Underground Transmission

Does the AESO consider the use of underground technology?

The AESO and transmission facility owners (TFOs) consider the use of underground transmission technology on a project-by-project basis to mitigate a siting or route selection issue. The Alberta Utilities Commission (AUC) ultimately approves the use of underground in each circumstance.

Two different types of underground technology exist: alternating current (AC) and direct current (DC), each of which has different characteristics that need to be assessed on an individual basis.

When is underground AC transmission considered?

AC underground transmission lines have different electrical characteristics and different maintenance and outage implications than AC overhead lines. Underground AC technology has most frequently been used in providing service where overhead transmission simply isn't viable and the higher cost of underground transmission is necessitated, such as into downtown urban cores like Edmonton and Calgary. In 2008, EPCOR completed a 10 km underground 240 kV transmission line extending from the north edge of Edmonton into the downtown core, adding to two 30-year-old 240 kV circuits feeding the downtown core from the south.

The AESO has worked with ENMAX Power and obtained AUC approval to proceed with the replacement of older 138 kV oil-insulated underground circuits in the Calgary downtown core with higher capacity cables. This project is currently in the construction phase.

Underground cables have also been funded by real estate developers on a case-by-case basis to reduce visual impact on new developments – examples include the Cougar Ridge residential development in Calgary and the Three Sisters development at Canmore, both of which involved 138 kV transmission.

When is underground DC transmission considered?

The majority of high voltage direct current (HVDC) transmission cable systems in the world are installed as subsea interconnections. Underground DC transmission has recently focused on the use of the newer "Voltage Source Converter" technology, which enables the use of underground or subsea (in the case of off-shore applications) HVDC cables for lengths spanning many kilometres. In relation to AC systems, these HVDC systems have a relatively higher cost associated with the converter stations needed to integrate the facilities at each end. As well, there is very limited ability to integrate new substations along the circuit. The technology is only now reaching beyond the 300 MW capacity limit, which is still the limit for facilities in service, although higher capacity circuits are under development.

With these attributes, DC technology has most frequently been used to interconnect adjacent jurisdictions, allowing some level of interchange between two larger networks. While Alberta has a 150 MW HVDC intertie to Saskatchewan in operation, we do not have any underground DC facilities at this time. AltaLink and ATCO Electric recently filed facility applications for two 500 kV HVDC circuits between the Edmonton area and the Calgary /Brooks area. Both of these Critical Transmission Infrastructure projects contemplate an overhead line solution.

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How is the decision to use underground transmission as a route mitigation made?

For existing technically feasible technology such as 240 kV or 138 kV underground cable, the TFO considers the application on a case-by-case basis for siting mitigation, and, after verifying with the AESO that the technical performance is acceptable, makes a recommendation to the AUC. The AUC ultimately approves the application of underground transmission.

In the case of the 500 kV transmission lines required for the Heartland Transmission Project, the AESO commissioned a study to determine the technical feasibility of using high voltage 500kV AC underground cables in the Edmonton/Fort Saskatchewan area.

The results of the study were released in February 2010 and are available at www.aeso.ca

Key findings from the underground feasibility study

The AESO commissioned a study to determine the technical feasibility and life cycle costs associated with burying a portion (10 to 20 km) of the proposed 500 kV double circuit line of the Heartland Project. The study indicates that the application of a 500 kV underground cable system is technically feasible with the condition that the performance of the cable and its accessories are tested and validated for cold weather conditions.

Ultimately, the AUC will make the final decision regarding the location of the line and the appropriateness of underground.

The AESO has directed the TFOs to carry out further investigation of underground, including prequalifying appropriate cable manufacturers and cable testing facilities.

Given the significant costs associated with testing underground cable, the AESO has proposed to conduct any required cable cold weather testing following receipt of a decision from the AUC, should such decision entail advancing an underground option.

The AESO will continue to monitor industry developments in underground transmission technologies and consider, where appropriate, underground transmission applications for future transmission projects.

Technical feasibility

Technical feasibility refers to factors regarding the maturity of the technology, and whether it can be integrated into an existing transmission system and operated dependably. Technical feasibility for 500 kV underground cables is difficult to determine as there are currently very few other underground 500 kV AC cables in service in the world, and only two with an underground line length greater than 15 km that the AESO was aware of at time of the study. Both installations are within a tunnel. The AESO's study included an examination of the technical feasibility of deploying a 20 km section of 500 kV AC underground cables as one component of a larger AC overhead project.

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