

Hydro One Networks Inc.

8th Floor, South Tower
483 Bay Street
Toronto, Ontario M5G 2P5
www.HydroOne.com

Tel: (416) 345-5700
Fax: (416) 345-5870
Cell: (416) 258-9383
Susan.E.Frank@HydroOne.com

Susan Frank

Vice President and Chief Regulatory Officer
Regulatory Affairs



BY COURIER

May 3, 2013

Ms. Kirsten Walli
Board Secretary
Ontario Energy Board
Suite 2700,
2300 Yonge Street
Toronto, ON M4P 1E4

Dear Ms. Walli:

EB-2012-0442 – Varna Wind Inc., S92 Leave to Construct – Hydro One Networks Inc's Responses to Interrogatory Questions

Please find attached two (2) hard copies of responses provided by Hydro One Networks Inc. to interrogatory questions from Board Staff.

An electronic copy of the Interrogatory responses, have been filed using the Board's Regulatory Electronic Submission System.

Sincerely,

ORIGINAL SIGNED BY SUSAN FRANK

Susan Frank

cc – Intervenors (by e-mail only)

attach

Ontario Energy Board (Board Staff) INTERROGATORY #1

Interrogatory

At page 1 of its evidence, Hydro One Networks Inc. (“Hydro One”) states that:

“Varna (as noted in response to Board Staff’s first interrogatory), accepted Hydro One’s policy of not allowing over-building (or joint-use) of high-voltage lines on Hydro One distribution poles along this route (due to safety and reliability concerns), and accordingly has located its transmission line on the road allowance on the opposite side of Hydro One’s distribution line”.

- a) When was the policy restricting joint-use of poles introduced by Hydro One? Are there any situations under the subject policy where exceptions are permitted that would allow for the joint-use of poles?
- b) Please elaborate on the “safety and reliability concerns” that prevent the joint use of poles? Please comment on what measures can be taken in the design phase to address the noted “safety and reliability concerns” such that joint-use of poles is permissible in this case.
- c) Are there any instances where joint-use of poles is currently permitted by Hydro One? Please provide the reasons for these exceptions.
- d) Is Hydro One aware of other utilities in North America that permit the joint-use of poles for the purpose of locating transmission and distribution lines? If the answer is “yes”, please provide the names of those utilities.

Response

- a) Hydro One Distribution’s formal documented policy addressing joint use of its poles with other parties has been in place since 2005. Hydro One actively encourages joint use of distribution infrastructure and has about 555 such agreements in place. Increasingly, agreements are being signed with distribution-connected generators requesting access to Hydro One’s distribution poles for their low-voltage circuits.

In 2011, Hydro One Distribution received a few requests for joint use arrangements involving ‘over-building’ or the attachment of high-voltage (above 50 kV) circuits to its distribution poles, with the high-voltage wires running longitudinally above the low-voltage (50 kV or less). Hydro One declined these requests (which specifically involved the attachment of 69, 115 or 230 kV circuits), based on general safety and reliability concerns and the fact that this was not standard practice. By late 2011, aware of the growing prevalence of transmission-connected generation, Hydro One began to examine this type of joint use arrangement in more detail. In Sept., 2012, after a careful review of the issues, Hydro One formally revised its joint use policy to explicitly prohibit transmission overbuild. The safety and reliability considerations which led to this change in its policy are detailed in response b) below. The policy

1 does allow for a single exception which grandfathers one arrangement already in
2 place. Please see the response to c) below.

- 3
4 b) Hydro One Distribution's safety and reliability concerns with this joint use
5 arrangement stem primarily from inductive coupling and possible electrical contact
6 between high- and low- voltage circuits. These concerns and a discussion of
7 mitigation measures are provided below:

8
9 **Inductive Coupling**

10
11 Hydro One conducted engineering studies on two proposals to attach 69 kV circuits
12 to its distribution poles, and determined that, as the 69 kV circuits are designed to
13 deliver the output of a generating facility, they can be expected to be loaded close to
14 capacity on a recurrent basis. The current on these circuits will be higher than the
15 traditional 400 Amp capacity of Hydro One Distribution feeders; therefore, inductive
16 coupling from the proposed circuit is likely to reach levels beyond those experienced
17 in normal Hydro One practice. This raised the following concerns:

- 18
19 i. *Induction contributing to Temporary Over-voltage* – Temporary Overvoltage
20 (“TOV”) is expected to be elevated dramatically in the presence of an unbalanced
21 fault on the proposed line, since the resulting coupling to the lower voltage circuit
22 is not moderated by cancellation of magnetic field contributions from balanced 3-
23 phase currents. Hydro One's design practice requires such TOV levels to be
24 limited to 1.3 pu (corresponding to industry requirement for an effectively
25 grounded system).
26
27 ii. *Induction contributing to increased Neutral to Earth Voltage levels* – Balanced
28 load currents on the proposed circuit will contribute to Neutral to Earth Voltage
29 (“NEV”) levels on Hydro One's 4-wire feeders. This contribution may raise NEV
30 levels beyond the 10 V limit mandated by the Ontario Electrical Safety Code
31 (“OESC”) for all customer service entrances and result in the supply system's
32 contribution to Animal Contact Voltage (“ACV”) at livestock farming operations
33 exceeding the permissible off-farm contribution limit of 0.5 V established in the
34 Distribution System Code.
35
36 iii. *Voltage Unbalance* -- Although the proposed circuit is expected to carry balanced
37 currents in normal operation, the resulting voltages induced into Hydro One's 3-
38 phase feeders would not be balanced because the respective phase conductor pairs
39 are not symmetrically displaced. Voltage unbalance on the Hydro One feeder is
40 therefore likely to be impacted, depending on the relative phasing of the system
41 voltage waveform versus the inductive contribution. Hydro One must comply
42 with the American National Standards Institute (“ANSI”) C84.1 standard, which
43 indicates that electric supply systems should be designed and operated to limit the
44 maximum voltage unbalance to 3% when measured at the revenue meter under
45 no-load conditions. At the same time, the National Equipment Manufacturers
46 Association (“NEMA”), which represents motor and drive manufacturers,

requires motors to give rated output for only 1% of voltage unbalance per NEMA MG-1-1998, and to be derated for application at higher unbalance.

Potential Conductor Breakage Leading to Electrical Contact

Hydro One Distribution's 44 kV feeders have a design rating of about 30 MVA, potentially serving 10,000 customers at an average 3 kW residential load. Over-building arrangements introduce the risk of direct conductor contact between the respective circuits, whether caused by natural or by contingent hazards. Contact between a high- and a low-voltage conductor would subject customers served from the lower voltage circuit to temporary overvoltages, which would be significantly higher than normal. Such overvoltages would in turn, potentially lead to permanent equipment damage and large-scale service disruptions, requiring extensive restoration times. Hydro One has determined that the probability of a breakage occurring at least once in a 40 km circuit over 50 years is 25% for a 230 kV line and 44% for a 115 kV line.

Increased Potential for Lightning Strikes

The higher poles used in over-building arrangements introduce an increased possibility of lightning strikes, with resulting potential pole fires and outages.

Mitigation Measures

Mitigating Inductive Coupling -- Induction issues may or may not be substantial, depending on project specifics, and the effects can vary along the route. At minimum, to accommodate over-building, Hydro One would have to replace its current distribution wood poles, which are 45 to 60 feet in height, with 100-foot steel poles, and implement framing which maintains specified distances between the high- and low-voltage wires. Such mitigation measures would require case-by-case assessment, design, monitoring, and additional technical "fixes" as may be needed to address issues which arise at individual locations. Even with these measures, complete elimination of the issues is not guaranteed.

Mitigating Potential Electrical Contact between High- and Low-Voltage Conductors -- Hydro One is not aware of any utility finding a sound engineering solution to the issue of potential electrical contact that does not compromise safety or service reliability. As utilities have become aware of these issues after the fact, surge arresters have been used to mitigate problems, but problems, nonetheless, remain. For example, in response to several instances of conductor contact on shared poles, the British Columbia Utilities Commission ("BCUC") issued a directive requiring installation of surge arresters as sacrificial devices to mitigate customer impact, and contemplation of changes to certain operating (reclosing) practices that involve a tradeoff between service reliability versus personnel and equipment safety.¹ It

¹ Letter L-35-11 Re: British Columbia Utilities Commission Directives to British Columbia Hydro and Power Authority (BC Hydro) in Letter L-60-10 originating from Order G-54-09 Mission/Stave Falls

1 should be noted that the Commission's directive concludes that the installation of
2 surge arresters, as directed, "will substantially but not entirely mitigate the damage"
3 caused by overvoltages resulting from conductor contact. Hydro One's design
4 philosophy is not to use underrated protective equipment (in this case, surge
5 arresters), because it is not a safe or prudent engineering practice.

6
7 *Mitigating Lightning Strikes and Pole Fires* -- The risk of pole fires can be managed
8 by resorting to steel poles, and the adverse impact on feeder service reliability can be
9 addressed by installing lightning arresters on each under-built lower voltage circuit,
10 placed at regular intervals along the entire exposure. These types of mitigation
11 measures, however, increase initial capital costs and ongoing future maintenance
12 costs related to an ongoing program of arrester inspections and possible replacement.

13
14 Following its review of these considerations, Hydro One decided not to allow new
15 joint use agreements involving transmission voltages on distribution poles, and
16 formalized this decision in the change to its joint use policy in 2012.

- 17
18 c) One exception to Hydro One's policy is an arrangement with a third party where
19 Hydro One's distribution line is under-built on the other party's transmission pole
20 line with 69 kV lines attached above. This is a legacy arrangement, which was
21 completed prior to Hydro One's more stringent reviews of such practices and would
22 not be undertaken today. Hydro One has been reviewing this arrangement in an
23 attempt to develop a solution amenable to both parties, but has not yet been able to
24 do so.

25
26 Also, in two instances, Hydro One has distribution circuits attached to transmission
27 structures and running longitudinally below Hydro One transmission (115 kV)
28 circuits. These too, are legacy arrangements. Unlike the proposals recently received
29 by Hydro One, the routes in these two cases follow transmission corridors.

- 30
31 d) In developing its position on this issue, Hydro One reviewed other utilities' practices
32 from information already available. Ten other utilities in Canada allow under-
33 building of distribution-voltage lines on transmission structures. Of the ten utilities
34 which have confirmed these practices, BC Hydro, Enmax and NB Power have
35 permitted Hydro One to disclose their names in connection with this matter. Hydro
36 One is not aware of the circumstances in which such use is permitted (that is, whether
37 it is restricted to off-road corridors, as may be the case for some, or not). Seven of
38 these utilities have indicated that they were dealing with issues arising from
39 accidental contact between the two voltage lines.

Ontario Energy Board (Board Staff) INTERROGATORY #2

Interrogatory

Preamble: At page 1 of its evidence, Hydro One states that:

“Today, Hydro One Distribution serves about 17 customers who will lie behind Varna’s transmission line, on the opposite side of the road from Hydro One’s existing distribution line. In addition, for the next 20 years (and possibly longer, coinciding with Varna’s generating contract), in order to serve future home builders or others requesting a new electrical service connection, Hydro One Distribution will have to get its lines across the transmission line.”

- a) As proposed 17 Hydro One Distribution customers will lie behind Varna’s transmission line and Hydro One Distribution anticipates it will receive requests for new customer connections in the future. In order to understand the rate of growth in new connections, please provide the number of new distribution customer connections that were connected along the subject route in the past five years (2008-2013 Year-to-date), and the expected new customer connections for the next five years (2013 – 2018).

Response

- a) In the last five years, Hydro One connected one new customer on this portion of the route. Over the next five years, one or two more new customers might require connection, but this is simply an estimate by Hydro One as it has no confirmed forecasts at this level. In addition to new connections, however, existing customers on the opposite side of the road could also require modifications of their service, for which the same access issues apply. For example, a customer request to upgrade a single-phase line to a three-phase line would require Hydro One Distribution to replace the customer’s existing line, triggering the issues described in Hydro One’s evidence. The Distribution System Code section 3.2.20 (b) classifies this as an expansion and the customer must bear the cost responsibility for this work (unlike a basic connection, which the distributor funds from rates).

Ontario Energy Board (Board Staff) INTERROGATORY #3

Interrogatory

Preamble: At page 3 of its evidence, Hydro One states in part that:

“An alternative that would eliminate many of the above-noted technical and operational issues associated with the shared rights of way for overhead wires, which has been discussed on a preliminary basis with Varna, would involve Hydro One relocating the road crossing portions of its distribution line underground. Hydro One’s current practice is to install overhead wires, particularly in rural areas, due to the generally lower cost of this approach vis-à-vis the underground alternative. However, in recognition of the increasing complexity of the issues related to overhead service noted above, and the number of projects similar to the current Application which are expected going forward, Hydro One is now considering making underground installations a policy requirement in these circumstances.”

- a) Would the issues (as noted in evidence) associated with the shared use of rights of way be eliminated if Hydro One were to permit the joint-use of poles in this case? Please explain why issues related to the shared use of rights of way cannot be eliminated if the joint-use of poles were to be permitted.
- b) In recognition of the fact that Hydro One expects a number of similar projects to occur in the future, would Hydro One be agreeable to undertaking a study comparing on a total costs basis (including transmission and distribution related costs) of the following two alternatives: (i) making underground installations a policy requirement; (ii) allowing co-location of transmission and distribution on same side of public roads sharing the same towers with appropriate cost responsibility between all parties. If such a study has already been undertaken please file the report pertaining to the study.

Response

- a) While some issues associated with the shared use of rights of way would be eliminated if Hydro One were to permit the joint use of poles¹ in this case, other, more serious issues would be introduced instead. If both high- and low-voltage wires must travel the same route, Hydro One believes, based on the considerations outlined in the response to Board Staff Interrogatory 1, that placement of the two circuits on opposite sides of the road, with an appropriate distance maintained between them, is less risky than joint use. This preferred configuration does not eliminate all the risks of joint use, but could confine them to the individual locations where the distribution line must cross under the transmission line to reach a customer. In this context, there are two options for the distribution feeder to cross beneath the transmission line – overhead and underground. An overhead crossing requires certain arrangements to maintain appropriate distances between the two

¹ For clarity, Hydro One means “joint use” in these circumstances as that defined in its response to Board Staff Interrogatory 1a).

1 voltages, and protocols to ensure safe and reliable operation at all times. An
2 underground crossing mitigates most risks associated with the overhead crossing
3 option, but carries greater upfront costs and may not be physically possible in some
4 locations. Hydro One remains in discussion with Varna on the transmission-
5 distribution crossing issue in the hopes that an agreement amenable to both parties
6 can be reached.

- 7
8 b) To be clear, Hydro One understands the phrase “co-location of transmission and
9 distribution on same side of public roads sharing the same towers” to mean the joint
10 use arrangement described in response a) above.² Hydro One has not conducted a
11 study comparing the alternatives on a total cost basis as proposed by Board Staff, but
12 is willing to initiate one. Such a study would take some time to complete.

² Hydro One notes this clarification, as the term “co-location” in the Summerhaven case means high- and low-voltage lines running parallel to each other on the same side of a public road, but *not* sharing the same structures (that is, there is no joint use of poles).

Ontario Energy Board (Board Staff) INTERROGATORY #4

Interrogatory

Preamble: At page 3 of its evidence, Hydro One states in part that:

“For the Varna project, this would involve relocating underground, all of the existing road crossings along the shared route, at a preliminary cost estimate of approximately \$320 thousand. Future new connections would also be put underground at an estimated incremental cost above overhead wire installation of between \$5,000 and \$9,000 per connection. (Costs arising from road boring in a very rocky area could be much higher, however).

- a) Hydro One has provided a cost estimate for one of the proposed solutions that entails relocating underground all of the existing road crossings along the shared route. In comparison to above noted cost estimate, what is Hydro One’s estimate of costs if joint-use of poles were to be permitted in this case? Please comment on whether allowing for the joint-use of poles is a less costly alternative compared to the “underground” option.

Response

- a) As noted in response to Board Staff Interrogatory 3, Hydro One has not determined the detailed costs of accommodating high-voltage circuits in a joint use arrangement with Hydro One’s low-voltage circuits. These costs could be developed as an aspect of the study discussed in response to Board Staff Interrogatory 3.