

APPENDIX I ALTERNATIVES ANALYSIS

ALTERNATIVES ANALYSIS

1. INTRODUCTION

TUAL bn, LLC (Applicant), a subsidiary of BrightNight, LLC, plans to construct, own, and operate the Nottingham Battery Energy Storage System (BESS), a lithium-ion battery energy storage facility capable of storing and delivering power to the Portland General Electric Company (PGE) regional transmission grid (Nottingham BESS). The Nottingham BESS is in Washington County, Oregon on Tax Lots 2S120D001200 and 2S120D001100 and will occupy a 12.5-acre site. The Nottingham BESS received its Special Use and Development Review approval from Washington County in May 2025 (Casefile L2400314-SU/D).

The Nottingham BESS will interconnect to PGE's regional transmission grid at the PGE Sherwood Substation, located within the City of Sherwood (City). An approximate 0.5-mile 230 kilovolt (kV) generation-tie line (gen-tie) will connect the Nottingham BESS to the Sherwood Substation; approximately 1,200 feet of the gen-tie is within the City of Sherwood and will be co-located on PGE's existing utility infrastructure. The Applicant is upgrading existing PGE poles to accommodate the approximately 1,200 feet of 230 kV gen-tie along with PGE's existing 115 kV line on up to five utility poles (proposed route). The proposed route for the gen-tie is shown in Figure 1.

This alternatives analysis evaluates whether there are reasonable alternative routes other than the proposed route within the City of Sherwood. The Applicant previously completed an alternatives analysis to inform the siting of Nottingham BESS and the gen-tie route within Washington County. The County's land use approval evaluated alternatives and approved the proposed route shown in Figure 1. Accordingly, this alternatives analysis only addresses the portion of the gen-tie located within the City of Sherwood from the point the gen-tie enters the City limits to its interconnection at the PGE Sherwood Substation.

The PGE Sherwood Substation is designated critical infrastructure with a capacity rating of 320 megavolt-ampere; the substation operates at a transmission voltage level of 230/115 kV. The term "critical infrastructure" refers to machinery, facilities, and information systems that enable critical functions of governance, public health, and the economy¹. A substation is critical infrastructure because it is the vital link for voltage transformation and power routing across the electrical grid. Substations are needed to safely transmit power to customers; substations also regulate power flow to prevent system overloads and use automatic breakers to stop local issues from becoming widespread power outages.

2. SUMMARY OF SITING CRITERIA

The Applicant identified five siting criteria to evaluate potential alternative gen-tie routes within the City of Sherwood. PGE requires the gen-tie to interconnect at a defined point within the

¹ The 2001 Critical Infrastructures Protection Act defines critical infrastructure as "systems and assets, whether physical or virtual, so vital to the United States that the incapacity or destruction of such systems and assets would have a depilating impact on security, national economic security, national public health or safety, or any combination of those matters."

northwest quadrant of the PGE Sherwood Substation, inside the substation perimeter fence (Figure 1). Because PGE has established this point of interconnection, it is a fixed endpoint and is not a variable in the Applicant's route analysis. PGE requires the gen-tie to connect to Bus V66 at Sherwood Substation. This Bus V66 connection point is currently unused and provides a straightforward route that minimizes 230 kV transmission line crossings between the interconnection point and the generating facility. Accordingly, to be considered feasible, an alternative route must provide a continuous alignment from the point at which the gen-tie leaves Washington County to the required point of interconnection.

Siting criteria are factors that are developed and then used to select the best physical location for placing utility infrastructure. The Applicant developed the siting criteria listed below to evaluate potential gen-tie routes and identify a route that is reasonable and feasible considering the project's physical, engineering, operational, property, and environmental constraints. Each siting criterion is defined and subsequently analyzed further in the sections below.

1. Least impact to existing PGE infrastructure
2. Least impact to future PGE infrastructure
3. Technical feasibility
4. Site control
5. Minimal environmental impacts

The siting criteria are considered collectively, rather than in isolation. An alternative route need not perform best under every criterion; however, on balance, must satisfy each siting criterion to a degree that provides a practicable means of constructing, interconnecting, operating, and maintaining the gen-tie.

The Applicant applied the five siting criteria to potential routes within the City of Sherwood, resulting in the proposed route and eliminating alternative routes. The proposed route is the only technically feasible route under the siting criteria, as described below.

2.1 LEAST IMPACT TO EXISTING PGE INFRASTRUCTURE

This criterion was defined to identify a route that would have the least amount of impact on existing critical infrastructure (i.e., the Sherwood Substation and associated existing transmission lines). This siting criterion was considered to protect the reliability of existing PGE infrastructure that is currently used to deliver safe and reliable electricity to customers across southeast Washington County.

The proposed route minimizes impacts to existing PGE infrastructure by using an established PGE utility alignment and replacing existing wood poles with steel monopoles capable of supporting both the existing 115 kV line and the new 230 kV line. Approximately 1,200 feet of the existing 115 kV line would be re-strung on the replacement structures rather than relocated to a new corridor.

This configuration allows the new 230 kV line to be integrated with existing PGE infrastructure while limiting the need to establish separate transmission structures or a new parallel alignment.

The proposed route also provides a direct approach to the required point of interconnection within the Sherwood Substation shown in Figure 1.

Alternative routes that depart from the existing alignment would require additional facilities and will introduce new crossings, clearance requirements, structure locations, or other conflicts with PGE's existing system. Undergrounding the gen-tie would not eliminate impacts to existing PGE infrastructure. An underground 230 kV line would require a trench or duct-bank system, vaults, transition facilities (dead-end poles and risers), and associated access, all of which would need to be located in relation to existing overhead and underground PGE facilities and infrastructure. Underground construction could create additional conflicts involving utility crossings, required separation, existing foundations, access, and existing or planned subsurface infrastructure. Additionally, emergency repairs to an underground line would require excavation to repair, which would potentially cause prolonged outages with the potential to impact normal substation operations and other utility services in the vicinity of Southwest Langer Farms Parkway. Lastly, because the existing 115 kV line would remain overhead and continue to require support structures, undergrounding the new 230 kV line would not eliminate the need to make future upgrades to the existing 115 kV overhead system. The underground alignment would still require relocation or reconstruction of portions of the existing 115 kV facilities to accommodate crossings, clearances, transition structures, and access. Alternative overhead routes and an alternative underground route were ruled out because these options fail to preserve or minimize impacts to existing PGE infrastructure. Accordingly, the proposed route best satisfies this criterion because it incorporates the new gen-tie into an existing utility alignment while minimizing unnecessary modifications and conflicts with existing PGE infrastructure, thus minimizing impacts to the system.

2.2 LEAST IMPACT TO FUTURE PGE INFRASTRUCTURE

This criterion was defined to identify a route that would have the least amount of impact on future critical infrastructure (i.e., any upgrades to the Sherwood Substation and associated transmission lines that may occur in the future). This criterion was considered to protect the future reliability of PGE infrastructure and opportunities to grow and expand that infrastructure to meet demand. The needs of the future must be considered because energy use is increasing, energy demand patterns are changing, and threats to energy infrastructure are increasing (e.g., storms, heatwaves and wildfires, cyber and physical security threats, and natural disasters).

Existing PGE infrastructure is shown on Figure 1 and includes the Sherwood Substation and several 115 kV and 230 kV transmission lines. This is critical infrastructure which is required to safely transmit power to the electric grid which serves the City of Sherwood and surrounding areas. The proposed route minimizes impacts to future PGE infrastructure by consolidating the existing 115 kV and new 230 kV lines within an established utility alignment. Replacing the existing poles with steel monopoles capable of accommodating both lines avoid the need to create a new, separate corridor with new poles that could constrain PGE's future use of surrounding areas.

Undergrounding would also occupy space that could affect future PGE infrastructure. Although an underground line would not occupy the same above-ground space as the proposed 230 kV line, the underground cable corridor, vaults, transition facilities, required separation areas, and permanent access requirements would encumber subsurface and surface areas. Those facilities could restrict future excavation, foundations, utility crossings, structure placement, or expansion of facilities associated with the Sherwood Substation. Thus, undergrounding does not necessarily preserve the corridor for future PGE use and could instead introduce a separate set of constraints on future facilities.

Additionally, once constructed, maintenance and repair to overhead lines is significantly less impactful to the surroundings compared to maintenance and repair to underground lines. Repairing an underground line requires excavating, results in down time, and takes longer compared to repairing an overhead line. Thus, the overhead option will be less impactful on future PGE infrastructure because potential damage to an overhead line will be faster to repair, will not require excavation, and will result in minimal downtime.

The proposed route best satisfies this criterion because it consolidates the existing and proposed transmission facilities within an established overhead alignment, minimizes the need to encumber additional areas with separate infrastructure, and will be less impactful to surroundings to maintain and repair.

2.3 TECHNICAL FEASIBILITY

This criterion was defined to identify a route that can realistically be built to meet the technical needs of the project while using current technology and resources. This criterion was considered to identify a route that can be physically built, connected, and operated using available engineering methods and considering site conditions.

The proposed route provides a direct and technically feasible means of connecting the new 230 kV line to PGE's required point of interconnection at the Sherwood Substation. The replacement steel monopoles are designed to accommodate the existing 115 kV line, new 230 kV line, and associated communications facilities while satisfying applicable structural, electrical clearance, safety, reliability, and operational requirements.

The Applicant previously considered an alternative route along the Oregon Department of Transportation right-of-way along Southwest Pacific Highway. However, that route was ruled out as technically infeasible because there is not sufficient space within the right-of-way, either below ground or overhead, to add additional utility infrastructure.

Applicant also considered installation of shorter poles that would only support the 230 kV gen-tie line, but this option was ruled out because of pinch points along the route and limited clearance spacing within the existing utility corridor. Due to spacing constraints and the presence of existing utility infrastructure, it is technically infeasible to add an additional utility line between the City limits and the point of interconnection unless it uses a shared pole design with PGE's existing 115 kV line.

Undergrounding a 230 kV transmission line presents materially different technical requirements. An underground configuration would require high-voltage cable systems, trenches or duct banks, splice vaults, transition facilities, appropriate cable separation and minimum bend radii, thermal management, and sufficient space for installation, maintenance, repair, and replacement. It also would need to accommodate existing utilities and transition into PGE's fixed interconnection point within the Sherwood Substation. Additional project-specific constraints that make undergrounding the gen-tie impracticable include:

- An underground line would need to cross under Southwest Langer Farms Parkway (this road is between the BESS and the Sherwood Substation) where there is an existing public utilities easement, which includes public utilities such as broadband internet. Because of the presence of existing utilities, cathodic protection would need to be addressed. The underground corridor would also need to support emergency excavation which would have the potential to impact normal operation of the Sherwood Substation and other public utilities in the vicinity.
- The nearby Meadowlark BESS project has proposed an underground gen-tie and because of the interconnection positions of the Meadowlark and Nottingham BESS projects, if the Nottingham gen-tie were also underground, the two gen-tie lines would have to cross as shown in Figure 1, which would effectively de-rate both BESS projects. When two underground utility lines cross, physical proximity between the lines reduces their performance and increases the impact of potential outages if there was a localized disruption in the area (one disruption would cause multiple outages). Putting both lines underground undermines the economics and viability of both projects and increases risks to grid reliability.
- The route of an underground line would have to go underneath the northwest corner of the Sherwood Substation, which is not feasible given the above-ground infrastructure and due to PGE's operating and maintenance practices.

These requirements are particularly relevant because undergrounding the new 230 kV line would not simply substitute underground cable for the proposed overhead conductor. It would require a materially different system and additional facilities while the existing 115 kV infrastructure must still be accommodated and subject to upgrades in the future; the shared pole design future proofs the design.

Accordingly, the proposed overhead route best satisfies the technical feasibility criterion because it uses an established utility alignment, accommodates both voltage systems on common replacement structures, requires no new additional poles, and provides a direct and practicable connection to PGE's required interconnection point.

2.4 SITE CONTROL

Site control is the legal authority to occupy or develop land. This criterion was evaluated to identify a route for which the Applicant has the legal right to permit and construct the gen-tie. The proposed route best satisfies the site control criterion because it is on property owned by PGE. Because the route uses PGE-owned property to reach the Sherwood Substation, it minimizes the need to obtain new easements, rights-of-way, or other property interests from third-party



landowners. The proposed route therefore provides a direct and practicable means of securing the property rights and access necessary to construct, operate, and maintain the gen-tie.

Undergrounding the gen-tie would not provide a site control advantage over the proposed overhead route. Although an underground alignment could also potentially be located on PGE-owned property, it would require sufficient property for the underground cable corridor and associated facilities, including trenches or duct banks, vaults, transition facilities, and construction and maintenance access. Those facilities could require a larger or different area of PGE property and could restrict PGE's use of the affected surface and subsurface areas for existing or future utility facilities.

Accordingly, the proposed overhead route best satisfies the site control criterion because it uses PGE-owned property and an existing utility alignment while minimizing additional property encumbrances and competing demands on PGE property. Undergrounding the gen-tie would not improve site control and could impose additional restrictions on the use of PGE's property.

2.5 MINIMAL ENVIRONMENTAL IMPACTS

Environmental impacts are the effects of a project on the natural world including air, water, soil, plants, and wildlife. This criterion was defined to identify the route that would have the least impact on the environment. To evaluate the potential environmental impact of different routes, Applicant considered the length of the gen-tie, the presence of existing utility infrastructure, and the installation method (overhead versus underground) and considered potential impacts to air quality, noise, habitat, water, and wildlife.

2.5.1 LENGTH OF GEN-TIE

All else being equal, a shorter gen-tie route would generally result in fewer environmental impacts than a longer route. A longer gen-tie route requires a larger construction area and generally more construction activity, resulting in greater potential for temporary noise, traffic, dust, and air quality impacts. A longer route also increases the area in which soil, vegetation, and habitat may be disturbed and, for an overhead route, increases the extent of above-ground facilities.

The eastern edge of the Sherwood Substation is approximately 200 feet from the Sherwood City limit and therefore represents the shortest gen-tie pathway within City limits to the substation. PGE, however, has no available interconnection capacity on the eastern side of the substation. Because PGE requires the gen-tie to interconnect at the defined point in the northwestern portion of the substation, an alternative approaching from the east would need to continue through the PGE utility corridor to reach that fixed interconnection point.

The proposed route provides the shortest practicable route between the City limit and PGE's required point of interconnection. It therefore minimizes the length of gen-tie facilities and the associated construction and environmental disturbance within the City.

2.6 USE AND SHARING OF EXISTING UTILITY INFRASTRUCTURE

The proposed route follows the alignment of existing PGE transmission facilities and replaces up to five existing wood utility poles with steel monopoles at the vicinity of existing pole locations. The



replacement structures would support both the new 230 kV gen-tie serving the BESS and the re-strung 115 kV PGE transmission line serving the regional grid. This shared configuration avoids the need for separate structures for the two transmission lines and concentrates new ground disturbance at or near locations already disturbed by existing utility facilities.

Alternative routes within the PGE utility corridor that cannot similarly use existing pole locations or share structures would require additional or different structure locations and associated ground disturbance. Thus, the proposed route minimizes environmental impacts by making use of existing infrastructure locations and consolidating the 115 kV and 230 kV lines on common structures.

2.6.1 INSTALLATION METHOD

The Applicant also considered the differing environmental impacts of overhead and underground construction, including impacts associated with construction, operation, maintenance, and repair over the operating life of the gen-tie. Neither installation method eliminates environmental impacts; rather, the nature, extent, and timing of those impacts differ.

Underground construction generally results in greater initial ground disturbance because excavation is required along much of the alignment for trenches or duct banks and associated infrastructure. This construction can result in greater soil and vegetation disturbance and additional temporary noise, dust, traffic, and construction-related air emissions. For the proposed overhead route, ground disturbance would generally be concentrated at structure locations and access areas. Applicant would replace up to five existing utility poles with new steel monopoles at previously disturbed locations, thereby limiting the extent of new ground disturbance.

Overhead and underground facilities also have different potential effects on wildlife. Undergrounding would eliminate the potential for birds to collide with the new 230 kV conductors. However, the proposed route is located within an existing overhead utility corridor where transmission infrastructure is already present. Birds and other wildlife using the area are therefore already exposed and habituated to overhead utility infrastructure within the corridor. The proposed work would not introduce overhead transmission infrastructure into an area where such infrastructure is absent. Instead, it would replace existing poles and co-locate the new 230 kV gen-tie and existing 115 kV transmission line on common structures. While these new common structures will increase the height of lines within the corridor, potential collision risk will be minimized through the installation of bird flight diverters on the conductors to increase line visibility to birds. Appendix H, *PGE Utility Facility Replacement and Interconnection Avian Collision Risk Assessment* provides a qualitative assessment of collision risk associated with the proposed route. Accordingly, while the new conductors may incrementally change the existing collision environment, the proposed route would result in substantially less change than construction of a new overhead utility corridor in an area without existing transmission infrastructure.

The installation methods also differ with respect to potential environmental impacts associated with long-term maintenance and repair. Overhead infrastructure is readily accessible for inspection, allowing damaged or deteriorating components to be identified and accessed without excavation. Maintenance and repairs can generally be conducted at the affected structure or



conductor. Because the proposed route is located within an existing PGE utility corridor, established utility access can also be used for inspection, maintenance, and repair.

Compared to overhead infrastructure, underground infrastructure is less accessible. Locating and repairing damage to an underground cable system can be more complicated and may require access through vaults or excavation to reach the affected cable. Such repairs can require construction equipment, soil disturbance, vegetation removal, and subsequent restoration. Major repairs or eventual replacement could result in renewed ground disturbance along portions of the underground alignment. Thus, although underground infrastructure avoids above-ground conductor maintenance and wildlife collision risks, repairs can result in more intensive ground disturbance when they are required.

Applicant also recognizes that undergrounding the gen-tie would reduce the visual effects associated with the new 230 kV conductors. That benefit is reduced in this location, however, because the proposed route is already occupied by overhead transmission infrastructure. The relevant comparison is therefore not between an overhead line and an otherwise undeveloped landscape, but between modifications to an existing overhead utility corridor and construction of an underground system within that same corridor.

On balance, the proposed overhead installation method minimizes environmental impacts by using an existing utility corridor, concentrating ground disturbance at previously disturbed pole locations, sharing structures between the 115 kV and 230 kV lines, and allowing maintenance and repairs to occur without the excavation that may be necessary for underground installation. Although undergrounding the gen-tie would eliminate the incremental collision risk associated with the new conductors and reduce their visual effects, those benefits are less significant in an established overhead utility corridor where birds and other wildlife are already habituated to utility infrastructure. Moreover, as described in the Technical Feasibility section, undergrounding is not technically feasible for this work. The proposed overhead configuration therefore provides the most reasonable and feasible installation method when the environmental effects of construction, operation, maintenance, and repair are considered together.

3. CONCLUSION

This alternatives analysis evaluated potential routes within the City of Sherwood between the City limit and the point of interconnection at PGE's Sherwood Substation (Figure 1). Considered collectively, the five siting criteria demonstrate that the proposed route is the most reasonable and feasible alternative for the gen-tie within the City of Sherwood. The proposed route minimizes impacts to existing PGE infrastructure by using an existing utility alignment and replacing existing poles with structures capable of supporting both the existing 115 kV line and new 230 kV gen-tie. It minimizes impacts to future PGE infrastructure by consolidating the transmission infrastructure within the existing alignment and avoiding additional infrastructure that could constrain PGE's future use of its property. The route is technically feasible because it provides a direct and constructible means of accommodating both transmission lines and reaching PGE's fixed point of interconnection at the Sherwood Substation. It provides the greatest certainty of site control because the route is located on PGE-owned property and does not require acquisition of property



rights from third-party landowners. Finally, it minimizes environmental impacts by providing the shortest practicable route to the required interconnection point, using previously disturbed locations, sharing structures between the 115 kV and 230 kV lines, and limiting ground disturbance associated with construction, maintenance, and repair.

The Applicant also considered undergrounding the gen-tie under each of the five siting criteria. Although undergrounding the gen-tie would reduce certain above-ground visual and wildlife impacts, it would require separate underground infrastructure, greater excavation and ground disturbance, additional maintenance and repair considerations, and could constrain the use of PGE property for existing and future utility infrastructure. Most importantly, as described in the Technical Feasibility section, undergrounding the gen-tie is not technically feasible for this work. Accordingly, undergrounding does not constitute a reasonable and feasible alternative to the proposed overhead route.

Considering the five siting criteria collectively, the proposed route makes the most efficient use of existing PGE infrastructure and PGE-owned property and provides a direct and technically feasible connection to PGE's required point of interconnection at the Sherwood Substation. This configuration minimizes new infrastructure conflicts, accommodates PGE's existing and future system needs, is technically feasible, reduces the need for additional property rights, and minimizes environmental disturbance compared with establishing a new utility alignment. Applicant therefore determined that the proposed route is the most reasonable and feasible alternative within the City of Sherwood.



Legend

- Sherwood City Limits
- Existing Transmission Lines
- Meadowlark Gen-Tie
- Existing Pole
- Replacement Pole
- Point of Interconnection
- Point where gen-tie enters City of Sherwood
- Gen-Tie Route - ruled out as not feasible
- Proposed Route: Existing 115 kV infrastructure to be updated to include 230 kV
- Proposed Utility Infrastructure (Outside City Limits)

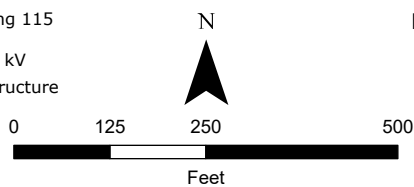


Figure 1
Alternatives Analysis
 ERM Inc on behalf of TUAL bn LLC
 City of Sherwood, OR

