# Programmatic Environmental Impact Statement

## High-Voltage Transmission Facilities in Washington

### Chapter 2 - Overview of Transmission Facilities, Development Considerations, and Regulations

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## Table of Contents

## TABLES



## FIGURES

# 2.0 Chapter 2 – Overview of Transmission Facilities, Development Considerations, and Regulations

This chapter provides an overview of the typical types of transmission facilities and describes both the Action Alternative and No Action Alternative. It also describes activities related to the new construction, operation and maintenance, upgrade, and modification of transmission facilities.

As detailed in Chapter 1, Introduction, this Programmatic Environmental Impact Statement (EIS) is fulfilling the directive of Revised Code of Washington (RCW) 43.21C.405 by evaluating potential future new construction and operation and maintenance of electrical transmission facilities with a nominal voltage of 230 kilovolts (kV) or greater (referred to herein as "transmission facilities"). This Programmatic EIS does not evaluate the potential effects of electricity generation, storage, local distribution, or customer use.

## 2.1 Overview of Transmission Facilities

The electrical systems of transmission facilities are generally divided into two categories for regulatory purposes: high voltage and low voltage. Consistent with the Federal Energy Regulatory Commission (FERC) National Reliability Standards, low-voltage transmission facilities are generally defined as those below 100 kV, while high-voltage transmission facilities typically operate above 200 kV and can sometimes include the 100 to 200 kV range as well (FERC 2023). While FERC oversees NERC as the Electric Reliability Organization under Section 215 of the Federal Power Act, the Bulk

Electric System definition—which generally includes transmission facilities operating at 100 kV or higher—is maintained and applied by NERC. Typical transmission voltages include 115 kV, 138 kV, 230 kV, 345 kV, 500 kV, and 765 kV (DOE 2023a).

Transmission facilities are broadly used to transfer electricity. As shown in **Figure 2.1-1**, electricity is generally produced at utility-scale power generation facilities. Electricity travels through a substation where the voltage is increased, allowing it to be transported over long distances via high-voltage transmission facilities, which can either be overhead or underground. The electricity is transported to another substation that reduces the voltage to levels suitable for the local distribution system, enabling it to be delivered to consumers. Local distribution systems that are made up of low-voltage transmission lines and transformers disseminate the electricity to individual customers, including houses, businesses, and industries (DOE 2023b). High-voltage transmission facilities can also be used to move generation through a networked system from one substation to another to serve large electrical loads while meeting the North American Electric Reliability Corporation (NERC) transmission system planning performance requirements and customer demands (NERC n.d.).

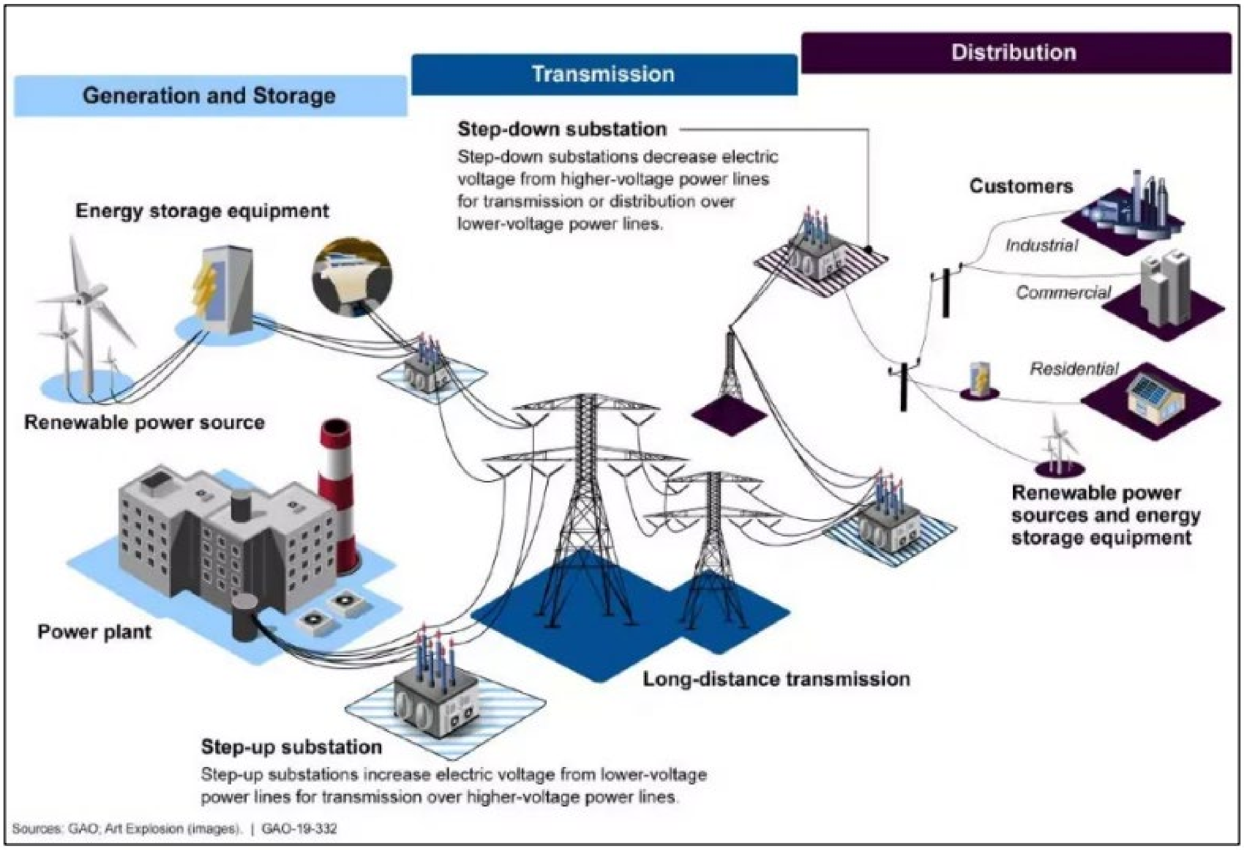


**Figure 2.1-1: Transmission Facility Components**

**Source**: GAO 2022

Electrical transmission facilities are essential for maintaining a reliable and stable power supply, minimizing loss during transport, and ensuring that electricity reaches consumers efficiently and safely. Transmission facilities have traditionally been used to transfer electricity generated from nonrenewable generation facilities, such as coal and gas, to customers. However, as the electricity demand increases, more renewable electricity sources, such as wind and solar, are being developed. These renewable energy facilities can be developed in remote locations or far from existing infrastructure. Therefore, new transmission facilities are often required to effectively deliver the energy produced. These transmission facilities can connect remote generation sites with a high potential for renewable energy production to areas with significant demand for energy but limited production capacity. Increased development of transmission facilities also improves grid resilience by providing redundancy, backups, additional supply, and regional and interregional connectivity[1] that can help compensate for the impacts and struggles associated with outages or disruptions. A more comprehensive transmission grid has the further benefit of reducing electricity prices for consumers since it lowers the cost associated with power delivery (DOE 2023b).

## 2.1.1 Overhead Transmission

Overhead low- or high-voltage transmission facilities can vary in design, ranging from single wood poles situated along roadways to lattice towers with bundled conductors located in dedicated corridors.

Overhead high-voltage transmission towers are designed to keep conductors (transmission lines) separated from their surroundings and from each other. The National Electric Safety Code has specific requirements for different operating voltages; the higher the voltage, the greater the separation distance required between conductors.

A variety of overhead transmission structures are regularly used. These include single wood poles, wood H-frame, engineered wood, lattice steel towers (LSTs), and tubular steel poles (TSPs) and tubular steel towers (see **Figure 2.1-2**). **Figure 2.1-2** presents a typical right-of-way (ROW) range of 125 to 200 feet for 230 kV or greater transmission facilities to reflect the variability in terrain, land use, and engineering design. This ROW range is a planning assumption, and final widths would be determined through project-specific environmental reviews.

Single wood poles are typically used for transmission facilities operating at 115 kV, where the ROW or easement[2] width is restricted.[3] Wood H-frames can be used for cross-country 115 kV facilities as they allow for greater average span distances. Wood H-frames can also be used for cross-country 230 kV facilities, where the topography allows. Guy wires are often used with these types of poles when the direction of the

[1] The linking of multiple electrical grids to allow the exchange of electricity between them. This connection helps balance supply and demand across different regions, enhancing the reliability and stability of the power supply.

[2] The permanent right authorizing the utility to use private land or property for another particular use. A utility can acquire certain rights to build and maintain a transmission facility (Xcel Energy n.d.).

[3] Refers to the ROW or easement width that is restricted from expansion beyond the original boundaries to accommodate larger structures, additional structures, or other actions that require additional space. A ROW could be restricted due to local zoning ordinances or land use plans that prohibit the expansion into areas such as communities or environmentally sensitive lands. Another reason a ROW could be restricted is due to adjacent properties being developed or other restrictions being present since the ROW was originally established.

line changes or at termination poles. Engineered wood poles, also referred to as glue-laminated poles, can be used for 115 kV and 230 kV facilities when the ROW is restricted.

The most commonly used structures for 230 kV transmission facilities and above, which are the focus of this Programmatic EIS, are LSTs and TSPs. LSTs consist of a steel framework with individual leg members and bracing systems. Bolted connections are used to assemble the lattice structure, ensuring stability and ease of maintenance. TSPs are hollow steel poles fabricated either as one piece or as several pieces fitted together (CPUC 2014a). However, it is assumed that the transmission facilities covered in this Programmatic EIS would require transmission structures that are generally large enough that they arrive at the site in separate pieces and are assembled in sections from the ground up, with cranes or helicopters used to lift sections in place (CPUC 2014b). The choice of design between LST and TSP typically depends on factors such as voltage requirements and the surrounding environment.

Design choices can include different engineering and structural options available to transmission developers to adapt to site-specific conditions. These may include the use of monopoles, lattice towers, undergrounding, or compact structures, depending on terrain, land use, environmental sensitivity, and safety requirements.

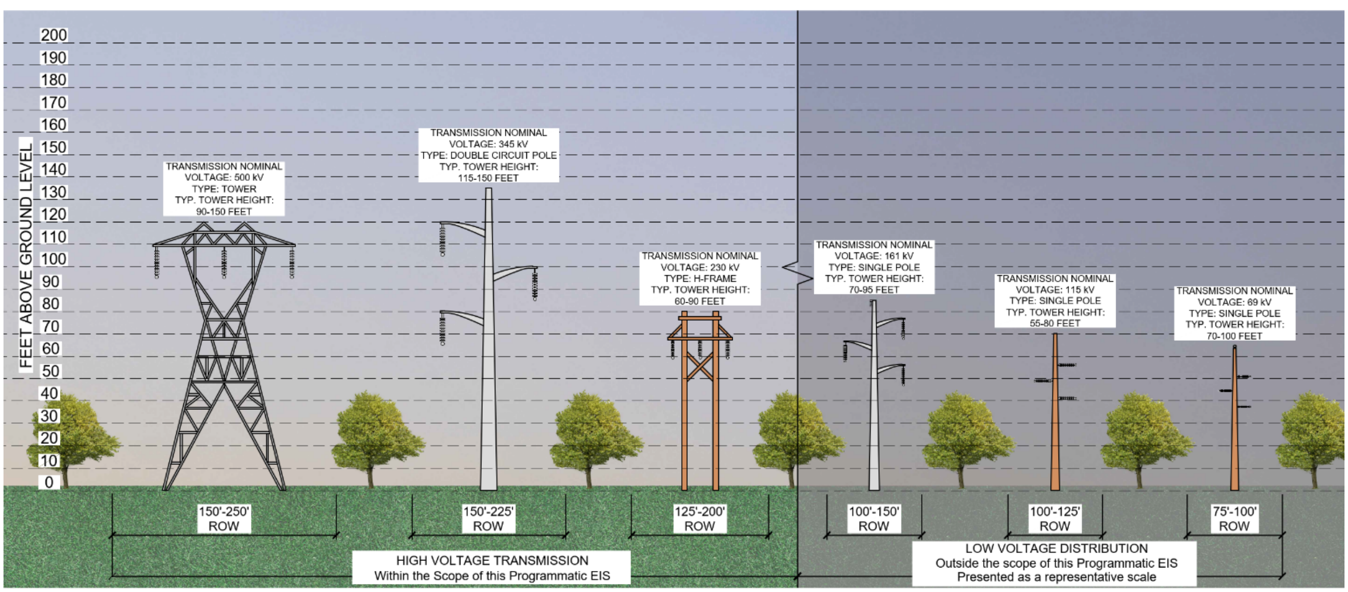


**Figure 2.1-2: Overhead Transmission Structure Types**

### 2.1.1.1 Substations and Transformers

The function of a substation is to transform electricity to a higher level of voltage, for efficient transmission over long distances, or lower voltage, for easier and safer local distribution. Substations also provide controlled switching and protection functions. Switching and protection functions are used to balance electricity loads, isolate faults in the system to prevent damage, and support maintenance and repair activities (Prismecs 2024). Substations can vary greatly in size and complexity, depending on the amount of voltage being transferred and the number of connecting transmission lines (CPUC 2014a). Based on need and type of transmission facility, substations can be as small as 500 square feet or cover over 100 acres, but are usually around 1 acre in size for local distribution systems and 10 to 20 acres for high-voltage transmission facilities (PSCW 2013; CPUC 2014a). **Figure 2.1-3** shows two examples of substations, reflecting the variety of sizes that may be used.

**Figure 2.1-3: Examples of Substation Footprints**

**Source**: EFSEC 2024

Substations may include transformers to increase or decrease the voltage of transmitted electricity. Given the amount of electricity passing through these transformers, it is vital to ensure that the components remain cool. Smaller transformers are typically self-cooling as their internal components are immersed in oil and are designed to allow the oil to cycle through the system and transfer heat to the external parts of the transformer. Larger transformers may need additional external cooling equipment, like pumps to force the cycling of oil or fans to force air across heat exchange surfaces (USDA 2001).

Switching stations are a distinct type of substation infrastructure that is also used to control transmitted electricity. Switching stations are different from substations in that they do not include transformers, and can connect or disconnect electric circuits and control the flow of electricity. Other substation components could include breakers, switches, and capacitor banks. In addition, control equipment, typically housed in a building, is required for the operation of the station.

### 2.1.1.2 Communication Systems

Communication systems help to provide safe and reliable electricity to the end user. The communication system shares real-time information, such as the system's status, with power-generating facilities, electrical substations, and utility operation centers (AEP Transmission n.d.). Transmission facilities also have communications for control of the line and substations to detect problems and shut down line sections (CPUC 2014a).

### 2.1.1.3 Obstruction Lighting and Marking

Consistent with the Federal Aviation Administration's (FAA's) guidance, obstructions such as overhead transmission facilities may be marked or lighted to warn aircraft operators of their presence during both daytime and nighttime conditions. Individual projects need to be reviewed to determine whether FAA marking and lighting requirements apply. They may be marked/lighted in any of the following combinations (FAA n.d.):

- **Aviation Red Obstruction Lights:** This option includes flashing aviation red beacons (20 to 40 flashes per minute) and steady-burning lights during nighttime operation. Orange and white paint is used for daytime markings.
- **Medium-Intensity Flashing White Obstruction Lights:** Medium-intensity flashing white obstruction lights may be used during daytime and twilight with automatically selected reduced intensity for nighttime operation. This system is not normally installed on structures less than 200 feet above ground level.
- **High-Intensity White Obstruction Lights:** Flashing high-intensity white lights may be used during daytime with reduced intensity for twilight and nighttime operation. In this type of system, the marking of structures with red obstruction lights and aviation orange and white paint may be omitted.

  High-intensity flashing lights may be used to identify some supporting structures of overhead transmission facilities located across rivers, chasms, gorges, etc. These lights flash in a middle, top, and lower light sequence at approximately 60 flashes per minute. The top light is normally installed near the top of the supporting structure, while the lower light indicates the approximate lower portion of the wire span. The lights are beamed toward the companion structure and identify the area of the wire span.

High-intensity flashing white lights are also employed to identify tall structures, such as chimneys and towers, as obstructions to air navigation. The lights provide 360-degree coverage around the structure at 40 flashes per minute and consist of one to seven levels of lights, depending on the height of the structure. Where more than one level is used, the vertical banks flash simultaneously.

- **Dual Lighting:** This option comprises a combination of flashing aviation red beacons and steady-burning aviation red lights for nighttime operation and flashing high-intensity white lights for daytime operation. Aviation orange and white paint may be omitted.
- **Catenary Lighting:** Lighted markers may be used for increased night conspicuity of high-voltage (69 kV or higher) transmission line catenary wires. Lighted markers provide conspicuity both day and night.
- **Omnidirectional Lighting:** Medium-intensity omnidirectional[4] flashing white lighting system that provides conspicuity both day and night on catenary support structures. The unique sequential/simultaneous flashing light system alerts pilots of the associated catenary wires.

Another type of obstruction lighting is the audio-visual warning system (AVWS), which represents a newer technology. Under 47 Code of Federal Regulations [CFR] 87.483, AVWS is a radar-based obstacle avoidance system that activates obstruction lighting and audible warnings to alert pilots of potential collisions with land-based obstructions. This system can be used in transmission facilities instead of, or in combination with, traditional obstruction lighting, which either flashes or shines continuously. AVWS may help to reduce the adverse environmental impacts associated with new or additional sources of light. As with other warning systems, AVWS must be approved for use by the FAA.

In addition to lighting, brightly colored balls can be attached to the conductors to make them more visible to low-flying aircraft. Line markers can be attached to the ground

[4] The capability of receiving or transmitting signals in all directions.

wire of transmission lines and some lower voltage conductors, depending on the marker type and local geographic conditions, to prevent birds from perching or building nests on the wires (APLIC 2012).

## 2.1.2 Underground Transmission

Underground high-voltage transmission facilities may also be technically feasible and, depending on project-specific applications and site-specific considerations, may have the following benefits:

- **Improved Reliability and Resilience:** Underground transmission facilities are less vulnerable to external threats, such as high winds, falling branches, and wildfires. This reduces the risk of power outages and enhances the overall reliability and resiliency of the power grid. However, if issues do arise, repairs can take substantially longer than overhead facilities due to repair complexity, limited access, and the technical skills required of transmission crews.
- **Lower Maintenance Costs:** While the initial installation costs are higher, underground transmission facilities often have lower long-term maintenance costs because they are less susceptible to damage from weather, vegetation, and other external factors.
- **Safety:** Although not completely excluded from safety risks altogether, underground transmission facilities reduce the risk of accidents and hazards associated with overhead transmission facilities, such as falling structures or wires.

While underground transmission has the benefit of increased resilience to severe weather conditions and reduced risks of power outages, it can cost 5 to 15 times more than overhead transmission facilities to install (EIA 2012; Xcel Energy 2024), require over 14 times as much soil excavation (DOE 2023b), and have a life expectancy that is approximately half as long (PRPA 2025).

The installation of underground cables often requires extensive excavation and disruption to the land. Excavation work for underground facilities is continuous along the corridor, as opposed to specific structure locations required for overhead transmission facilities. Additionally, developers must construct large underground concrete boxes periodically along the corridor that measure approximately 8 to 10 feet wide by 24 to 30 feet long by 8 to 10 feet high (PSCW 2011; Xcel Energy 2024). These boxes, referred to as vaults, are used by utility crews to splice cables together during new construction and during the operation of the transmission facility to perform maintenance and repairs (see **Figure 2.1-4**). Vaults must be placed every 900 to 3,500 feet, depending on the type of cable, topography, and voltage (PSCW 2011). Given the size of the vaults, areas where they must be placed would require substantially more excavation. Higher-voltage underground transmission facilities, such as those addressed in this Programmatic EIS, may also require that vaults be constructed in adjacent pairs to handle redundant sets of cable during maintenance (PSCW 2011). The spacing of the conductors may also vary depending on the voltage to address heat dissipation from the conductors.

Developers typically construct overhead transmission facilities because underground facilities are more expensive and harder to maintain when required. Another typical consideration for developers is how the additional costs would be allocated. Some utility providers have tariffs in place that require the local jurisdiction or customer group requesting the underground transmission facility to pay the difference between the overhead and underground costs (PSE 2014). As of 2009, an estimated 0.5 percent of all transmission lines of at least 200 kV or higher in the United States were underground (EIA 2012). There are instances where 230 kV facilities or above have been placed underground, typically for very short segments or in specific urban areas where overhead transmission facilities are not feasible.

**Figure 2.1-4: Underground Vaults**

**Source**: Xcel Energy 2024; Oldcastle Infrastructure n.d.

# 2.2 Alternatives

## 2.2.1 Action Alternative

This Programmatic EIS evaluates potential adverse environmental impacts associated with the development of electrical transmission facilities with a nominal voltage of 230 kV or greater in Washington. Electrical transmission facilities are defined in RCW 80.50.020(12) as "electrical power lines and related equipment." Therefore, the Action Alternative in this Programmatic EIS includes the development of new overhead and underground transmission facilities, as well as the upgrade or modification of existing transmission facilities.

The Programmatic EIS was developed to assess transmission facilities rated at 230 kV or higher, without specifying the transmission type (high-voltage alternating current [HVAC] or high-voltage direct current [HVDC]). The analyzed adverse environmental impacts were designed to be inclusive of both technologies, allowing flexibility for future project-specific applications. The impact determination ranges provided in the Programmatic EIS are intentionally broad, allowing them to encompass the environmental considerations of both HVAC and HVDC systems.

### 2.2.1.1 Overhead Transmission Facilities

This Programmatic EIS evaluates the new construction, operation and maintenance, upgrade, and modification of overhead transmission facilities, which include the following facilities:

- Transmission structures (towers and poles)
- Conductors (wires)
- Ground wires
- Insulators
- Substations, including transformers and ancillary equipment, such as converter stations

After a project-specific environmental review is complete and necessary permits are obtained, it is expected that several years would be needed to construct a transmission facility, with the timeframe varying based on the length of the transmission facility, the complexity of new construction, and site-specific topography.

#### 2.2.1.2 Underground Transmission Facilities

Although high-voltage transmission facilities are not typically constructed underground, this Programmatic EIS includes underground construction as part of the Action Alternative. Constructing high-voltage transmission facilities underground could be beneficial to protect visual resources, avoid aviation and military operations, or improve electrical reliability in high-risk weather areas. Transmission facilities could also be placed underground to meet the needs of certain site constraints. Due to the extensive construction methods required for this option, it is assumed that, per mile, underground transmission would take longer to construct than overhead facilities.

This Programmatic EIS evaluates the new construction, operation and maintenance, upgrade, and modification of underground transmission facilities, which include the following:

- Insulated conductor cables
- Vaults
- Transition structures (risers)

### 2.2.2 No Action Alternative

Under the No Action Alternative, this Programmatic EIS would not be adopted as a planning or guiding environmental review framework. Instead, transmission facility siting and development would continue under existing state and local regulatory processes. Each project would be evaluated for environmental compliance independently, without the advantage of using all or portions of the environmental analysis provided in this document.

The No-Action Alternative could lead to longer timelines for project-specific environmental reviews, duplicative reviews, and less coordinated mitigation at the project level. Having to conduct full, standalone project-specific environmental reviews without the use of this Programmatic EIS could also increase costs and create uncertainty for transmission facility developers, utility providers, and the State Environmental Policy Act (SEPA) Lead Agency.

# 2.3 Stages of Transmission Facility Development

Transmission facility development includes site characterization, environmental analyses and permit approvals, new construction, operation and maintenance, and decommissioning[5] (see **Figure 2.3-1**). The stages of transmission facility development analyzed in this Programmatic EIS include new construction, operation and maintenance, upgrade, and modification.

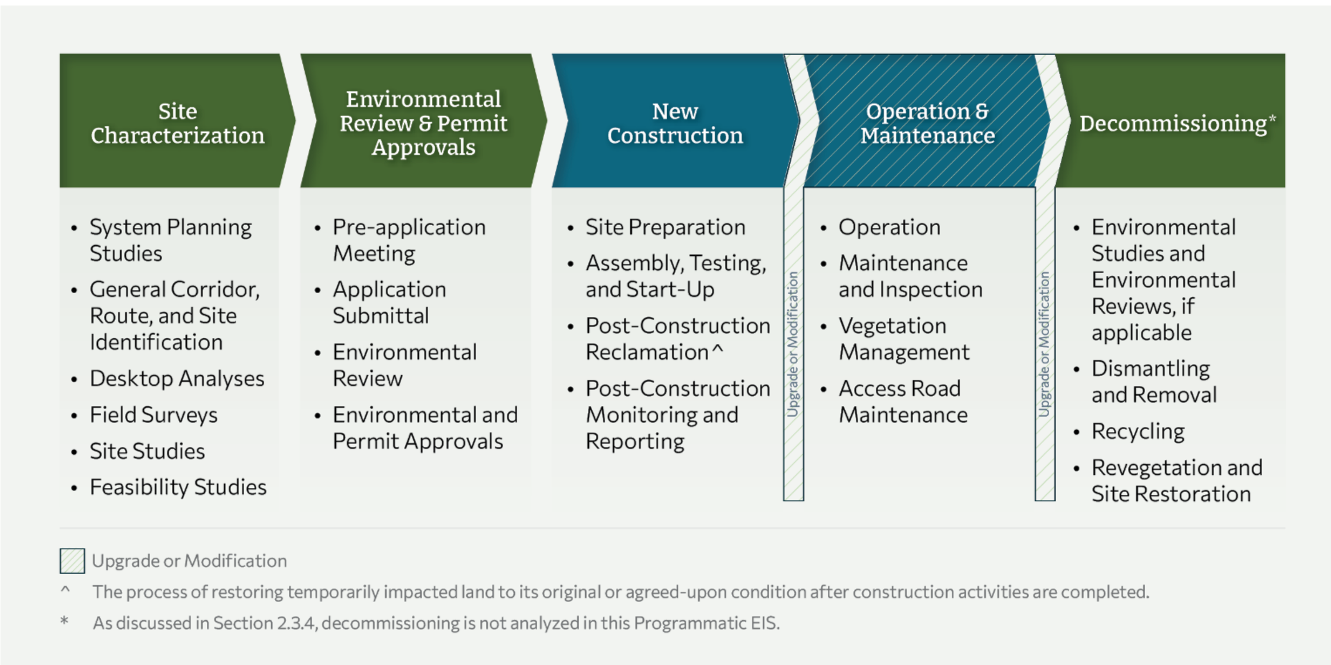


**Figure 2.3-1: Stages of Transmission Facility Development**

As illustrated in **Figure 2.3-1**, upgrades or modifications to existing transmission facilities may occur after construction, during the operation and maintenance stage, and prior to decommissioning. These changes are typically undertaken to enhance efficiency, improve performance, or respond to evolving technological and regulatory requirements.

[5] The steps taken to safely retire a facility from service. This process ensures that the site can be reused or returned to safe state.

The adverse environmental impacts of upgrades are generally comparable to those of routine maintenance activities, while modifications may result in adverse environmental impacts similar to those experienced during initial construction.

## 2.3.1 Site Characterization

Initially, applicants identify the scale and scope of their proposed transmission facility project. Site characterization typically involves conducting desktop analyses, system planning studies, and, with agreement from the landowner(s), field surveys. Very little modification to the site is attributed to this period, but adverse environmental impacts could still occur. For example, obtaining soil core samples could have unanticipated impacts on cultural, Tribal, and historical resources or could impact critical habitat. Therefore, for the purposes of the adverse environmental impact analysis completed for this Programmatic EIS, site characterization is included as part of new construction.

Siting considerations typically include the transmission ROW width, delivery points, the geography of an area, and access to proposed or existing transmission facilities, such as substations. Considerations would also include zoning requirements and identification of critical areas.

The ROW width decisions should be supported by project-specific environmental analyses, not solely by engineering discretion. Reduced ROWs[6] should only be used in exceptional, constrained circumstances and would still meet all applicable safety, reliability, and environmental standards. If the SEPA Lead Agency determines during the project-specific environmental review that an existing or proposed easement is inadequate, due to physical limitations, landowner restrictions,[7] or environmental sensitivities, they may propose design changes to address these issues. Design changes would align with the Mitigation Strategies outlined in this Programmatic EIS. The applicant should engage with the SEPA Lead Agency and other agencies with

[6] Refers to a narrower-than-typical ROW or easements. Reduced ROWs or easements may be required when the ROW is restricted and the full width (e.g., 200 feet) is not feasible due to existing land use, environmental sensitivity, or infrastructure limitations.

[7] Eminent domain is a separate legal process governed by state and federal laws that allows utility companies or government entities to acquire private property for public use, typically with compensation to the landowner. It is important to note that eminent domain is not analyzed as part of this Programmatic EIS.

jurisdiction to present the proposed design changes. The SEPA Lead Agency should evaluate whether the changes:

- Reduce or eliminate the adverse environmental impact.
- Maintain compliance with applicable regulations.
- Introduce additional adverse environmental impacts not analyzed in this Programmatic EIS.

The project-specific application should demonstrate why the easement is inadequate, how the design change remedies the issue, and how the change aligns with the Mitigation Strategies provided in this Programmatic EIS.

The following activities could involve minimal or no site disturbance:

- Mapping and desktop assessment of surface hydrology and floodplains
- Mapping and desktop assessment of habitat, including wetland identification
- Mapping and assessment of water types, including identification of waters that contain fish and water crossings
- Mapping and identification of species (plants and wildlife)
- Completing desktop studies for Tribal, cultural, and historic resources
- Completing desktop slope evaluations and soil stability studies
- Completing desktop assessment of existing land use and ownership
- Completing due diligence assessments for lands with previous industrial uses
- Completing an evaluation of seismic stability and potential storm event runoff
- Completing a baseline air quality assessment, if requested by the SEPA Lead Agency

The following activities could include ground disturbance:

- **Digging and boring:** Conducted for subsurface investigations and environmental surveys. These activities could aid understanding of soil and rock properties, soil conditions, subsurface environmental and/or cultural resources, soil or groundwater contamination, and geotechnical suitability.
- **Auguring:** Similar to drilling but often used for shallower depths.

- **Trenching:** Used to install temporary utilities or to expose existing underground utilities.

## 2.3.2 Transmission Construction

Once an applicant has obtained all necessary environmental approvals and permits for a transmission facility (see Section 1.6 of Chapter 1, Introduction), the new construction process begins. The duration of new transmission facility construction can vary based on a variety of factors, including size, scale, type of facility (e.g., wood pole or LST; overhead or underground), whether it is a new transmission facility or an upgraded or modified facility, and site-specific characteristics. However, in general, all new transmission facility construction includes the following stages, described in the sections that follow:

- Site Preparation
- Site Construction
- Post-Construction Reclamation
- Post-Construction Monitoring and Reporting

New construction activities, including oversight, administration, compliance, and monitoring, would be managed by the applicant. The workforce is likely to consist of laborers, craftsmen, machine operators, supervisory personnel, and construction management personnel. The number of workers employed during the new construction of transmission facilities would vary greatly depending on the size and scale of the proposed project. It is generally anticipated that new construction of a transmission facility could require the following general roles and approximate counts:

- **Project Managers and Engineers:** Around 10 to 20 individuals, including civil, electrical, and environmental engineers
- **Construction Workers:** Ranges from 50 to 200 workers and includes line workers, equipment operators, and general laborers

It is assumed that new underground transmission facility construction would require more construction workers than overhead transmission facilities. New construction activities may occur concurrently or sequentially, moving along the length of the transmission facility route, depending on the nature and complexity of the project. For example, construction activities occurring sequentially would initiate a crew to prepare a site. Once site preparation is completed, the crew would move on to the next location while a second crew begins the assembly and start-up of the transmission facility at the first location.

### 2.3.2.1 Site Preparation

Site preparation begins with conducting all necessary preconstruction surveys, such as preconstruction wildlife surveys, for micro-siting and/or mitigation. Once surveys are finalized, the site preparation process can commence. The preparation of new overhead and underground transmission facility construction sites could include the establishment of applicable temporary erosion and sediment controls, clearing or grubbing of vegetation, tree removal, grading, constructing temporary staging and laydown areas, improving roads, and constructing new roads.

Projects in urban settings often face additional challenges in site preparation, such as limited space, higher traffic disruption, and stricter regulatory requirements. While rural[8] settings may not have these same challenges, they can face logistical challenges, such as difficult terrain and longer distances for material transport. Regardless of whether a setting is urban or rural, projects in environmentally sensitive areas may require special considerations to minimize adverse environmental impact, including more stringent permitting processes and additional Mitigation Measures.

#### New Construction Access

New construction access roads would likely be required for the movement of trucks, cranes, concrete trucks, bulldozers, and other equipment. New construction access would vary depending on the project scope, location, terrain, and environmental setting. Although existing roads would be used to the greatest extent feasible, roads may need to be improved, or new access roads may need to be constructed. Road improvements could include laying rock or gravel where the soil is unstable, removing any overgrown vegetation, and widening the road and adjacent disturbance areas for safety clearances. New roads would require clearing, grading, and installing gravel or other suitable material. In areas with steep slopes or grades, drain drips or water bars could be required for adequate drainage and to minimize soil erosion. In such areas, it is often required that terraces be created to ensure level work areas at the structure locations. In wetland or unstable soil areas, matting could be installed to allow heavy construction equipment access while minimizing adverse environmental impacts on

[8] Rural encompasses all population, housing, and territory not included within an urban area.

soils, vegetation, and habitat. Furthermore, temporary bridges across waterways could be installed for access. Before constructing new roads, special consideration is given to the anticipated restoration required after new construction is completed, including revegetation, rock cover, and other drainage and erosion control features (PacifiCorp 2021).

Access roads could also serve as the primary means of movement for maintenance crews through operation and maintenance. These roads could be used to access transmission facilities, substations, and ancillary facilities for inspection, maintenance, and/or emergency repairs over the life of any project (PacifiCorp 2021).

## Clearing and Grading

Clearing of existing shrubs, vegetation, asphalt, obstructions, and trees could be required for transmission facility ROWs, new and improved access roads, and staging and laydown areas, as well as future operational conditions. Site grading would entail establishing applicable temporary erosion and sediment control features, removing excess soils or soils that are unsuitable for new construction from the site, and replacing them with load-bearing granular materials and aggregates to facilitate new construction. The extent of site grading would depend on the proposed transmission facility and environmental setting. New construction in areas with steep slopes or unstable soils would require more earthmoving equipment to achieve appropriate elevations for site construction. Site grading activities could require the use of excavators, scrapers, dozers, paddle wheel scrapers, haul vehicles, and graders.

## Staging and Laydown Areas

Staging areas are used to temporarily store materials, construction equipment, or vehicles and to assemble transmission facility components. The size and total number of staging areas vary depending on the size, scale, and type of transmission facility being proposed. In urban areas, parking lots or already developed areas can be used, while remote areas may require additional clearing and grading.

### Helicopter Landing Zones

Helicopters can be used for a variety of new construction activities where traditional ground equipment may not be allowed or is limited, such as in remote or sensitive areas. For example, helicopters can be used for the following activities (NWPPA n.d.):

- Conducting micro-siting surveys[9]
- Conducting alternative geotechnical analyses
- Transporting personnel, equipment, and/or materials
- Setting structures
- Stringing wires
- Post-construction monitoring or surveys

As part of the site preparation period, helicopter landing zones or pads may be needed for refueling and loading. The number and size of landing pads would depend on the helicopter model being used, the length of the proposed transmission facility, and the number of restricted new construction sites. Helicopter landing pads would be constructed as close to the proposed new construction site as practicable. The landing zone locations would also be prioritized in areas that require minimal site preparation and that are free of obstructions, such as open spaces, fields, or parking lots.

## 2.3.2.2 Site Construction (Assembly, Testing, and Start-Up)

The following sections describe the site construction process and activities associated with the assembly, testing, and start-up of overhead and underground transmission facilities.

### Overhead Transmission

New overhead transmission facility construction is typically completed in the following stages, but various construction activities may overlap, with multiple construction crews operating simultaneously:

- Installing structure foundations
- Assembling and erecting support structures

[9] The process of identifying the exact placement of a transmission facility structure.

- Stringing conductors, ground wires, and fiber-optic lines

### Foundations

Except for wood pole construction, most overhead transmission facilities have some form of concrete foundation. The size of the foundation typically depends on the type of structure and the terrain. New construction begins with the auguring of holes for structure footings. LSTs typically require four footings, each 3 to 4 feet wide and 15 to 30 feet deep. TSPs require one hole that is typically 8 to 12 feet wide and 40 to 60 feet deep. After the footing holes are excavated, they are reinforced with steel and then filled with concrete. It is anticipated that the foundations for both LSTs and TSPs would have a slight projection above the ground. Once the concrete has cured, crews can begin new construction of the structure itself (CPUC 2014b).

### Structure Installation

For wood pole construction, including engineered wood, once the insulators are attached to the wood poles, they are typically installed directly into the ground without a separate concrete foundation. Depending on the soil type, wood poles may require the use of casings. The structure installation process involves digging a hole, placing a pole in the hole, and then backfilling the hole with soil or other materials. The depth of the hole and the type of backfill material are carefully chosen to ensure stability and support for the pole. Guy wires are added at termination or turning wood structures and may be used to enhance the stability of the system.

Steel overhead transmission facility structures are generally built from the ground up. Sections of LST structures are assembled near the installation site and lifted into place. Crews then bolt the sections together. TSPs can be assembled entirely near the site and erected in one piece or assembled in sections, depending on the terrain and available space. Structures can be lifted and set in place by a crane or helicopter, depending on accessibility for ground-based construction equipment (CPUC 2014b).

Overhead transmission facilities can be used to clear span water crossings, including riparian areas, wetlands, wetland buffers, and surface waters. Taller structures are often needed to meet clearance requirements, and careful consideration should be made for the placement of foundations, access roads, and construction work areas.

Structures and foundations would be designed to meet the requirements of the following applicable publications:

- American Society of Civil Engineers (ASCE) Standard 10, Design of Latticed Steel Transmission Structures

- ASCE Standard 48, Design of Steel Transmission Pole Structures
- ASCE Manual of Practice 113, Substation Structure Design Guide
- American Institute of Steel Construction 360 Specification for Structural Steel Buildings
- American Concrete Institute 318 Building Code Requirements for Structural Concrete and Commentary
- ASCE Manual of Practice No. 74 – Guidelines for Electrical Transmission Line Structural Loading, Fourth Edition (2020), which provides comprehensive guidance on structural loading concepts and applications for transmission line design.
- ASCE 141 – Design of Wood Transmission Structures, which outlines best practices for the structural design and use of wood poles.
- ASCE 123 – Design of Concrete Pole Structures, which provides design criteria and methodologies for concrete transmission poles.
- ASCE 104 – Recommended Practice for Fiber-Reinforced Polymer (FRP) Poles, which addresses the use of FRP materials in utility structures.

#### Conductors, Ground Wires, and Fiber-Optic Lines

New construction of overhead transmission facilities includes the wire-stringing operation, during which conductors and ground wires are strung between structures. This operation can also include the installation of sheaves, vibration dampeners, weights, suspension, identification markers, and dead-end hardware assemblies for the entire length of the route (CPUC 2014b).

Conductors are the “wires” that are connected to the structures that relay the electric current. Conductors used in transmission lines are usually constructed from aluminum placed over a steel core for reinforcement. Conductors are generally not insulated, with air serving as the insulating material (Xcel Energy 2024). For voltages up to 200 kV, a single conductor per phase can be used, which includes a total of three wires. For voltages over 200 kV, bundled conductors are used to increase the capacity of the line and reduce power loss. Bundled conductors consist of two or more conductor cables per phase connected by non-conducting spaces (CPUC 2014a). Each alternating-current circuit has three phases (e.g., lines), whereas each direct current circuit has two phases.

A lightweight sock line, or pilot line, is strung by bucket trucks, heavy equipment, and sometimes helicopters. The pilot line is threaded through wire rollers attached to the insulator of each structure. The pilot line is then attached to a conductor pulling cable, which is connected to a tensioning machine on a truck. The conductors are pulled from one structure to the next by a puller machine (CPUC 2014b). The puller and tensioner work together during the pulling operation to ensure that the conductor maintains the proper ground clearance at all times. Wire set-up sites or pulling stations, where the associated pulling machinery and equipment are staged, are located at intervals along the span (CPUC 2014b).

After a section of conductor is pulled through a series of structures, a tensioner is used to apply the proper tension. Applying proper tension is crucial as conductors can expand and contract with temperature changes, ensuring they will not sag too low when temperatures are high (CPUC 2014b). Guard poles or guard structures may be installed at transportation crossings, flood control areas, utility crossings, parks, and other sensitive locations to protect these underlying areas during wire-stringing operations. The guard structures intercept the wire in the event that it drops below a conventional stringing height, preventing damage to structures. These guard structures are temporary and are removed after conductor installation is complete (CPUC 2014a). At crossings of interstate and state highways, closures may be required during stringing operations to ensure public safety.

Once the conductors are pulled through the structures and have adequate tension, they are permanently connected (i.e., “clipped in”) to the insulator, which is attached to the structure. Insulators are made from non-conductive material and are used to prevent the unintended flow of electricity between conductors and supporting structures (CPUC 2014a). Insulators have historically been made of porcelain or toughened glass, which requires routine maintenance to avoid dust build-up, leading to insulator flashover and noise. Newer insulators are made of polymer or silicon, which are lightweight and shatter-resistant (CPUC 2014a).

Ground wires are unpowered protective wires that are strung along the tops of towers to protect the system from lightning strikes. Ground wires sometimes include a fiber optic communication line to provide reliable control of the lines and substations (CPUC 2014a). Finally, vibration dampeners, weights, and spacers between the conductors of a bundled phase are installed (CPUC 2014b).

Fiber optic lines, or communication systems, help to provide safe and reliable electricity to the end user. The communication system shares real-time information, such as the system's status, with power-generating facilities, electrical substations, and utility operation centers (AEP Transmission n.d.). A primary communication wire is typically installed as part of the transmission facility, and a secondary communication path can also be installed for redundancy. Communication systems can be installed both above and below ground. The communication line can be attached to transmission structures or installed in separate locations, such as nearby streets. The ground wire sometimes incorporates a fiber optic communications line (CPUC 2014a).

### Substations and Transformers

New construction of a substation begins with site preparation, including clearing of vegetation, site grading, and installation of site drainage, ground grid, and concrete foundations (including spill prevention, control, and countermeasures for the transformer[s]). A non-conductive gravel pad is placed over the substation yard, and a security fence is installed surrounding the site for safety and security (PSCW 2013). In some instances, a communication tower may be required.

## Underground Transmission

In this Programmatic EIS, underground transmission facilities can include the following construction methods:

- Open trenching
- Trenchless crossings (including horizontal direction drilling [HDD], jack and bore, or tunneling)

Underground transmission facilities must be buried, which requires substantially more earthwork than overhead transmission facilities. There are two primary methods used for installing underground transmission facilities: open trenching and trenchless crossings. Both are evaluated in this Programmatic EIS, as described below.

### Open Trenching

The most common technique of underground transmission facility construction is open trenching. Open trenching is the most straightforward method and can be performed with basic construction skills and equipment. Open trenching involves the use of heavy machinery to dig an open trench at a depth typically of 6 to 8 feet, but can be greater (PSCW 2011). This method allows precise control of the trench depth, making it suitable for projects with specific depth requirements. Traditional trenching equipment is generally less expensive to purchase and maintain in comparison to trenchless crossings that require drilling or tunneling. In the event of utility repairs or maintenance, traditional trenching offers relatively direct access to the utilities compared to trenchless. However, open trenching results in surface disruption, which can be problematic in urban or environmentally sensitive areas. Additionally, restoration of the surface after trenching can be time-consuming and costly.

### Trenchless Crossings

The second method is trenchless crossings, used when open trenching is not practical due to the presence of structures or sensitive surface resources, shallow bedrock or groundwater levels, or because the soil will not bear the weight of heavy equipment (Hair 2015). Trenchless crossing techniques evaluated in this Programmatic EIS include HDD, jack and bore, and tunneling.

#### Horizontal Directional Drilling

The HDD technique uses a surface-launched drilling rig to dig an underground tunnel with minimal surface disruption (Hair 2015). The process begins with crews digging, sending, and receiving pits. A drilling rig is used to cut a small pilot hole throughout the length of the route. Once it reaches the receiving end, it is pulled back through the pilot hole, creating a large tunnel while pulling the transmission line through. HDD is suitable for soft to hard clays and wet soils and involves drilling rather than extensive excavation (City of Portland n.d.). This method also provides flexibility in the drilling path, allowing the operator to maneuver around obstacles and along curves. HDD is anticipated to result in minimal adverse environmental impacts on natural habitats, is more suitable for environmentally sensitive areas, and can reduce post-construction site restoration costs (Hair 2015).

HDD can be used as a method for crossing bodies of water and sensitive ecosystems, including riparian areas, wetlands, wetland buffers, and surface waters.

#### Jack and Bore

Jack and bore is another trenchless construction technique that uses a hydraulic auguring machine to create an underground tunnel. The jack and bore process requires excavation at the entry and exit points for the jack and bore machine to be positioned. Typical boring pits are around 14 by 35 feet and deep enough to accommodate the boring equipment (PSCW 2011). A casing, which includes the transmission wires, is then jacked horizontally through the ground while a rotating auger simultaneously removes the soil. This technique is generally limited in maneuverability and steering; therefore, it is often used for short, straight segments (FDOT 2010).

#### Tunneling

Tunneling is generally used in urban areas where open trenching would not be a viable option and is typically employed at greater depths than HDD or jack and bore. In most cases, a tunnel boring machine (TBM) is used and can encompass the installation of tunnels by microtunneling, pipejacking, or conventional tunneling. The main difference between microtunneling/pipejacking and conventional tunneling is the method of lining the tunnel. Pre-formed pipes are used as the structural lining in microtunneling/pipejacking, and in conventional tunneling, the lining is typically formed of precast concrete segments that are interlocked to line the tunnel bore as the TBM advances (National Grid 2023).

New construction using tunneling would include forming work areas and entry and exit areas for the TBM to be used. The first step of tunneling is to construct the launch and reception shafts. Following new construction of the shafts, a base slab and tunnel headwall structure would be cast at the bottom of each shaft, and a thrust wall installed within the launch shaft to allow the TBM to advance. The TBM would be lowered into the launch shaft, and tunneling would commence between the launch and reception shafts. Once the tunnel is constructed and the transmission conductors have been installed, either the shafts would be capped using prefabricated beams/slabs, then backfilled, or a tunnel head house would be constructed. The requirement for a tunnel headhouse would be determined depending on whether the required cable ratings could be achieved without mechanical ventilation within the tunnel (National Grid 2023).

### Supporting Infrastructure for Underground Transmission Facilities

Additional infrastructure for underground transmission facilities would likely include underground vaults, transition structures, and lightning arrestors.

#### Underground Vaults

Once the trench or tunnel is prepared and the vaults are constructed, the underground cable can be placed. These cables consist of several components but can be described generally as a bundle of copper or aluminum conductor wires through which electricity passes, surrounded by an insulation layer composed of gas, fluid, polyethylene, or other non-conductive materials. Both the wire bundle and the insulation layer are then encased in an outer jacket that protects the wire from water infiltration and external damage (PSCW 2011).

#### Transition Structures

When underground transmission facilities need to connect to overhead transmission facilities, a transition structure or station is needed. Transition structures and stations may be used across a range of voltage levels, depending on system design, operational needs, and site-specific conditions. For underground transmission facilities less than 345 kV, a 60- to 100-foot-tall transition structure similar in composition and construction to an overhead transmission support structure is installed. Transition structures are designed to keep conductors separated. The insulated overhead conductor is linked through a solid insulator device to the underground conductor. This insulator device keeps moisture out of the cables and ensures that the overhead line is appropriately distanced from the supporting structure (PSCW 2011). Transition stations are similar in composition to a small substation and typically cover 1 to 2 acres. These stations require grading, access roads, and stormwater management facilities (PSCW 2011).

#### Lightning Arrestors

Lightning arrestors are installed where the underground cable connects to the overhead transmission facility to protect it from lightning strikes. Lightning arrestors are critical to the longevity of underground cables since the insulating material cannot be repaired if large voltage changes damage the cables (PSCW 2011).

## 2.3.2.3 Post-Construction Restoration

### Backfilling of Trenches, Holes, and Tunnels

After the overhead support structures or cables and vaults have been installed, all trenches, holes, and/or tunnels are backfilled with the soils previously excavated from the site. In some instances, other backfill material is used in trenches around the cables to ensure sufficient heat transfer to the surrounding soils and groundwater (PSCW 2011).

### Site Restoration and Revegetation

Reclamation and maintenance requirements for overhead and underground transmission ROW can vary depending on the specific regulations and guidelines set by different authorities. Although more extensive, typically, site restoration for underground transmission facilities is similar to overhead transmission facilities.

Once new construction activities are completed and all excavated areas are backfilled, all roadways, landscaped areas, and undeveloped areas are restored to their pre-construction or agreed-upon conditions and topography (PSCW 2011). Infrastructure such as driveways, curbs, and private utilities impacted by transmission facility development would be restored to their pre-construction conditions.

Transmission facility development would also be required to vegetate disturbed areas to stabilize the soil and prevent erosion. This often involves an integrated vegetation management approach in which native species that are compatible with the local ecosystem are planted. This Programmatic EIS outlines revegetation requirements, such as approving seed mixes by the SEPA Lead Agency in coordination with other stakeholders. Furthermore, tall trees would not be planted within the ROW of overhead transmission facilities to avoid interference with overhead lines, and deep-rooted shrubs or trees would not be planted within the ROW of underground transmission facilities to prevent interference with underground lines.

## 2.3.3 Transmission Operation and Maintenance

Activities for the operations stage would vary based on type of facility, scale, and site characteristics. Facilities are not expected to have staff on site daily, but maintenance crews are anticipated to be regularly deployed. Unlike other components associated with transmission facilities, substations may be staffed on a routine or daily basis during operations and typically have a permanent access road connecting the site to the nearest public road (PSCW 2013). This is particularly necessary and important should large equipment need replacing.

### 2.3.3.1 Post-Construction Monitoring and Reporting

Once initial post-construction restoration is completed, ongoing monitoring and reporting associated with Mitigation Measures identified in this Programmatic EIS would be implemented. These efforts could include, but are not limited to, the following:

- Monitoring earth resources throughout operation and maintenance to avoid and/or minimize adverse environmental impacts related to soil compaction, soil erosion, and/or accretion.[10]

[10] The process of growth or increase, typically by the gradual accumulation of additional layers of matter.

- Implementing a vegetation management plan to reduce direct and indirect adverse environmental impacts on sensitive vegetation.
- Implementing an invasive species management plan to reduce the spread of invasive species on the ROW, adjacent new construction sites, and access roads.
- Implementing a revegetation plan to restore areas impacted by project construction. The revegetation plan would include a monitoring plan to determine the success of the restoration areas through operation and maintenance.
- Implementing a wildlife mitigation and monitoring plan, including avian protection and monitoring, throughout operation and maintenance to minimize adverse environmental impacts on the surrounding habitat and wildlife species.
- Archaeological monitoring during maintenance activities to avoid and/or minimize adverse environmental impacts on cultural resources.

## Routine Inspections

Routine inspection and maintenance are vital to the longevity and efficiency of transmission facility operation. Recurring inspections would occur throughout the life of a transmission facility project and are required by federal regulations FAC-003-4 and FAC-501-WECC-4. Activities associated with routine inspections would vary depending on the type of transmission facility, scale, and location. Generally, routine inspections for transmission facilities would include an examination of the different components of the facility such as poles, anchors, hardware, fixtures, and conductors. Conductors and fixtures could be tested for corrosion, breaks, broken insulators, and correct tension. Substation structures would be inspected on a recurring basis for corrosion, equipment misalignment, operational parameters, or foundation problems.

## Maintenance and Repairs

Maintenance of transmission facilities could include repairing old, degraded, obsolete, or inoperable components, conductors, or structures. Maintenance could also include replacing a component, conductor, or structure with a direct, "like-for-like" component to support ongoing facility operation. It is anticipated that required maintenance and repairs would be addressed as soon as warranted, in accordance with the National Electrical Safety Code (NESC).

## Right-of-Way Maintenance

ROW conditions would be examined during the routine inspections. The transmission facility ROW is likely to require ongoing maintenance to ensure adequate access to the structures. Access roads may require regrading or repairs to water bars or culverts due to flooding or inadequate drainage. Vegetation and debris along access roads and ROWs would be addressed and maintained as well.

## Vegetation Maintenance

As discussed above, overhead transmission facility ROWs would be free of tall trees, while underground transmission facility ROWs would be free of any deep-rooted shrubs or trees. Vegetation within transmission ROWs and adjacent areas must be inspected and maintained on a regular basis to meet requirements set forth by NERC (FAC-003-4).

Vegetation maintenance would be required on a recurring basis to manage the growth of trees or vegetation within or encroaching upon the transmission facility ROW. This can include mowing, trimming, tree removal, and the use of herbicides. Other new remote sensing technologies, such as Light Detection and Ranging (LiDAR), can be used for more effective vegetation management (DOE 2023a). In addition to routine vegetation management activities, there may be emergency situations where tree hazards require immediate response.

In some instances, helicopters can be used in remote areas to conduct scheduled vegetation maintenance. The use of helicopters can reduce ground disturbance, as well as the time needed to complete the required maintenance activities (BPA 2021). As discussed in Section 3.1 of Chapter 3, Affected Environment, Significant Impacts, and Mitigation, helicopters would be restricted from flying above sensitive wildlife habitats during noise-sensitive periods and would not conduct field landings or fly below 50 feet above ground level.

### 2.3.3.2 Upgrade of Existing Transmission Facilities

Upgrading existing transmission facilities is considered to improve the facility's efficiency, reliability, and capacity without expanding the existing facility footprint[11] or causing new ground disturbance[12]. Upgrading an existing transmission facility may include disturbing previously reclaimed or restored areas that are within the existing ROW, replacing infrastructure with advanced technologies within vaults, or upgrading associated above-ground components. It is assumed that all ROW and disturbed areas, including temporary disturbance (e.g., laydown areas), affected by the upgrade have been previously analyzed for adverse environmental impacts.

Upgrades do not include routine operation and maintenance activities, such as repairing or replacing components to maintain safe and reliable operation and maintenance of the transmission facility; however, adverse environmental impacts are anticipated to be similar. Activities associated with upgrades can include:

- **Reconductoring:** It is anticipated that as electric power demand increases, more or larger cables and conductors would be needed to increase the capacity and the interconnectivity of the grid to meet this fluctuation in demand. Historically, installation of new circuits has been the preferred solution to increase transmission capacity, but limited ROW and opposition from local communities can make "reconductoring" a practical alternative. Advances and innovations in materials can be applied to conductors, resulting in higher thermal rating and strength, which can reduce transmission and distribution losses, minimize safety hazards, and increase energy supply to end users (DOE 2015). It is anticipated that reconductoring transmission facilities to take approximately 6 to 18 months to complete (Grid Lab 2024).
- **Advanced Transmission Technologies:** Incorporating advanced technology into existing transmission facilities can help to improve the efficiency and

[11] The physical area occupied by a transmission facility or associated infrastructure, including its height and width. This includes the permanent space required for structures such as towers, substations, access roads, and ancillary facilities. The footprint encompasses both the area within the ROW and any additional land area required for permanent infrastructure. It does not include temporary workspaces unless they result in permanent land conversion or long-term environmental impact.

[12] Any temporary or permanent alteration of land, vegetation, water, or other natural features resulting from new construction, operation and maintenance, or modification activities associated with new or existing transmission facilities. Disturbance may include soil compaction, vegetation removal, grading, excavation, or hydrologic changes. It is categorized as:
· **Temporary disturbance:** Impacts that are fully restored to pre-project conditions following completion of the activity (e.g., temporary laydown yards or access routes).
- **Permanent disturbance**: Impacts that result in long-term or irreversible changes to land use or ecological function (e.g., installation of new towers or permanent access roads).

effectiveness of electricity delivery and increase the overall reliability of the system. The technology can be applied to both grid software and grid hardware. Advanced grid software technology can include solutions such as dynamic line rating[13] that focus on improvements in the control systems and decision-making processes. Although dynamic line rating is considered a software technology improvement, it also involves the installation of physical hardware, such as advanced conductors and weather monitoring systems. There are also physical assets and infrastructure solutions, such as power flow controllers and advanced conductors and cables that focus on carrying, converting, or controlling electricity. These different technologies can be implemented independently or in tandem to improve the overall efficiency and effectiveness of the transmission system (DOE 2020). It is anticipated that installing advanced transmission technology could take approximately 3 to 12 months[14] (Grid Lab 2024).

**Table 2.3-1** provides considerations on how upgrades to existing transmission facilities may result in adverse environmental impacts of lesser magnitude than those for new construction. These considerations are intended to inform planning and stakeholder engagement by highlighting where environmental outcomes may be improved by upgrades compared to new construction. These considerations do not constitute formal impact determinations, which are addressed in Chapter 3, Affected Environment, Significant Impacts, and Mitigation. For additional context regarding how the upgrade of an existing transmission facility may affect a specific environmental resource, refer to the corresponding section in Chapter 3.

### Table 2.3-1: Considerations for the Upgrade of Existing Transmission Facilities Compared to New Construction

| Consideration | Description |
|---|---|
| **No New Ground Disturbance** | Upgrading existing transmission facilities reduces the need for new land clearing, as ground disturbance is limited to areas that have already been reclaimed or restored within the existing ROW. Because no new ground disturbance occurs, the potential for disturbance-related adverse environmental impacts is minimized compared to new construction. |

[13] A technology used in electric power transmission to optimize the capacity of transmission lines based on real-time conditions rather than static assumptions.

[14] The timeframes provided in this Programmatic EIS are approximate. Exact timeframes would be determined for each project-specific application and may vary on a case-by-case basis.

| Consideration | Description |
|---|---|
| **Utilization of Existing Infrastructure and ROWs** | Upgrades utilize existing infrastructure and ROWs, avoiding extensive new development and minimizing adverse impacts to environmental resources. |
| **Reduced Erosion and Water Contamination Risk** | Upgrades involve less soil disturbance and construction activity, minimizing risks of erosion, sedimentation, and contamination compared to new construction. |
| **Resiliency of Existing Vegetation** | Upgrades typically affect areas already adapted to disturbance, so native plants and ecosystems within the ROW may be resilient to impacts, minimizing adverse environmental impacts. |
| **Reduced New Risk of Wildlife Mortality** | Upgrades would occur in existing ROWs and not require extensive new transmission lines avoiding the introduction of new sources of collision risk and electrocution compared to new construction. |
| **Barriers to Movement** | Upgrades would occur in an existing ROW and would not introduce new barriers to movement. Upgrades to access roads may result in improved fish passage if the works include upgrading crossing structures (e.g. culverts). |
| **Fragmentation** | Upgrades would occur in an existing ROW and would not create new fragmentation. |
| **Emergency Access and Response** | Upgrades within existing ROWs benefit from established access routes, facilitating emergency response and reducing the need for new road construction. |
| **EMF Exposure** | EMF exposure levels would typically be unchanged or only marginally affected by upgrades, especially if conductor configurations remain similar. |
| **Reduced Wildfire Risk** | Upgrading aging infrastructure may reduce wildfire risk by replacing deteriorated components, improving clearances, and integrating fire-resistant materials. |
| **Reduced Construction Activities and Duration:** | Upgrading existing infrastructure typically involves a smaller scope of work and shorter construction timeframes, reducing the duration of adverse environmental impacts. |
| **Land Conversion** | Upgrades do not require the conversion of previously undisturbed land to utility use, thereby preserving existing land uses and minimizing habitat fragmentation. |
| **Established Access and Management** | Access routes, maintenance roads, and safety protocols are already in place for existing facilities, reducing the need for new roads or changes to established recreational patterns. |
| **Regulatory and Stakeholder Familiarity** | Recreation managers, landowners, and user groups are often already familiar with the presence and management of the existing facility, which can help with coordination and minimize unanticipated conflicts. |
| **Preservation of Cultural and Historic Resources:** | Since upgrades do not create new ground disturbance, they are typically less likely to impact archaeological or culturally sensitive sites. |
| **Minimal New Visual Impact** | Upgrades maintain existing visual profiles, avoiding new visual intrusions into landscapes or scenic viewsheds. |

As analyzed throughout Chapter 3, upgrades are generally assumed to result in impact determinations that are similar to those identified for the operation and maintenance stage due to the considerations identified in **Table 2.3-1**. While not all considerations would be implemented for every upgrade, their inclusion reflects the potential for reduced environmental impact. These considerations may not be universally applicable and should be considered during the project-specific environmental review, and are dependent on the scope, location, and design of the proposed project.

#### 2.3.3.3 Modification of Existing Transmission Facilities

Applicants could also pursue opportunities to modify existing transmission facilities. Modifying existing transmission facilities is considered to improve efficiency and reliability, and increase the existing system's capacity. According to RCW 80.50.060, modification means a significant change to an electrical transmission facility. The statute explicitly excludes the following activities from this definition:

- Minor improvements, such as the replacement of existing transmission facilities or supporting structures with equivalent facilities or structures

  *This Programmatic EIS categorizes these activities under upgrade.*

- Relocation of existing electrical transmission facilities

  *This Programmatic EIS considers relocation outside the ROW under new construction.*

- Conversion of existing overhead transmission facilities to underground

  *This Programmatic EIS treats this activity as part of new construction.*

- Placement of new or additional conductors, supporting structures, insulators, or their accessories, or replacement of supporting structures already built

  *This Programmatic EIS considers these activities under upgrade.*

Modifying an existing transmission facility can include replacing transmission towers, transformers, substations, switchyards, underground cabling, and ancillary equipment.[15] Modifying existing transmission facilities would not result in new or expanded ROWs unless required for safety, regulatory compliance, or necessary

[15] Secondary systems and devices that support the main transmission infrastructure.

access. Modification of existing transmission facilities could result in new or expanded footprint or disturbance.

Activities associated with modifying an existing transmission facility would vary greatly depending on the proposed action. Modifying existing transmission facilities could include, but is not limited to, the following activities:

- **Right-Size Replacement:** Right-size replacement[16] intends to provide opportunities to modify in-kind replacement of existing transmission facilities to increase their capabilities. Right-size replacements can extend a system's useful life and reduce the need for new transmission facilities. This type of modification would be similar to constructing a new transmission facility in that it intends to address long-term transmission needs, increase the capacity of the existing transmission facility, and is located in the same general route as the existing transmission facility ROWs (18 CFR Part 35). However, the analysis in this Programmatic EIS assumes that right-size replacement modifications would not expand the existing transmission facility's ROWs. For example, reconductoring may require the replacement of some or all of the existing transmission facility structures due to design load requirements imparted by the often larger and heavier conductor. This activity could increase the structure's dimensions, including height, but it would not require new or additional ROW. It is anticipated that right-size replacement could take approximately three to five years to complete (Grid Lab 2024).
- **Modifying:** Modifying existing transmission facilities can include constructing additional transmission towers, transformers, substations, switchyards, underground cabling, and ancillary equipment. It is anticipated that modifying an existing transmission facility could take approximately the same amount of time as new construction. This activity could increase the structure's dimensions, including height, but it would not require new or additional ROW.

**Table 2.3-2** provides considerations on how the modification of an existing transmission facility may result in adverse environmental impacts of lesser magnitude than those for new construction. These considerations are intended to inform planning and stakeholder engagement by highlighting where environmental outcomes may be improved by modifications compared to new construction. These

[16] Under FERC Order No. 1920, right-size replacement refers to modifying or upgrading an existing transmission facility to increase its capacity, thereby extending a system's useful life and reducing the need for new transmission facilities.

considerations do not constitute formal impact determinations, which are addressed in Chapter 3, Affected Environment, Significant Impacts, and Mitigation. For additional context regarding how the modification of existing transmission facilities may affect a specific environmental resource, refer to the corresponding section in Chapter 3.

**Table 2.3-2: Considerations for the Modification of Existing Transmission Facilities Compared to New Construction**

| Consideration | Description |
|---|---|
| **Reduced Ground Disturbance Compared to New Construction** | Modifying existing transmission facilities generally limits new disturbance to areas within the existing ROW or to new areas required for access or safety. This approach can minimize the need for additional land clearing and may reduce adverse environmental impacts compared to new construction. |
| **Utilization of Existing Infrastructure and ROWs** | Modifications also use existing infrastructure and ROWs, but may require new disturbance within these areas or the expansion of ROWs to accommodate safety clearances. This can lead to greater impacts compared to upgrades, but still less than those associated with new construction. |
| **Reduced Erosion and Water Contamination Risk** | Modifications may introduce new disturbance within existing ROWs, increasing risks of erosion and contamination, though impacts are generally less than those of new construction. |
| **Partial Resiliency of Existing Vegetation** | Modifications may affect previously undisturbed areas within the ROW, but areas outside of new disturbance may retain resilience compared to new construction. |
| **Reduced New Risk of Wildlife Mortality** | Modifications may require new transmission lines or expansion of ROW to accommodate safety clearances that could introduce sources of wildlife mortality. However, modifications would generally be sited within existing ROW, reducing the amount of new transmission line and clearing compared to new construction. |
| **Reduced New Barriers to Movement** | Modifications may require the expansion of ROWs, which could exacerbate the existing barrier. However, these barriers are expected to be less impactful than those associated with new construction. |
| **Reduced Fragmentation** | Modifications would predominantly be located in an existing ROW and would be less likely to create new fragmentation. |
| **Emergency Access and Response** | Modifications may require new or widened roads for safety, but still benefit from some existing access routes. This would reduce the extent of new road construction compared to the potential need for road construction associated with new construction. |
| **EMF Exposure** | EMF exposure levels would typically be unchanged or only marginally affected by modifications, especially if conductor configurations remain similar. |
| **Reduced Wildfire Risk** | Modifications may reduce wildfire risk if they include infrastructure improvements. |

| Consideration | Description |
|---|---|
| **Reduced Construction Activities and Duration:** | Modifications may require more extensive work than upgrades, but typically less than new construction, resulting in shorter durations of adverse environmental impact. |
| **Land Conversion** | Modifications may require conversion of some previously undisturbed land to accommodate expanded ROWs, but adverse environmental impacts are anticipated to be less than those associated with new construction. |
| **Established Access and Management** | Modifications may require new or widened roads, but still benefit from some existing access and management protocols. |
| **Regulatory and Stakeholder Familiarity** | Modifications to existing facilities maintain some stakeholder familiarity, though new disturbances may require additional coordination. |
| **Minimal New Visual Impact** | Modifications may have minimal changes to the existing visual profiles. |

The modification of an existing transmission facility may introduce new ground disturbance, additional facility components, or expanded ROWs to accommodate access or safety clearances. Therefore, modifications are anticipated to result in impact determinations similar to those associated with new construction, as analyzed throughout Chapter 3. However, adverse environmental impacts are expected to be of lesser magnitude than those associated with new construction due to the considerations outlined in **Table 2.3-2**. While not all considerations would be implemented for every modification, their inclusion reflects the potential for reduced environmental impact. These considerations may not be universally applicable and should be considered during the project-specific environmental review, and are dependent on the scope, location, and design of the proposed project.

## 2.3.4 Transmission Decommissioning

While decommissioning is acknowledged as a potential stage in the lifecycle of transmission facilities, it is not analyzed in detail in this Programmatic EIS. This is because transmission facilities are rarely decommissioned, and when they are, the specific methods, timing, and environmental conditions are highly site- and project-specific. As such, decommissioning is not included in this programmatic-level analysis.

Future project-specific environmental reviews would address decommissioning impacts, if applicable. As part of that review, the SEPA Lead Agency may defer the environmental analysis of decommissioning to a later point in time under WAC 197-11-060(5), which allows for phased review. This means the SEPA Lead Agency can choose to address decommissioning when more specific and timely information is available, such as closer to the end of a facility's useful life, when decommissioning would be in the planning stage. Alternatively, the SEPA Lead Agency may require a decommissioning analysis during the project-specific environmental review if it determines that the proposal has unique aspects that could result in probable significant adverse environmental impacts during decommissioning.

Transmission facilities are decommissioned following the end of their useful lives, which generally range from 40 to 100 years. Underground transmission facilities typically have a life expectancy closer to 40 years, while overhead transmission facilities can approach 100 years (PRPA 2025). In some cases, transmission facilities may be retained in place for potential future use, system redundancy, or to minimize environmental disturbance associated with removal.

If a transmission facility is no longer needed at the end of its useful life, the applicant would be required to prepare a decommissioning plan and conduct appropriate project-specific environmental analyses, as identified by the SEPA Lead Agency when decommissioning is proposed (see General Measure Gen-8 and Gen-10 in Section 3.1 of Chapter 3, Affected Environment, Significant Impacts, and Mitigation). Furthermore, the SEPA Lead Agency may require financial security as part of a decommissioning plan.

To guide this process, General Measure Gen-8 outlines the requirements and timing for a decommissioning analysis. General Measure Gen-10 provides additional directions, including the need to adapt relevant management plans—such as vegetation management plans—for the decommissioning stage. Together, these measures promote regulatory consistency and help ensure that environmental impacts associated with decommissioning are appropriately assessed and mitigated.

When decommissioning and removal of the transmission facility is required, the decommissioning plan would provide a detailed outline of the following procedures:

- Complete decommissioning-stage environmental studies, as determined by the SEPA Lead Agency (at the time of project application or when decommissioning is proposed). These environmental studies could include socioeconomic studies and environmental assessments to better determine applicable Mitigation Measures.

- Remove project components, including conductors, insulators, hardware, structures, and foundations.
- Recycle or properly dispose of removed materials.
- Restore and revegetate all disturbed areas.