Manitoba Hydro

NEEDS FOR AND ALTERNATIVES TO (NFAT)

Manitoba Hydro's Response to PUB Question #1

Ref.: PUB/MH II-402, 2005/06 Winter & Summer

1. Please confirm that this is MH's most recent filing of the top 50 winter and top 50 summer peak hours of generation.

2. Provide the average domestic (common bus) and export transmission losses for the 50 top winter and for the 50 top summer loads.

Ref.: PUB/MH II-402, 2005/06 Winter & Summer
Attached Tables (PUB/MH II-402, pp. 2 & 3 of 3 (amended to include incremental loss calculations))

3. Verify or re-calculate the incremental shares (load-squared basis) of the transmission losses going to domestic/common bus firstly and then the exports secondly.

Transmission Losses Incremental Winter Averages		
Domestic	**Export**	**Overall**
5.2%	**12.55%**	**8.09%**
Incrementally Summer Averages		
5.8%	**15.7%**	**9.59%**

4. Provide a monthly tabulation of MH's peak (5x16) and off-peak during both winter and summer energy loads, and HVDC & AC transmission losses for 2005/06 and 2012/13.

Response:

1. Manitoba Hydro filed the top 50 winter and top 50 summer peak hours of generation for the years 2005/06, 2008/09 and 2010/11 in PUB/MH I-041a. The 2005/06 table was refiled in PUB/MH II-402 to include the total system loss calculation for each hour. Therefore, it is confirmed that PUB/MH II-402 is the most recent filing of the top 50 hours of generation for 2005/06.

2. Due to limited time available, statistics for the top 50 summer and winter average domestic (common bus) loads could not be compiled. Manitoba Hydro does not

consider the requested information germane to the analysis of the Preferred Development Plan.

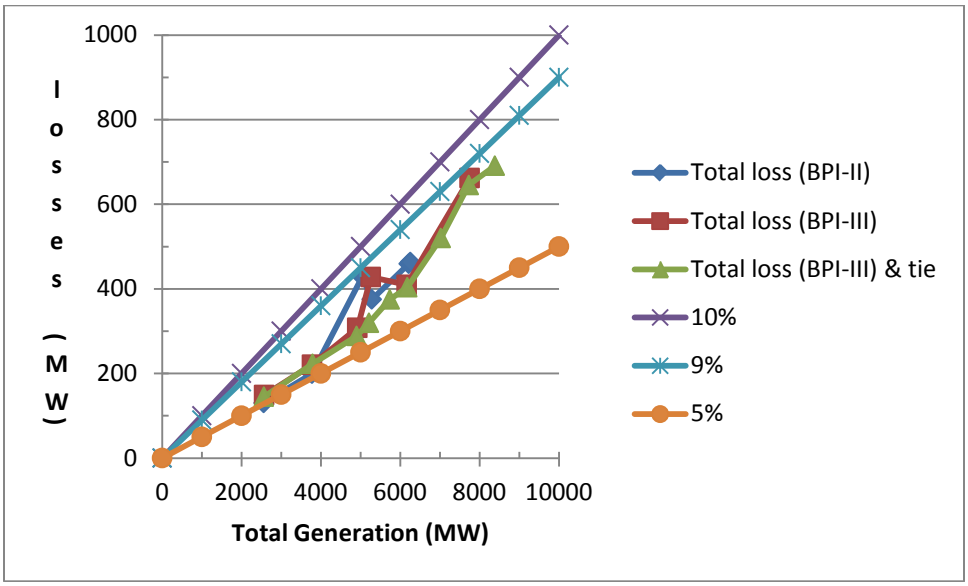
3. The accurate calculation and tracking of system losses and allocation to various load classes including exports is a complex engineering calculation. For this reason Manitoba Hydro has adopted a method for accounting purposes which determines total losses required to supply total load and assigns the same hourly loss/gain ratio to all load classes (residential, commercial, industrial, exports and imports).

With the exception of load flow studies based on actual hourly system data, Manitoba Hydro does not endorse other incremental loss accounting methodologies including the one requested in this Undertaking. These other methodologies have no technical justification for being more accurate or appropriate than the Manitoba Hydro average loss accounting method as they ignore:

a) That exports and imports can be scheduled simultaneously at any time during the day,
b) That all Manitoba Hydro generators can be the source of exports or can be reduced by imports,
c) That the marginal MW of load being served by Manitoba generation is not always an export MW,
d) That Manitoba Hydro is not the only entity using its transmission system to export or import from Manitoba as access to Manitoba Hydro's transmission system is available to all as provided under the MH Transmission Tariff,
e) That loop flows from the US increase losses in Manitoba and are beyond Manitoba Hydro's control. Loop flows are routine and aren't the result of Manitoba Hydro exports activities. However Manitoba Hydro, as a Balancing Authority, must supply this loop flow. In the winter case studied below, average loop flow was 136 MW or about 9% of total exports and for the summer case it was 126 MW or about 6% of total exports.
f) That a portion of the Manitoba load is served on an interruptible basis equivalent to exports.

An example of the potential range of losses calculated using an accurate power system model is given in the figure below. The model data used were from the same twenty-one power flow cases provided to Power Engineers[1] with HVdc station losses[2] also included.

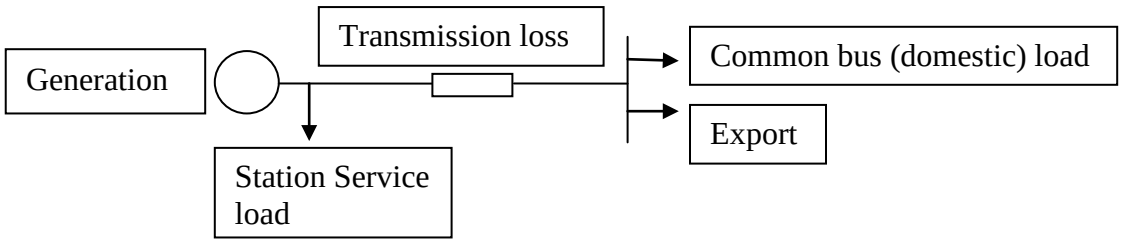
[1] Page 16-19, Power Engineers report to the Public Utilities Board, Jan. 13, 2014.
[2] See PUB/MH II-327b and PUB/MH II-328a



The expected losses ranged between five and nine percent of total generation. In the NFAT analysis Manitoba Hydro has made a conservative assumption of 10%. This value is reasonable for both the existing system and the future system including Bipole III and the new 500 kV tie to the U.S.

However as requested in the Undertaking Manitoba Hydro has calculated incremental losses below using the alternative methodology requested although as explained above it is no more accurate than the Manitoba Hydro practice.

A simple representation of losses in Manitoba can be shown by the following diagram.



Assuming transmission loss is represented by an equivalent resistance (R), then $I_{cb}^2R=Loss_{cb}$. Transmission losses associated with supplying the common bus load is ($Loss_{cb}$). Similar formulas can be derived for transmission losses associated with exports ($Loss_{export}$) and total losses ($Loss_{total}$).

$$I_{cb}^2R=Loss_{cb}$$
$$(I_{cb} + I_{export})^2R=Loss_{total}$$

Substitute $I_{cb} = Load_{cb}/V$ and $I_{export} = Load_{export}/V$ into the above.

$$Loss_{cb}=Loss_{total} * (Load_{cb}^2/(Load_{cb}+Load_{export})^2$$

The above formula assumes common bus (domestic) load is supplied first and exports are supplied next. As mentioned above, this is a hypothetical situation as exports and imports can be scheduled at any time during the day. The results of applying this loss formula are shown in the table below.

Case	A: Load at common bus (MW)	B: MB Exports (MW)	C: Total loss (MW)	D: $A^2/(A+B)^2$ *C Incremental Load losses (MW)	Domestic losses (percent of load at common bus)	E: C-D Incremental Export losses (MW)	Export losses (percent of MB exports)	Total losses (percent of generation)
05/06 Winter	3073	1557	397.6	175	5.70%	222	14.3%	8.1%
05/06 Summer	2365	2091	467.2	132	5.56%	335	16.0%	9.6%

4. Due to limited time available, monthly tabulation of the requested loads and losses could not be compiled. Please refer to PUB/MH II-464b for typical summer and winter peak losses that were analyzed for each of the last 3 years. Total losses, including a breakdown between HVDC and AC losses are given. PUB/MH II-330c can be referred to for an analysis of the losses that occur during various periods including:

   • 5×16 summer (peak)
   • 5×8 summer (night-time)
   • 2×16 summer (weekends)
   • 5×16 winter (peak)
   • 5×8 winter (night-time)
   • 2×16 winter(weekends)