SUBJECT: Transmission Line

REFERENCE: Chapter 2; Section 2.3.5; Page 55

QUESTION:

What are the lattice structure weights utilized in the cost estimates for the transmission lines – approximately.

RESPONSE:

Approximate lattice structure weights for 230 kV lines such as are included in the North-South Transmission System Upgrades are:

Self-support angle	37,000 lbs
Guyed suspension	8,000 lbs

SUBJECT: Transmission Line

REFERENCE: Chapter 2; Section 2.3.5; Page 55

PREAMBLE: With respect to the North-South AC Transmission Line it would be helpful to understand the assumptions made in development of the $300,000 per km estimate.

QUESTION:

Was it considered the assembling of the structure would be in a central yard and flown to individual locations.

RESPONSE:

Work planning is the responsibility of the contractor, including decisions of where to assemble and how to transport the structures to tower sites.

Towers have only rarely been flown into place by helicopter on recent past Manitoba Hydro projects.

SUBJECT: Transmission Line

REFERENCE: Chapter 2; Section 2.3.5; Page 55

PREAMBLE: With respect to the North-South AC Transmission Line it would be helpful to understand the assumptions made in development of the $300,000 per km estimate.

QUESTION:

If assembled in central yards – was the thought to use helicopters for transporting structures - or trucking to sites.

RESPONSE:

Work planning is the responsibility of the contractor, including decisions of where to assemble and how to transport the structures to tower sites.

A common practice has been to partly assemble structures at a central yard and truck the pieces to site for erection or to assemble at the tower site. Larger towers are often assembled on site.

Towers have only rarely been flown into place by helicopter on recent past Manitoba Hydro projects.

SUBJECT: Transmission Line

REFERENCE: Chapter 2; Section 2.3.5; Page 55

PREAMBLE: With respect to the North-South AC Transmission Line it would be helpful to understand the assumptions made in development of the $300,000 per km estimate.

QUESTION:

Do they anticipate utilizing man-camps for workers if this area is that remote?

RESPONSE:

Worker housing is the responsibility of the contractor.

Camps have been used on past projects in more remote areas, albeit more commonly accommodation has been secured in local communities through short and medium term leases of rooms, apartment, houses and cottages.

SUBJECT: Transmission Line

REFERENCE: Chapter 2; Section 2.3.5; Page 55

PREAMBLE: With respect to the North-South AC Transmission Line it would be helpful to understand the assumptions made in development of the $300,000 per km estimate.

QUESTION:

If not, what would the typical drive time be from show-up to work site – or how far away would the contractor have to travel to get to the work (this combined with short days in winter would reduce productivity a bit more).

RESPONSE:

Housing and transportation to site is the contractor's responsibility for their personnel. Based on recent project experience, contractors have generally managed their housing to limit commute times to less than an hour. Commuting during pre-dawn and post-sunset hours has been a common practice.

The following commutes condition may be anticipated for the North-South AC Transmission projects:

Dauphin – Neepawa: southern location with abundant housing and easy access

Herblet to OverFlowing R.: northern location with sparse housing and limited highway access, maximum commute distance of approximately 70km along right-of-way, depending on contractor choice of housing.

Kelsey to Birchtree: northern location with potential housing at both ends and limited highway access, maximum commute distance of approximately 40 km along right-of-way, depending on contractor choice of housing.

Birchtree to Wuskwatim: northern location with potential housing at both ends and limited highway access, maximum commute distance of approximately 20 km along right-of-way, depending on contractor choice of housing.

SUBJECT: Transmission Line

REFERENCE: Chapter 2; Section 2.3.5; Page 55

PREAMBLE: With respect to the North-South AC Transmission Line it would be helpful to understand the assumptions made in development of the $300,000 per km estimate.

QUESTION:

Does this include contractor mob/demob costs being higher as this is in a remote area?

RESPONSE:

Mobilization and demobilization costs would expected to be higher in remote areas, however the northern projects in the North-South AC Transmission Lines are geographically similar to several recent Manitoba Hydro transmission lines projects on which the per km estimate was based.

SUBJECT: Transmission Line

REFERENCE: Chapter 2; Section 2.3.5; Page 55

PREAMBLE: With respect to the North-South AC Transmission Line it would be helpful to understand the assumptions made in development of the $300,000 per km estimate.

QUESTION:

Would wire (sock lines) be pulled in with helicopters?

RESPONSE:

It is up to the contractor to select a stringing method for a given project.

Common practice on past Manitoba Hydro projects has been to pull out the hard line with a dozer. Helicopter stringing is not expected.

SUBJECT: Transmission Line

REFERENCE: Chapter 2; Section 2.3.5; Page 55

PREAMBLE: With respect to the North-South AC Transmission Line it would be helpful to understand the assumptions made in development of the $300,000 per km estimate.

QUESTION:

We would assume they would use overland travel (frozen ground) to access sites. Is there any reason or areas that would preclude this assumption and they would have to do matting or temporary bridges?

RESPONSE:

No special access provisions are anticipated to be required for the North-South AC Transmission Line projects beyond frozen ground and snow bridges, as has been the common practice on recent Manitoba Hydro transmission line projects.

However, the contractor is responsible for building access and may elect to use other means beyond frozen ground.

SUBJECT: Transmission Line

REFERENCE: Chapter 2; Section 2.3.5; Page 55

PREAMBLE: With respect to the North-South AC Transmission Line it would be helpful to understand the assumptions made in development of the $300,000 per km estimate.

QUESTION:

Can someone send a drawing of what their mat footing and anchor consists of – typically? (Would assume the mat footing is a pad either poured in place or prefabed piece brought in and set in place?)

RESPONSE:

Mat footings and mat anchors are typically either precast concrete or timbers assembled on site. Typical drawings have been provided to POWER Engineers, and are of a size which cannot be attached to this response. Parties wishing to receive a copy of the drawing may do so by contacting Manitoba Hydro at mboyd@hydro.mb.ca.

SUBJECT: Transmission Line

REFERENCE: Chapter 2; Section 2.3.5; Page 55

PREAMBLE: With respect to the North-South AC Transmission Line it would be helpful to understand the assumptions made in development of the $300,000 per km estimate.

QUESTION:

Are the anchors ischebeck or screw in type – and how far down to firm soil?

RESPONSE:

Precast concrete mat or timber mat anchors are anticipated on projects where firm soils are accessible near surface. Alternatively, helical piles have commonly been used for anchors on recent Manitoba Hydro transmission line projects to penetrate 20 to 40' (typical), as singles or in pairs as conditions warrant.

Grouted anchors in overburden or rock were a common practice in decades past.

SUBJECT: Transmission Line

REFERENCE: Chapter 2; Section 2.3.5; Page 55

PREAMBLE: With respect to the North-South AC Transmission Line it would be helpful to understand the assumptions made in development of the $300,000 per km estimate.

QUESTION:

I think the lines are double circuit – please confirm?

RESPONSE:

All lines in the North-South AC Transmission Line are single circuit.

SUBJECT: Transmission Reliability

REFERENCE: Did not appear to be specifically addressed in NFAT filing.

PREAMBLE: Regarding Option 2A--This is a variation of option 2 - with an increased 2300 MW Bipole III rating (2000 MW with 15% overload) and includes a 230kV north-south ac transmission development of 100MW. The collector system is separated into two parts to meet the system reliability criteria; However, Three units of Kettle generation are switchable between the two collector systems to minimize the impact of equipment outages. The north-south HVdc transfer capability is increased by 629MW, so about 200MW of Conawapa generation is non-firm. This option would also firm up an additional 85MW transmission capacity for Wuskwatim and Kelsey generation. Effectively, about 120 MW of the Northern generation is non-firm. The estimated cost of this option is about $0.33B in 2011 dollars.

QUESTION:

Option 2A does not completely provide for on-line valve group sparing for Bipole 1, leaving approximately 300 MW unavailable with one valve group out of service. What is the basis or justification for not continuing the past policy of providing on-line valve group sparing?

RESPONSE:

As indicated in the response to PUB/MH-I 192, Option 2A leaves approximately 200 MW generation unavailable with one valve group out of service.

With the largest valve-group outage, the transmission capability of today's system has a spare shortage of about 200 MW. Therefore Option 2A is an improvement over today's spare capability. Also, Option 2A can be readily upgraded to option 2 with additional investment if full valve group spare is determined necessary in the future.

Therefore Option 2A is justified based on:

- Its ability to provide improvement over today's levels of valve group spare transmission capability.
- Upgradability to full spare transmission capability (Option 2) that can be done readily if and when full spare transmission is determined necessary and can be economically justified.
- Most economical for acceptable performance for least pre-investment.

SUBJECT: Transmission Reliability

REFERENCE: Did not appear to be specifically addressed in NFAT filing.

PREAMBLE: Regarding Option 2A--'This is a variation of option 2 - with an increased 2300 MW Bipole III rating (2000 MW with 15% overload) and includes a 230kV north-south ac transmission development of 100MW. The collector system is separated into two parts to meet the system reliability criteria; However, Three units of Kettle generation are switchable between the two collector systems to minimize the impact of equipment outages. The north-south HVdc transfer capability is increased by 629MW, so about 200MW of Conawapa generation is non-firm. This option would also firm up an additional 85MW transmission capacity for Wuskwatim and Kelsey generation. Effectively, about 120 MW of the Northern generation is non-firm. The estimated cost of this option is about $0.33B in 2011 dollars.

QUESTION:

Option 2A provides for 100 MW of new ac transmission development presumably to provide additional firm transmission capability. On the surface, this appears to be about 200 MW short. However, Manitoba Hydro analysis in section 2.3.1 concludes that the shortage varies from 20 – 120 MW depending on switching configurations for operating Kettle generation between NCS1 and NCS2. It is also noted that experience shows that switching capability is not always feasible during winter conditions. Please provide an explanation regarding the acceptability of all risks associated with not providing firm transmission for all hydro generation capability.

RESPONSE:

Considering the load forecast, it is most unlikely that this 120 MW of generation would introduce any risks for Manitoba Load serving capability for the next 30 years. Option 2A meets the NERC TPL reliability standard.

Without firm transmission capacity, there would some risks that up to 200 MW generation might be bottled under certain operating conditions therefore the value of that portion of

generation will be reduced in the market. This further demonstrates that Option 2A is prudently recommended, and allows for a future decision to upgrade to the full spare transmission Option 2 after a thorough evaluation of future market conditions and the associated risks.

As indicated in the response to PUB/MH I-192, the northern collector system will be split into two systems to meet the reliability requirements. A switching scheme is planned to transfer the power between the two systems in case of element outages in one system. The switching devices of the Manitoba Hydro system are fully capable of switching operation under -50C. However, Manitoba Hydro typically limits the switching operation for temperatures below -30C to optimize the required maintenance work and associated cost.

SUBJECT: Transmission Reliability

REFERENCE: Did not appear to be specifically addressed in NFAT filing.

PREAMBLE: Regarding Option 2A--'This is a variation of option 2 - with an increased 2300 MW Bipole III rating (2000 MW with 15% overload) and includes a 230kV north-south ac transmission development of 100MW. The collector system is separated into two parts to meet the system reliability criteria; However, Three units of Kettle generation are switchable between the two collector systems to minimize the impact of equipment outages. The north-south HVdc transfer capability is increased by 629MW, so about 200MW of Conawapa generation is non-firm. This option would also firm up an additional 85MW transmission capacity for Wuskwatim and Kelsey generation. Effectively, about 120 MW of the Northern generation is non-firm. The estimated cost of this option is about $0.33B in 2011 dollars.

QUESTION:

According toManitoba Hydro, splitting the NCS bus presumably takes care of the reliability issue for NCS bus faults. However, page 28 of [1] states that 'transfer of 100 MW generation to ac development will aid in reducing the risk of unacceptable frequency depressions for ac system faults to a certain extent'. However, Table 1 in the executive summary of [1] shows a moderate to high risk of unacceptable frequency depressions causing load shedding for option 2A. Please explain how Option 2A sufficiently mitigates the reliability risk of severe frequency depression and load shedding for AC faults with normal clearing and other events?

RESPONSE:

Due to the unique three-bipole HVdc scheme of Manioba Hydro's system, ac system faults , which affects the power delivery on all three bipoles, are more severe in comparion to a dc contingency such as a pole of bipole loss. The most critical reliability issues are due to the faults in the NCS and they have been resolved by splitting the NCS into two systems. However

splitting of the NCS does not provide any mitigation for potential reliability issues associated with ac faults in the southern system.

The system studies carried out using future system models did not show any reliability violations due to ac faults in the southern system. However, it was shown that the margin to potential load shed is minimal when all the proposed generation is delivered on the HVdc system (Option 3A). Given that there are uncertainties, such as the use of a generic model of Bipole III, in the system models used for study of a 30 year long-term horizon, it is concluded that there is considerable risk in reliability violations due to southern system faults when all the proposed generation is delivered on the HVdc system. This risk can be reduced by reducing the loading on the HVdc system.

Option 2A meets the NERC TPL standard. The risk of reliability violation due to faults in the southern system is mitigated by transfering some of the NCS generation onto ac transmission, or simply by bottling generation. Option 2A proposes to transfer 100 MW of NCS generation onto ac transmission and mitigates this risk. Therefore benefits of ac transmission development are two fold. It provides spare transmission for valve group outages as well as reducing the risk of reliability violations due to southern system faults.

Please refer to the responses to PUB/MH I-192 and CAC/MH I-014(a).