P1 – System Planning Report Transmission Tariff Work Group

September 10, 2019

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Report Objective

The study will provide a consistent framework to discuss and potentially determine project drivers for past and future transmission projects. To the extent that transmission costs are recovered from load and a majority of bulk transmission cost is currently recovered through the monthly coincident peak charge, an understanding of the AESO planning process for assessing and proposing transmission upgrades is critical in assessing transmission tariff design to arrive at a rate structure and rate level that is fair and efficient, resulting in optimal outcomes for all load customers.

Report Methodology

This report uses a question and answer format to understand, at a fairly detailed level, the process from planning objectives to alternative selection, and build drivers to impact of system, region and area load. This report includes tables summarizing project drivers and costs for historical and planned transmission system project.

1. Planning Objectives

What are the objectives of transmission planning?

Objective of transmission system planning is to ensure timely availability of transmission capacity to serve forecasted generation and load demand in Alberta in compliance with acts, regulations, Reliability Standards and planning criteria.

Transmission system planning aims to ensure timely availability in a manner that maximizes the utilization of existing and planned transmission assets.

Transmission system planning recognizes the differences in lead time between load, generation, and transmission developments.

2. Planning Inputs

What are the main inputs into transmission system planning?

Forecast load location and level, and generation location and dispatch are main inputs that are used to create scenarios for transmission system planning studies.

Anticipating location and size of generation development is particularly challenging and important due to significant impact of dispatch on transmission system, and long lead time for transmission developments compared to comparatively shorter lead time for generation developments.

2.1 Forecasting

How is load and its location, and generation and its location forecasted?

The AESO produces a long-term outlook of load and generation for next 20 years. Load forecasting methodology is a blend of top-down economic-based Alberta internal load (AIL) peak forecasts combined with bottom-up point of delivery (POD) level load shapes.

The generation development in the *2017 Long-term Outlook* (2017 LTO) scenarios is based on two main factors: ensuring demand is met, and aligning with policy directions including renewable generation additions and coal-fired generation retirements. In considering what generation is likely to develop, the AESO reviews the characteristics of generation technologies including costs, operating characteristics, resource availability, and market behavior in addition to policy-driven incentives. In addition to the Reference Case, the 2017 LTO contains six other scenarios which are based on known uncertainties currently facing Alberta's electricity market. Each scenario contains an assumption change from the Reference Case while maintaining an underlying set of assumptions

Project specific forecasts are used to ensure than any filed system Need Identification Document (NID) contains most up-to-date information. As the AESO develops its long-term outlook based on broad economic assumptions, it is prudent for the AESO to conduct a more detailed review of a smaller geographic area to ensure that specific area drivers of load and generation are fully understood before recommending a system transmission facility upgrade.

2.2 Dispatches

How are dispatch scenarios created?

The AESO uses historical generator output and future market simulations to determine appropriate dispatch levels for its planning studies.

For conventional generation, the AESO determines high, low and economic dispatches during a particular load condition guided by historical statistics, market simulations and credible generation development scenarios.

Non-dispatchable generation sources such as wind and solar are more variable, and therefore less predictable. The AESO assumes most onerous conditions in planning studies: for the entire system, simultaneous wind powered generating units' capacity factor of 0% for low generation dispatch and 92% for high generation dispatch. Intertie is dispatched based on the planning requirements with consideration of historical statistics.

2.3 Study Conditions Determination

How are study conditions i.e. stress cases determined?

The AESO Reliability Standards and planning criteria are consistent with *North America Electric Reliability Corporation*. Planning criteria are attached to the System need identification document. The AESO planning criteria and guidelines have not changed materially over time.

Of particular note is that the *Transmission Regulation* requires transmission system to accommodate all expected in merit generation under system normal (i.e. no contingency) conditions.

A planning base case is a transmission system model representing a single snapshot in time, usually representative of a system wide condition such as summer peak, winter peak or summer light loading.

A study case is a transmission system model derived from the planning base case that focuses on stress conditions for a particular study for specific area(s) or conditions instead of a system wide condition.

The study area is usually comprised of a number of planning areas or one single large area such as Fort McMurray (FMM). In general, study areas refer to "regional" systems in a planning context.

Transmission planning studies are based on a wide range of study cases to ensure resiliency and flexibility of transmission plans.

3. Planning Alternatives

How are planning alternatives determined?

Planning alternatives are identified based on a number of different factors such as termination points, technology, voltage levels, nature of need such as enabling system access or bulk reinforcement for transfer out or in capability, flexibility (such as staging), and location of generation (source) and load (sink).

Planning alternatives are evaluated and ranked based on three main factors:

1. Technical performance;
2. Cost; and
3. Land, environmental, and social impact assessments.

4. Transmission Build Drivers

What are the drivers for major transmission developments?

Transmission reinforcements are needed when reliability and planning requirements (eg. flows, voltage level, or stability margin) exceed the capability of the existing system. This can occur as a result of specific combinations of conditions such as load location and level, generation location and dispatch, and credible contingencies inside and outside the study region. Usually, multiple conditions drive the need for transmission reinforcement.

The primary driver for major transmission developments represented through a number of recent system enhancements is provided below;

- **Bulk power transfers:** FMM (three 240 kV lines), south of Keephills, Ellerslie and Genesee (SOK), Heartland, Foothills Area Transmission Development (FATD), and future Central East Transfer Out (CETO) developments
- **Local load supply:** South and west of Edmonton project, and Northwest region (north of Wesley Creek)
- **Generation integration capability and access:** Most components of Southern Alberta Transmission Reinforcement (SATR), South of Calgary developments, and Keephills-Ellerslie-Genesee (KEG) loop
- **Both regional load and generation combined:** Hanna Regional Transmission Development (HRTD) Phase 1
- **Others:** Intertie restoration

The AESO currently anticipates more localized or regional transmission developments to address local generation and load constraints in areas, such as the Northwest and Edmonton in the next five years. Other developments may be required depending on the pace of generation replacement and development in the province. Please refer to the AESO LTP for more detail.

Transmission development need drivers may change as the system evolves and plans must be resilient and flexible to accommodate changes in both load and generation drivers. For example, HRTD Phase 1 project had major load drivers but as the system evolved, renewable generation development in the Central East area has increased. The AESO adjusted its plans for HRTD to further function as a collector system for renewable generation development interest in the region.

How can the AESO address generation development related drivers?

The AESO is taking a more proactive approach in developing efficient transmission plans in high potential areas and providing critical information to generation developers rather than “chasing” individual generation development applications. The AESO is now developing its LTP to provide a reasonable opportunity for generation to connect and participate in electricity market(s) where resource potential is rich or proven and market participant interest is proven.

The AESO plans to periodically publish transmission system available capability maps, regional system plans and LTPs to inform generation developers. The AESO can then optimize transmission build to ensure healthy market competition and developer interest by continuously enabling a transmission system with low levels of congestion in alignment with the *Transmission Regulation*. This approach extends to encouraging the efficient use of transmission capability available at brown field sites, particularly at coal fired generation sites that maybe phased out. The AESO applies construction milestones when applicable to control timing of transmission construction projects.

5. Impact of Area, Regional and System Coincident Peak

How does coincident peak factor into planning?

Planning for bulk transmission system accounts for seasonal peaks, light and shoulder load system conditions. These system planning studies model system coincident load conditions and not the simple summation of individual customer highest loads or contracted loads.

Planning for regional and sub-regional system takes into account coincident load for the study area as well as individual customer highest load and contracted load. This approach ensures that transmission system can offer the contracted capacity exchange levels on an individual customer basis. Coincident peak load for the study area may or may not occur at the same time as regional peak or system peak.

6. Impact of Load or Generation Increase or Reduction

How does an increase or decrease in load or generation factor into planning?

Impact on need for transmission reinforcements depends on the nature of area – existing load, generation and transmission infrastructure, as well as new developments – additional load or generation interest.

a. Impact of load

If a transmission need is driven by load growth, then higher the load, the more severe the reliability issue is. For example reduction of load in some areas of the Northwest planning region could reduce existing transmission constraints driven by lack of transmission capability to supply this load. In such cases, the duration and magnitude of load reduction is important. However in some other parts of the system, such as Calgary region and southern Alberta, reducing load would cause further stress on the transmission system.

In some areas of the system, a load increase can consume local generation and reduce stress on outflow transmission paths. For example increasing load in parts of the Northeast region would better utilize existing transmission assets.

Reducing or increasing load outside of an area can impact transmission need in that area as well, since regional power transfer flow would change as a result of such changes.

b. Impact of generation

Generation additions in specific load surplus areas may defer transmission reinforcement, for example in parts of the Northwest region.

Type, size and expected dispatch of generation, combined with the capability of underlying transmission system determine the impact on transmission system.

Non-dispatchable renewable generating assets outputs do not follow system loading conditions. Their higher output operating condition coincident with lighter load condition may increase power flows on certain transmission paths thereby creating a need for transmission reinforcement.

7. Planning Regional and Bulk Definitions

How are regional system and bulk system defined and utilized?

Regional systems are designed to serve load and generation within the region. Bulk system focuses more on enabling high power flow exchanges between regions across the entire transmission system.

If a transmission development is only supporting a specific region, it would be considered regional. If a transmission development is transferring (a large amount of) power across the transmission system, it would have bulk elements to it and potentially some regional elements as well.

8. Historical System Projects – Drivers and Costs

Please see attached spreadsheet. It is summarized below:

Project	Driver(s)	In service Date	Cost ($ million)
Fort McMurray West Line	Critical Transmission Infrastructure (CTI)	2019	1,430*
South and West Edmonton	Load	2018	240
Red Deer	Load and generation	2017	384
Foothills Area Transmission Development – East	Generation	2016	445
Hanna	Load and generation	2016	997
Central East	Load and generation	2016	337
Other SATR	Generation	2016	1,052
Southern Alberta Transmission Reinforcement (SATR): Cassill – Bowmanton	Load and generation	2016	386
Christina Lake	Load and Generation	2015	490
High Voltage Direct Current (HVDC) Lines	CTI	2015	3,700
Heartland	CTI	2015	700
North Fort McMurray Transmission Development	Load	2013	352
Northwest Transmission Development	Load and generation	2013	583

* denotes approximate present value of all payments to be made to Alberta Power Line over about 35 years

9. 2017 LTP System Projects – Drivers and Costs

Please see attached spreadsheet. It is summarized below:

Project	Driver(s)	In service Date	Cost ($ million)
Calgary Downtown	Load and generation	2021	102
Provost to Edgerton and Nilrem to Vermilon (PENV)	Load and generation	2023	242
Multiple medium term projects	Load and generation, or Load, or Generation	2024-2028	1,399
Multiple long term projects	Load, or Generation	2029-	233