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BY COURIER

April 30, 2009

Ms. Kirsten Walli
Secretary
Ontario Energy Board
Suite 2700, 2300 Yonge Street
P.O. Box 2319
Toronto, ON
M4P 1E4

Dear Ms. Walli:

EB-2007-0709 – Hydro One Networks' Comments on Proposed Amendments to the Distribution System Code

In response to the Board's March 31, 2009 Notice of Proposal to Amend a Code in this proceeding, Hydro One provides the attached Submission of Hydro One Networks Inc. Regarding the Board's Proposed Changes to Amend the Distribution System Code.

An electronic copy of the submission has been filed using the Board's Regulatory Electronic Submission System (RESS) and the proof of successful submission is attached.

Sincerely,

ORIGINAL SIGNED BY SUSAN FRANK

Susan Frank

Attach.

EB-2007-0709

IN THE MATTER OF the *Ontario Energy Board Act, 1998*,
S.O. 1998, c. 15 (Sched. B);

AND IN THE MATTER OF a proceeding pursuant to
subsection 70.2 of the *Ontario Energy Board Act, 1998*
to amend the Distribution System Code

SUBMISSION OF HYDRO ONE NETWORKS INC. REGARDING THE BOARD'S PROPOSED CHANGES TO AMEND THE DISTRIBUTION SYSTEM CODE

APRIL 30, 2009

Contact Information

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Hydro One Networks Inc. ("Hydro One") is pleased to provide comments on the Board's proposed amendments to the Code to add a new Appendix H, which specifies an investigation procedure for distributors to follow in addressing farm stray voltage issues. Hydro One supports the goals of the proposed amendments but has some comments to assist the Board. For the issues identified in sections H.5.2.2 (3) & (4), Hydro One is prepared to work with Board staff to consider options to address the limitations.

1) Section H.5.2.2 (3)

Hydro One has identified a technical limitation in the formula proposed to determine the contribution to ACV from the distribution system ($VccD = (Vpfsv - Vphalf)/(Vpfull - Vphalf) \times (Vccfull - Vcchalf) + Vcchalf$) for single phase farms. This formula relies on approximations that are only valid when the in-farm sources of stray voltage do not contribute significantly to animal contact voltage. When there are wiring problems in the farm, this formula no longer takes into account the on-farm contributions correctly, and may artificially skew the contribution of the distributor. As a result of producing misleading results, the proposed procedure could cause many remedial measures on the part of the distributor to appear ineffective; and would increase costs and add more confusion to the process for the farm customer. An illustrative example is shown in Appendix HONI.1, where two different scenarios are used to show how the calculation of contribution to ACV from the distributor varies greatly depending on the level of impedance in the farm neutral wiring.

2) Section H.5.2.2 (4)

This section covers "farms with three phase balanced load." In reality, farms with three-phase service will always have unbalanced load to some extent. This section should be modified to cover farms with **unbalanced** load. There will be many single-phase loads (eg lights, appliances, heaters) that will create current unbalance. Therefore the on-farm contribution to ACV will also depend on farm neutral currents, as is the case with single-phase service.

3) Section H.5.1.2 (6)

Provisions should be made to disregard measurements where an isolated significant transient such as a temporary fault may cause an undue skewing of the results. These events should be highlighted and resolved rather than simply added to the data set.

4) Section H.4.1 (1)

Hydro One is unaware of Cat IV rated equipment, necessary for working in outdoor environments that could meet the level of accuracy specified. The equipment resolution and accuracy specified in the procedure should match what is commercially available.

5) Coming into Force

Hydro One would also like to suggest that a period of 90 days after the proposed changes are published is too short for larger distributors to implement the required steps to perform this testing. The procedure outlined in Appendix H will require new equipment and has material changes from the test procedure Hydro One currently uses. This would require tendering, ordering and receipt of new equipment; scheduling of training of a number of staff across the Province on how to use the new equipment and procedures; documentation of new work processes and preparation of computer systems for electronic data storage. We propose that a period of 180 days is more realistic.

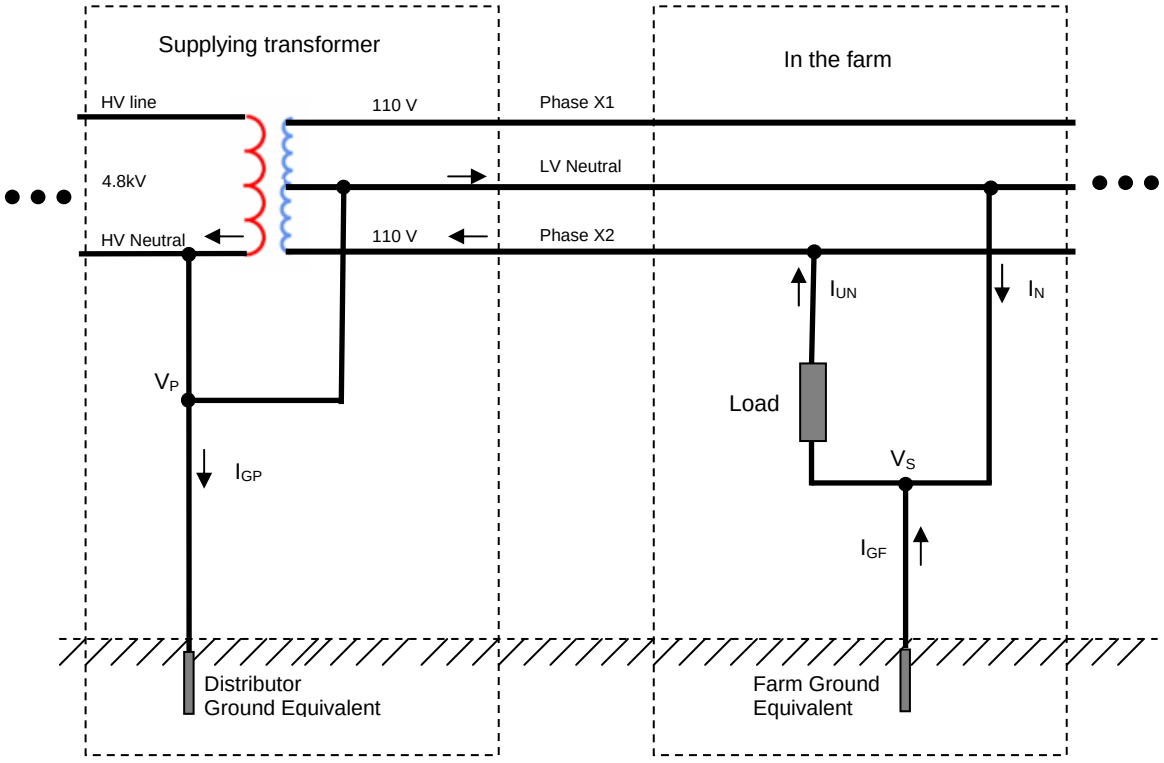
APPENDIX HONI.1

This Appendix includes an example to illustrate a technical flaw in the formula in Section H.5.2.2 (3) to calculate contribution to ACV (VccD) from the distribution system. The proposed formula for single phase farms is:

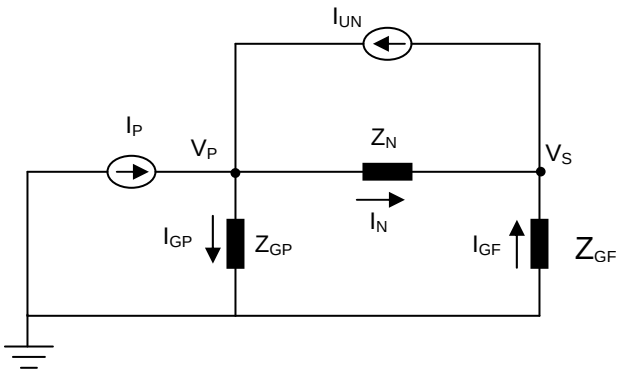
$$VccD = (Vpfsv - Vphalf)/(Vpfull - Vphalf) \times (Vccfull - Vcchalf) + Vcchalf$$

Example

In the following example, the on-farm stray voltage source is represented by unbalance current I_{UN}. The unbalanced current returns to the supplying transformer through the LV neutral and the grounding electrodes.



The above farm electrical circuits can be modeled as the following simpler circuits. A bad LV neutral connection is taken as the example here.



Z_N = 0.05 ohms, representing a healthy neutral connection, or 0.5 ohms, representing a bad neutral connection.

Z_{GF} = 4 ohms, representing the aggregated farm ground impedance.

Z_{GP} = 1 ohms, representing the aggregated distributor ground impedance

The animal contact voltage $V_{CC} = kV_S$, where k is a coefficient depending on the animal contact impedance and the transfer impedance between the farm ground conductor and the animal. Here for example, we assume k = 0.25.

Since all farm loads are turned off in the proposed load box test ($I_{UN} = 0$), the linear relation established by the load box text will be:

$$VccD = kVs = 0.25\ Z_{GF}/(Z_{GF}+Z_N)\ V_P \qquad [1]$$

Note that formula [1] is equivalent to the proposed formula in Appendix H.

However, V_P results from both I_P and I_{UN}:

$$V_P = I_P\ Z_{GP}\ (Z_N + Z_{GF}) / (Z_{GP} + Z_{GF} + Z_N) + I_{UN}\ Z_{GP}\ Z_N /(Z_{GP} + Z_{GF} + Z_N) \qquad [2]$$

We assume a worst case with equivalent I_P of 2 amps on the primary side of the transformer and unbalance current I_{UN} of 20 amps in the following two scenarios:

Scenario 1: The farm neutral is healthy with neutral impedance of 0.05 ohms

In this scenario, according to formula [2]

$V_P = 2 * 1* (0.05 + 4) / (1 + 4 + 0.05) + 20 *1*0.05 / (1 + 4 + 0.05) = 1.604 + 0.198 = 1.80$ volts

From formula [1], the distributor contribution accordingly is calculated as

$VccD = 0.25*4 / (4+0.05)\ V_P = 0.247\ V_P = 0.247 * 1.80 = 0.44$ volts.

The result shows a contribution of less than 0.5 volts.

Scenario 2: There is a bad neutral connection on the farm with neutral impedance of 0.5 ohms

In this scenario, according to formula [2]

$V_P = 2 * 1\ (0.5 + 4) / (1 + 4 + 0.5) + 20 *1*0.5 / (1 + 4 + 0.5) = 1.636 + 1.818 = 3.45$ volts

From formula [1], the distributor contribution is calculated as

VccD =0.25*4 / (4+0.5) V_P = 0.222V_P = 0.222 * 3.45 = 0.77 volts.

The result shows a contribution of more than 0.5 volts.

This example shows that the calculated contribution of the distributor increased by 75% because of on-farm problematic wiring.