

The AESO Commissioned 500 kV Underground Transmission Feasibility Study

Edmonton, Alberta

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VP TRANSMISSION

- Heartland Project represents an important project as part of the AESO's Long-Term Transmission System Plan. The plan supports the objectives of the Provincial Energy Strategy.
- During the planning process, numerous transmission options are evaluated giving consideration to reliability, cost, technology, and high level siting implications.
- This is another step in the stakeholder consultation process which is in progress.

Fred Ritter

TRANSMISSION

- The AESO
 - Introduction of the 500 kV Underground Transmission Feasibility Study conducted by CCI
 - Project Team and Roles
 - Background
- Cable Consulting International Ltd.
 - *Feasibility Study for 500 kV AC Underground Cables for use in the Edmonton Region of Alberta*
- The AESO
 - Summary of CCI's Key Conclusions
 - The AESO's Next Steps
 - Questions

As a result of concerns raised by stakeholders, the AESO commissioned a Study to:

- Evaluate the technical feasibility for the application of 500 kV AC underground transmission for a portion of the 500 kV double circuit transmission line proposed for the Heartland Project.

While the AESO, and others, provided information to CCI relevant to the study, the findings and recommendations contained within the study are those of CCI alone.

Feasibility Study Project Team

- The AESO:
 - Cable Consulting International Ltd. (CCI)
 - Teshmont Consultants LP
- Transmission Facility Owners (TFOs):
 - AltaLink Management Ltd.
 - SNC Lavalin
 - EPCOR Distribution and Transmission Inc. (EDTI)

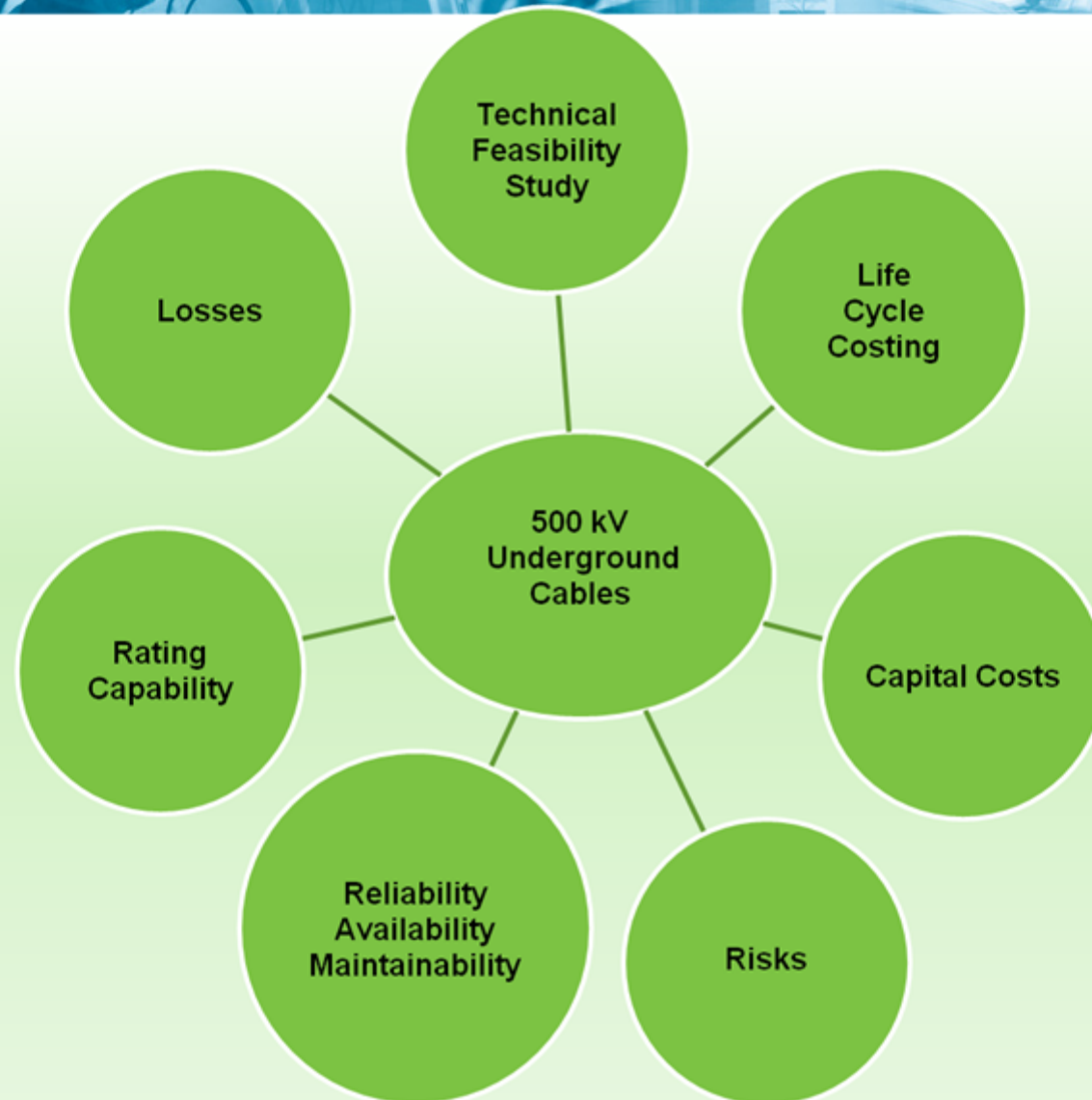
- Cable Consulting International (CCI) of the UK was the primary consultant contracted to carry out the study.
- AESO engaged Teshmont Consultants LP to study:
 - Reactive compensation requirements for underground cable options.
 - Project losses evaluation.

- AltaLink and EDTI provided input to the study, including:
 - Constructability.
 - Operating/maintenance issues.
 - Transport requirements.
 - Cost estimates for cable civil works.
 - Transition station layouts and estimated costs.
 - Cost estimates for overhead lines and substations.
 - General routing data.

- Issued an RFI in April 2009 to a number of organizations to assess capability to carry out the study.
- Contracted with CCI in June 2009 to do the study work.
- Gathered input from RETA before finalizing scope.
- Met with AltaLink and EDTI on an ongoing basis to coordinate study efforts and share information.

- Participated, along with AltaLink and CCI, in a visit to Japan in July 2009 to see the world's longest 500 kV underground transmission system installation.
- The AESO, AltaLink, EDTI, SNC, CCI and Europacable held a technical forum on September 18, 2009 in Edmonton to share technical aspects of 500 kV AC underground with stakeholders.
- Provided a study update with the Heartland Project Team on November 24 at the RETA sponsored Transmission Rally.

Feasibility Study Focus Areas



Scope of Study

- Evaluate the technical feasibility of burying a portion of the proposed double circuit 500 kV line for Heartland.
- Focus the study on the East TUC (Transportation Utility Corridor) proposed route (65 km), recognizing that results can be applied elsewhere.
- Evaluate various underground technologies.
- Identify the estimated costs and risks associated with underground.
- Include an evaluation of losses and estimated life cycle costs.
- Coordinate efforts with the TFOs, including AltaLink and EDTI.

Cable Consulting International Ltd.

Feasibility Study for 500 kV AC Underground Cables for use in The Edmonton Region of Alberta

Cable Consulting International Ltd.



Brian Gregory
BSC, CENG, FIEE, MIEEE

Alan Williams
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CCI's Key Conclusions

Cable Consulting International Ltd

KEY CONCLUSIONS

CCI's Key Conclusions

- 500 kV underground transmission system utilizing solid dielectric , cross-linked polyethylene technology (XLPE) is technically feasible, with the proviso that the performance of the cable and accessories are tested and performance validated for cold weather conditions.

- Project total estimated costs (end-to-end) would increase 2 to 3 fold with the inclusion of 10 to 20 km underground transmission systems for the Study Project (Heartland Project).
- Estimated installation costs for 500 kV underground transmission systems are 7 to 10 times higher than 500 kV overhead transmission lines.
- Given system capacity requirements, staging a cable installation appears feasible with the proviso reliability requirements can be met.
 - Requires further analysis

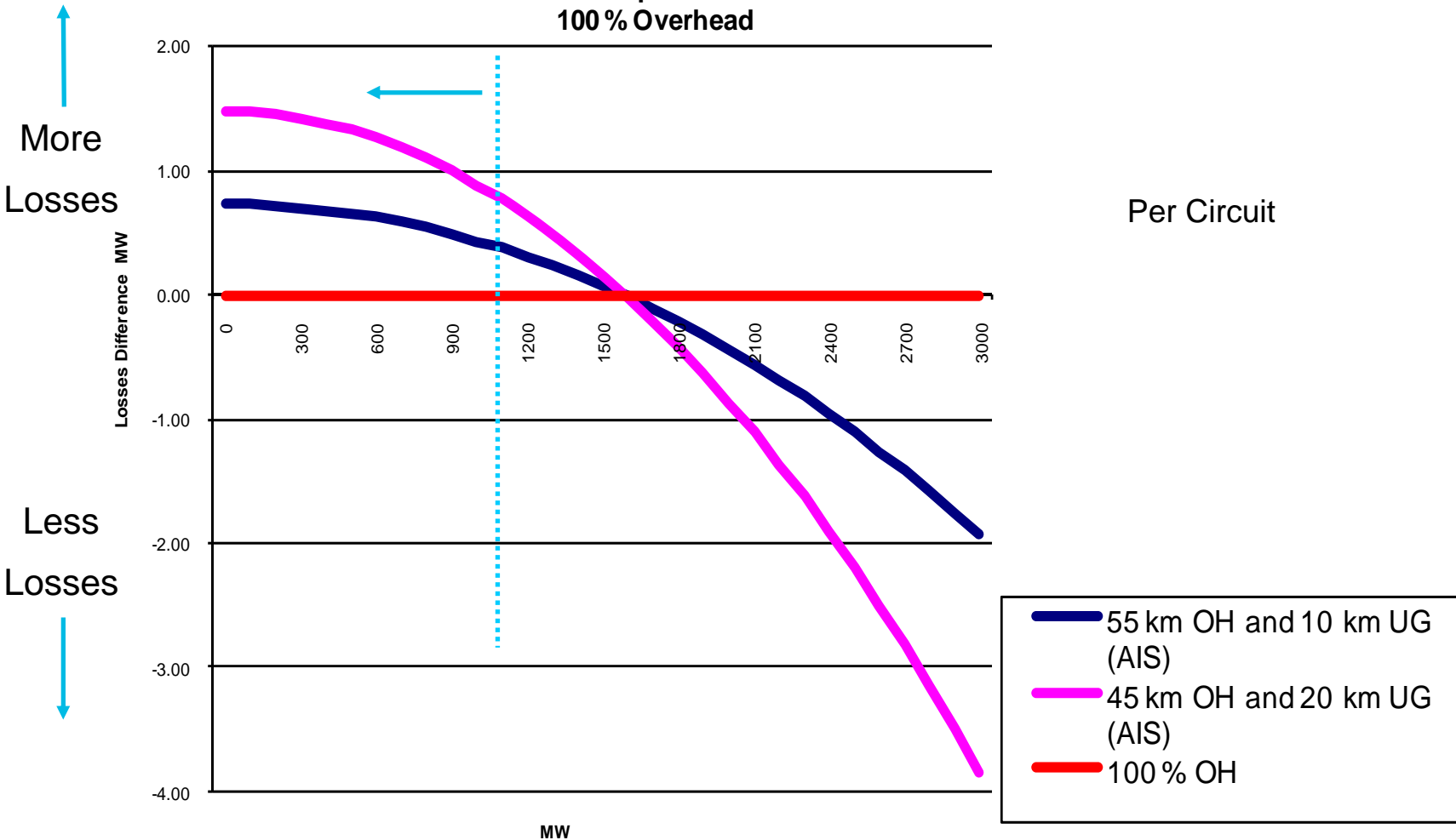
- Lifecycle cost analysis (40 years) concludes that the all-overhead line solution remains the lower cost alternate.
- 500 kV underground transmission system is technically complex and typically involves custom design for each application.
- Given the limited world experience with 500 kV underground, reliability of 500 kV cable systems is difficult to assess:
 - Additional analysis is required.

- Introduction of a 500 kV cable system does not result in added savings in system losses given the projected loading of the 500 kV lines will generally remain below 1,700 MW, as illustrated by the following graph:

Key Conclusions

Combined Overhead and Underground transmission Compared to 100% Overhead

Per Circuit



- Significant lead time is required to evaluate, test, supply and install 500 kV underground cable that would delay, if underground was selected, the in-service date for the Heartland Project by 1 to 2 years.
 - More analysis required to examine options for reducing this time.

The AESO's

NEXT STEPS

- Investigate, in collaboration with the TFOs, design and testing options to validate 500 kV cable and accessories qualification and performance in cold weather conditions.
- Move to the next stage: carry out, in collaboration with the TFOs, design studies to determine an acceptable underground configuration for possible application to the Heartland Project:
 - Include a thorough reliability analysis.
- Continue to provide stakeholders with updates on underground study efforts.

- Continue to monitor industry developments in underground transmission technologies.
- The AESO would support the TFOs to submit information on underground to the Alberta Utilities Commission (AUC) as part of the Facility Application Submission for the Heartland Project.

Inquiries and Feedback

Stakeholder Relations

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Questions?