Transmission Developers Inc.

Champlain Hudson Power Express Project

Exhibit E-2

Other Facilities

EXHIBIT E-2
OTHER FACILITIES

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FIGURES

EXHIBIT E-2: OTHER FACILITIES

E-2.1 CONVERTER STATION AND AC INTERCONNECTION

Champlain Hudson Power Express, Inc. (CHPEI) proposes to construct, operate, and maintain a new 2,000 megawatt (MW) underwater/underground high-voltage direct current (HVDC) transmission system to be known as the Champlain Hudson Power Express Project (the Project). Two HVDC converter stations are required to convert the HVDC current flowing on the Project into high-voltage alternating current (HVAC) for use in the AC distribution systems of the Consolidated Edison Company of New York, Inc. (Con Edison) in New York City and United Illuminating Company (UI) in Connecticut. The converter stations will be installed in Yonkers, New York and in Bridgeport, Connecticut. Each of the HVDC converter stations will have nominal ratings of 1,000 MW and will be of a "compact type" (Siemens HVDC Plus™ or ABB HVDC Light™). The approximate dimensions of each converter station facility are approximately 525 feet by 230 feet and 81 feet tall. An example configuration of the proposed converter stations is shown below; more detailed typicals will be provided with the supplemental information to be submitted in July 2010. Construction drawings of the proposed converter station will be submitted as part of the Environmental Management & Construction Plan (EM&CP).

Hydro-Québec (HQ) will own two 1,000 MW HVDC converter stations in Quebec. These converter stations will be sited close to HQ's existing 735/315 kilovolt (kV) AC substation. There will be a double circuit, three-phase 345 kV AC interconnection from a take-off structure at the Hertel substation to a take-off structure in the HVDC converter station HVAC switchyards. From the Hertel converter stations, HVDC transmission cables owned by HQ, will traverse an approximate 35-mile route south to the international border between the United States and Canada, at which point the HQ owned cables will connect to four HVDC underwater cables of the Project.

Two of the four HVDC underwater cables (one bipole) will terminate 319 miles south of the international border at the 1,000 MW HVDC converter station located in Yonkers, New York. Figure E-2-1 represents an example of the type of converter station proposed for this site. The location of the Yonkers converter station is shown on Figures provided in Exhibit 2. These cables will be routed via Horizontal Directional Drill (HDD) from the Hudson River to the new converter station facility. From there, the Yonkers converter station will be connected to approximately 6.6 miles of double-circuit 345 kV AC cable which will terminate at a new CHPEI step-down 345/138 kV AC transformer substation located adjacent to and tied into the existing Con Edison Sherman Creek substation, near the intersection of West 201st Street and 9th Avenue, in the Borough of Manhattan. The proposed Sherman Creek transformer substation is required to reduce the HVAC electric power supplied by the Project from 345 kV AC to 138 kV AC, which is the connection voltage at the Sherman Creek substation. Like the other landfalls, the cable will be routed via HDD from the Hudson River to the proposed transformer substation. The location of the existing Sherman Creek substation is shown on Figures provided in Exhibit 2.

The proposed Sherman Creek step-down transformer substation will include two 800 milli volt amp (mVA) three-phase transformers and Gas Insulated Switch Gear which is used to reduce the substation footprint. The new transformer substation facility dimensions will be approximately 145 feet by 130 feet and 30 feet tall. Detailed typicals of the proposed transformer substation will be provided with the supplemental information to be submitted in July 2010. Construction drawings of the proposed transformer substation will be submitted as part of the EM&CP.

The remaining two HVDC cables (one bipole) will continue another 66 miles through the Hudson River, Harlem River, and East River into Long Island Sound before terminating at an HVDC converter station to be constructed in Bridgeport, Connecticut.

E-2.2 DESIGN AND INSTALLATION DETAILS – CONVERTER STATION

The following is a list of the major converter station components:

- Three (3) single phase three-winding transformers;
- AC filter system to absorb the major part of the harmonic currents;
- Phase reactors;
- Valve bridge built with insulated gate bipolar transistors (IGBT's);
- DC capacitor;
- Control and protection system for operation and monitoring of the station; and
- Other auxiliary systems, including AC auxiliary power, DC distribution, valve cooling system, ventilation system, and fire protection system.

The converter stations will be designed, manufactured, installed, and tested by ABB, Inc. (ABB) or Siemens Power Transmission & Distribution, Inc. (Siemens). All structures will be constructed in accordance with the National Electrical Safety Code (NESC) and applicable American National Standards Institute (ANSI) Standards.

HVAC interconnections will be designed and constructed under the direction of Con Edison in New York City and under the direction of UI in Connecticut. Final details of the interconnections will be in accordance with the requirements of the New York Independent System Operator (NYISO) System Reliability Impact Study (SRIS) in New York and in accordance with the interconnection requirements of Independent System Operator-New England (ISO-NE) in Connecticut.

Lightning protection will be provided in the form of a combination of poles and overhead ground wires.

All facilities will be designed and constructed to be aesthetically pleasing and minimize environmental impacts. Construction and site preparation activities at each site will include the following:

- Excavation and grading;
- Construction of foundations for the converter building, transformers, and switchgear; and

- Installation of appropriate drainage systems, and station service including electrical and water.

All construction will be in compliance with applicable local, building, and safety codes. All power equipment will be factory-tested in accordance with applicable standards prior to shipment. The converter station control and protection system will designed, assembled, and tested by ABB / Siemens prior to installation and on-site testing. This will ensure the system's proper operation and reduce on-site commissioning time.

The target commissioning date for this Project is the fourth quarter of 2014, with commercial operation in early 2015.

E-2.2.1 Control and Protection

The control and protection system of the HVDC transmission system will be designed, manufactured and tested by the HVDC converter station contractor selected. Off-site testing and commissioning of the control and protection systems will be performed prior to shipment to the construction sites.

The control system of an HVDC transmission installation is designed in redundant two-channel technology. The backup systems operate in hot standby mode to the channel that is active. An integrated rapid response switching logic selects the non-faulty channel automatically. Control component failure, faulty maintenance, or repair work in one system will therefore not impair transmission capacity.

The division of the converter station into filter-, transformer-, valve-, DC yard-, and cable zones gives selective response and annunciation. Each zone is monitored by at least two independent protection systems.

The protection of the HVAC bus bars and the HVAC grid interconnection will be designed according to the requirements for the local grid.

The event recorder always receives detailed information on fault events. This time tagged information is stored and available for analysis. In addition to remote access, the information can be retrieved locally from the protection device for onsite diagnosis providing detailed knowledge about cause and effect.

E-2.2.2 Cooling Systems

The duplicated valve cooling pumps are controlled by frequency converters for maximum flexibility for the flow control of cooling water. The frequency converter also makes it possible to use a DC backup source to keep the pump running if auxiliary power is lost for a long time.

E-2.2.3 Station Service

The station service power system is vital for reliable operation of the HVDC converter station. The design of station service power is focused on:

1. **Redundant power supplies, one from the internal AC bus and one from an external source.**

   The supply to the internal AC bus can be taken from a yoke winding on the converter transformer. In this way, the power supply is guaranteed at all times when the station is in operation. The output voltage is 6 to 10 kV, which means an intermediate transformer is necessary to provide a 400 volt system.

   The external power supply is taken from a local AC system provided by the customer and is used as a back-up source.

2. **Automatic changeover**

   The incoming feeds to the 400 volt switch-gear have automatic changeover control. The supply coming from the internal AC bus is pre-selected as a primary supply, and the supply from the external local AC system is pre-selected as a backup supply. If the pre-selected supply fails, changeover to the backup supply takes place within a pre-set time. When the pre-selected supply returns, the changeover system changes back to the primary supply within the pre-set time.

   The control equipment and other station DC loads are supplied from a duplicated station battery system with a backup time of at least two hours.

   Critical AC loads within the control equipment, such as servers, computers, local area network (LAN) switches, etc., are supplied from a DC/AC inverter fed from the station battery and with an automatic switchover to the alternative AC supply in the event of inverter failure or overload.

E-2.2.4 Fire Protection

For the HVDC station, fire protection and fire-fighting design will be in accordance with National Fire Protection Association (NFPA) and with the requirements of all authorities having jurisdiction over any parts of the works.

The valve enclosures, the control enclosure and all areas that have a high demand because of sensitive equipment are equipped with air sampling systems. The air sampling system can detect smoke at a very early stage. Being able to detect smoke at an early stage is an advantage, since this can prevent unnecessary tripping or shutdown of the station.

The power transformer is isolated by firewalls. Depending on the local regulations or client requirements, the transformer may or may not be protected by a sprinkler system. The converter reactors have smoke detectors.

If necessary, the valve enclosures and other areas equipped with air sampling systems can be protected with total flooding by gas or water mist extinguishing systems in accordance with NFPA 2001 or NFPA 750.

If a water pumping system is required, it will consist of one electric pump and one standby diesel driven pump. A ring main water loop will then be located on the site (underground) for a fire-fighting water supply. It is connected to an isolation valve that will bring redundancy in the ring main loop for fire fighting water. Fire hydrants will be positioned at strategic locations around the site area close to the main loop. Water supply storage will be connected to the fire fighting water loop.

The signals from the detection system and the pumps will be connected to a fire alarm panel in the operator control room.

E-2.3 DESIGN AND INSTALLATION DETAILS – STEP-DOWN TRANSFORMER SUBSTATION

The following is a list of major components for the proposed Sherman Creek 345/138 kV AC step-down transformer substation:

- Two (2) three phase three-winding oil immersed transformers – 800 mVA;
- Gas insulated switch gear – breakers, disconnects, grounding devices, current transformers and potential transformers;
- Control and protection system for operation and monitoring of the station; and
- Other auxiliary systems, including AC auxiliary power, DC distribution and fire protection system.

The proposed 345/138 kV AC step-down transformer substation will be designed, manufactured, installed, and tested by a Gas Insulated Switch Gear manufacturer, such as Mitsubishi Electric Power Products, Inc. (MEPPI). All structures will be constructed in accordance with the National Electrical Safety Code (NESC) and applicable ANSI Standards.

HVAC interconnections will be designed and constructed under the direction of Con Edison in New York City. Final details of the interconnections will be in accordance with the requirements of the NYISO System Reliability Impact Study (SRIS) in New York.

Lightning protection will be provided in the form of a combination of poles and overhead ground wires.

All facilities will be designed and constructed to be aesthetically pleasing and minimize environmental impacts. Construction and site preparation activities at each site will include the following:

- Excavation and grading;
- Construction of foundations for the transformers, control building, and switchgear; and
- Installation of appropriate drainage systems, and station service including electrical and water.

All construction will be in compliance with applicable local building and safety codes. All power equipment will be factory-tested in accordance with applicable standards prior to shipment. The substation control and protection system will designed, assembled, and tested by the manufacturer prior to installation and on-site testing. This will ensure the system's proper operation and reduce on-site commissioning time.

The target commissioning date for this Project is the fourth quarter of 2014, with commercial operation in early 2015.

E-2.3.1 Control and Protection

The division of the substation into 345 kV switchgear-, transformer-, 138 kV switchgear, and cable zones gives selective response and annunciation. Each zone is monitored by at least two independent protection systems.

The protection of the HVAC bus bars and the HVAC grid interconnection will be designed according to the requirements for the local grid.

The event recorder always receives detailed information on fault events. This time tagged information is stored and available for analysis. In addition to remote access, the information can be retrieved locally from the protection device for onsite diagnosis providing detailed knowledge about cause and effect.

E-2.3.2 Cooling Systems

The duplicated station service supplies ensure that the transformer cooling systems are at all times powered, all alarms and faults on the cooling system are connected to the substation annunciator.

E-2.3.3 Station Service

The station service power system is vital for reliable operation. The design of station service power is focused on:

1. **Redundant power supplies, one from the each transformer.**

   The two internal supplies for the substation will come from the tertiary windings of the transformers with a third feed from an independent source. The external (third) power supply is taken from a local AC system provided by the customer and is used as a backup source.

2. **Automatic changeover.**

   The incoming feeds to the 400 volt switchgear have automatic changeover control. The supply coming from the internal AC bus is pre-selected as a primary supply, and the supply from the external local AC system is pre-selected as a backup supply. If the pre-selected supply fails, changeover to the backup supply takes place within a pre-set time. When the pre-selected supply returns, the changeover system changes back to the primary supply within the preset time.

   The control equipment and other station DC loads are supplied from a duplicated station battery system with a backup time of at least two hours.

E-2.3.4 Fire Protection

The design of fire-fighting and fire protection will be in accordance with NFPA and with the requirements of all authorities having jurisdiction over any parts of the works. The power transformer is isolated by firewalls. Depending on the local regulations or other requirements, the transformer may or may not be protected by a sprinkler system. The signals from the detection system and the pumps will be connected to a fire alarm panel in the control room.

Figure E-2-1
Typical Compact Indoor HVDC Converter Station