been provided in this COP (Section 4.2, Biological Resources, and Appendix R, Threatened and Endangered Species Review).
	Marine Mammal Protection Act (MMPA) Incidental Harassment Authorization (IHA) or Letter of Authorization (LOA)	MMPA 16 U.S.C. §§ 1361 *et seq.*	Information to support consultation between federal permitting agencies and federal wildlife resource agencies has been provided in this COP (Section 4.2, Biological Resources). Dominion Energy will use information provided in this COP, additional detail from ongoing Project engineering, and information received from pre-application consultations to prepare the application for the IHA or LOA for submittal in Q1 2021.
	Magnuson-Stevens Fishery Conservation and Management Act	Magnuson-Stevens Fishery Conservation and Management Act 16 U.S.C. §§ 1801 *et seq.*	Information to support consultation between federal permitting agencies and federal wildlife resource agencies has been provided in this COP (Section 4.2, Biological Resources, Appendix D, Benthic Resource Characterization Report, Appendix E, Essential Fish Habitat Assessment, and Appendix R, Threatened and Endangered Species Review).
U.S. Fish and Wildlife Service (USFWS) Northeast Region (Region 5)	Section 7 Consultation under the ESA ESA ITP if required	ESA 16 U.S.C. §1531 Migratory Bird Treaty Act, 16 U.S.C. §§ 703 *et seq.* Bald and Golden Eagle Protection Act 16 U.S.C. § 668	Information to support consultation between federal permitting agencies and federal wildlife resource agencies has been provided in this COP (Section 4.2, Biological Resources and Appendix R, Threatened and Endangered Species Review).
Advisory Council on Historic Preservation (ACHP)	NHPA Section 106 and 110 Consultation	NHPA 54 U.S.C. § 306108 and 16 U.S.C. § 470	Information to support consultation between federal permitting agencies and Virginia Department of Historic Resources has been provided in this COP (Section 4.3, Cultural Resources, and Appendix F, Marine Archaeological Resource Assessment, Appendix G, Terrestrial Archaeological Resource Assessment, and Appendix H, Historic Properties Resource Assessment)

Regulatory Agency	Permit or Approval	Statutory Basis	Status
USCG, Sector Virginia	Approval for Private Aids to Navigation (PATON) Local Notice to Mariners (LNTM) Captain of the Port (COTP) Letter	49 U.S.C. § 44718 33 U.S.C. § 1221	Lighting and marking has been developed in consultation with the USCG and provided in this COP (Section 3.4.2, Onshore Construction, and Appendix S, Navigation Safety Risk Assessment). Dominion Energy will prepare the PATON and LNTM a minimum of 4 months prior to commencement of operations and a minimum of 2 weeks before commencing activities, respectively.
BOEM, USCG, USACE, or U.S. Department of the Navy, as appropriate	Permits/Permissions and Approvals Required for Unexploded Ordnance Survey, Identification and Disposition	10 U.S.C. § 2710	These permits/permissions and approvals will be completed prior to construction.
Federal Aviation Administration	Onshore Obstruction Evaluation/Notice Criteria Tool	14 CFR Part 77, as applicable 14 CFR § 77.9	Information to support consultation between the FAA and the DoD has been provided in this COP (Section 4.4.10, Aviation and Radar and Appendix T, Obstruction Evaluation and Airspace Analysis).
U.S. Department of Defense (DoD)	Consultation	Public Law 114-92, National Defense Authorization Act (NDAA) of 2016, Amendment to § 358, FY11 NDAA	Information to support consultation between the federal permitting agencies and DoD has been provided in this COP (Section 4.4.8, Department of Defense and Outer Continental Shelf National Security Maritime Uses and Appendix S, Navigation Safety Risk Assessment
EPA, Region 3, Air Programs Branch	OCS Air Permit	Clean Air Act 42 U.S.C. §§ 7401 *et seq.*	The required OCS Notice of Intent (NOI) will be submitted to EPA Region 3 and neighboring state agencies (VDEQ and North Carolina Department of Environmental Quality) prior to submittal of the OCS air permit application. Virginia has received delegation to issue OCS air permits under 40 CFR Part 55, and is anticipated to be the responsible permitting agency. An OCS air permit application will be submitted to VDEQ and approval received prior to construction.
VDEQ, NCDCM, BOEM	Concurrence with Federal Consistency Certification	Section 307 of the Coastal Zone Management Act (CZMA), 16 U.S.C. § 1456	Information necessary to support this certification was provided in this COP (Appendix P, Coastal Zone Management Act Consistency Certifications). A copy of the Federal Consistency Certification has also been included in Appendix P, Coastal Zone Management Act Consistency Certifications.

Regulatory Agency	Permit or Approval	Statutory Basis	Status
VMRC	Submerged Land Permit	Code of Virginia §28.2-1200 through §28.2-1213; 4 VAC 20	Approval will be obtained through the Joint Permit Application Process. Information to support the acquisition of the authorization has been provided in this COP (Section 1.0, Introduction, Section 2.0, Project Siting and Design Development, Section 3.0, Description of Proposed Activity, Section 4.0, Site Characterization and Assessment of Impact-Producing Factors, and Appendix K, Conceptual Project Design Drawings).
VDEQ	Water Quality Certification Virginia Water Protection Permit	CWA Section 401	Approval will be obtained through the Joint Permit Application Process. Information to support review of the Project under the CWA has been provided in this COP (Section 1.0, Introduction, Section 2.0, Project Siting and Design Development, Section 3.0, Description of Proposed Activity, Section 4.0, Site Characterization and Assessment of Impact-Producing Factors, and Appendix K, Conceptual Project Design Drawings).
	Conformity Determination	Clean Air Act 42 U.S.C. §§ 7401 *et seq.*	General Conformity requirements (40 CFR 93 Subpart B) are currently not anticipated to apply to any emissions during construction of the Project, as no construction activities are currently located in any defined nonattainment or maintenance areas.
	OCS Air Permit	Clean Air Act 42 U.S.C. §§ 7401 *et seq.*	Virginia has received delegation to issue OCS air permits under 40 CFR Part 55, and is anticipated to be the responsible permitting agency. An OCS air permit application will be submitted to VDEQ and approval received prior to construction.
	Emergency Generator General Permit	9 VAC §5-540-90	An emergency generator general permit application will be submitted to VDEQ and approval received prior to construction.
	Construction Stormwater General Permit Authorization	9 VAC §25-31-170	Information to support the acquisition of the authorization will be provided upon approval of the COP.
	Stormwater Pollution Prevention Plan	9 VAC §25-870-55	Information to support the acquisition of the authorization will be provided upon approval of the COP.
	Erosion and Sediment Control Plan	Code of Virginia § 62.1-44.15:51	Information to support the acquisition of the authorization will be provided upon approval of the COP

Regulatory Agency	Permit or Approval	Statutory Basis	Status
Virginia State Corporation Commission (SCC)	Certificate of Public Convenience and Necessity (CPCN)	Code of Virginia § 56-265.2	Construction and O&M of transmission lines and/or facilities above 115 kV in Virginia usually require the issuance of a CPCN from the State Corporation Commission. A Coordinated Environmental Review facilitated by VDEQ will be conducted.
Virginia Department of Conservation and Recreation (VDCR)	Virginia Scenic Rivers and invasive species consultation; invasive species management plan	N/A	To be conducted in support of permit applications.
Virginia Department of Wildlife Resources (VDWR)	Natural heritage/protected species consultation	N/A	To be conducted in support of permit applications.
Virginia Department of Historic Resources (VDHR)	Historic properties consultation	N/A	To be conducted in support of permit applications.
Virginia Department of Agriculture and Consumer Services (VDACS)	Consultation	N/A	To be conducted in support of permit applications.
Virginia Department of Forestry (VDOF)	Consultation	N/A	To be conducted in support of permit applications.
City of Virginia Beach	Floodplain Development Permit Land Disturbance Permit Conditional Use Permit/Site Plan Review	To be determined	Information to support the acquisition of the authorization will be provided upon approval of the COP.
Chesapeake	Floodplain Development Permit Conditional Use Permit/Site Plan Review	To be determined	Information to support the acquisition of the authorization will be provided upon approval of the COP.
Local Wetlands Board Virginia Beach	Local Wetlands Approvals	To be determined	Approval will be obtained through the Joint Permit Application Process. Information to support review of the Project under the has been provided in this COP (Section 4.1.2, Water Quality and Appendix U, Wetland Delineation Report).
Various Virginia Counties / Municipalities, and Virginia Department of Transportation	Transportation permits if needed; use of wide load and similar vehicles on public roads	24 VAC §30-151	Information to support the acquisition of the authorization will be provided upon approval of the COP.

1.5 Agency and Public Outreach

Starting with initial planning and subsequent execution and delivery of the Lease in November 2013, Dominion Energy has undertaken a comprehensive engagement and outreach campaign. The purpose of this program has been to solicit feedback from Project stakeholders, including federal, state and local regulatory and resource management agencies, elected officials, interest groups, and the public to advance the permitting and development process and to create positive awareness of the Project by highlighting local community, statewide, and regional benefits.

Outreach in support of development of the CVOW Pilot and Commercial Projects has been ongoing since 2011. From 2011 to 2014, Dominion Energy consulted with Virginia stakeholders during the earliest stages of development and planning. From 2015 to present, Dominion Energy has completed more than 20 required studies and surveys and applied for and received local, state and federal permits. In 2019, Dominion Energy began to meet with federal, state, and local officials and other stakeholders to discuss the Project. At these meetings, Dominion Energy provided background information on the Project, including the scope, proposed environmental surveys and evaluations, and the anticipated timing of the permit applications. Appendix L, Summary of Agency and Stakeholder Engagement, summarizes the agency coordination and pre-application meetings conducted on behalf of the Project through June 1, 2021.

Dominion Energy recognizes the importance of commercial and recreational fisheries in the Hampton Roads region and brought on a dedicated Fisheries Liaison Officer (FLO) in 2017, who has been coordinating with fisheries stakeholders to facilitate communications for this Project within the commercial and recreational fishing community. Engagement with the commercial and recreational fishing community has been ongoing since 2012 through the CVOW Pilot Project, which provided stakeholders with a high degree of baseline knowledge about Dominion Energy's plans to develop offshore wind projects in Virginia. Dominion Energy will continue to build on these efforts for the life of the CVOW Commercial Project as described in more detail in Section 4.4.6, Commercial and Recreational Fishing and Appendix V, Fisheries Communication Plan.

Dominion Energy also contacted Native American tribes to invite them to be a part of the CVOW Commercial Project process and to request information to be considered in the document. Dominion Energy intends to continue tribal coordination and anticipates that this early and ongoing consultation will lead to a more streamlined and effective permitting process for the Project. Project information was also provided during this time period to stakeholders representing various interest groups, including maritime stakeholders such as the Virginia Maritime Association, the Virginia Pilot Association, the American Waterways Operators, the Port of Virginia, Virginia Power commercial customers, State Military Reservation (SMR), the U.S. Coast Guard (USCG), the U.S. Navy (Navy), the Hampton Roads Alliance, and the Cities of Chesapeake and Virginia Beach. On November 12, 2020 Dominion Energy hosted an interagency meeting to provide a Project overview to key regulatory stakeholders. In 2021, Dominion Energy is continuing to engage other industry stakeholders, as well as elected officials representing the region and will be hosting in-person and virtual open houses in June 2021.

Dominion Energy is committed to continued stakeholder communications and effective public outreach. The public outreach program includes the following:

- Identifying and meeting with local associations, citizen groups, environmental justice communities, and other non-governmental organizations to inform them about the Project and address any issues that may be raised;
- Establishing key advisory/research partnership roles with the Virginia Institute of Marine Science (VIMS) and the Virginia Aquarium;
- Meeting with key federal, state, and local agencies, elected officials, and other potentially interested stakeholders to identify issues;
- Holding public and virtual open houses to provide information about the Project; and
- Maintaining a Project-specific web site with information on the status of the Project.[4]. Details available on the web site include: a description of the Project, including photos and visual simulations; news briefs; contacts for additional information; and other appropriate Project-related information.

A summary of Dominion Energy's stakeholder engagement and outreach through June 1, 2021 is provided in Appendix L.

1.6 Company Overview

Dominion Energy is a power and energy company headquartered in Richmond, Virginia that operates in 16 states across the U.S., offering clean, safe, reliable, and affordable energy to more than 7.5 million customers. Dominion Energy's operating segments include power generation, power delivery, and gas infrastructure, and fall into two basic categories of service: making energy and moving energy. Dominion Energy invests in the communities where is operates and its employees live and work and strives to protect the natural resources within those communities. Dominion Energy's first and most important core value is to send every employee home safe and sound, every day. Dominion Energy's mission is to serve its customers safely and reliably; strengthen communities; minimize environmental impact; and reward shareholders.

Through efforts to work towards sustainability, Dominion Energy reduced carbon dioxide emissions by 70 percent since 2005 and set a goal of net zero carbon and methane emissions by 2050 for both the electric and natural gas businesses. Currently, more than 85 percent of Dominion Energy's energy generation comes from clean energy sources or natural gas. Investments in infrastructure and new projects, such as offshore wind generation, solar and battery storage, facilitate its goal to better serve its customers and protect the planet.

Dominion Energy's dedication to a clean environment continues to be reflected in renewable energy initiatives. Dominion Energy's current renewable energy portfolio includes more than 4,600 MW of solar generation in operation or under development. When fully operational, Dominion Energy's combined resources can supply power to more than 1.1 million typical households at peak output. Dominion Energy

[4] https://coastalvawind.com/

has the third-largest solar portfolio among utility holding companies in the U.S., and plans to add nearly 16,000 MW of solar over the next 15 years, which is nearly a 40-fold increase from current capacity.

Dominion Energy's CVOW Pilot Project, a two 6-MW wind turbine project on a site leased by the Virginia Department of Mines Minerals and Energy (DMME), completed construction in October 2020 and commenced commercial operation in January of 2021. This will further inform development for the Project in the adjacent Virginia Wind Energy Area leased by Dominion Energy from BOEM. It will also help create the expertise and the necessary domestic supply chains that will ultimately lower the costs of offshore wind development.

1.7 Authorized Representative and Designated Operator

Dominion Energy will be the operator of the Project. The contact information for the Authorized Representative for the Project is as follows:

Name of Authorized Representative	Joshua J. Bennett
Title	Vice President, Offshore Wind
Phone Number	(804) 638-0248
Email	joshua.j.bennett@dominionenergy.com
Address	707 East Main Street, Richmond, VA 23219

1.8 Certified Verification Agent

Pursuant to 30 CFR § 585.705, a CVA must be engaged to certify to BOEM that the proposed facility is designed to withstand the environmental and functional load conditions for the intended life of a project at its proposed location. In accordance with 30 CFR § 585.706, Dominion Energy has included a CVA nomination for BOEM approval as Appendix M under confidential cover.

1.9 Financial Assurance

In accordance with 30 CFR § 585.516, Dominion Energy is required to provide BOEM a supplemental bond, a decommissioning bond, or other financial assurance to assure that lessee obligations can be fulfilled prior to issuance of the COP. BOEM, however, has the authority to allow evidence of financial strength and reliability to meet financial assurance requirements, as detailed in 30 CFR § 585.527. BOEM approved Dominion Energy's use of financial strength for the CVOW Pilot Project.

Dominion Energy has a strong financial standing and a long history of undertaking, self-funding, or obtaining the necessary financing for large infrastructure projects in a responsible manner. Demonstration of financial strength as required by 30 CFR § 585.527 will be provided during the COP process.

1.10 Design Standards

Dominion Energy is currently developing individual codes and standards documents for each of the four offshore technical areas: Foundations, Offshore Substations, Inter-Array and Offshore Export Cables, and WTGs. These documents will be reviewed by the CVA prior to submission to BOEM. The CVA will finish the review of each document with a letter approving the use of standards. For each of the four technical areas, Dominion Energy will provide the codes and standards documents together with the CVA letters to BOEM for review and comment. The Hierarchy of Standards is provided in Appendix B.

2 PROJECT SITING AND DESIGN DEVELOPMENT

The Project has evolved through considerable iterations since an initial conceptual study was completed more than 10 years ago (Dominion Virginia Power 2010) in response to the establishment of the Virginia Offshore Wind Development Authority (VOWDA) to promote the development of wind resources off of Virginia's Atlantic coast. Dominion Energy's commitment to offshore wind led to the development of the CVOW Pilot Project (formerly called the Virginia Offshore Wind Technology Advancement Project [VOWTAP]) starting in 2013, which completed construction in 2020 and is located on a separate lease tract. For the Project, Dominion Energy secured the Lease from BOEM (2013) through a competitive bidding process in 2013, with the intent to develop between 2,500 MW and 3,000 MW (2.5 to 3.0 gigawatts [GW]) of renewable energy by January 2028.

Since acquiring the Lease in 2013, Dominion Energy considered numerous potential options and alternatives to support the selection of the PDE for the Project to allow for flexibility in engineering and design. This PDE facilitates the advancement of the Project review and approval processes through BOEM under the terms of the Lease as well as other federal, state, and local regulations. This process has involved both siting and design alternatives for Project elements such as alternative locations for the Project's infrastructure, foundation designs, and technological infrastructure (e.g., onshore grid connections, onshore and offshore substation locations, export/transmission cable routes, WTGs, and WTG layouts).

This section describes the Project siting, components, and technology that are being considered in defining the PDE for the Project, in accordance with BOEM's *Guidelines for Information Requirements for a Renewable Energy Construction and Operations Plan* ([COP Guidelines] BOEM 2020). This section presents a description of the development and evolution of the PDE from the Lease Area to the Point of Interconnection (POI) and includes key project components within that footprint. Project overview maps are included throughout this section where applicable.

2.1 Project Siting and Design

The siting process started with BOEM's evaluation of the Virginia WEA in its environmental assessment of commercial wind lease issuance and site assessment activities (BOEM 2012). This resulted in the designation of the Lease Area, with Dominion Energy as the leaseholder, and proposed development of the Project.

Dominion Energy has been engaged in Project siting activities since the Lease was signed in 2013. Project siting has been conducted with respect to submarine and terrestrial constraints to identify the most feasible and least impactful means to deliver energy from the Project to the electric power transmission grid. The evolution of the PDE is informed by several factors, including: desktop assessments, site-specific surveys and analyses; supply chain capacity; commercial availability; and, engagement with regulators and stakeholders (a complete record of stakeholder outreach and engagement is provided in Appendix L, Summary of Agency and Stakeholder Engagement). Where available, existing public data was also used to inform the siting assessment. The following sections document the criteria used in evaluating various alternatives and refining the components that define the PDE.

2.1.1 Key Offshore Project Components

The Offshore Project Area includes the entire Lease Area, where between 179 and 205 WTGs and two to three Offshore Substations and the Inter-Array Cables would be installed, and the Offshore Export Cable Route Corridor where up to nine export cables would be installed pursuant to approved right-of-way (ROW).

2.1.1.1 *Wind Turbine Generator Layout*

Dominion Energy's identified Preferred Alternative based on all relevant legal and practical considerations (Preferred Alternative) would achieve the Commonwealth of Virginia's legislative requirement of between 2,500 MW and 3,000 MW of offshore wind energy using the highest-capacity WTG available at the time of Project execution. The layout would allow spacing of WTGs of 0.75 by 0.93 nm (1.39 by 1.72 km) in an offset grid pattern and would include two to three Offshore Substations placed in between the rows in the grid pattern. In the development of the Preferred Alternative, up to nine spare locations would be included to provide flexibility to minimize or avoid culturally and environmentally sensitive areas or locations that are not feasible due to seabed conditions. The PDE would include an additional nine potential positions in the fish haven area. The Offshore Project Components are expected to be developed over a three-year construction period beginning in 2024.

The number of WTGs required was determined as part of the WTG selection process to include the number of turbines required to reach the required capacity of the Project, including some spare positions for contingency and the potential opportunity to achieve a higher total capacity. In evaluating layout options for the WTGs, Dominion Energy has considered the array of existing marine uses within the Lease Area, including shipping, commercial/recreational fishing, Department of Defense (DoD) training and testing, and Department of Homeland Security activity. These marine uses, in addition to environmental constraints, were factored into the engineering analysis of available conceptual options in developing the PDE.

From a power-generation perspective, the preferred layout is to have the WTGs arranged in such a way that the total wake effects for the individual turbines are minimized, which together with an aim to maintain a uniform layout to ease navigation, resulted in an offset grid pattern as part of the PDE. The spacing provided within this offset grid pattern is anticipated to be consistent with the findings expected to be published in the Final USCG Atlantic Coast Port Access Route Study. See Section 3, Description of Proposed Activity, for additional information on the turbine layout carried forward in the PDE.

The fish haven area, located along the northern boundary of the Lease Area, includes several charted wrecks, debris, and other intentionally scuttled items that compose an array of artificial reef sites. While this area is included in the PDE for the Project, Dominion Energy has developed several layout options with the fish haven as an exclusion zone (e.g., without WTGs, Inter-Array Cables, or other infrastructure). Alternatively, if seabed conditions within the fish haven area are feasible to support the buildout of WTGs, such development may be a favorable addition of vertical hard structure within this fish haven area where placement of structure, in addition to increased capacity for the Project, may be beneficial to marine resources, recreational fishing, and other marine uses within the fish haven area.

The possibility of a layout with corridors of 1 nm in one or both directions in the layout grid was assessed; however; 1 nm spacing would preclude the Lease Area from attaining the goal in the Virginia Clean

Economy Act to achieve a project capacity of between 2,500 MW and 3,000 MW of offshore wind power by 2028. The WTG selected for the Project has the largest capacity of any WTGs available in the market, and it is not possible to place a sufficient number of WTGs within the Lease Area to achieve the required name plate capacity without having WTG spacing smaller than 1 nm by 1 nm (1.9 km by 1.9 km).

During the WTG selection process, the following alternative layouts were initially considered but not carried forward, in part due to even closer spacing than proposed using SG-14-222 DD 14-MW WTGs: 217 WTGs with individual capacity of 12 MW and 274 WTGs with individual capacity of 9.5 MW. Those layouts were not carried forward because they were less attractive not only from a cost-benefit perspective, but also would also result in a significantly larger environmental impact, particularly seabed disturbance and underwater noise emission due to a larger number of foundation positions to install. More information on impacts of underwater noise can be found in Section 4.2.5, Marine Mammals and Section 4.2.6, Sea Turtles. Furthermore, those alternative layouts would significantly increase the number of WTGs, resulting in even tighter spacing than the Preferred Alternative.

Table 2.1-1 summarizes the WTG layout Alternatives and identifies those that were eliminated and those that are carried forward in the Preferred Alternative and PDE for the Project. The WTG spacing for the Preferred Alternative is shown within the context of vessel types common to the Offshore Project Area in Figure 2.1-1. The Project overview is shown in Figure 2.1-2 and the Preferred Alternative WTG layout is shown below in Figure 2.1-3.

Table 2.1-1. WTG Layout Alternatives

Layout Option	Number of WTGs & Offshore Substations	Spacing of WTGs	Description	Carried Forward in the PDE?
Alternative 1 (Preferred Alternative)	188 WTGs (179 to 205 positions including spares and fish haven area), 3 Offshore Substations (2 to 3 Offshore Substations)	East-West = 0.93 nm Northwest-Southeast = 0.75 nm	188 WTGs (SG-14-222 DD, 14 to 16 MW each) and 17 potential additional positions including the positions in fish haven area	Yes – Preferred Alternative
Alternative 2	142 WTGs, 2 to 3 Offshore Substations	East-West = 1.00 nm North-South = 1.00 nm	142 WTGs (14 to 16 MW each) including positions within the fish haven area	No; Will not meet the goals in the Virginia Clean Economy Act with 2.5 to 3.0 GW in service by Jan 2028
Alternative 3	274 WTGs, 2 to 3 Offshore Substations	East-West = approx. 0.60 nm Northwest-Southeast = approx. 0.80 nm	274 WTGs (9.5 MW each) including positions within the fish haven area	No; Will not meet the goals in the Virginia Clean Economy Act with 2.5 to 3.0 GW in service by Jan 2028
Alternative 4	217 WTGs, 2 to 3 Offshore Substations	East-West = approx. 0.65 nm Northwest-Southeast = approx. 0.90 nm	274 WTGs (12 MW each) including positions within the fish haven area	No; Will not meet the goals in the Virginia Clean Economy Act with 2.5 to 3.0 GW in service by Jan 2028
Alternative 5	Not determined	Not determined	Up to 4 stages of development, approximately 400 to 600 MW each.	No; Was explored early in the Project development but later eliminated as an Alternative. Dominion Energy made an operational decision for the Project to be constructed over a period of three years of construction.

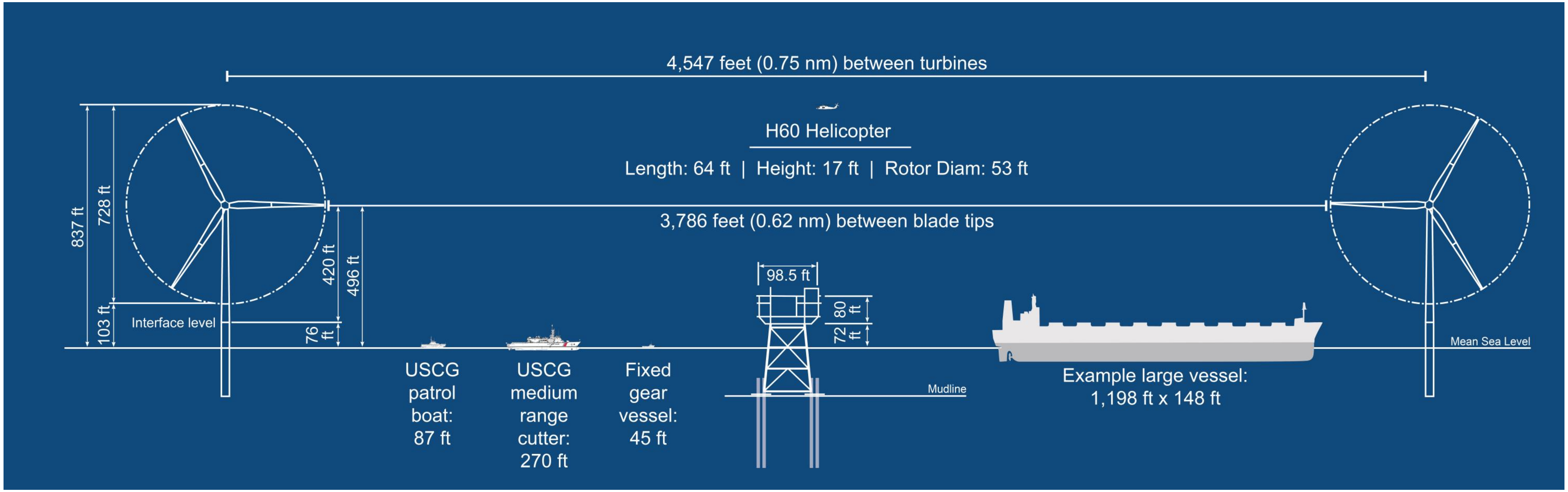


Figure 2.1-1. Scaled Representation of Vessel Types Common to the Offshore Project Area Relative to WTG Rotor Diameter and 0.75 nautical mile (nm) Turbine Spacing

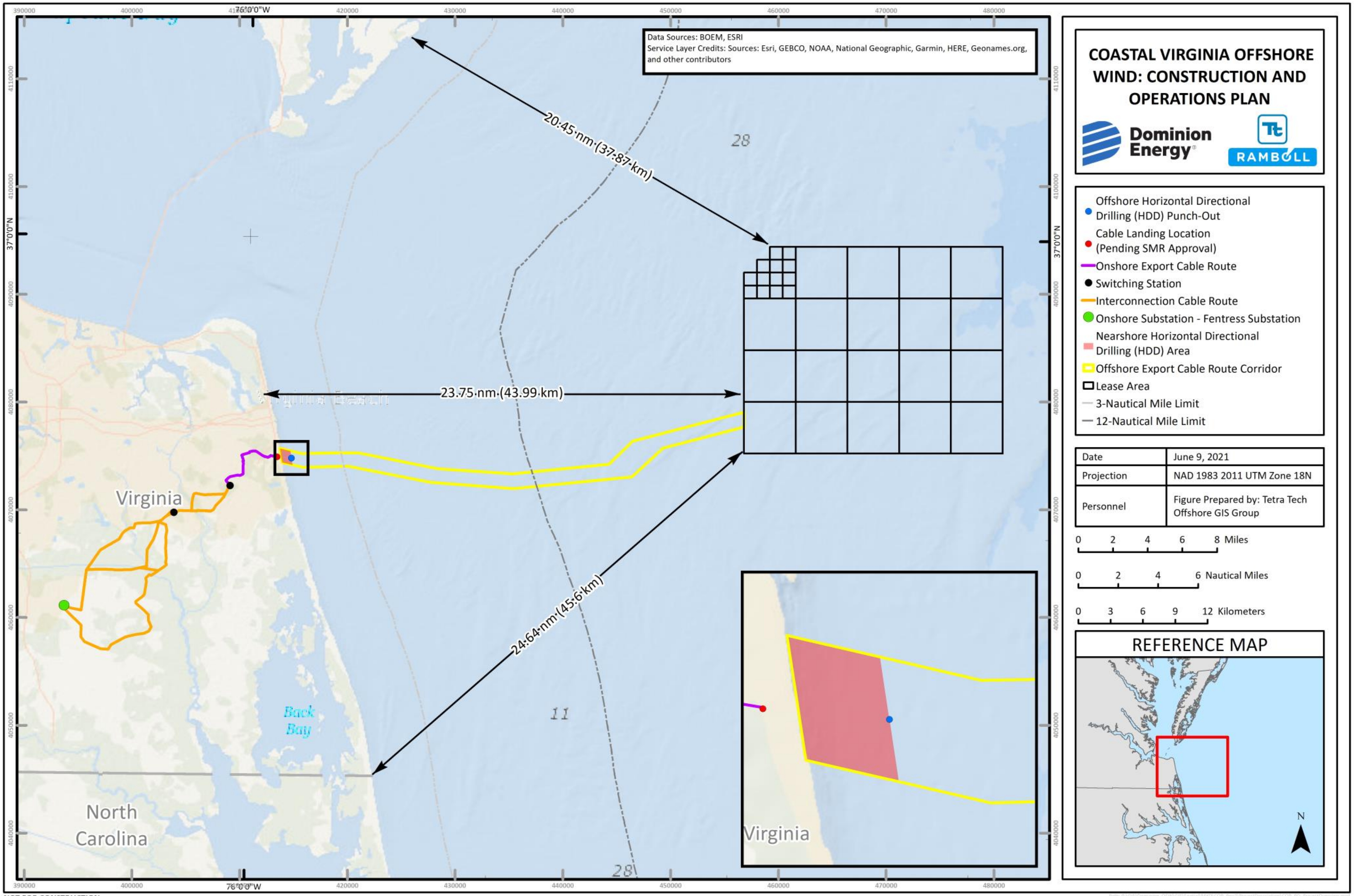


Figure 2.1-2. CVOW Commercial Project Overview

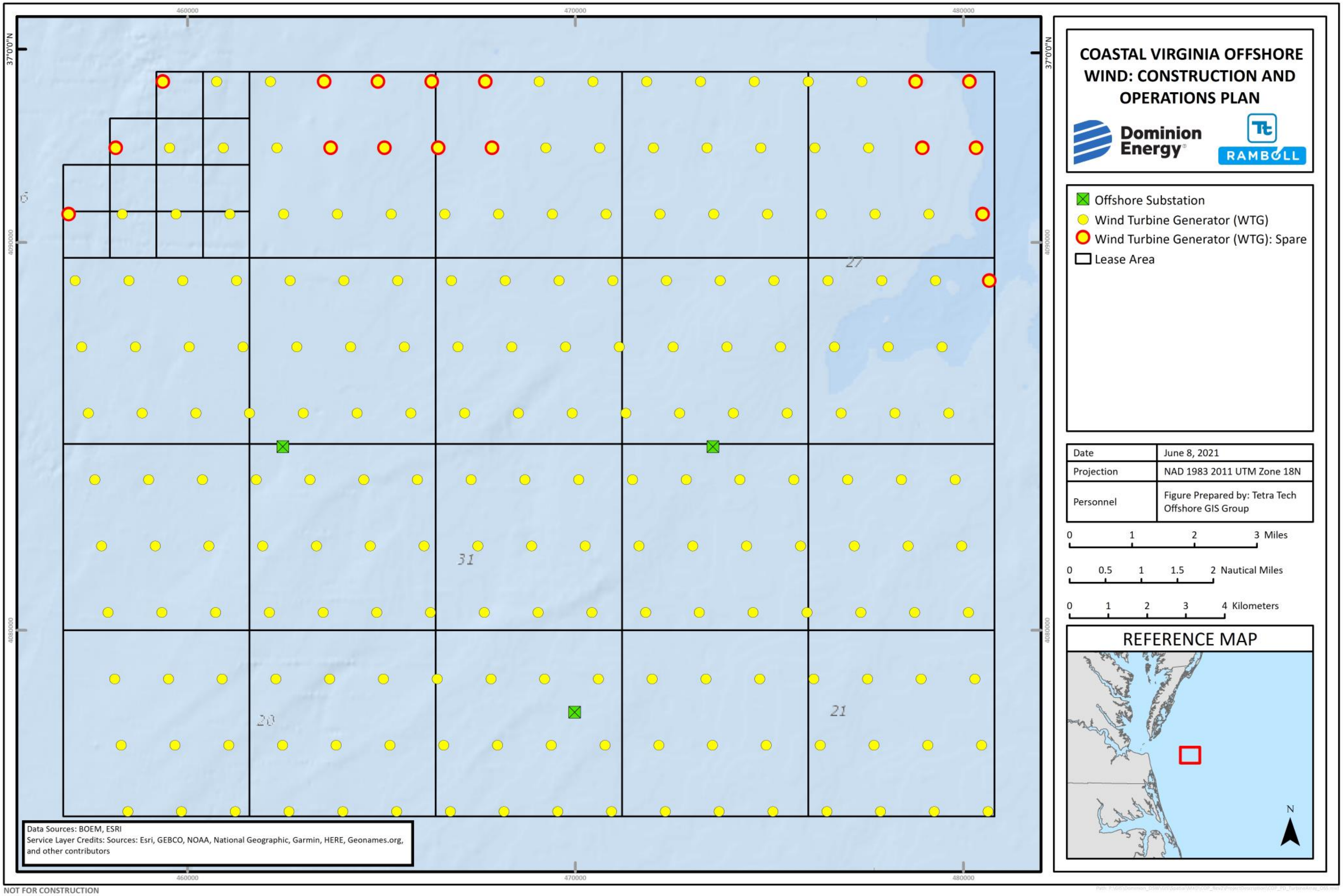


Figure 2.1-3. WTG and Offshore Substation Layout for the Preferred Alternative

2.1.1.2 *Offshore Export Cable Routing*

An offshore routing constraints analysis was conducted along the Offshore Export Cable Route Corridor as well as the adjacent CVOW Pilot Project cable route, dating back to 2013 when the Project was first identified. Constraints analyses are ongoing through the Appendix W, Preliminary Cable Burial Risk Assessment. This constraints analysis identified potential Offshore Export Cable Routes; evaluated routing feasibility; and identified other challenges associated with existing cable assets, such as the Dam Neck Ocean Disposal Site (DNODS), and Navy training and testing locations. The potential challenges and complexities of the offshore export cable routing (e.g., length, seabed features, burial depth, installation hazards, biological/cultural resources, commercial/recreational fishing, etc.) were considered as part of the selection criteria for the Preferred and Alternative Cable Landing Locations. To the extent possible, the most direct route served as the starting point in developing the Offshore Export Cable Route Corridor. This also is driven by technical constraints and costs, including cable costs, installation time, and limits associated with available and efficient HVAC transmission (see Appendix W, Preliminary Cable Burial Risk Assessment for additional details). Additional discussion regarding high-voltage direct-current (HVDC) as an alternative for cable technology is provided in Section 2.2.5, Offshore Export Cables.

As described in Section 4.1.1, Physical and Oceanographic Conditions, the seabed offshore of Virginia Beach is predominantly characterized as fine to medium-grained sand with isolated patches of coarse-grained sand and occasional gravel. Grab samples collected during the 2013 Fugro HRG Survey contained primarily poorly to well-graded sand and silty sand. Shallow- and medium-penetration sub-bottom profiler data collected during the 2013 Tetra Tech CVOW Pilot Project survey (Tetra Tech 2013), the 2013 Fugro HRG survey (Fugro 2013), and the ongoing 2020 TerraSond/Alpine HRG surveys as well as the 2020 geotechnical investigations indicate that the seabed is typically composed of unconsolidated sand with interbedded silt, clay, and gravel. These seabed conditions are generally amenable to facilitate cable burial, except in areas of existing cable crossings.

The U.S. Army Corps of Engineers (USACE) typically manages and regulates dredged and maintained channels. The location and depths of navigation channels are authorized by the federal government, and the USACE periodically performs condition surveys to identify when maintenance dredging may be needed to keep channels available at the authorized depth. Should a cable route cross a maintained channel, it must be buried deep enough below the authorized depth to ensure that the channel can be maintained safely without posing a risk to the cable and must account for future increases in channel depth. As such, the crossing of federally maintained channels should be avoided to the extent practical by the cable routing. According to USACE guidance, offshore export cables are required to be buried 15 ft (4.6 m) below the federally authorized channel depth or 15 ft (4.6 m) below the existing seabed, whichever is deeper, to minimize the chance of interaction with maintenance dredging of channels. Although the Offshore Export Cables for this Project will not cross any navigation channels, the USACE Norfolk District will be engaged throughout the planning and engineering processes so that Dominion Energy fully understands plans to re-align or deepen the Atlantic Ocean Channel (AOC) and confirm where dredged materials would be deposited, relative to the proposed Offshore Export Cable Route Corridor.

Dominion Energy prepared a Preliminary Cable Burial Risk Assessment (Appendix W); a probabilistic method to determine a recommended depth of lowering (DOL) at each point along the cable route that will protect the cable from external aggression and minimize risk both to and from the cable. In order to achieve the target DOL, a burial tool capable of the target trench depth will be specified. A summary of the pre-mitigation Preliminary Cable Burial Risk Assessment (Appendix W) findings is as follows:

- **Anchoring**: The initial probabilistic study indicates that a depth of lowering not less than 3.3 ft (1.0 m) is necessary, with up to 8.2 ft (2.5 m) in select segments based on risk tolerance and pending more detailed additional information;
- **Vessel traffic/navigation channels**: The Offshore Export Cable Route Corridor passes close to the southern extent of the USACE maintained deep water shipping channel (Chesapeake Southern approaches). It is understood that there are potential initial plans to extend the channel, as well as the possibility of deepening it to accommodate larger vessels;
- **Military activity**: The approaches to Chesapeake Bay are heavily trafficked by Navy vessels. Such traffic may or may not be visible via Automatic Identification System data; therefore, this specific risk to the cable is difficult to quantify;
- **Dropped objects**: Due to the volume of commercial and military vessels transiting the area, dropped objects are a risk and should be further studied;
- **Fishing**: The area is lightly fished. Seabed penetration from fishing gear is expected to be less than 11.8 inches (in) (30 centimeters [cm]). Fishing-related risk mitigation is not considered to be a major driver of the overall burial depth along the Offshore Export Cable Route;
- **Sediment mobility**: Mobile sediments and sand waves are present, particularly the central and eastern sections of the Offshore Export Cable Route Corridor, though mobile seabed is not anticipated to be extreme and should be mitigated through additional burial depth and/or pre-installation clearing of sand waves or ridges;
- **Unexploded Ordnance (UXO)/Munitions and Explosives of Concern (MEC)**: Due to the Virginia Capes (VACAPES) Operating Area and associated firing range, UXO/MEC is a concern, particularly from anti-aircraft munitions;
- **Geotechnical** (soft seabed, hard soils, etc.): Seabed conditions are generally suitable to reaching target burial depths of 6.6 to 9.8 ft (2 to 3 m) through the use of properly selected burial tools. Some areas of dense sands and very stiff clays should be expected. Softer seabed and loose sands may also allow increased penetration by anchors in some limited areas of the Offshore Export Cable Route Corridor;
- **Dredging/dumping/borrow areas/mining**: The maintained Atlantic Ocean Channel and the associated DNODS both occur in close proximity to the Offshore Export Cable Route and will be part of discussions with the USACE to understand specific burial requirements. Some risk due to these activities will remain and shall be mapped out and refined as more data and information become available; and
- **Crossings/other cable assets**: The preliminary Offshore Export Cable Route crosses three in-service fiber optic cables. Additionally, there are potential conflicts with those cables plus an extra installed (unoccupied) duct at the shore landing site. Detailed analysis and design of the crossings must occur in conjunction with negotiations with these cable asset owners and should also account for the risk of anchor strikes and related factors.

The Offshore Export Cable Route would need to run parallel to the CVOW Pilot Project export cable (in-service since October 2020), as well as cross three in-service telecommunications cable systems: MAREA, BRUSA, and DUNANT. All three of the telecommunications cable systems approach from the east and land at the Croatan Beach parking lot.

Though the details of the cable are not available to the public, it is inferred that a Navy subsea cable asset was installed approximately 4 nm (7 km) south of the Offshore Export Cable Routes. The only evidence of this cable asset that has been located in the public domain is referenced in the Final Environmental Assessment (EA) for the Sandbridge Beach Erosion Control and Hurricane Protection Project on Virginia Beach in 2018 (USACE 2018). In addition, the Offshore Export Cable Route Corridor separating the two sand resource area polygons due south of DNODS is another indication that a cable passes through the area.

The Offshore Export Cable Route would also need to cross the DNODS dredged material placement area, which has been used actively for dredged material placement since 1967. The DNODS receives approximately 1.2 million cubic yards of dredged material every two years to support the maintenance dredging of federal navigation channels. Since this is a federally authorized project, Section 408 considerations apply to the DNODS. Offshore Export Cables would be routed in coordination with USACE to minimize interference with planned disposal and/or sand resource extraction activities within the DNODS. The in-service telecommunications cables and the CVOW Pilot Project ROW alignments traverse DNODS Zones 2 and 5, since these are the zones of the DNODS earmarked to receive sediment of a finer nature. Because this material is not suitable for beach nourishment, these cells would not be anticipated to be used as sand borrow areas. Once the Offshore Export Cable Route crosses the DNODS, any of the Offshore Export Cable Route Alternatives may be used to approach any of the Cable Landing Locations (Appendix W).

Two sand borrow areas are known to exist in the vicinity of the Offshore Export Cable Route Corridor. The first is offshore of the northern part of the City of Virginia Beach, known as the Cape Henry Borrow Area. The other is the Sand Bridge Borrow Area, located off of Dam Neck/Sand Bridge. These areas represent potential sand resources to be used to replenish eroded beaches to provide important protection from tropical storms to local communities. Impacts to the utility of sand resources may complicate permitting considerations. Sand borrow operations in the vicinity of cables also pose an inherent risk of incident.

Due to the proximity of extensive DoD training and testing operating areas within the VACAPES Range Complex, as well as the onshore proximity of the Navy's Dam Neck Annex to the Cable Landing Locations, the DoD is a major stakeholder to any routes being developed in this area and will continue to be engaged on cable routing plans for the Project. Dominion Energy successfully coordinated these efforts in support of construction of the CVOW Pilot Project and will continue to coordinate throughout development of the Project.

2.1.2 Key Onshore Project Components

The Onshore Project Area includes the Cable Landing Location, Onshore Export Cable Route, the Switching Station, Interconnection Cable Route, and the Onshore Substation.

2.1.2.1 *Cable Landing Locations*

The Offshore Export Cable Route Corridor includes approaches to all Cable Landing Locations. The Offshore Export Cable Route Corridor exits the Lease Area between aliquots 6112 and 6162 and runs west-southwest, roughly paralleling the CVOW Pilot Project corridor. The route then turns to the southwest and crosses the DUNANT, MAREA, and BRUSA telecommunications systems to become the southernmost cable running towards shore. After the crossings, the route turns west-southwest and then west. This keeps the route 0.75 nm (1.4 km) north of the "No-Go" line from the Navy Office of Seafloor Cable Protection for cable systems approaching from the north. The route continues south of the traffic separation scheme (TSS) and the Chesapeake Bay Buoy, running parallel to the CVOW Pilot Project corridor, with no direct overlap with the federal navigation channel. The route then turns to the west-northwest and enters Warning Area 390 and Special Use Airspace (SUA) W-50 and then DNODS Cells 2 and 5. The route continues into the beach crossing R-6606 and Danger Zone 405 before landing at the alternative locations listed below.

The transition from the Offshore Export Cables to the Onshore Export Cables would occur at the Cable Landing Location. Dominion Energy identified the Cable Landing Location as the Proposed Parking Lot, west of the Firing Range at SMR (formerly known as Camp Pendleton), pending SMR approval, with alternative locations considered but eliminated at a combination of Croatan Beach Parking Lot (five cables) and the SMR Beach Parking Lot (four cables), or the Croatan Beach Parking Lot (all nine cables). Additional alternatives are described below with consideration for engineering, environmental, logistical, and cost constraints. Additional context, descriptions, and assessment of these approaches to the cable landing are discussed in Appendix W, Preliminary Cable Burial Risk Assessment.

The Cable Landing Location and Alternatives considered but eliminated from the PDE are included in Table 2.1-2, shown in Figure 2.1-4, and described further within the subsections below.

Proposed Parking Lot, west of the Firing Range at the SMR, Pending SMR Approval

The Cable Landing Location at the Proposed Parking Lot, west of the Firing Range at SMR would be near the end of Rifle Range Road, adjacent to the existing CVOW Pilot Project landing location. The Proposed Parking Lot, west of the Firing Range would be suitable for the construction of the planned horizontal directional drilling (HDD) vaults and the start of the terrestrial routes. HDD in the offshore direction could cross the duct of the existing CVOW Pilot Project and preclude the need for nearshore shallow-water crossings. HDD would also be considered from the landing site to a point inland to minimize impacts to Lake Christine and other features at the SMR. While this Cable Landing Location requires extensive coordination and planning, this option is likely to be the most successful in terms of available space, technical issues, and the mitigation of stakeholder issues relative to the other landing locations considered, and is therefore the only Cable Landing Location carried forward in the PDE.

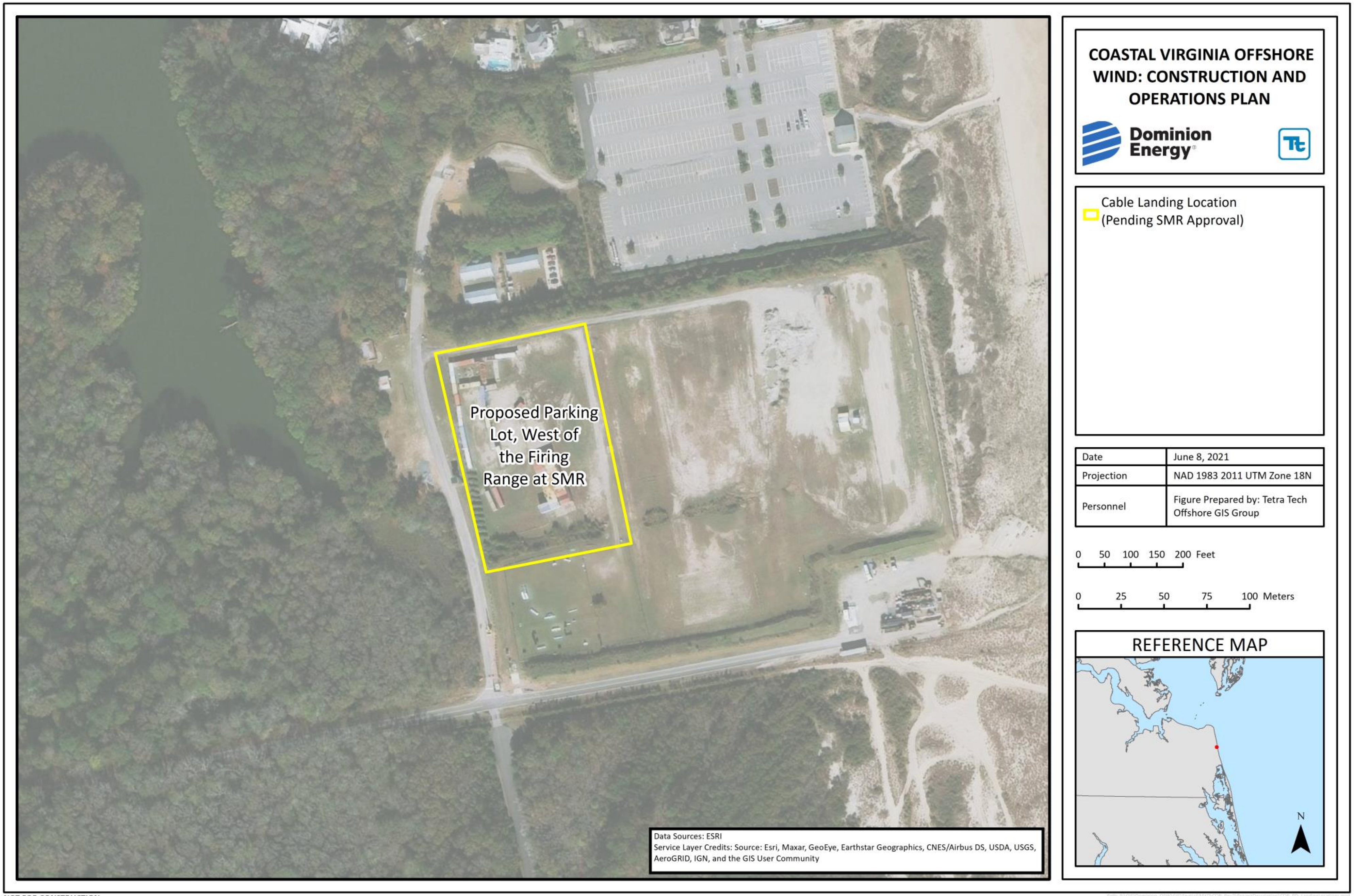


Figure 2.1-4. Onshore Project Components—Cable Landing Location

Table 2.1-2. Cable Landing Location Alternatives

Cable Landing Location	Landing Description	Export Cable Distance in nautical mile (kilometer)	Carried Forward in the Project Design Envelope?
Proposed Parking Lot, west of Firing Range at SMR	This would have all nine cables land at the Proposed Parking Lot, west of the Firing Range at SMR, located east of Regulus Avenue and north of Rifle Range Road, directly south of the Croatan Beach parking lot.	24.4 (45.1)	**Yes**
Croatan Beach/SMR Beach Parking Lots – 5/4 Cable Split	This would split the Cable Landing Locations between the Croatan Beach Parking Lot (five cables) and the SMR Beach Parking Lot (four cables). The Croatan Beach Parking Lot is a public parking lot located off of Washington Avenue east of Lake Christine, just north of the SMR. The SMR Beach Parking Lot is near the eastern terminus of Rifle Range Road, located directly south of the Croatan Beach parking lot and adjacent to the existing CVOW Pilot Project landing location.		No
Croatan Beach Parking Lot	This would have all nine cables land at the Croatan Beach Parking Lot.		No
Rudee Inlet	This potential Cable Landing Location would be on either the north or south side of Rudee Inlet or on the Rudee Heights peninsula behind General Booth Boulevard and conveyed under the inlet and associated channel and dredging areas via horizontal directional drilling, then run along General Booth Boulevard to the Switching Station.	24.1 (44.7)	No
Croatan Neighborhood	This potential Cable Landing Location runs into a vacant lot in the Croatan Beach neighborhood.		No
10th Street Virginia Beach	This potential Cable Landing Location runs into a vacant lot on 10th Street.		No
Dam Neck Annex	This potential Cable Landing Location is off Dam Neck Road near the Dam Neck Naval Annex.	24.6 (45.5)	No
Sandbridge Road	This potential Cable Landing Location is in the vicinity of Sandbridge Road, near the Back Bay Wildlife Refuge.	23.6 (43.7)	No

Croatan Beach Parking Lot

The Croatan Beach Parking Lot is a public parking lot located off Washington Avenue east of Lake Christine, just north of the SMR. The Croatan Beach Parking Lot has also previously been used for fiber optic cable landing locations via HDD. The location of the existing fiber infrastructure proves a positive from the perspective of technical feasibility, adequate layout space, and ability to use the area for offseason construction without causing undue detriment to the local community and stakeholders. HDD from this lot could traverse under the existing telecommunications cable HDD ducts, mitigating the need for nearshore shallow-water cable asset crossings, which can be complex and prone to issues due to sediment mobility. To implement this, detailed deconfliction of the HDD and landing areas would be required. Deconfliction of the terrestrial route must also consider the existing fiber optic cable backhaul routes, which further limit space. For reasons stated above, this location is not carried forward in the PDE.

SMR Beach Parking Lot

The SMR Beach Parking Lot is a non-public parking lot located at the end of Rifle Range Road east of Lake Christine, along the beachfront of the SMR. The SMR Beach Parking Lot is also the HDD landing location of the existing CVOW Pilot Project export cable. This location could not accommodate all nine cables, therefore if this location is used it would be part of the 5/4 split (5 cables at Croatan Beach Parking Lot, 4 cables at SMR Beach Parking Lot) and there is adequate layout space to accommodate that configuration without causing undue detriment to the SMR activities. HDD from this parking lot could traverse under the existing CVOW Pilot Project cable HDD ducts, mitigating the need for nearshore shallow-water cable asset crossings, which can be complex and prone to issues due to sediment mobility. To implement this, detailed deconfliction of the HDD and landing areas would be required. For reasons stated above, this location is not carried forward in the PDE.

Rudee Inlet

Challenges related to this location include the requirement to run an offshore export cable route through the DNODS Cells 2 and 5 to the north of the existing telecommunications cables, to avoid adding nearshore crossings of the fiber cables. This is a deviation from the Offshore Export Cable Route Corridor surveyed in 2020. It may also require further deconfliction of the AOC and TSS, with Section 408 considerations and additional maritime stakeholder involvement. The maintained (dredged) inlet channel, seawalls, and moving sand shoals immediately outside of the inlet could be avoided through the siting of the HDD. A second HDD from the landing site to a point further inland could further mitigate some of the issues with congestion and limited space for cable routing. For example, a landing immediately north of Rudee Inlet (e.g., near Atlantic Avenue and 2nd Street) could have an offshore HDD to the southeast, avoiding the inlet and shoreline stabilization features. An additional HDD from that location could convey the cable under the inland portion of Rudee Inlet waterway and allow routing down General Booth Boulevard. Similarly, if a longer HDD was found to be feasible and if space were available, a landing on the Rudee Heights peninsula behind Rudee Inlet could allow for a single HDD per cable offshore and facilitate a land cable route down General Booth Boulevard. All of these options have significant land availability and stakeholder constraints that may be fatal flaws upon further investigation. For reasons stated above, this location is not carried forward in the PDE.

Croatan Beach Neighborhood

Challenges related to this cable landing location include the residential location and active neighborhood association. The streets are very narrow, further complicating logistics and physical use of this area, especially in regard to mobilizing HDD equipment. Installation of the terrestrial route along these narrow streets may not be feasible, especially if multiple cables are landed and a larger duct bank is required to be installed under the street. Narrow streets may not allow for one-way traffic during terrestrial construction, which may limit access to homes and the beaches during installation, potentially representing a fatal flaw to receiving local stakeholder approvals. A terrestrial route to the Switching Station through the Croatan Beach neighborhood would face stakeholder constraints due to the narrow streets and limited access. For reasons stated above, this location is not carried forward in the PDE.

10th Street

The offshore approach to this cable landing location would require crossing of the TSS and the AOC, which would likely trigger the need for deeper burial as dictated by the USACE under the Section 408 process. Should the AOC be deepened in this area in the future, the cable would be installed at a depth where it would remain undisturbed by deeper dredging of the tow-way deep water vessel route. The approach would also pass approximately 1.5 nm (2.8 km) south of the Navy's Shipboard Electronic Systems Evaluation Facilities (SESEF) Buoy. Given the sensitive nature of the testing related to the SESEF, substantial coordination with the DoD would be required to ensure there is no conflict. It is possible that an HDD rig may be able to set up in the parking lot between 9th and 10th Streets. The HDD path could then drill along 10th Street to avoid drilling under any building or major structures to access to the shoreline. The offshore and onshore constraints associated with this landing are complex and therefore, this location is not carried forward in the PDE.

Dam Neck Annex

The Dam Neck Annex cable landing location targets a parking lot just south of the Shifting Sands Beach Club. The traverse across the last 3 nm (5.6 km) of the nearshore area is not as perpendicular to the shoreline as is usually preferred for cable routing, due to the need to traverse the DNODS Cells 2 and 5. The more perpendicular approach is usually preferred to get the cable through the surf zone and area of storm wave influence as directly as possible. A potential landing at the Dam Neck Annex was initially investigated due to accessibility and available space at the landing for HDD operations. As this area is used by the Dam Neck Annex for various activities, infringing on these spaces represents a significant stakeholder issue. Initial discussions with the DoD regarding the Dam Neck Annex indicated that stakeholder issues and permissions to utilize the property for the landing and terrestrial route may not be acceptable and alternative locations should be considered. For reasons stated above, this location is not carried forward in the PDE.

Sandbridge Road

A potential landing in the vicinity of Sandbridge Road was investigated at a desktop level for feasibility. Discussions with the Navy's Office of Seafloor Cable Protection resulted in the determination of an exclusion zone for any subsea cable routes approaching from the north of the Sandbridge Road area. This line originates along the shoreline at Dam Neck Annex and extends to the shelf break to the east. This feature, and perhaps others like it, may be the reason the DoD prohibits any cables approaching from the north from crossing the DoD exclusion line and traversing south across the seabed to the Sandbridge area, which eliminated Sandbridge as a potential export cable landing location. As such, a route to land in the area of the Sandbridge community or any points further south is precluded given this fatal flaw. For reasons stated above, this location is not carried forward in the PDE.

2.1.2.2 *Onshore Export Cable Route*

The Onshore Export Cables will convey the energy produced by the Project from the Cable Landing Location to a Common Location south of Harpers Road. Onshore Export Cable Route Alternatives associated with routing options from the Cable Landing Locations were retained for the PDE (in no particular order), as listed below:

- **Onshore Export Cable Route – Alternative 1 (Not Carried forward in PDE)**: Alternative 1 would have all nine cables land at the Proposed Parking Lot, west of the Firing Range at SMR, pending SMR approval, where the SMR plans to build a parking lot, which would be located between the Cable Landing Location and Regulus Avenue, and the Cable Landing Location would be converted to a parking lot. The 4.7 mi (7.6 km)-long route to the Harpers Road Switching Station would include a HDD below Lake Christine, pending SMR approval running northwest through

SMR land, then crossing General Booth Boulevard just south of the Virginia Aquarium with an HDD below Owl Creek and following Bells Road, then crossing South Birdneck Road and coming onto the Naval Air Station (NAS) Oceana Parcel, pending Navy approval, from the east. From the NAS Oceana Parcel, the route proceeds south along Oceana Boulevard, then west along Harpers Road to a Common Location south of Harpers Road. From here, Interconnection Cable Route Alternatives 1 through 5 would continue on to the Onshore Substation from this location as overhead alternatives and a new Switching Station would be located here on private land. Interconnection Cable Route Alternative 6 would continue underground from Harpers Road to a Switching Station north of Princess Anne Road, where it would transition to overhead before continuing on to the Onshore Substation.

- **Onshore Export Cable Route – Alternative 2 (Carried forward in PDE)**: This Alternative would also have all nine cables land at the same Proposed Parking Lot, west of the Firing Range at SMR pending SMR approval, following the same route to the same Common Location south of Harpers Road. The only difference in the route is that the portion of the route on the NAS Oceana Parcel runs west-southwest to Oceana Boulevard instead of turning to the south within the NAS Oceana Parcel before reaching Oceana Boulevard, then on to a Common Location south of Harpers Road.
- **Onshore Export Cable Route – Alternative 3 (Not Carried forward in PDE)**: This Alternative would have five cables land at the Croatan Beach Parking Lot (a public parking lot located off Washington Avenue east of Lake Christine) and four cables land at the SMR Beach Parking Lot. The 4.4 mi (7.1 km)-long route would follow Regulus Avenue, to Rifle Range Road, to General Booth Boulevard, to Oceana Boulevard, coming into the Switching Station on the NAS Oceana parcel, pending Navy approval, from the south.
- **Onshore Export Cable Route – Alternative 4 (Not Carried forward in PDE)**: This Alternative would also have five cables land at the Croatan Beach Parking Lot and four cables land at the SMR Beach Parking Lot, same as Alternative 3, following a similar 2.4 mi (3.9 km)-long route to the Switching Station, with the exception of following South Birdneck Road at the General Booth Boulevard intersection, coming into the Switching Station on the NAS Oceana parcel, pending Navy approval, from the east.
- **Onshore Export Cable Route – Alternative 5 (Not Carried forward in PDE)**: This Alternative would have all nine cables land at the Croatan Beach Parking Lot. The 4.3 mi (6.9 km)-route to the Switching Station would follow Regulus Avenue, to Rifle Range Road, to South Birdneck Road, to General Booth Boulevard, and Oceana Boulevard, Switching Station on the NAS Oceana parcel, pending Navy approval, from the south.
- **Onshore Export Cable Route – Alternative 6 (Not Carried forward in PDE)**: This Alternative would also have all nine cables land at the Croatan Beach Parking Lot, same as Alternative 5, following a similar 2.3 mi (3.7 km)-long route to the Switching Station, with the exception of following South Birdneck Road at the General Booth Boulevard intersection, coming into the Switching Station on the NAS Oceana parcel, pending Navy approval, from the east.

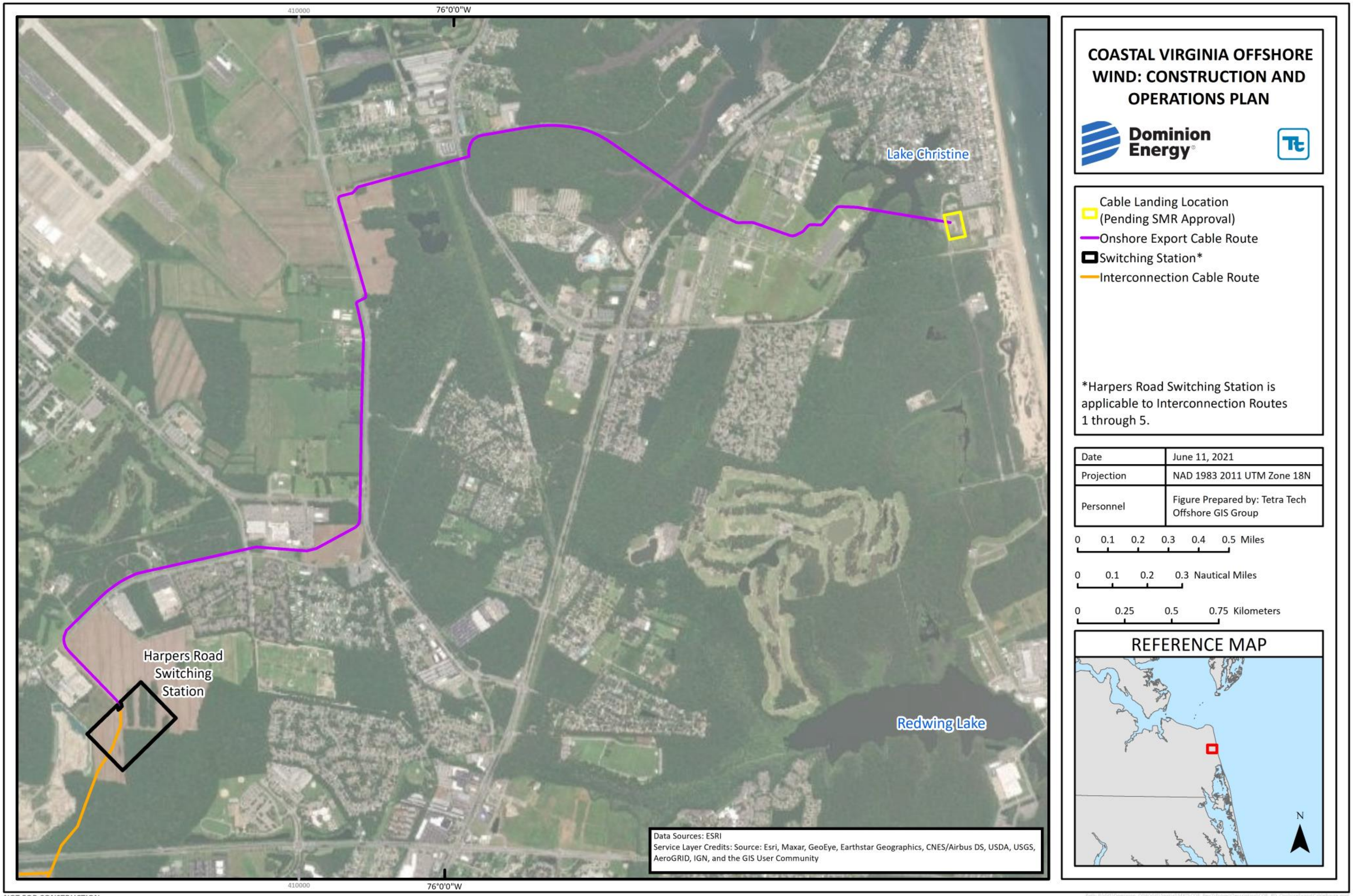
- **Onshore Export Cable Route – Alternative 7 (Not Carried forward in PDE)**: This Alternative would also have all nine cables land at the same Proposed Parking Lot, west of the Firing Range at SMR, pending SMR approval, as Alternative 1, following a similar 2.3 mi (3.6 km)-long route, with the exception of a jog to the north along Regulus Avenue before converging with the Alternative 1 route west of Lake Christine within SMR land.

The Onshore Export Cable Route carried forward in the PDE is shown in Figure 2.1-5. Route length, route description, construction/operational corridors, and other details are included in Section 3, Description of Proposed Activity.

2.1.2.3 *Switching Station*

A Switching Station would be required to consolidate the energy of the Onshore Export Cables and to transition an underground cable configuration to an overhead configuration. Dominion Energy also considered locations for a separate “Transition Station” where the Interconnection Cable Route transitions from underground to overhead facilities transmission configuration, but determined a common location for the underground cables to transition to overhead cables is preferrable to minimize the Project footprint. Therefore, “Switching Station” is carried forward in the PDE and “Transition Station” is not carried forward in the PDE. Siting the most suitable location for a new Switching Station must consider cost, constructability, design requirements, consistency with existing land use and zoning, and minimization of disturbance, environmental and human impacts. Dominion Energy evaluated the current capacity load and potential for upgrades at existing substations. Dominion Energy considered several possible locations and configurations for the development of the Switching Station:

- Switching Station at the NAS Oceana Parcel (not carried forward in PDE)—located on NAS Oceana property between Oceana Boulevard and South Birdneck Road;
- Transition Station at the Common Location south of Harpers Road (would require connection to the Switching Station at the NAS Oceana Parcel (not carried forward in PDE);
- Switching Station at the Common Location south of Harpers Road (carried forward in PDE);
- Transition Station located north of Princess Anne Road (would require connection to the Switching Station at the NAS Oceana Parcel or Common Location south of Harpers Road, Not carried forward in PDE);
- Switching Station located north of Princess Anne Road (carried forward in PDE);
- Switching Station at the Oceana Boulevard Parcel (not carried forward in PDE)—located on NAS Oceana property at the northeastern end of runway 5R/23L; and
- Switching Station at the Corporate Landing Parcel (not carried forward in PDE)—located at Dam Neck Road and Corporate Landing Parkway.



NOT FOR CONSTRUCTION

Figure 2.1-5. Onshore Project Components—Onshore Export Cable Route Carried Forward in the PDE

2.1.2.4 *Interconnection Cable Route*

The Interconnection Cables will transfer the electricity from the Common Location south of Harpers Road to the existing Fentress Substation (Onshore Substation, the POI) and would consist of circuits of three 230-kilovolt (kV) Interconnection Cables installed overhead, or a combination of overhead-underground (hybrid) within the Interconnection Cable Route Corridor. The Interconnection Cable Route begins at the Common Location south of Harpers Road and ends at the Onshore Substation. As described above, Dominion Energy considered several alternatives including both separate and combined Switching and Transition Station facilities. Alternatives associated with the combined switching and transition station facilities (referred to as the Switching Station) located either south of Harpers Road or north of Princess Anne Road, were retained for the PDE.

The overhead structure configuration within the Interconnection Cable Route Corridor would consist of a double circuit structure configuration and a single circuit configuration to total the three required circuits. Note that while interconnections are commonly referred to as ‘circuits’, for consistency with terminology commonly associated with offshore wind projects, ‘cables’ is used throughout.

Dominion Energy is considering overhead and hybrid Interconnection Cable Route Alternatives (in no particular order of preference) within the PDE for the Interconnection Cable Route, as summarized in Section 3, Description of Proposed Activity, and shown in Figure 2.1-6. The Study Area includes an approximately 170 square-mile area delineated by Dominion Energy’s Atlantic and Lynnhaven Substations to the north; the Atlantic Ocean coastline to the east; Green Run, Stumpy Lake, and Thrasher Substations to the northwest; Chesapeake Substation to the west; and the existing Fentress Substation (Onshore Substation), the POI, to the south. The Study Area lies within portions of the developed cities of Virginia Beach and Chesapeake and includes the Gum Swamp and associated North River wetlands complex and more rural areas. It encompasses dense residential and commercial developments, large and numerous publicly owned lands, forested wetlands, watercourses and associated floodplains, including the Intracoastal Waterway, agricultural fields, military airport facilities, sports complexes, and golf courses.

Dominion Energy conducted a comparative analysis using geographical information system (GIS) resources to assess the benefits, constraints, and risks of several route options to identify the preferred Interconnection Cable Route. The analysis considered route length, land use, constructability, existing utilities/ROWs, and environmental constraints (e.g., wetlands and water bodies, historic and cultural resources, sensitive species habitat, potential for contamination, and potential community opposition). Dominion Energy anticipates that a maximum construction ROW width of 75 ft (41 m) would be needed for underground cables and that a maximum construction and operational ROW of 140 ft (49 m) would be needed for overhead cables.

Potential routing constraints and collocation opportunities in developing the Hybrid and Overhead Interconnection Cable Route Alternatives between the Switching Station and the Onshore Substation include, but are not limited to, the following:

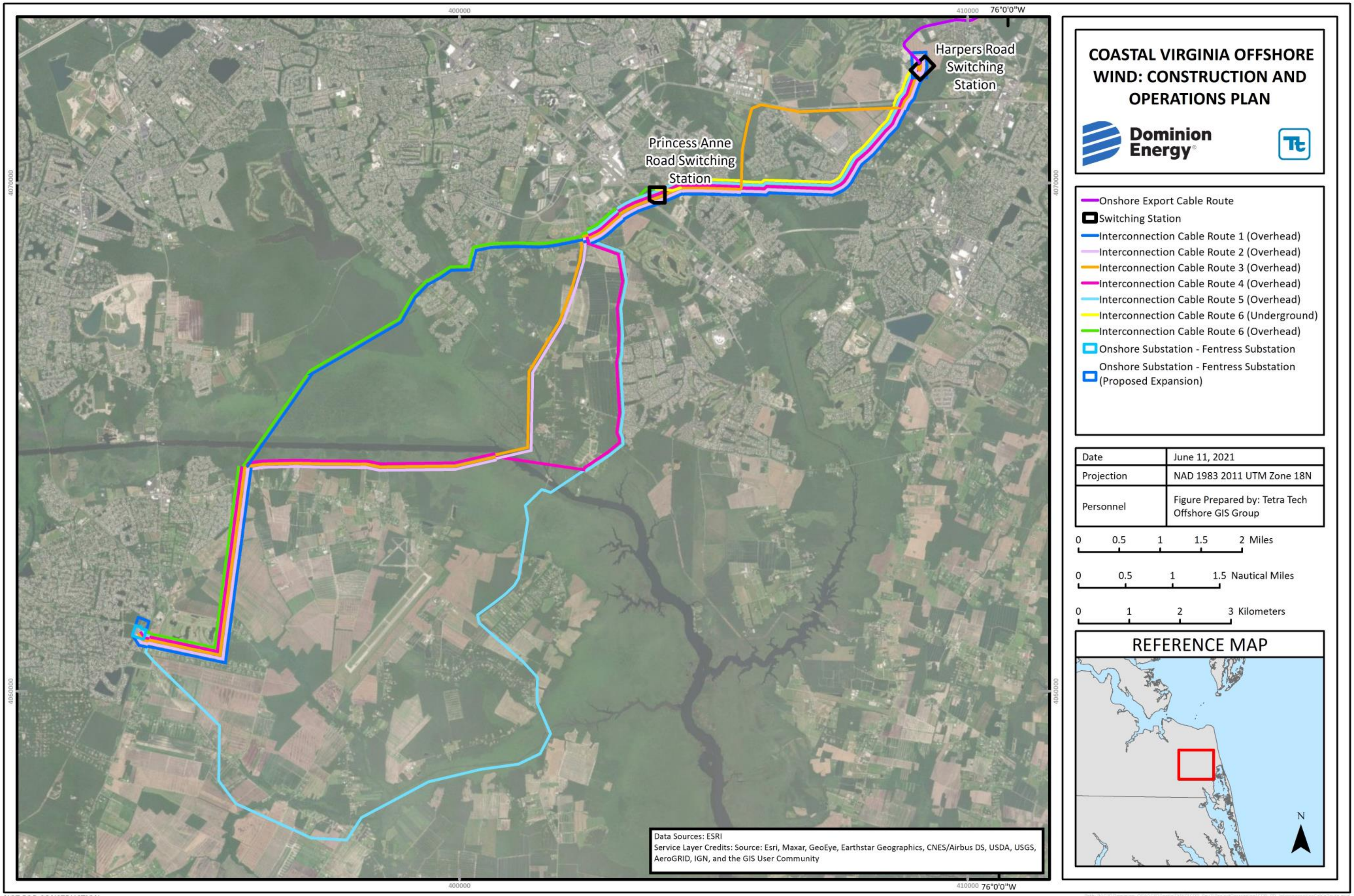


Figure 2.1-6. Onshore Project Components – Overhead Interconnection Cable Routes and Onshore Substation

NAS Oceana: Several alternatives considered development of the Switching Station on a parcel within NAS Oceana property, pending Navy approval. Dominion Energy has already been in discussions with the Navy regarding a lease/purchase option for this parcel as well as leases or easements for ROWs. The infrastructure within NAS Oceana (e.g., runways, buildings, roadways, training areas, etc.) limits routing opportunities to the north and west while existing development blocks routing opportunities to the south and southeast. The Interconnection Cable Route Alternatives identified cross the southeastern edge of NAS Oceana before turning south into undeveloped open lands north of Dam Neck Road. Based on the location of the Switching Station, further study of NAS Oceana flight approach surfaces are needed to determine possible limitations on tower heights near runways 14R/32L and 14L/32R.

Residential Areas: The high density of residential development to the south and west of the NAS Oceana Parcel limits the routing options in all directions. All Interconnection Cable Route Alternatives are designed to avoid residential areas as much as possible and to limit new ROWs acquisition on residential lots.

City of Virginia Beach-owned Property: South and west of NAS Oceana is a relatively large area described in the 2017 Virginia Beach Master Plan as the Interfacility Traffic Area, where the City of Virginia Beach purchased multiple tracts of undeveloped lands to control development within the high-noise level jet flight path area connecting NAS Oceana and Naval Auxiliary Landing Field Fentress. Parklands owned by the City of Virginia Beach are discussed below. Other holdings by the city include parcels acquired for construction and operation of the Southeast Expressway and Greenbelt—a previously planned 21.4-mile-long planned highway between Virginia Beach and Chesapeake (see Existing Transmission Line description below).

Other city-owned lands in the area include large, wooded lots as well as large agricultural and forested land holdings southwest of the Virginia Beach National Golf Course. Conceptual development plans for city-owned lands in these areas are described in the Virginia Beach Master Plan. It should be noted that in Virginia, publicly-owned lands can be a constraint to transmission line routing because these lands can only be used with the consent and permission of the public land owner. They are not subject to condemnation by Dominion Energy consistent with Virginia law.

City of Virginia Beach Parks: There are several city-owned parks, including several large parks, present in the study area. City-owned parks include: the North Landing Park, Virginia Beach National Golf Course, Princess Anne Athletic Complex, Virginia Beach Sportsplex, and the US Field Hockey National Training Center and Hockey Complex. Other less developed city parks in the routing area include the Holland Pines Park, the West Neck Creek Natural Area, the Rolling Woods Park, and the Litchfield Manor Park.

Back Bay National Wildlife Refuge: Numerous federally owned parcels make up the refuge, which extends from Lake Tecumseh in the north to Back Bay, located in the southeastern portion of the Study Area, approximately 10 miles south of Dominion's Sandbridge Substation. None of the Interconnection Cable Route Alternatives currently included in the PDE cross the refuge.

North Landing River: The Virginia DCR's North Landing River Natural Area Preserve is one of Virginia's largest natural area preserves consisting of an extensive wetland complex including the forested swamps and tidal marshes of the lower North Landing River. In addition to the Commonwealth's land holdings (3,441 acres), The Nature Conservancy (TNC) owns an additional 7,500 acres of land known as the North Landing Preserve. Four Interconnection Cable Route Alternatives currently included in the PDE cross North Landing River near the bridge at North Landing Road, but none of these alternatives cross TNC lands in this area. While none of the Interconnection Cable Route Alternatives currently included in the PDE cross TNC lands near the bridge at North Landing Road, two Interconnection Cable Route Alternatives cross TNC lands further west adjacent to an existing Dominion transmission line across the Intracoastal Waterway.

Intracoastal Waterway: This federally owned waterway is maintained by USACE and subject to its regulatory jurisdiction and is also an historic district (Albemarle & Chesapeake Canal) listed on the National Register of Historic Places (NRHP). The waterway connects the Southern Branch of the Elizabeth River to the west and North Landing River to the East. Two of the Interconnection Cable Route Alternatives currently included in the PDE cross a segment of the waterway/canal adjacent to an existing Dominion transmission line.

Existing Transmission Lines and other Collocation Opportunities: Several existing transmission line corridors, primarily owned and operated by Dominion Energy, may provide opportunities for collocation. The Virginia State Corporation Commission (SCC) requires that existing transmission lines be considered as routing opportunities to the fullest extent when planning new transmission lines. Many of the existing transmission line corridors within the Study Area are in heavily developed areas where homes and other buildings have been built to the edge of the ROW, precluding expansion to accommodate additional lines. However, portions of these corridors were considered as potential routing opportunities during routing of the onshore transmission lines.

Another major routing opportunity in the study area is the previously planned Southern Expressway and Greenbelt (SEGB), a 21.4-mile-long planned highway conceived as an east-west connection between Virginia Beach and Chesapeake. The SEGB project was jointly proposed by the VDOT and the Federal Highway Administration in the Cities of Virginia Beach and Chesapeake, with a Final Environmental Impact Statement completed in 2008. Although the Project has since been terminated, the City of Virginia Beach (and to a much lesser extent the City of Chesapeake) acquired undeveloped lands that form a partial corridor from the NAS Oceana area to an interconnect with I-64 and I-464, near the Dozier Corner area in Chesapeake. Some of this corridor is adjacent to Dominion's existing transmission line Nos. 147/2118. In other areas, residential developments have been built around the corridor or within it. A portion of the undeveloped corridor crosses the Virginia Beach Sports Complex. Much of the land that forms a portion of this corridor that could be useable to support a transmission line is owned by the City of Virginia Beach.

Forested Wetlands, Streams, and Rivers: Between the developed areas of the cities of Virginia Beach and Chesapeake is a large expanse of the Gum Swamp. The swamp extends on either side of the Intracoastal Waterway. This undeveloped area is characterized by forested wetland and flowing waters. Notable landowners in the Gum Swamp area include the City of Virginia Beach, TNC, USACE, and the U.S. Government.

National Register of Historic Places Listed and Eligible Properties: In addition to the Albemarle & Chesapeake Canal, the Study Area encompasses numerous NRHP-listed and -eligible historic resources (See Section 4.3.3, Aboveground Historic Resources for additional information), including several historic districts. These districts include: Cedar Grove/James Bell House (near the NAS Oceana Parcel); the SMR, Princess Anne Courthouse Village, and Virginia Beach Courthouse Village (In Virginia Beach); and Blue Ridge-Fentress, Centerville-Fentress, and Centre Hill (in Chesapeake near the Onshore Substation).

In addition to the major constraints listed above, the study area also contains unavoidable crossings of federally owned land, city-owned land, city-owned parkland, and privately owned conservation land. Because these constraints are unavoidable, consultation with the applicable agency or owner is ongoing to determine the feasibility of the route alternatives. A summary of Dominion Energy's stakeholder engagement and outreach is provided in Appendix L.

Once the routing constraints and collocation opportunities were identified and assessed based on the level of information available prior to the start of agency and stakeholder consultations, potential overhead and hybrid route alternatives were identified within the Study Area between Harpers Road and the Onshore Substation. Collocating the potential Interconnection Cable Route Alternatives with existing transmission lines and other routing opportunities was prioritized. However, large scale (i.e., point to point) collocation opportunities with existing transmission lines between Harpers Road and the Onshore Substation were determined to not be viable due to bottlenecks caused by residential developments and city parks, among other factors. The various transmission lines that currently traverse the area between Harpers Road and the Onshore Substation cross numerous residential developments and commercial areas. In many cases, the residential lots or commercial buildings are built up to edges of the transmission line ROWs on one or both sides of the corridor. These developments generally preclude the expansion of the ROW to accommodate development of a new transmission line entirely collocated with an existing line.

In addition to collocation along the SEGB corridor, three existing transmission line corridors offer shorter opportunities for collocation within the Study Area. These include line numbers 147/2118, which extend between NAS Oceana and Landstown Substation; line numbers 271/174, which extends between Landstown and Fentress Substations; and line number 2085, which extends between Landstown and West Station Substations. Each of these areas were incorporated into the Interconnection Cable Route Alternatives.

The routing discussed above is limited by overhead transmission line route location availability, particularly in the northeast to central part of the Study Area that incorporates the most developed portions of the City of Virginia Beach (i.e., between London Bridge Road and the Virginia Beach Sports Center). Existing development is the major constraint, followed by public land ownership and the abundance of wetlands. Lands to the east and south of the NAS Oceana Parcel were also investigated for potential routes to the south to try to avoid the congested municipal and commercial areas of Virginia Beach. However, existing residential development right up to the Back Bay National Wildlife Refuge and the large expanses of tidal wetland making up the Refuge prohibit the development of routes through or around this area. Essentially, almost all lands between the NAS Oceana Parcel and the Virginia Beach Sports Complex are already fully developed, are publicly owned, or consist of forested or tidal wetland areas. Where sufficient space is available and constraints are absent, Overhead Interconnection Cable Route Alternatives were routed through the existing constraints to provide as many preliminary options as possible to allow productive discussions with stakeholders.

Once the routing opportunities and constraints were identified and assessed based on the level of information available prior to the start of agency and stakeholder consultations, potential overhead, underground, and hybrid routes were identified for further investigation between Harpers Road and the Onshore Substation. Initially, eight overhead routes and five hybrid routes were identified and included in the PDE in the December 2020 COP.

In March 2021, after collection of additional information, engineering review, and consultations with the Cities of Virginia Beach and Chesapeake and other agencies, Dominion Energy determined that three of the initial eight overhead routes and the five initial hybrid routes were not feasible to construct and/or permit due to various reasons, including greater impacts of eliminated routes to the human and natural environments. These routes subsequently were eliminated from further consideration and removed from the PDE. Additional refinements were made to the remaining overhead routes to resolve engineering/constructability issues, address agency/stakeholder comments, or avoid or minimize impacts on the natural and cultural environments, and one new hybrid route was identified.

The six Interconnection Cable Route Alternatives have been renumbered since the December 2020 version of the COP. Table 2.1-3 below lists all Interconnection Cable Route Alternatives initially identified and considered, including the new Hybrid Route, and how those that remain in the PDE have been renamed and renumbered.

Table 2.1-3. Interconnection Cable Route Alternatives

Interconnection Cable Route Alternatives included in December 2020 PDE	Interconnection Cable Route Alternatives currently included in June 2021 PDE
Overhead Interconnection Cable Route Alternative 1	Not Carried Forward in PDE
Overhead Interconnection Cable Route Alternative 2	Interconnection Cable Route Alternative 2
Overhead Interconnection Cable Route Alternative 3	Interconnection Cable Route Alternative 3
Overhead Interconnection Cable Route Alternative 4	Not Carried Forward in PDE
Overhead Interconnection Cable Route Alternative 5	Interconnection Cable Route Alternative 4
Overhead Interconnection Cable Route Alternative 6	Interconnection Cable Route Alternative 5
Overhead Interconnection Cable Route Alternative 7	Not Carried Forward in PDE
Overhead Interconnection Cable Route Alternative 8	Interconnection Cable Route Alternative 1
Hybrid Interconnection Cable Route Alternative 1	Not Carried Forward in PDE
Hybrid Interconnection Cable Route Alternative 2	Not Carried Forward in PDE
Hybrid Interconnection Cable Route Alternative 3	Not Carried Forward in PDE
Hybrid Interconnection Cable Route Alternative 4	Not Carried Forward in PDE
Hybrid Interconnection Cable Route Alternative 5	Not Carried Forward in PDE
Not Applicable	Interconnection Cable Route Alternative 6

As stated above, a total of 13 Interconnection Cable Route Alternatives were initially considered; however, only five overhead and one hybrid Interconnection Cable Route Alternatives were carried forward in the PDE, as listed below:

- **Interconnection Cable Route Alternative 1 (Previously called Interconnection Cable Route Alternative 8, Carried forward in PDE)**: This approximately 13.9 mi (22.4 km)-long overhead route runs southwest from the Switching Station along the formerly proposed Southeastern Parkway Corridor, crossing Dam Neck Road and London Bridge Road, then joins with existing Dominion-owned transmission lines (line 147/2118) heading west for 1.8 mi (2.9 km). From there, the route continues southwest again along the formerly proposed Southeastern Parkway Corridor, crossing Princess Anne Road, Landstown Road, Salem Road, and Indian River Road, then re-joins with existing Dominion-owned transmission lines (line 271) for the remaining 6.0 mi (9.6 km) to the Onshore Substation.

- **Interconnection Cable Route Alternative 2 (Previously called Interconnection Cable Route Alternative 2, Carried forward in PDE)**: This approximately 14.8 mi (23.8 km)-long overhead route follows the same route as Overhead Interconnection Cable Route Alternative 1, with the exception of an approximately 6.2 mi (10.0 km) segment that runs south from the Princess Anne Sports Complex, crossing Salem Road, and Indian River Road parallel and to the west of North Landing Road before crossing the Albemarle and Chesapeake Canal, then runs west and re-joins existing Dominion-owned transmission lines (lines 271 and 174) for the remaining 3.4 mi (5.5 km) to the Onshore Substation.
- **Interconnection Cable Route Alternative 3 (Previously called Interconnection Cable Route Alternative 3 Carried forward in PDE)**: This approximately 15.1 mi (24.3 km)-long overhead route follows the same route as Overhead Interconnection Cable Route Alternative 2, with the exception of an approximately 2.7 mi (4.3 km) segment that runs west along Dam Neck Road, past London Bridge Road, then turns south just before Taylor Farms, where it again aligns with Overhead Interconnection Cable Route Alternative 1 for the remaining 12.2 mi (19.6 km) to the Onshore Substation.
- **Interconnection Cable Route Alternative 4 (Previously called Interconnection Cable Route Alternative 5, Carried forward in PDE)**: This approximately 16.0 mi (25.7 km)-long overhead route follows the same route as Overhead Interconnection Cable Route Alternative 2, with the exception of an approximately 4.5 mi (7.2 km) segment that joins existing Dominion-owned transmission lines (line 2085) between Landstown Road and Indian River Road, then crosses Upton’s Lane and crosses the Albemarle and Chesapeake Canal west of North Landing Road, where it again aligns with Overhead Interconnection Cable Route Alternative 2 for the remaining 6.4 mi (10.3 km) to the Onshore Substation.
- **Interconnection Cable Route Alternative 5 (Previously called Interconnection Cable Route Alternative 6, Carried forward in PDE)**: This approximately 19.7 mi (31.7 km)-long overhead route follows the same route as Overhead Interconnection Cable Route Alternative 4, with the exception of an approximately 11.2 mi (18.0 km) segment that runs southwest from Upton’s Lane, crosses the Albemarle and Chesapeake Canal east of North Landing Road, then follows Mount Pleasant Road, Fentress Airfield Road, and Blackwater Road, crossing the Pocaty River twice before heading west across agricultural fields, then approaches the Onshore Substation from the southeast.
- **Interconnection Cable Route Alternative 6 (New Alternative, Carried forward in PDE)**: This hybrid route includes approximately 4.1 mi (6.6 km) of underground and 9.9 mi (15.9 km) of overhead cable that follows the same route as Overhead Interconnection Cable Route Alternative 1, with the exception of the location of the Switching Station. The route would continue following Overhead Interconnection Cable Route Alternative 1 as an underground transmission line until a point north of Princess Anne Road where it would transition to an overhead transmission line

configuration. A Switching Station would be built north of Princess Anne Road, therefore no aboveground Station would be built at Harpers Road. From the Switching Station north of Princess Anne Road, the route aligns with Overhead Interconnection Cable Route Alternative 1 for the remaining 9.7 mi (15.5 km) to the Onshore Substation.

- **Interconnection Cable Route Alternative 7 (Previously called Hybrid Interconnection Cable Route Alternative 1, Not Carried Forward in PDE**: This approximately 22.1 mi (35.6 km)-long hybrid route follows the same route as Overhead Interconnection Cable Route Alternative 5, with the exception of the segment that runs along Dam Neck Road, past London Bridge Road, then turns south just before Taylor Farms, where it again aligns with Overhead Interconnection Cable Route Alternative 5. This route also takes a more southerly crossing of the Albemarle-Chesapeake Canal and then again diverges along Land of Promise Road south of the Fentress Airfield, from Long Ridge Road to Whittamore Road;
- **Interconnection Cable Route Alternative 8 (Previously called Hybrid Interconnection Cable Route Alternative 2, Not Carried Forward in PDE)**: This approximately 17.5 mi (28.2 km)-long hybrid route follows the same route as Overhead Interconnection Cable Route Alternative 2 from the NAS Oceana parcel, pending Navy approval, with the exception of the segment between Holland Road and Salem Road south of the Virginia National Golf Club;
- **Interconnection Cable Route Alternative 9 (Previously called Hybrid Interconnection Cable Route Alternative 3, Not Carried Forward in PDE)**: This approximately 21.9 mi (35.2 km)-long hybrid route from the NAS Oceana parcel, pending Navy approval, is collocated along Oceana Boulevard, to General Booth Boulevard, Princess Anne Road, then crosses to the west over West Neck Creek and the North Landing River, where it then follows the same route as the Overhead Interconnection Cable Route Alternative 5.
- **Interconnection Cable Route Alternative 10 (Previously called Hybrid Interconnection Cable Route Alternative 4, Not Carried Forward in PDE)**: This approximately 22.2 mi (35.7 km)-long hybrid route from the NAS Oceana parcel, pending Navy approval, is collocated along General Booth Boulevard, Nimmo Parkway, Upton Drive, Princess Anne Road, then crosses to the west over West Neck Creek and the North Landing River, where it then follows the same route as the Overhead Interconnection Cable Route Alternative 5.
- **Interconnection Cable Route Alternative 11 (Previously called Hybrid Interconnection Cable Route Alternative 5, Not Carried Forward in PDE)**: This approximately 22.6 mi (36.4 km)-long hybrid route from the NAS Oceana parcel, pending Navy approval, is collocated along General Booth Boulevard, then through mixed residential/commercial areas along Upton Drive, Sandbridge Road, then two options through agricultural fields west of New Bridge Road, crosses Princess Anne Road, then crosses to the west over West Neck Creek and the North Landing River, where it then follows the same route as the Overhead Interconnection Cable Route Alternative 5.

Additional descriptions of the Interconnection Cable Route lengths, route descriptions, construction/operational corridors, and other details are included in Section 3, Description of Proposed Activity.

2.1.2.5 *Onshore Substation*

Dominion Energy has been evaluating potential POI locations since an initial Integration Study conducted in 2010 (Dominion Virginia Power 2010), which at that time identified the Landstown Substation and the Fentress Substation as potentially suitable POIs due to their proximity to the Offshore Project Area and potential cable landing locations, as well as the capacity available for generation injection into the grid. The 2010 study, however, pointed out that an injection of 2,700 MW of energy would overload the Landstown Substation by 145 percent at existing capacity (Dominion Virginia Power 2010). The Fentress Substation was therefore identified as a more favorable POI location because of its capacity for additional power, proximity to the Project, as well as being an integrated 230-kV and 500-kV substation—the only 500-kV substation located within a reasonable distance to the Cable Landing Location Alternatives in Virginia Beach, Virginia. As part of this same study, the PJM Interconnection Regional Transmission Organization, the local electrical power transmission system operator, also considered the Fentress Substation as a feasible option in its evaluation of multiple points along the East Coast for interconnection of a large offshore wind power generation project.

This early study and resulting analysis, combined with the planning and execution of the CVOW Pilot Project, has resulted in Dominion Energy conducting a thorough analysis of POI locations. While the Fentress Substation represents the only feasible POI location for a project of this size, there are several transmission line alternative routes (as provided in Section 2.1.2.4, Interconnection Cable Routes) that could deliver the full 2,500 MW to 3,000 MW of power to the Fentress Substation and to the PJM grid.

Dominion Energy evaluated and submitted a project to the PJM in the fall of 2019 for the injection of 2,640 MW of energy at the Fentress Substation. PJM has completed the Feasibility Studies and System Impact Studies for this project submittal and is currently evaluating the Facility Studies. The construction of a new 230-kV Switching Station will be required to collect the energy and send the power through three new 230-kV 14-mile transmission lines to the Fentress Substation. The new 230-kV lines will terminate at the Fentress Substation where they will be converted to 500 kV via three new 500/230-kV autotransformers. Four new 500-kV breakers will be required to expand the Fentress Substation to accommodate the addition of the new autotransformers.

2.2 Key Project Component Technologies

While the Preferred Alternative for the Project includes SG-14-222 DD 14 to 16-MW WTGs, monopiles for the WTGs, and two to three HVAC Offshore Substations, alternative technologies for key Project Components were also considered in the design of the Project, as described in this section. The Project development activities performed, which included engineering of the components, site surveys, and outreach to the market, had the objective to establish a PDE that is commercially, technically, and environmentally feasible to achieve a Project capacity of 2,500 to 3,000 MW.

2.2.1 Wind Turbine Generators

The Preferred Alternative for the Project includes SG-14-222 DD WTGs with individual capacity up to 16 MW including power boost. Several different WTGs of various sizes available in the market were considered for the Project. The WTG model was selected through a competitive tender process, where it was concluded that the selected WTG is the most commercially attractive and technically robust choice out of the turbines offered to achieve a Project capacity of 2,500 to 3,000 MW.

The selected WTG was the most attractive from an overall environmental perspective as well. Out of the considered WTGs, the selected WTG requires the fewest number of positions, which results in a smaller ground disturbance, fewer underwater noise emissions, and allows for wider turbine spacing. The large WTGs on fewer positions is a cost-effective solution that also comes with an opportunity to optimize the construction schedule for the Project.

2.2.2 Wind Turbine Generator Foundations

As part of the Research and Activities Plan for the CVOW Pilot Project (Dominion Energy 2015), several foundation types were evaluated as alternatives. Each foundation type was evaluated based on seabed type, water depth, and supply chain capacity/availability. The analysis of foundation types completed as part of the CVOW Pilot Project informed the analysis, selection, and design parameters for the Project. Other foundation types were considered. However, once it was established that the supply chain could provide monopiles with sizes applicable for the Project, and after consideration of the superior advantages of monopiles, the alternative foundation types were not carried forward in the PDE:

- **Monopiles** (*Preferred Alternative*): Monopiles are considered the WTG Foundation Preferred Alternative for the Project based on water depth and the expected sediment conditions within the Lease Area. Monopile foundations include a single vertical, cylindrical steel pile driven into the seabed. Unless a continuous monopile with directly attached secondary structures is selected, a steel transition piece, which may contain secondary structure components (e.g., boat landings and access platforms), would be connected to the monopile (see Section 3, Description of Proposed Activity). Monopiles are considered to be the most technically feasible and cost-effective of available options for the Project based on water depth and the seabed conditions within the Lease Area. Furthermore, monopiles are also a well-proven concept with a mature supply chain and the largest market share. The foundation design includes scour protection installed at the base;
- **Jackets** (not carried forward in the PDE): Numerous projects have been constructed using jacket foundations. Jackets are feasible in deeper water depths or in weak soil conditions where a monopile would become too large for cost-effective fabrication and installation. For the Project, jackets would have been less cost-effective than monopiles;
- **Suction buckets** (not carried forward in the PDE): Some projects in Europe have used suction bucket jackets; however, no commercial-scale projects have been constructed using monopile buckets. Suction buckets are only applicable in specific soil conditions. Due to the limited applications and dependence on soil conditions, suction buckets would be considered less feasible than conventional monopiles for the Project;
- **Gravity-Based Structures (GBS)** (not carried forward in the PDE): GBS technologies were eliminated from consideration for the Project, as GBS has only been applied on a limited number of offshore wind projects in substantially shallower water depths and would require heavy structures with large footprints and expensive installation setup, as well as comprehensive seabed preparation prior to installation; and

- **Floating foundations** (not carried forward in the PDE): are only considered feasible for substantially deeper water depths and currently have not yet been applied on commercial-scale projects.

2.2.3 Inter-Array Cables

The Preferred Alternative for the Inter-Array Cable system is a voltage of 66 kV, with the individual cables sized to the capacity required. The most commonly used voltage for array cables is 66 kV, and the alternative would be using 33-kV cables, which would not be feasible for a large-scale project with large-capacity WTGs. Using 33-kV cables would require fewer WTGs per array cable string, and thus a substantially larger number of Inter-Array Cable strings, which would significantly increase cost, technical complexity, and ground disturbance.

2.2.4 Offshore Substations

Two scenarios were evaluated with consideration to the number of Offshore Substations: three Offshore Substations, each with a capacity of up to 1,000 MW, or two Offshore Substations, each with a capacity of up to 1,500 MW. Dominion Energy evaluated both options and decided to include two to three Offshore Substations in the PDE for this Project in order to ensure that a number of global manufacturers are capable of constructing and installing Offshore Substations of this size in order to maintain flexibility when selecting suppliers.

In general terms, a lower number of Offshore Substations is desirable since it comes with lower fabrication cost, shorter installation time, and lower O&M cost. However, when the Offshore Substation reaches a certain size, the installation options become limited, driving up the complexity and cost. Globally, there are only a few Offshore Substations with capacity beyond 1,000 MW under construction, while some Offshore Substations with capacity of up to 1,000 MW have been constructed. The alternative of fewer or more than two to three Offshore Substations has, therefore, not been carried forward.

2.2.5 Offshore Export Cables

Dominion Energy evaluated the costs, benefits, and engineering constraints of utilizing HVAC vs. HVDC offshore export cables. The Preferred Alternative for the Project is multiple (up to nine) HVAC Offshore Export Cables, each with three conductor cores, rather than HVDC. HVDC was not carried forward as an alternative to HVAC since it comes with a significantly higher construction cost than HVAC and is only considered feasible on projects situated significantly farther from shore.

The Preferred Alternative for the Offshore Export Cables is nine 230-kV HVAC cables with an outside diameter up to 11.4 in (290 millimeters [mm]). 230 kV complies with the voltage level required when connecting to the grid, and it is expected that nine offshore export cables are needed to transfer the electricity from the Offshore Substations to shore. The Preferred Alternative is the maximum Offshore Export Cable diameter that the market is expected to be able to supply to the Project.

An alternative with a lower number of cables would require cable sizes that exceed what can be supplied by the market and is thereby not considered feasible. A larger number of cables would be more costly and would require a wider Offshore Export Cable Route Corridor and increase the ground disturbance.

2.3 Summary of Options Carried Forward in the Project Design Envelope

Dominion Energy has identified a variety of Alternatives that have benefited from the long history of the CVOW Pilot Project as well as the Project. This collective information was utilized to consider all available options and arrived at the Alternatives comprising the PDE, consisting of the Onshore and Offshore Project Components identified in Table 2.3-1.

Table 2.3-1. Summary of Project Components in the Project Design Envelope

Project Component	Preferred Alternative	Project Design Envelope
WTG	14 MW (SG-14-222 DD)	Up to 16 MW (SG-14-222 DD)
WTG Layout	188 WTGs with monopile foundation Spacing = 0.75 to 0.93 nm No WTGs within the fish haven area	179 to 205 WTGs with monopile foundation Spacing = 0.75 to 0.93 nm Fish haven area may include WTGs
Foundations	Monopiles	Monopiles
Inter-Array Cables	66-kV Inter-Array Cables	66-kV Inter-Array Cables
Offshore Substations	Three Offshore Substations (880 MW each) Actual capacity may vary depending on final capacity of the Project	Two Offshore Substations (up to 1,500 MW each) Three Offshore Substations (up to 1,000 MW each) Actual capacity may vary depending on final capacity of the Project.
Offshore Export Cables	Up to nine buried submarine HVAC cables located within the Offshore Export Cable Route Corridor Cable Landing Location at the Proposed Parking Lot, west of the Firing Range at SMR	Up to nine buried submarine HVAC cables located within the Offshore Export Cable Route Corridor Cable Landing Location between the SMR and Croatan Beach Parking Lots
Onshore Export Cable Route (Landing to Harpers Road)	Cable Landing Location between the SMR and Croatan Beach Parking Lots to the new Switching Station; one Alternative	
Switching Station	Two Options, depending on Interconnection Route; Harpers Road Common Location, or north of Princess Anne Road	
Interconnection Cable Route (Harpers Road to Onshore Substation/POI	Switching Station to the Onshore Substation/POI; five overhead Alternatives, one hybrid Alternative, with two Switching Station options (of these, one will be selected)	
Onshore Substation	Fentress Substation	

3 DESCRIPTION OF PROPOSED ACTIVITY

This section describes the Offshore and Onshore Project Components, which are comprised of components proposed as part of the PDE (see Section 1.2 Project Design Envelope). Activities associated with the construction and installation, O&M, and decommissioning of the Project Components are also discussed. A quick reference guide to the Project terms, components, and activities that will be referenced throughout the COP can be found in the Executive Summary.

3.1 Project Location

The proposed locations for development of the Project have been selected based on the environmental and engineering site characterization studies that have been completed to date. The location of Project Components will be further refined based on final engineering design as well as ongoing discussions, agency reviews, public input, and the NEPA review process.

The Offshore Project Components, including the WTGs, Inter-Array Cables, and Offshore Substations, would be located in federal waters within the Lease Area, while the Offshore Export Cable Route would traverse both federal and state territorial waters. The boundary of the Lease Area is located 20.45 nm (37.87 km) from the northwest corner to the Eastern Shore Peninsula and 23.75 nm (43.99 km) from Virginia Beach, Virginia. The Lease Area itself is 13.0 nm (24.08 km) from the westernmost to easternmost edge, 10.4 nm (19.26 km) from the northernmost to southernmost edge, and 112,799 total acres in size. Figure 3.1-1 provides an overview of the locations of the Offshore Project Area. The Onshore Project Components would include the Onshore Export Cables, Switching Station, Interconnection Cables, and an Onshore Substation. The Onshore Project Components would be located within the municipalities of Virginia Beach and Chesapeake, Virginia. Figure 3.1-2 provides an overview of the locations of the Onshore Project Area, including alternative routing options.

During construction and installation, the Project would involve temporary construction laydown area(s) and construction port(s) in Europe or North America. The operation stage of the Project would include an onshore O&M facility with an associated base port. Additional detail regarding these sites is provided in Section 3.5, Operations and Maintenance.

For the purposes of this COP, the Offshore Project Area refers to the maximum footprint of the facilities from and including the Lease Area to the Offshore HDD Punch-Out location (includes Offshore Export Cable Route Corridor), to the Nearshore HDD Area (refers to the area from the Offshore Punch-Out location approximately 2,953 to 3,281 ft [900 to 1,000 m] from shore to the Cable Landing Location onshore in Virginia Beach). The Onshore Project Area refers to the maximum footprint of the facilities including the area from the Cable Landing Location to the POI at the Onshore Substation (includes Onshore Export Cable Route Corridor, Switching Station, Interconnection Cable Route Corridor, and Onshore Substation.)

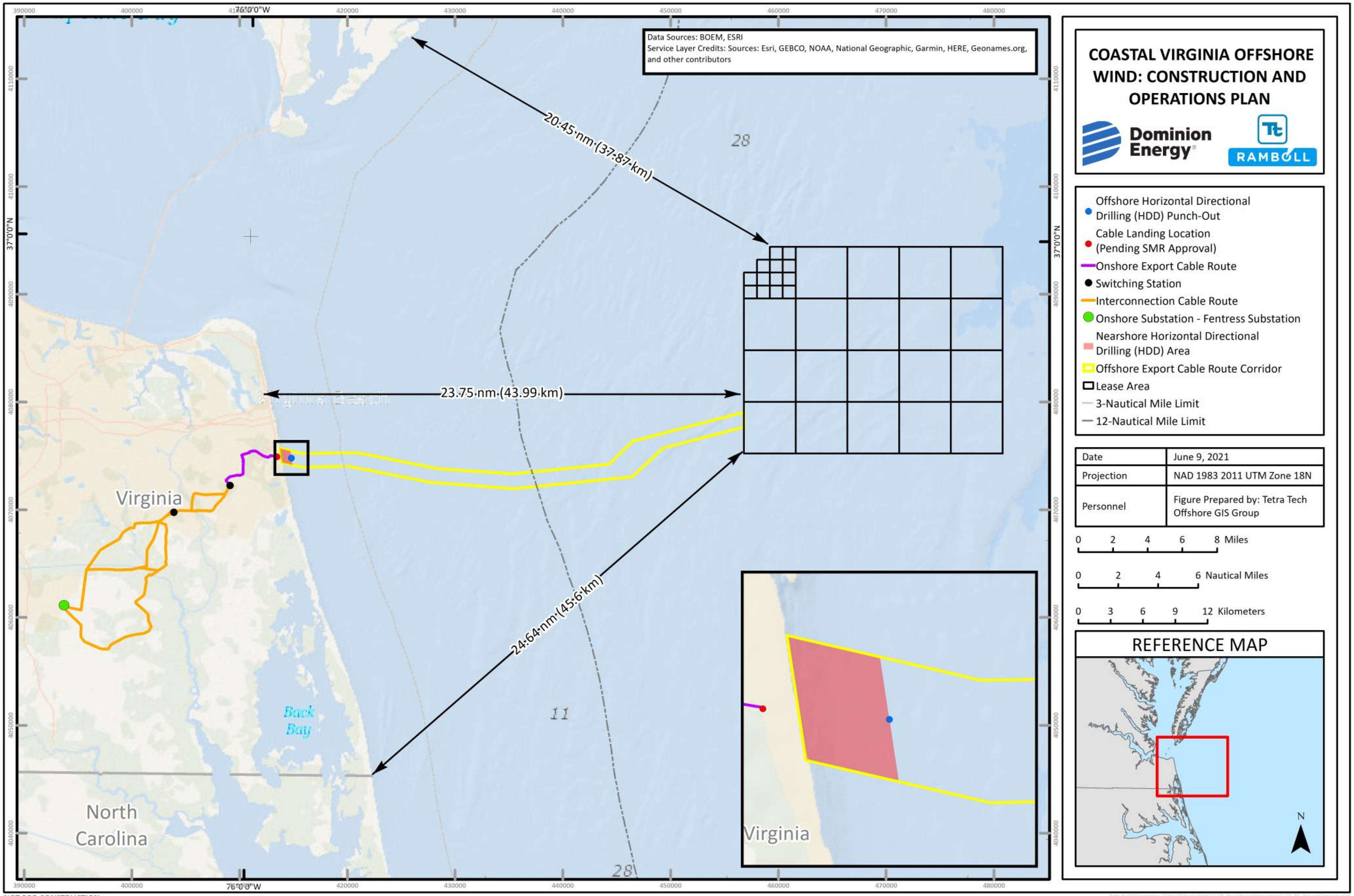


Figure 3.1-1. CVOW Commercial Offshore Project Area Overview

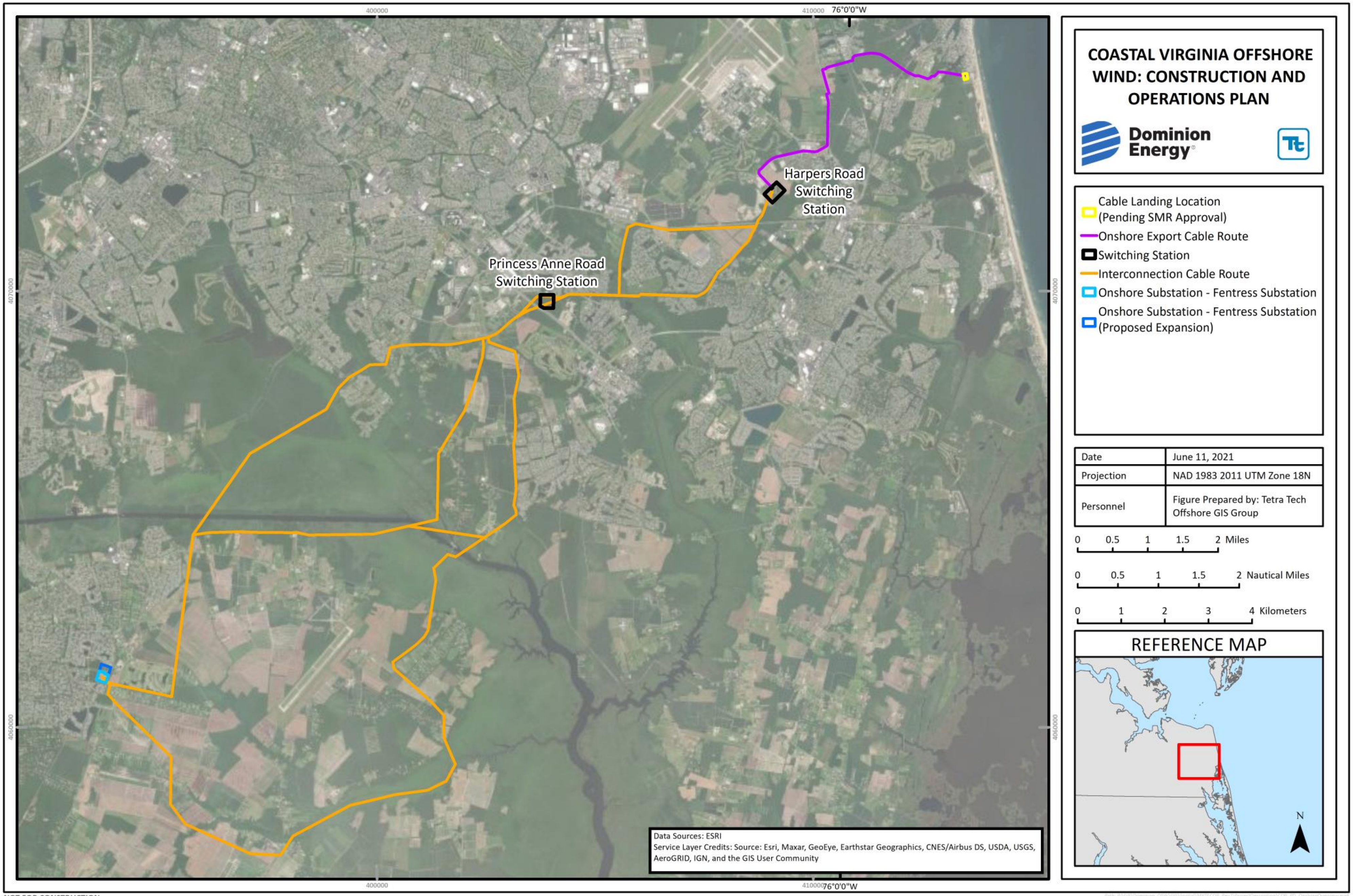
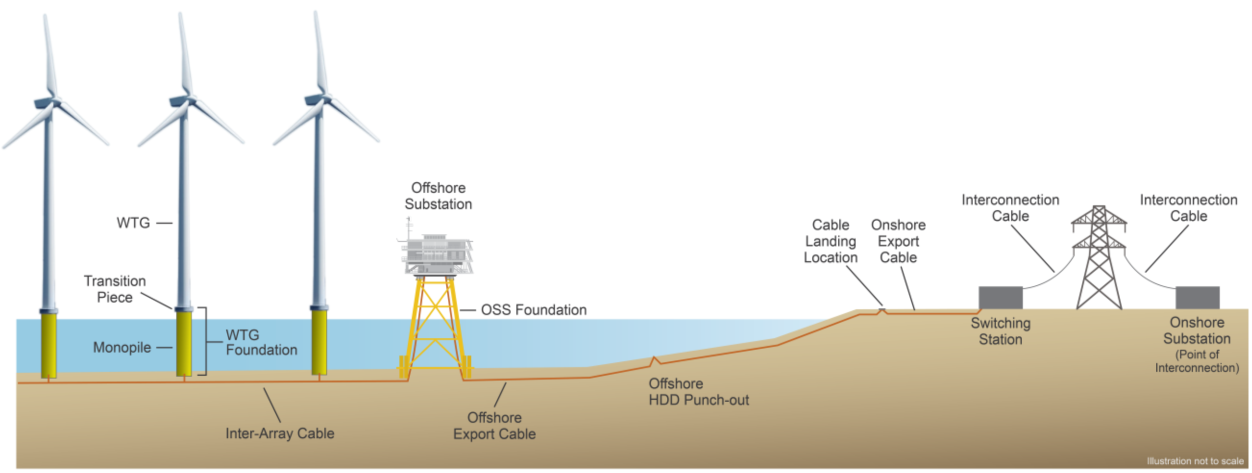


Figure 3.1-2. CVOW Commercial Onshore Project Area Overview (including alternative routing options)

3.2 Project Infrastructure Overview

The design of an offshore wind project requires a number of elements that are engineered in consideration of the characteristics of the environment in which they would be located and for the purpose they serve. Relative to and consistent with the PDE concept, Dominion Energy is considering a range of potential project design values and construction and installation techniques associated with various components of the Project. The use of a PDE is necessary to anticipate changes in available technology and Project economics and to ensure that the outcome of the environmental review and approval process for the Project can be accommodated within the Project's final design.

While much of the infrastructure of an offshore wind project is located in the offshore marine environment, the need to interconnect with the existing onshore electrical grid requires that several of the infrastructure elements are located on land. Within the Lease Area, the WTGs would generate electricity that would be transferred to the Offshore Substations via a series of Inter-Array Cables. The WTG strings would be connected to each other via a link/switch to provide redundancy in the event of an Inter-Array Cable failure. The Offshore Substations would then transform the power to a higher voltage for transmission and transport to shore by the Offshore Export Cables. The Offshore Export Cables will be brought ashore via HDD at the Cable Landing Location, where they would transition into the Onshore Export Cables that will transport the power to a Common Location south of Harpers Road. The Interconnection Cable Route begins at Harpers Road. The Interconnection Cables will transmit and transport the power from Harpers Road to the Onshore Substation, which would be the final POI into the existing electrical grid. The Switching Station will collect power and facilitate transition from underground transmission line to overhead transmission line. Figure 3.2-1 provides a generalized schematic of the major Project components.



*Note: The Interconnection Cable will begin before the Switching Station for Interconnection Cable Route Alternative 6

Figure 3.2-1. Generalized Schematic of Major Project Components

In addition to the proposed infrastructure, Portsmouth Marine Terminal is an existing port facility located on the west bank of the Elizabeth River and is most likely to support the staging of Project components and construction vessels for the Project. A port in Newport News, Virginia is also under consideration as an alternative in the Hampton Roads Region. Dominion Energy is considering locations in Newport News, Portsmouth and Norfolk, Virginia, with Lambert's Point, which is located on a brownfield site, as the preferred location, to serve as the O&M facilities for the Project.

The following sections provide details regarding the PDE under consideration for each of the major Project Components, associated construction and installation processes and O&M activities, and a high-level overview of decommissioning. The subsections are organized to start with the WTGs in the Lease Area, where the electricity will be generated, and end at the POI into the existing electrical grid at the Onshore Substation. The final selections and construction and installation strategies would be reviewed by the CVA and submitted to BOEM prior to construction and installation.

3.3 Project Design

This section further describes the proposed Project infrastructure and provides details on design and siting methodologies.

3.3.1 Offshore Project Components

The Offshore Project Components are comprised of the WTGs, WTG Foundations (including the monopiles and transition pieces), the Inter-Array Cables, the Offshore Substations, Offshore Substation Foundations (jacket foundations), and the Offshore Export Cables, each of which is described below.

3.3.1.1 *Wind Turbine Generators*

As discussed in Section 1.2, Project Design Envelope, Dominion Energy has selected Siemens Gamesa Renewable Energy (SGRE) as the preferred WTG supplier. To anticipate advancements in the available WTG technology, Dominion Energy requires flexibility in the final design of the WTG. Therefore, the PDE sets both minimum and maximum realistic design scenarios for both WTG design and layout parameters against which potential environmental effects can be assessed.

While a range of designs of WTG from SGRE may be considered, all WTGs for the Project are expected to follow the traditional offshore WTG design with three blades and a horizontal rotor axis. Specifically, the blades will be connected to a central hub, forming a rotor that turns a shaft connected to the generator. The generator will be located within a containing structure known as the nacelle situated adjacent to the rotor hub. The nacelle will be supported by a tower structure affixed to the WTG Foundation. The nacelle will be able to rotate or “yaw” on the vertical axis to face the oncoming wind direction.

In support of the development of the Project, Dominion Energy has selected the SGRE SG 14-222 DD WTG. Table 3.3-1 provides a summary of the physical characteristics of the SG 14-222 DD WTG. See Figure 3.3-1 and Appendix K, Conceptual Design Drawings for simplified drawings demonstrating the size and components of the Preferred Alternative for the WTG. For the purpose of the assessments presented within this COP, the WTG design envelope has been defined by minimum and maximum parameters that are representative of the SGRE WTGs currently on the market or expected to become available in time to be used for the Project. Regardless of WTG size, Dominion Energy is permitting up to 205 WTG positions, including 17 alternative, or spare, positions.

Table 3.3-1. Summary of WTG Parameters

Parameter	Minimum	Maximum	Preferred Alternative
Project nameplate capacity	2,500 MW	3,000 MW	2,640 MW
WTG generating capacity	14 MW	16 MW	14 MW
Cut in wind Speed	6.7 miles per hour (mph) (3 meters per second [m/s])	11.2 mph (5 m/s)	6.7 mph (3 m/s)
Cut out wind speed	55.9 mph (25 m/s)	67.1 mph (30 m/s)	62.6 mph (28 m/s)
Total number of WTGs	179	205	188
Turbine tip height from mean sea level (MSL)	804 ft (245 m)	869 ft (265 m)	837 ft (255 m)
Hub height from MSL	446 ft (136 m)	489 ft (149 m)	473 ft (144 m)
Rotor diameter	725 ft (221 m)	761 ft (232 m)	728 ft (222 m)
Distance from bottom of turbine tip to Highest Astronomical Tide (HAT) (air gap)	82 ft (25 m)	115 ft (35 m)	109 ft (33 m)

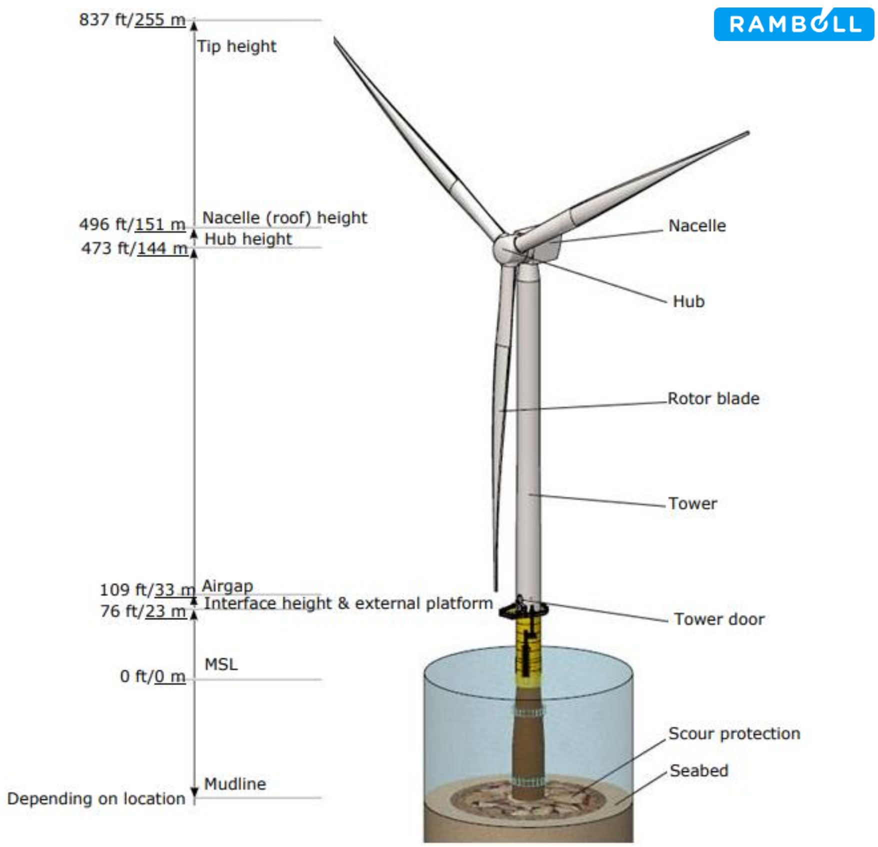


Figure 3.3-1. Simplified Elevation Drawing of the WTG

A brief technical description of the main components of the SG 14-222 DD WTG are provided below.

The SG 14-222 DD rotor is a three-bladed cantilevered construction, mounted upwind of the tower. The power output is controlled by pitch regulation. The rotor speed is variable and is designed to maximize the aerodynamic efficiency.

The blades are made of fiberglass-reinforced epoxy and carbon fiber-reinforced epoxy, manufactured using the SGRE propriety IntegralBlade® manufacturing process. The blades are mounted on pitch bearings and can be feathered for shutdown purposes. Each blade has its own independent pitching mechanism capable of feathering the blade under any operating condition. The blade pitch arrangement allows for optimization of the power output throughout the operating range, and the blades are feathered during standstill to minimize wind loads.

The rotor hub is cast in nodular cast iron and is fitted to the generator rotor with a flange connection. The hub provides a comfortable working environment for service technicians during maintenance of blade roots and pitch bearings. A cast, hollow and fixed main shaft ensures a comfortable internal access from the canopy to the hub. A cast bed frame connects the shaft to the tower. The yaw bearing is an externally geared ring with a friction bearing. A series of electric planetary gear motors drives the yawing.

The rotating parts of the WTG are supported by a single bearing. The bearing is a double row tapered roller bearing. The bearing is lubricated by an automatic lubrication system.

The generator is a fully enclosed synchronous generator with permanent magnet excitation. The generator rotor construction and stator windings are designed for high efficiency at partial loads. The generator is positioned between the tower and the hub producing a comfortably lean arrangement of the internals in the nacelle. The mechanical brake is fitted to the generator and has hydraulic calipers.

The weather screen and housing around the machinery in the nacelle is made of glass fiber-reinforced plastic panels.

The WTG is mounted on a tapered tubular steel tower. The tower has internal ascent and direct access to the yaw system and nacelle. It is equipped with platforms and internal electric lighting.

The controller is a microprocessor-based industrial controller. The controller is complete with switchgear and protection devices. It is self-diagnosing and has an interface for easy readout of status and adjustment of settings. The NetConverter® power conversion system allows generator operation at variable speed, frequency and voltage while supplying power at constant frequency and voltage to the medium-voltage transformer connected to the Offshore Substation. The power conversion system is a modular arrangement for easy maintenance and is water cooled.

The SG 14-222 DD WTG is also equipped with the SGRE Supervisory Control and Data Acquisition (SCADA) system. This system offers remote control and a variety of status views and useful reports. The status views present information including electrical and mechanical data, operation and fault status, meteorological data and grid station data. In addition, the WTG is equipped with the unique Turbine Condition Monitoring System, which monitors the vibration level of the main bearing and compares the actual vibration spectra with a set of established reference spectra. It can also provide result review, detailed analysis, and reprogramming.

The WTG operates automatically. It is self-starting when the wind speed reaches an average of about 6.7 to 11.2 miles per hour (mph) (3 to 5 meters per second [m/s]). The output increases approximately linearly with the wind speed until the wind speed reaches around 42.7 to 49.2 ft/s (13 to 15 m/s). At that point, the power is regulated at rated power.

The WTG will be equipped with Power Boost technology, which is a software enhancement that will enable the WTGs to generate power output above nameplate capacity under certain operational conditions. Power Boost functionality will be governed by certain operational limits such as ambient temperature, internal components temperatures, pitch angles, and wind turbulence level. The SG 14-222 DD WTG Power Boost Technology, which would increase the generation capacity of each WTG up to approximately 16 MW under certain operating conditions.

In contrast to some WTGs that automatically shut down outside of their operational limits for self-protection, the SG 14-222 DD WTG is equipped with the High Wind Ride Through (HWRT) system. The HWRT system will slowly ramp down power output instead, enabling smoother production ramp-down and thereby a more reliable electrical grid. The SG 14-222 DD WTG has been designed to withstand site conditions, including hurricane force winds expected in the Lease Area. The WTGs will also be protected both externally and internally by a lightning protection system.

Each of the WTGs will require various oils, fuels, and lubricants to support the operation of the WTGs. Table 3.3-2 provides a summary of the oils, fuels, and lubricants proposed, as well as the anticipated volumes. In addition, the WTGs will be designed to minimize the potential for spills and leaks through the implementation of containment measures. The spill containment strategy for each WTG is comprised of preventive, detective, and containment measures. These measures will be developed and implemented prior to construction activities. See Appendix Q for a preliminary version of the Oil Spill Response Plan that will continue to be developed as the Project matures.

Table 3.3-2. Oil/Fuel/Lubricant Parameters per WTG

Oil/Fuel/Lubricant	Expected Amount
Hydraulic oil	30 gallons (gal, 115 liters [l])
Cooling fluid	476 gal (1,800 l)
Gear oil (yaw gears)	up to 5 gal (20 l)
Transformer app	1,717 gal (6,500 l)

WTG Control System

Each WTG will have its own control system to carry out functions like yaw control and ramp down in high wind speeds. As described above, each WTG will contain a SCADA system, which will allow Dominion Energy to monitor performance and to control operations remotely. In the event of a planned or emergency maintenance shut down, the SCADA systems will be utilized.

Operation of the WTGs will be continuously monitored by the SCADA system, which has the capability of being both locally and remotely operated over a local area network to ensure the WTGs are operating within their specified design limits. The SCADA system will at consist of, at minimum, the main SCADA, a Remote Terminal Unit, a server, a router and firewalls.

Communication systems include public address, general alarm, closed circuit television, and local area network. As further described in Section 3.5.1, Offshore Operations and Maintenance, the final operations and maintenance plan will include details of the WTG control system and emergency plans for shutdowns.

WTG Foundations

For the purpose of this COP, monopiles are being considered to support Project WTG Foundations. The WTG Foundation concept consists of two parts, a lower foundation pile (monopile) driven into the seabed and an upper transition piece mounted on top of the monopile (together referred to as the WTG Foundation). The transition piece is connected to the WTG tower with a flange. Dominion Energy is considering either a two-part WTG Foundation comprised of a monopile with grouted or bolted transition piece or a single-part, continuous monopile integrated with the transition piece. Each WTG Foundation will consist of a monopile structure and transition piece that will contain supporting structures such as access ladders, boat landing, and platforms. Illustrative examples of the WTG Foundation are provided in Figure 3.3-2 and Figure 3.3-3.

Integration with the supporting structures is also being considered. In the case of a continuous monopiles, the WTG tower and secondary structures will be attached directly to the monopile.

The WTG Foundations are foreseen to have scour protection installed around the base of the monopile. The need, type, and method for installing scour protection will be determined in consultation and coordination with relevant jurisdictional agencies prior to construction and installation.

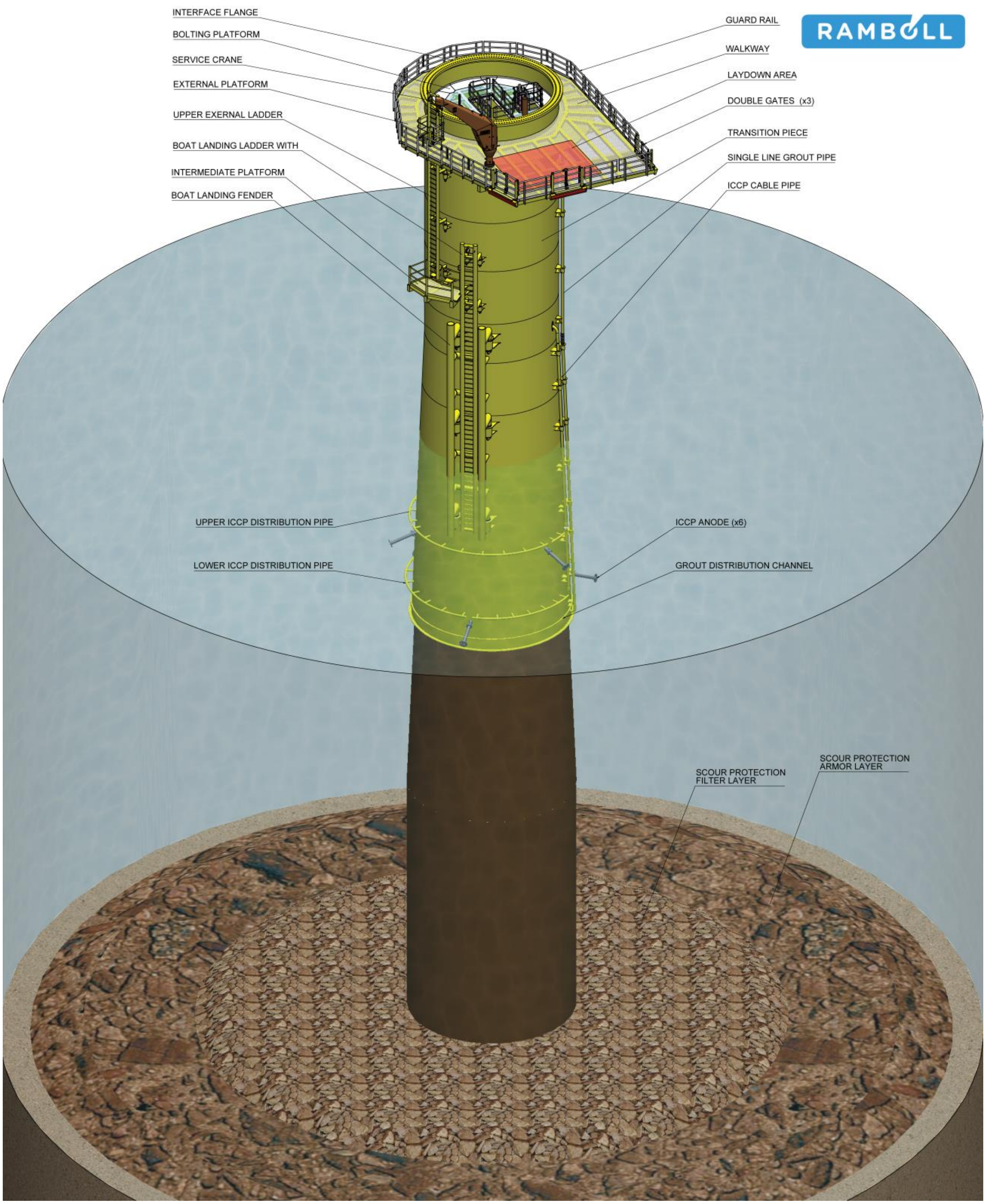


Figure 3.3-2. Illustrative Example of the WTG Foundation

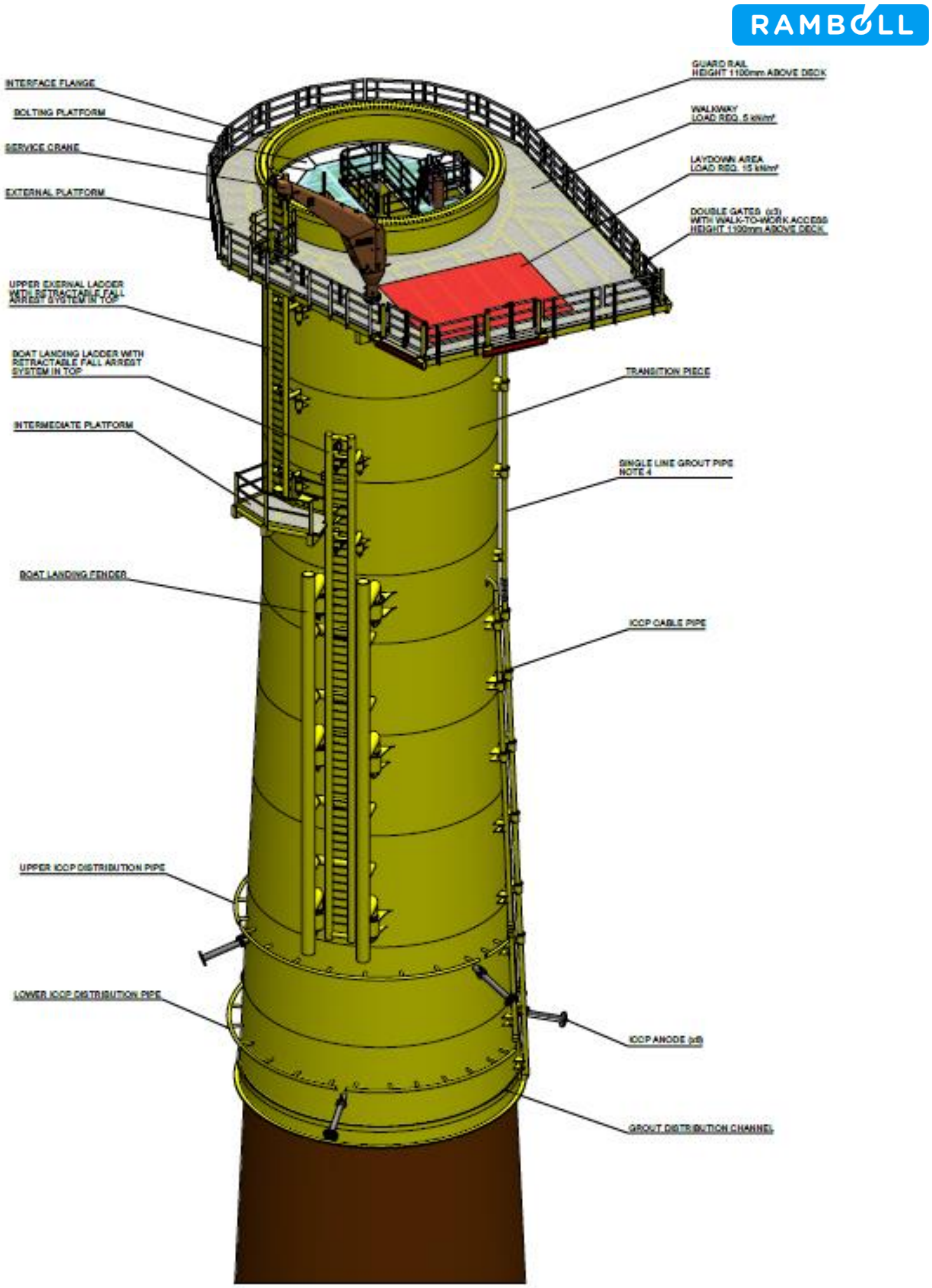


Figure 3.3-3. Illustrative Example of the Transition Piece

The final design of the WTG Foundations will be determined by the final engineering design process, informed by factors including WTG loads, water depth, soil conditions, and wave and tidal conditions at each final installation location. While the monopiles will vary in geometry and penetration depth across the

Lease Area, the transition pieces will be designed in clusters based on the range of water depths and metocean conditions within the Lease Area. For purposes of this COP, the WTG Foundations have been conceptually designed in a number of clusters based on the water depth variation across the Lease Area. The WTG minimum and maximum foundation design parameters are provided below in Table 3.3-3.

Table 3.3-3. WTG Foundation Design Parameters

Foundation Parameter	Minimum	Maximum	Preferred Alternative
Monopile			
Number of monopiles	179	205	188
Monopile diameter a/	23 ft (7 m)	36 ft (11 m)	Site Specific—Varies across Project
Base diameters (with scour protection) b/	98 ft (30 m)	230 ft (70 m)	Site Specific—Varies across Project
Seabed penetration	82 ft (25 m)	197 ft (60 m)	Site Specific—Varies across Project
Diameter at HAT	23 ft (7 m)	36 ft (11 m)	Site Specific—Varies across Project

a/ Per WTG Foundation
b/ Per WTG Foundation if scour protection is required

Dominion Energy believes that it is possible to design and install the size and type of monopiles included in the PDE to the desired target penetration depth. This is based on current knowledge of the ground conditions from the data collected in support of the CVOW Pilot Project, in addition to extensive geotechnical investigations completed to date in the Lease Area that were completed specifically to inform the CVOW Commercial Project. Dominion Energy is completing extensive geophysical and geotechnical surveys to inform final siting and design of the Project. Additional detail, including a preliminary drivability assessment based on site-specific data, decades of use in offshore wind, and engagement with manufacturers, will be included in the FDR/FIR to be reviewed by the CVA and submitted to BOEM prior to construction and installation.

WTG Layout

Designing and optimizing the layout of the WTGs is a complex, iterative process taking into account a large number of inputs and constraints including, but not necessarily limited to:

- Site conditions:
  - Wind speed and direction;
  - Water depth;
  - Seabed conditions;
  - Environmental constraints (anthropogenic and natural); and
  - Seabed obstructions (e.g., wrecks, UXO, existing cables);
- Design considerations:
  - Turbine type;
  - Construction/installation set-up;
  - Foundation design;
  - Electrical design; and

- Stakeholder considerations:
  - Commercial and Recreational Fishing (see Section 4.4.6); and
  - Marine Transportation and Navigation (see Section 4.4.7 and Appendix S, Navigation Safety Risk Assessment).

As further described in Section 4, Site Characterization and Assessment of Impact-Producing Factors, the design of the WTG layout considered all existing uses of the Lease Area and surrounding areas such as vessel traffic patterns, commercial and recreational fishing activities, minimization of impacts to biological and cultural resources, as well as the safety of mariners and Project personnel. The WTG layout has been designed to maximize power density in the Lease Area and minimize costs to the ratepayer to support the goals of the Virginia Clean Economy Act. Based on these considerations, the WTG layout was designed to include a 397 ft (121 m) setback (measured from the center point of the WTG) from the edge of the Lease Area to minimize potential impacts to existing uses and resources within and adjacent to the Lease Area. The setback is based on an assumed WTG blade length of 361 ft (110 m) plus 3.3 ft (1 m) to account for the rotation axis, with an additional 33 ft (10 m) buffer to ensure that all WTG components are fully located within the Lease Area. Additionally, a 984 ft (300 m) buffer was placed around known biological and cultural resources such as artificial reefs or shipwrecks. These buffers would also be adhered to if micrositing is required due to the presence of previously unknown resources that may be identified during the remainder of geophysical surveys.

Dominion Energy anticipates that between 179 and 205 WTGs would be installed in the Lease Area to reach the Project generation capacity required to produce between 2,500 MW and 3,000 MW of renewable energy. For purposes of this COP, Dominion Energy is considering up to 205 WTG construction and installation locations within the Lease Area as the maximum design scenario. Of the 205 WTG construction and installation locations, 17 locations are considered spare locations to provide the flexibility to switch positions if any of the 188 preferred locations are determined unfavorable for WTG Foundation construction and installation, which would minimize the risk associated with uncertainties concerning the findings of ongoing geophysical surveys, geotechnical sampling, and Project development. Additionally, some WTG Foundation installation locations may be shifted by up to 500 ft (152 m) from the proposed WTG Foundation installation locations to avoid obstructions and local site condition variations, which may be identified during the geotechnical campaign, considered unfeasible for placement of WTG Foundations.

The preferred WTG layout would be arranged in a grid pattern oriented at 35 degrees to minimize wake losses within the wind farm. WTGs would be spaced approximately 0.75 nm (1.39 km) in an east-west direction and 0.93 nm (1.72 km) in a north-south direction. However, the distances between some turbines in the final WTG layout may be slightly larger or smaller, subject to micrositing. The proposed WTG layout is shown below in Figure 3.3-4.

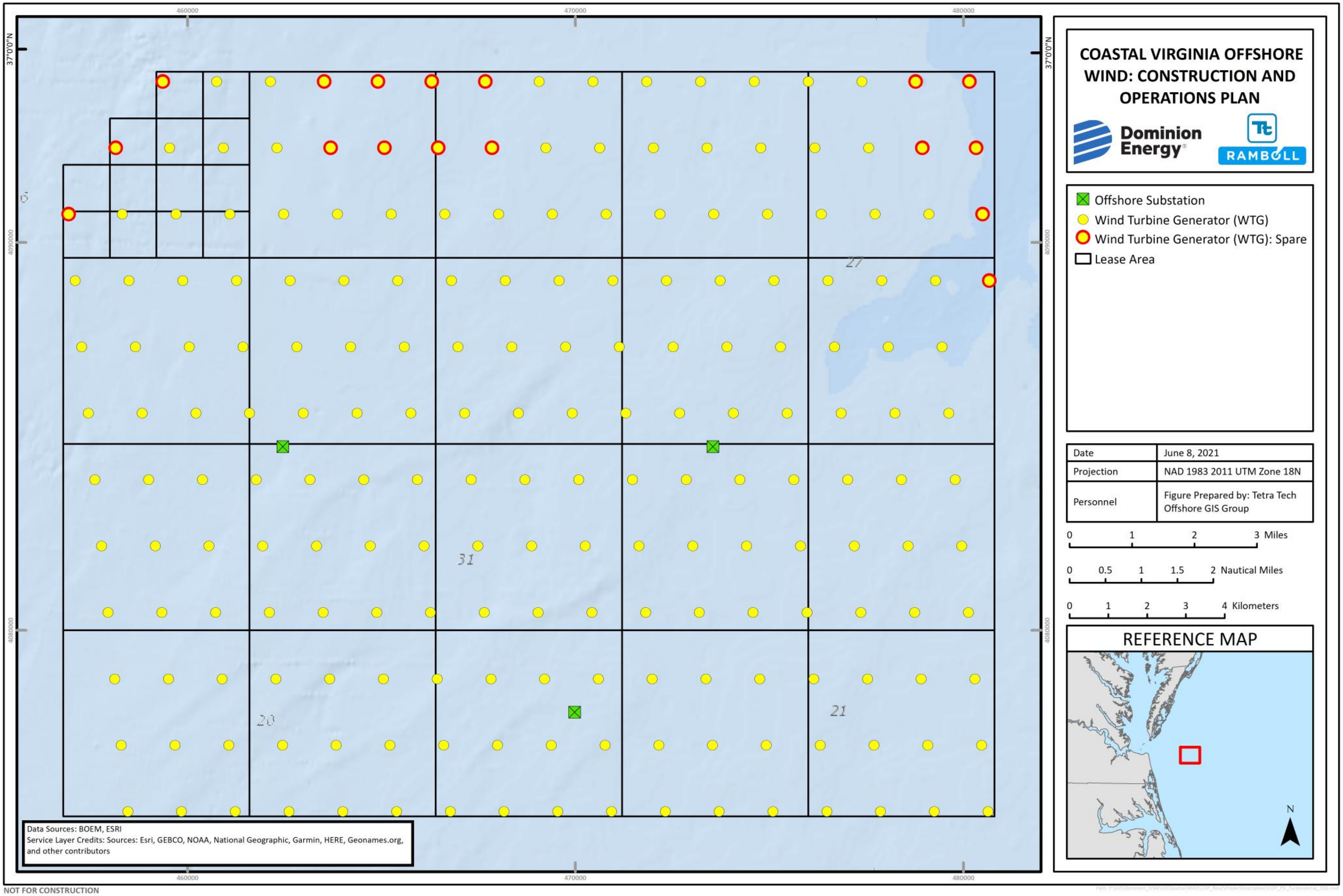


Figure 3.3-4. **CVOW Commercial WTG and Offshore Substation Layout**

The spare WTG locations are located along the northwestern and northeastern boundaries of the Lease Area and within an area referred to as the fish haven area along the northern border of the Lease Area. The Fish haven area is an area of documented various recreational fisheries uses within the Offshore Project Area, particularly within the portion of the Lease Area called the "Triangle Wrecks" (also known as "Triangle Reef"). In the event that WTGs need to be shifted due to constraints at the preferred locations, preference would first be given to the spare locations in the northeastern and northwestern corners of the Lease Area, respectively, when possible. Any WTGs within the fish haven area would be sited to avoid the items associated with the artificial reef, as well as other biological or cultural resources identified during geophysical surveys. The final WTG layout will be provided as part of the FDR/FIR, to be reviewed by the CVA and submitted to BOEM prior to construction and installation.

3.3.1.2 *Inter-Array Cable*

The Inter-Array Cables will carry the electrical current produced by the WTGs to the Offshore Substations. The Inter-Array Cable system will be comprised of a series of cable "strings" that interconnect a small grouping of WTGs to the Offshore Substations. The Inter-Array Cables will consist of strings of three-core copper and/or aluminum conductor, with a rated voltage of 72.5 kV and an operating voltage of 66 kV, connecting up to six WTGs per string. The Preferred Alternative currently included in the PDE for the Inter-Array Cable strings includes variable cable dimensions. The Preferred Alternative would utilize all-copper conductor cables with the largest cable diameter of 7.1 inches (in) (180 millimeters [mm]). The smallest diameter cable would be used to connect the WTGs located furthest from the Offshore Substation, which would then transition to the medium and then largest cable diameter as the Inter-Array Cables approach the Offshore Substation.

In order to be able to provide auxiliary power to each WTG in the event of a potential cable failure, sets of WTG strings throughout the Project are connected via a link/switch. In normal operation this link/switch is open. In the event of a cable failure, the link/switch would be closed so that WTGs could continue normal operations while the cable failure is repaired.

Assuming utilization of the preferred positions within the WTG layout, Dominion Energy anticipates approximately 12 WTG strings would be connected to each Offshore Substation, for a total of 36 WTG strings. However, if WTGs are shifted to spare locations, the Inter-Array Cable layout would need to be reassessed and the number of WTGs per string and/or the number of WTG strings connecting to each Offshore Substation may be modified to maintain a reasonable balance of power between Offshore Substations. Table 3.3-4 provides a summary of the PDE for the Inter-Array Cable design parameters. An illustration of a representative cross-section of an Inter-Array Cable can be found in Figure 3.3-5 and an illustration of a representative Inter-Array Cable layout is provided in Figure 3.3-6.

Table 3.3-4. Inter-Array Cable Design Parameters

Parameter	Minimum	Maximum	Preferred Alternative
Number of Cables	209	230	209
Length per Cable	4,528 ft (1,380 m)	8,366 ft (2,550 m)	4,528 ft (1,380 m) to 6,923 ft (2,110 m), varies by location
Total Length of Cable	273.4 mi (440 km)	300.7 mi (484 km)	273.4 mi (440 km)
Operating Voltage	59.4 kV	66 kV	66 kV
Cable Diameter	5.6 in (141 mm)	7.9 in (200 mm)	Up to 7.1 in (up to 180 mm)

Figure 3.3-5. Representative Cross Section of an Inter-Array Cable

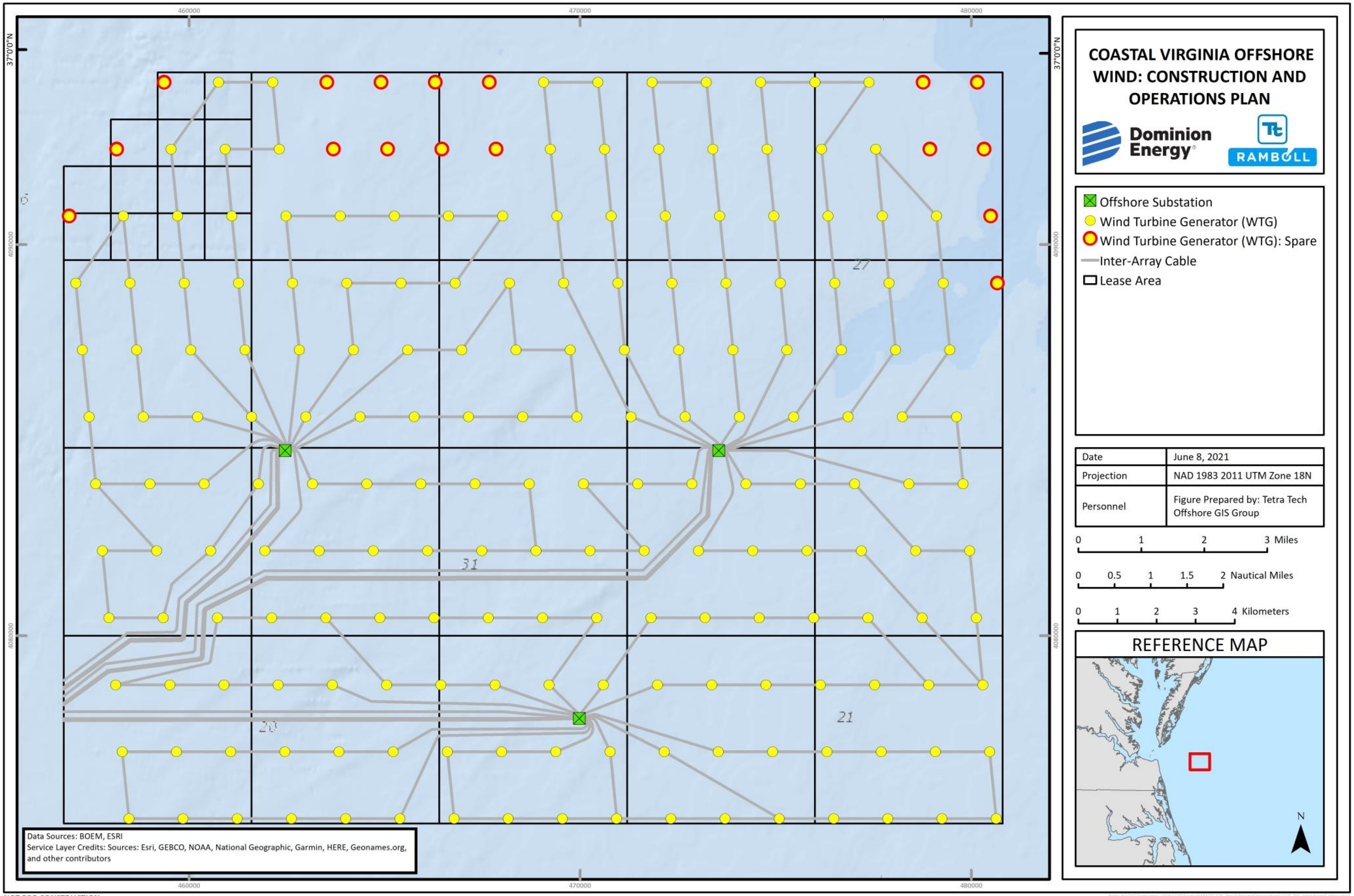


Figure 3.3-6. Representative Inter-Array Cable Layout

3.3.1.3 *Offshore Substation*

The Offshore Substation is an offshore platform containing the electrical components necessary to collect the power generated by the WTGs (via the Inter-Array Cable system) and transform it to a higher voltage for transmission and transport of that power to the Project's onshore electricity infrastructure (via the Offshore Export Cables). Dominion Energy is proposing to construct two to three Offshore Substations each with a rated capacity of 1,000 MW to 1,500 MW, respectively. The locations of the Preferred Alternative of three 1,000-MW Offshore Substations, are shown in Figure 3.3-4. The Offshore Substation is comprised of two main components: (1) a foundation attached to the seafloor and (2) a topside that contains the decks holding the main electrical and support equipment. Each Offshore Substation will contain equipment for high-voltage transmission, including two main transformers and four auxiliary transformers, and other facilities such as heating and ventilation systems, low-voltage distribution, diesel generators, uninterrupted power supply/batteries, pollution prevention system, SCADA systems, and control panels for operation of the substation auxiliary systems, WTGs and the high voltage/medium voltage power transmission.

The Offshore Substation will contain multiple deck levels, including the roof deck, utility deck, cooler deck, main deck, cable deck and cellar deck (located on the Offshore Substation Foundation), which will hold the equipment, cables, and maintenance/shelter area. Dominion Energy is also considering adding a helideck to support monitoring and maintenance to each of the Offshore Substations for normal and emergency access by helicopters. The addition of a helideck would increase the size of the roof deck, which is accounted for in the maximum design parameters, and may also affect the orientation of the decks and increase the weight of the Offshore Substation.

A summary of the Offshore Substation topside design parameters are provided in Table 3.3-5 and an example of an Offshore Substation is provided in Figure 3.3-7.

Table 3.3-5. Offshore Substation Topside Design Parameters

Parameter	Minimum	Maximum	Preferred Alternative
Voltage transformed at Offshore Substation	66/230 kV		66 kV to 230 kV
Width	98 ft (30 m)	203 ft (62 m)	98 ft (30 m)
Length	178 ft (54.4 m)	230 ft (70 m)	178 ft (54.4 m)
Height	65 ft (20 m)	131 ft (40 m)	80.4 ft (24.5 m)
Base Height above HAT (air gap)	56 ft (17 m)	89 ft (27 m)	66 ft (22.9 m)

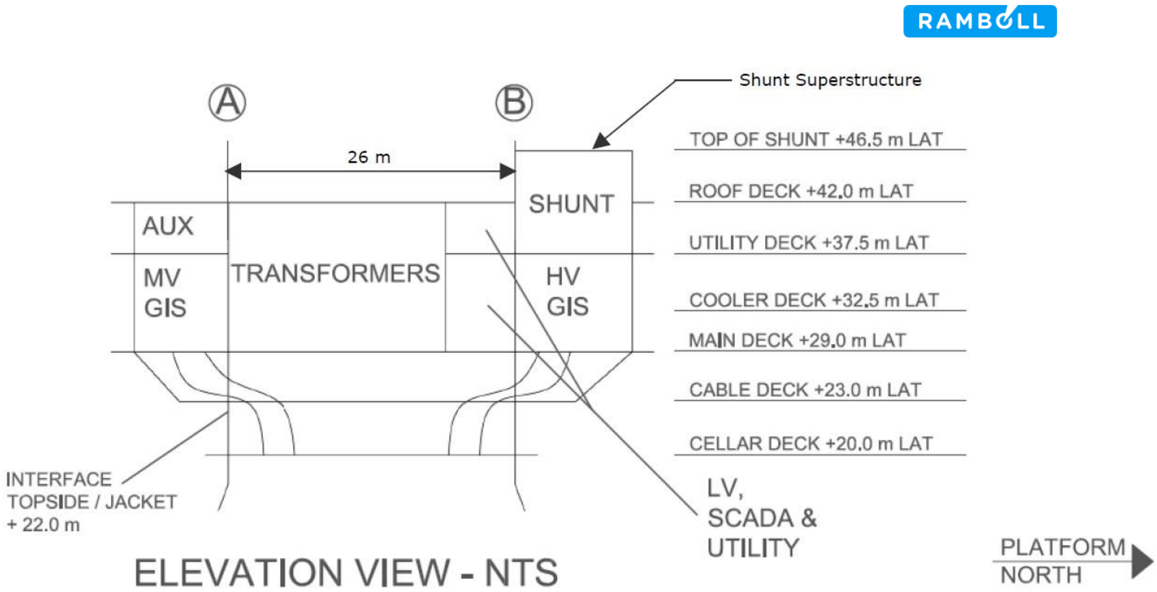


Figure 3.3-7. Example Schematic of the Offshore Substation Topside and Jacket Foundation

Each of the Offshore Substations will require various oils, fuels, and lubricants to support operation. The Offshore Substation topside will be designed to minimize the potential for spills and leaks through the implementation of containment measures. The spill containment strategy for each Offshore Substation is comprised of preventive, detective, and containment measures. Each Offshore Substation will also contain a collection and sump system including an oil water separator system, specifically designed to collect and contain the volume of a single fluid within a suitable response time. Table 3.3-6 provides a summary of the Offshore Substation oils, fuels, and lubricants proposed for use at each Offshore Substation, as well as the anticipated volumes (see also Appendix Q, Oil Spill Response Plan).

Table 3.3-6. Oil/Fuel/Lubricant Parameters per Offshore Substation

Oil/Fuel/Lubricant	Minimum Amount	Maximum Amount
Hydraulic oil	264 gal (1,000 l)	396 gal (1,500 l)
Diesel	5,283 gal (20,000 l)	7,925 gal (30,000 l)
Sulfur hexafluoride gas	6,614 pounds (lb) (3,000 kilograms [kg])	13,228 lb (6,000 kg)
Synthetic ester	13,209 gal (50,000 l)	66,043 gal (250,000 l)
Generator lube oil	18 gal (70 l)	53 gal (200 l)

Offshore Substation Foundations

Dominion Energy is proposing the use of piled jacket foundations to support the Offshore Substations; both pre- and post-installed pile designs are under consideration as part of the PDE, however, pre-installed piled jacket foundations are considered the Preferred Alternative. While the individual Offshore Substations will be similar in size, the final design of the Offshore Substation piled jacket foundations will be position specific and determined by the final engineering design process, informed by factors including water depth, soil conditions, wave and tidal conditions, Inter-Array Cable connections, and the size of the high-voltage equipment at each final Offshore Substation construction and installation location. Table 3.3-7 provides a summary of the Offshore Substation Foundation design parameters and Figure 3.3-8 below provides a general schematic of the Offshore Substation and Offshore Substation Foundation.

Table 3.3-7. Offshore Substation Foundation Installation Design Parameters

Foundation Parameter	Minimum	Maximum	Preferred Alternative
Number of piles a/	4	12	4–8
Pile diameter	4.9 ft (1.5 m)	11.5 ft (3.5 m)	6.9 ft–9.2 ft (2.1 m–2.8 m)
Base dimensions	98 ft x 98 ft (30 m x 30 m)	217 ft x 256 ft (66 m x 78 m)	180 ft x 180 ft (55 m x 55 m)
Scour protection diameter (per leg)	0 ft (0 m)	115 ft (35 m)	N/A
Seabed penetration	131 ft (40 m)	230 ft (70 m)	164 ft to 180 ft (50 m to 55 m)
Seabed footprint (without scour protection) a/	9,687 ft^2 (900 m^2)	55,412 ft^2 (5,148 m^2)	32,560 ft^2 (3,025 m^2)
Seabed footprint (with scour protection) b/	17,222 ft^2 (1,600 m^2)	122,849 ft^2 (11,413 m^2)	45,477 ft^2 (4,225 m^2)
Dimensions at Lowest Astronomical Tide	82 ft x 82 ft (25 m x 25 m)	118 ft x 167 ft (36 m x 51 m)	98 ft x 98 ft (30 m x 30 m)

a/ Per Offshore Substation Foundation
b/ Per Offshore Substation Foundation if scour protection is required

The cellar deck, the lowest of several decks on the Offshore Substation, is expected to be part of the Offshore Substation Foundation and would be an open deck with access from the boat landing and the upper decks. The primary purpose of the cellar deck is to facilitate the cable pull-in and to make it possible to perform this prior to construction and installation of the Offshore Substation topside. The cellar deck would include room for a maximum of 18 J-tubes for Inter-Array Cables (and up to one spare J-tube), and up to five J-tubes for Offshore Export Cables, for a total of up to 24 J-tubes. The cellar deck would provide sufficient space for a cable pulling winch and cable hang-offs. High voltage and medium voltage cable connections would be added to join the pre-installed cables on the topside to the corresponding Inter-Array and Offshore Export Cables. The cable connections would be located between the cellar deck and cable deck.

The Offshore Substation Foundations are foreseen to have scour protection installed around the base of the piled jackets. The need, type, and method for installing scour protection will be determined in consultation and coordination with relevant jurisdictional agencies prior to construction and installation.

Based on current knowledge of the ground conditions from the data collected in support of the CVOW Pilot Project, in addition to geotechnical investigations completed to date in the Lease Area, Dominion Energy believes that it is possible to design and install the size and type of piled jacket foundations included in the PDE to the desired target penetration depth. Dominion Energy is completing extensive geophysical and geotechnical surveys to inform final siting and design of the Project. Additional detail, including a preliminary drivability assessment based on site-specific data, decades of use in offshore wind, and engagement with manufacturers, will be included in the FDR.

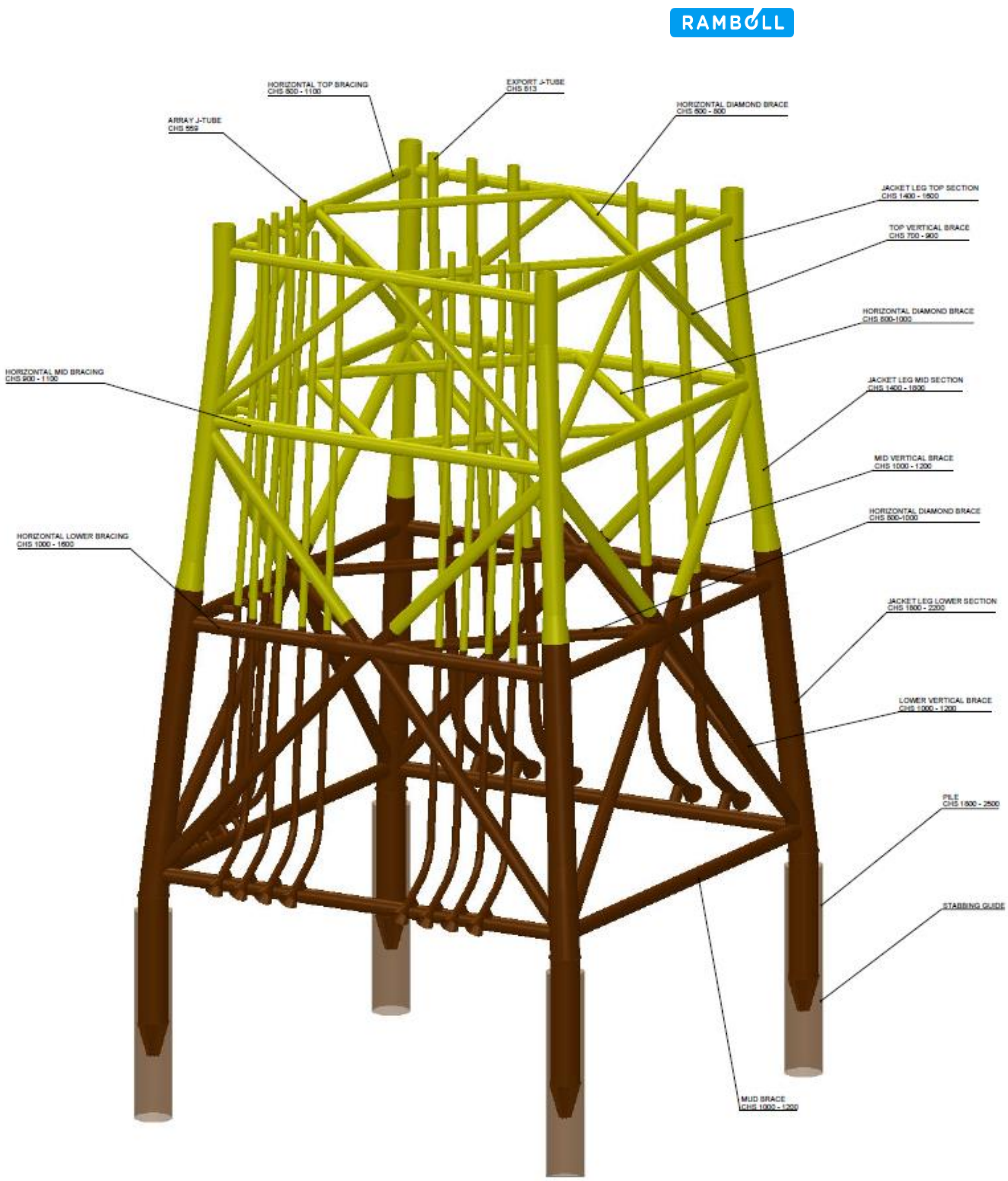


Figure 3.3-8. Example Schematic of the Offshore Substation Jacket Foundation

3.3.1.4 *Offshore Export Cable*

The Offshore Export Cables would transfer the electricity from the Offshore Substations to the Cable Landing Location in Virginia Beach, Virginia. The WTG strings would be connected to each other via link/switch, and each Offshore Substation will be tied to a WTG string.

The Offshore Export Cables have been designed based on the energy capacity needs of the Project as well as consideration of site-specific installation conditions, including seabed temperature, burial depth, and seabed thermal resistivity. The design of the Offshore Export Cables will be further refined based on the results of the system studies, geotechnical surveys, and landfall design.

Electricity would be transferred from each of the three Offshore Substations to the Cable Landing Location via three 3-core copper and/or aluminum-conductor 230-kV subsea cables, for a total of nine Offshore Export Cables. A cross-section of a typical subsea cable is provided in Figure 3.3-9. The Offshore Export Cable Route Corridor width associated with the three cables originating from each Offshore Substation would be 1,280 ft (390 m), which was determined based on the following factors: water depth, anticipated repair vessel deck height and length, radius of cable bight after repair, and minimum cable spacing requirements.

Figure 3.3-9. Cross-Section of Typical Subsea Cable

Upon exiting the Lease Area, the three Offshore Export Cable Route Corridors originating at the Offshore Substations would merge to become one overall Offshore Export Cable Route Corridor containing all nine Offshore Export Cables. The Offshore Export Cable Route Corridor between the western edge of the Lease Area and the Cable Landing Location would range from 3,840 ft (1,170 m) down to 1,970 ft (600 m) wide.

Variability in the Offshore Export Cable Route Corridor width is driven by several external constraints that are present at different locations along the Offshore Export Cable Route Corridor including existing telecom cable and transmission cable crossings; the DoD exclusion area to the south; the vessel traffic lane and proposed Atlantic Coast Port Access Study safety fairway to the north; crossing DNODS; obstructions, exclusion areas, and seabed conditions identified from existing data and ongoing surveys; potential risks due to the use of the area by third parties; and the approach to the HDD at the Cable Landing Location.

The maximum Offshore Export Cable Route Corridor width of 3,840 ft (1,170 m) would be maintained along portions of the Offshore Export Cable Route Corridor where available space and seabed conditions permit. Along areas of the Offshore Export Cable Route Corridor where the Offshore Export Cable Route Corridor width must be reduced to 2,950 ft (900 m) to avoid constraints and obstructions, several additional design factors were considered to evaluate the reduced cable spacing required to fit within the available area, including flexibility (or lack thereof) in size of repair bight; further discussion with cable installers on cable repair vessel requirements; maximizing generation availability following a fault and during cable repair; and the level of contingency included in the cable specification.

Along the approximately 1.9 mi (3 km) section of the Offshore Export Cable Route Corridor that crosses through the DNODS, USACE has indicated that only cells 2 and 5 should be utilized for cable installation. Due to the width of the available area between DNODS cells 2 and 5, and the telecom and transmission cables previously installed in that area, the section of the Offshore Export Cable Route Corridor through the DNODS must be further reduced to 1,970 ft (600 m). The specific spacing of the Offshore Export Cables through the DNODS would need to be designed based on further detailed risk assessment of installation conditions and additional discussions with cable installers.

Within the Offshore Export Cable Route Corridor, the nine Offshore Export Cables would generally be spaced approximately 164 to 558 ft (50 to 170 m) apart. At certain locations, the Offshore Export Cables may be spaced 164 to 328 ft (50 to 100 m) apart based on natural and environmental constraints. The Offshore Export Cable Route Corridor and individual Offshore Export Cable Routes within the corridor are shown in Figure 3.3-10. The maximum design scenario for the Offshore Export Cables is provided below in Table 3.3-8.

Table 3.3-8. Offshore Export Cable Design Parameters

Offshore Export Cable Feature	Minimum	Maximum	Preferred Alternative
Number of Cables	9	9	9
Voltage per Circuit	230 kV	230 kV	230 kV
Cable Diameter	10.3 in (262 mm)	11.4 in (290mm)	10.3 in (262 mm)
Total Corridor Length (from the Lease Area to the Cable Landing Location)	37.28 mi (60 km)	49.01 mi (79 km)	37.28 mi (60 km) to 44.74 mi (72 km)
Width of Construction Corridor (Offshore Work Area to Offshore Substations) a/	1,334.36 ac (540.00 ha)	2,635.37 ac (1,066.50 ha)	1,334.36 ac (540.00 ha) to 1,601.24 ac (648.00 ha)
Requested Operational Right-of-Way a/	1,969 ft (600 m)	2,953 ft (900 m)	1,969 ft (600 m) to 2,953 ft (900 m)

a/ Based on total corridor length multiplied by number of cables (9) multiplied by minimum 33 ft (10 m) (preferred) and maximum 50 ft (15 m) width of trencher.

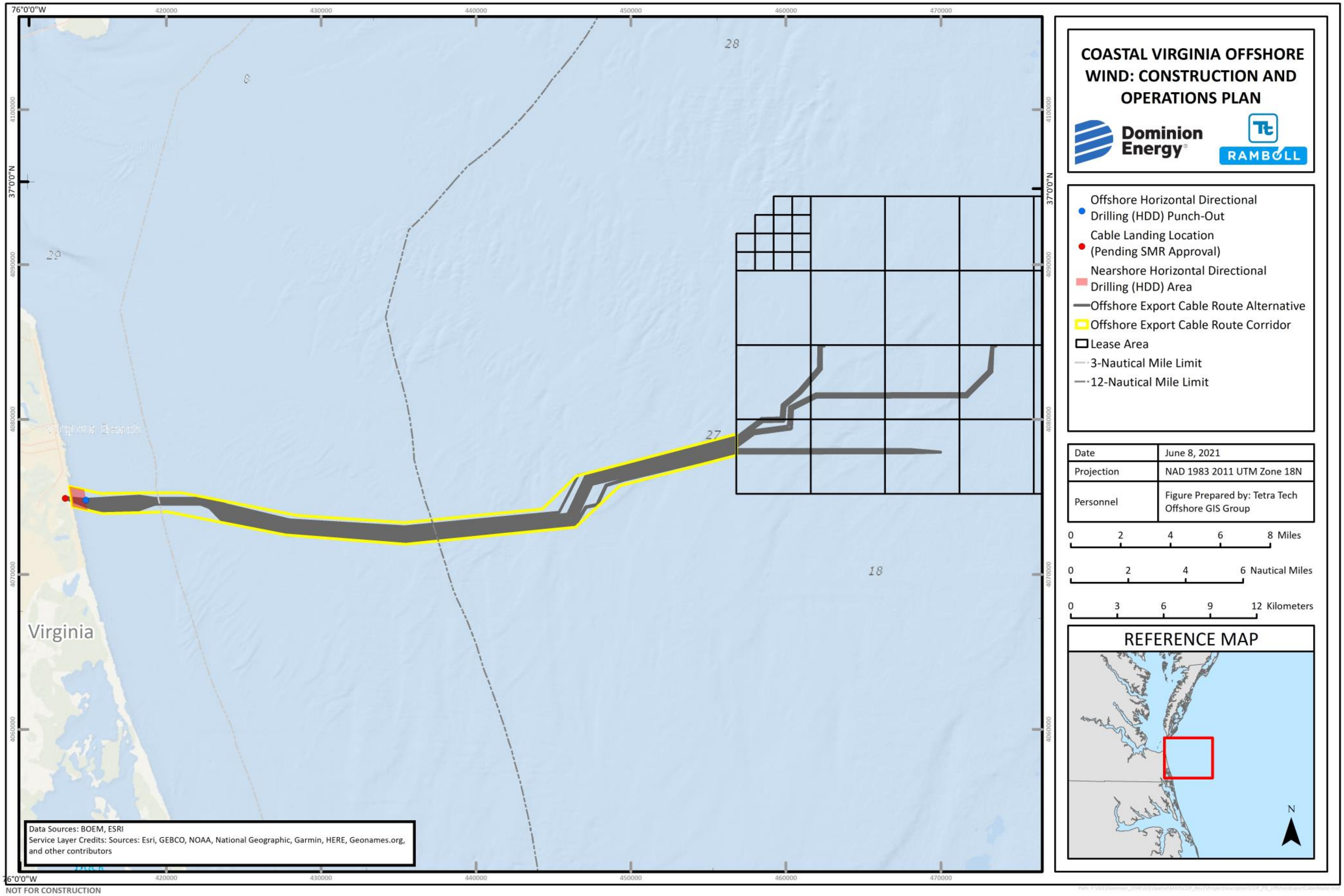


Figure 3.3-10. **Offshore Export Cable Route Corridor and Offshore Export Cable Routes**

Cable/Pipeline Crossings

Dominion Energy has identified three cables located within the Offshore Export Cable Route Corridor that will be crossed by the Offshore Export Cables (see Figure 3.3-11). These cables include three in-service telecoms cables. The telecoms cables are the MAREA, BRUSA, and DUNANT cables.

At cable crossing locations, both the existing infrastructure and the Offshore Export Cables must be protected. This protection and crossing method will be determined on a case-by-case basis depending on the specifications of each crossing, including the depth and angle of crossing and through negotiations with each individual asset owner. At a minimum, it is expected that each asset crossing will include two layers of some form of cable protection that would be installed prior to and post Offshore Export Cable installation and, potentially, a third layer of protection if stabilization and scour protection of the cable crossing is deemed necessary.

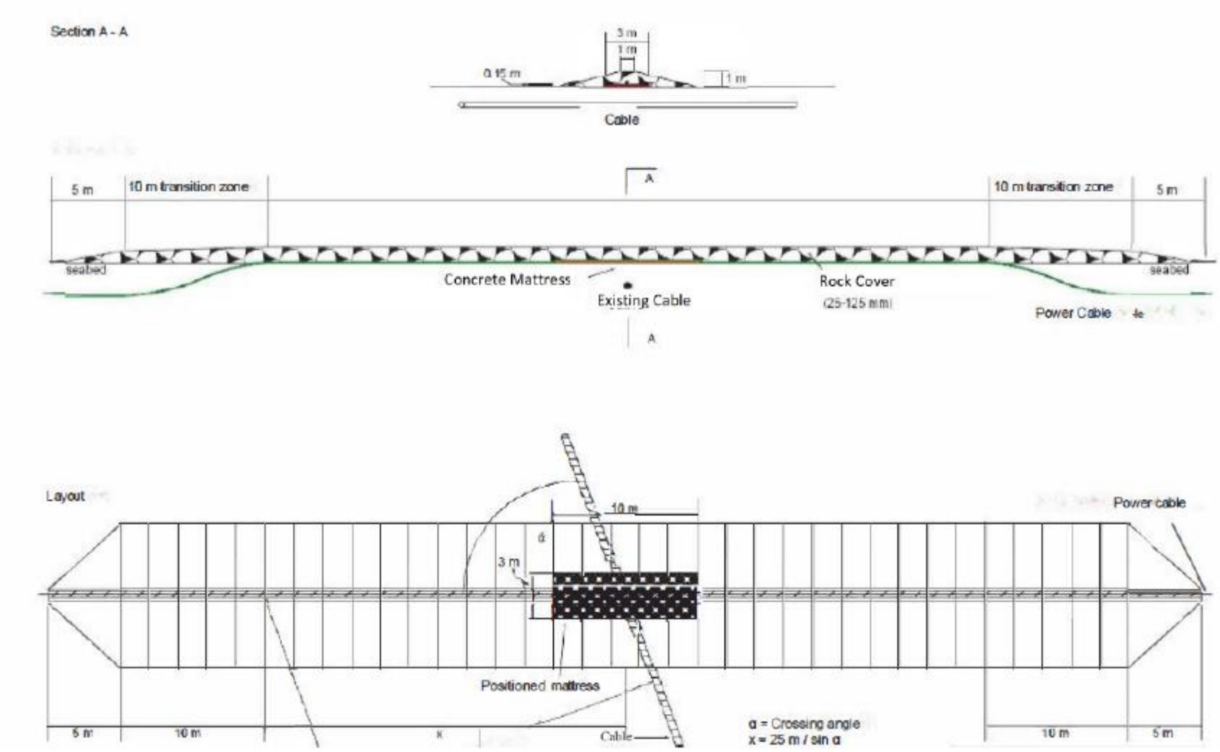


Figure 3.3-11. Example Schematic of Offshore Export Cable Crossing

Final crossing designs will be completed in coordination with each of the asset owners and formalized in crossing agreements. Cable crossing design drawings, separation, and burial/cover details will be provided in the FDR/FIR, to be reviewed by the CVA and submitted to BOEM prior to installation.

3.3.2 Nearshore and Onshore Project Components

3.3.2.1 *Cable Landing Location*

As stated in Section 3.2, Project Infrastructure Overview, the intersection of the Offshore Export Cables and Onshore Export Cables would occur at the Cable Landing Location, located at the Proposed Parking

Lot west of the Firing Range at SMR, pending SMR approval, in Virginia Beach, Virginia (see Figure 3.3-12). Dominion Energy plans to use a HDD to install the Offshore Export Cable under the beach and dune from the Offshore HDD Punch-Out approximately 2,953 to 3,280 ft (900 to 1,000 m) offshore of the Cable Landing Location(s) to a maximum depth of 125 ft (38 m) below grade. The Offshore Export Cables would be brought to shore through a series of conduits. Upon exiting the conduits, the nine 230-kV Offshore Export Cables would be spliced to a series of nine separate single circuit HDD vaults laid in a single ROW and transition to the Onshore Export Cables at the Cable Landing Location (See Section 3.3.2.2, Onshore Export Cable).

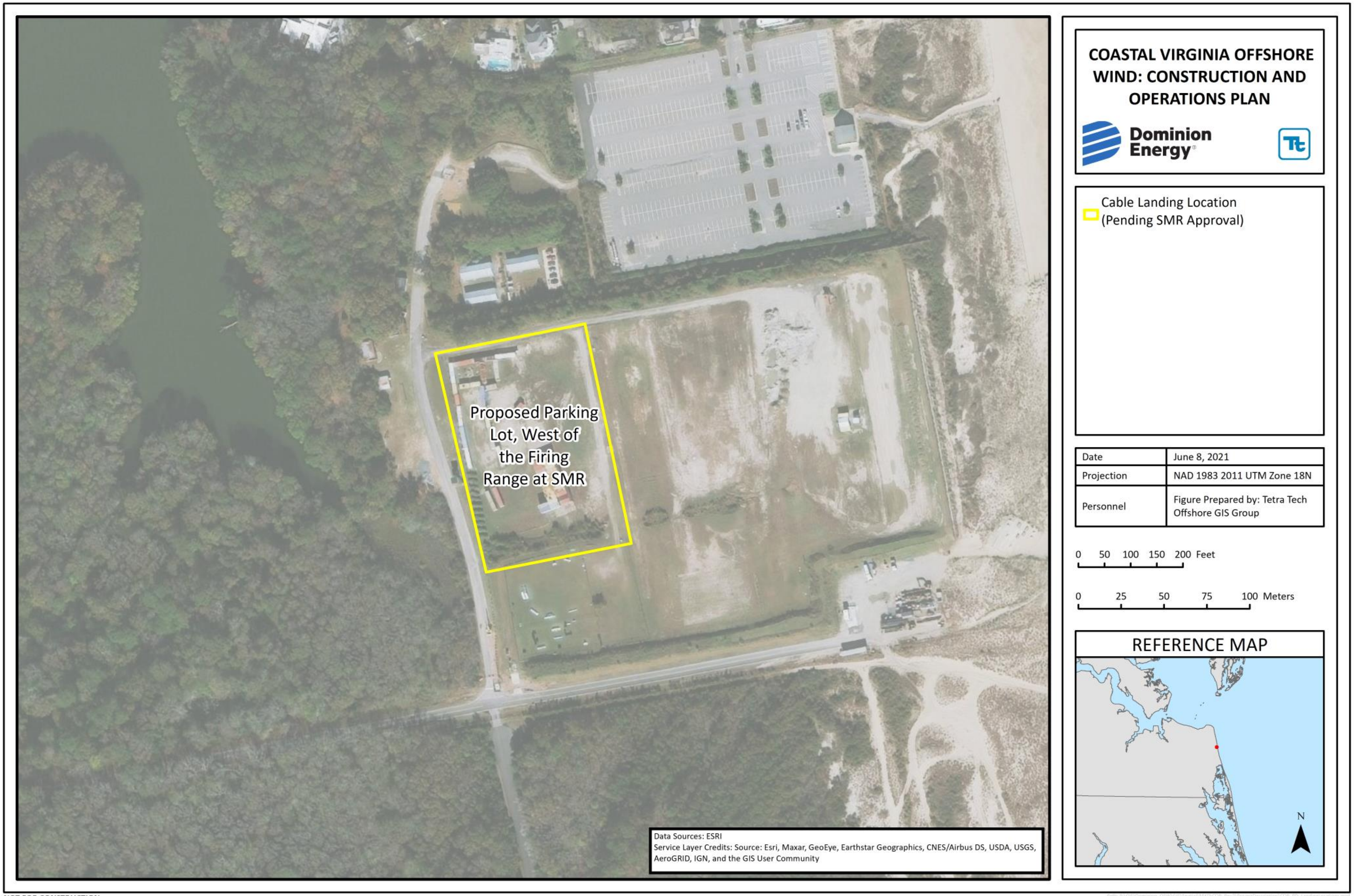
The Proposed Parking Lot west of the Firing Range at SMR is located east of Regulus Avenue and north of Rifle Range Road. The Proposed Parking Lot west of the Firing Range at SMR would be suitable for the construction of the planned HDDs and the start of the terrestrial routes. The HDDs would also be considered from the landing site to a point inland to minimize impacts to Rifle Range Road and other features at the SMR.

For HDD, a drill rig is placed at the entry point, and a pilot string is inserted into the ground. The drill bit is hydraulically powered by bentonite drilling mud fed through the pilot string. The bentonite mud transports the soil away and fills the hole behind the drill head, preventing it from collapsing. The drill head is connected to the non-rotating pilot string by a swivel. The diameter of the cutting head is larger than that of the pilot string, which is encased by a drill string, and additional lengths of pilot string and drill pipe are added as the drill bit advances through the soil.

When the cutting head emerges at the exit point it is removed, and the pilot string is with-drawn through the drill pipe. A reamer is then attached to the drill string, which is pulled back through the hole, wash pipe being attached behind the reamer. In the process, the hole is enlarged by the reamer, and if necessary, the process is repeated with larger reamers. When the hole is sufficiently large enough to accommodate the topical pipe string, this is attached to the wash pipe and pulled through the hole with a reamer attached to the pull head as a precautionary measure.

Typical diameters would be 2.5 in (63 mm) for the pilot string and 5 in (125 mm) for the drill string, with reamers of 14 in (350 mm) and 24 in (600 mm) or sufficiently large to accommodate a power cable.

The route of the pilot string is determined by the entry angle and by the design of the drilling unit. The cutting head includes a hydraulic motor that uses the energy of the circulating drilling mud to rotate the bit. The cutting head is mounted on a bent transition unit (bent sub), the angle of which determines the curvature of the pilot hole and forms the transition to the non-rotating pilot string. Any deviation from the prescribed path is corrected by rotating the pilot string, thus forcing the drilling unit into a revised direction. In this way, the drill can be made to exit within a few meters from a target point located up to several kilometers away. If the exit point is unacceptable, the pilot string is withdrawn a certain distance and the route corrected.



NOT FOR CONSTRUCTION

Figure 3.3-12. Onshore Project Components—Cable Landing Location

Determination of the current position of the cutting head will be accomplished by one or more of the following devices:

- A pendulum providing inclination relative to horizontal;
- A single shot survey camera providing tool face inclination and compass bearing;
- A Plumb Bob arrangement providing inclination; and/or
- A triangulation system using sonar stations providing azimuth.

The string is retracted, and the hole redirected if the cutting head should hit a large boulder.

The success of HDD depends on the soil conditions, and the method is unsuitable for coarse cohesionless materials (gravel, cobble). The most appropriate ground is uniform clay or soft rock (shale, limestone, sandstone), but project experience includes also solid rock (granite, basalt).

For shore approach HDD, a pilot hole is drilled to a pre-excavated pit at the marine exit point. A crane barge with supporting equipment to handle drill pipe and hole openers (reamers) is positioned offshore, and the drill string is pulled onto the crane barge. A number of hole opening passes are carried out, until the drilled hole is sufficiently large to accommodate the topical cable, and the crane barge is then replaced by a cable lay vessel continue installation.

HDD does not involve any activities between the entry point and the exit point and is therefore a preferred method for crossing environmentally sensitive shore areas. Even in the absence of such concerns, it is an attractive alternative to cutting a deep trench through a high cliff. HDD can be established with HDPE carrier pipes and the maximum HDD length is 1640 ft (500 m) to 6560 ft (2000 m) depending on the soil conditions.

3.3.2.2 *Onshore Export Cable*

The Onshore Export Cables would transfer the electricity from the Cable Landing Location at the Proposed Parking Lot west of Firing Range at SMR, in Virginia Beach, Virginia to a Common Location south of Harpers Road and would be comprised of 27 single-phase 230-kV Onshore Export Cables installed underground within the Onshore Export Cable Route Corridor. The Project is currently evaluating one Onshore Export Cable Route within the PDE for the Project. The Onshore Export Cable Route will HDD below Lake Christine, pending SMR approval, running northwest through SMR land, then crossing to General Booth Boulevard just south of the Virginia Aquarium with an HDD below Owl's Creek and following Bells Road, then crossing to South Birdneck Road and, pending Navy approval, onto the NAS Oceana Parcel, from the east. From the NAS Oceana Parcel, the route proceeds south along Oceana Boulevard, then west along Harpers Road to a Common Location south of Harpers Road. The Onshore Export Cable Route is approximately 4.75 mi (7.64 km) long and the operational corridor will be approximately 54.67 ac (22.12 ha). The Onshore Export Cable Route is shown in Figure 3.3-13.

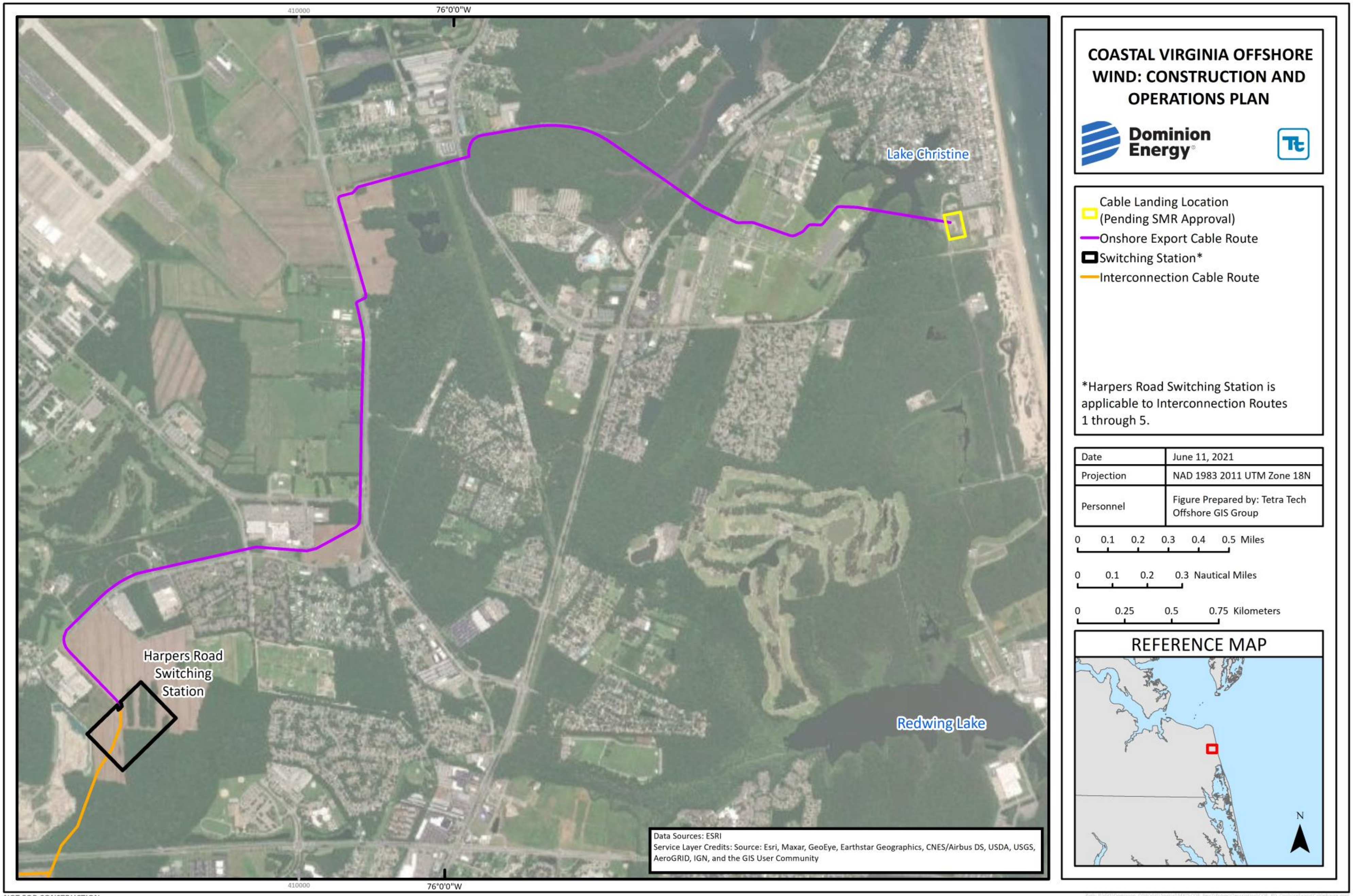


Figure 3.3-13. Onshore Project Components—Onshore Export Cable Route

3.3.2.3 *Switching Station*

The Switching Station is proposed to be constructed either south of Harpers Road or north of Princess Anne Road, in Virginia Beach, Virginia (Switching Station; see Figure 3.3-13). See Section 4.5.3, Land Use and Zoning, for comprehensive site information. The Switching Station would collect power and convert an underground cable configuration to an overhead configuration. The power would then be transmitted to the existing Onshore Substation location for distribution to the grid.

The Switching Station is an electric transmission system asset and would be comprised of circuit breakers, gas-insulated switchgear, shunt reactors, and static synchronous compensators. The Switching Station would be an aboveground, fenced facility which will include the station electrical components described above and associated site development stormwater management facilities/storage ponds. The facility and its components will generally have the appearance of a typical larger Dominion Energy substation.

The operational footprint of the Switching Station at Harpers Road is anticipated to be approximately 26.3 ac (10.6 ha). The operational footprint of the Switching Station at Princess Anne Road is anticipated to be approximately 22.3 ac (9 ha).

The Switching Station would serve as a transition point where the power transmitted through twenty-seven 230-kV Onshore Export Cables coming from the Cable Landing Location would be collected to three 230-kV Interconnection Cables that would connect to the expanded Onshore Substation at Fentress, to be finally stepped up to 500 kV.

Dominion Energy is currently considering either an open-air or gas insulated design for the Switching Station. The gas insulated Switching Station design would be approximately one and a half times smaller in size of the open-air substation design, inclusive of the reactive equipment required for the installation of the underground transmission lines. The Switching Station will include a gas insulated switchgear building, control and security enclosures, three static synchronous compensators, three shunt reactors, one filter bank, static poles, and other ancillary equipment. The facility is planned to be surrounded by a security fence approximately 20 ft (6.1 m) in height. The Switching Station will have a maximum of two emergency back-up generators, each 150 kW, 3-Phase, 120/240 volts alternating-current, at 418 Amperes. The fuel source will include one 2,100-gallon (gal, 7,949.4-liter [l]) propane tank for each generator. Representative schematics of the Switching Station can be found in Appendix K, Conceptual Design Drawings.

3.3.2.4 *Interconnection Cable*

A triple-circuit 230-kV transmission line would be constructed from Harpers Road along an Interconnection Cable Route Corridor to the expanded/upgraded Onshore Substation at Fentress. The Interconnection Cable would be installed as either all overhead transmission facilities, or a combination of overhead and underground (hybrid) transmission facilities. Dominion Energy is evaluating five Overhead Interconnection Cable Route Alternatives and one Hybrid Interconnection Cable Route Alternative from Harpers Road to the Onshore Substation, at the POI.

Dominion Energy anticipates that a maximum construction and operational corridor width of 75 ft (23 m) would be needed for underground cables and that a maximum construction and operational corridor width of 140 ft (43 m) would be needed for overhead cables. Existing ROWs will be utilized to the extent practical.

The overhead structure configuration within the Interconnection Cable Route Corridor generally would consist of a double circuit structure configuration and a single-circuit structure configuration or a triple single-circuit structure configuration, either of which total the three required circuits. The height of the overhead Interconnection Cables will be between 110 ft and 170 ft. The final height of the overhead Interconnection Cables is dependent on the terrain within the route. As such, final heights will be determined following site specific surveys and detailed engineering. Note that while interconnections are commonly referred to as 'circuits', for consistency with terminology commonly associated with offshore wind projects, 'cables' is used throughout.

A description of each Interconnection Cable Route being evaluated as part of this Project is outlined in Table 3.3-9 (also see Section 2), and shown in Figure 3.3-14 for an overview of each of the routes.

3.3.2.5 *Onshore Substation*

The Onshore Substation would be expanded/upgraded and is located northwest of the intersection at Centerville Turnpike and Etheridge Manor Boulevard in Chesapeake, Virginia. See Section 4.4.3, Land Use and Zoning, for comprehensive site information. The Onshore Substation would serve as the final POI for power distribution to the Pennsylvania-New Jersey-Maryland Interconnection (PJM) grid.

As discussed in Section 2, Project Siting and Design Development, the Onshore Substation was identified as a potential POI location because of its proximity to the Project, as well as being an integrated 230/500-kV substation—the only 500-kV substation located within a reasonable distance to the Cable Landing Location(s) in Virginia Beach, Virginia. The Onshore Substation will require expansion/upgrades to accommodate the electricity from the Project.

The current footprint of the Onshore Substation is approximately 12 ac (4.9 ha). The expansion/upgrades to the Onshore Substation footprint are anticipated to require approximately an additional 13 ac (3.3 ha), for a total of 25 ac (10.1 ha). The Onshore Substation expansions/upgrades would serve as the POI for the three 230/500-kV auto-transformers for connection into the grid.

The existing equipment at the Onshore Substation impacted by this Project includes one 500-kV transmission line, two 230/500-kV transformer banks, and security fence.

The Onshore Substation expansion/upgrades will include the addition of three 230/500-kV transformer banks, a 500-kV gas insulated switchgear building, static poles, and other ancillary equipment. The facility is planned to be surrounded by a security fence approximately 20 ft (6.1 m) in height. The Onshore Substation will have a maximum of two emergency back-up generators, each 150 kW, 3-Phase, 120/240 volts alternating current, at 418 Amperes. The fuel source will include a 2,100 gal (7,949.4 l) propane tank for each generator.

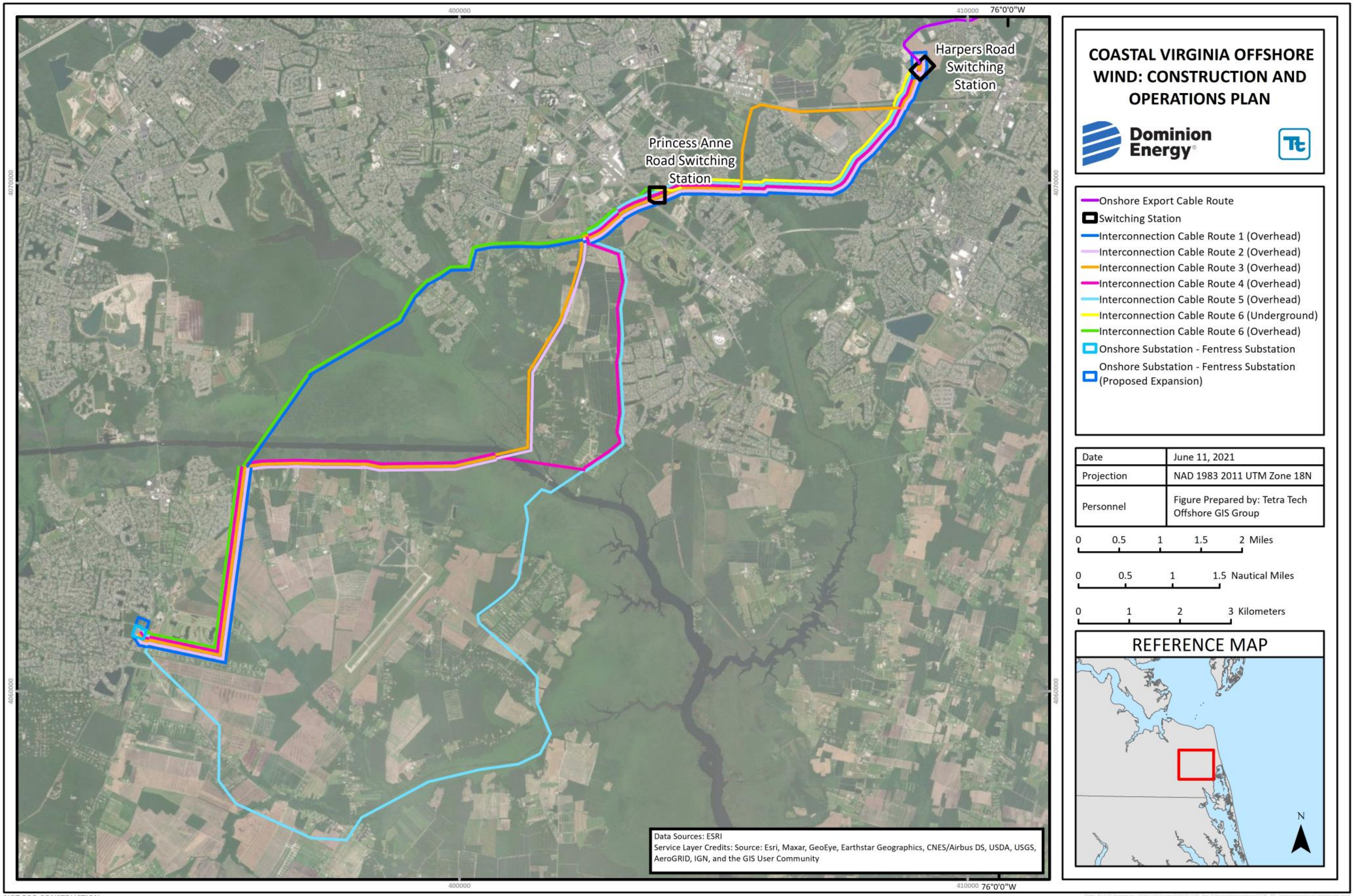


Figure 3.3-14. Onshore Project Components—Interconnection Cable Routes (including alternative routing options), Switching Stations and Onshore Substation

Table 3.3-9. Interconnection Cable Route Alternatives

Route Alt. #	Onshore Route Description	Route Length (miles) a/	Operational Corridor Area (acres)
Overhead Routes			
1	This overhead route runs southwest from the Switching Station along the formerly proposed Southeastern Parkway Corridor, crossing Dam Neck Road and London Bridge Road, then joins with existing Dominion-owned transmission lines (line 147/2118) heading west for 1.8 mi (2.9 km). From there, the route continues southwest again along the formerly proposed Southeastern Parkway Corridor, crossing Princess Anne Road, Landstown Road, Salem Road, and Indian River Road, then re-joins with existing Dominion-owned transmission lines (line 271) for the remaining 6.0 mi (9.6 km) to the Onshore Substation.	13.9	263.64
2	This overhead route follows the same route as Overhead Interconnection Cable Route Alternative 1, with the exception of an approximately 6.2 mi (10.0 km) segment that runs south from the Princess Anne Sports Complex, crossing Salem Road, and Indian River Road parallel and to the west of North Landing Road before crossing the Albemarle and Chesapeake Canal, then runs west and re-joins existing Dominion-owned transmission lines (lines 271 and 174) for the remaining 3.4 mi (5.5 km) to the Onshore Substation	14.8	271.54
3	This overhead route follows the same route as Overhead Interconnection Cable Route Alternative 2, with the exception of an approximately 2.7 mi (4.3 km) segment that runs west along Dam Neck Road, past London Bridge Road, then turns south just before Taylor Farms, where it again aligns with Overhead Interconnection Cable Route Alternative 1 for the remaining 12.2 mi (19.6 km) to the Onshore Substation	15.1	266.97
4	This overhead route follows the same route as Overhead Interconnection Cable Route Alternative 2, with the exception of an approximately 4.5 mi (7.2 km) long segment that joins existing Dominion-owned transmission lines (line 2085) between Landstown Road and Indian River Road, then crosses Upton's Lane and crosses the Albemarle and Chesapeake Canal west of North Landing Road, where it again aligns with Overhead Interconnection Cable Route Alternative 2 for the remaining 6.4 mi (10.3 km) to the Onshore Substation	16.00	317
5	This overhead route follows the same route as Overhead Interconnection Cable Route Alternative 4, with the exception of an approximately 11.2 mi (18.0 km) long segment that runs southwest from Upton's Lane, crosses the Albemarle and Chesapeake Canal east of North Landing Road, then follows Mount Pleasant Road, Fentress Airfield Road, and Blackwater Road, crossing the Pocaty River twice before heading west across agricultural fields, then approaches the Onshore Substation from the southeast	19.7	373.93
Hybrid Route			
6	This hybrid route follows the same route as Overhead Interconnection Cable Route Alternative 1, with the exception of the location of the Switching Station. The route would continue following Overhead Interconnection Cable Route Alternative 1 as an underground transmission line until a point near Princess Anne Road where the underground transmission line would transition from underground to an overhead transmission line configuration. A Switching Station would be built north of Princess Anne Road. No aboveground Station would be built at Harpers Road. From the Switching Station north of Princess Anne Road, the route becomes overhead and aligns with Overhead Interconnection Cable Route Alternative 1 for the remaining 9.88 mi (15.9 km) to the Onshore Substation	13.97 [OH =9.88] [UG =4.09]	218.66

a/ OH = overhead; UG = underground

3.3.2.6 *Construction and Operations and Maintenance Ports*

Dominion Energy currently is evaluating the leasing of a portion of the existing Portsmouth Marine Terminal (PMT) facility in the city of Portsmouth, Virginia, to serve as a potential Construction Port. The Construction Port will be used to store monopiles and transition pieces and to store and pre-assemble wind turbine generation components. Dominion Energy understands that the Virginia Port Authority (VPA) is planning to improve PMT to support offshore wind development. Dominion Energy anticipates that the port upgrades will meet the needs of Dominion Energy's efforts to construct an offshore wind farm off the coast of Virginia. Dominion Energy further understands that VPA-made improvements to PMT are planned to benefit the larger offshore wind industry for years to come, are not dependent upon approval of the Project, will be completed in advance of the Project, and are being separately reviewed and authorized by the USACE and local authorities, as needed.

Dominion Energy currently is evaluating several alternatives to lease portions of existing facilities in the Hampton Roads, Virginia Region. The preferred lease location for the O&M Facility is Lambert's Point, which is located on a brownfield site in Norfolk, Virginia. Dominion Energy is also evaluating leasing portions of existing facilities at VPA's PMT or Newport News Marine Terminal. Dominion Energy anticipates that they will require a building with an area of up to approximately 0.8 (0.3 ha), and a height of up to approximately 45 ft (13.7 m) to meet the needs of an operation and maintenance facility for an offshore wind farm off the coast of Virginia. In the event that upgrades or a new, build to suit, facility is needed, construction would be undertaken by the lessor and would be separately reviewed and authorized by the USACE and local authorities, as needed.

3.4 Construction and Installation

This section describes the construction and installation strategies, equipment, and timing for the Offshore and Onshore Project components that are currently under consideration.

3.4.1 Offshore Construction and Installation

3.4.1.1 *Wind Turbine Generators*

Construction and installation of the WTGs will include the following sequence of activities: installation of the first two filter layers of scour protection, construction of the WTG Foundation; pull-in of the Inter-Array Cable, and construction of the WTG. The cable pull-in may also be done after the WTG construction and installation, if required. The types of vessels used to conduct these activities are outlined in Section 3.4.1.5, Summary of Construction Vessels and Helicopters.

Depending on the water depth at the WTG construction and installation location, one or two-layers of scour protection would be required. The first layer, and possibly the second layer, of scour protection would be installed prior to construction and installation of the WTG Foundation. Scour protection would consist of large rocks sourced from the U.S. and/or Canada and would be installed with either a jack-up vessel (JUV) or dynamically positioned (DP) vessel equipped with a fallpipe. Dominion Energy anticipates that two scour protection installation vessels will be needed to complete installation of scour protection prior to commencing construction and installation of the WTG Foundations. Partial installation of the scour protection will be completed throughout the first year of installation, and the second layer of scour protection will be completed following each WTG Foundation construction and installation period as needed.

Following installation of the scour protection, the WTG Foundations would be transported to the Offshore Project Area. Sufficient buffer stock of WTG Foundations will be required prior to commencing WTG construction and installation to ensure that as many WTG Foundations can be installed during the first construction and installation season as possible.

Installation of the WTG Foundations would entail lifting, upending, and placement of each WTG Foundation at its construction and installation location. Each monopile would be lifted off by the on-board crane of the installation vessel with a dedicated lifting tool. The monopile would be placed on the seabed on top of the pre-installed scour protection layers and driven to the target depth of penetration by an on-board hydraulic hammer while guided by the pile gripper. Depending on location and specific seabed characteristics, without pile-driving, it is anticipated that placement of the monopile will result in some level of initial penetration into the sea floor. Following placement of the monopile, pile-driving will be used to install the WTG Foundation to the target penetration depth for that foundation. Monopiles will be installed by either one or more dynamically positioned heavy lift vessels (HLVs) or JUVs with sufficient crane capacity. Monopiles would be installed in one or more years between May 1 and October 31 to avoid the North Atlantic right whale migration season (See Section 4.2.5, Marine Mammals).

During pile-driving activities, Dominion Energy will implement near-field and/or far-field noise mitigation systems to minimize underwater sound propagation. Examples of near-field noise mitigation systems include the Hydro Sound Damper, the Noise Mitigation Sleeve or the AdBm Noise Mitigation System. The basic principle of the near field noise mitigation system is to hold air around the pile that will scatter, damp, and reflect underwater sound waves during piling. The Hydro Sound Damper system uses special air-filled balloons and polyethylene elements for noise reduction by scattering and reflection of underwater sound waves and additional foam elements of materials with high damping effects. The AdBm system is similar, using lamellas with resonators. The Noise Mitigation Sleeve is a large pipe which is placed around the pile to be driven.

Dominion Energy is considering the use of a double big bubble curtain (BBC) for far field noise mitigation. A BBC system is a compressed air system (air bubble barrier) for sound absorption in water. Sound stimulation of air bubbles at or close to their resonance frequency effectively reduces the amplitude of the radiated sound wave by means of scattering and absorption effects. A BBC functions as follows: air is pumped from a separate vessel with compressors into nozzle hoses lying on the seabed and it escapes through holes that are provided for this purpose. Thus, bubble curtains are generated within the water column due to buoyancy. Noise emitted by pile-driving must pass through those ascending air bubbles and is thus attenuated. The sound attenuating effect of the noise mitigation system BBC or air bubbles in water is caused by sound scattering on air bubbles (resonance effect) and (specular) reflection at the transition between water layer with and without bubbles (air-water-mixture; impedance leap). The BBC consists of a hose ring deployed at a certain radius (depending on the water depth) around the WTG Foundation location. The main BBC equipment includes:

- Hose with holes for the air bubbles and chains as weight to keep it on the seabed;

- The operation and placement vessel; and
- The air compressors (sometimes placed on a separate vessel).

The deployment of the hoses would be executed before the installation vessel is in position and would be recovered as soon as the piling is completed and re-deployed at the next WTG Foundation construction and installation location.

Installation of the transition piece will entail lifting and placing the transition piece on top of the installed monopile, establishing the grouted connection by filling the annulus between the monopile and the transition piece. The transition piece will be mechanically stabilized (e.g. by means of threaded bars or jacks) during the grouting and grout curing process. Completion works would be conducted to ensure the integrity of the transition piece before successor construction and installation activities commence.

The transition pieces would be supplied by feeder barges to the Offshore Project Area. A JUV or HLV(s) would then place the transition piece on top of the pre-installed monopile. Construction and installation of the transition pieces may start later than the construction and installation of the monopiles to ensure a sufficient number of pre-installed monopiles completed within WTG construction and installation window (planned between November 1 and April 30). Monopile construction and installation vessels may assist with construction and installation of the transition pieces during the non-piling season to optimize and minimize total construction and installation time for the Project.

In addition to the Preferred Alternative of a monopile with a transition piece, a continuous monopile is also being considered. In that case, no transition piece would be installed, but instead the secondary structures would be attached to the monopile. The WTG tower would be installed directly on the monopile.

The WTG construction and installation process consists of the load-out, offshore transport, mechanical erection, and offshore commissioning of the WTGs. Once the Inter-Array Cables have been pulled into the WTG Foundation, WTG construction and installation will commence. As a fallback, Inter-Array Cables could also be installed after the WTG. The WTG components, including the fully assembled tower section, nacelle, and blades, will be transported to the Lease Area by a JUV. Alternatively, additional WTG construction and installation vessels may be used to reduce construction and installation time. If foreign flagged vessels are used, the WTG components will be supplied on towed barges or by other means of supply. The WTG construction and installation vessels will most likely be of JUV-type. Floating construction and installation vessels may be used as well. Dominion Energy anticipates up to four sets of WTGs will be transported to site per vessel. Once on-site, construction and installation of the WTGs will commence, with fully assembled towers being the first components to be installed on the foundations, followed by the nacelle and blades. Dominion Energy proposes to install up to two WTGs at a time in an accelerated construction and installation scenario. WTG construction and installation activities are anticipated to last up to 30 months. The anticipated area to be temporarily impacted during construction and installation of the WTGs is provided below in Table 3.4-1.

Table 3.4-1. WTG Construction and Installation Parameters

Vessel	Operation	Total Temporary Area Impacted ac (ha) a/
Monopile		
JUV b/	Scour Protection Installation	121.6 (49.2)
JUV c/	Noise Mitigation	40.5 (16.4)
- d/	Noise Mitigation	3.0 (1.2)
- e/	Noise Mitigation	83.5 (33.8)
JUV f/	Monopile Construction and Installation	40.5 (16.4)
Barge g/	Monopile Feeder	12.2 (4.9)
Transition Piece		
JUV h/	Transition piece Construction and Installation	40.5 (16.4)
Barge i/	Transition piece Loading	6.1 (2.5)
WTG		
JUV j/	WTG Loading	13.5 (5.5)
JUV k/	WTG Construction and Installation	40.5 (16.4)
JUV l/	WTG Commissioning	40.5 (16.4)

Notes:

a/ All disturbance will occur within areas previously cleared by the Qualified Marine Archaeologist. Disturbance areas for each of the activities listed above are expected to overlap each other in the same WTG construction and installation area. As such, the area of temporary impact should not be considered cumulative (i.e. impacts should not be added together).

b/ Scour protection installation with a 4-leg JUV, 3-layer scour protection, 188+17 positions, 2,153 ft^2 (200m²) spud can size from Seajacks Scylla

c/ Noise mitigation with 4-leg JUV, 188+17 positions, 200m² spud can size from Seajacks Scylla

d/ Ground disturbance by NF Noise Mitigation System itself, conservative 3-37 approx. Of diameter = 2* monopile diameter, width 1 m assumed

e/ Ground disturbance by FF Noise Mitigation System hose itself, assumption: both BBC are laid in 656 ft (200 m) and 492 ft (150 m) radius from monopile, width of 750 mm assumed

f/ Monopile construction and installation with a JUV, 4 legs, 188+17 positions, 200m² spud can size from Seajacks Scylla

g/ 4-point spread mooring, 1 monopile per barge, 188 + 17 positions

h/ Transition piece construction and installation with a JUV, 4 legs, 188+17 positions, 200m² spud can size from Seajacks Scylla

i/ 4-point spread mooring, 2 transition pieces per barge, 188 + 17 positions

j/ WTG loading with a JUV, 4 legs, 188+17 positions, 4 WTG sets on deck, 200m² spud can size from Seajacks Scylla

k/ WTG construction and installation with a JUV, 4 legs, 188+17 positions, 200m² spud can size from Seajacks Scylla

l/ WTG commissioning by a 4-leg JUV, 188+17 positions, 200m² spud can size from Seajacks Scylla

Preliminary assessment of leg penetrations of the JUV indicates that penetrations of more than 33 ft (10 m) can be expected at some WTG installation locations which is similar to what was experienced during installation of the CVOW Pilot Project where leg penetrations up to 66 ft (20 m) below mudline were reported (Ørsted 2020). Surveys have shown that during pulling of the legs the holes will be refilled with seabed material to a large extent (“natural backfill”). Remaining hole depths for the CVOW Pilot Project were measured with maximum 8 ft (2.5 m) during as-built survey. Further levelling of the holes is expected with time due to the influence from waves and current. Surveys planned for summer 2021 will show to which extent this has happened already during one year of operation on the CVOW Pilot Project.

As a pre-emptive measure for CVOW Pilot Project the one spudcan hole closest to each of the monopiles was actively backfilled with filter material (in addition to the natural backfill). However, later analyses of the lateral monopile capacity have shown that this was not necessary from a design viewpoint.

The proposed approach for the Project is as follows:

- Pre-emptive active backfilling of spudcan holes is not planned;
- The influence of spudcan holes will be assessed in terms of the penetration depth, footprint of the hole, remaining hole depth (after extraction) and distance to monopile and scour protection. Following the jacking operation related site-specific assessment and leg penetration analysis on a location by location basis, the sensitivity assessment shall take place before the actual operation and shall define limits below or above an active backfilling will become necessary;
- Measured leg penetrations and as-built hole depth will be compared to the predictions;
- Only in case of a detrimental effect on the integrity of the foundation or the scour protection, which cannot be compensated by remaining safety margins in the design or other measures, would an active backfilling operation be performed; and
- The installation manual shall set limits to the use of water jetting during leg extraction at locations with sensitive very silty soil.

To facilitate appropriate activities on the Lease, Dominion Energy intends to submit a request for departure from the regulations at 30 CFR §§ 585.637(a) and 585.708(a)(5)(ii) to allow commencement of WTG operations one WTG string at a time on a rolling basis. Allowing commencement of operations to occur on a rolling basis as WTG strings are completed would minimize risks to the structural and operational integrity of the WTGs over the operational lifetime of the Project and avoid unnecessary delays in generating renewable energy for customers.

The 25-year design life of the WTG only accounts for limited cumulative standstill time where the WTG would not be in operation due to grid circumstances such as outages or WTG failures. Aside from structural requirements, the WTGs require energization not only for idling (pitching and yawing) as soon as possible after mechanical completion, but also to ensure preservation of electrical equipment by maintaining the required ambient conditions through e.g. dehumidification and heating systems. Delaying commercial operations until construction and installation of all WTGs is complete and the administrative process of finalizing the FIR for activities that the CVA has witnessed firsthand would cut into the overall standstill time, reduce the lifespan of the pitch bearings, and increase fatigue on the foundation and blades.

Dominion Energy intends to revise the CVA Scope of Work in order to support the process and procedure to commission the WTG strings. Detailed information on the commissioning sequence will be included in the FDR/FIR to be reviewed by the CVA and submitted to BOEM prior to commissioning of the WTG strings. The CVA would review and witness all relevant engineering, fabrication, and construction and installation operations, and if no exceptions have been raised that prevent the facility from going into commercial operations, Dominion Energy proposes that the CVA would provide a provisional certification upon completion of the 240-hour reliability test. Additionally, the cable will have passed its Site Acceptance Test for the WTG reliability tests to start and the facility will have passed the required PJM grid tests before the end of the WTG reliability tests. The turbines are designed to continue operating upon completion of the 240-hour reliability test (except for grid compliance checks when new generation is added to the grid), which is the industry standard for proving the readiness of an offshore wind facility to enter commercial operation.

Below is a proposed cumulative construction and installation schedule for WTGs to become available for Commercial Operations:

- 2025: up to 56 WTGs constructed/installed; up to 53 WTGs commissioned;
- 2026: up to 104 WTGs constructed/installed; up to 103 WTGs commissioned; and
- 2027: up to 28 WTGs installed, up to 32 WTGs commissioned, and any potential backlog from 2026.

Table 3.4-2 provides the anticipated maximum temporary disturbance associated with construction and installation of the WTG Foundation per WTG.

Table 3.4-2. WTG Construction and Installation Parameters

Vessel	Operation	Total Temporary Area Impacted ac (ha) a/
Monopile		
JUV b/	Scour Protection Installation	121.6 (49.2)
JUV c/	Noise Mitigation	40.5 (16.4)
- d/	Noise Mitigation	3.0 (1.2)
- e/	Noise Mitigation	83.5 (33.8)
JUV f/	MP Construction and Installation	40.5 (16.4)
Barge g/	MP Feeder	12.2 (4.9)
Transition Piece		
JUV h/	TP Construction and Installation	40.5 (16.4)
Barge i/	TP Loading	6.1 (2.5)
WTG		
JUV j/	WTG Loading	13.5 (5.5)
JUV k/	WTG Construction and Installation	40.5 (16.4)
JUV l/	WTG Commissioning	40.5 (16.4)

Vessel	Operation	Total Temporary Area Impacted ac (ha) a/

Notes:
a/ All disturbance will occur within areas previously cleared by the Qualified Marine Archaeologist. Disturbance areas for each of the activities listed above are expected to overlap each other in the same WTG construction and installation area. As such, the area of temporary impact should not be considered cumulative (i.e. impacts should not be added together).
b/ Scour protection installation with a 4-leg JUV, 3-layer scour protection, 188+17 positions, 2,153 ft^2 (200m²) spud can size from Seajacks Scylla
c/ Noise mitigation with 4-leg JUV, 188+17 positions, 200m² spud can size from Seajacks Scylla
d/ Ground disturbance by NF Noise Mitigation System itself, conservative approx. Of diameter = 2* MP diameter, width 1 m assumed
e/ Ground disturbance by FF Noise Mitigation System hose itself, assumption: both BBC are laid in 656 ft (200 m) and 492 ft (150 m) radius from MP, width of 750 mm assumed
f/ MP construction and installation with a JUV, 4 legs, 188+17 positions, 200m² spud can size from Seajacks Scylla
g/ 4-point spread mooring, 1 MP per barge, 188 + 17 positions
h/ TP construction and installation with a JUV, 4 legs, 188+17 positions, 200m² spud can size from Seajacks Scylla
i/ 4-point spread mooring, 2 TPs per barge, 188 + 17 positions
j/ WTG loading with a JUV, 4 legs, 188+17 positions, 4 WTG sets on deck, 200m² spud can size from Seajacks Scylla
k/ WTG construction and installation with a JUV, 4 legs, 188+17 positions, 200m² spud can size from Seajacks Scylla
l/ WTG commissioning by a 4-leg JUV, 188+17 positions, 200m² spud can size from Seajacks Scylla

3.4.1.2 *Inter-Array Cable*

For the purposes of the COP, Dominion Energy has established a maximum design envelope for the Inter-Array Cables that identified a range of cable installation methods and requirements based on the current knowledge of the ground conditions from the geophysical and geotechnical investigations completed to date in the Lease Area, and also based on experience installing the export cable for the CVOW Pilot Project. The final installation methods and target burial depths will be determined by the final engineering design process, informed by detailed geotechnical data, discussion with the chosen installation contractor, risk assessments, and coordination with regulatory agencies and stakeholders. Detailed information on the final technique(s) selected will be included in the FDR/FIR to be reviewed by the CVA and submitted to BOEM prior to installation.

The details related to the installation of the Inter-Array Cables are described in the following sections. Generally, installation activities consist of pre-installation activities, such as surveys and route clearance/pre-lay grapnel runs, laying and burial of the cable (either simultaneously or done in two separate campaigns), and post-installation surveys. Target and minimum depths of burial will be established based on the Cable Burial Risk Assessment (Appendix W) as well as the factors listed above, but the final depth will be no greater than 5.58 ft (1.7 m). In the event that the target burial depth cannot be achieved along various portions of the Inter-Array Cables, Dominion Energy will assess and potentially implement secondary protection methods such as rocks, geotextile sand containers or concrete mattresses . If burial depths cannot be achieved, the process to implement such secondary protection will be addressed in the FDR/FIR. However, Dominion Energy does not currently anticipate the need for additional cable protection on the Inter-Array Cables. Installation of the Inter-Array Cables is expected to take approximately 38 to 44 weeks, assuming a cable burial speed of 492 to 657 feet per hour (150 to 200 meters per hour). A summary of the Inter-Array Cable installation parameters is detailed in Table 3.4-3.

Table 3.4-3. Inter-Array Cable Installation Parameters

Parameter	Minimum	Maximum
Total Length per cable	4,528 ft (1,380 m)	8,366 ft (2,550 m)
Target Burial Depth	3.94 ft (1.2 m)	5.58 ft (1.7 m)
Trench Width (Temporary)	33 ft (10 m)	49 ft (15 m)
Trench Width (Permanent)	0	2 ft (0.5 m)
Seabed Footprint (Temporary)	3.4 ac (1.4 ha)	9.5 ac (3.8 ha)

Pre-Installation Activities

Prior to the installation of the Inter-Array Cable, Dominion Energy will complete route clearance, including UXO surveys, and pre-lay grapnel activities to identify and remove as appropriate any obstructions within the proposed 65.62 ft- (20 m) wide Inter-Array Cable installation corridors. UXO surveys, in particular, will be completed in a wider corridor of 164.04 ft (50 m) to allow for re-routing of the cable as necessary to avoid identified features, where clearance is not possible. These pre-installation activities are necessary to allow the Inter-Array Cable lay and burial to be completed with minimal impacts from hazards along the route that could result in cable and/or equipment damage, timing delays, and/or insufficient burial.

Cable Lay and Burial Activities

Once the pre-installation activities are complete, the Inter-Array Cables will be loaded onto a cable lay vessel at the cable fabrication facility and brought to the Lease Area for lay and burial. Dominion Energy proposes to complete installation with the following methods, included in the PDE: jet plow, jet trenching, chain cutting, trench former, hydroplow (simultaneous lay and burial), mechanical plowing (simultaneous lay and burial), pre-trenching (both simultaneous and separate lay and burial), mechanical trenching (simultaneous lay and burial), and/or other available technologies.

For all the proposed installation methods, a narrow temporary trench is created into which the cable is fed while the equipment is towed along the seabed. The cable burial equipment will rest on skids or wheels with a width of approximately 16 ft (5 m). The Inter-Array Cable will be buried to a minimum depth of 3.9 ft (1.2 m) and to a maximum depth no greater than 5.58 ft (1.7 m); however, the exact depth will be dependent on the substrate encountered along the route.

Post-Installation Surveys and Cable Protection

Upon completion of the cable laying and burial activities, Dominion Energy will conduct post-lay and post-burial surveys to verify both cable location and buried depth. Post-lay surveys will be conducted from a vessel using a remotely operated vehicle or burial assessment sled. Results of this analysis will determine the need for additional cable protection. At this time, Dominion Energy does not anticipate the need for cable protection along the Inter-Array Cable Routes. The location of the Inter-Array Cables and associated cable protection, if deemed necessary, will be provided to the National Oceanic and Atmospheric Administration’s (NOAA’s) Office of Coast Survey after installation is completed so that they may be marked on nautical charts.

3.4.1.3 *Offshore Substation*

As discussed in 3.2, Project Infrastructure Overview, Dominion Energy will utilize piled jacket foundations to support the Offshore Substations. Engineering for each site specific piled jacket foundation is ongoing; however, Table 3.4-4 provides the anticipated maximum temporary disturbance associated with construction and installation of the piled jacket foundations per OSS.

Table 3.4-4. Offshore Substation Construction and Installation Impact Area

Vessel	Operation	Total Temporary Area Impacted ac (ha) a/
JUV b/	Scour Protection Installation	32.0 (12.9)
JUV c/	Offshore Substation Pre-Piling	10.7 (4.3)
Floating HLV or Crane Vessel d/	Offshore Substation Jacket Construction and Installation	0.7 (0.3)
Deck Carrier e/	Offshore Substation Jacket Supply	0.2 (0.1)
Floating HLV or Crane Vessel f/	Offshore Substation Topside Construction and Installation	0.7 (0.3)
Deck Carrier g/	Offshore Substation Topside Supply	0.2 (0.1)
JUV h/	Offshore Substation Commissioning	3.6 (1.5)

Notes:

a/ All disturbance will occur within areas previously cleared by the Qualified Marine Archaeologist. Disturbance areas for each of the activities listed above are expected to overlap each other in the same Offshore Substation construction and installation area. As such, the area of temporary impact should not be considered cumulative (i.e. impacts should not be added together).

b/ SP installation with a 4-leg JUV, 3-layer SP, 3 jackets with 12 piles each, 200m² spud can size from Seajacks Scylla

c/ Pre-piling of 3 x 18 Offshore Substation piles with jack up/down for each pile, 4 legs, 2,153 (200m²) spud can size from Seajacks Scylla

d/ Crane Vessel with 8-point spread mooring

e/ 4-point spread mooring system, 1 jacket per Deck Carrier

f/ Crane Vessel with 8-point spread mooring

g/ 4-point spread mooring system, 1 topside per Deck Carrier

h/ Commissioning by a 4-leg JUV, 5 times re-positioning per topside due to bad weather, 200m² spud can size from Seajacks Scylla

The details related to the construction and installation of the piled jackets for the Offshore Substation Foundations are anticipated to be similar to that described above for the WTG Foundations with monopiles: pre- construction and installation survey and site preparation activities, placement of the jacket, and pile-driving (or pile-driving before placement of jacket in the case of pre-piled jacket). Dominion Energy proposes to install the piles for the Offshore Substation Foundations within the same campaign as the WTG Foundations during the anticipated piling season (May 1 through October 31), followed by Offshore Substation topside construction and installation.

Construction and installation of the Offshore Substation topside will take place following the construction and installation of the piled jacket foundation. Once the Offshore Substation topside is brought to the site, the topside will be lifted and placed on the foundation via a crane on a floating HLV or floating crane vessel. The topside will then be welded or grouted to the foundation, after which the Offshore Substation will undergo commissioning and final connection of the Offshore Export Cables and Inter-Array Cables.

Dominion Energy proposes to install the Offshore Substation topside throughout the year. Each Offshore Substation topside is anticipated to take approximately 2.5 days (net) to install and a total of 60 days anticipated for the complete construction, installation and commissioning of the three topsides.

Pre- Construction and Installation Activities and Site Preparation

Prior to construction and installation of the piled jacket foundations, an area of up to 99 ft (30 m) around each construction and installation site will be checked and cleared for debris, large boulders, and UXO.

Placement of Jacket

Once the construction and installation location has been prepared, the jacket will be brought to the site via feeder barge or vessel. The jacket will be lifted and placed in the designated target position via a floating DP HLV.

Pile-Driving

The Offshore Substation Foundation piles may either be installed before the jacket is placed on the seabed (pre-installed) or after the jacket is placed on the seabed (post-installed). In the pre-construction and installation alternative, a piling template will be lowered onto the location where the jacket will be installed. The piles will be lifted and placed into the template and driven to the target depth by a hydraulic hammer. After all piles are installed, either the template will be recovered and used for the next Offshore Substation Foundation or it will stay on the seabed. In the post-construction and installation scenario, the jacket will be placed in position, and the piles will be inserted into the pile sleeves to initiate pile-driving activities. The piles will be driven to the target penetration depth by an on-board hydraulic hammer. Specifications for the pile-driving activities can be found in Section 4.1.5, Underwater Acoustic Environment. Dominion Energy proposes to pile drive one piled jacket foundation at a time. Each Offshore Substation Foundation is anticipated to take approximately 5 days to install, with a total of 30 days anticipated for the complete construction and installation of the three piled jackets.

As with the monopiles, Dominion Energy also proposes to use appropriate noise mitigation measures in accordance with applicable requirements and in accordance with the tolerance requirements in relation to inclination and elevation.

Connection of Offshore Substation

Following construction and installation of the Offshore Substation Foundations, the connection between jacket and piles will occur. For the post-piling approach, the piles would be cut above the sleeves afterwards, as required. The Offshore Substation topside will then be brought to the site and installed.

3.4.1.4 *Offshore Export Cable*

The Offshore Export Cables will be installed within an Offshore Export Cable Route Corridor ranging in size from approximately 3,840 ft (1,170 m) down to 1,970 ft (600 m) wide. The Offshore Export Cables will be buried to a target depth of approximately 3.3 ft (1 m) to 16.4 ft (5 m) below stable seabed elevation to minimize the risk of cable exposure or damage; however, depending on seabed conditions, actual burial depth may vary. Stable seabed elevation is the minimum seabed level over the lifetime of the Project, identified by assessing the rate of movement of mobile sediment. The target burial depth may vary along different sections of the Offshore Export Cable Route Corridor but the final depth will be no greater than 16.4 ft (5 m) below grade. In the event that the target burial depth cannot be achieved along various portions of the Offshore Export Cables, Dominion Energy will assess and potentially implement secondary protection methods such as rocks, geotextile sand containers, or concrete mattresses. The process to implement such secondary protection will be addressed in the FDR/FIR.

Dominion Energy performed a Preliminary CBRA (Appendix W) that assessed, at high-level, the area risks present within the Lease Area itself as well as the surrounding region, and preliminarily identified and quantified risk factors along the Projects Offshore Export Cable Route Corridor. External constraints that were considered in design of the Offshore Export Cable Route Corridor are discussed in further detail in the CBRA. Target burial depths at specific locations along the Offshore Export Cable Route Corridor may be refined following the results of the ongoing geophysical surveys, additional sediment mobility studies (see Appendix CC Seabed Morphology Study), and coordination with USACE and other stakeholders, and will be formalized in the FDR/FIR, to be submitted to BOEM prior to installation.

The method of cable protection system recommended by the CBRA to mitigate risks may include direct burial, rock dumping, laying concrete mattresses, and ducting, noting that the cable protection method may influence the cable's current rating significantly and also complicate the cable recovery in the event of required repairs. Other risk mitigations to protect installed cable could include anchorage/fishing exclusion zones. Cable protection is described in detail below.

Installation Methodology

Dominion Energy has completed preliminary geophysical and geotechnical surveys along the Offshore Export Cable Route Corridor to inform preliminary cable routing and selection of the most appropriate tools for installation of the Offshore Export Cables to the target burial depths. Based on the current understanding of site-specific conditions between the Cable Landing Location in Virginia Beach, Virginia, and the Lease Area, Dominion Energy anticipates the following burial tools as the primary installation methodologies:

- Jet Trench;
- Trench former;
- Chain cutting;
- Hydroplow;
- Mechanical plowing (simultaneous lay and burial);
- Pre-trenching (both simultaneous and separate lay and burial); and
- Mechanical trenching (simultaneous lay and burial).

Installation of the nearshore section of the Offshore Export Cables will be conducted utilizing pre-lay survey, pre-lay grapnel run, and a pull-in method through a pre-installed landfall conduit. Cable jointing, post-jointing tests, the cable lay operations, the cable pull-in at the Offshore Substations and the cable burial operations will also occur with a separate burial assistance vessel equipped with a jet trencher or other burial tool(s). The nearshore section of the Offshore Export Cable will be installed by a shallow draft cable lay vessel. The cable lay vessel loads the cables either at the manufacturing yard or at a marshalling port depending on the detailed schedule for the cable installation. The cable lay vessel would start with the shore pull-in at the Offshore HDD Punch-Out. The cable lay and bury will occur simultaneously using one of the available technologies outlined above. The cable ends will be sealed temporarily, wet stored, and protected on the seabed.

The final manufacturing location for the Offshore Export Cables has not yet been determined but is assumed to be Europe for the purposes of this COP. Offshore Export Cables would be transported to the U.S. by either the cable lay vessel itself and/or by deck carriers equipped with turntables. For the purposes of this COP, Dominion Energy has assumed that all nearshore Offshore Export Cables would be transported on deck carriers while the other Offshore Export Cables would be picked up at the fabrication yard by the cable lay vessel. The separately transported Offshore Export Cables would either be directly transpooled at the marshalling port to the cable lay vessel or temporarily stored on turntables at the quayside in a U.S. port. The Offshore Export Cables are split into a nearshore section and a farshore section that are connected to each other by an in-line subsea cable joint. Two nearshore and three farshore Offshore Export Cable installation campaigns would be the preferred installation strategy. Alternative strategies are under consideration and are dependent on several factors such as cable manufacturing location, transport method, burial method, use of a separate burial vessel or not, as well as additional considerations.

The farshore sections of the Offshore Export Cables and the Inter-Array Cables would be installed with a large DP cable lay vessel. The installation would start at the wet stored cable ends from the Nearshore HDD Area installation. The wet stored Offshore Export Cable ends would be picked-up, jointed to the farshore section of the Offshore Export Cable, and then laid down on the seabed. The farshore Offshore Export Cables would be surface laid from the Nearshore HDD Area towards the Offshore Substations (three Offshore Export Cables per Offshore Substation) and pulled into the cable deck of the Offshore Substation jacket foundations for temporary storage. A Jones-Act compliant DP Trencher Support Vessel equipped with a jet-trencher would bury the farshore Offshore Export Cables to a target depth of between 3.3 ft (1 m) to 16.4 ft (5 m).

The Offshore Export Cable termination and testing campaign would be supported by a separate vessel. Dominion Energy is considering a Service Operation Vessel with motion compensated gangway to transfer people to the foundations for the termination and testing campaign.

The net durations related to the HDD and Offshore Export Cable installation have been provided in the base case alternative and are as follows:

- The HDD is assumed at a rate of 12 days per /unit;
- Cable laying speed of the nearshore cables is 656 ft/hr (200 m/hr), including the simultaneous burial;
- Cable laying speed of the farshore cables is 1,312 ft/hr (400 m/hr); and
- Cable jointing takes 7 days per joint.

Based on the identified range of installation methods and requirements, Dominion Energy has established a design envelope for installation of the Offshore Export Cables that reflects the maximum seabed disturbance (Table 3.4-5). Temporary seabed disturbance during Offshore Export Cable installation includes Offshore Export Cable Route Corridor preparation including boulder and/or sandwave removal and associated installation vessel anchoring; and permanent disturbance (includes areas where additional cable protection may be required post-installation).

Table 3.4-5. Offshore Export Cable Route Corridor Installation Parameters

Vessel	Operation	Total Temporary Area Impacted ac (ha)
Barge a/	Shore pull-in	1.1 (0.432)
Shallow cable lay vessel b/	Offshore Export Cable installation	306.8 (124.16)
- c/	Offshore Export Cable Installation	1.0 (0.405)
JUV d/	Cable crossings	5.3 (2.16)
MSV e/	pre lay grapnel run	3,162.9 (1,280)
Shallow cable lay vessel + cable lay vessel f/	Offshore Export Cable installation	150.2 (60.8)
MSV g/	pre lay grapnel run	2,352.4 (952)
Cable lay vessel h/	Inter-Array Cable installation	111.7 (45.22)
	TOTAL	**6,091.6 (2,465.2)**

Notes:
a/ 8-point spread mooring or JUV for shore pull in assistance, 9 Offshore Export Cables
b/ Beaching of Vessel, 2 per day, 194 days (P_{80} value), keel size of 105 ft x 328 ft (32 m x 100 m)
c/ Wet end storages of messenger line at landfall and nearshore section for jointing with farshore section, 9 cables, 49 x 49 ft (15 x 15 m) area
d/ Cable crossing preparation done with a JUV, 2,153 ft^2 (200m^2) spud can size from Seajacks Scylla
e/ Pre-lay grapnel run for the nearshore + farshore Offshore Export Cable campaign, width equal to 40 ft (12 m) corridor and assuming 66 ft (20 m) conservatively
f/ Laying of 671 km of export cable (nearshore + farshore section, incl. 20% contingency to current base case), trench width is assumed 950 mm, could be much smaller (approximately 450 mm)
g/ Pre-lay grapnel run for the Inter-Array Cable campaign, width equal to 40 ft (12 m) corridor and assuming 66 ft (20 m) conservatively
h/ Laying of 484 km of Inter-Array Cable (incl. 20% contingency to current base case), trench width is assumed 950 mm, could be much smaller (approximately 450 mm)

Sandwave Removal

As described in Table 3.4-5, prior to installation of the Offshore Export Cables, seabed preparation activities including sandwave removal may be required. The amount of sandwave removal anticipated will be refined following the results of the ongoing geophysical surveys, additional sediment mobility studies (See Appendix CC Seabed Morphology Study), and the CBRA (See Appendix W). Sandwave removal is typically completed for the following reasons:

- Many of the cable installation tools proposed require a relatively flat seabed surface to comport with the operational criteria (pitch and roll) of the tools; and
- Sandwaves are generally mobile in nature. Therefore, the export cables must be buried beneath the stable seabed elevation to prevent cable exposure occurring over time. In areas where larger sandwaves exist, this can only be achieved by removing a portion of the mobile features before installation takes place.

Sandwave removal would require clearing of the area, most likely using subsea excavation methods, depending on the volume and technical requirements.

Boulder Removal

Boulder removal may be required in targeted locations to clear boulders within the Offshore Export Cable Route Corridor. Boulder removal can be performed using a combination of methods to optimize clearance of boulder debris of varying size and frequency. Dominion Energy has assumed the route would be cleared of boulders within the footprint of the cable, as needed. Boulder removal would occur prior to installation and would be completed by a support vessel based on pre-construction surveys.

Cable Protection

Target and minimum depths of burial will be established based on the Cable Burial Risk Assessment (Appendix W). In the event that the target burial depth cannot be achieved along various portions of the Offshore Export Cable Route Corridor, Dominion Energy will assess and potentially implement secondary protection methods such as rocks, geotextile sand containers, or concrete mattresses. The process to implement such secondary protection will be addressed in the FDR/FIR.

The location of the Offshore Export Cables and associated cable protection will be provided to NOAA's Office of Coast Survey after installation is completed so that they may be marked on nautical charts. The area of impact for cable protection is accounted for in Table 3.4-5.

For the purpose of the environmental assessments presented within this COP, Dominion Energy has assumed that the Offshore Export Cable Route Corridor will require additional protection, using a combination of the following solutions depending on the technical requirements:

- Dumped rocks,
- Geotextile sand containers, and/or
- Concrete mattresses.

Schematics of these measures are provided in Appendix K, Conceptual Design Drawings.

3.4.1.5 *Summary of Construction Vessels and Helicopters*

Construction of the Project will require the support of numerous vessels and helicopters (see Table 3.4-6). For each vessel type, the route plan for the vessel operation area will be developed to meet industry guidelines and best practices in accordance with International Chamber of Shipping guidance. The Project will require operational Automatic Identification Systems (AIS) on all vessels associated with the construction, operation, and decommissioning of the Project, pursuant to USCG and AIS carriage requirements. AIS will be required to monitor the number of vessels and traffic patterns for analysis and compliance with vessel speed requirements. All vessels will operate in accordance with applicable rules and regulations for maritime operation within U.S. federal and state waters. Similarly, all aviation operations, including flying routes and altitude, will be aligned with relevant stakeholders including Federal Aviation Administration (FAA) and state and local regulations. Additionally, the Project will adhere to vessel speed restrictions as appropriate in accordance with NOAA requirements, Lease stipulations, and COP approval conditions. Emissions associated with vessel activities are addressed in Section 4.4.12, Public Health and Safety.

Table 3.4-6. Preliminary Summary of Offshore Vessels for Construction—envelope figures regarding CO_2 air emissions directly related to construction of the wind farm based on the preferred alternative

Vessel ID	Vessel Role	Vessel Class	Number of Vessels	Breadth (ft)	Width (ft)	Draft (ft)	Average Fuel Consumption (t/d)	Days on Project @P50 WDT, incl. Spare Pos.	Total Fuel Consumption (t)	Most Likely Operation Period*	Frequency of Transit	Transit Destination
1	Scour Protection Installation	Fall Pipe Vessel	2	125	532	22	25	1,139	56,975	10/2023 to 02/2025 and 07/2025 to 10/2025	Weekly	Canada
2	Transport monopile/transition pieces from U.S. port to installation site	U.S. barge	4	105	400	20	0	327	0	04/2024 to 10/2024 and 04/2025 to 09/2025	(188+17)/2 = 103 cycles in total for all barges	Portsmouth, VA
3	Feeder Barge for transition pieces	U.S. barge	2	70	250	15	0	327	0	10/2024 to 04/2026	(188+17)/4 = 52 cycles in total for all barges	Portsmouth, VA
4	Tug	U.S. ocean-going tug	8	40	125	21	8	290	18,568	04/2024 to 04/2026	103 + 52 = 155 cycles in total	Portsmouth, VA
5	Monopile Installation	HLV	2	161	709	50	45	422	37,980	04/2024 to 09/2025	N/A	N/A
6	Anchor handler	Anchor Handling Tug (AHT)	2	71	16	6	8	422	6,752	04/2024 to 09/2025	188+17 = 205 cycles in total per AHT	Portsmouth, VA
7	Installation transition pieces + pre-piling	JUV	1	128	437	23	20	473	9,465	09/2024 to 11/2025	N/A	N/A
8	Noise Monitoring	Crew Transfer Vessel (CTV)	2	33	86	6	5	1,428	14,280	09/2023 to 07/2027	Daily	Portsmouth, VA
9	Noise Mitigation	Platform Support Vessel	2	60	263	19	10	267	5,340	05/2024 to 10/2024 and 05/2025 to 07/2025	2 cycles in total + X due to bad weather	Portsmouth, VA
10	Secondary works	Platform Support Vessel	1	102	457	20	15	463	6,951	09/2024 to 11/2025	Weekly	Portsmouth, VA
11	Crew Transfer	CTV	2	33	86	6	8	583	9,334	04/2024 to 11/2025	Every 2nd day	Portsmouth, VA
12	Transport jackets from EU port to installation site	Deck Carrier/Semi-submersible	3	158	739	35	50	20	3,000	11/2024 to 04/2025	3 cycles in total	Europe or GoM area
13	Installation	HLV	1	161	709	50	65	60	3,900	11/2024 to 04/2025	N/A	N/A
14	Anchor handler	AHT	2	71	16	6	8	60	960	11/2024 to 04/2025	3 cycles in total	Portsmouth, VA
15	Transport topsides from port to installation site	Deck Carrier/Semi-submersible	3	158	739	35	50	20	3,000	11/2024 to 04/2025	3 cycles in total	Europe or GoM area
16	Installation	Semi-Submersible HLV	1	289	657	40 to 105	70	60	4,200	11/2024 to 04/2025	N/A	N/A
17	Anchor handler	AHT	2	71	16	6	8	60	960	11/2024 to 04/2025	3 cycles in total	Portsmouth, VA
18	Commissioning	DP2 JUV	2	230	132	20	5	240	2,400	11/2024 to 07/2025	N/A	N/A
19	HDD-installation	Drill Rig spread	2	40	9	N/A	0	218	0	09/2023 to 02/2024	N/A	N/A
20	Nearshore Marine assistance	U.S. Multi-Purpose Support Vessel (Multicat)	2	40	92	14	6	218	2,621		Weekly	Portsmouth, VA

Vessel ID	Vessel Role	Vessel Class	Number of Vessels	Breadth (ft)	Width (ft)	Draft| (ft)	Average Fuel Consumption (t/d)	Days on Project @P50 WDT, incl. Spare Pos.	Total Fuel Consumption (t)	Most Likely Operation Period*	Frequency of Transit	Transit Destination
21	Nearshore Marine assistance	U.S. tug (small)	1	26	76	10	5	218	1,092		Weekly	Portsmouth, VA
22	Landfall	Landfall Beach spread	1	N/A	N/A	N/A	2	176	353	12/2023 to 02/2024 and 09/2024 to 12/2024	Weekly	N/A
23	Shore pull-in	U.S. Pull-in support barge	1	60	180	6	10	176	1,764		Weekly	Portsmouth, VA
24	Shore pull-in	U.S. workboat (tug)	2	26	76	10	5	176	1,764		Weekly	Portsmouth, VA
25	Pre-lay Grapnel Run	Multipurpose Support Vessel	1	37	197	9	10	29	288		Weekly	Portsmouth, VA
26	Pre-Installation Survey	Survey Vessel	1	42	181	11	4	16	62		Weekly	Portsmouth, VA
27	Cable Laying and Burial	Shallow-draft Cable Lay Vessel	1	79	289	15	20	176	3,528		N/A	N/A
28	Cable Burial	Hydroplow (Jetting)	1	20	53	14	0	176	0		N/A	N/A
29	Crew Transfer	CTV	2	33	86	6	8	176	2,822		Every 2nd day	Portsmouth, VA
30	As-built Survey	Survey Vessel	1	42	181	11	4	16	62		Weekly	Portsmouth, VA
31	Pre-lay Grapnel Run	Multipurpose Support Vessel	1	37	197	9	10	47	470	10/2024 to 01/2025 and 04/2025 to 07/2025 and 11/2025 to 02/2026	Weekly	Portsmouth, VA
32	Pre-lay Survey	Survey Vessel	1	42	181	11	4	24	96		Weekly	Portsmouth, VA
33	Cable Laying	Deep-draft Cable Lay Vessel	1	105	529	22	29	162	4,698		N/A	N/A
34	Crew Transfer	Walk-to-work vessel (W2W)	1	53	355	19	10	63	630		N/A	N/A
35	Crew Transfer	CTV	1	33	86	6	8	63	504		Every 2nd day	Portsmouth, VA
36	Cable Burial	Trenching Support Vessel	2	73	348	32	15	243	7,290		N/A	N/A
37	Cable Burial	Burial tool (Post-lay Jetting)	2	25	46	19	3	243	1,458		N/A	N/A
38	As-built Survey	Survey Vessel	1	42	181	11	4	24	96		Weekly	Portsmouth, VA
39	Pre-lay Grapnel Run	Multipurpose Support Vessel	1	37	197	9	10	37	371	01/2025 to 04/2025 and 07/2025 to 11/2025 and 02/2026 to 05/2026	Weekly	Portsmouth, VA
40	Pre-lay Survey	Survey Vessel	1	42	181	11	4	27	109		Weekly	Portsmouth, VA
41	Cable Laying	Deep-draft Cable Lay Vessel	1	105	529	22	29	190	5,502		N/A	N/A
42	Crew Transfer	W2W	1	53	355	19	10	222	2,224		N/A	N/A
43	Crew Transfer	CTV	2	33	86	6	8	167	2,669		Every 2nd day	Portsmouth, VA

Vessel ID	Vessel Role	Vessel Class	Number of Vessels	Breadth (ft)	Width (ft)	Draft| (ft)	Average Fuel Consumption (t/d)	Days on Project @P50 WDT, incl. Spare Pos.	Total Fuel Consumption (t)	Most Likely Operation Period*	Frequency of Transit	Transit Destination
44	Cable Burial	Trenching Support Vessel	2	73	348	32	15	285	8,538		N/A	N/A
45	Cable Burial	Burial tool (Post-lay Jetting)	2	25	46	19	3	285	1,708		N/A	N/A
46	As-built Survey	Survey Vessel	1	42	181	11	4	27	109		Weekly	Portsmouth, VA
47	Installation	JUV	2	184	473	23	20	660	26,388		Vessel 1: Every 12-14 days Vessel 2: N/A	Vessel 1: Portsmouth, VA Vessel 2: N/A
48	Transport WTGs from U.S. port to installation site	U.S. barge	2	105	400	20	0	660	0	06/2025 to 02/2027	Approximately every 3 days	Portsmouth, VA
49	Transport WTGs from U.S. port to installation site	U.S. ocean going tug	3	40	125	21	8	660	15,833		Approximately every 3 days	Portsmouth, VA
50	Crew Transfer	CTV	1	33	86	6	8	660	5,278		Daily	Portsmouth, VA
51	Commissioning spread	W2W	2	53	355	19	10	660	13,194	06/2025 to 04/2027	N/A	N/A
52	Site Security	Safety vessel, HDD	1	var	var	var	5	1,557	7,786	09/2023 to 08/2027	Bi-weekly	Portsmouth, VA
53	Site Security	Safety vessel, WTG	2	var	var	var	5	1,557	7,786	09/2023 to 08/2027	Bi-weekly	Portsmouth, VA
54	Site Security	Safety vessel, Cable Routes	3	var	var	var	5	1,557	7,786	09/2023 to 08/2027	Bi-weekly	Portsmouth, VA
55	Observation Vessel	CTV	2	33	86	6	5	1,557	15,571	09/2023 to 08/2027	Daily	Portsmouth, VA
56	Removing sandwaves [i.a.]	Trailer Suction Hopper Dredger	1	var	var	var	25	98	2,453	2023	Daily	Portsmouth, VA
57	Boulder Picking [i.a.]	Anchor Handling Tug + crane barge	2	181	60	12	10	98	1,963	2023	Weekly	Portsmouth, VA
58	Boulder Ploughing[i.a.]	Anchor Handling Tug + towed plough	1	299	73	27	70	131	9,160	2023	Weekly	Portsmouth, VA
59	Crossing Protection (concrete mattresses)	Offshore Support Vessel	1	230	50	20	8	189	1,512	2024 to 2026	Between 3 and 27 cycles	Portsmouth, VA

N/A = not applicable

3.4.2 Onshore Construction and Installation

HDD activities are anticipated to last 9 to 12 months. The target burial depth for HDD will range between 10 to 115 ft (3 to 35 m). From the onshore HDD work area at the Cable Landing Location, the HDD will be up to 9,842 ft (3,000 m) long and exit approximately 2,953 to 3,280 ft (900 to 1,000 m) offshore. The maximum temporary workspace at the Offshore HDD Punch-Out would be up to approximately 394 ft by 262 ft (120 m by 80 m). HDD activities will be performed to a maximum depth of 125 ft (38 m) below grade. The cable conduit dimensions will be approximately 1.6 ft (0.5 m) in diameter. The following equipment may be used at both the HDD entry and exit points: rig site, mud pit, mud pump, mud tank, recycling unit, power unit, topsoil storage (if required), drill pipe storage, crew facilities, workshop, offices, and other facilities. Additionally, cofferdams or conductor barrels may also be used at the Offshore HDD Punch-Out to minimize the release of sediment and drilling fluids into the marine environment. If required, the cofferdams are expected to be approximately 1,000 ft (305 m) offshore. HDD activities are anticipated to take approximately 9 to 12 months, with a total of 9 conduits and 4 to 5 weeks per conduit.

Dominion Energy anticipates that the location where the Offshore Export Cables exit the seafloor at the Offshore HDD Punch-Out location will require additional protection. This protection may consist of one or more of a number of solutions, including rock berms, concrete mattresses, etc.

The results of ongoing geotechnical and geophysical surveys will be used to select the most appropriate Cable Landfall Location construction and installation technique which will be formalized in the FDR/FIR, to be reviewed by BOEM prior to construction and installation.

3.4.2.1 *Onshore Export Cable*

From the Cable Landing Location in Virginia Beach, Virginia, the Onshore Export Cable would be installed underground within a HDD vault to the Switching Station over a period of 18 to 24 months. The installation methodology proposed would comply with local and state regulations and guidelines. Based on the existing conditions along each Onshore Export Cable Route, the Project would utilize a combination of open trenches, HDD, and duct banks at varying depths along the selected route.

The Onshore Export Cable Route installation would include the following main activities:

- Prepare the installation corridor;
- Install ducting;
- Establish jointing bays;
- Pull onshore export and interconnection cables through the ducts;
- Join the cables; and
- Restore the installation corridor.

Onshore installation activities will include backhoes, excavators, bulldozers, skid-steer loaders, dump trucks, cranes, and temporary generators. The maximum proposed depth of disturbance for the open trench onshore export HDD Vault to install the Onshore Export Cables is 13 ft (4 m) below grade. The Onshore Export Cable will be installed within a maximum 75 ft (23 m)-wide trench. A HDD Vault design has not yet been finalized; however, current plans include multiple designs ranging from 4.3 to 8.3 ft (1.3 to 2.5 m) wide. Both two-HDD Vault and three-HDD Vault solutions are currently under consideration.

3.4.2.2 *Switching Station*

Construction of the Switching Station would involve site clearing and grading, foundation and equipment construction, and site mitigation and restoration. It is expected that construction of the Switching Station will take up to approximately 12 months. The Switching Station construction would include the following main activities:

- Site access;
- Site preparation, including clearing and/or filling (if necessary), excavation, and grading;
- Construction of stormwater management system;
- Construction of the foundation;
- Construction of the electrical infrastructure and other associated structures and services including connection to local utilities; and
- Land restoration and landscaping.

Prior to construction, Dominion Energy will conduct land and other surveys including geophysical, geotechnical, environmental, and cultural studies to support permits and approvals for construction of the Switching Station. Construction activities will include backhoes, excavators, bulldozers, skid-steer loaders, dump trucks, cranes, and temporary generators.

The Switching Station will contain both static pole steel structures and backbone foundations. The maximum depth for vibrated/driven pipe piles is anticipated to be 30 ft (9 m) for the static pole steel structures and 50 ft (15 m) for the backbone structures. The maximum areas of land disturbance associated with construction activities at the Switching Station is anticipated to be approximately 26 ac (10.5 ha).

3.4.2.3 *Interconnection Cable*

From the Common Location south of Harpers Road, the Interconnection Cable would be installed either overhead or a hybrid of overhead and underground to connect to the Onshore Substation. It is expected that construction and installation of the Interconnection Cable will take approximately 1 to 2 years. The Interconnection Cable installation would include the following main activities:

- Easement acquisition and ROW survey/flagging;
- Clearing and prep of ROW as needed, including installation of erosion control devices (ECDs);
- ROW access road grading;
- Tree clearing;
- Materials delivery;
- Foundation prep and install;
- Construction of structures/insulator strings;
- Stringing conductors;
- Interconnect and energize; and

- Restore the construction corridor.

Construction and installation activities will include backhoes, excavators, bulldozers, skid-steer loaders, dump trucks, cranes, and temporary generators. Maximum vertical disturbance depth for vibrated/driven pipe piles for the single-circuit engineered steel monopole structures is anticipated to be 60 ft (18 m). Maximum vertical disturbance depth for vibrated/driven pipe piles for the double-circuit engineered steel monopole structures is anticipated to be 12 x 53 H piles of 80 ft (24 m). For the underground route, the maximum proposed depth of disturbance for the open trench interconnect duct bank is 13 ft (4 m) below grade. Dominion Energy anticipates that a maximum construction and installation corridor width of 135 ft (23 m) would be needed for underground cables and 140 ft (43 m) for overhead cables for overhead cables. Anticipated temporary construction and installation corridors for each of the potential Interconnection Cable Routes are outlined in Table 3.4-7.

Table 3.4-7. Interconnection Cable Route Alternatives

Interconnection Route Type	Route Alt. #	Construction/Installation Corridor Area (ac)
Overhead	1	263.64
	2	271.54
	3	266.97
	4	317.00
	5	373.93
Hybrid	6	218.66

3.4.2.4 *Onshore Substation*

It is expected that construction of the expanded/upgraded Onshore Substation will take up to approximately 1-2 years. Expansion/upgrades to the Onshore Substation would include the following main activities:

- Safety fencing would be installed along the perimeter of the additions;
- Erosion controls would be implemented in accordance with the Dominion Energy's Erosion and Sediment Control Plan, as applicable;
- The site would be prepared, including clearing, filling, excavation, and grading as necessary;
- A stormwater management system would be installed in accordance with Dominion Energy's Stormwater Pollution Prevention Plan (SWPPP), as applicable;
- Foundations, sumps, and spread footing would be installed;
- Heavy-load vehicles would be used to deliver and place equipment;
- Cable installation would be completed, including connection of the Onshore Export Cables;
- Testing and commissioning of the new equipment; and
- Landscaping would be installed and/or restored as required by applicable regulations.

Construction activities will include backhoes, excavators, bulldozers, skid-steer loaders, dump trucks, cranes, and temporary generators. The deepest foundations for the Onshore Substation will be the backbone foundations. The maximum depth for vibrated/driven pipe piles is anticipated to be 50 ft (15 m) for the backbone structures. The maximum areas of land disturbance associated with construction activities at the Onshore Substation is anticipated to be approximately 46.2 ac (18.7 ha).

3.5 Operations and Maintenance

The commercial lifespan of the Project is expected to be 33 years, based on the operations term of the Project specified in the Lease.

The Project will be designed to operate with minimal day-to-day supervisory input, with key systems monitored from a central location, 24 hours a day. Dominion Energy intends on leasing a portion of an existing facility to act as the O&M facility. Dominion Energy is evaluating leasing options in VPA's PMT and Newport News Marine Terminal in the Hampton Roads area of Virginia. The preferred lease location for the O&M Facility is Lambert's Point, , which is located on a brownfield site in Norfolk, Virginia. This O&M facility will monitor operations and include office, control room, warehouse, shop, and pier space.

During the operations term, the Project will require both planned and unplanned inspections and maintenance, which will be carried out by a team of qualified engineers, technical specialists, and associated support staff. The team will ensure that all components are maintained and operated in a safe and reliable manner, compliant with regulatory conditions and in accordance with commercial objectives.

The O&M plan for both the Project's onshore and offshore infrastructure will be finalized as a component of the FDR/FIR review process. An Oil Spill Response Plan and Safety Management System will also be developed and implemented prior to construction and installation activities (see Appendices Q and A for preliminary versions of these that will continue to be developed as the Project matures in consultation with BOEM and the Bureau of Safety and Environmental Enforcement).

In accordance with 30 CFR § 585.626(b)(9), Dominion Energy will provide a list of wastes expected to be generated during the Project following more detailed engineering.

3.5.1 Offshore Operations and Maintenance

All Offshore Project Components will require routine maintenance and inspections. It is anticipated that Crew Transfer Vessels and Service Operation Vessels will be used to support O&M activities offshore. Helicopters are currently being considered to support the Project; Dominion Energy is continuing to evaluate logistics, and the relevant impact assessments will be updated as needed.

Generally, offshore O&M activities will include:

- Inspections of Offshore Project Components for signs of corrosion, quality of coatings, and structural integrity of the WTG components;
- Inspections and maintenance of the WTG and Offshore Substation electrical components/equipment;
- Surveys of the Offshore Export Cables and Inter-Array Cables routes, to confirm the cables have not become exposed or that any cable protection measures have not worn away. The frequency and schedule of these surveys will be determine based upon various factors, to be detailed with and agreed upon during discussions with the applicable agencies;
- Sampling and testing (including of lubricating oils, etc.);
- Replacement of consumable items (such as filters, and hydraulic oils);

- Repair or replacement of worn, failed, or defective systems (such as WTG blades, bolts, corrosion protection systems, protective coatings, cables, etc.; including cleaning off subsea marine growth, realigning machinery, renewing cable protection using additional rock dumping or mattress placement, etc.);
- Updating or improving systems (such as control systems, sensors, etc.); and
- Disposal of waste materials and parts (in line with best practice and regulatory requirements).

The WTGs will be monitored through the SCADA System (as discussed in Section 3.3.1.1, Wind Turbine Generators). The Offshore Export Cables and Inter-Array Cables will be monitored through Distributed Temperature Sensing equipment. The Distributed Temperature Sensing system will be able to provide a real time monitoring of temperature along the Offshore Export Cable Route, alerting Dominion Energy should the temperature changes, which could be the result of scouring of material and cable exposure.

In the event of a fault or failure of the Offshore Project Components, Dominion Energy will repair and replace the Project component in a timely manner. Should the Offshore Export Cables or Inter-Array Cables fault, the failed or damaged portion of the cable will be spliced and replaced with a new, working segment. This will require the use of various cable installation equipment, as described earlier in this Section.

Pursuant to 30 CFR § 585.200(b), in conjunction with its COP, Dominion Energy has the right to one or more Project easements, without further competition, as necessary for the full utilization of the lease. Dominion Energy will request an operational ROW within the Offshore Export Cable Route Corridor to support necessary O&M activities, particularly should a fault or failure occur, as soon as a more definitive route is identified. Additional licenses and/or easements required for the portion of the Offshore Export Cable Route Corridor in state waters are discussed in Section 1.4.2, State and Local Permits, Approvals, and Consultations.

Appropriate safety systems will be included on all WTGs, including fire detection and an audible and visible warning system, painting and marking, lightning protection, and appropriate lighting for aviation and maritime industries. The WTGs will contain an automatic detection system, which will detect fires, and activate alarms in the event of an outbreak. In addition to this, an alarm will be sent to the SCADA system indicating the location of the event. The substructure is assumed to be protected against corrosion by means of a combination of anodes and coating of structural members. Each WTG will contain a shelter area, in addition to safety and rescue equipment, should any event occur while maintenance crew are on-site.

3.5.2 Onshore Operations and Maintenance

The Switching Station and the Onshore Substation will be equipped with monitoring equipment. The Switching Station and the Onshore Substation will also be regularly inspected during the operations term, which may result in routine maintenance activities, including the replacement of and/or update to electrical components/equipment. The Onshore Export Cables and Interconnection Cables will require periodic testing, with readings taken from access chambers, but should not require maintenance, though occasional repair activities may be required should there be a fault or damage caused by a third party or unanticipated events.

3.5.3 Summary of O&M Vessels and Helicopters

Dominion Energy will provide this information after further planning has occurred.

3.5.4 Lighting and Marking of Offshore Project Components

The WTGs will be lit and marked in accordance with FAA and USCG requirements for aviation and navigation obstruction lighting, respectively. Dominion Energy will light and mark all WTGs in accordance with FAA Advisory Circular 70/7460-1M (FAA 2020), BOEM's Draft Proposed Guidelines for Providing Information on Lighting and Marking of Structures Supporting Renewable Energy Development (2019), and *International Association of Marine Aids to Navigation and Lighthouse Authorities Recommendation O-139 on The Marking of Man-Made Offshore Structures* (IALA 2013), and United States Coast Guard Fifth District Local Notice to Mariners entry 36-20 as detailed below:

- All foundations will be painted yellow from the level of Highest Astronomical Tide (HAT) up to 50 ft (15.3 m) and utilize retro reflective material;
- WTG towers will have alphanumeric marking in black, approximately 10 ft (3 m) high and will be visible in all directions in both daytime and nighttime. A unique alphanumeric marking scheme will be subsequently determined, in coordination with the USCG. Letters will be easily visible by using either illumination or retro-reflecting material;
- WTGs above the yellow demarcation line for navigational aids will be painted no lighter than RAL 9010 Pure White and no darker than RAL 7035 Light Grey;
- All WTGs in excess of 699 ft (213 m) above ground level will require two synchronized flashing red lights (with medium intensity L-864 and LED color between 675 and 900 nanometers) placed on the back of the nacelle on opposite sides with a flash rate of 30 flashes per minute. While every turbine may be outfitted with a light, not all may be turned on and there will be no unlit separations or gaps more than 0.5 mi (804 m) around the perimeter and no unlit separation or gaps of more than 1 mi (1.6 km) within the grid or cluster of turbines. In accordance with Advisory Circular 150-5345-43, obstruction light fixtures must include infrared (IR) emitters or be used in conjunction with a standalone IR emitter in order to be night vision goggle compatible; and
- Additionally, mid-level lighting (model L-810) will be required at a half-way point on the tower between the top of the nacelle and ground level. Mid-level lighting should be flashing red lights configured to flash in unison with the nacelle lighting and should contain a minimum of three of the L-810 lights.
- While not required by FAA guidance, Dominion Energy is also considering an Aircraft Detection Lighting System (ADLS) to minimize the number of hours/day aviation lighting is in full effect. This system would activate only when signaled by the presence of a nearby aircraft (vs. a continuous activation). This system has the potential to decrease visual impacts to other stakeholders due to the decreased hours/day that the lights are activated. The impact of implementing an ADLS system was examined as a part of the aviation assessments, which utilize local flight data to determine an area-specific result.

In accordance with IALA 0-139 and USCG Local Notice to Mariners (LNTM) entry 33-20, the following will also apply:

- Each WTG will be lit as an offshore structure in accordance with 33 CFR Part 67 and USCG First District LNTM entry 33-20;
- Lighting will be located on all WTG structures and visible throughout a 360-degree arc from the water's surface;
- Corner Towers/Significant Peripheral Structures will have quick flashing yellow lights energized at a 5 nm (9.3 km) range;
- Outer Boundary Towers will have yellow 2.5 second lights (FL Y 2.5s) energized at a 3 nm (5.6 km) range;
- Interior Towers will have yellow 6 second or yellow 10 second lights (FL Y 6/FL Y 10) energized at a 2 nm (3.7 km) range and all lights will be synchronized by their structure location within the field of structures;
- All temporary base, tower, and construction and installation components preceding the final structure completion will be marked with quick yellow obstruction lights visible throughout 360 degrees at a distance of 5 nm (9.3 km). These will not require permits, only USCG notification for appropriate marine notices and broadcasts until the final structure marking is established;
- The aids to navigation on each WTG will be mounted below the lowest point of the arc of the rotor blades and will exhibit at a height above HAT of no less than 20 ft (6 m) and no more than 50 ft (15 m);
- Sound signals will be located on all structures located at corners/Significant Peripheral Structures and will sound every 30 seconds (4 second blast, 26 seconds off) and will be set to project at a range of 2 nm (3.7 km). This will not exceed 3 nm (5.6 km) spacing between perimeter structures, and will be Mariner Radio Activated Sound Signal activated by keying VHF Radio frequency 83A five times within ten seconds;
- Sound signals will be timed to energize for 45 minutes from last VHF activation;
- Aeronautical obstruction lights fitted to the tops of turbines will not be visible below their horizontal plane; and
- Aeronautical obstruction lights will be night vision imaging system compliant.

In addition, Dominion Energy is considering construction of closed circuit television systems for both security monitoring of the Project and as a capability that could assist with search and rescue operations in the Project Area if required. Additionally, Dominion Energy will work with stakeholders such as the USCG to ensure lighting in the Project Area can be controlled to maximize compatibility with Night Vision Goggle equipment.

3.6 Decommissioning

In accordance with 30 CFR Part 585 and other BOEM requirements, Dominion Energy will be required to remove and/or decommission all Project infrastructure and clear the seabed of all obstructions following termination of Project operational activities and the Lease. The decommissioning process for the WTGs and Offshore Substations is anticipated to be the reverse of construction and installation, with Project components transported to an appropriate disposal and/or recycling facility. All foundations/Project components will be removed to 15 ft (4.6 m) below the mudline (30 CFR § 585.910(a)), unless other methods are deemed suitable through consultation with the regulatory authorities, including BOEM. Offshore Export Cables and Inter-Array Cables will be retired in place or removed in accordance with a Decommissioning Plan; Dominion Energy would need to obtain separate and subsequent approval from BOEM to retire any portion of the Project in place. Offshore Project components will be decommissioned using a similar suite of vessels, as described in Table 3.4-6. Environmental impacts are anticipated to be similar to those experienced during construction and construction and installation activities, as described in Section 3.4, Construction and Installation. Onshore Project Components will be decommissioned in accordance with a plan developed with and approved by the appropriate parties (i.e. landowners and agencies). Although Dominion Energy has assumed a Project lifetime of approximately 33 years for the purposes of this COP, some construction and installation and components may remain fit for continued service after such time. Unless otherwise authorized by BOEM, Dominion Energy will complete decommissioning within 2 years of termination of the Lease and either reuse, recycle, or responsibly dispose of all materials removed. Decommissioning activities will be detailed in a Decommissioning Plan, which is subject to an approval process that includes public comment and government agency consultation. The Decommissioning Plan will be developed based on a factor-based approach, utilizing the environmental and socioeconomic factors to determine a strategy and methodology that is appropriate at the time. As part of this plan, Dominion Energy will compile an inventory of Project components and detail the methods proposed to decommission the Project components. As Project components are decommissioned, Dominion Energy will record and remove from the inventory list, to facilitate confirmation that Project components have been properly removed from the seafloor and that the Project Area is cleared of obstructions. This inventory will include those Project components described in Section 3.3, Project Design.

Table 3.6-1 provides additional detail on removal methods and assumptions that likely would be applicable based on present day understanding of available decommissioning approaches.

Table 3.6-1. Summary of Decommissioning Methods and Assumptions

Project Component	Removal Method	Comments and Assumptions
Wind Turbine Generator (WTG)	Removal of the WTGs is done using a reversed construction and installation method. Decommissioning of the turbines and towers is assumed to include removal of the rotor, nacelle, blades and tower to be removed in the reverse construction and installation order.	• Materials brought onshore to U.S. port for recycling and disposal; • Steel in the tower is assumed to be recycled; and • The blades are assumed to be recycled.
WTG Foundation	Removal of the monopiles is done using a reversed construction and installation method. Removal of the monopile is assumed to be cut off below the mud line and be lifted off by a HLV to a barge prior to decommissioning.	• Monopile to be cut below mudline and transported to U.S. port for recycling; and • Steel is assumed to be recycled.
Offshore Substation topside	Removal of the Offshore Substation topside is done using a reversed construction and installation method. The Offshore Substation topside is assumed to be lifted off by a HLV to a barge prior to decommissioning.	• Transported to U.S. port for recycling and disposal; and • Steel from the topside is assumed to be recycled.

Project Component	Removal Method	Comments and Assumptions
Offshore Substation Foundation	The Offshore Substation Foundation piles are assumed to be cut below the mud line, before the jacket is lifted off in one section by a HLV to a barge prior to decommissioning.	• Cut below mudline and transported to U.S. port for recycling; and • Steel from the jacket and piles is assumed to be recycled.
Cables	The Offshore Export Cables and Inter-Array Cables are assumed to be lifted out and cut into pieces or reeled in.	• Total removal of cable and transported to U.S. port for recycling; and • Core material to be recycled.
Onshore Substation	Removal of the all buildings and equipment, unless suitable for future use.	• Materials to be recycled; and • To be demolished and recycled unless suitable for future use. Site to be prepared for future use.
Onshore Export and Interconnection Cables	Removal of the Onshore Export Cable and Interconnection Cable is assumed to be limited to disconnecting and cutting at the fence line below ground level, this on both side.	• Remaining cable capped off and earthed; and • Removal of termination points and cut of cable 3 ft (0.9 m) below ground level.
Scour protection and rock filling	Alternatives: • Removal of scour protection and rock filling; and • Leave scour protection in place, as undisturbed as possible.	• Assumed to be removed unless leaving in place is deemed appropriate through consultation with the appropriate authorities.