5. FACILITY DESIGN PLAN

The project components were selected to optimize energy production while minimizing negative environmental effects and complying with provincial and municipal regulations. The project's design is meant to leverage these project components capabilities to design, construct, and operate the most efficient wind farm possible. As described in **Section 4.1** of this report, wind farm design is determined by a complex series of environmental, regulatory, economic, and technical factors. The information in this section provides additional information on the design plan for the project. For further reference, the site plan can be found in **Figure 2a**.

The project will consist of the major components summarized in **Table 4**.

Table 4: General Design Parameters [1]

Wind Turbines	49 Wind Turbines 31 GE 1.6 MW Units and 18 GE 2.75 MW Units
Wind Turbine Foundations	Approx 18m x 18m x 3m Spread Footing[2]
Underground Collector System	159 km Underground Cable w/ limited HDD
Power Line (Overhead & Underground)	Option 1 (69 kV) - 36.9 km Option 2 (230 kV) - 47 km
Project Substation	1.3 ha
Interconnect Substation	Option 1 (69 kV) - 0.6 ha Option 2 (230 kV) - 0.7 ha
Operations and Maintenance Building	Approxiamtly 550 m^2 (Building Only)
Access Roads	Approxiamtly 24 km

[1] Actual dimensions and quantities are subject to final design and engineering
[2] Actual foundation size subject to final design and site geotechnical characteristics. Soil reinforcement (piles) may be required at some wind turbine sites

5.1 Design Overview

The project will include 31 GE 1.6 MW and 18 GE 2.75 MW wind turbine generators with a total installed nameplate capacity of 99.1 MW and an expected energy generation of 91.4 MW[3]. According to Part II, Section 4 of *Ontario Regulation 359/09,* the Project is a Class 4 Wind Facility, which is a wind farm facility:

- At a location where no part of a wind turbine is located in direct contact with surface water other than in a wetland
- The nameplate capacity of the facility is greater than 50 kW
- The greatest sound power level is greater than 102 dBA.

5.2 Wind Turbine Generators

The GE 1.6 MW and GE 2.75 MW wind turbines to be used in the project are a three-blade, upwind, horizontal axis wind turbine with a rotor diameter of 100 metres and 103 metres, respectively. The turbine's rotor and nacelle are mounted on top of a tubular steel tower with a hub height of 80 metres and 85 metres, respectively. The nacelle houses the generator, inverter, gearbox, bearings, couplings, rotor and auxiliary equipment. The nacelle is constructed of fiberglass, lined with sound insulating foam and has lighting and ventilation to allow work to be conducted inside.

Figure 5: GE 1.6 Series Nacelle

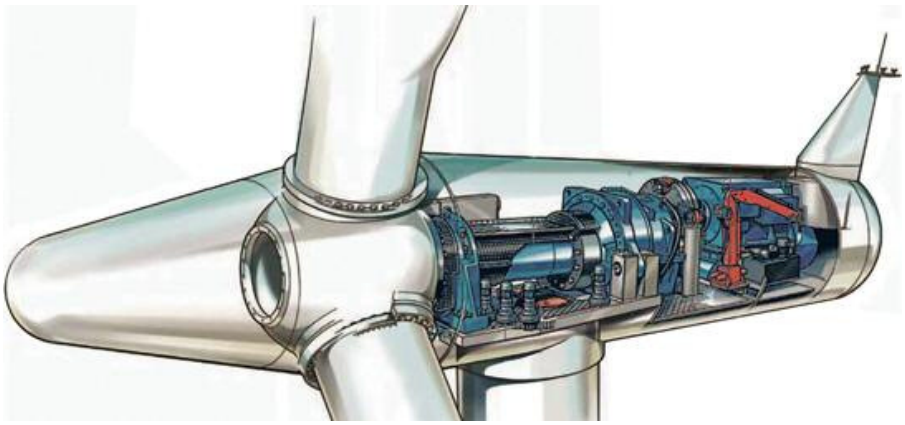
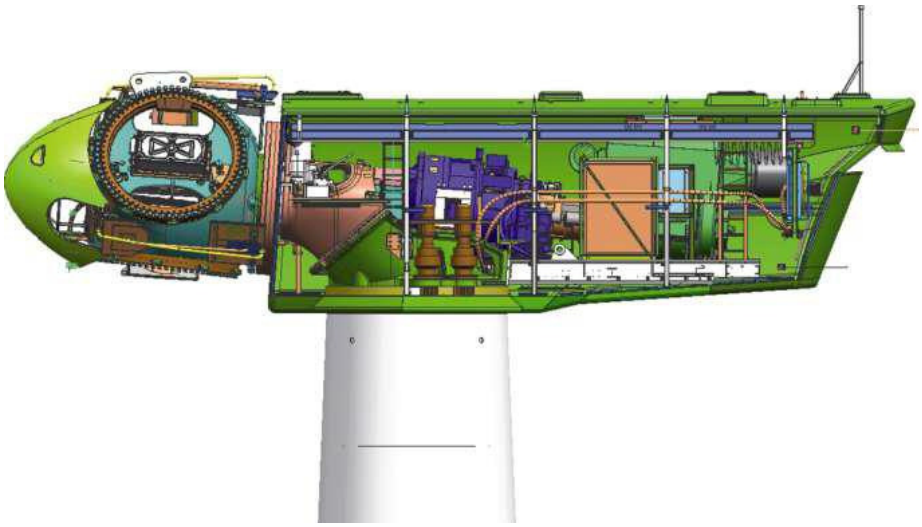


Figure 6: GE 2.75 Series Nacelle



The wind turbines will be configured for cold weather operation and utilize electric drive pitch control. The wind turbines use active yaw control to keep the blades pointed into the wind. The turbines are designed to operate at a variable speed. The GE 1.6 MW wind turbine uses a doubly fed asynchronous generator (DFIG) with a partial power converter system. The GE 2.75 MW turbines use a permanent magnet (PM) generator with power electronic converter.

The wind turbine's blades are mounted on a hub which is connected to the main drive shaft within the nacelle. Each turbine tower consists of three (GE 1.6) or four (GE 2.75) stacked segments that are mounted on a concrete foundation. Details for each model's turbine foundation are provided in **Section 5.3.** Please refer to the Wind Turbine Specifications Report for more detailed information on the wind turbines proposed for the project. Conceptual drawings of the foundations are provided in **Appendix E**. Please refer back to **Table 3**, which outlines the wind turbines' general characterisitcs.

The wind turbines will be lit at night for air safety according to Transport Canada (TC) standards and designated lighting plan. NavCanada has reviewed the proposed site plan and has provided a letter indicating that NavCanada has no objection to the site plan.

The wind turbines have been sited to minimize environmental impacts and noise emissions at sensitive receptors. Mitigation and monitoring measures during the operations phase are

discussed in **Section 8**, the Environmental Effects Monitoring Plan, and the Environmental Impact Study Report. Refer to the Construction Plan Report for further information about mitigation and monitoring measures related to turbine construction and installation activities.

5.3 Wind Turbine Foundations

Depending on soil conditions, the size of the excavation for the turbine will be approximately 3 metres deep and up to 18 metres in diameter. Each turbine type will be a spread footing type, which is essentially a gravity foundation that relies upon soil overburden and concrete to provide sufficient weight to resist overturning at extreme wind speeds. It has been confirmed through preliminary geotechnical studies that this type of foundation is appropriate with the soils found at the wind farm site. See the **Appendix E** for conceptual drawings of project components.

Geotechnical studies were completed and more information can be found in the Construction Plan Report. All turbines are expected to have a typical spread footing type of foundation and will require a depth of excavation of 2.5 metres to 3 metres, or more, to provide adequate frost protection. Some foundations may require additional foundation support which will be determined by soil and water conditions. Conceptual drawings of the foundations are provided in **Appendix E**.

5.4 Underground Collector System

A pad mount transformer will be located adjacent to the base of each of the wind turbines to transform the electricity from 690 V (1.6 MW unit) or 690 V (2.75 MW Unit) to 34.5 kV for transmission through the collection system. The underground collector system has been designed to follows access roads and road allowances where possible and also to transect participating landowner parcels to reduce the length of the collector lines. Collector lines located along municipal or county roads will be located inside the right-of-way. **Table 5** provides a summary of the collector system design.

Table 5: Electrical Collector System Summary

34.5 kV Underground Collector System Line Length	Approximately 50 km in length with 3 phases for a total cable length of approximately 151 km
Horizontal Directional Drilling (HDD) under roadways or wetlands	Refer to the Construction Plan Report

For further descriptions of these crossings and the HDD method refer to the Construction Plan Report, Water Assessment Report and Water Body Report.

5.5 Power Line (Grid Interconnection)

DWP is currently seeking permitting on two options to connect the project to the provincial grid however, only one option will be constructed. The options include:

- A dual-circuit 69 kV power line installed on top of Hydro One poles within the public right-of-way under a Joint Use Agreement with Hydro One and interconnecting to Hydro One's existing "E9V" 230 kV transmission line, or
- A single, 230 kV power line running along a private easement and former rail right-of-way and interconnecting to the Orangeville TS 230 kV BUS.

Additional details on the design, construction methodology, maintenance, and decommissioning of both power line options can be found in the Construction Plan Report and Decommissioning Plan Report. Additional information on the proposed power line options can be found in **Section 4.3** of this Report and **Tables 6** and **7** provide summaries of the design characteristics for each power line option. Conceptual drawings of the project substation and interconnect substation for the 69 kV power line option can be found in **Appendix E**. Conceptual drawings of the project substation and interconnect substation for the 230 kV power line option can be found in **Appendix E.**

Table 6: Power Line Design Characteristics – Dual-Circuit 69 kV Power Line (Option 1)

Project Substation (Melancthon, Ontario)	1.2 ha on private land 34.5 kV - 69 kV Main Transformer
Dual-Circuit 69 kV Power Line	36.9 km, dual-circuit 69 kV power line installed on top of Hydro One power poles under Joint Use Agreement. Poles to be installed at 45 m spacing. Pole heights to range from 35' to 80' with majority of new poles 70' or higher. Subject to final design.
Point of Interconnect Substation (Mono, Ontario)	0.6 ha on private land 69 kV to 230 kV Main Transformer

Table 7: Power Line Design Characteristics – Single-Circuit 230 kV Power Line (Option 2)	
Project Substation (Melancthon, Ontario)	1.2 ha on private land 34.5 kV to 230 kV Main Transformer
230 kV Power Line	47 km, single circuit, 230 kV wood pole line installed along a private easement and former rail corridor. Poles to be installed at 90 m to 150 m spacing. Pole heights to range from 70' to 85'. Subject to detailed design.
Switching Substation (Amaranth, Ontario)	0.7 ha on private land Switch & circuit breaker

Please Note: The point of interconnect substation for the 69 kV power line option has intentionally been located in a non-significant woodlot to reduce noise emissions and visual impact on neighboring receptors. Some clearing of trees will be required, in addition to leveling and grading the footprint and access roads at each substation. These activities are further discussed in the Construction Plan Report.

5.6 Transformer and Spill Containment System

Under power line Option 1, the project substation would use a 34.5 kV to 69 kV step-up power transformer and under power line Option 2, the project substation would use a 34.5 kV to 230 kV step-up power transformer.

Regardless of the power line option that is selected, the main transformer(s) will be placed into a spill containment system to capture and control any oil leaks or hazardous discharge from the transformer(s). The spill containment system will consist of an impervious concrete basin, oil water separator (OWS), pump-out sump, and an oil absorbing material. The spill containment system will have a minimum volume equal to the volume of transformer oil and lubricants plus the volume equivalent to providing minimum 24-hour duration, 25-year return storm capacity for the storm water drainage area around the transformer under normal operating conditions. Additional oil containment materials and clean-up kits will be maintained on-site at the spill containment center and wind farm staff will be trained in their use and emergency procedures.

Monitoring of the spill containment system will consist of monthly inspections of the spill containment system's physical condition and operating performance. The system will be designed and maintained to ensure that the concentration of any oil or grease (effluent matter) does not exceed a maximum concentration of 15 mg/L. In the event of any exceedance of this concentration, DWP will notify the MOE and County and Municipal authorities and take immediate action to identify the cause of the exceedance and to prevent further exceedances. DWP will also monitor the system's sewage works including quarterly sampling/recording of

effluent (oil and grease) discharge. Records of the systems performance and monitoring plan will be kept on site at the O&M facility.

A comprehensive emergency response plan will be implemented as part of the wind farm's operating procedures and in the event of a spill, municipal, county, and provincial governments will be notified, and updated on an ongoing basis, as part of the containment and remediation process.

5.7 Access Roads

Access roads are required in order to deliver the wind turbine components and allow operation and maintenance of the wind turbines. Wherever possible, DWP will use existing roadways and accesses and upgrade existing roads where necessary to minimize environmental impacts. Access roads will be approximately 5 metres wide during operations (reduced from 20 metres temporarily during construction) to accommodate maintenance vehicles and heavy equipment for larger repairs/replacements.

Table 8: Access Road Infrastructure Summary

Length of wind turbine access roads	Approximately 26.2 km
Watercourse Crossings/ Culverts	1

One new watercourse crossing (crossing 12 in the Water Body Report) will be required for the turbine access roads between T35 and T36 (plus two municipal drain crossings, near T45 and T25). Further, there may be a need to upgrade existing road-watercourse crossings to be able to support trucks and other heavy equipment. The culvert will remain during the operations phase. DWP is currently undertaking an assessment of municipal road water crossings to assess the suitability of culverts at existing water crossing locations.

Please refer to **Figure 2a**, the Wind Farm Site Plan, for routing of access roads. For further information about technical details, environmental effects, mitigation and monitoring related to development of access roads; please refer to the Construction Plan Report and the Water Assessment Report.

5.8 Operations and Maintenance Building

An O&M building will be constructed and used for the duration of the operational phase of the project. From this building the wind facility will be operated, monitored and controlled 24 hours per day. The footprint of the O&M building will be approximately 2 hectares and would include a building, parking and a small laydown area. It will provide office and storage space and a workspace for maintenance of equipment and serve as the Project Office once the Project is operational. The building will also have a small kitchen and washroom facilities. The building will have a separate containment area for the storage of spent oil and lubricants until they are transported off-site.

It is expected eight to ten full-time and five part-time employees will work from the O&M building. Adjacent to the building there would be a gravel parking area for visitors as well as and employees. Access to the building will be from County Road 21.

Please refer to **Appendix E** for conceptual drawings of the O&M building.

5.9 Process Features

5.9.1 Water Taking

A water well will be required to provide a potable water source for the O&M Building. The draw of this well will be less than 50,000 litres/day therefore a MOE Permit to Take Water is not necessary.

5.9.2 Sewage

A septic system, with a minimum 3,000 litre tank and small field bed, will be constructed to service the washroom facilities in the O&M building. The septic tank will likely be constructed of concrete or fiberglass and will conform to industry standards and local building codes. See **Section 6.6.2** for a description of septic system operation and maintenance.

5.9.3 Stormwater Management

No stormwater management or sediment control is required during the operation and maintenance phase of the facility; therefore, no stormwater equipment is required. Stormwater management measures and equipment related to construction and installation activities are

discussed in the *Construction Plan Report*. A concrete spill containment system will be installed to capture any leaks from the transformer(s) as previously described in **Section 5.5**.

The increase in runoff coefficient over the project location (+120 metres) is estimated at 5.5%, therefore quantity control is not proposed. Minor flow attenuation may be provided via swales.

The extensive use of surface drainage allows for removal of suspended solids during flow over grassed areas. Although the majority of the site poses no increased loading of Total Suspended Solids (TSS) or other pollutants (concrete pads and rooftops are not considered to increase TSS loading), spill containment design features for the substation have been considered as described in **Section 5.5**.

5.9.4 Waste Management

Project operations will result in the generation of solid waste (i.e., office waste, materials packaging, used mechanical parts, etc.) and used turbine lubricant and oils. Waste will be temporarily stored in a secured area of the O&M building. Refer to **Section 6.6.4** for a description of waste management during project operations.

5.9.5 Contaminants to Air

Emissions from motorized vehicles are discussed in Section 7.6.5 of the Facility Operations Plan.

6. FACILITY OPERATIONS PLAN

6.1 Turbine Operation and Monitoring

The wind turbines will be operated in a manner consistent with nationally recognized standards for operation of wind turbine facilities in Canada.

6.2 Site Supervision and Training

A staff of eight to ten full-time and up to five part-time employees will operate the wind farm from the O&M building These maintenance personnel will be trained in wind farm maintenance, safety procedures, first-aid, lock-out/tag-out procedures, high-voltage maintenance, and other areas of wind farm maintenance. Safety and technical training of staff