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Ontario Electricity Distributor Practices Relating to Management of System Losses

Regulatory Audit Office

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Ontario Energy Board

Commission de l'énergie de l'Ontario

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Executive Summary

About this Report

In its 2007-2010 Business Plan, the Ontario Energy Board (Board) stated that it would conduct audit reviews of electricity distributor practices relating to the management of system losses. These reviews were carried out by our Regulatory Audit Office ("Audit") in early 2008. Known as the Distribution System Losses (DSL) Study, the findings are provided in this report.

Context

The Board allows electricity distributors to recover distribution system losses by approving a loss factor as a component of their rates. As part of their regular rate adjustment application, distributors apply to the Board to update their loss factors. If a distributor's losses exceed 5%, it is required to provide an explanation and action plan as to how it intends to reduce its losses.

To better understand current industry practices and perspectives, we surveyed 53 Ontario electricity distributors regarding:

- The procedures used to calculate system losses for reporting purposes;
- Whether they have metering and technical capabilities to accurately calculate and report system losses;
- How they monitor and manage distribution losses; and
- Their perception regarding the regulatory environment's impact on how they manage their system losses.

In addition, we conducted an informal survey of other jurisdictions to determine their distribution system loss experience and regulatory practices.

Key Findings

- Distributors calculate distribution losses by determining the difference between the total kilowatt-hours (kWh) purchased from the Independent Electricity System Operator (IESO) and embedded generators, and the total kWh sold to customers for the same period. As interval metering is not currently available for all retail meters, some estimates need to be made. All of the distributors in our sample believed that the accuracy of loss calculation will improve significantly when smart meters are fully deployed.

- Currently, distributors do not differentiate between technical and non-technical losses: it is deemed impractical to do so, given certain estimates are involved, such as unbilled revenue and unmetered scattered load. In any event, non-technical losses are typically believed to be a small percentage of total losses. It is also very difficult to measure the amount of technical losses directly due to the composition and scale of the distribution systems[1]. As a result, losses cannot be attributed to root causes. This difficulty does not appear to be confined within Ontario as initial research of several other jurisdictions showed that efforts to accurately measure all aspects of the losses are rare. However, with increasing system capability and the full deployment of smart meters, more accurate measurements may become more feasible.

- Most of the distributors have processes in place to ensure that anomalies in losses are identified and investigated on a timely basis. These processes include conducting visual inspections of meters for broken seals, tampered meters and jumped wires, performing random checks of billing multipliers, and auditing customer consumption and comparing it to previous periods.

- We reviewed a sample of 2006 and 2008 rate applications with high loss factors that were submitted to the Board, and found that distributors either had loss optimization projects in progress or had included a loss optimization plan for their service area in their rate applications. In instances where the latter had not been included with the rate application, distributors were required to file one within 90 days.

- Our survey of four other jurisdictions revealed that, similar to Ontario, system losses are treated as a pass-through cost (i.e., the cost of the system losses are passed through to consumers). In three of the jurisdictions, we discovered that system losses recoverable in rates are based on the utility's actual loss experience in prior years. In one jurisdiction, the estimates in rates are based on financial and engineering modelling.

- A majority of distributors indicated that there were insufficient incentives for them to optimize losses. Some of the factors mentioned were:
    - Distribution losses are a pass-through cost and distributors do not benefit from achieving efficiency improvements.
    - Loss optimization projects tend to be capital intensive and distributors have more important priorities to address, such as safety, security and reliability of service.
    - While distributors may not undertake capital projects solely for the purpose of loss reduction, it is often viewed as a beneficial by-product and taken into account in capital investment decisions driven by other priorities.

- Most of the distributors who received market adjusted revenue requirement (MARR)[2] funding for Conservation and Demand Management (CDM) used some of the money for implementing programs to mitigate system losses. The "Guidelines for Electricity Distributor Conservation and Demand Management EB-2009-0037", posted on the Ontario Energy Board's website in March 2008, indicate that any measures to maximize the efficiency of the infrastructure will not be considered a CDM initiative.

[1] Some large distributors use system modeling to estimate technical losses for some or all of their systems.
[2] In 2005, the Board gave its approval to electricity distributors to recover the third instalment of market adjusted revenue requirement (MARR) to invest an equivalent amount in conservation and demand management (CDM) initiatives.

The Guidelines note that “the Board is of the view that maximizing efficiency of the distribution system should be part of prudent asset management practices….”, and “the Board notes that its planned initiative to develop appropriate distributor asset management practices will provide an opportunity to further explore the role of energy efficiency in asset management planning”.

1. Background

One of the key initiatives outlined in the Ontario Energy Board's 2007-2010 Business Plan is the development of tools to measure and monitor utility cost effectiveness and service performance. As part of our ongoing work in this area – and recognizing that losses at the distribution system level have revenue value of about $350 million annually – the Regulatory Audit Office undertook this Distribution System Losses Study (the "DSL Study").

Distributors calculate the distribution system loss on the electricity distribution system as the difference between the total amount of electricity accepted into the system (i.e., amount delivered from the transmission system, the production of distribution connected generation, plus the net import through interconnections with other distribution systems), and the total amount of electric energy delivered by the distribution system (i.e., load that is metered with interval recording meters, demand meters and energy meters, as well as load that is unmetered).

The term *distribution system loss* is typically used to describe two types of losses, technical and non-technical:

- Technical losses on distribution systems are primarily due to heat dissipation resulting from (a) current passing through resistance in conductors and (b) from magnetic losses in transformers, which include a conductor loss and a core loss. The core loss does not vary with loading. Technical losses can be estimated analytically.

- Non-technical losses occur as a result of theft, billing errors, metering inaccuracies and unmetered energy. Such losses cannot be quantified analytically other than by subtracting technical losses from total losses.

Under the Board's Reporting and Record Keeping Requirements (RRR), distributors report their actual distribution losses annually. For more details about RRR data on distribution losses, see Appendix A of this report.

Since the actual distribution losses experienced by the distributor differ from the approved loss factor in its rates, a portion of losses may accumulate in a distributor's deferral account until it is ordered to be cleared through rates.

2. Objective and Scope

The objective of the study was to review distributors' practices and gather information on:

- Distributors' reported distribution system losses (see Summary in Appendix A);
- How distribution system losses are measured and reported;
- How distribution system losses are reflected in rates (see Summary in Appendix B);
- Factors contributing to the losses;
- How distributors manage or reduce distribution system losses; and
- Benchmarks or standards, if any, for distribution system losses in other jurisdictions and how Ontario's distributors measure against these standards (See Summary in Appendix C).

This study did not examine legal and regulatory frameworks in other jurisdictions with respect to system losses as the focus was on reviewing management practices.

3. Approach

In conducting this study, we applied the following approach:

- From the information available through RRR and/or other filings, we compiled distribution system loss data for all distributors over the last five years.
- We invited a sample of 53 distributors to complete a questionnaire (see Appendix D) that would assist the Audit team in understanding various aspects of distribution system losses.
- We reviewed information from the completed surveys and synthesized it for the purpose of this report.
- An additional informal survey of other jurisdictions was conducted to determine their distribution system loss experience and regulatory practices.
- We reviewed the 2006 and 2008 Electricity Distributors' Rate applications of a sample of distributors with high Total Loss Factor (TLF) to determine the reasons for high losses and distributors' action plans for optimizing the losses.

4. Detailed Findings

4.1 Determination/Calculation of Distribution System Losses

Respondents to our survey were asked to describe how they calculated and reported their distribution system losses. The survey included questions on technical vs. non-technical losses and sought views regarding the impact of smart meters on the accuracy of calculating distribution system losses.

Our findings are summarized as follows:

- Distributors are not able to differentiate between technical and non-technical losses. However, many distributors commented that non-technical losses were not a material component of their total losses.
- Distribution system losses are calculated by determining the difference between kWh purchased (from the IESO and embedded generators) and kWh sold per retail meter readings, including unbilled revenue to customers plus an adjustment for unmetered scattered load.
- Due to the composition and scale of the distribution system, a direct measurement of actual technical and non-technical losses is very difficult. Instead, some distributors model some or all of their system. One large distributor relies on studies which are designed to calculate the magnitude, composition and allocation of system losses based on annual aggregate metering information for energy purchases, energy sales and system modeling methods.
- There was some inconsistency in how distributors reported distribution system losses under RRR. While most of the distributors in our sample excluded the supply facility losses, a few reported that their distribution losses included their supply facility losses.
- Some distributors stated that their system losses calculation is a best estimate because of the inherent flaws due to potential metering errors and the fact that all meters are not read at the same time. In addition, distributors need to estimate loads that are not metered (e.g., unmetered scattered loads, street lights).
- In general, all of the respondents calculated year-end system losses that involved some estimating, including unbilled kWh related to non-interval meters and unmetered scattered load. Only a few performed a monthly loss calculation for monitoring purposes, indicating that there is little motivation or requirement to calculate system losses more frequently than the current annual filing requirement.
- All of the respondents said that the implementation of smart meters will greatly improve the accuracy of loss calculations. Smart meters will allow for access to real time consumption data not currently available for small-volume consumers. In addition, smart meters will provide more accurate data for year-end analysis and will eliminate the need to prorate a bill, since readings will tell them exact customer usage versus what was purchased by the distributor.
- Based on an analysis of RRR information filed with the Board for the years from 2002 to 2006, we found that the average loss reported over a five year period for all distributors was 4.3%. Over this 5 year period, the reported losses varied considerably from year to

year for each distributor with the average minimum value equal to 3.7% and the average maximum equal to 4.9% for a typical distributor. This year over year variability may be attributable to a number of things including temperature and load fluctuations, estimation errors in loss calculations, and reporting errors.

- Losses can not be attributed to root causes in a meaningful way because certain estimates are involved. However, system capability is increasing and accurate measurement may become more feasible with the full deployment of smart meters. While we did not conduct an exhaustive search of other jurisdictions, we did learn that efforts elsewhere to accurately measure all aspects of the losses are rare.
- There is inconsistency in how distributors treat ancillary loads associated with lighting and/or heating distribution stations. While some of these loads are metered, and the utilities bill themselves for consumption, others are not metered and the utilities attribute this non-billed consumption as distribution system losses.
- There is considerable confusion as to the amount of system losses that have accumulated in each distributor's commodity deferral account.

4.2 Metering and Technical Capability

Our survey asked distributors to indicate their metering and technical capability to accurately calculate distribution system losses, including whether they had the capability to perform same day meter readings on their wholesale and retail meters to ensure consistent cut-off for the final calculation of system losses.

We found that:

- All of the respondents' wholesale meters have interval metering capability. Approximately 30-40% of the retail load (i.e., large commercial customers) has such capability, while the rest are read manually.
- All of the respondents indicated that concerns related to metering and technical capabilities will be reduced once smart meters are deployed and operational.

4.3 Monitoring and Managing Distribution System Losses

We reviewed a sample of distributors' rate filings to determine the reasons for high losses and the types of plans being implemented to reduce these losses.

The main factors cited for high losses were:

- Extensive lower density service areas, long distribution feeder lengths per customer served and reduced opportunity to achieve optimal loading of local distribution transformers; and
- Inadequate conductor size, transformer efficiency, feeder imbalance and outdated substations.

Most of the distributors whose rate filings were sampled had ongoing loss optimization projects under way or had submitted a plan for their service area either with their rate applications to the Board or within 90 days of the Board decision.

The survey included questions about the distributors' loss monitoring and management practices (e.g., how distributors monitor losses to ensure that any anomalies are identified and investigated on a timely basis), and whether the distributors had performed any studies to optimize losses. In addition, the survey asked distributors how they related their distribution system losses to their capital planning program.

We found that:

- 20% of the respondents had completed independent system optimization studies within the last five years, and had either implemented, or were in the process of implementing recommendations based on these studies.
- Most of the respondents have recently worked on capital programs that include loss optimization projects. The result: these distributors' average distribution system losses dropped from 4.09% in 2002 to 3.68% in 2006. Some projects were undertaken partly to reduce distribution losses, including:
  - Converting portions of their system to higher voltages (e.g., from 4 kV or 8 kV to 27.6 kV);
  - Installing capacitor banks to improve load factor, thereby reducing system losses;
  - Rerouting certain feeders to better balance the overall system and substation loading;
  - Installing larger conductors during line replacement; and
  - Eliminating older distribution stations that have high transformer losses.
- Many distributors have phase-rebalancing programs in place to minimize losses on unbalanced phases and to connect new services to the phase with the lightest load.
- According to most distributors, when considering new capital projects, loss reduction is a lower priority than other considerations, such as safety, system security and service quality. Respondents reported, however, that consideration of line loss improvements does impact their final project selection and design criteria. Distributors factor losses into, for example, selecting material and equipment, including:
  - choosing the sizing of the conductor;
  - using costly copper conductor instead of aluminum, as the latter is associated with higher losses; and
  - determining purchasing criteria for transformers.
- All of the respondents comply with the Meter Accuracy Verification program related to both wholesale and retail meters, as set by Measurement Canada. In addition, most of the respondents have additional internal processes to verify metering information in their Customer Information System to control system losses due to metering inaccuracies. Such processes include:
  - utilizing a cross phase analyzer – a metering testing device – for any new poly-phase or transformer type meters that are installed;
  - performing random checks of billing multipliers;

  - meter resealing, which provides reports identifying technical problems with particular brands of meters or batches of meter installations;
  - investigating exception reports that highlight zero usage readings, meters that show consumption with no billing account, and other material variances in consumption.
- Most of the distributors conduct audits on customer bills by comparing the previous year's and the previous month's consumption to the current billings.
- Distributors conduct visual inspections of meters when performing maintenance related to, among other things, broken seals, tampered meters and jumped wires.
- Distributors work with local law enforcement to assist with theft of power issues.

4.4 Impact of Regulatory Environment on Distribution System Loss Management Practices

The survey asked distributors to comment on whether the current regulatory environment gives them flexibility to optimize system losses and whether they see any regulatory barriers to reducing the losses.

- A majority of respondents (54%) felt that the regulatory environment is not sufficiently flexible to enable them to optimize distribution system losses.
- 36% of respondents were neutral on this issue and 10% were somewhat positive – they did not see any significant barriers to loss optimization.

All of the respondents either had undertaken or were planning capital projects that included a component related to loss optimization, although that in itself was not generally the primary reason for undertaking the initiative. Most of the projects with a loss optimization component were funded through the Board's CDM initiative (under the third tranche of MARR – see footnotes 1 and 2 on page 2).

Respondents identified a number of ways in which the regulatory environment impacts – adversely for the most part – their loss optimization activities. The following is a sample of the feedback:

- While capital spending on improving efficiencies has long-term payback, distributors are constrained from directing more efforts to loss reduction activities. Among the reasons offered, loss reduction activities are capital-intensive and there are other regulatory demands on capital.
- Since the cost is a pass-through, the distributor does not stand to gain financially from loss reduction efforts. Gains in productivity are negated when the system loss factor is recalculated during rate review. A distributor's return on investment to reduce system losses is limited to the return on rate base and depreciation recovery in rates on any associated capital investment.
- Distributors lack incentive to maximize the potential of distributed generation. To minimize system losses, distributed generation facilities should be located and sized appropriately and be given incentive to operate in a way that both reduces the

distribution system's demand on the transmission system and provides stabilization for the distribution system. Distributors argue that maximizing the potential of distributed generation is hindered by regulatory uncertainty, which poses impediments such as:

  - The queuing process for connecting new distributed generation causes connection congestion. Generators that are located strategically and could therefore have a large positive impact on losses do not always get connected on a timely basis.
  - Often it is uneconomical to invest in capital upgrades before a distributed generator can be connected, since the marginal costs may not be covered by additional revenues.
  - There is potential lost revenue to a distributed generation-serving customer load and no means to recover certain costs[3] (e.g., costs related to managing the generator account).

- The current economic evaluation and cost allocation processes, at times, make the optimum decision from a system perspective unfavourable for the customer. For example, in areas with high growth, it may be more efficient to feed a subdivision from a distribution station that is farther away because of loading on the closer substation. System losses climb dramatically as loading increases on substations and feeders. Careful balancing of these loads is required. Distributors must, therefore, deal with the trade-off between optimum system configuration and the cost to the customer of meeting that optimum configuration.
- The costs of upgrading the distribution system are considerable compared to the benefits (i.e., the payback period). The recovery period for capital work is perceived to be prohibitive to investing in equipment that could reduce losses.
- The current Incentive Rate Mechanism (IRM)[4] does not provide distributors with incentive to reduce losses. Rather, it encourages distributors to focus on improving system operations to meet service quality requirements, while losses are passed through to customers. Operational improvements, however, do not always enhance system efficiency. There are no incentives for a distributor to upsize conductors, add capacitor units or purchase more expensive low-loss transformers, as such improvements do not have operational or service quality-related benefits.
- It would be an inefficient use of capital to convert parts of the system that have not reached the end of their useful life.

To explore how line losses are treated in other regulatory environments, we surveyed five other jurisdictions and received responses from four. We learned that:

- Line loss is a pass-through cost in all jurisdictions surveyed.
- For rate setting purposes, Ontario is the only jurisdiction that has a line loss threshold, where an explanation is required for losses above the threshold or an action plan for loss reduction must be filed with the regulator.

[3] The Board plans to undertake a future initiative pertaining to distribution connection cost recovery.
[4] The Board is currently consulting on the development of the 3rd generation of incentive regulation, under which the treatment of capital investment is a matter being considered.

- Three of the four jurisdictions allow line losses to be recovered in rates, based on the distributors' actual line loss experience in prior years. In one jurisdiction that comprises two distributors, the estimates in rates are based on financial and engineering modelling.
- In one jurisdiction with multiple distributors, a uniform loss factor is applied to all distributors in the entire jurisdiction. In the other three jurisdictions, the practice is similar to Ontario, where loss factors are treated as unique to each distributor.

Although the jurisdictions surveyed gave some indication about loss levels in their systems, we cannot draw conclusions about comparability with Ontario statistics without further analysis (e.g., some jurisdictions combine transmission and distribution losses, others keep them separate). Please refer to Appendix C for line loss factors in other jurisdictions.

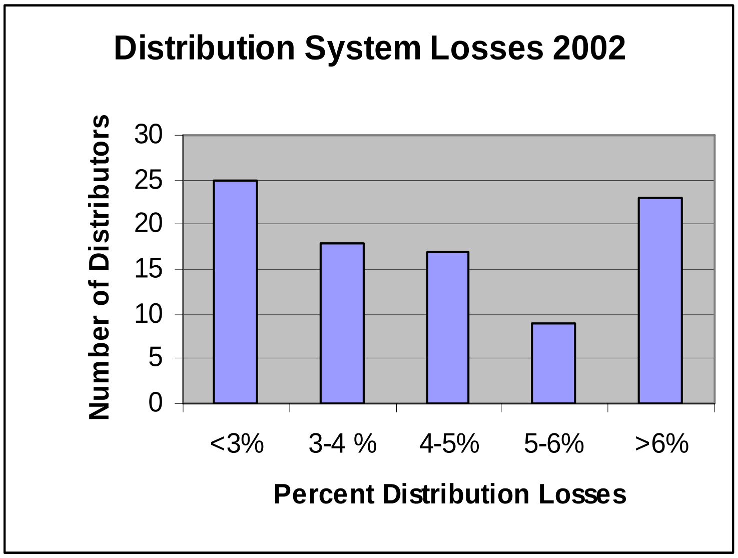
4.5 Suggestions for Change

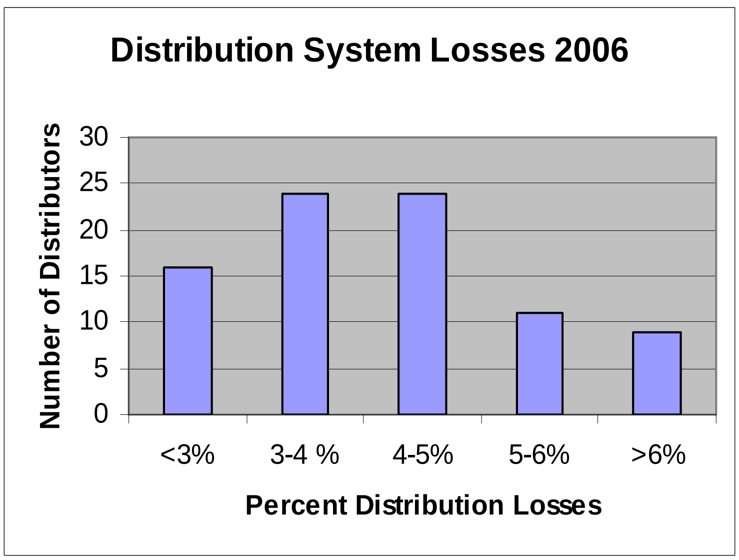
In the final part of our survey, distributors were invited to share their suggestions for changes we could make or advocate to improve the management of distribution system losses. The following represents a sample of responses offered:

- Consider providing loss optimization incentives to distributors who have high levels of losses.
- With the impending installation of smart meters, there is no point in pursuing loss reduction initiatives at this time.
- Any framework put in place for managing and optimizing system losses should build in flexibility for distributors because a one-solution-fits-all approach is not appropriate.
- With technology shifting from mechanical to electronic meters, losses due to internal meter error accuracy are being reduced. Unlike mechanical meters, which tend to register low readings as they fail and a malfunction can go undetected for some time, electronic meters normally will cease to display upon failure or indicate another readily detectable error. With a properly verified and sealed electronic meter, inaccuracy occurs much less frequently.
- A program to sample cross-phase loading of standard meter installations, combined with more frequent analysis of non-standard meter installations, was suggested as the most effective means to minimize meter inaccuracies due to equipment failure, as well as a good way to balance load in reducing system losses.

Appendix A

Distribution Losses Reported Under RRR





Distribution Losses from 2002 to 2006, As Reported Under RRR

	2002	2003	2004	2005	2006
Average	4.49%	4.15%	4.30%	4.24%	4.32%
Range	1.14% - 10.09%	1.13% - 9.38%	1.16% - 9.73%	1.01% - 8.75%	1.88% - 8.85%

Note: Under the RRR requirements of the Board, distributors report their actual distribution losses annually. The RRR data on distributors' losses does not include Supply Facility Loss Factor information (a relatively small component) and, for embedded distributors, the host distributor's distribution loss factor; as such, RRR data cannot be directly compared to the approved Total Loss Factor approved in rates.

Loss Factors in Rates

The Board allows electricity distributors to recover distribution system losses in their rates by approving a Total Loss Factor (TLF) within these rates for each customer class. When determining retail settlement costs, a distributor must adjust measured consumption at a consumer's meter for total losses by multiplying it by the approved TLF. The TLF is equal to the value by which the end-use metered load must be multiplied on the customer bill to equal the estimate of the total energy supplied to the customer. For example, if the approved losses for the distributor are 5.42%, the retail meter reading must be multiplied by a factor of 1.0542 as an adjustment to account for losses.

Approved TLF in Rates

Year	Range	Average
2005	1.0275 to 1.1660	1.0542
2006	1.0255 to 1.0898	1.0531

In accordance with the 2006 Electricity Distribution Rate (EDR) Handbook, distributors – as part of their rate adjustment application – apply to the Board to update their TLF. The adjusted TLF is based on the average of the previous three years' actual losses experienced by the distributor. If a distributor's losses exceed 5% (i.e., DLF greater than 1.05), the distributor is required to provide an explanation along with an action plan as to how it intends to reduce losses. A specific method for calculating the loss factor for the 2008 Cost of Service (COS) application has not been defined. However, a sample of 2008 COS applications selected for this study indicated that the distributors have continued to use the method described in 2006 EDR Handbook.

For non-embedded distributors, the TLF consists of two components – Supply Facility Loss Factor (SFLF) and Distribution Loss Factor (DLF):

- According to 2006 Electricity Distribution Rate Handbook, the DLF is calculated by dividing wholesale purchase by retail sales.
- The SFLF[5] is an adjustment to the metered amount that is used to calculate the Net Energy Market Settlement Charge paid to the IESO. Currently, 1.0045 is the default SFLF included in rates.

For embedded distributors, there are three components of the TLF – the DLF of the distributor, the DLF of the host distributor, and the SFLF. Hydro One is the largest host distributor, and their current DLF is 1.034 (or 3.4%).

[5] The Board's Retail Settlement Code provides a detailed description of the SFLF.

Appendix C

Loss Factors in Various Jurisdictions

Jurisdiction	Average Distribution Loss %[6]	Information Source
Alberta Energy and Utilities Board	4.24%	Obtained from the regulator.
Michigan Public Service Commission	4.46%[7] 9.16%[8] (co-op only)	Obtained from the regulator.
Essential Services Commission (Victoria, Australia)	3 to 5%[9] (urban) Up to 10%[10] (rural)	"Approval of Network Average Distribution Loss Factors for 2002/03 – Draft Decision by Essential Services Commission, Victoria, Australia". Obtained from the regulator's website.
Ontario Energy Board	5.3%[11]	Average calculated from the tariff sheets of all distributors. See Appendix B.

Jurisdiction	Average Blended Loss %[12]	Information Source
Régie de l'énergie - Quebec	7.5%[13]	Obtained from the regulator.
British Columbia Utilities Commission	9.55%	Obtained from the regulator and its website.
Michigan Public Service Commission	7.32%[14]	Obtained from the regulator.
North Carolina Utilities Commission	5.6%	"A Study of Feasibility of Energy Efficiency as an Eligible Resource as Part of a Renewable Portfolio Standard for the State of North Carolina" (December 2006). Obtained from the State of North Carolina's website.

[6] Average distribution losses in rates of the residential rate class.
[7] Average distribution losses for the subset of distributors whose rates are set with DLF only.
[8] Average distribution losses for the subset of distributors who are co-ops.
[9] For distributors with urban-based networks.
[10] For distributors with predominantly rural networks.

[11] The tariff rate comprises up to two or three components: the DLF of the distributor, the SFLF, and in case of embedded distributor, the DLF of the host distributor (see Appendix B for a detailed description).
[12] Average blended transmission and distribution losses.
[13] Blended transmission and distribution loss factor used by all the distributors in the province. Hydro-Quebec is the only distributor that goes to the regulator for rate setting. There are nine municipal distributors and one co-op, all of which use the loss factor approved for Hydro-Quebec.
[14] Average blended transmission and distribution loss factor for a subset of distributors whose rates are set with blended loss factors.

Appendix D

Review of Distribution System Losses
Questionnaire
January 2008

Utility Name______________________

As set out in the Board's letter of January 8, 2008, the Board is conducting a review of distribution system losses. Please refer to that letter for further information regarding the purpose of the review and regarding internal and external reporting on the questionnaire responses and the results of the review.

Respondent Instructions:

Please review the questions set out below and provide your responses in electronic form by e-mail to Raj Sabharwal at rajvinder.sabharwal@oeb.gov.on.ca by **January 21, 2008**.

Please provide as much narrative detail as possible in your responses to the questions set out in sections A through D. If your response to a question set out in section E is already provided in an earlier response, you need not repeat it. However, it would be appreciated if a cross-reference to the applicable earlier question were provided (e.g., "See the response in Section A").

A. Impact of Regulatory Environment on How Distributors Control and Manage Distribution System Losses

Please provide your views on whether the current regulatory environment provides sufficient flexibility to enable distributors to optimize system losses, and whether you see any regulatory barriers to reducing the losses.

B. Determination/Calculation of Distribution System Losses

Please describe the procedure that you use to calculate distribution system losses for reporting under RRR**.** Please identify whether you can distinguish between technical[15] and non-technical[16] losses, and describe how you ensure that losses are calculated and reported accurately.

C. Metering and Technical Capability

Please describe whether your utility has the metering and technical capability to accurately calculate and report on system losses. For example, do you have the capability to perform same day readings on

[15] Technical losses are due to such things as heat dissipation resulting from current passing through resistance in conductors and from magnetic losses in transformers, etc.
[16] Non-technical losses occur as a result of such things as theft, billing errors, metering inaccuracies and unmetered energy.

wholesale and retail meters to ensure consistent cut-off for the final calculation of system losses?

D. Ability to Monitor and Manage Distribution System Losses

Please describe your distribution system loss management practices. Among other things, please provide responses to the following:

- How do you monitor losses to ensure that any anomalies will be identified and investigated on a timely basis?
- Do you have a meter accuracy verification program in place to identify when losses are due to metering inaccuracies?
- Do you conduct substation meter data collection and analysis at regular intervals?
- How do you relate distribution system losses to your program of capital work?

E. Supplementary Questions

1. Have you had an independent study of distribution system losses conducted? If so, when and for what purpose? Please provide a copy of the study report.
2. Are the quantities used in determining unbilled revenue for accounting purposes the same as the quantities used in calculating distribution system losses? If not, what are the differences?
3. Do you have any uncleared distribution system losses in a variance account? If so, how much was in the variance account as of December 31, 2006?
4. Have you identified the components of your system that contribute the most to your technical energy losses? What are these components, and what are the reasons for these losses? What is the approximate kWh of energy passing through each of these components annually?
5. How do you identify any theft of energy? What were some of the lessons learned from your experiences that might benefit other distributors in dealing with the theft of energy?
6. What actions do you take to determine the reasons for higher than normal or higher than expected distribution system losses?
7. Does your utility, as a matter of course, follow specific practices during meter reading activities that are designed to identify losses (e.g., inspection of meters for tampering or bypass)? If so, please provide a description of your practices.
8. What changes in the configuration of your distribution system or other changes, including replacing or upgrading any components of your

distribution system, have you made within the last 5 years or are you planning to make in order to improve the efficiency of your distribution system?

9. How do you expect that smart meters will affect the management of distribution system losses?

F. Suggestions for Change

Have you any suggestions for changes/improvements that the Board could make or encourage that would improve the management of distribution system losses?