
2017/18 & 2018/19 ELECTRIC GENERAL RATE APPLICATION

Manitoba Hydro Undertaking #54

Manitoba Hydro will provide the presentation Dr. Swatek presented on the risks of reduction associated with the construction of Bipole III.

Response:

Please find attached the presentation on the need for Bipole III delivered by Dr. Swatek during the 2014/15 & 2015/16 General Rate Application oral hearings (Exhibit MH-57). The presentation was delivered on June 3, 2015 (Transcript pages 2108 – 2123).

Manitoba Hydro offered to re-file this presentation and is providing additional information below, to assist in understanding the system reliability that Bipole III brings to the Manitoba Hydro HVDC transmission system when it comes into operation. Statistically, introducing Bipole III substantially reduces the risk of significant weather events impacting the HVDC transmission system and disconnecting southern Manitoba from the northern load generation as follows:

Tornados:

- Pre Bipole III: 1:17 year return period
- Post Bipole III: 1:3700 year return period

Synoptic (wide front) Wind:

- Pre Bipole III: 1:90 year return period
- Post Bipole III: 1:560 year return period

Combined Wind and Ice:

- Pre Bipole III: 1:20 year return period
- Post Bipole III: greater than 1:200 year return period

Why we need Bipole III

Dr. David R. Swatek, Manager, System Planning

Pei Wang, System Analysis /Controls & AC/DC
Planning Engineer

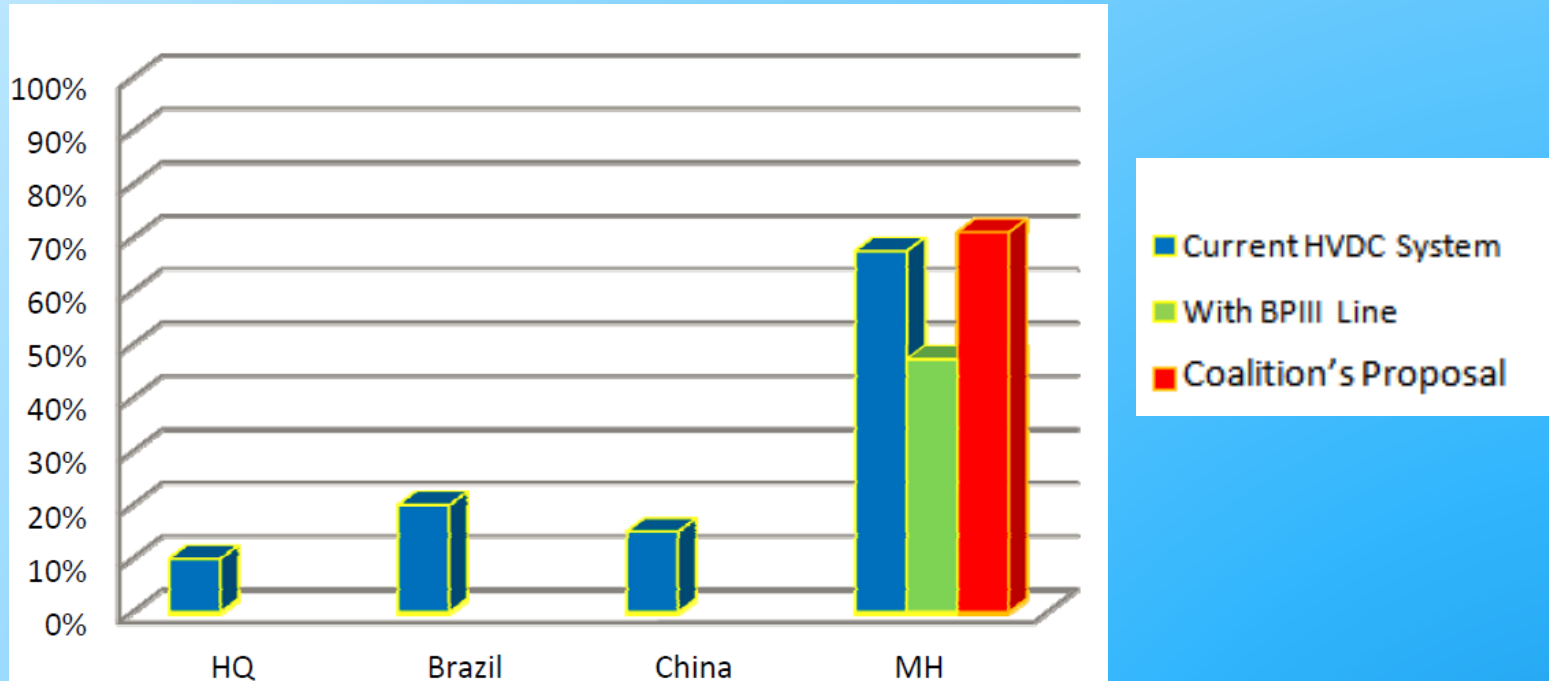
Alastair Fogg, Manager, Bipole III Project Controls

The Existing Bipole I and II System



- Link to 70% of the Province's generating capacity
- Bipole I and II HVdc lines constructed on the **same Right-of-way (same corridor)**
- 900km overhead lines, difficult terrain and access in the north
- Terminated at **a common station** – Dorsey (inverter)

Maximum Percentage Power through a Single Facility



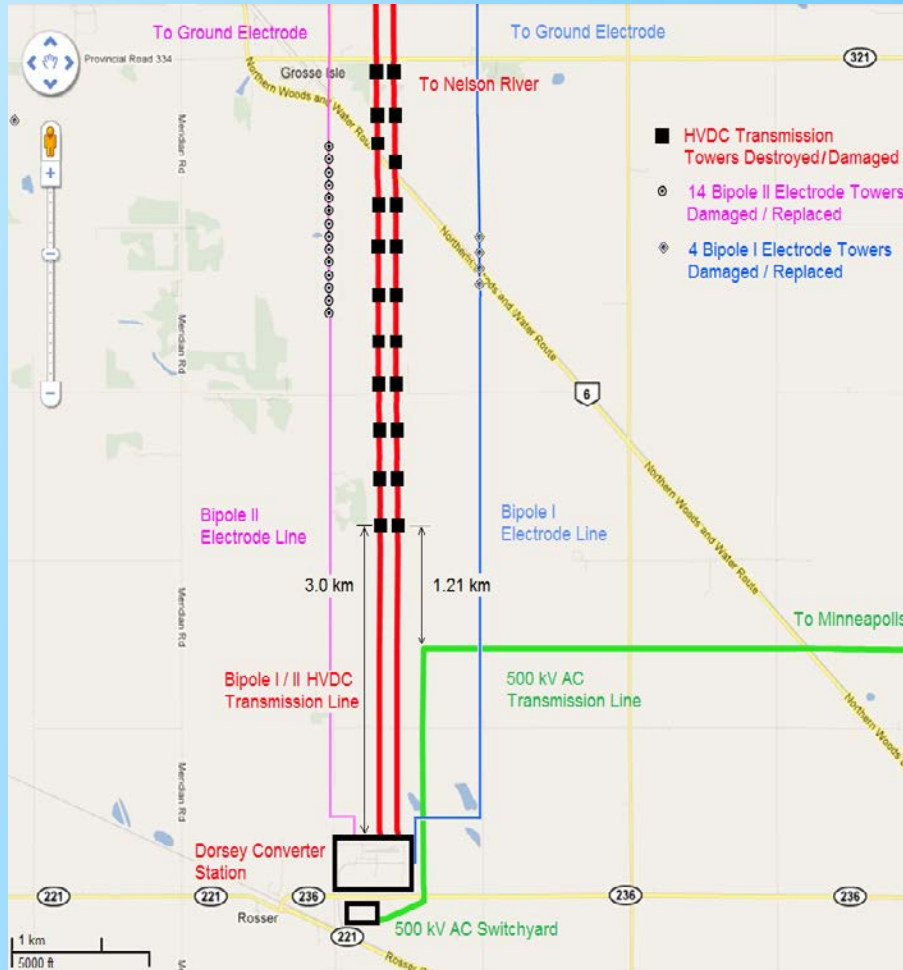
- Manitoba has highest percentage of power concentrated in a single facility for a major network in the world.
- “Too many eggs in one basket”

Why is Bipole III Required?

- Bipole III is required for reliability
 - Bipole I & II DC Transmission Line Failure
 - Only one southern converter station (Dorsey)
 - Long restoration times
- We've experienced loss of corridor before
 - *Real risk, not theoretical*
- Need to ensure reliable supply to Manitobans



Reliability Risk –1996 Wind Event



- 19 DC towers down
- Electrode line damaged

Reliability Risk – Dorsey Converter Station



- Dorsey is currently single terminus point for HVDC system
- Significant weather events (tornados, etc.) in the vicinity of Dorsey in the past
- A loss at Dorsey could mean loss of connection to northern generation for up to 3 years.

Reliability Risk – 2011 Ice Event



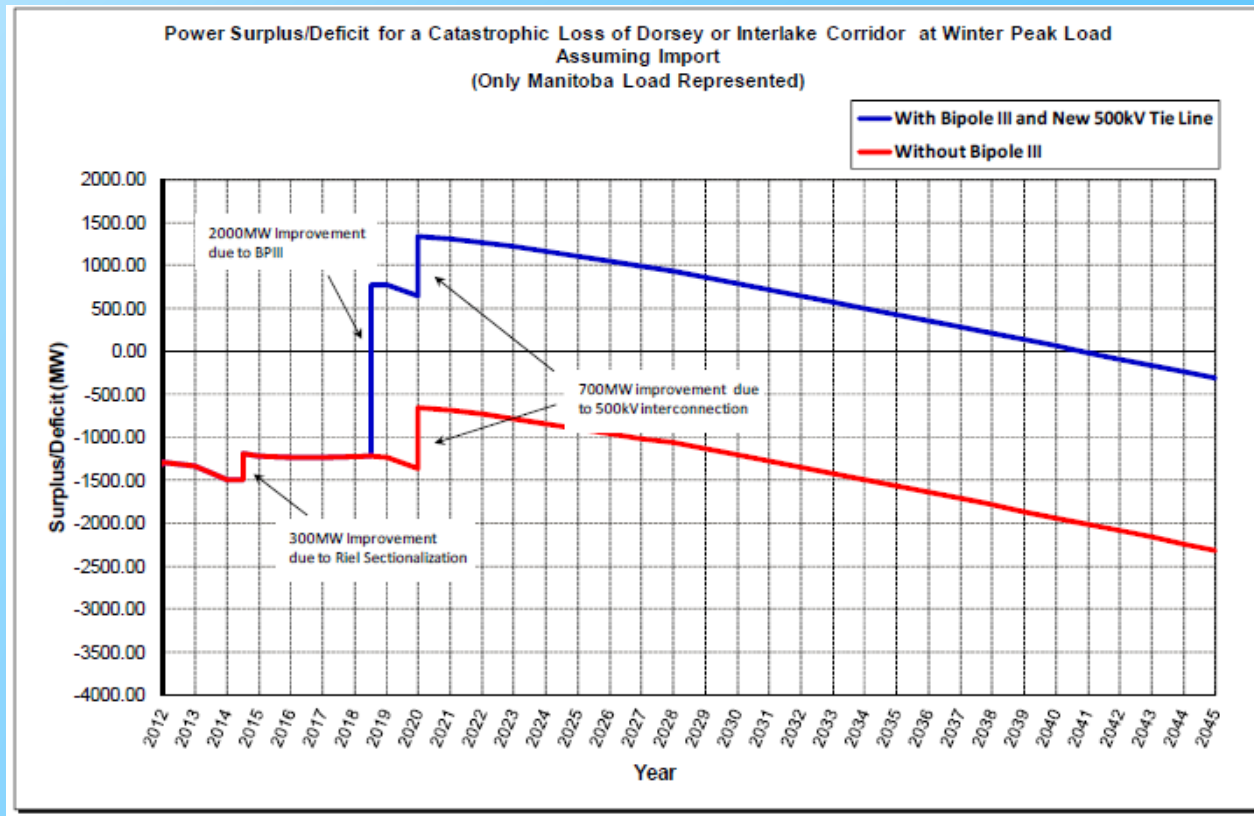
- With the tower bases locked in ice, torsional forces at the base bent members.
- Broken hardware, guy wire, and anchor rods.

- This structure was initially noted to be resting on the pin, about 3 inches off the plate.
- Eventually the structure was reset on a new helical pier foundation.

Governing Criteria

- Generation Planning Criteria: i.e. 12% reserves, low flow years.
- NERC Transmission Reliability Standards
 - TPL-001 (N), TPL-002 (N-1), TPL-003 (N-2)
- HVDC Adequacy Criteria
 - “spare pole over load” (1986 criteria),
 - to be replaced with “on-line spare valve group”
- Composite Reliability
 - Loss of Load Expectation (LOLE): 0.1 day/year guideline
 - Guideline since 1996 / explicit reporting requirement since 2012
- NERC TPL-004 – low probability, extreme events
 - Mandated to study consequences, but not necessarily to fix
 - LOLE does not replace TPL-004

TPL-004 Deterministic Analysis – Supply Deficit



- Supply deficit of approx. 700MW for Bipole I/II line loss in winter of 2020 vs. 1300MW surplus with Bipole III.
- Rotating blackouts for about 140,000 homes (5 kW per household), even with new 500kV import line

Probabilistic Analysis – Weather Hazards

- Manitoba Hydro has worked closely with field experts to evaluate weather hazards (Tornados, wide front wind, ice and etc) and other risks of losing the existing HVDC system after the 1996 event.
- Since 2001, three studies (Teshmont 2001, Teshmont 2006 and Teshmont 2012 reports) have been completed incorporating the advancement of study methodology and tools, and availability of extreme weather data -- filed as evidence in the CEC hearing

Probabilistic Analysis – Weather Hazards

- Teshmont 2012 Report

Events	Return Period of Failure (years)
Tornados	17 (Table 4-2)
Synoptic (wide front) Wind	90 (Table 5-1)
Combined Wind and Ice	20* (Table 5-1)

*MH used a more optimistic 50 year return period for LOLE studies

Probabilistic Analysis – LOLE

- A probabilistic adequacy analysis was performed to evaluate the impact of Bipole III. (2012)
- The existing system does not meet the industry LOLE guideline of 0.1 day/per year without Bipole III.
(EMERGING NERC Requirement)
- Bipole III significantly improved the system reliability with LOLE meeting the 0.1 day/per year guideline. (draft report, 2012)
- Together with new proposed 500kV tie line and Keeyask G.S, a reliable performance of Manitoba hydro system is ensured in the long term (probabilistic adequacy analysis was provided during 2014 NFAT)

Questions ?



Riel Converter Station Site