500 kV AC Underground Transmission Technical Feasibility Study

The Alberta Electric System Operator (AESO) began a public consultation process in 2007 to discuss the need for transmission reinforcement in the Edmonton area. As a direct result of input received from concerned stakeholders, in June 2009 the AESO commissioned an independent consulting firm, Cable Consulting International Ltd., (CCI) a company headquartered in the United Kingdom, to conduct a study (referenced as "the CCI Study" or "the Study") to explore the technical feasibility of utilizing high voltage 500 kV AC underground transmission technology for a portion of the Heartland Transmission Development project (Heartland Project).

Who else was involved in the Study?

In providing support to CCI and the Study, the AESO worked closely with the AltaLink/EPCOR Heartland Project Team and engaged Teshmont Consultants LP to provide support with the power system analysis. The AESO also consulted with Responsible Electricity Transmission for Albertans (RETA), a public landowner group in the area, who provided input into the scope of the CCI Study.

Why do you need a study anyway? Can't you just bury the line?

Underground transmission at 500 kV is technically complex. There are relatively few installations in the world to draw on for experience. Given an application for the Heartland Project that requires high power transfer capability (up to 3000 MW), the AESO must carry out a thorough analysis to ensure the reliability of the system can be maintained.

The technology must be carefully assessed given limited world operating experience. There are currently no existing 500 kV underground cable systems, of similar length, to what is being evaluated for the Heartland Project, worldwide, that operate under similar extreme winter weather conditions as found in northern Alberta. The only operating facility that utilizes long cable lengths with splices or joints is located in a tunnel in Tokyo, Japan, where the air temperature around the cable can be controlled.

As this type of technology is relatively new and with limited operating experience, factors including technical feasibility, reliability, maintenance and repair, impact to in-service date, installation, life cycle costs and system power losses need to be considered.

The Study draws a number of conclusions and suggests next steps. The following are some of the key findings identified by the AESO from the Study.

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Technical Feasibility

The application of a 500 kV underground cable transmission system appears to be technically feasible for use in the Edmonton region. However, as this type of cable and its accessories, have not been tested with the winter ground temperatures found in the Edmonton region, confirmation of technical feasibility is required through further testing and validation.

Reliability

The reliability of a 500 kV underground transmission system is difficult to assess given the limited world operating experience. Additional analysis is required to calculate the reliability of an underground transmission system to determine acceptability with an application to the Heartland Project.

Maintenance and Repair

On the assumption that an underground cable system would be reliable, it must also be anticipated that failures will occur. Therefore, consideration must also be given to repair time in the event an underground cable or cable accessory fails. This affects the availability of a 500 kV underground circuit.

The average repair time associated with 500 kV underground cable and accessories failure is estimated at 30 days.

Impact to in-service date

The Heartland Project schedule based on the application of an all overhead solution indicates that an in-service date of 2013 (first quarter) is achievable.

The Heartland Project in-service date would likely require an extension of between one to two years (2014 – 2015) if an underground cable option is pursued. Further investigation will be required to examine options to reduce this cycle time.

Installation and Life Cycle Costs

Installation costs for 500 kV underground cable systems are considerably higher than 500 kV overhead transmission lines. Costs for underground cable transmission are seven to 10 times higher per unit than overhead lines. In the case of the Heartland Project where an underground cable option could represent 20 per cent to 30 per cent of the total line length, the total project costs would be two to three times more expensive than an entirely overhead transmission line option.

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System Power Losses

The Study concludes that additional system power loss savings on the proposed double circuit 500 kV line are not achievable with the inclusion of an underground cable transmission segment. The entirely overhead transmission line option represents increased efficiency, in terms of power losses, when compared to an option that includes an underground cable segment.

What are the next steps?

The AltaLink/EPCOR Heartland Project Team is preparing to file the Facility Application for the Heartland Project with the Alberta Utilities Commission in the spring of 2010.

In parallel with the Facility Application process, the AESO will investigate possible design and testing options to validate performance of underground cable and accessory designs in cold winter temperatures, in collaboration with the Heartland Project Team and cable manufacturers.

The AESO will continue to monitor industry developments in underground transmission technologies.

To view the Study, please visit our website at www.aeso.ca or www.poweringalberta.com.

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