London Hydro Inc.

ED-2002-0557

Narrative for Smart Meter Cost Recovery Application

Board File Number

EB-2012-0187

MANAGER'S SUMMARY

London Hydro hereby applies and seeks the approval for the following:

- The Board's determination that Smart Meter capital $24,403,496 and operating expenditures $806,711 to December 31, 2011 are prudent;
- A Smart Meter Disposition Rider ("SMDR") to recover for the difference in the deferred revenue requirement through to April 30, 2012 related to smart meters deployed through to December 31, 2011, and the Smart Meter Funding Adder revenue collected to April 30, 2012;
- A Smart Meter Incremental Rate Rider ("SMIRR") to recover the annual revenue requirement for the period May 1, 2012 though to April 30, 2013, associated with Smart Meters installed from the inception of the Smart Meter program through to December 31, 2011. The SMIRR is calculated as a proxy for the incremental change in the distribution rates that would have occurred if the assets and operating expenses were incorporated into the rate and the revenue requirement. This rate rider will be in effect until the implementation of new approved distribution rates as determined in London Hydro's next cost of service. The next cost of service filing is required to be submitted for distribution rates for 2013;
- London Hydro is not requesting the recovery of Stranded Meter costs in this application. These meters continue to be included in rate base for rate-making purposes, as is recommended by the Board in its Decision with Reasons in the Smart Meter Combined Proceeding (EB-2007-0063). London Hydro intends to seek recovery of the Stranded Meters in the next cost of service application for 2013;
- In the event that the OEB is unable to issue its Decision and Order for both prudence review of Smart Meter costs and establishment of Smart Meter recovery rates effective May 1, 2012, that there be continuation of the existing approved Smart Meter Funding Adder (EB-2010-0097) in the amount of $1.46 per metered customer until such time as this smart meter cost recovery application is approved by the Board.

London Hydro confirms that the Board's updated Smart Meter Model, version 2.17, issued December 15, 2011, was used to calculate the SMDR and the SMIRR. The Model is included in this Application and filed in Appendix A. The revenue requirements for each year (2006 through to 2012) have been calculated utilizing the Model, and are consistent with the approach of other applications that have been approved by the Board. The resulting revenue requirement for the SMDR is offset by both monthly SMFA collected from our customers and the carrying charges, calculated on the monthly SMFA balances. The cost of capital parameters used in the Model to determine deferred revenue requirement are those approved by the Board in London Hydro's last cost of service rate application (EB-2008-0235).

To provide for an allocation of the SMDR true-up and the SMIRR 2012 revenue requirement each customer class, London Hydro is proposing to utilize a similar approach as was approved by the Board's Decision and Order in Powerstream's 2010 Smart Meter Application (EB-2010-0209). The two customer classes that directly benefit from the smart meter initiative, and request recovery from are Residential and GS< 50 kW classes. The recoveries and proposed rate charges

for SMDR and SMIRR are reflected in this Application under the titles Smart Meter Disposition (SMDR) and Smart Meter Incremental Rate Rider (SMIRR).

The monthly bill impacts based on the proposed SMDR and the SMIRR, are for Residential class (typical 800 kWh per month) net increase of $1.52 or 1.45%, and for GS < 50 kW class (typical 2,000 kWh per month) net increase of $3.34 or 1.29%. These impacts have been determined by the introduction of the proposed SMDR and SMIRR rates to the proposed rates that have been applied for in London Hydro's 2012 IRM rate application (EB-2011-0181). The impacts are discussed further in this Application under the title Rate Change Summary and Bill Impacts.

In proceeding with this Application, London Hydro is aware that in the Model there is a note that states, "The Board expects that the majority (I.e. 90% or more) of costs for which the distributor is seeking recovery will be audited". In regard to Table 1 below, London Hydro confirms that all costs submitted for recovery have been audited and included in our financial statements for the year-ended December 31, 2011.

Table 1 – Calculation of Total Costs Seeking Recovery to Total Costs That Have Been Audited

Year	OM&A	Capital	Total	Cumulative	Audited Y/N	% of Cumulative Costs Audited
2006			0	0	Y	100.0%
2007	5,998		5,998	5,998	Y	100.0%
2008	101,711		101,711	107,709	Y	100.0%
2009	113,349	4,999,448	5,112,797	5,220,506	Y	100.0%
2010	422,882	16,262,194	16,685,077	21,905,582	Y	100.0%
2011	162,771	3,141,854	3,304,625	25,210,207	Y	100.0%
2012	746,000	511,307	1,257,307	26,467,514	N	

London Hydro requests these expenditures be considered final. Model notes also identify that "a distributor may also include historical costs that are not audited and estimated costs, corresponding to a stub period or to a forecast for the test rate year".

London Hydro respectfully requests that as 100% of expenditures (total audited costs up to end of Year 2011, in the amount of $25,210,207 compared to total cumulative costs up to end Year 2011, in the amount of $25,210,207) that the Board proceed with this applicant's request to undertake a prudence review and approve cost recovery of smart meter costs to December 31, 2011.

Status of the Smart Meter Program

London Hydro installed a total of 7,467 smart meters up to December 31, 2009. The capital costs totalled $1,905,548. The mass deployment of smart meters incurred in 2010 with 129,970 meters installed with capital expenditures in 2010 of $13,826,064. By the end of 2011, the total number of smart meters installed in the London Hydro service territory was 146,437 (134,658 Residential meters and 11,779 GS < 50 kW meters). This represents London Hydro achieving installation completion figures of 99.96% of our Residential class customers and 98.47% of our General Service < 50 kW class customers.

Although London Hydro has completed its mass deployment of Smart Meters, there remains a small number of smart meters pending installation. The main reasons for the small number of

smart meters being delayed past December 31, 2011 is associated with either the customer's refusal to permit the installation of a smart meter, temporary technical constraints such as restricted configurations to place new meter, or difficulty in accessing the meter point at the customer's premise. Increased correspondence with these customers, via mail or phone call, as well as additional site visits are expected to resolve the matter, and permit the successful installation of most of the remaining units. The process is for each location to receive a minimum of two site visits, in addition to written and phone communications. Those customers refusing to have a smart meter installed will be reminded that their account could be subject to restrictions and possible disconnection of their electricity supply.

These remaining 211 residential smart meter installations, of which 149 are attributable to growth in 2012, are projected to be completed within 2012. As for the remaining 285 GS < 50 kW customers, there is the expectation to install 202 meters during 2012.

Table 2 below reflects the smart meter installation activity by year, in London Hydro's territory, and compares smart meter installation results with the number of mandated customers who are required to have a smart meter installed. As reflected in the table, the smart meter installations are substantially complete.

Table 2 Smart Meter Implementation

Customer Class	2009 Audited	2010 Audited	2011 Actual	Total to December 31, 2011	2012 Forecast	Total	Total Customer Count December 31, 2011	% of Total Customer Count
Residential	7,462	125,078	2,118	134,658	211	134,869	134,714	100.1%
General Service Less Than 50 kW	5	4,892	6,882	11,779	202	11,981	11,962	100.2%
Total	7,467	129,970	9,000	146,437	413	146,850		

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1 INTRODUCTION

1.1 Background

1.1.1 The Need for Smart-Meters and Time-of-Use Electricity Rates

The catalyst for the deployment of Smart-meters and introduction of time-of-use electricity prices throughout Ontario was the final report of the Electricity Conservation & Supply Task Force entitled: *Tough Choices – Addressing Ontario's Power Needs*, dated January 2004.[1] Section 4.5, *Enabling Customers to Better Respond to Prices*, of this report sees Smart meters as a viable means to promote energy conservation.

Minister of Energy Dwight Duncan had the following to say to the Ontario Legislature on May 5, 2004:

> *On April 19 of this year, Premier McGuinty announced the most broad-ranging and sweeping energy conservation program in the history of Ontario. At that time, we announced our intention to put smart meters into every Ontario home by 2010, with an interim target of 800,000 meters in place by 2007. … We'll allow local distribution companies to begin investing approximately a quarter of a billion dollars, the largest investment in conservation in the history of the province. …"*

1.1.2 The Ministry of Energy's Vision of Smart-Metering

The Ministry of Energy's conceptual vision of the overall structure and elements of a Smart-metering system is depicted in Figure 1-1 below.

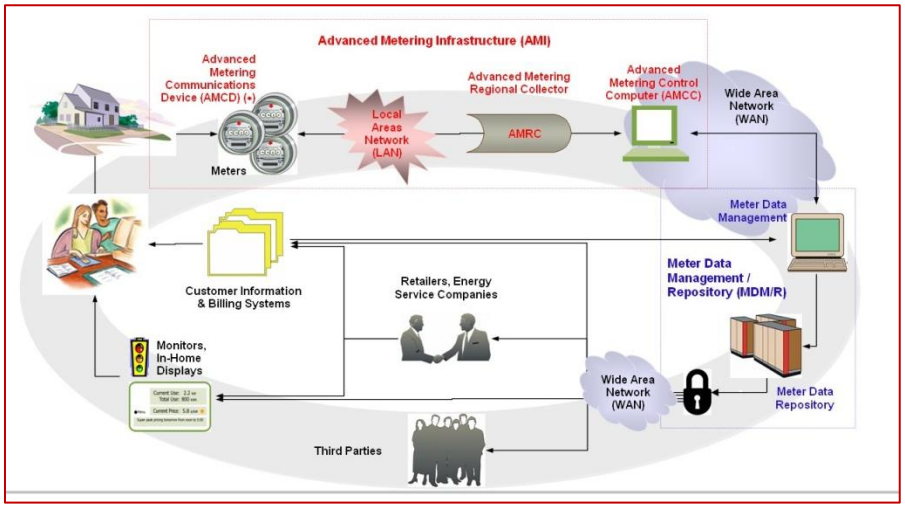


Figure 1-1, Ministry of Energy Vision of Advanced Metering Infrastructure

[1] Electricity Conservation & Supply Task Force report: *TOUGH CHOICES – Addressing Ontario's Power Needs*; Final Report to the Minister; January 2004. Electronic versions of this publication are available on the Ontario Government Documents website at URL: http://govdocs.ourontario.ca/search

In this graphic the term "*Advanced Metering Infrastructure*" (AMI) refers to the Smart-meters themselves, a central computer system referred to as the "*Advanced Metering Control Computer*" (AMCC), and all the communications media in between required to transfer the hourly consumption data from the Smart-meters to the AMCC.

Naturally more than the AMI is required to produce a time-of-use for the customer or to permit the customer to view their consumption profiles via some web presentment tool.

A series of five (5) regulations were published by the Ministry governing LDC procurement and deployment of Smart-metering systems, namely:

- O. Reg. 425/06, *Criteria and Requirements for Meters and Metering Equipment, Systems and Technology*
- O. Reg. 427/06, *Smart Meters: Discretionary Metering Activity and Procurement Principles*
- O. Reg. 426/06, *Smart Meters: Cost Recovery*
- O. Reg. 428/06, *Priority Installations*
- O. Reg. 393/07, *Designation of Smart Metering Entity*

In the intervening years, there have been amendments to these regulations.

1.1.3 The Benefits of Smart-Meters

Smart-metering systems can provide benefits to both the customer and to the LDC. Potential benefits to both parties are identified below:[2]

(i) Customer service benefits -

The customer service benefits are:

- Improved service. Two-way communications with every premise and interval data from every meter means that London Hydro can offer not only improved metering and billing services, but also a number of other service improvements for customers. These include real time pricing, customer selected due date, remote premise monitoring, usage alerts, energy management, remote home control, power outage notification, etc.

  Note: Customer-selected due dates may not be offered as a customer service option so long as London Hydro is contracted by the City to read domestic water meters and bill the customer (in the same envelope as the electric bill).

- Faster transactions. The ability of a customer representative to order a final meter read without having a meter reader make a special visit to the

[2] London Hydro Report EM-10-01, *Advanced Metering Infrastructure & Time-of-Use Electricity Pricing: Strategic Communications Plan for Customer Awareness and Engagement; Issued*: April 5, 2010. Section 4.2.3 *Communicate the Benefits of a Smart-meter to the Customer*.

customer's premise makes it possible to prepare the customer's final bill and close out, as well as open, an account more quickly.

- Customer privacy. Many customers object to having meter readers on their properties. Automated meter reading virtually eliminates this source of customer complaints.
- Energy management. The capability to deliver interval data to customers will enable London Hydro to help customers make informed decisions about ways to better manage their energy use. The availability of this data also enables the customer service representative to deal efficiently with customer calls that require current meter data to resolve.
- Rate design. Since London Hydro can collect interval data or time-of-use (TOU) register reads every day, London Hydro can offer our customers advanced rate designs, such as an extension of existing TOU pricing and critical peak pricing, or demand response programs. Customer will be able to choose the option that best meets their needs.

Some customer benefits will occur as soon as the AMI is operational; others will emerge over time.

(ii) London Hydro benefits -

The customer is not the only beneficiary of advanced metering infrastructure (or Smart-metering). Some of the specific benefits that London Hydro expects to obtain include:

- Meter reading savings. About 60 percent of the AMI cost benefit results from a significant reduction in labour and associated vehicle, fuel and maintenance costs as meter read routes are converted over to the network.
- Reduced customer contact center costs. The system will provide the "most recent" meter read (usually prior day or early same day) for customer service representatives to resolve high bill complaints, complaints about missed or estimated reads, meter access problems, etc.
- Reduced billing costs. Savings in the area of customer billing are primarily related to reducing the number of service order dispatches to customer premises when customers wish to close their London Hydro account.
- Customer selected due date. The new system will enable meters to be read for billing purposes on the day that best coincides with the customer's preference for their payment due date.
- Load monitoring and forecasting. AMI will provide daily inputs to the load forecast, versus monthly. Since all smart meters collect interval data and can be used for load research, varied samplings and many load studies can be undertaken.
- Distribution system planning. Accurate, geographically specific usage data will enable London Hydro's engineering and operations personnel to more effectively plan and manage the distribution system. Data can be assembled at the individual customer or feeder level up to the transmission station

level. Better data enables more effective utilization of existing resources, including individual transformers.

- Service connections from the office. The capability of the system to perform remote service connects and disconnects (in selected areas) will reduce the number of field visits London Hydro needs to perform.
- Outage detection, mapping and restoration. Once London Hydro has integrated AMI with a planned new Outage Management System (OMS), control room and operations staff will be able to identify the extent of outages and monitor the progress of restoration activities. This will help London Hydro minimize unnecessary dispatching and crew costs, and speed up service restoration.

  Note: This particular item could be categorized as both a customer service benefit and a LDC benefit.
- Tamper and theft detection. The technology includes tamper detection alarms and other capabilities to detect the possibility of energy theft or diversion. Once the system is deployed, London Hydro can also perform data analysis on interval meter data to help determine possible theft.
- Reduced field service calls. The new system will enable operators to "ping" a meter to determine whether there is power at the meter. This aids in faster resolution of the customer inquiry and can save an expensive service call.
- Demand response / direct load control programs. Recording interval data on all AMI meters provides the ability to support demand response or direct load control programs – either through price signals or direct control over the power supply to equipment or appliances – is an important capability of the new system. London Hydro expects to leverage this technology to partially fulfill its mandated CDM targets as given in OEB Decision and Order EB-2010-0215 / EB-2010-0216.

AMI sets the foundation through the collection of interval data and the two-way communication capabilities for a broad array of customer services and cost reduction opportunities that will continue to be developed and deployed long after the system is deployed.

Some of the identified benefits will naturally occur upon or in the months following Smart-meter deployment, whilst others will emerge over a much longer time-frame.

1.1.4 Cost Recovery for Smart Meter Investments

Throughout the Smart Meter initiative described herein, London Hydro has received some offsetting funding through the collection of various funding adders, specifically:

- A Smart Meter Funding Adder ("SMFA") in the amount of $0.27 per month per metered customer was first approved by the OEB in 2007 (see EB-2007-0552);
- In 2009, the SMFA was revised to $1.00 (see EB-2008-0235), and
- In 2011, the SMFA was revised to $1.46 per month per metered customer (see EB-2011-0097).

The presently-approved SMFA has a sunset date of April 30th, 2012 (see EB-2011-0097).

This application is essentially an assessment of whether the prevailing SMFA is sufficient to recover prudent investment costs by the sunset date.

1.2 Scope

The document covers London Hydro's investments in Advanced Metering Infrastructure and associated corporate computing enhancements necessary to fulfill the Ministry of Energy's Smart-metering vision of providing time-of-use electricity billing as an energy conservation measure.

1.3 Purpose

London Hydro is applying to the Ontario Energy Board for recovery of its incurred investments in Advanced Metering Infrastructure and associated enhancements to its corporate computer systems, all necessary to bill London Hydro's customers on the basis of hourly electricity consumption measured by the Smart-meter and the application of time-of-use electricity prices. This narrative is intended to generally describe and thereby support the various expenditures and hence the overall application.

1.4 Authors' Special Note

In recent years there has been explosive growth in the Smart-meter marketplace throughout North America. Barely a month goes by without a news release of yet another contract award for an Advanced Metering Infrastructure (AMI) to a major utility. Unfortunately such business success stretches most AMI supplier's resources to the extent that LDC customers aren't provided with the level of service that the LDC's deserve and that the suppliers wish to provide.

When Ontario LDC's embarked on the procurement of AMI systems, it was well known that the technology wasn't as mature as the LDC user community would have preferred and, as such, there would certainly be technology deployment issues.

The technology deployment issues raised within this document should not in any way be construed as detracting from the reputation and integrity of our AMI component suppliers or their respective technology offerings. It has indeed been a privilege to have partner companies of the calibre of KTI Limited / Sensus Metering, Capella Communications / BelAir Networks, Itron, and others mentioned herein.

London Hydro will continue to work closely with our suppliers of AMI technology with the goal of jointly advancing the state-of-the-art for AMI systems. For some elements of the overall deployment, success will just occur a little later than London Hydro and its partner suppliers initially envisioned. But London Hydro has every confidence that it will be attained.

1.5 References

[1] Ontario Energy Board publication: G-2011-0001, *Guideline: Smart Meter Funding and Cost Recovery – Final Disposition*; December 15, 2011.

[2] Ontario Ministry of Energy publication: *Functional Specification for Advanced Metering Infrastructure - Version 2*; July 5, 2007.

[3] Ontario Energy Board publication: G-2008-0002, *Guideline: Smart Meter Funding and Cost Recovery*; October 22, 2008.

[4] Ontario Energy Board Decision with Reasons EB-2007-0063, *Combined Proceeding to Review Costs Incurred by Thirteen Electricity Distributors for Certain Smart Metering Activities*; August 8, 2007.

1.6 Terminology

The definitions given below are not intended to embrace all legitimate meanings of the phases. Rather the definitions below are specific to this document.

Applicability Statement 2 is a specification of the Electronic Data Interchange over the Internet (EDIINT) working group of the Internet Engineering Task Force (IETF).

Blade server is a stripped-down server computer with a modular design optimized to minimize the use of physical space and energy. Whereas a standard rack-mount server can function with (at least) a power cord and network cable, blade servers have many components removed to save space, minimize power consumption and other considerations, while still having all the functional components to be considered a computer. A blade enclosure, which can hold multiple blade servers, provides services such as power, cooling, networking, various interconnects and management. Together, blades and the blade enclosure form the blade system

1.7 Acronyms, Abbreviations and Symbols

1.7.1 Acronyms

AGL	=	Above Ground Level
AMCC	=	Advanced Metering Control Computer
AMCD	=	Advanced Metering Communication Device
AMI	=	Advanced Metering Infrastructure
AMRC	=	Advanced Metering Regional Collector
AS2	=	Applicability Statement 2
CIS	=	Customer Information System
CMEP	=	California Metering Exchange Protocol
ESA	=	Electrical Safety Authority
ESQR	=	Electricity Service Quality Requirements
IRM	=	Incentive Rate Mechanism
LDC	=	Local Distribution Company
MDM/R	=	Meter Data Management and Depository

MDUS	=	Meter Date Unification & Synchronization
ODS	=	Operational Data Store
OM&A	=	Operation, Maintenance & Administration
PILs	=	Payments in Lieu of Taxes
RF	=	Radio Frequency
RIS	=	Read Interval Success
RMA	=	Return Material Authorization
RFP	=	Request for Proposal
RFQ	=	Request for Quotation
RNI	=	Remote Network Interface
SIT	=	System Integration Testing
SMDR	=	Smart Meter Disposition Rider
SME	=	Smart Meter Entity
SMFA	=	Smart Meter Funding Adder
SMIRR	=	Smart Meter Incremental Rate Rider
SOW	=	Statement of Work
TGB	=	Tower Gateway Base-station
TOU	=	Time-of-Use
WAN	=	Wide Area Network
WiMAX	=	Worldwide Interoperability for Microwave Access

2 REVIEW OF AMI PROCUREMENT PROCESS

London Hydro worked closely with Ministry of Energy staff throughout the entire procurement process from the time of the initial meetings with the Ministry regarding the mechanics or process for becoming authorized to the dissemination of the results to some 60 LDC's.

Other LDC's submitting applications for Smart Meter cost recovery may simply reference the London Hydro AMI procurement process without a complete understanding of the intricacies and complexity of this process. The following subsections are intended to provide an overview of the London Hydro AMI procurement process referred to in Ontario Regulation 427/06.

2.1 Creation of a Smart-Metering Purchasing Consortium

The initial regulations governing Smart-meter systems were restrictive in nature in that the LDC had to be "*authorized*" to proceed with Smart-meter procurements, but London Hydro (like many other LDC's) was uncertain as to how to become "*authorized*". A number of meetings were held with Ministry of Energy staff on this matter.

On the belief that there could be volume discounts and procurement efficiencies (for both the LDC's and AMI system suppliers) via the formation of a buying group, London Hydro set about to establish an informal Smart-Metering purchasing consortium. Each participant would be asked to contribute their expertise to the initiative and if the endeavour was successful the costs of a Fairness Commission and consultant (with expertise in radio system technology and power line carrier technology) would be shared amongst the consortium membership using some formula related to the size of the LDC.

While the initial focus was on LDC's throughout south-western Ontario, due to word-of-mouth other LDC's expressed interest, and it didn't take very long before approximately thirty LDC's had elected to participate in London Hydro's Smart-Metering purchasing consortium.

In parallel with this activity, a number of other LDC's had engaged the Ontario-based firm UtilAssist to assist them with their own Smart-Meter endeavours. At some point in time between the RFP issuance date and the closing date for submissions, UtilAssist contacted London Hydro about participation – it didn't make sense for UtilAssist to duplicate London Hydro's efforts of developing an RFP and undertaking a similar procurement process.

UtilAssist was invited to participate on the Technical Evaluation Panel in a win-win arrangement. The Smart-Metering purchasing consortium received another source of expertise (with UtilAssist participation) and UtilAssist could provide first-hand knowledge to their clients.

Over 60 LDC's were now represented with the combination of London Hydro's Smart-Meter purchasing consortium and UtilAssist's LDC clients.

2.2 Development of an RFP

The RFP was primarily developed by London Hydro but with some assistance and advice from the members of the Smart-Meter purchasing consortium. The formal titles of the RFP documents are:

- London Hydro document: *Request for Proposal for Advanced Metering Infrastructure (AMI) - Phase I Smartmeter Deployment*; dated August 14, 2007
- London Hydro document: *Information Supplement to Request for Proposal For Advanced Metering Infrastructure (AMI) - Phase I Smartmeter Deployment*; dated August 14, 2007.

The above-referenced documents have not been included in this application (given that the Ministry of Energy has specifically recognized the entire procurement process in Regulation 427/06) but copies are certainly available upon request.

The RFP established the following weightings for a "*best value*" (also called a "*best buy*") procurement:

- 50% technical;
- 30% cost (including future costs); and
- 20% other factors (such as bidder's proposed team, previous experience, adherence to quality management principles, financial viability of bidder, etc.).

2.3 Incorporating LDC-Specific Conditions into the Evaluation

One of the realities going into this venture is recognition that the participating LDC's are very different. We have different populations and types of revenue meters, different productivity rates for exchanging meters, different costs and approaches to providing a 120 V_{ac} supply to a regional collector, different experiences with broken meter bases, etc. Furthermore, technical requirements that are very important to one LDC may be of little or no importance to another LDC.

It was never the intention that all participating LDC's would procure the same AMI system. Rather the evaluation process was designed so that the recommended AMI solution would be LDC-specific (i.e. the "*best buy*" AMI solution for LDC A could be entirely different than the "*best buy*" AMI solution for LDC B).

This objective was achieved as described following:

- Every participating LDC came up with their LDC-specific technical weighting factors that would be applied against each stated technical requirement in the RFP. So for example if LDC A wished to de-emphasize a requirement, they might assign a weighting factor of 0.5 against a given requirement. But LDC B may see that same requirement as being more important and assign a weighting factor of 1.5 or 2. These LDC-specific weighting factors would then be applied

against the scores generated by the Bid Evaluation Technical Panel to arrive at the LDC-specific technical score for each combination of bidder and LDC as depicted in Figure 2-1 below.

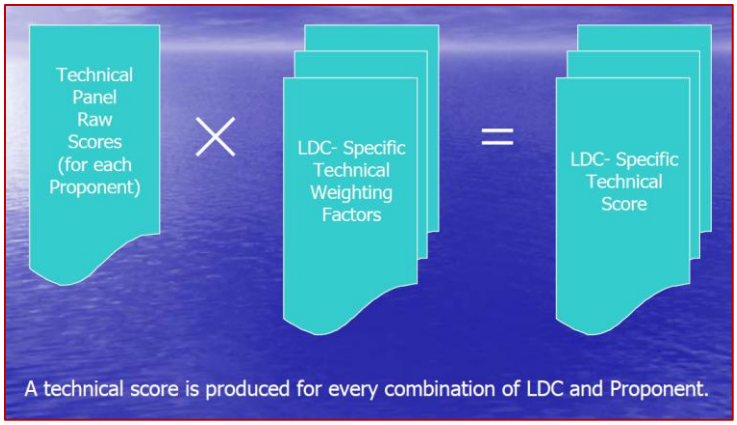


Figure 2-1, Methodology for LDC-Specific Technical Scores

- Every participating LDC submitted their LDC-specific meter populations and LDC-specific costs and assumptions (e.g. meter exchange productivity rates, labour rates, probability of broken meter bases, etc.). The ENWIN representatives developed a very elegant and comprehensive spreadsheet analysis for assessing the "*most probable life-cycle costs*" and "*net present value*" for each combination of LDC and bidder as depicted in Figure 2-2 below.

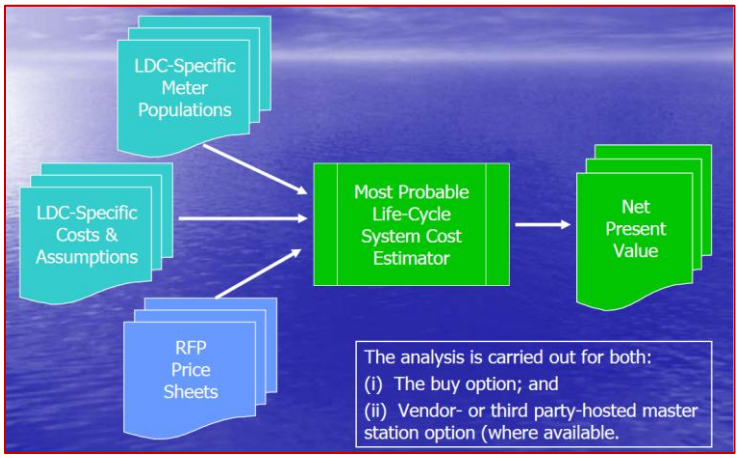


Figure 2-2, Methodology for LDC-Specific Ownership Costs

To preserve the principles of fairness, the LDC-specific technical weighting factors, LDC-specific meter populations, and LDC-specific costs and assumptions were to be submitted directly to the Fairness Commissioner in advance.

2.4 Retaining a Fairness Commissioner

Ministry of Energy staff provided London Hydro with contact information for three (3) Fairness Commissioners. Requests for Quotation were sent to these three firms,

two replies were received, and the services contract was awarded to PRP International Inc.[3]

2.5 Overview of the RFP and Submission Evaluation Process

2.5.1 Development of Procedures Documents

To ensure that the overall RFP and subsequent evaluation would be fair and transparent, a number of guideline documents were developed in advance, specifically:

- Guidelines for Conducting the Bidder's Conference
- Guidelines for Responding to Bidder's Inquiries and Issuing Addenda
- Guidelines for the Technical Evaluation of the LAN Communications Sub-System.
- Evaluation Plan of Bid Submissions for "*Advanced Metering Infrastructure (AMI) - Phase I Smartmeter Deployment*"
- Guidelines for the Evaluation of Sample Revenue Meters and Regional Collectors
- Guidelines & Workbook for Bidder Interviews
- Proponent Debriefing Template

The above-referenced documents have not been included in this application (given that the Ministry of Energy has specifically recognized the entire procurement process in Regulation 427/06) but copies are certainly available upon request.

2.5.2 Issuance of RFP and Addenda

The RFP was formally released to potential respondents in August 2007. Copies were sent by courier to known AMI suppliers, and other potential AMI suppliers were invited to obtain a copy of the RFP via advertisements posted on the MERX website, London Hydro's website, the London Free Press and the Globe & Mail newspaper.

During the bid period, due to the combination of other LDC's joining the consortium and questions posed by bidders, three (3) addenda were issued. The addenda titles and issue dates are given below:

- Addendum #1 to London Hydro's Request for Proposal for Advanced Metering Infrastructure (AMI) – Phase I Smartmeter Deployments; Issued: October 2, 2007.
- Addendum #2 to London Hydro's Request for Proposal for Advanced Metering Infrastructure (AMI) – Phase I Smartmeter Deployments; Issued: October 23, 2007.

[3] Internal London Hydro memorandum of May 2, 2007 to Vinay Sharma from Gary Rains; Re: *Smartmetering – Selection of Fairness Commissioner*.

- Addendum #3 to London Hydro's Request for Proposal for Advanced Metering Infrastructure (AMI) – Phase I Smartmeter Deployments; Issued: November 6, 2007.

The above-referenced documents have not been included in this application (given that the Ministry of Energy has specifically recognized the entire procurement process in Regulation 427/06) but copies are available upon request.

2.5.3 Bidder's Conference

The bidder's conference was held on September 19th, 2007 at London Hydro's facilities. A copy of the bidder's conference Power Point presentation is available upon request.

2.5.4 Closing Date and Number of Proposals Received

By the established closing date of November 14th, 2007 proposals were received from 16 proponents.

The Fairness Commissioner and London Hydro's Purchasing Agent carried out a cursory examination to ensure that each submitted proposal was "complete".

2.5.5 Evaluation of Submissions

Before embarking on the formal evaluation of the Smart-meter proposals, it was necessary to establish a governance or reporting structure for the various evaluation panels, and to ensure that the CEO's of the participating LDC's and the Ministry of Energy was kept abreast of progress. The reporting structure is depicted in Figure 2-3 below.

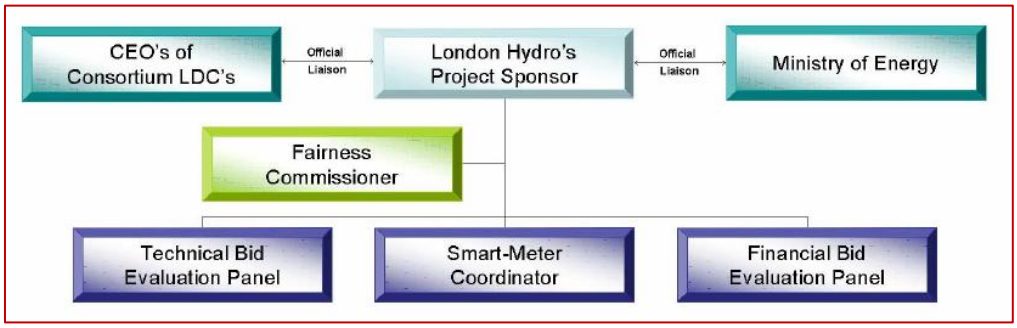


Figure 2-3, Smart-Meter Evaluation Project Reporting Structure

The Bid Evaluation Technical Panel consisted of 19 members from 10 LDC's, a subject expert on communications, a technology advisor from the City of London's water division, and a Ministry appointee.

The reporting structure of the Bid Evaluation Technical Panel is depicted in Figure 2-4. The Bid Evaluation Technical Panel carried out their work in accordance with the evaluation plan and guideline documents referenced earlier in Section 2.5.1 herein.

The Bid Evaluation Financial Panel consisted of 5 members from 4 LDC's.

The Fairness Commissioner often served as Chairperson / Moderator at meetings of the Panels.

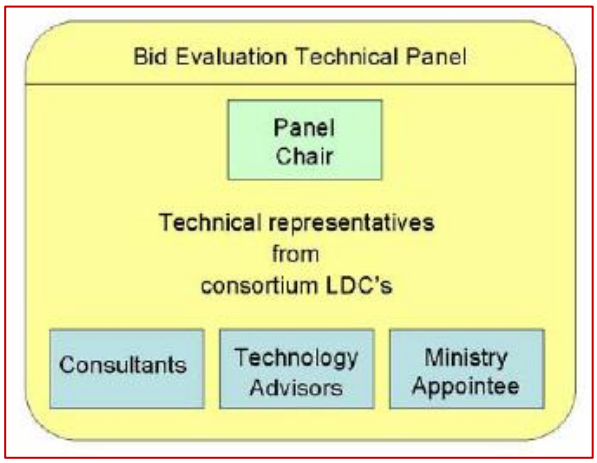


Figure 2-4, Structure of Bid Evaluation Technical Panel

In cases where panel members were confused by a vendor's response or there was disagreement regarding the interpretation of a response, formal requests for clarification were issued to affected vendor in the Spring of 2008.

Finally, those bidders that were deemed to have some likelihood of securing a procurement contract were invited to London Hydro to answer specific questions and to demonstrate specific features of their offering (e.g. the man- machine interface). Again these meetings adhered to the project document entitled: *Guidelines & Workbook for Bidder Interviews*.

2.5.6 Dissemination of Results

The results of the evaluation process were provided to the CEO of each participating LDC at a meeting held on May 26, 2008 at the Ministry of Energy offices.

Each participating LDC was provided with a sealed envelope from the Fairness Commissioner that identified:

- The "*best buy*" AMI vendor for that LDC's circumstances; and
- The "*second best buy*" AMI vendor for that LDC's circumstances.

Also included was a signed statement by the Fairness Commissioner that the overall process was transparent and fair.

A copy of London Hydro's letter from the Fairness Commissioner is attached as Appendix D.

The expectation was that LDC's would now start contract negotiations with the identified "*best buy*" vendor, but if negotiations came to an impasse, they could move on to their "*second best buy*" vendor. Some LDC's continued using the Fairness Commissioner services throughout this contract negotiation phase.

2.5.7 Vendor Debriefing Sessions

Bidders that requested a debriefing session were provided with feedback in a structured meeting using the "*Proponent Debriefing Template*" referenced in Section 2.5.1 above. The template itself is considered public domain information. The vendor-specific debriefing information is considered confidential but will be made available to the Ontario Energy Board upon request.

2.6 Formal Recognition of London Hydro's Procurement Process

The culmination of London Hydro's efforts was formal recognition by the Ministry of Energy via Ontario Regulation 427/06, *Smart Meters: Discretionary Metering Activity and Procurement Principles*. The appropriate clause has been replicated below for convenience of reference:

> **Authorized discretionary metering activity**
>
> 1. …
> **:**
> 8. Metering activities conducted by a distributor that has procured its smart meters pursuant to and in compliance with the parameters and process established by the Request for Proposal for Advanced Metering Infrastructure (AMI) – Phase 1 Smartmeter Deployment dated August 14, 2007, together with any amendments to it, issued by London Hydro Inc.

2.7 Contract Negotiations & Statement of Work Development

The evaluated "*best buy*" AMI solution for London Hydro was the Sensus FlexNet AMI solution.

While the original intention was that London Hydro would lead the development of a common Statement of Work for use by all LDC's that would be proceeding with the Sensus FlexNet AMI solution, this notion proved impractical for a number of reasons, including:

- London Hydro wished to host its own system, whereas all others in the Sensus community (with the exception of Sudbury) were more interested in having KTI Limited host their system;
- London Hydro wished to obtain its own radio spectrum for the wireless LAN element, whereas all others in the Sensus community (again with the exception of Sudbury) were more interested in leasing spectrum from Pagenet Paging Network of Canada Inc. (more commonly known simply as PageNet);

  Note: Although not the deciding factor, it is noteworthy that private spectrum can provide additional cyber-security protection in that eavesdropping equipment is more readily available for public spectrum.
- Many other LDC's wished to have UtilAssist represent them in the contract negotiations and Statement of Work development;
- Differences in timing as to when LDC's wished to proceed to the next step, etc.

A copy of London Hydro's Statement of Work (SOW) is available upon request. Schedule A, *Pricing and Licensing*, of this SOW document includes competitive price information, so we would ask that the pricing information in this part of the document be redacted if the document is to be distributed to any party outside the Ontario Energy Board.

Note: The front page of the SOW could be perceived as somewhat deceptive in that it implies that this is a multi-LDC Statement of Work document. Draft versions of this document were distributed to other LDC's (that so requested it) for use as a template and with the hope that there could be a multi-LDC SOW. Unfortunately, for the reasons cited above, this didn't happen and the signatories to SOW fully understand this history and didn't have any issues leaving the title page intact.

3 REVIEW OF LONDON HYDRO'S OVERALL SYSTEM ARCHITECTURE

There are many elements between the Smart-meter installed on a house or small business and the time-of-use bill that is generated each month for that residential or small business customer. The following subsections provide high level and somewhat simplified descriptions of the three major elements of London Hydro's overall meter-to-billing solution.

3.1 Sensus FlexNet Advanced Metering Infrastructure

The Sensus FlexNet® advanced metering infrastructure consists of revenue meters that are outfitted with FlexNet radio accessories and that communicate with FlexNet radio transceiver sites distributed throughout the service territory. The FlexNet transceivers in turn are connected to a FlexNet master station (located within London Hydro's corporate offices) via a wide area network of the LDC's choosing. A simple overview of this FlexNet AMI architecture is depicted in Figure 3-1 below.

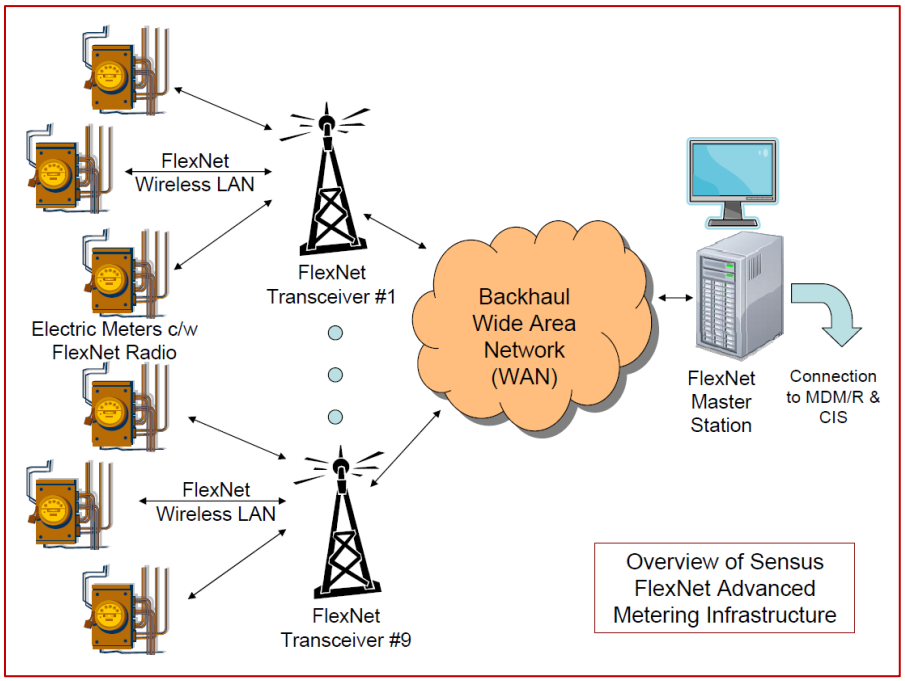


Figure 3-1, Overview of Sensus FlexNet AMI

In London Hydro's case:

- there will initially be in excess of 145,000 Smart-meters installed with growth capacity provisions to accommodate 200,000 Smart-meters;
- there are nine (9) distinct radio transceiver sites located throughout London Hydro's franchise service territory;
- the so-called wireless LAN communications between the Smart-meters and FlexNet radio transceivers is via licensed narrow-band spectrum in the 932 / 941 MHz band;

- the wide area network (WAN) component is not part of the Sensus FlexNet solution and is separately described in Section 3.2 below; and
- the Sensus master station software actually resides on London Hydro's Blade server farm (as opposed to being a stand-alone server device as suggested by Figure 3-1 above).

For readers more familiar with the terminology used in the Ministry of Energy's Functional Specification [Ref 2], the FlexNet TGB transceivers depicted in Figure 3-1 would be comparable to what the Functional Specification refers to as a "*Regional Collector*".

3.2 BelAir Networks Wireless Broadband Wide Area Network

The Belair Networks wireless broadband wide area network provides a communications path from the FlexNet TGB transceivers distributed throughout London Hydro's franchise service territory to the FlexNet RNI master station located in London Hydro's complex at 111 Horton Street.

The WAN operates in the license-exempt 5.8 MHz band and has a redundant hub-and-spoke arrangement generally as depicted in Figure 3-2 below.

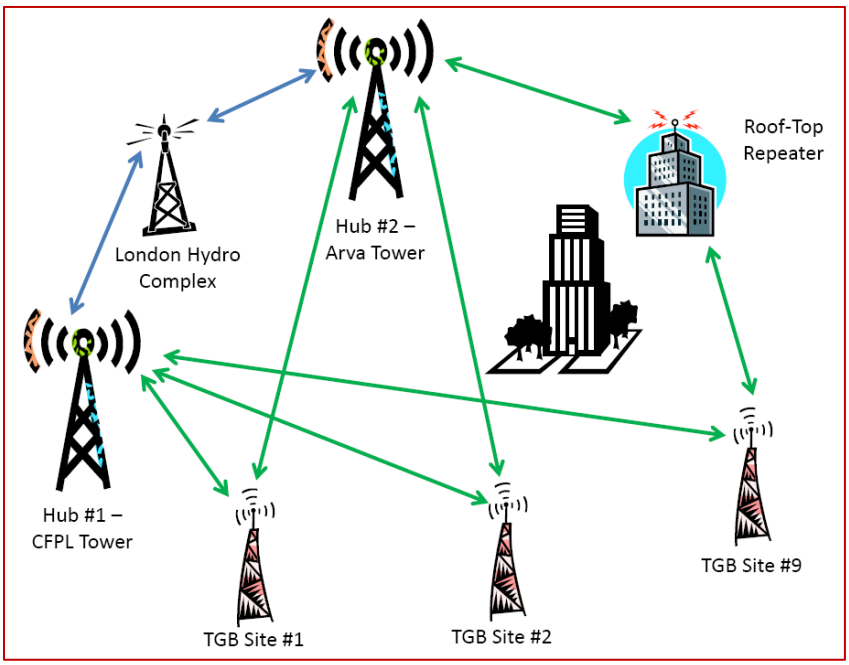


Figure 3-2, Overview of BelAir Networks WAN Subsystem

The BelAir Networks microwave transceiver at London Hydro's complex communicates with the two designated communications hubs; the first located on the CFPL broadcast tower, and the second located on a communications tower at Arva Reservoir & Pumping Station.

The BelAir microwave transceivers at the various FlexNet TGB sites have directional antennas aimed at both "*hub*" locations. For some locations, it is not possible to

establish a line-of-sight connection to both hub locations (often due to high rise office buildings in the core area of the city, or terrain challenges) and so a "roof-top repeater" is installed as an intermediate device to relay the microwave signals between the TGB site and the hub locations that is otherwise in a shadow.

With the described WAN configuration, there is path redundancy meaning that for each TGB site, there are at least two WAN paths to London Hydro's complex.

3.3 Corporate Computer Systems

The conceptual arrangement of that part of London Hydro's corporate computer systems directly related to the Smart-meter project is depicted in Figure 3-3 below. To simplify the arrangement for the reader, discrete computers or servers are shown for each component where in reality London Hydro has a Blade server system and a virtual machine environment.

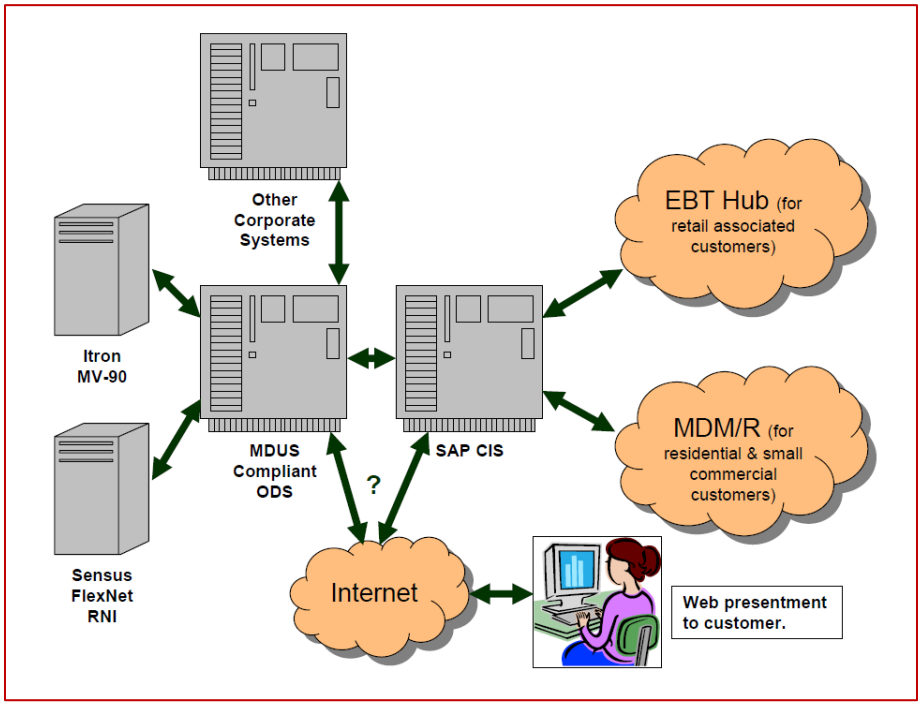


Figure 3-3, Conceptual Architecture of Corporate Computer Systems

Note: Figure 3-3 is an excerpt from an older presentation. At the time, there was some uncertainty as to whether the source of meter data for web presentment to the customer would be the SAP CIS or the ODS. As such there is a "?" shown on the graphic beside these data streams.

The core elements of London Hydro's Smart-meter to customer bill solution are:

- A Customer Information System (CIS) based on SAP's *Industry Solutions for Utilities* (IS-U) product;
- An Operational Data Store (ODS) that provides support functionality to the SAP CIS for a number of AMI systems and interoperates with the SAP IS-U system via SAP's *Meter Data Unifications & Synchronization* (MDUS) specification;

- A Sensus FlexNet RNI master station that is the head-end device for the Sensus FlexNet *Advanced Metering Infrastructure* (AMI) solution.

There are also secure data interconnections to the provincial *Meter Data Management & Repository* (MDM/R), to energy retailers via the so-called "*EBT hub*", and finally to customers via web presentment software.

4 DESCRIPTION OF AMI SYSTEM COST ELEMENTS

4.1 Procurement of Sensus FlexNet AMI & Ancillary Equipment

4.1.1 Procurement of Sensus FlexNet AMI

A copy of the Statement of Work document covering the design, supply, delivery, training, spare parts and documentation for a Sensus FlexNet AMI is available upon request.

London Hydro's capital investment cost for this system may differ from the investment costs of peer LDC's that also procured a Sensus FlexNet AMI for reasons cited below:

- London Hydro has historically offered developers of apartment buildings the choice of a bulk metering arrangement or individual tenant metering. As a result, London Hydro has a significant population of tenant-metered apartment buildings. The unit cost of a "*network-style*" revenue meter that are needed for use in apartment buildings is twice the price of the common "*3-wire, 1-1/2 element*" energy meter used for single-family residential homes and town houses. Refer to Schedule A in the Statement of Work document for meter-specific pricing information.
- London Hydro opted to host its own Sensus FlexNet RNI master station (as opposed to incurring a recurring O&M expense to have KTI Limited host the system).
- London Hydro opted to obtain its own radio spectrum and install the associated radio transceivers and antennas throughout its service territory (as opposed to incurring a recurring O&M expenses to have PageNet provide the wireless communications infrastructure).

4.1.2 Procurement of Expansion Hardware for Corporate Computer System

London Hydro believes that all technology between a revenue meter and the customer's bill is a core LDC function. London Hydro has an Accredited Meter Shop (meaning that we can verify and seal electricity meters on behalf of the federal government), an MV-90 data collection system with which all types of settlements are performed, and a state-of-the-art Customer Information System. Advanced Metering Infrastructure simply complements these existing systems and as such London Hydro opted to host our own AMI system and develop the requisite expertise that is required to operate and maintain these systems and truly leverage our AMI for other future applications, e.g. demand response, customer home area networks, and an array of engineering applications.

To host our own AMI system, it was necessary to expand the existing blade server farm to provide additional capacity and memory to accommodate addition of the

Sensus FlexNet RNI master station software.[4] It would later become necessary to expand the blade servers again to accommodate a test environment for the RNI and other systems related to the overall solution.[5]

4.1.3 Procurement and Installation of Radio Communications Towers

Given that Sensus' RF propagation study indicated that 50 feet above-ground-level (AGL) would be adequate for the antennas associated with the FlexNet radio transceivers, London Hydro elected to install transceivers in existing bungalow-style municipal substations. A radio communications tower, with an appearance of residential TV antennas that were commonplace prior to the popularity of cable TV, could be installed adjacent the bungalow. The radio transceiver would be installed within the substation bungalow adjacent existing SCADA equipment with the consequent benefits of existing security and environmental control systems.

Following a formal Request for Quotation process, a contract was awarded for turn-key radio communications tower installation services. The successful vendor would procure and install the requisite radio communications towers and install the antennas associated with both the 900 MHz wireless LAN system and the 5.8 GHz wireless WAN system on the towers, and also install the interconnecting microwave-class cabling between the antennas and associated transceiver equipment located within the municipal substations.

4.1.4 Securing Licensed Radio Spectrum

As noted earlier (in Section 4.1.1 herein), London Hydro opted to secure its own radio spectrum for wireless communications between the population of revenue meters and the nine (9) FlexNet TGB transceiver sites distributed throughout the service territory.

Michael Martin of IBM Consulting had originally been retained as a subject matter expert to support the UniFi London project (that will be later described in Section 4.2.2 herein) and, based on that positive experience, London Hydro subsequently engaged him to provide expertise both in the development of certain parts of the RFP and to be a "*technology advisor*" for the Bid Evaluation Technical Panel (refer to Figure 2-4 on page 13 herein).

Once London Hydro committed to procuring the Sensus FlexNet AMI, the contractual arrangements with IBM Consulting were extended to provide technical assistance with the review of an RF propagation study (a required deliverable under the contract with KTI Limited and Sensus) and to guide London Hydro in its dealings with Industry Canada to secure radio spectrum in the 932/941 MHz band. The channel plan for this spectrum is set forth in Industry Canada publication SRSP-505,

[4] Memorandum of January 16, 2009 to Vinay Sharma from Gary Rains; re: *Smart-Metering Master Station – Authorization to Procure Expansion Hardware*.

[5] File memorandum of July 29, 2009 by Gary Rains; re: *Advanced Metering Infrastructure (AMI) System – Accelerated Expansion of Blade Servers to Create a System Test Environment*.

Technical Requirements for Multi-point Communications Systems Operating in the Bands 928-929 / 952-953 MHz and 932-932.5 / 941-941.5 MHz; Issue #2, 1995.

4.1.5 Miscellaneous Support Software Procurements

To provide disaster recovery services for the FlexNet RNI master station database, it was necessary to procure agent licenses for Microsoft SQL Server to permit the backup and recovery products to access the RNI databases.[6]

London Hydro also procured a software tool (Aqua Data Studio Version 8.0) used by developers (including Sensus) to monitor and access various records within the RNI database.[7] This tool, in combination with some of the inherent features of the FlexNet RNI master station, has proved to be invaluable for diagnosing the overall system when performance is below expectations or another anomaly is encountered.

4.2 Procurement of BelAir Wireless Backhaul System

4.2.1 Assessment of the Backhaul Options

The Sensus FlexNet AMI solution does not include a wide area network component, i.e. the communications system for providing backhaul services between the FlexNet TGB transceivers distributed throughout the service territory and the FlexNet RNI master station. Some LDC's will have fiber-optic communications links with extra capacity that can be used, others may have radio systems originally deployed for distribution automation or similar applications that again have extra capacity, whilst others may opt for a public carrier option (e.g. communications services provided by Bell, Rogers, or others).

London Hydro didn't have existing communications systems with additional capacity available so carried out a study comparing the initial investment cost, ongoing operating and maintenance cost, and other factors such as reliability and performance of various public and private options. The recommended option (primarily based on anticipated cost savings) was procurement and installation of a private wireless broadband communications system.

Note: As part of the AMI procurement process previously described in Section 2 herein, Section 2.6, *Public Wireless Communications Carriers as a WAN Option*, of London Hydro's RFP encouraged bidders to partner with public carriers for the WAN element. As such, London Hydro had access to competitive pricing for a public carrier WAN option and was able to use this information for comparison to private WAN options.

4.2.2 The UniFi London Initiative

At the time London Hydro started examining options for a wireless broadband wide area network system, formal discussions were initiated with the City of London. It was known that various first responder agencies (e.g. London Fire Department, London Police Department, Thames Emergency Medical Services Incorporated) and

[6] Memorandum of September 2, 2009 to Gary Rains from Joe Michienzi; re: *Smart Meter RNI System*.

[7] Memorandum of April 28, 2010 to Gary Rains from Joe Michienzi; *Request for Aqua Data Studio Software*.

London Transit had a need to upgrade their wireless communications systems and there would certainly be mutual benefits associated with a joint undertaking, i.e. a common municipal broadband wireless system should certainly be more cost effective than each party independently constructing their own broadband wireless system.

The resulting multi-party project was coined the "*UniFi London*" initiative. Various subject matter experts were interviewed but the project team unanimously selected Michael Martin of IBM Consulting to provide technical expertise. Two (2) short-term proof-of-technology projects were carried out; one using Motorola's MOTOMESH™ mesh networking technology (as an example of one class of wireless solutions); and the other using BelAir Networks networking technology (as an example of another class of wireless solutions).

Note: London Hydro's portion of the funding for both the consultant and technology demonstration projects did not come from the Smart-metering deferral account.

The field trials clearly highlighted the challenges associated with installing a ubiquitous broadband wireless system in the core area of a city. As it turned out:

- The City departments and agencies that were participating in the UniFi London initiative had a clear need for mobility (effective communications to moving vehicles);
- The UniFi London project team clearly wanted a standards-based solution to promote interoperability and thereby minimize future costs of end-use equipment. The clear preference was WiMAX technology, but the standards pertaining to the "*mobile*" version were still only early draft editions and hence subject to change, thereby presenting a significant risk to early adopters.
- Following the 9/11 attacks in United States, there was a concerted effort in both United States and Canada to allocate the 700 MHz band for first responders, but no channel plan for this spectrum had yet been finalized in Canada.
- London Hydro's need to procure a wireless backhaul system for its Smart-metering endeavour was immediate, whereas the various City departments had stop-gap solutions that could defer the purchasing decision for several years.

It was therefore decided by the participants in the UniFi London initiative that London Hydro would procure a wireless broadband system that best meets their needs, and at some undefined later date, the membership would re-convene to revive the project. If, at a later date, London Hydro's system could be expanded to fulfill the broader needs, then this option would be entertained.

At this point in time, Industry Canada's Spectrum Management Department has yet to issue a channel plan for the 700 MHz band to be used by first responders.

4.2.3 Procurement of a BelAir Networks WAN Solution

London Hydro issued an RFP to the marketplace on December 19, 2008 to procure a turnkey wireless broadband communications system to provide backhaul services

between the nine (9) FlexNet TGB transceivers and the FlexNet RNI master station located in London Hydro's complex located at 111 Horton Street. The successful bidder would be responsible for design, installation, testing, spare parts and staff training of a reliable system with sufficient expansion capability for anticipated future traffic.

A copy of the RFP entitled: "*Wireless Backhaul Network to Interconnect Advanced Metering Infrastructure*" is included as Appendix M for convenience of reference. Again, the "best buy" methodology was used for the evaluation of competitive bids.

An internal document from our Energy Management Department entitled "*Advanced Metering Infrastructure Project: Selection of a Wireless Backhaul Communications System*" summarizes the detailed selection process and recommends the "best buy" WAN system vendor. A copy of this memorandum is included herein as Appendix L.

The configuration of the Capella / BelAir Networks wireless broadband backhaul system was generally described earlier in Section 3.2 (starting on page 17 herein).

The successful competitive bid was awarded to Capella Telecommunications as the prime contractor with BelAir Networks Ltd as the equipment supplier. The successful bidder's technology uses the license-exempt 5.8 GHz spectrum.

4.2.4 Reinforcement of Radio Communications Towers

In the broadcast industry, it is common practice that parties requesting attachment of new antennas (with associated ice guards and waveguides or microwave cable) engage a structural engineer to demonstrate that with the addition of the new appurtenances, the communications tower will continue to meet the latest edition of CSA Standard S37, *Antennas, Towers and Antenna-Supporting Structures*. In cases where the new equipment will over-load the communications tower, the onus is on the requesting attachment party to pay costs associated with reinforcement of the communications tower.

Note: The governing CSA standard has been revised a few times over the past several decades, each time becoming more stringent. A communications tower constructed forty years ago and in accordance with the prevailing edition of the standard at the time is likely to be considered as having an inadequate safety margin by today's requirements.

One of the "*hub*" sites chosen for London Hydro's WAN system was the CFPL broadcast tower that is west of Wharncliffe Avenue and south of Commissioners Road. As the London Police Department was also in the midst of negotiating the installation of radio equipment on the CFPL broadcast tower, London Hydro arranged with London Police Department to share in the cost of a structural engineer, the design, fabrication and installation of mechanical reinforcement (as required), the qualified riggers to install the equipment for both parties.

The other "*hub*" site chosen for London Hydro's WAN system was an existing communications tower located at Arva Reservoir and Pumping Station and owned by the city of London. As there was no opportunity for cost sharing at this site, London Hydro retained a licensed structural engineer to carry out a structural analysis of the

Arva communications tower, paid for some minor reinforcing work, and contracted with a qualified rigger to install the WAN radio equipment.

The existing communications tower at London Hydro's complex (used for voice communications, line stringing, distribution automation, and SCADA) had a tubular steel design that has fallen out of favour in recent decades because one can't measure the level of corrosion on the interior surfaces of the tubular members and therefore assess its remaining structural strength. All modern communications towers use members formed from "angle iron" structural steel.

For the London Hydro communications tower, the structural engineer opined that since it was almost impossible to determine the residual structural integrity, it would be more cost effective to procure and install a new communications tower than to incur the complexity and associate cost of reinforcing the existing tower. Based on this recommendation, London Hydro procured another communication tower from the manufacturer that was already supplying towers for installation at selected municipal substations.

4.2.5 Securing Leases for Roof-top Mounted Repeaters

One of the design criteria associated with the wireless broadband WAN is that there are two (2) independent paths from each FlexNet TGB transceiver to the FlexNet RNI master station. It is imperative that each FlexNet TGB transceiver have robust communication with both "hub" locations – the first at the CFPL broadcast tower, and the second at Arva Reservoir and Pumping Station.

In order to achieve this design objective, it was necessary to install four (4) repeater or relay units – intermediate transceivers between the source FlexNet TGB transceiver and the destination hub that receive the source radio signal and retransmit it to the destination hub (and vice versa). This is a common method of circumventing obstructions such as high office or apartment buildings.

A repeater unit was installed on the existing communications tower at Springbank Reservoir (where London Hydro and the City have other radio systems installed).

Three other repeaters were installed on the roof-tops of apartment buildings, for which London Hydro pays an annual lease amount.

Note: One of London Hydro's consultants had access to highly confidential roof-top lease rates from which London Hydro was able to establish a rate that would be acceptable to the owners of the subject buildings. Given that the selected buildings aren't overly attractive to commercial carriers, London Hydro was able to make initial offerings at the low end of the spectrum.

4.2.6 Procuring a Communication Shelter at CFPL Site

The timing of London Hydro's Smart-metering system was opportune. Look Communications had an existing communications shelter (fully equipped with environmental control systems and an emergency power system) located at the base of the CFPL broadcast tower. It was rumoured in the broadcast industry that Look

Communications intended to withdraw from the business, sell off their assets, and allow their lease and attachment agreements with CFPL lapse.

Note: The London Police Department was also planning to install new radio equipment on the CFPL broadcast tower. London Hydro planned to share the cost of the requisite reinforcing of the CFPL broadcast tower and riggers to install the antennas, ice guards and microwave cable for both parties. The communications shelter was certainly large enough to accommodate both London Hydro's transceivers and those of the London Police Department.

London Hydro offered to procure the communications shelter "*as is*" and assume the lease agreement with CFPL. If London Hydro was receptive to using its contracted riggers to removing the antenna, ice shield, and interconnecting waveguides from the broadcast tower, the communications shelter could be had for the unbelievably low price of $5K.

Soil samples in the vicinity of the communications shelter to determine whether the soils had been contaminated with diesel fuel or other contaminants (in which clean-up costs would be a contractual matter between Look Communications and CFPL), a purchase order was issued to Look Communications, and the occupancy agreement for the communications shelter was transferred to London Hydro (with the London Police Department as an authorized sub-tenant).

Note: London Hydro does not charge the London Police Department a rental fee for occupancy of this communications shelter. Rather a reciprocal arrangement dating back to the era of London PUC is in place whereby London Hydro has radio equipment installed at a number of City-owned facilities (e.g. Arva Reservoir, Springbank Reservoir, Oxford Street East communications tower, White Oak Road pumping station, etc.) and pays neither rent nor attachment fees.

Minor costs were subsequently incurred to replace a damaged electrical panel, bring the fire detection system into compliance, and maintain the standby diesel generator.

4.3 Installation of Smart-Meters

4.3.1 Smart-Meter Installation Strategy

A deployment in excess of 140,000 Smart-meters was certainly well beyond the capacity of London Hydro's Electric Metering staff. As such, the following strategy was developed:

- London Hydro would contract the installation of single-phase and network-style Smart-meters to a qualified installation contractor;
- London Hydro staff would assume responsibility for Smart-meter installations on polyphase and transformer-rated services, both of which require a greater skill level;
- Meter bases are the customer's responsibility, but it is well known in industry that certain vintages and makes of meter bases are prone to having the internal standoff insulators break when the revenue meter is extracted. On a project of this scale it is undesirable to hold up the meter installation contractor until the homeowner is advised of the problem, reluctantly engages a licensed electrician, and finally has the repaired or replaced meter base inspected by the Electrical

Safety Authority (ESA). For project expediency and as a customer service, London Hydro would contract with one or more standby electrical contractors that could immediately respond to instances of broken meter bases.

- Following installation of a Smart-meter, London Hydro's contract meter readers would continue to manually read meters for two complete billing cycles following installation so that the meter readings transmitted electronically could be compared with those provided by the contract meter readers. On a project of this scale, it was deemed appropriate to have such a quality control mechanism so that we could detect anomalies early and confidently report to concerned customers that two cycles of "end-to-end" validation were carried out.

The remainder of this section describes the various cost elements associated with mass deployment of Smart-meters.

4.3.2 Selection of a Smart-Meter Installation Contractor

In July 2009, London Hydro issued an RFP for Smart Meter Installation Services in which the results of the competitive bid process favoured Honeywell Corporation. A copy of the RFP for Smart Meter Installation Services, dated July 31, 2009, is contained in Appendix J.

A requirement contained in the RFP for Smart Meter Installation Services was that "automated workforce management tools will be required to interface with this system for purposes such as Billing and Inventory". One result of this requirement was that Honeywell's smart meter installation crews used hand-held devices that provided electronic service orders to be dispatched electronically, when installing the meters. This automation provided for the streamlining of smart meter installation processes so that required installation and meter data could to be uploaded to various London Hydro systems efficiently. Incorporating automatic processes resulted in the avoidance of potential manual data entry errors, and the considerable burden and costs associated with extensive manual data entry of over 146,000 meters.

4.3.3 Selection of an Electrical Contractor to Repair Meter Bases

Invitation to Tender T2010-N-3, *Supply of Electrical Labour and Material to Repair and / or Replace Electric Meter Bases*; dated February 2010, was sent to 27 local electrical contractors, and advertised both in the London Free Press and via London Hydro's website. A copy has been included as Appendix U.

Based on an evaluation of the fifteen (15) responses, and the expected call frequency for stand-by electrical contractors, a recommendation was made to have a pool of two (2) electrical contractor firms. A summary of the bid evaluation process and recommendation to this effect was prepared and presented to London Hydro's Board of Directors at the March 2010 meeting. The selected electrical contractors were subsequently formally notified by Purchasing.

In cases where repair to the customer's meter base was required, the customer received a customer-specific letter. A copy of the letter template is included as Appendix U.

Surprisingly, the number of damaged meter bases was far less than expected at only 295 meter bases, or about 0.37% of the population of residential meter bases. This is well below the frequency of broken meter bases encountered in other jurisdictions.[8]

4.3.4 Disposal of Removed Revenue Meters

A Request for Quote (RFQ) was issued in July 2009, for the removal and disposal of scrapped conventional meters. The RFQ were sent to four area scrap dealers that had bid on our scrap material tenders in the past. Of the two bids that were received, one was not compliant with one of the significant requirements of the RFP. The winning bid was awarded to Green-Port Environmental Managers Ltd. To provide efficiency and cost savings, the managing of the disposal of scrap meters was sub-contracted to our smart meter installation vendor, Honeywell Inc. This arrangement allowed Honeywell to change out of the meters and transport these meters to the disposal sites to Greenport recycle bins. Honeywell administrating the disposal of the meters consolidated the processes and record keeping efforts and provided cost savings. London Hydro received from Honeywell, a copy report from Greenport outlining the disposals. This report also included the amount of scrap value that was credited to Honeywell, which in turn Honeywell credited to London Hydro.

A copy of the Request for Quotation for Recycling/ Disposal of Scrap Meters, issued July 2009 can be referenced in Appendix K.

4.3.5 Incremental Administrative Support

To support the mass deployment of Smart-meters by the selected installation contractor, two (2) administrative clerical staff was contracted for a limited duration to provide services as described following:

- In the Electric Metering Department, to process the multitude of service orders corresponding to the mass deployment of Smart-meters; and
- In the Finance Department, to process insurance claims arising from the mass deployment of Smart-meters. In total, 63 insurance claims were processed (i.e. customer communications and relevant evidence collected and passed on the designated insurance adjuster).

[8] Paper submitted to CS Week for the Expanding Excellence Award – Best Smart Infrastructure Project: *A Unique Approach to Smart Meter Deployment at London Hydro*; Vinay Sharma & Gary Rains; May 2011; Orlando, Florida.

4.4 AMI Project Management

4.4.1 Retaining a Project Management Professional

At the outset of the deployment phase of the project, a large internal team was assembled with responsibilities for planning, execution and progress reporting on various aspects of the overall AMI project. Specific roles included:

- Deployment of Smart-meters
- Specification and procurement of WAN
- Construction of communications towers for WAN and LAN applications
- Radio spectrum licensing
- Deployment of FlexNet RNI master station software
- MDM/R registration
- Procurement

For the first year of the project, the project team met on a weekly basis to review project status, identify issues, develop contingency plans, etc. As the project evolved, the composition of the project team changed, i.e. throughout the mass meter deployment phase, representatives from corporate communications, meter reading, and the customer call centre become active members of the project team.

This project was a significant undertaking and the internal staff that participated on the project team were burdened with these activities on top of their normal job duties.

A certified project management professional (PMP) from IBM Consulting was brought in to augment the AMI project team, prepare and update project Gantt charts, and create high-level status reports for London Hydro's executive management team.

4.4.2 Retaining a Wireless Communications Subject Matter Expert

London Hydro required a subject matter expert in wireless communications to review the submitted RF propagation studies, secure licensed spectrum in the 900 MHz band for the LAN element, and provide expertise and guidance with specification, procurement and deployment of the wireless WAN.

The arrangements for securing an appropriate subject matter expert have previously been outlined in Section 4.1.4, *Securing Licensed Radio Spectrum* (starting on page 21 herein).

4.5 AMI Deployment Challenges

In spite of the contingency planning that was undertaken for this project, a number of issues did arise that required management. Such incidents inevitably introduce a delay, additional cost, or both to the project.

4.5.1 Interference with Emergency 911 Radio Channel

The London Fire Department has a radio link between the London Courthouse (located at 80 Dundas Street) and a radio tower located in the Middlesex County Works Yard (located outside London on the south side of Gainsborough Road and west of Vanneck Road) to provide 911 services to the village. This 911 radio link uses spectrum adjacent to London Hydro's Smart-meter spectrum.

In the weeks following the start of London Hydro's deployment of Smart-meters, the London Fire Department reported drop-out problems with the 911 radio link. There was suspicion that the Smart-meter wireless communication was interfering with the 911 radio link.

The subsequent investigation revealed that the directional antenna on the tower in the village was out of alignment. It is believed that a rigger that was recently maintaining other equipment on the tower accidentally contacted and misaligned the 911 antenna.

To preclude any possibility of interference in the future, and with the permission of the London Fire Department, London Hydro changed the polarity of the 911 radio link so that one system now had "*vertical*" polarity and the other had "*horizontal*" polarity and there would never be any possibility of interference in future.

4.5.2 Approval Delays with GE kV2 Revenue Meter (for 600 V Delta Services)

Three-phase three-wire 600 V services (commonly referred to as "*600 V delta services*") were popular around the time of the Second World War to provide service continuity to factories of all sizes. Several decades ago, this servicing arrangement fell out of favour due to safety concerns. These days, LDC's generally maintain the diminishing population of such services and use all customer-initiated upgrade opportunities to convert to a three-phase four-wire 347/600Y V service.

Note: It may be seen from Table 6-3, *Population of Energy-Only Revenue Meters*, within London Hydro's RFP that at the time there were 107 electric services that require a 600V delta meter.

The only revenue meter approved by Measurement Canada for application on 600 V delta services is the GE type kV2-series of meters.

It is understood that the first time the GE kV2c meter outfitted with a Sensus FlexNet radio accessory was submitted to Measurement Canada for type approval, it failed thereby requiring re-design and re-submission.

According to the Measurement Canada Notice of Approval, the resubmitted GE kV2 meter with FlexNet radio accessory was approved on October 22, 2010.[9] However, London Hydro did not receive delivery of the requisite quantities of this meter until November, 2011.

Note: Measurement Canada subsequently issued a series of Modification Acceptance Letters (MAL's), namely MAL-E240, -E241 and –E246, covering the GE kV2 meter equipped with

[9] Measurement Canada Notice of Approval AE-1059 Rev 18.

the FlexNet radio accessory. The most significant was that, for Sensus applications, the meter would be branded as an iCon-APX meter.

4.5.3 Discontinued Sensus Type APX Polyphase Revenue Meter

There was significant interest among LDCs in the Sensus *type APX* 3-element auto-ranging three-phase revenue meter which could be used for small business applications (i.e. many customers in the "*general service < 50 kW*" tariff classification. The type APX meter received formal approval from Measurement Canada on May 5, 2010.[10]

In spite of regular inquiries as to when manufacturing of this new meter would be geared up and the meter available for deployment, answers weren't forthcoming. Finally, in the Fall of 2010 it was made public (at an Ontario Sensus Users Group meeting) that Sensus has ceased production of the APX meter and LDC's would have to use either the ALPHA A3 or GE kV2 meter for their three-phase meter applications.

4.5.4 Extended Turn-Around for RMA Meters

Given the magnitude of the Smart-meter rollout, a 1% infant mortality failure rate would correspond to 1,400 revenue meters that needed field replacement. Towards the end of the mass meter deployment, London Hydro (like most other LDC's) experienced significant delays in obtaining replacements to replace failed meters returned to Sensus with an authorizing Return Material Authorization (RMA).

For example, London Hydro has 672 revenue meters returned on RMA in 2010 and 179 meters returned on RMA in 2011 that have yet to be repaired or replaced, re-sealed, and returned. And there is no reliable commitment as to when such meters will arrive.

There are similar issues with the delivery of new revenue meters. Promises of 10 to 12 weeks delivery cycles remain to be fulfilled 16 weeks later.

This problem has two ramifications to London Hydro, namely:

- The organization has had to order and carry larger quantities of meters than are necessary to meet forecast requirements as a means of overcoming the RMA return issues and tardy meter deliveries; and
- Work planning is a significant challenge – for example, the network optimization work was delayed many times due to the inability to obtain inventories of meters to replace defective in-service meters.

4.5.5 Other Revenue Meter Issues

London Hydro identified a number of issues related to the Elster ALPA A3 revenue meter outfitted with a FlexNet communications accessory circuit board. Examples of

[10] Measurement Canada Notice of Approval AE-1828

the discovered issues include command sequences that cause the meter's communications to seize, instances where the electricity consumption was recorded in the wrong time period, etc.

Note: The Elster ALPHA A3 meters are largely deployed within the small business sector, i.e. customers in the "general service < 50 kW" tariff classification.

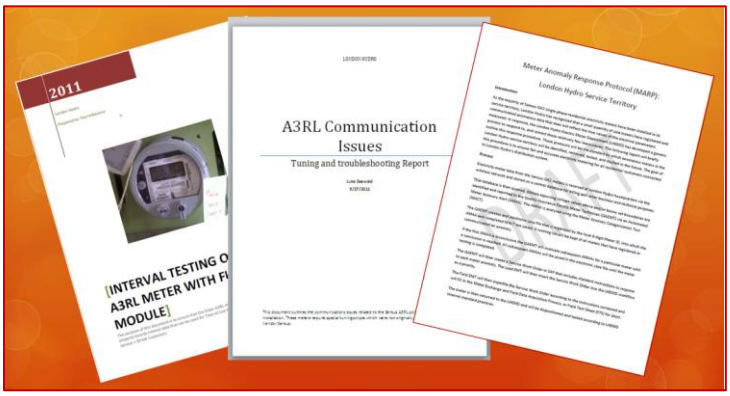


Figure 4-1, Reported Issues with Polyphase Revenue Meters

While these identified shortcomings have now been addressed, the effort required (by both London Hydro and the vendor) to diagnose the underlying problem, reproduce it in a test environment, develop and test a solution, and disseminate the software upgrades to the population of affected meters inevitably resulted in project delays and additional expenses.

Note: As an accredited Meter Shop, London Hydro has an obligation to share such findings with Measurement Canada. The information was also shared with other LDCs.

4.5.6 Congestion of the FlexNet 900 MHz LAN

Once London Hydro had deployed more than 100,000 Smart-meters, it was observed that the performance of the 932/941 MHz wireless LAN was decreasing as more meters were installed. There are a number of configuration changes that can be made to "*tune*" or optimize the operation of the system (e.g. adjusting the modulation scheme between FSK-7 and FSK-13, adjusting the transmission scheme or the frequency by which a meter will communicate via an alternate path as opposed to directly with the FlexNet TGB, assignment of specific meters to operate a repeater devices when required, etc.). Unfortunately the network tuning efforts which went on for several weeks weren't yielding a perceptible improvement in performance.

The system designer, Sensus, was called upon to assess the root cause of the problem. In late 2010, Sensus reported that indeed there was network congestion, not on the transmission channels from the FlexNet TGB transceivers, but on the receive channels wherein the FlexNet TGB transceivers were receiving data transmissions from the population of Smart-meters. The proposed solution was to replace the omni-directional antennas and associated FlexNet TGB transceivers at four (4) sites to a sector arrangement, whereby at each of the subject sites, three directional antennas (each covering roughly 120 degrees) and three FlexNet TGB transceivers would be installed. Theoretically, at these sites, as each antenna was only receiving in a 120

degree sector, the network traffic on the associated FlexNet TGB would only be one-third of the previous network traffic, thereby providing congestion relief.

Figure 4-2 below shows the original arrangement (of one FlexNet TGB transceiver and one omni-directional antenna) for the 111 Horton Street tower.

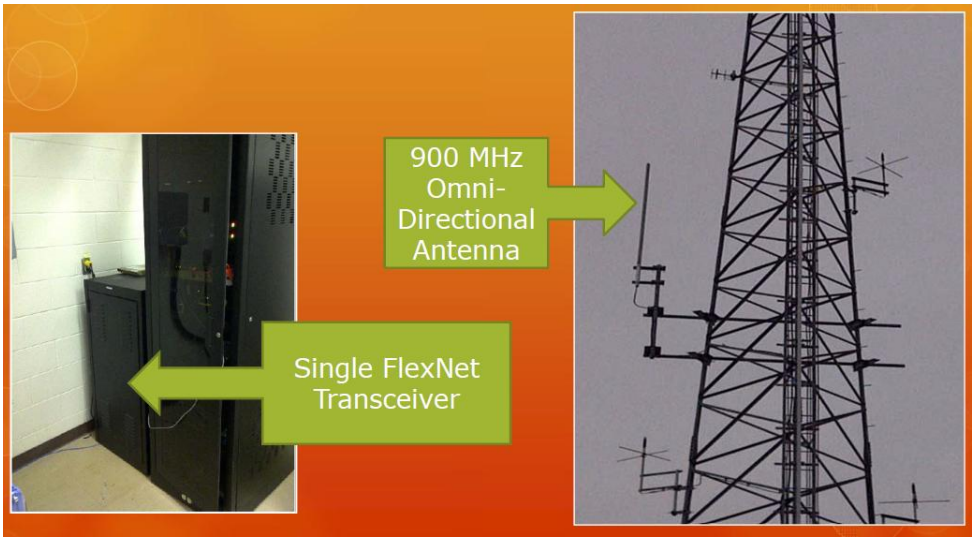


Figure 4-2, Original Single Transceiver / Single Antenna Arrangement

Figure 4-3 shows the modified arrangement with three (3) rack-mounted FlexNet TGB transceivers installed in a common enclosure and three (3) directional antennas installed on the tower each broadcasting and receiving in a 120 degree sector.

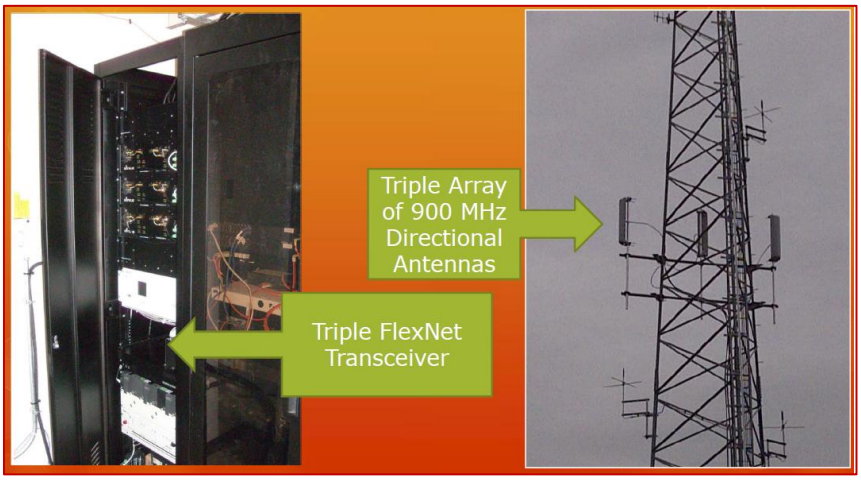


Figure 4-3, Modified Triple Transceiver / Triple Antenna Arrangement

Pursuant to Section 9.1, *Guarantee of FlexNet® Wireless Communications System Design*, of the Statement of Work, the vendor was entirely responsible for the significant cost of supplying and installing (4 sites x 2 additional TGB's per site =) 8 additional FlexNet TGB transceivers, associated antennas, and interconnecting microwave cable. The vendor was further responsible for re-certifying the communications towers for the additional cantilever loading. It was found that the

communications tower within the Adelaide Street municipal substation compound had to be reinforced.

Note: London Hydro incurred the cost of Ethernet LAN switches at the four sites (to provide a data connection between three FlexNet TGB transceivers and the single BelAir WAN transceiver). London Hydro had planned to install managed substation-hardened Ethernet LAN switches at the various sites at a later date to provide a connection to SCADA RTU's, a diagnostic port, and a connection point for Substation Maintenance staff. With a managed device we would also have remote diagnostics and a mechanism for implementing cyber-security measures.

Delivery to site of the requisite TGB transceivers didn't occur until late Spring of 2011 and the retrofit operations occurred throughout the summer of 2011.

This issue was the primary reason (but not the only reason) for London Hydro's application to the Ontario Energy Board to delay the mandated in-service date for time-of-use billing. Refer to EB-2011-0092 – London Hydro's application for Adjustment to Mandated Time-of-Use End Date.

While the previously described network reinforcement measures were expected to cure the congestion issue, the overall improvement was not as great as expected. Sensus field staff with expertise and diagnostic equipment for their RF system returned to London in the Fall of 2011 to investigate why there were geographic clusters of revenue meters that weren't able to communicate with the FlexNet TGB transceivers (contrary to the RF propagation study). The investigation revealed a large number of these meters were factory-programmed with the incorrect transmit frequency.

RF issues still prevail, but Sensus and London Hydro are jointly making progress. It will simply take more time to perfect the operation of the 900 MHz LAN system so that it finally operates within Sensus' design parameters and London Hydro's expectations.

4.5.7 Financial Distress of Turnkey Communications Tower Contractor

Part way through the project, the contractor that was retained to supply and install communications towers at seven (7) sites came into financial distress, was unable to obtain credit from the communications tower manufacturer and couldn't continue the project without payment in full before any materials arrived on site and the work completed.

The lowest cost option for London Hydro was to terminate the existing contract (based on inability to perform in accordance with the specified conditions), procure the communications towers directly from the manufacturer, and retain an alternative contractor to complete the work.

4.5.8 Power Supply Certification Deficiency for Roof-Top Repeaters

With respect to the wireless broadband backhaul system, when the repeaters were installed on the roof tops of three (3) apartment buildings, the subsequent electrical inspection carried out by ESA revealed that the battery-backup power supplies did not have CSA certification. More than six months elapsed while the contractor resolved the matter with component supplier and the ESA.

Note: The remediation of this issue was a supplier expense, and not a London Hydro expense.

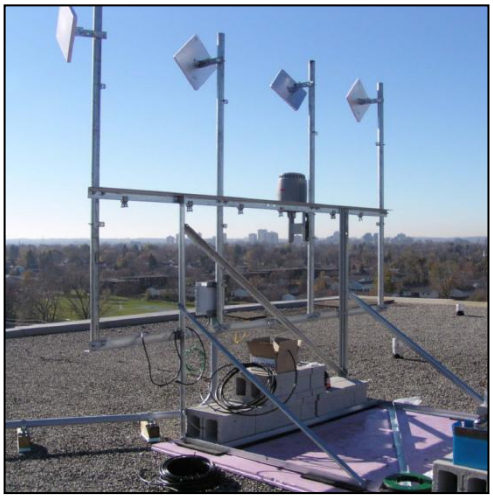


Figure 4-4, Typical 5.8 GHz Rooftop Repeater Installation

4.5.9 Smart-Meter Exchange Refusals

Not all of London Hydro's customers were elated to be having a Smart-meter installed on their premises. As of December 31st, 2011 some 175 customers still didn't have a Smart-meter on account of customer refusals to have their traditional revenue meter exchanged for a Smart-meter. By March 15th, 2012 this number had been whittled down to 132 customers still without Smart-meters.

At any rate, London Hydro will have to revert to more aggressive means (e.g. service disconnections, etc.) in the forthcoming months to complete the Smart-meter installations.

4.5.10 Hard to Access Residential & Small Business Accounts

In the LDC industry, the term "*hard to access*" refers to metering installations whereby the LDC faces challenges in accessing a premise to perform a meter exchange. A typical instance is the case where a homeowner is deceased and the executor of the estate lives out-of-town or even out-of-country and has no interest in travelling to London simply to permit access to the home. Such accounts usually have minimum electricity consumption and there is no occupant available to benefit from time-of-use electricity rates.

Note: This issue isn't specific to the Smart-metering initiative. LDC's have had to deal with this matter when the federal accuracy seal on the revenue meter expires and the meter needs to be removed from service for reverification and re-sealing.

Other "*hard to access*" installations include those dwellings occupied by so-called "*snow birds*" who live outside the country for six months of the year.

5 DESCRIPTION OF OTHER AMI SYSTEM COST ELEMENTS

5.1 Procurement of Polyphase Demand Meters

Advanced metering infrastructure represents a considerable investment, so all opportunities to leverage the technology for other or future applications to maximize cost effectiveness were considered.

The Ministry's functional specification [Ref 2] covers energy meters only (for residential and general service less than 50 kW customers). However, LDC's are interested in leveraging their AMI investment in wireless communication technology to support (in future):

- combination energy and demand meters for general service greater than 50 kW customers, and
- bi-directional revenue meters for customers that are participating in the Ontario Power Authority's Feed-In Tariff (FIT or microFIT) program.

London Hydro has about 1,600 customers in the General Service Greater Than 50 kW tariff classification that will eventually be outfitted with interval-style revenue meters.

Section 6.1.7.2, *Revenue Meters beyond Scope of Provincial AMI Specification*, of London Hydro's RFP requires that the successful AMI supplier provide both functionality for the "*combination*" meters that will be required for this class of customer and appropriate communications system bandwidth and space in their data base (for channel recording on 15-minute intervals, in comparison to Smart-meters that are single-channel recorders on hourly intervals).

London Hydro anticipates procuring a nominal 25 "*combination*" meters that will be used during System Acceptance Testing to confirm that the requisite functionality is correctly provided.

5.2 Cyber-Security Provisions

The baseline requirements for system security and data privacy given in the Ministry of Energy's functional specification [Ref 2] are replicated below for convenience of reference:

2.11 Security and Authentication:

2.11.1 The AMI shall have security features to prevent unauthorized access to the AMI and meter data and to ensure authentication to all AMI elements.

At the meeting held on September 21st, 2006 between London Hydro and Ministry of Energy staff, London Hydro expressed concern that the Ministry's baseline system security requirement is too vague. Given the expected price-tag for an AMI system

coupled with the expected in-service lifetime, cyber security is an important element and as such London Hydro's RFP would augment the Ministry's broad requirements with specific requirements drawn from Energy Management Systems used to monitor and control interconnected electrical transmission systems and Supervisory Control & Data Acquisition (SCADA) and Distribution Automation (DA) systems used to monitor and control electrical distribution systems – specifically the NERC *Critical Infrastructure Protection* suite of security standards. Again, for convenience of reference, an excerpt from London Hydro's RFP, specifically Section 6.2.6.4, *Electronic Security*, has been included as Appendix F herein.

While an argument can be presented that expenditures related to state-of-the-art cyber-security exceed the Ministry's minimum requirements as given in their functional specification [Ref 2], London Hydro prefers to believe that the Ministry of Energy embraced the enhanced and specific definition of cyber-security embedded in the London Hydro RFP by specifically endorsing procurements of AMI systems under the London Hydro RFP process within Ontario Regulation 427/06.

Internal memoranda are available authorizing the procurement of firewall products for the FlexNet RNI master station,[11] and the procurement of secure Ethernet LAN switches in substations that are outfitted with FlexNet TGB transceivers and BelAir Networks WAN transceivers.[12] The Ethernet LAN switches were procured under Request for Quotation Q2011-N-11.

A third-party verification of the cyber-security provisions of the FlexNet RNI master station and its connections to the WAN was conducted by the same contractor (Digital Boundary Group) that provides this service for London Hydro's corporate computer systems and as an extension to the existing contractual arrangements. At an appropriate time, this independent verification will be extended to encompass the WAN and LAN elements, and entire system cyber-security verifications will be performed on a regular basis.

5.3 Network Operating Centre

London Hydro constructed a modest Network Operating Centre (NOC) in a secure office adjacent to the secure data centre on the first floor of the building. Basically the NOC is little more than three or four wall-mounted flat-panel high-resolution computer monitors (each measuring at least 1 m across the diagonal).

The rationale for such an investment is given in the memorandum of April 2, 2010 to Gary Rains from Peter O'Grady, re: *Recommendation to Construct a Minimal Network Operating Centre*. A key excerpt from this memorandum is replicated below for convenience of reference:

[11] Memorandum of January 8, 2010 to Vinay Sharma from Gary Rains; re*: Sensus FlexNet Advanced Metering Infrastructure – Advanced Procurement of Ethernet Local Area Network (LAN) Communication Switch*.

[12] Memorandum of March 28, 2011 to Vinay Sharma from Gary Rains; re: *Sensus FlexNet™ AMI – Remediation of Network Performance Issues – Procurement of Ethernet LAN Switches for Four (4) Substations*.

The rationale behind the Network Operating Centre is analogous to a dynamic map-board as would be used with a SCADA, EMS or DA system in a utility Dispatch Centre & Control Room. For day-to-day operations, the Power System Operators rely entirely on the tabular information and schematic diagrams on their respective workstations to control the operation of the power distribution system – and the dynamic map-board serves no real purpose.

However, the literature on human factors and control room design will show that Power System Operators more effectively respond to less-frequent wide-scale outages by simultaneously using the dynamic map-board to maintain an overview of the power distribution system and using the workstation displays to provide detailed context for the network substations and circuits. This combination of overview and context displays is effective because it both minimizes Operator information overload and confusion. This same philosophy has been applied to the Network Operating Centre where data communications networks (with their nodes and branches) are being managed as opposed to electrical power distribution networks (with their substations and circuits).

6 DESCRIPTION OF SYSTEM INTEGRATION COST ELEMENTS

The Sensus FlexNet AMI transports the hourly electricity consumption information from the population of Smart-meters to the FlexNet RNI master station (or what the Ministry refers to as an "*Advanced Metering Control Computer*" – refer to Figure 1-1 on page 1 herein) but this doesn't produce a customer bill, or manage move in / move outs, meter replacements, etc. A number of computer systems, including the provincial MDM/R have to be integrated with the Sensus FlexNet RNI master station to make a fully operational system.

6.1 Data Exchange with Provincial MDM/R

Clause 2, *Cost recovery, meter data functions*, of Ontario Regulation 426/06, *Smart Meters: Cost Recovery*, compels LDC's to transmit the Smart-meter hourly consumption data to the provincial MDM/R for "… *verification, validation and editing of such meter data, processing of meter data into data that is ready for billing purposes, aggregation of meter data into rate periods, and storing and managing of meter data.*"

The process of sending meter data to the provincial MDM/R daily and receiving validated meter data in return is fairly straightforward. The complexity arises in that the provincial MDM/R basically has to duplicate some of the functionality of the LDC's Customer Information System in a synchronized manner to frame the data for customer-specific billing cycles, to handle meter exchanges, to handle move in / move outs and other reasons for off-cycle billing, etc.

The following subsections highlight London Hydro's expenses associated with transferring meter data to and from the provincial MDM/R and synchronizing the MDM/R with London Hydro's CIS.

6.1.1 Retention of a Project Manager

A Request for Quotation (RFQ) for Project Manager for Data Management and Smart Meter Deployment was issued October 2008, referenced Appendix L. Due to the significant expertise and experience needed to provide for the success of an involving and complex project, London Hydro required a consultant who would be contracted throughout this project. This person needed to contribute as an AMI consultant, AMI Project Advisor, and Solution Architect.

As included in the RFQ for Project Manager for Data Management and Smart Meter Deployment, the consultant was expected to:

- Define requirements for AMCC, CIS, and MDM/R.
- Identify all tasks for:
  - Configuration of AMCC
  - Configuration of CIS
  - Configuration of MDM/R
- Manage the completion of the above tasks.

- Manage all interface requirements and development between AMCC, CIS, and MDM/R.
- Responsible for the deliverables from various team members for all data related activities.
- Work with other project managers to ensure the completion of overlapping tasks.
- Prepare reports, including a project plan for the project Director.
- Manage London Hydro's registration with SME for all MDM/R related work.
- Develop training documents and business processes for smart meter data related activities.
- Manage training on all new systems for London Hydro staff.
- Other assigned work regarding the smart meter project.

Additional details as to the responsibilities for the Project Management position, included in Appendix M Statement of Work Expectations for Project Manager (Contract Position) and Energy Management Department: Project Manager for Data Management Q2008-N-22. The position was made on a contract basis versus as a full time position to balance effective management of the smart meter project with keeping the cost constrained.

6.1.2 Integration with Provincial MDM/R

Following the completion and go-live of a new CIS implementation in 2009, London Hydro began to plan for implementation of MDM/R interfaces and processes to support Smart Metering and Time-of-Use billing. Due to the extensive transition and stabilization work underway with the new CIS at the time, we felt that it would be prudent to engage resources who were already familiar with and working on our CIS implementation project. Such an arrangement would avoid extensive ramp-up and development conflicts as could happen by adding another new development team unfamiliar with changes already in progress throughout our new CIS.

To this end we approached our original system integration vendor for the SAP CIS implementation (and who were working on production support at that time) for an effort estimate based on the rate card provided as part of the RFP process for the CIS implementation. In addition, to ensure this work was competitively evaluated by the vendor, we also approached a sub-contractor for an equivalent estimate. In reviewing these two options we determined that the sub-contractor quote was the lower cost option for London Hydro and they were willing to commit to a fixed price engagement to ensure the cost would remain contained.

6.1.3 Procurement of AS2 Encryption Server and End-Use Software

The provincial MDM/R requires that the transfer of meter data between an LDC and the MDM/R be via an AS2 encryption server.[13] The LDC also needs to procure AS2 client software that complies with the interoperability requirements given in Section 3, *Guidance for Selecting AS2 Software*, of MDM/R publication SME-MAN-9001, *MDM/R File Transfer Services and Web Services – Configuration Workbook.*

To avoid procuring a physical AS2 server, the three (3) servers required to run AS2 encryption (proxy, trader and failover for redundancy) were virtualized and operate on the expanded blade server system (as previously described in Section 4.1.2 herein).

In October, 2009, London Hydro issued Request for Quotation Q2009-N-28 entitled: *File Transfer Service (FTS) / Application Standard – 2 (AS2) Software*. Only two quotations were received. Following an evaluation of the proposed products, and recommendation to procure the Cleo Communications' client product was presented to the London Hydro's Board of Directors at their November 2009 meeting.

6.2 Enhancement to SAP IS/U Customer Information System

6.2.1 General Strategic Principles

It is probably a worthwhile lead-in to this section to state London Hydro's umbrella principles for IT investments in general and its application to the Smart-metering initiative in specific:

- To provide customer confidence in seeing the benefits of shifting the load, London Hydro focused on data quality of the hourly data. The real benefit is that the customer will now be able to have insurance of the integrity of the data and be able to use this data to help shift their load and actually see the results of the change that they made reflected in the customer view. Our approach is engage the customer in demand management and not just "*bill presentment*" .
- London Hydro's goal is to build it once with a right-sized system and evolve with industry-leading enterprise systems/vendors (e.g. SAP, Itron, Intergraph) which will avoid future costs of dealing with standalone "*best of breed*" or smaller scale systems that would need replacing. Our strategy is to extend our systems to handle new emerging functionality at a reasonable cost as opposed to having to install new systems at a much higher cost in the future.
- The size of London Hydro requires us to use a larger system such as SAP CIS which has a high entry point that can accommodate significantly more meters than we have. We have initiated collaboration discussions with other LDCs (e.g.

[13] MDM/R publication SME_MAN_9001, *MDM/R File Transfer Services and Web Services - Configuration Workbook*; Version 1.0; October 15, 2008. Electronic version of document is available on MRM/R's website at: http://www.ontario-sme.ca/sites/default/files/SME_MAN_9001%20FTS%20%20and%20Web%20Services%20Configuration%20Workbook%20v1.pdf

Hydro One) that have picked the same systems (e.g. SAP and Itron) and architecture (e.g. MDUS). There will be opportunities to share future project upgrade and enhancement costs.

6.2.2 Development of a Strategy for Smart-Meters & TOU Billing

London Hydro invested in a new Customer Information System, namely SAP's *Industry Solution for Utilities* (IS-U) product at a time when Smart-meters was envisioned but specific Smart-meter requirements had not yet been developed by the Province.

Note: The investment and ongoing maintenance costs of the new SAP CIS were included in London Hydro's Cost of Service rate application (EB-2008-0235). These costs are not included in this Application. However, other costs such as integration of the AMI with the new SAP CIS are applied for in this application.

The IS-U product offering includes a module that SAP calls *Energy Data Management* (EDM). The literature indicates that EDM is a solution that meets the requirements of interval reading, schedule management, and the billing of interval energy consumption. EDM covers the following areas:

- Central database for energy data (Energy Data Repository)
- Settlement and schedule management using the settlement workbench
- Billing of profiles using real-time-pricing billing (RTP billing)

Unknown to London Hydro, in the Spring of 2008, SAP initiated a collaborative effort with a number of much larger utilities (i.e. CenterPoint Energy, CLP Power Hong Kong Limited, Consumers Energy, Energy East, Florida Power & Light, Oklahoma Gas & Electric and Public Service Electric & Gas) in the development of a strategy for integrating various AMI systems with the SAP IS-U product. This collaborative group would be known as the SAP AMI Lighthouse Council. Although the immediate goal was the integration of Advanced Metering Infrastructure (AMI) with Enterprise technology, this was seen as laying the foundation for the industry's broader "*Smart Grid*" vision.

To be cost effective, London Hydro was interested in conversing with other larger electric utilities that had implementation experience with the EDM module to avoid pitfalls and identify successful approaches. Unfortunately there didn't seem to be any such utilities in Canada or United States.

An SAP subject matter expert was retained to examine the intricacies of the Ontario electricity marketplace, the activities to be carried out by the provincial MDM/R, and based on this information to advise whether the EDM module was appropriate and capable of carrying out the requisite data synchronizing and other activities.

The SAP subject matter expert's report is on file. It concludes that:

- The EDM module has the capacity and capability to do what needs to be done, but there would be an immense amount of configuration and programming required, and we may very well end up with an orphan system;

- An alternative approach would be to adopt the recommendations of the SAP Lighthouse Council and invest in a separate but integrated "*Meter Data Unification & Synchronization*" (MDUS) system. This is the direction that the utility membership in the SAP Lighthouse Council will ultimately implement, and such an approach should ultimately result in the lowest cost and widely supported solution.

At the time, there were only three (3) products that were certified as meeting SAP's MDUS integration specification and "*use cases*". It is understood that now there are a few more alternative MDUS-compliant products.

6.2.3 Selection of an MDUS-Compliant Product

Once the necessity for an MDUS-compliant product was presented to London Hydro's Board of Directors[14] and authorization was received to initiate a formal procurement process, London Hydro developed a *Supplier Self-Certification Declaration for the Supply, Delivery, and Integration of an MDUS-Compliant Operation Data Store (ODS)* to accompany the formal request. A copy of this document has been included as Appendix Q. The formal request was issued shortly thereafter.

As part of the overall evaluation process, both responders were invited to conduct an orchestrated presentation of their respective offerings. Presentations were conducted in late Fall of 2010 by the two respondents.

Based on the evaluation criteria, a recommendation to purchase the Itron Enterprise Edition™ offering was prepared and presented to London Hydro's Board of Directors at their June 21st, 2010 meeting.[15] With the Board's approval, a Statement of Work was negotiated between London Hydro and Itron. Finally a formal purchase order was issued to Itron covering the licensing, configuration, integration, testing, training, and documentation for their Enterprise Edition product.

Note: Since MDUS is a term well known to the SAP Lighthouse Council, but unfamiliar outside this group, London Hydro often refers to the Itron Enterprise Edition as an Operational Data System (ODS), a term that is more widely used and understood amongst Ontario LDC's.

6.2.4 Sharing the Investment Cost

In the evaluation and selection of the Itron Enterprise Edition solution (as an MDUS-compliant extension of the SAP IS-U CIS system) consideration was given to inherent functionality beyond what would be required to fully support the AMI.

Specifically, the Itron Enterprise Edition product inherently provides functionality to:

[14] London Hydro report entitled: *Acquisition of MDUS/ODS Software*; prepared by Mark Rosehart; include in submission binder to London Hydro's Board of Directors in advance of September 29th, 2009 meeting.

[15] Recommendation and supporting documentation entitled: *Operational Data Store Vendor Selection*; included in submission binder to London Hydro's Board of Directors in advance of June 21, 2010 meeting.

- settlement for renewable energy projects (such as microFIT) that are specifically excluded from the Smart-meter initiative;
- eventually transfer our existing MV-90 meter data collection system
- provide an interface to a planned future Outage Management System (OMS);
- provide an interface to London Hydro's distribution system analysis software (such as the CYME product for carrying out load flow analyses)
- provide an interface for measuring and reporting on quality of service (e.g. voltage alarms, service interruption notifications, etc.).
- provide demand response functionality desirable for CDM programs.

Given the combined purposes of this product, London Hydro has elected to recover part of the investment costs under the Smart-meter rate rider and the remaining part of the investment under a cost-of-service application.

The rationale for the division of investment cost in the Itron Enterprise Edition product (also referred to as an Operational Data Store, or ODS) is given below:

- Cost elements to be borne by Smart Metering initiative -

  The project activities related to define, design, build and testing of ODS implementation project towards the following deliverables needs to be considered a part of the Smart Metering:
  - Data collection from Sensus RNI to ODS which includes daily & historical interval consumption data and events
  - ODS synchronization with MDM/R through VE11 exception report; the complete process involves importing VE11 report into ODS, Web services and CMEP Trilliant export to ODS
  - Setting up meter configuration which includes hierarchy configuration for Meters, premise, service point, channels
  - Setting up VEE services in ODS and configuration of validation sets
  - Minimum AMI software licenses excluding MV90 (Service Mode) and Customer Care components
  - Minimum hardware/infrastructure for AMI, Operating System, database, network, environments, hardware and storage
  - MDUS Web services (total 31) synchronization with SAP
  - Corresponding project management, documentation, training, define & design workshops
- Cost elements to be recovered via "*Cost Of Service*" mechanism -

  The project activities related to define, design, build and testing of ODS implementation project towards the following deliverables needs to be considered a part of the Cost Of Service:

- Sensus RNI Master Data Sync with ODS – this is to populate the "*customer address*" field (and perhaps other attribute fields) within the RNI to provide improved diagnostics capability.
- Capability to calculate Bill Determinants, configuration for cycles, routes and schedules
- performing settlement of energy quantities, importing IESO files, aggregation by groups, setting up formulas, calculation of NSLS, Streetlight interval data based on OEB approved profiles
- Wholesale validation of energy quantities (MV90 and IESO)
- MDUS Web services (total 24) synchronization with SAP
- Account and service address configuration for SAP and ODS synchronization
- Out of box and custom reports
- System administration, security, system performance, disaster recovery, data migration
- Corresponding project management, documentation, training, define & design workshops

Based on an assessment of the project execution plan, licensing costs, and labour costs for configuring the system, developing the system, and overall integration testing, the overall investment in an MDUS-compliant ODS has been appropriately allocated between this Smart Meter application and expenditures for London Hydro's capital Information Technology assets.

6.3 Project Management

In early 2010, London Hydro established a Project Management Office to provide oversight and coordination of all IT projects. A governance framework included a Steering Committee made of senior management representing Customer Service, CDM, MDM, Corporate Relations and IT. The committee met on regular basis to review the status, project and resource plans, risk register and change management including training. The PMO produced overall integrated plan to coordinate all the tasks associated with projects associated with the transition to TOU billing that included AMI, MDMR interfaces, SAP CIS changes, Measurement Canada changes, ODS and TOU web presentment. As well, a dedicated testing team was established for end-to-end regression testing for "*meter to cash*" processes including all the interfaces to Sensus RNI and MDMR.

With respect to the resource management, London Hydro issued a Request for Proposal (RFP)[16] for resource augmentation and project work. The purpose of the RFP is to establish a prequalified vendor list for a period of three years with an annual evaluation of vendor performance. London Hydro expected to prequalify at least three and no more than five vendors. We received 14 responses to the RFP. The

[16] London Hydro document: Request for Proposal T2011-N-3, *Prequalification for SAP/AMI Resource Augmentation & Vendor Price Schedules.*

responses identified different sourcing models, lists of highly skilled resources with utility experience and very competitive role based pricing.

The Board of Directors approved five vendors to be on the prequalified SAP/AMI vendor list based on price, skills and vendor. This enabled London Hydro to solicit quotes and enter into contract negotiations with the pre-qualified vendors for specific resources and project work while minimizing the need to go through the process of issuing and awarding public RFPs. These five vendors have provided their broad and diverse capabilities including local SAP utilities bench strength, system integrator experience, local staff augmentation specialists, and different resourcing models.

6.4 System Integration Challenges

6.4.1 Compliance with Measurement Canada's Bill Presentment Requirements

Historically the customer's monthly electricity bill showed both the reading on the meter's register at the start of the billing period and the reading on the meter's register at the end of the billing period.

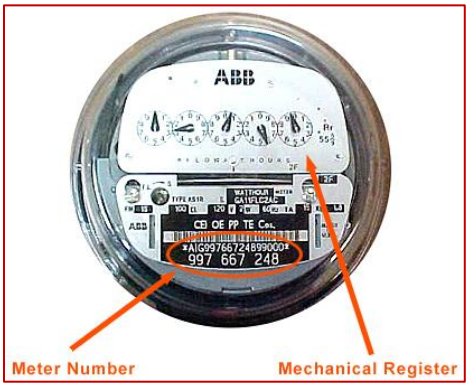


Figure 6-1, Typical Register for Energy Meter

Even though the Sensus FlexNet AMI reports hourly register reads to the master station, they are discarded as the provincial MDM/R expects to receive interval data (the difference in the register values between two consecutive hours, which is the hourly consumption values) and no provision was initially provided give LDC's register read values corresponding to the beginning and end of the bill period.

Industry Canada has ruled that the MDM/R approach of eliminating the two register readings from the customer's bill is a violation of the federal Electricity & Gas Inspection Act and Regulations. Consequently, the MDM/R is modifying its software to reconstruct "register" values corresponding to the beginning and end of the customer's bill period.

Ironically, even though the Sensus FlexNet AMI discards the requisite two values, the implications of incorporating the messaging protocol changes associated with eMeter's EnergyIP Version 7.2 (the version to which the MDM/R is migrating) is significant.

As part of March 2011 transition plan submitted to the OEB, London Hydro had assumed a relatively simple change to be implemented by the Smart Meter Entity (SME) in the provincial MDM/R service to add register read data and deliver a Measurement Canada compliant solution (i.e. two fields being added to the file sent from the MDMR to the SAP CIS system) within the structure of the existing billing interfaces. The anticipated delivery for London Hydro's functionality changes to support this was November 2011. The associated cost projected for these changes was small as our CIS system had existing capability to handle register read data in

combination with Time-of-Use quantities as part of standard functionality; therefore, the project scope was limited primarily to changes in the external billing quantity interfaces (generally referred to as the MDM/R '5000' and '6000' interfaces) plus an additional interface to submit register reads in a standard format.

Once London Hydro had completed the initial MDM/R developments and was in a position to initiate work on the Measurement Canada compliance solution being delivered with the MDM/R 7.2 release, a detailed review and requirements gathering for this implementation ultimately revealed our initial assumptions to be invalid as the SME imposed new MDM/R billing quantity interfaces (generally referred to as '5500' and '6500') changes on LDCs, completely replacing the existing billing quantity interfaces with new interfaces of an entirely different structure as well as significant changes in master data synchronization processes. The result of these changes is a significant increase in the scope of development, testing and project management, moving from enhancement of existing functionality to net new development and process logic changes to accommodate the MDM/R process logic.

The following diagram from the IESO illustrates the evolution of the Measurement Canada change that has resulted additional scope/work, retesting and overhead/coordination required since these changes are being implemented during London Hydro's transition to TOU billing.

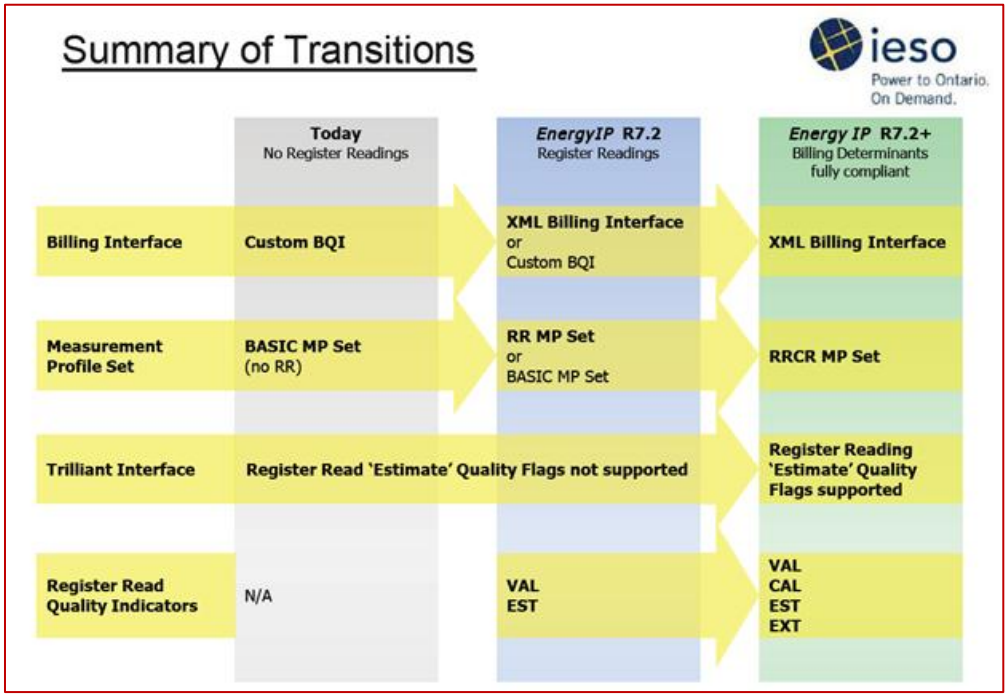


Figure 6-2, Summary of Transitions to MDM/R Interface

London Hydro issued an RFQ (Q2011-N-34) for the MDM/R Measurement Canada Changes (Release 7.2) Project to our five SAP/AMI pre-qualified vendors on June 30, 2011. We received responses from three vendors on July 20, 2011 but no vendor response was deemed appropriate to proceed.

As an alternative, the project team recommended utilizing our existing contractors with staff augmentation as a lower cost option to proceed. This arrangement gave London Hydro the needed flexibility in an environment of changing scope and timelines.

In summary, the above-described scope changes (that are entirely outside of London Hydro's control) as to MDM/R / IESO solution and Measurement Canada compliances have negatively impacted the costs associated with MDM/R integration changes.

6.4.2 Ongoing Acceptance Testing of Software Revisions

Certainly one of the challenges associate with a project of this magnitude that is occurring over an extended time-frame is the reality that the various systems are undergoing regular change.

The following graphic shows the various versions of the Sensus FlexNet RNI software (3 software releases so far during project implementation period), the provincial MDM/R software (3 software releases so far during project implementation period), and the SAP enhancement packs (4 releases so far during project implementation period) that London Hydro has had to deal with throughout the duration of the project.

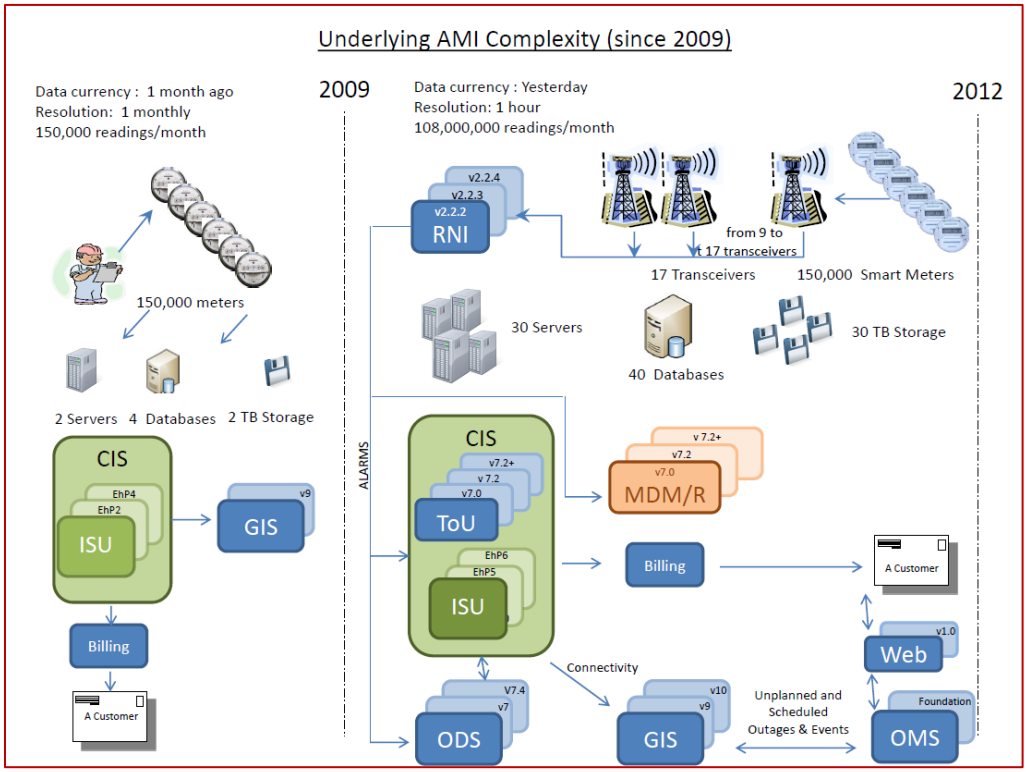


Figure 6-3, The Progression of Corporate Computer Systems Complexity

In all cases, the various software elements are being upgraded to solve some short-coming or deficiency. The problem, however, is that each software revision has to be

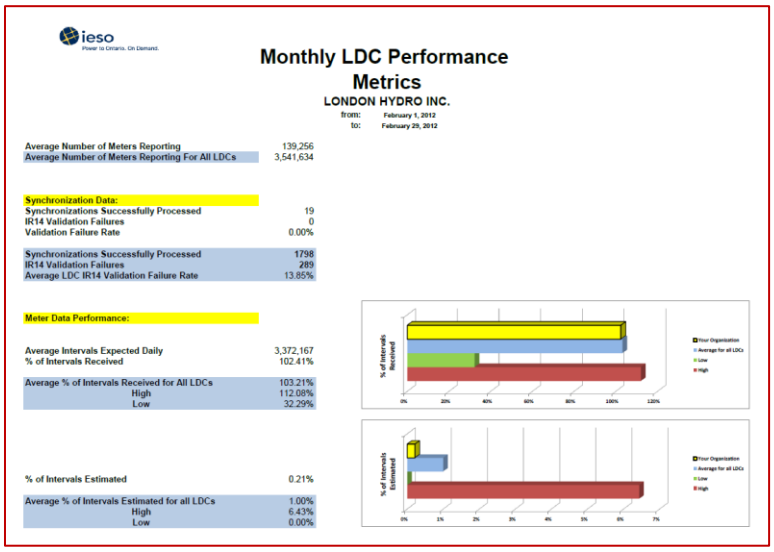
subjected to extensive testing (with its associated delays and costs) in a testing environment before it can be considered for promotion to the production environment.

Figure 6-3 also highlights the underlying AMI complexity that has been introduced since 2009 based on Smart-meter deployment as well as the systems and corresponding versions that have had to be tested and reconfirmed to ensure that the customers are receiving quality data to manage their time of use billing. Specifically:

- Prior to 2009, we required one read per month from each customer which resulted in approximately 150,000 monthly meter readings. In 2012, we are now required to present our customer's with a view of yesterday's hourly readings. This equates to approximately 108,000,000 meter readings per month. We need to validate each of these readings and corresponding estimates to ensure that any gaps that may have resulted from outages, disconnects, reconnects, moves, and other planned events are accurately reflected to our customers.
- We need our customers to be confident that all of their hydro usage is being billed in the correct buckets (on peak, mid peak, or off peak) as this has a direct impact on their bill. It is London Hydro's responsibility to ensure that all of our systems are properly connected and data integrity is maintained. For example, we had to enhance our RNI network with more transceivers/collectors (from 9 to 17) to address issues beyond our control (AMI network performance).
- Figure 6-3 also highlights the underlying IT infrastructure required to manage all the data that is coming into the system and that is needed to be able to answer any questions/queries from the customer. It also displays the alarms we need to get back from our head system and into our ODS to make sure that we avoid estimating during power outages so that we can accurately reflect the event to the customer through the web.
- The other underlying piece that has required significant testing and overall project management given the multiple and concurrent enhancements and versions over this three year period on both on our CIS side as well on the MDMR side. Most of our major systems have gone through three version upgrades which have needed to be re-tested and re-confirmed that they work together. Our GIS and OMS have been connected so that customers affected during an outage or any scheduled planned events are given an exact view of the event.
- Prior to 2009 our entire landscape was within our control/premise and now we are very dependent on the MDMR and the head end system (a vendor) to provide us data, and to ensure we make our service level. To satisfy customer inquiries we now have to make sure that we have a three-way match between data (head-end system, CIS, and MDMR). In the past we only had to be concerned with one database. This increased system complexity was required to properly support TOU billing and now will be sustained as we move forward.

The feedback that London Hydro is receiving from the MDM/R is however testament to the virtue of the extensive software testing that London Hydro carries out before promoting a new software release to "*production*" status. Below is an excerpt from

the IESO's "*Monthly LDC Performance Metrics*" report for February 2012 that is specific to London Hydro.



Monthly LDC Performance Metrics

LONDON HYDRO INC.

from: February 1, 2012
to: February 29, 2012

Average Number of Meters Reporting	139,256
Average Number of Meters Reporting For All LDCs	3,541,634
Synchronization Data:	
Synchronizations Successfully Processed	19
IR14 Validation Failures	0
Validation Failure Rate	0.00%
Synchronizations Successfully Processed	1798
IR14 Validation Failures	289
Average LDC IR14 Validation Failure Rate	13.85%
Meter Data Performance:	
Average Intervals Expected Daily	3,372,167
% of Intervals Received	102.41%
Average % of Intervals Received for All LDCs	103.21%
High	112.08%
Low	32.29%
% of Intervals Estimated	0.21%
Average % of Intervals Estimated for all LDCs	1.00%
High	6.43%
Low	0.00%

Figure 6-4, Excerpt from Monthly LDC Performance Metrics

The February report is consistent with the January report and indicates:

- London Hydro's validation failure rate is 0% whereas the average LDC validation failure rate is 13.85%
- All daily intervals are received from London Hydro whereas the receipt of daily intervals from other LDC's ranges from a low of 32.29% to a high of 112.08%
- The number of intervals estimated for London Hydro is 0.21% whereas the average for all other LDC's is 1% (with an identified range from 0% to 6.43%)
- The number of intervals discarded is 0.02% for London Hydro whereas the average for all other LDC's is 8.75% (with an identified range from 0% to 89.27%)

These MDM/R metrics demonstrate that the time and effort that London Hydro expended on data quality testing was entirely worthwhile.

7 OTHER ASSOCIATED COST ELEMENTS

7.1 Customer Engagement

In the early stages of the Smart Meter Program, London Hydro developed a customer communications plan to help guide and shape clear messages about the smart meter and time-of-use electricity pricing initiatives.

The communications plan not only provides information and understanding of the deployment milestones of the physical infrastructure pertaining to the Smart Meter Program, but also focuses on changes that either affects the customer or their means to interact with London Hydro. This would include, interactive voice response (IVR) presentation of time-of-use energy information, web presentment, bill inserts on time-of-use electricity pricing (such as changes to monthly bill and commodity pricing structure, and highlights of the home energy report card energy conservation program).

Part of the strategic communications plan has been with regard to activities associated with the Smart Meter Deployment. Approximately two weeks prior to the scheduled Smart Meter exchange date, customers would receive a mailed envelope containing the announcement (on London Hydro letterhead) that the customer would be receiving a Smart-meter in the near future. On the date of the Smart Meter exchange, the Contractor would leave behind an informational package containing both an announcement that a smart meter was installed today (on London Hydro letterhead), a brochure prepared by the Province entitled "Getting Smart about SMART METERS - ANSWER BOOK", all contained in a Smart Meter biodegradable door bag. The letter and brochure were enclosed in a PolyGone oxo-degradable plastic sleeve for protection from the elements. The letter and brochure was found to be very useful in both keeping our customers engaged in smart meters and ensuring that questions and concerns were addressed immediately.

Other smart meter communications included customer packages at Community Living, a registered charity for the support of residents with intellectual disabilities and their families. To assist customers, a software conversion program that permits download of Ministry of Energy website marketing materials has been made available to our customers.

The communication program to introduce Time-of-Use rates includes:

- "Introducing Time-of-Use Rates: A Quick Guide: billing insert
- "Time-of-Use Rate Coming Soon" highlighted envelope
- "We're Here to Help You Learn About Time-of-Use Rates" customer welcome package
- Two decals per customer bill "Power, Smarter" static cling laundry decals
- New Customer Welcome Package Electricity Rates insert stating both TOU and RPP Tier rates

- Billboard, bus shelter and radio ad campaigns promoting use of large consuming appliances to after 7 P.M. on weekdays and all weekend.

A pamphlet "*Time-of-Use is coming*" sent to customers via bill inserts informing our customers as to the TOU, is shown in Figure 7-1 below. The pamphlet includes a request for the customer to visit the London Hydro website so that they can access useful tools like seeing their energy usage, and comparing energy costs during Off-Peak, Mid-Peak, and On-Peak times.

Figure 7-1, Example of Customer Communication Pamphlet

As London Hydro is introducing TOU billing to our customers during the first quarter of 2012, much of the TOU introduction expenditures will be incurred during the same period.

7.2 Web Presentment

The Smart Metering Initiative (SMI) is an initiative by the Government of Ontario to create a conservation culture and a toolset for demand management based upon the province-wide deployment of smart meters.

Part of the regulatory requirements of the SMI includes making TOU data available to customers. Presenting TOU data on the web fulfills this requirement. Alternatively, the requirement is fulfilled by the MDM/R IVR system whereby customers retrieve their interval data over the phone.

London Hydro's strategic communications plan for customer awareness and engagement provided a vision for web presentment of a customer's hourly energy consumption profile (as transmitted from the customer's smart meter) along with analysis tools and information about energy conservation and time-of-use electricity pricing. This project will work towards fulfilling that vision, and build a framework that can be leveraged for other forms of presentment, such as mobile devices. This project will include a mobile application, which will be further enhanced in 2012, and beyond as other infrastructure components are deployed (GIS, OMS).

The implementation of smart metering and TOU pricing will provide customers with a pricing incentive to understand more about their usage patterns and trigger questions of how to reduce costs. London Hydro can take advantage of this increase in complexity to show customers how they can better manage energy usage and become more engaged in these changes. This will provide a better image to consumers and also increase utilization of customer self-service functions to increase service level.

Elements of the web presentation customer interface also include customer education such as "10 Smart Meter Lane" (an interactive on line tool developed by the IESO to help customers understand electricity pricing that is both engaging and informative, the presentment of customer load profile, online energy procurement assistant (assist in consumer's in understanding their bill by breaking down the overall bill into component elements), Online residential bill disaggregation tool (proving residential energy analysis of interest to customers), and access to the online Energy Star Homes savings calculator.

London Hydro began its Customer Engagement initiative in 2011. An RFP was produced with several deliverables. During the selection of the vendor, we narrowed the scope to web presentment of smart meter Time-Of-Use data, and a property management portal. These efforts began in 2011 and will extend into Q1 2012.

The TOU website has been made available to all MyAccount users. The look and feel has received positive feedback from the customers. We will continue to make enhancements based on customer feedback and vendor's recommendations to improve the user experience.

London Hydro has contracted with the company Sonic Boom to provide web presentment of customer time-of-use electricity consumption data in an intuitive and user-friendly method (and other web interfaces). London Hydro owns the intellectual property for the TOU web presentment so there will be no ongoing licensing or maintenance fees.

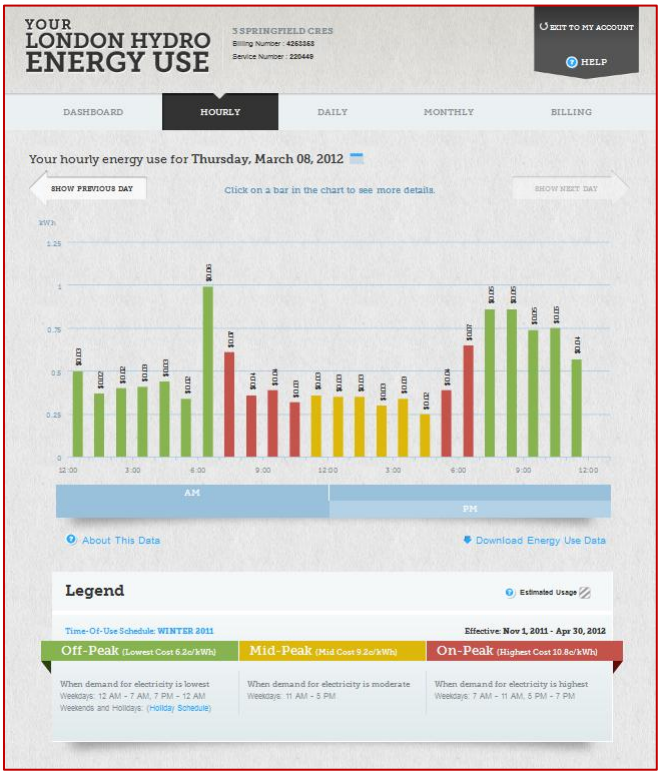


Figure 7-2, Example Web Presentment of TOU Consumption Data

Also included in web site for TOU is the "10 Smart Meter Lane" tool. The customer has the opportunity to see how shifting the time they use electricity can make a difference on their electricity bill.

8 OUTLOOK FOR 2012

8.1 Conversion of Customers to TOU Electricity Rates

On account of a number of technology challenges that were largely outside of London Hydro's control, London Hydro previously made application to the Ontario Energy Board for a delay to its mandated in-service data for time-of-use electricity billing. Refer to EB-2011-0092. The key elements outside London Hydro's control were the AMI network performance and availability of the IESO Measurement Canada solution. Although the application requested a May 2012 completion date, the OEB only granted an extension to March 31st, 2012. The London Hydro plan was adjusted according to accommodate the new date that introduced risks associated with a short customer cut-over period and assumed all outstanding issues outside our control would be completed on-time.

The following graphic shows London Hydro's progress in converting customers to TOU billing in comparison to the graph included in the application.

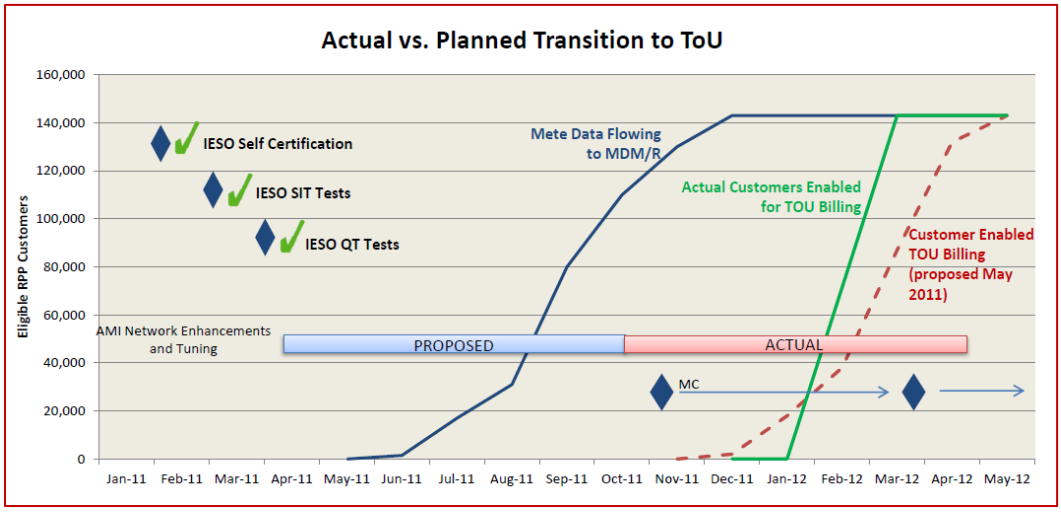


Figure 8-1, Actual Versus Planned Customer Transition to TOU Billing

The actual events are noted in green in Figure 8-1. In particular, the network enhancement tuning we thought would be finished by October 2011 is still ongoing and is scheduled to be completed by April 2012. The other major change has been the Measurement Canada compliance solution which we were expecting in November 2011 but was delayed to the end of March 2012 and could be further delayed based on a recent IESO announcement of version 7.2+.

Notwithstanding these two major factors, London Hydro is on track to achieve the March 2012 OEB TOU completion date. London Hydro's data synchronization began last June and was completed in December 2011. As well, beginning in December 2011, we started moving 20 pilot group customers to TOU billing. Based on the positive feedback and no transition issues customers were given the 30 days' notice in January. Migration of customers based on their billing period started in February and is expected to be substantially complete by March 31, 2012. London

Hydro was able to achieve this aggressive timeline based on quality code, thorough testing and effective project management.

Table 8-1, Actual Customer Transition to TOU Electricity Rates

Weekend	Customer Accounts Cut-Over to TOU Rates	Cumulative Customers on TOU Electricity Rates
November 1, 2011	20	20
February 25, 2012	18,530	18,550
March 3, 2012	52,595	71,145
March 10, 2012	32,206	103,351
March 17, 2012	35,147	138,498
Poly-phase meters	6,597	145,095
New installs	55	**145,150**

The only customers in jeopardy of not being billed on the basis of time-of-use electricity rates are:

- Those remaining customers that adamantly refuse to have a Smart-meter installed as previously described in Section 4.5.9, *Smart-Meter Exchange Refusals* (starting on page 35 herein);
- Those "*hard to access*" premises as previously described in Section 4.5.10, *Hard to Access Residential & Small Business Accounts* (starting on page 35 herein); and
- Those three-phase revenue meters where there is an unresolved issue associated with over-the-air programming to correct a logic error whereby meter data isn't always correctly placed in the correct hourly time period. This is described in Section 8.2 below.

8.2 Outstanding FlexNet AMI Work Elements

There are a few performance issues remaining with the FlexNet AMI that London Hydro will have to work closely with Sensus to resolve, namely:

- System latency – the AMI system is still incapable of delivering the meter data from 98% of the installed customer base by the requisite 5:00 am local time.
- Over-the-air reprogramming of meters – there is an issue when a meter can't communicate directly with a FlexNet TGB transceiver site, but instead has to communicate via an intermediate meter is co-called "buddy mode" (wherein that intermediate meter simply operates as a signal repeater). The over-the-air reprogramming of such end meters doesn't work properly. This is important for two reasons – some specific brands of meters need updated software to correct deficiencies previously identified in Section 4.5.5 herein, and London Hydro further wants to update all revenue meters to invoke the data encryption functionality.

Note: To be clear, these matters are Sensus' issues to resolve. As always London Hydro will cooperate with Sensus in whatever manner is desirable to improve the FlexNet AMI solution for the entire community of Sensus users.

Given the increased number of FlexNet TGB transceivers installed to alleviate a congestion issue (previously outlined in Section 4.5.6 herein) and the uncertainty as to whether further enhancements will be required, London Hydro has an interim spectrum licensing understanding with Industry Canada. A comprehensive and updated filing will be required (likely in the forthcoming months) to demonstrate compliance with the federal regulations and guidelines covering licensed spectrum.

Other required work activities include:

- Turning ON the data encryption features for the data transmissions between the population of revenue meters and the various FlexNet TGB transceiver sites;
- Invoking security features of the Ethernet LAN switches that interconnect the FlexNet TGB transceivers with BelAir Networks WAN equipment; and finally
- Completing an end-to-end cyber-security audit (that will encompass both documented procedures and implementation).

Finally, the FlexNet RNI master station software will have to be upgraded to Version 3.x (to address issues related to polyphase demand meters) when it becomes available in the summer of 2012. It is understood that there are architectural changes associated with the new 3-series that may require an expansion to both the server and memory requirements.

8.3 Outstanding BelAir Networks WAN Work Elements

Now that the power supply certification issue associated with the repeaters (as previously described in Section 4.5.8 herein) has been remedied, the only remaining work activity is user acceptance testing for the WAN system.

8.4 Outstanding Corporate Computer System Work Elements

With respect to the system integration challenges associated with fulfilling the Measurement Canada bill presentment requirements (previously described in Section 6.4, *System Integration Challenges* (starting on page 46 herein), London Hydro has outstanding work based on the availability of EnergyIP version 7.2 (resident on the provincial MDM/R's site. Specifically:

- Currently, London Hydro is self-certifying its version 7.0 changes on the 7.2 environment before March 31st as requested by the IESO. London Hydro will migrate to 7.2 after ensuring thorough end-to-end testing is complete.
- Further, IESO has recently announced EnergyIP Release 7.2+ Enhanced Billing Process to comply with Measurement Canada billing requirement (specifically Section 5.7.3). Where interval data is used for the application of rates (e.g. TOU quantities, hourly quantities) the summation of these rate-based quantities must equal the register reading difference. According to the IESO, EnergyIP Release 7.2+ will support compliance with Measurement Canada's requirement for equality of rate-based quantities with the register reading difference through the deployment of an enhanced billing process providing Calculative Reads Equality Adjustment functionality. In this release, modifications are also being made to the

Trilliant Meter Read Interface and Register Read Calculator to process new register read quality indicators.

- London Hydro needs to assess the changes which may be involved with 7.2+ functionality to ensure that the project team can efficiently manage the overall development and testing efforts in a cost-effective manner.

Finally, for the web presentment product (previously described in Section 7.2 herein) London Hydro intends to re-direct the link for the source of hourly consumption data from the provincial MDM/R to our own Operational Data Store (previously described in Section 6.2 herein). This will provide the customer with access to today's (unverified) meter data up until 1-1/2 hours ago and also resolve the issue wherein customers are unable to view their consumption profiles on Sundays when the provincial MDM/R is unavailable.

8.5 Disaster Recovery

Presently London Hydro has a contractual arrangement with an outside company for the provision of disaster recovery services for the enterprise computing systems (including the Sensus FlexNet AMI). London Hydro is working jointly with the City of London on a plan wherein each organization provides system backup services to the other. It is too early in the process to quantify the savings that result to both organizations from this arrangement, and of the overall savings, how much can be attributed to future OM&A expenses for the AMI and ODS.

9 FINANCIAL ANALYSIS

9.1 Accounting Methodology for Smart-Meter Costs

In tracking incurred costs related to the installation and maintenance of smart meters and associated communication equipment, hardware and software, London Hydro believes that it is fully compliant with the accounting directives and guidelines issued by the OEB, and specifically:

- Ontario Energy Board publication: G-2011-0001, *Guideline: Smart Meter Funding and Cost Recovery – Final Disposition* [Ref 1]
- Ontario Energy Board publication: G-2008-0002, *Guideline: Smart Meter Funding and Cost Recovery* [Ref 3].
- Ontario Energy Board Decision with Reasons EB-2007-0063, *Combined Proceeding to Review Costs Incurred by Thirteen Electricity Distributors for Certain Smart Metering Activities* [Ref 4]

To guide the various project managers responsible for various aspects of the overall Smart-meter program, an internal guideline document was prepared to assist internal staff to allocate expenses to the appropriate accounts. Expenditures are recorded and reconciled based on Section 4, *Cost Breakdown for Functional Specification for an Advanced Metering Infrastructure*, within Procedural Order No 3 to Ontario Energy Board combined proceedings EB-2007-0063. Within this guideline, each component is explained and has an associated work order assigned to apply to the respective expense. This guideline attempts of convey various principles that likely wouldn't be intuitive to project staff such as:

- *ONLY direct labour costs can be included for smart meter installation*
- *General supervisory costs are NOT to be included*.
- *ONLY incremental expenses directly related to the operating, maintenance of smart meters will qualify for OM&A smart meter accounting. All other operating, maintenance and administrative expenses costs should be charged to the regular business unit (non-smart meter accounts).*

A copy of this internal guideline document has been included as Appendix T.

Costs applied to the smart meter accounts are reconciled monthly. These costs are further documented with copies of invoices and other documentation which are reviewed to substantiate that the costs are appropriate for smart meter recording.

9.2 Commentary on Expenditures Beyond Minimum Functionality

With respect to the Smart-meter project, the term "*minimum functionality*" doesn't have an intuitive meaning. Whereas one would naturally believe that it means something akin to "*the Smart-meter itself and all upstream communications media and computer systems required to provide the customer with a bill based on time-of-use electricity rates*", the regulatory interpretation is far narrower. With reference to

Figure 1-1 (on page 1 herein), it is basically those elements within the box labelled "*Advanced Metering Infrastructure (AMI)*". Everything outside the box is considered "*expenditures that exceed minimum functionality*".

In distinguishing between "*expenditures associated with minimum functionality*" and those "*expenditures beyond minimum functionality*" in the organization of this narrative document and the recordings of expenditures meeting minimum functionality, London Hydro has complied with:

- Ontario Energy Board publication: G-2011-0001, *Guideline: Smart Meter Funding and Cost Recovery – Final Disposition* [Ref 1]
- Ontario Energy Board publication: G-2008-0002, *Guideline: Smart Meter Funding and Cost Recovery* [Ref 3].

Further guidance is provided from a passage on page 7 of the transcript from the OEB's combined proceeding on smart meter costs (EB-2007-0063) which is replicated below for convenience of reference:

> *… this proceeding relates only to the recovery of smart meter costs associated with minimum functionality. Costs in addition to minimum functionality can be recovered as part of distribution rates in an individual utility's next rate case. Those costs may include web presentment, the Customer Information System integration with the Meter Data Management/ Meter Date Repository, consumer education, re-engineering business practices and integration with retailers.*

9.2.1 Capital Investment Expenditures Beyond Minimum Functionality

With respect to capital expenditures beyond minimum functionality, London Hydro provides the following commentary:

- SME Costs –

  London Hydro has <u>not</u> included in this Application any claim for recovery of costs of the Smart Meter Entity (SME), nor for the requesting for the establishment of a deferral account to track these costs. London Hydro is waiting for the SME to formally apply to the OEB for approval of a service fee schedule. It is anticipated that the eventual recovery of SME costs will reviewed through a Board generic proceeding in which an appropriate charge to each smart metered customer will be determined and approved.

- Procurement of AS2 Encryption Server and Client Software-

  As discussed in Section 6.1.3, *Procurement of AS2 Encryption Server and End-Use Software* (starting on page 41 herein) every LDC needs to procure an AS2 encryption server and client software for the secure transmission of meter data to and from the MDM/R.

- Procurement of MDUS-Compliant ODS -

  It will be recalled from the discussion in Section 6.2, *Enhancement to SAP IS/U Customer Information System* (starting on page 41 herein), that London Hydro's

starting point was a SAP IS/U customer information system. A SAP subject-matter expert was called upon to assess whether or not the *Energy Data Management* (EDM) module that is an inherent component of the IS/U product would be adequate for the expectations of the emerging Ontario electricity marketplace. The recommendation that London Hydro received was that rather than develop an "*orphan*" implementation within EDM, the option that presented the lowest long term ownership costs, the least risk (in that it would be supported by SAP), and the greatest flexibility for the future Smart Grid vision, would be an investment in an MDUS-compliant Operational Data Store. London Hydro procured the Itron Enterprise Edition as its MDUS-compliant ODS. The MDUS interfaces between SAP IS/U, Itron Enterprise Edition, and the Sensus FlexNet RNI are highlighted in Figure 9-1 below:

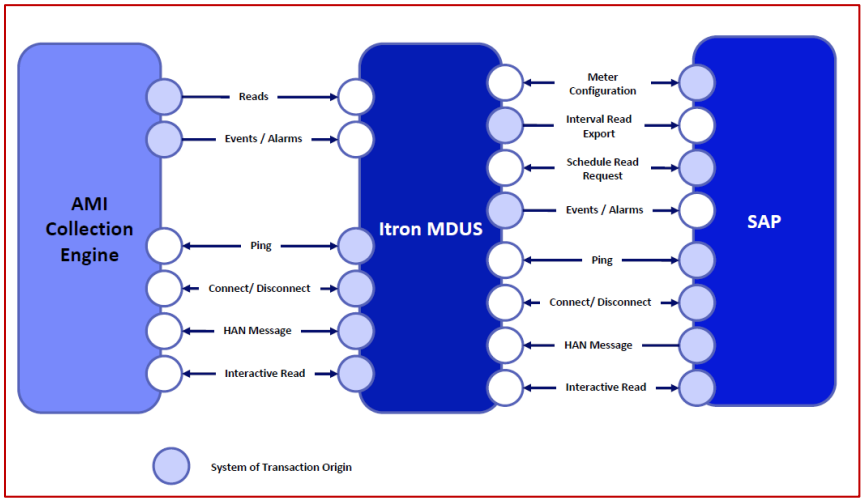


Figure 9-1, MDUS-Compliant Data Interfaces

The MDUS / ODS project costs provide for a total of $862,505, in which $107,328 in quality testing is included as well as development for integration of ODS / MDUS with SAP/MDM/R system in the amount of $755,177.

- MDM/R Integration -

  The subject of MDM/R integration and Measurement Canada compliance for bill presentment are certainly inter-related topics but are discussed herein under separate bullets.

  The work elements (i.e. project management, software configuration, software development, testing, training, documentation, etc.) associated with integration of London Hydro's Sensus FlexNet AMI and SAP IS/U customer information systems were discussed in Section 6.1, *Data Exchange with Provincial MDM/R* (starting on page 39 herein). Certainly one of the challenges associated with this endeavour was the number of software revisions, both at the provincial MDM/R and with London Hydro's CIS that had to be installed and thoroughly tested during the project itself. This unexpected work element is described in Section 6.4.2, *Ongoing Acceptance Testing of Software Revisions* (starting on page 48 herein).

Overall, the MDM/R Integration "*software*" costs amount to a total of $1,800,841 in which $640,848 in quality testing is included.

Projected and remaining MDM/R Integration "*software*" costs of $248,300, contained in 2012 projections, involve further work of software integration in the amount of $76,300 and required testing in the amount of $172,000.

- Measurement Canada Compliance -

  The Measurement Canada challenges were described in Section 6.4.1, *Compliance with Measurement Canada's Bill Presentment Requirements* (starting on page 46 herein). London Hydro is attempting to integrate its AMI/CIS systems with the provincial MDM/R at the very time that it is undergoing change to address the Measurement Canada bill presentment requirements as well as a change from CMEP 1 to CMEP 2 (also referred to as "*Enhanced CMEP*"). Furthermore, whereas London Hydro assumed that it would simply have to add a couple of fields to the existing data transmission protocol (i.e. the "*register values*" corresponding to the beginning and end for the billing cycle) as it turns out the protocol change was more extensive and the software update at the MDM/R is much later than expected.

  The scope changes and amount of acceptance testing and re-testing were certainly not anticipated in London Hydro's project plans.

  The overall cost for project management, software re-design, and testing (both by ourselves and with the MDM/R) incurred by London Hydro is $232,318 and systems scope and related changes to meet Measurement Canada compliances of $282,411, for a total of $514,728.

  Costs projected in 2012 for Measurement Canada changes consist of $120,170 for further testing and $129,830 in system scope changes to meet Measurement Canada compliances including project management.

9.2.2 OM&A Expenditures Beyond Minimum Functionality

Operation, maintenance and administrative (OM&A) costs associated with those investments beyond minimum functionality (as described above in Section 9.2.1) include:

- Annual licensing and maintenance costs for the ODS system. Pursuant to the governing licensing agreement, the total ODS maintenance costs for 2010 through to 2012 are approximately $102,000.
- As London Hydro has ownership of the web presentment software, there is no recurring license fee.

9.3 Overview of Smart Meter Costs

Smart-meter costs classified as being within the definition of "*minimum functionality*" are further subdivided into capital investment costs and recurring OM&A costs for presentation and discussion in the following subsections. There is also a comparison

of these expenditures to the predicted expenditures included in London Hydro's previous rate filing.

9.3.1 Smart Meter Costs

London Hydro's average total capital cost per Smart-meter (actual and audited costs up to December 31, 2011 and projected costs in 2012) is $169.66 and compares favourably to the OEB sector average capital cost of $186.76 (as evidenced from OEB "Sector Smart Meter Audit Review Report issued by the Regulatory Audit and Accounting Group on March 31, 2010).

Table 9-1, Comparison of Average Cost of Smart-meter with Sector

	London Hydro	OEB Sector Report
Smart Meter Capital Expenditures	$ 24,914,803	$ 570,339,200
Total Smart Meter Installations	146,850	3,053,931
Capital Expenditure per Smart Meter	$ 169.66	$ 186.76

In this Application, London Hydro is seeking recovery of costs related to the 146,437 smart meters that have been installed in the London Hydro service area, from the inception of the smart meter implementation program up to December 31, 2011. Actual smart meter costs include Capital Costs of $24,403,496 and OM&A costs of $806,711 that have been audited up to December 31, 2011.

In addition, London Hydro is seeking the recovery of smart meter costs applicable for 2012. The smart meter costs associated with expenditures in 2012 are Capital Costs of $511,307 and OM&A costs of $746,000.

Many of the costs in 2012 are associated with issues with London Hydro's obligation to comply with Measurement Canada Billing requirements, delays from the SME (IESO), and AMI network congestion issues. Both Measurement Canada and the SME are issues that are had industry wide impact, not specific to London Hydro. All three issues are identified as being beyond the control of London Hydro management.

Also associated with 2012 costs, is the hiring of five temporary contract staff in our CIS Department to handle expected significant customer call volume increases in our call center pertaining to TOU rollout. Other significant expenditures in 2012 are the provision of advance notice to customers of TOU and educational information as to TOU for our customers.

The London Hydro Smart Meter Program was expected to be substantially completed within fiscal 2011. As mentioned earlier in the Application is the issue of network congestion challenges. Network congestion issue arose from the AMI vendor's

design assumptions resulting in an inadequate number of radio transceivers to achieve the throughput performance requirements. In the Board's Decision and Order (EB-2011-0092 London Hydro Inc. Application for Adjustment to Mandated Time-of-Use End Date) the Board provide the following Decision:

> *London Hydro has made a considerable effort towards completing TOU pricing implementation, and has installed smart meters for all of its eligible customers. I accept that the AMI issues described in the application are sufficient to constitute an extraordinary and unanticipated circumstance that justifies some delay in the implementation of TOU pricing for this utility.*

The Board Decision granted London Hydro a delay for implementation of TOU with an extension date to March 31, 2012. This required delay, and associated workload needed for substantial testing related to the congestion problems of the AMI radio transceivers have resulted in costs incurring into to 2012. Both Measurement Canada and SME issues have also impacted costs going into 2012.

Capital costs for 2012 include necessary expenditures for the remaining Smart-meter installations, remaining advanced metering regional collector (AMRC) implementation costs, activation fees for wide area network (WAN), and costs associated beyond minimum functionality such as remaining costs for TOU implementation and integration with MDM/R.

One capital cost that is not applied for in this Application is the development of the Web Presentation. London Hydro has developed a web presentment product that will facilitate customer service, customer education, and TOU tools that will be of benefit to the customer. However, London Hydro has chosen not to include these costs in the Application, although web presentment is available and acknowledged as a benefit to our customers.

OM&A Costs for 2012 include maintenance costs on advanced metering communication device (AMCD), advance metering regional collector (AMRC), Advanced Metering Control Computer (AMCC), wide area network (WAN), and cost beyond minimal functionality. Both 2012 Capital costs and OM&A costs are provided in more detail in the following Capital Expenditures and OM&A Costs sections.

Table 9-2 below provides further details to both Capital and OM&A costs. Resulting cost per meter figures are $169.66 for Capital Expenditures and $10.57 for OM&A costs for the Smart Meter Program.

Table 9-2, Summary of Smart-Meter Costs

	Residential	GS < 50 kW	Total
Installations:			
Installed by December 31, 2010	132,540	4,897	137,437
Installed by December 31, 2011	2,118	6,882	9,000
Total Up to December 31, 2011	134,658	11,779	146,437
Installed by April 30, 2012	211	202	413
Total	134,869	11,981	146,850

Capital Costs:		
Expenditures upto December 31, 2010	$	21,261,642
Actual Expenditures for 2011	$	3,141,854
Total Up to December 31, 2011		24,403,496
Projected Expenditures for 2012 (upto April 30th)	$	511,307
Total	$	24,914,803

OM&A Costs:		
Expenditures upto December 31, 2010	$	643,940
Actual Expenditures for 2011	$	162,771
Total Up to December 31, 2011		806,711
Projected Expenditures for 2012 (upto April 30th)	$	746,000
Total	$	1,552,711

Total Costs Per Meter		
Capital Costs	$	169.66
OM&A Costs	$	10.57
Total	$	180.24

The Capital and OM&A costs reflected in the above table includes expenditures both up to December 31, 2010 and up to December 31, 2011, and agree with the balances as recorded in London Hydro's 1555 Smart Meter Capital & Recovery Offset variance account and 1556 Smart Meter OM&A variance account. Further, these account figures agree with the quarterly reports submitted to the Board during the duration of the Smart Meter Program.

Recordings to both accounts 1555 and 1556 have been consistent with the Board's direction and a spreadsheet reflecting details and a reconciliation of both account 1555 and 1556 can be found in Appendix B.

9.3.2 Capital Expenditures

Table 9-3 below reflects the actual audited capital expenditures for 2007 through to fiscal 2011.

Table 9-3, Smart Meter Capital Expenditures

	2007 Audited	2008 Audited	2009 Audited	2010 Audited	2011 Actual	2012 Forecast	Total
Costs Related to Minimum Functionality							
1.1 ADVANCED METERING COMMUNICATION DEVICE (AMCD)							
1.1.1 Smart Meters			$ 1,712,963	$ 12,336,995	$ 355,472		$ 14,405,430
1.1.2 Installation Costs			$ 170,001	$ 1,487,629	$ 441,740	$ 28,900	$ 2,128,270
1.1.3a Workforce Automation Hardware			$ 22,584	$ 1,440	$ 1,276		$ 25,300
Sub-total	$ -	$ -	$ 1,905,548	$ 13,826,064	$ 798,488	$ 28,900	$ 16,559,000
1.2 ADVANCED METERING REGIONAL COLLECTOR (AMRC) (includes LAN)							
1.2.1 Collectors	$ -	$ -	$ 1,239,678	$ -	$ -	$ -	$ 1,239,678
1.2.2 Repeaters (AMRC 15-year life assets)	$ -	$ -	$ 572,729	$ 305,049	$ 44,720	$ 63,600	$ 986,098
1.2.3 ~~Installation~~ (AMRC 35-year life assets)	$ -	$ -	$ 332,544	$ 179,086	$ 6,627	$ 53,700	$ 571,956
Sub-total	$ -	$ -	$ 2,144,950	$ 484,135	$ 51,347	$ 117,300	$ 2,797,732
1.3 ADVANCED METERING CONTROL COMPUTER (AMCC)							
1.3.1 Computer Hardware	$ -	$ -	$ 140,328	$ 96,992	$ 33	$ -	$ 237,353
1.3.2 Computer Software	$ -	$ -	$ 15,476	$ 21,474	$ -	$ -	$ 36,950
1.3.3 Computer Software Licences & Installation	$ -	$ -	$ 9,472	$ 18,253	$ -	$ -	$ 27,724
Sub-total	$ -	$ -	$ 165,275	$ 136,719	$ 33	$ -	$ 302,027
1.4 WIDE AREA NETWORK (WAN)							
1.4.1 Activation Fees	$ -	$ -	$ 100,801	$ 352,664	$ 7,424	$ 328,000	$ 788,890
Sub-total	$ -	$ -	$ 100,801	$ 352,664	$ 7,424	$ 328,000	$ 788,890
1.5 OTHER AMI CAPITAL COSTS RELATED TO MINIMUM FUNCTIONALITY							
1.5.1 Customer Equipment	$ -	$ -	$ 3,759	$ 122,443	$ 17,643	$ -	$ 143,845
1.5.2 AMI Interface to CIS	$ -	$ -	$ 525,851	$ 199,967	$ 223,795	$ -	$ 949,613
1.5.3 Professional Fees	$ -	$ -	$ 4,235	$ 2,695	$ -	$ -	$ 6,930
1.5.4 Integration	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1.5.5 Program Management	$ -	$ -	$ 120,206	$ 55,685	$ -	$ -	$ 175,892
1.5.6 Other AMI Capital	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Sub-total	$ -	$ -	$ 654,052	$ 380,789	$ 241,438	$ -	$ 1,276,279
Total Capital Costs Related to Minimum Functionality	$ -	$ -	$ 4,970,626	$ 15,180,372	$ 1,098,730	$ 474,200	$ 21,723,929
Costs Beyond Minimum Functionality							
1.6 CAPITAL COSTS BEYOND MINIMUM FUNCTIONALITY							
1.6.2 Costs for deployment of smart meters to customers other than residential and small general service	$ -	$ -	$ -	$ -	$ -	$ 12,800	$ 12,800
1.6.3 Costs for TOU rate implementation, CIS system upgrades, web presentation, integration with the MDM/R, etc.	$ -	$ -	$ 28,821	$ 1,081,822	$ 2,043,123	$ 24,307	$ 3,178,074
Total Capital Costs Beyond Minimum Functionality	$ -	$ -	$ 28,821	$ 1,081,822	$ 2,043,123	$ 37,107	$ 3,190,874
Total Smart Meter Capital Costs	$ -	$ -	$ 4,999,448	$ 16,262,194	$ 3,141,854	$ 511,307	$ 24,914,803
Cumulative Smart Meter Capital Costs	$ -	$ -	$ 4,999,448	$ 21,261,642	$ 24,403,496	$ 24,914,803	

With respect to capital expenditures within minimum functionality, London Hydro provides the following commentary:

- Smart-meter installations –

  As of December 31st, 2011, London Hydro had completed the installation of smart meters for:

  - 99.84% of residential customers, and
  - 98.3% of small business customers (i.e. those in the "*general service < 50 kW*" tariff classification.

  The outstanding Smart-meter installations are those customers previously described in Section 4.5.9 (on page 35 herein) that aren't receptive to receiving a Smart-meter and those hard-to-access locations previously described in Section 4.5.10 (on page 35 herein). The costs associated with remaining smart meter installs are recorded in the 2012 forecast.

- Smart-meter installations –

  Recall from Section 4.1.1 (on page 20 herein) that London Hydro has a significant population of apartment buildings with individual tenant metering and the cost for a network-style revenue meter required for this application is twice the price of 3-wire 1-1/2 element revenue meters installed on houses and townhouses. Since 8.6% of the meters installed in residential premises were "*network-style*" Smart-meters, any comparison of London Hydro's "*average cost*" to other LDC's must certainly take this factor into account.

- Smart-meter installations –

  There are no Canadian manufacturers of revenue meters, the cost of revenue meters is a significant portion of an LDC's overall AMI investment costs, and hence the overall cost of an AMI system can be greatly influenced by the prevailing currency exchange rate.

  The London Hydro RFP process addressed this issue by allowing bidders to price their meters in Canadian dollars but based on the prevailing currency exchange rate at the time of proposal closing date. Price adjustments would then be made in accordance with the methodology used by the federal government.

  Figure 9-2 below shows the fluctuations in the USD/CAD exchange rate that occurred over the five-year time-frame from March 2007 to March 2012.[17]

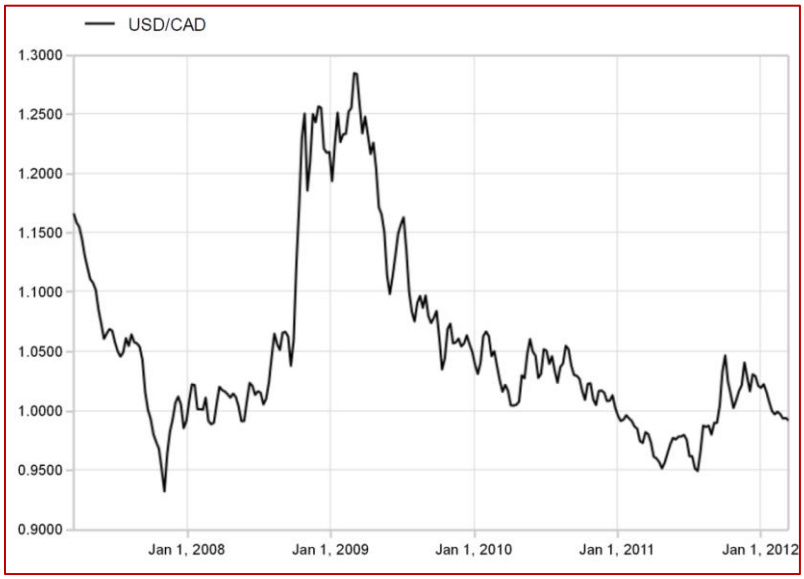


Figure 9-2, Five-Year Currency Exchange Rates (Mar 2007 - Mar 2012)

At the November 8, 2007 closing date of the RFP, the exchange rate was favourable (i.e. 1 CAD = 1.07 USD), but by the time London Hydro had finalized Statement of Work negotiations and executed a contract on May 7, 2009 the situation had reversed.

Rather than mitigating risk of further degradation of the Canadian dollar by one of several available financial instruments at the most unfavourable point in time, it was believed that over the life-time of the contract, the exchange rate might return to something closer to parity.

The following graph shows the foreign exchange adjustment factor that London Hydro incurred for the common single-phase three-wire residential meters (i.e. ANSI Form 2S meters) received throughout the duration of the project.

[17] Source: www.oanda.com/currency/historical-rates

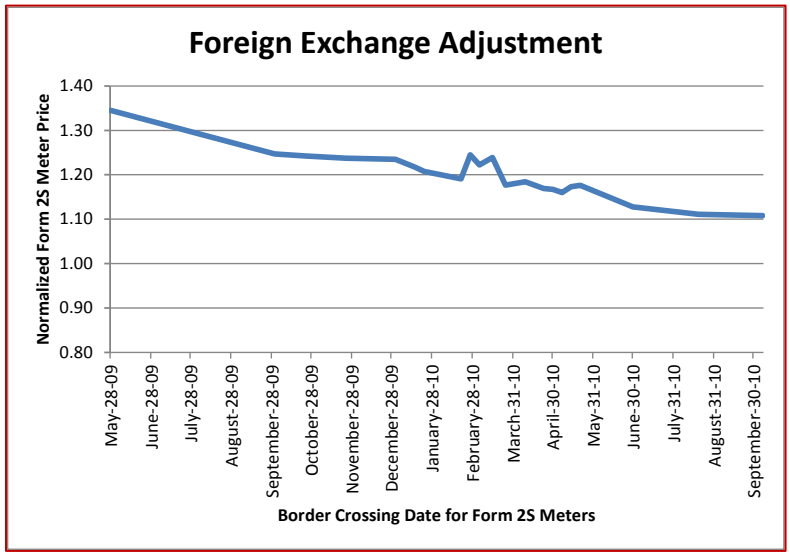


Figure 9-3, Foreign Exchange Adjustments for Form 2S Meters

In hindsight (which is always perfect), London Hydro is fortunate that the AMI contract wasn't executed earlier such as in mid-2008.

- Regional collector investments –

  The entries in the left column of Table 9-3 are predefined (and not alterable) in the financial reporting spreadsheet created by the OEB. It isn't always intuitive from the title what the nature of the investment is, so the following narrative is intended to provide some clarity.

  The expense titled "*1.2.1 Collectors*" refers to the procurement cost for the nine (9) Sensus FlexNet TGB radio transceivers.

  For appropriate financial reporting two asset groups have been created, the first with an associated 15-year asset life, and the second with an associated 35-year asset life.

  Capital expenditures in the 15-year category would include (but aren't necessarily limited to the following:

  - The consulting services associated with obtaining licensed radio spectrum, as described in Section 4.1.4, *Securing Licensed Radio Spectrum* (starting on page 21 herein);
  - Other contractors associated with the radio spectrum (e.g. Perth Communications to assist resolution of potential interference issue described in Section 4.5.1, *Interference with Emergency 911 Radio Channel*; Novanet to confirm signal strength at border as a condition of license, etc.);
  - The procurement and installation of 900 MHz antennas;
  - Industry Canada fees associated with the application process for spectrum licensing.
  - Replacement meter rings and security seals.

Note: It isn't intuitive that investments in meter rings and security seals should be associated with the LAN, but this is the instruction given in footnote 6 in EB-2007-0063.

Assets in the 35-year category would include the procurements and installations of communications towers and the reinforcing of existing communications towers where required.

- WAN investments –

  Again, the entries in the left column of Table 9-3 are predefined (and not alterable) in the financial reporting spreadsheet created by the OEB. The term "*activation fees*" would be appropriate in cases where an LDC elected to use a public carrier (i.e. Bell, Rogers, etc.) offering to provide WAN services. However in London Hydro's case the lowest cost option was installation of a private wireless broadband WAN. So, in London Hydro's case, the row title "*activation fees*" should more aptly be titled "*private WAN investment cost*".

- AMI Interface to CIS –

  This expenditure has several components, namely:

  - The incremental licensing fee for the SAP IS-U system;
  - Some incremental labour costs to interface the Honeywell work force management tools (as described in Section 4.3.2 herein, Honeywell was the Smart-meter deployment contractor) with London Hydro's CIS system and the FlexNet RNI;
  - Some software configuration work by a software contractor.

- Project management –

  This expenditure is for the incremental project management professional described in Section 4.4, *AMI Project Management* (starting on page 29 herein).

- Capital costs beyond minimum functionality: item 1.6.2 -

  Although combination demand / energy meters (for "*general service greater than 50 kW*" customers) are outside the scope of the Ministry of Energy's Functional Specification [Ref 2], London Hydro's RFP includes a requirement that the AMI system include functionality for transporting such meter data from such meters. As such, London Hydro intends to procure a nominal 25 such revenue meters for the purposes of system acceptance testing. Such meters have not been procured to date because it is known that there is an issue that won't be resolved until Version 3.x of the FlexNet RNI software – which won't be released until the summer of 2012.

- Capital costs beyond minimum functionality: item 1.6.3 -

  This expenditure has several components, namely:

  - Systems integration with the provincial MDM/R, as described in Section 6.1, *Data Exchange with Provincial MDM/R* (starting on page 39 herein);

- Procurement and integration of an MDUS-compliant ODS, as described in Section 6.2, *Enhancement to SAP IS/U Customer Information System* (starting on page 41 herein);
- Development of a web presentment interface for customer energy consumption data, as described in Section 7.2, *Web Presentment* (starting on page 52 herein); and

Note: Although web presentment is mentioned, no cost recovery for this project element is sought under this Application.

- Modifications to the bill presentment to fulfill Measurement Canada's requirements, as described in Section 6.4.1, *Compliance with Measurement Canada's Bill Presentment Requirements* (starting on page 46 herein).

One significant projected cost for 2012 is release of the outstanding progress payments for the wide area network (WAN). It will be recalled from Section 4.5.8, *Power Supply Certification Deficiency for Roof-Top Repeaters* (starting on page 35 herein) that a certification deficiency precluded powering up these roof-top repeater units. Without these units in-service, any measurements of system performance (in comparison to the contractual expectations) would be somewhat meaningless. As such, with the delay in milestone achievements, the associated progress payments were suspended (into 2012 as it turned out).

9.3.3 Operation, Maintenance and Administrative Costs

Table 9-4 below reflects the actual OM&A expenditures for 2007 through to fiscal 2011.

Table 9-4, Smart Meter OM&A Expenditures

	2007 Audited	2008 Audited	2009 Audited	2010 Audited	2011 Actual	2012 Forecast	Total
Costs Related to Minimum Functionality							
2.1 ADVANCED METERING COMMUNICATION DEVICE (AMCD)							
2.1.1 Maintenance *(may include meter reverification costs, etc.)*	$ -	$ -	$ 4,695	$ 19,890	$ 4,300	$ -	$ 28,884
Sub-total	$ -	$ -	$ 4,695	$ 19,890	$ 4,300	$ -	$ 28,884
2.2 ADVANCED METERING REGIONAL COLLECTOR (AMRC) (includes LAN)							
2.2.1 Maintenance	$ -	$ -	$ -	$ 114,138	$ 170,561	$ 290,200	$ 574,899
Sub-total	$ -	$ -	$ -	$ 114,138	$ 170,561	$ 290,200	$ 574,899
2.3 ADVANCED METERING CONTROL COMPUTER (AMCC)							
2.3.1 Hardware Maintenance *(may include server support, etc.)*	$ -	$ -	$ 12,461	$ -	$ -	$ 6,000	$ 18,461
2.3.2 Software Maintenance *(may include maintenance support, etc.)*	$ -	$ -	$ 458	$ 1,360	$ 1,316	$ 53,400	$ 56,534
Sub-total	$ -	$ -	$ 12,919	$ 1,360	$ 1,316	$ 59,400	$ 74,994
2.4 WIDE AREA NETWORK (WAN)							
2.4.1 WAN Maintenance	$ -	$ -	$ 440	$ 19,839	$ 22,165	$ 33,600	$ 76,043
Sub-total	$ -	$ -	$ 440	$ 19,839	$ 22,165	$ 33,600	$ 76,043
2.5 OTHER AMI OM&A COSTS RELATED TO MINIMUM FUNCTIONALITY							
2.5.1 Business Process Redesign	$ -	$ -	$ -	$ -	$ -	$ 15,000	$ 15,000
2.5.2 Customer Communication (may include project communication, etc.)	$ -	$ -	$ 62,230	$ 7,780	$ 49,047	$ 405,100	$ 524,156
2.5.3 Program Management	$ -	$ -	$ 4,358	$ 123,110	$ 199,570	$ 211,200	$ 538,238
2.5.4 Change Management (may include training, etc.)	$ -	$ -		$ 58,608	$ 8,058	$ 4,000	$ 70,665
2.5.5 Administration Costs	$ -	$ -	$ 24,779	$ 32,234	$ 33,928	$ 5,000	$ 95,940
2.5.6 Other AMI Expenses (manual meter reading savings 2011-2012)	$ 5,998	$ 101,711	$ 3,929	$ -	$ (330,000)	$ (330,000)	-$ 548,362
Sub-total	$ 5,998	$ 101,711	$ 95,296	$ 221,731	$ (39,398)	$ 310,300	$ 695,638
TOTAL OM&A COSTS RELATED TO MINIMUM FUNCTIONALITY	$ 5,998	$ 101,711	$ 113,349	$ 376,957	$ 158,944	$ 693,500	$ 1,450,459
2.6 OM&A COSTS RELATED TO BEYOND MINIMUM FUNCTIONALITY							
2.6.3 Costs for TOU rate implementation, CIS system upgrades, web presentation, integration with the MDM/R, etc.	$ -	$ -	$ -	$ 45,925	$ 3,827	$ 52,500	$ 102,252
Total OM&A Costs Beyond Minimum Functionality	$ -	$ -	$ -	$ 45,925	$ 3,827	$ 52,500	$ 102,252
Total Smart Meter OM&A Costs	$ 5,998	$ 101,711	$ 113,349	$ 422,882	$ 162,771	$ 746,000	$ 1,552,711
Cumulative Smart Meter OM&A Costs	$ 5,998	$ 107,709	$ 221,058	$ 643,940	$ 806,711	$ 1,552,711	

With respect to OM&A expenditures within minimum functionality, London Hydro provides the following commentary:

- Smart meter maintenance expenditures –

  As described in Section 4.3.3, *Selection of an Electrical Contractor to Repair Meter Bases* (starting on page 27 herein), London Hydro arranged for repairs or replacement of the customer's meter base in cases where the meter exchange revealed internal damage to the meter base's standoff insulators or jaws. This customer service benefit did much to appease customers in accepting the smart meter and TOU program. Having the individual customer bear the costs of replacement of their own meter base would certainly have generated some bad publicity about the entire Smart-metering program.

- Regional collector maintenance expenditures –

  The OEB model doesn't allow modifying the "*titles*" of the various OM&A expenditures. As such, under this title, London Hydro has included:

  - The annual fees, payable to Industry Canada for licensed radio spectrum;
  - The annual attachment fees associated with antennas on the CFPL broadcast tower and the occupancy fee (which includes the supply of electricity) for the lands at the base of the tower where London Hydro's communication shelter resides; and
  - The annual FlexNet technology licensing fee. This fee structure is based on a monthly charge per end-point (which in this application is a revenue meter) and a monthly charge per FlexNet TGB transceiver.

- AMCC software maintenance –

  This expenditure covers the SAP IS-U licensing fees specific to AMI, plus the annual licensing / maintenance fees associated with the software products identified in Section 4.1.5 and Section 6.1.3 herein.

- Wide area network (WAN) maintenance -

  Under this title, London Hydro has included the annual lease fees associated with roof-top microwave repeaters as earlier described in Section 4.5.8, *Power Supply Certification Deficiency for Roof-Top Repeaters* (on page 35 herein).

  Also included is the BelAir Networks annual software maintenance fee that provides software upgrades as they are released and limited technical support.

- Other AMI OM&A expenses: customer communications -

  Under this title, London Hydro has included costs associated with the various materials distributed to customers as described in Section 7.1, *Customer Engagement* (starting on page 51 herein).

  Significant costs are projected for 2012 in order to provide notice and introduction of TOU. London Hydro is rolling out TOU billing during the first quarter of 2012, with completion targeted before March 31, 2012.

- Other AMI OM&A expenses: program management –

This expenditure covers staff training (not staff labour, but the "*time and expenses*" costs for the on-site trainers for both Sensus and BelAir technology), minor works to prepare a field office for Honeywell in the Lower Stores area (e.g. installing a LAN connection, etc.) and the cost associated with two (2) incremental staff – one for managing the various computer networks and the other for handling and resolving exceptions from the MDM/R (i.e. diagnosing whatever issue occurring within the AMI including WAN to generate an exception in the first place).

- Other AMI OM&A expenses: administration costs -

  This expenditure covers incremental part-time labour that were contracted in the Metering Department to assist with processing the Service Orders associated with mass meter deployment, and in the Finance Department for processing insurance claims related to Smart-meter installations.

- Other AMI OM&A expenses: other AMI expenses –

  London Hydro incurred certain expenses related to the Smart-meter purchasing consortium, e.g. retention of a Fairness Commission (as described in Section 2.4 herein), a communications subject matter expert to participate in the proposal evaluations (as describe in Section 2.5.5 herein), etc. While London Hydro did receive monetary contributions from the participating LDC's, the lion's share of expenses were borne by London Hydro and the net amount (i.e. overall expenses less contributions from other LDC's) is shown in the table under 2008.

- Other AMI OM&A expenses: manual meter reading savings -

  One significant offset to OM&A costs are the realization of savings from reductions in contracting for manual meter reads.

  Although not previously discussed herein, London Hydro's strategy for the mass deployment of Smart-meters was to continue to manually read the meters for two billing cycles and compare the meter reading electronically communicated through the AMI to the meter reading taken by the contract meter reader. This was an important data quality / system integrity measure, so London Hydro's savings in contracted meter reading costs were deliberately delayed by two months.

  Note: Although a few anomalies were discovered (i.e. differences between the meter reading transmitted electronically through the AMI and the meter reading recorded by the contract meter reader), the subsequent investigation revealed that in every case the contract meter reader had transposed two numbers or otherwise incorrectly entered the meter reading into the hand-held device.

  Total costs savings of approximately $330,000 per annum was achieved in 2011 and 2012. It was determined that these savings should be contained in this Application and credited to our customers at same time as implementation of approved requested rate riders.

  It will be seen that the appropriate credit is shown in Table 9-4.

2012 OM&A Cost Projections

Table 9-5 below is a forecast of 2012 OM&A costs in comparison to OM&A costs incurred in previous years.

Table 9-5, Cumulative Average OM&A Cost Per Revenue Meter

OM&A Costs	Previous to 2009 Audited	2009 Audited	2010 Audited	2011 Actual	2012 Forecast
Smart Meter Costs	$ 107,709	113,349	422,882	162,771	746,000
Cumulative Smart Meter OM&A Costs	$ 107,709	221,058	643,940	806,711	1,552,711
Cumulative Smart Meters Installed	0	7,467	137,437	146,437	146,850
Cumulative Average OM&A Cost per meter		29.60	4.69	5.51	10.57

In Table 9-5 above OM&A Smart-meter cost per meter reflects a larger annual average OM&A cost being forecasted into 2012 compared to other years. London Hydro projects a $420,100 one-time expense for customer notifications and introduction of TOU (as previously described in Section 7.1, *Customer Engagement*, herein). Much of these expenses are anticipated to be incurred in the first half of the year.

The construction of capital assets took longer than anticipated; therefore we incurred less maintenance costs in prior years. The AMI infrastructure now essentially deployed, and full year of maintenance is forecasted for 2012.

9.3.4 Comparison of Expenditures to Previous Rate Filing

Table 9-6 below is a comparison of actual Smart-meter capital investment expenditures (2006 to 2012) to those presented in the IRM 2011 rate filing.

Table 9-6, Comparison of IRM Rate Filing to Actual Summary of Capital Expenditures

	Total Actual Expenditures	IRM 2011 Rate Application	Variances	
Costs Related to Minimum Functionality				
1.3 ADVANCED METERING CONTROL COMPUTER (AMCC)				
1.3.1 Computer Hardware	$ 237,353	$ 306,528	($69,175)	-23%
1.3.2 Computer Software	$ 36,950	$ 36,976	($26)	0%
1.3.3 Computer Software Licences & Installation	$ 27,724	$ 26,312	$1,412	5%
Sub-total	$ 302,027	$ 369,816	($67,789)	-18%
1.4 WIDE AREA NETWORK (WAN)				
1.4.1 Activation Fees	$ 788,890	$ 746,701	$42,189	6%
Sub-total	$ 788,890	$ 746,701	$42,189	6%
1.5 OTHER AMI CAPITAL COSTS RELATED TO MINIMUM FUNCTIONALITY				
1.5.1 Customer Equipment	$ 143,845	$ 112,259	$31,586	28%
1.5.2 AMI Interface to CIS	$ 949,613	$ 949,613	$0	0%
1.5.3 Professional Fees	$ 6,930	$ 42,456	($35,526)	-84%
1.5.4 Integration	$ -	$ -	$0	
1.5.5 Program Management	$ 175,892	$ 257,715	($81,823)	-32%
1.5.6 Other AMI Capital	$ -	$ -	$0	
Sub-total	$ 1,276,279	$ 1,362,043	($85,763)	-6%
Total Capital Costs Related to Minimum Functionality	$ 21,723,929	$ 20,942,405	$781,524	4%
Costs Beyond Minimum Functionality	$ -			
1.6 CAPITAL COSTS BEYOND MINIMUM FUNCTIONALITY	$ -			
1.6.2 Costs for deployment of smart meters to customers other than residential and small general service	$ 12,800	$ -	$12,800	
1.6.3 Costs for TOU rate implementation, CIS system upgrades, web presentation, integration with the MDM/R, etc.	$ 3,178,074	$ 2,985,789	$192,285	6%
Total Capital Costs Beyond Minimum Functionality	$ 3,190,874	$ 2,985,789	$205,085	7%
	$ -			
Total Smart Meter Capital Costs	$ 24,914,803	$ 23,928,194	$986,609	4%

The variances of capital expenditures identified in Table 9-6 between projected amounts filed in the 2011 IRM Rate Application and those amounts contained and applied for in this Application, total $986,609.

With respect to the overall capital variance, London Hydro provides the following commentary:

- The variances are attributable to requirement to install an additional 1,300 meters due to customer growth, unbudgeted meter adapter purchases (based to socket),

unexpected additional site visits for re-initialization of smart meters, and additional transceivers needed to address network congestion and performance problems from the AMI system resulted in the requirement for additional licensing and testing costs. The costs of the additional transceivers were absorbed by the AMI vendor who had acknowledged the AMI design problems. However, due to this AMI performance problem, additional investment, filing costs of radio plan to Industry Canada, activation fees, and tower costs were needed to permit solution to network congestion issue for the WAN system.

- Many variances are the result of the IRM application model not permitting for segregation of costs beyond minimum functionality. One such development is that expenditures towards the purchase of meters required for customers GS over 50 kW, an amount of $12,800 recorded in 1.6.2 Costs for Deployment of smart meters to customers other than residential and small general service. Another 2011 IRM model restriction not permitting the separation of costs beyond minimum functionality is associated with 1.5.2 Other AMI capital costs related to minimum functionality. The AMI interface to CIS expenditure of $949,613 included software licenses for SAP AMI, project management, testing and development of interfaces from Sensus RNI to SAP. The interface is used to capture hourly interval data, create validation queues and process quality flags. A robust interface is required with timely master data synchronization for meter install, removals and replacements to ensure the TOU customer consumption is attributed to the correct hour.

- Advanced Metering Regional Collector (AMRC) costs were reclassified to group the 15-year life repeater assets such as antennas and radio licensing activities and 35-year life repeater assets such as towers.

- Advanced Metering Control Computer (AMCC) costs were impacted favourably by the acquiring of additional servers and storage to support consolidation and virtualization efforts that in fact resulted in reductions to the number of physical assets required. One benefit of this investment was to realize increased operation efficiencies and reduced ongoing software and hardware costs. Smart meter related storage is shared with other corporate applications, and therefore not included in the smart meter program.

- Total costs beyond minimum functionality have been significantly affected by both pursuit of Measurement Canada solution and delay in IESO deployment of the MDM/R. Refer to Section 6.4. Additional information pertaining to the above issues, and are considered to be beyond the control of management, are as follows:

    - MDM/R Impact on TOU Billing System -

      Our original intent per the TOU Delay submission made to the OEB was to roll out Time of Use billing to London Hydro to coincide with the availability of the MDM/R Measurement Canada register read solution. Unfortunately due to delays at the IESO in making these changes available to LDCs, we will transition to TOU without the register read solution and implement this as an additional change in a timely matter once the MDM/R capabilities are delivered by the IESO.

    - Measurement Canada Impact on TOU Billing System -

There is still additional work including developments to support requirements set out by Measurement Canada which due to scheduling of the certification process, were not able to be considered in the initial development. This work is already well underway and scheduled to go live in Q1 2012, aligned with the IESO deployment of the MDM/R update and London Hydro's mandated TOU deadline.

Currently, the MDM/R changes are still being tested with an unconfirmed release date for the revised system. London Hydro anticipates that it will complete its implementation of the Measurement Canada changes within three months of the MDM/R system acceptance and release for use.

The total variance (in comparison to the 2011 IRM filing) is $192,285. This is comprised of scope changes to achieve compliance with Measurement Canada bill presentment requirements and additional MDM/R integration work associated with the new March 31st, 2012 TOU implementation deadline.

Table 9-7 below is a comparison of actual Smart-meter OM&A expenditures (2006 to 2012) to those presented in the IRM 2011 rate filing.

Table 9-7, Comparison of IRM Rate Filing to Actual Summary of OM&A Costs

	Total Actual Expenditures	IRM 2011 Rate Application	Variances
Costs Related to Minimum Functionality			
2.1 ADVANCED METERING COMMUNICATION DEVICE (AMCD)			
2.1.1 Maintenance *(may include meter reverification costs, etc.)*	$ 28,884	$ 27,995	$ 889
Sub-total	$ 28,884	$ 27,995	$889
2.2 ADVANCED METERING REGIONAL COLLECTOR (AMRC) (includes LAN)			
2.2.1 Maintenance	$ 574,899	$ 532,500	$ 42,399
Sub-total	$ 574,899	$ 532,500	$42,399
2.3 ADVANCED METERING CONTROL COMPUTER (AMCC)			
2.3.1 Hardware Maintenance *(may include server support, etc.)*	$ 18,461	$ 29,661	($11,200)
2.3.2 Software Maintenance *(may include maintenance support, etc.)*	$ 56,534	$ 210,458	($153,924)
Sub-total	$ 74,994	$ 240,119	($165,125)
2.4 WIDE AREA NETWORK (WAN)			
2.4.1 WAN Maintenance	$ 76,043	$ 80,740	($4,697)
Sub-total	$ 76,043	$ 80,740	($4,697)
2.5 OTHER AMI OM&A COSTS RELATED TO MINIMUM FUNCTIONALITY			
2.5.1 Business Process Redesign	$ 15,000	$0	$15,000
2.5.2 Customer Communication (may include project communication, etc.)	$ 524,156	$387,330	$136,826
2.5.3 Program Management	$ 538,238	$666,458	($128,220)
2.5.4 Change Management (may include training, etc.)	$ 70,665	$70,900	($235)
2.5.5 Administration Costs	$ 95,940	$172,279	($76,339)
2.5.6 Other AMI Expenses	-$ 548,362	($888,362)	$340,000
Sub-total	$ 695,638	$408,605	$287,033
TOTAL OM&A COSTS RELATED TO MINIMUM FUNCTIONALITY	$ 1,450,459	$1,289,959	$160,500
2.6 OM&A COSTS RELATED TO BEYOND MINIMUM FUNCTIONALITY	$ 102,252	$250,000	($147,748)
Total OM&A Costs Beyond Minimum Functionality	$ 102,252	$250,000	($147,748)
Total Smart Meter OM&A Costs	$ 1,552,711	$1,539,959	$12,752

The variances of OM&A costs identified in Table 9-7 between projected amounts filed in the 2011 IRM Rate Application and those amounts contained and applied for in this Application, total $12,752.

With respect to the overall OM&A variance, London Hydro provides the following commentary:

- The additional transceivers needed to address network congestion and performance problems from the AMI system resulted in the requirement for additional maintenance and technology licensing fees. The costs of the additional technology licensing fees approximate $43,000. Additional Industry Canada radio frequency fees were also required.

- Server maintenance costs for new servers thought to be only used for the smart meter program were found to also be able to transfer some utilization of the servers to rest of the corporate organization. These costs applicable to use of rest of organization were transferred out of smart meter costs.

- The development of the interface to CIS including AMI functionality within SAP was not completed until late 2011. Annual $70,000 maintenance was forecasted with the IRM for years 2010-2012. The current forecast includes maintenance fees only for year 2012, resulting in $140,000 favourable variance.

- The delays related to MDM/R and Measurement Canada resulted in significant impacts to variances such as communication costs. Additional notice and informational mail outs were required to our customers. To provide sufficient notification and promotion of TOU, radio ads, bus shelters, and bill boards were also employed. Total additional customer communications costs approximate $136,000. Other incremental costs are associated with the hiring of five temporary customer service staff to support customer inquiries related to TOU billing.

- Other variances are costs reductions due to $81,000 in MDM/R fees were not realized, yet forecasted in the 2011 IRM application. London had expected that MDM/R fees would have commenced before 2013. Another favourable variance is the $47,000 decrease in due to the delay in hiring personnel for backhaul network operations. Administration Costs also had favourable variances as a result of lowered time frame for the hiring of temporary staff to perform service order updates and provide customer claims processing (associated with alleged damages to customer property from smart meter installs).

- Manual meter reading savings were reallocated from classification 2.5.3 Program Management to 2.5.6 Other AMI Expenses, to provide better comparability. As well a true up as to projected savings was needed when actual realized results in total for 2011 and 2012 were found to be $330,000. Complications due to network congestion problems were associated with the delay in moving from manual reads, and therefore no 2010 savings being realized.

- Section 2.6 OM&A Costs related to beyond minimum functionality included annual software maintenance for the ODS of approximate $50,000 for the years 2010, 2011 and 2012; and web presentment of $50,000 annually for both 2011 and 2012. The total costs that had been forecasted in the 2011 IRM for software maintenance was $250,000.

  System development and upgrades were completed in year 2011, and therefore, two year maintenance incurred versus earlier projections of $50,000 annual maintenance for a three year period, resulting in $50,000 favourable variance.

  Cost savings were realized for our customers by London Hydro deciding to own and manage the web presentment site when the project is completed. This will result in no external maintenance contract fee costs for the web presentment site service. Maintenance savings is expected to total $100,000.

9.4 Determination of Smart-Meter Disposition Rider

London Hydro is seeking approval of the Smart Meter costs in this Application and the transfer of the approved amounts from the Smart Meter deferral accounts to the required fixed asset, revenue, and expense accounts. Also being requested for approval is a Smart Meter Disposition Rate Rider that reconciles the Revenue Requirement for commencement of the Smart Meter Program through to December 31, 2011 compared to Smart Meter Funding Adder revenues collected from April 1st, 2006 to April 30th, 2012.

The Total Revenue Requirement and Smart Meter true-up for both SMDR and SMIRR are reflected in Table 9-8 below. These calculations are sourced from the Smart Meter Model V 2.17, as filed in Appendix A. London Hydro confirms that the Model has been completed in accordance with the instructions in Ontario Energy Board publication: G-2011-0001, *Guideline: Smart Meter Funding and Cost Recovery – Final Disposition* [Ref 1].

Table 9-8, Smart Meter True-up

Smart Meter True-up	SMDR Amount	SMIRR Amount
Revenue Requirement 2006	$ -	
Revenue Requirement 2007	$ 6,089	
Revenue Requirement 2008	$ 104,104	
Revenue Requirement 2009	$ 285,369	
Revenue Requirement 2010	$ 1,715,709	
Revenue Requirement 2011	$ 3,242,112	
Revenue Requirement 2012	$ -	$ 4,431,525
Total Revenue Requirement	$ 5,353,383	$ 4,431,525
Smart Meter Rate Adder Revenues	$ (6,705,705)	
Carrying Charge	$ (212,586)	
Smart Meter True-up	$ (1,564,908)	$ 4,431,525

London Hydro is proposing that the Smart Meter True-up of ($1,564,908) be dispersed to both Residential and GS < 50 kW customer classes, as each of these classes were involved with the Smart Meter installations. To provide for an allocation of the Smart Meter True-up to each customer class, London Hydro is proposing to utilize a similar approach as was approved by the Board's Decision and Order in PowerStream's 2010 Smart Meter Application (EB-2010-0209).

The Total Revenue Requirement has been allocated to each customer class on the basis of the following:

- Return (deemed interest plus return on equity) and Amortization allocated between the customer classes based on the capital costs of the meters installed for each class,
- OM&A expenses allocated on the basis of the number of meters installed for each class,
- PILs allocated based on the revenue requirement allocated to each class before PILs.

As reflected in Table 9-9 below, the average cost of installing the smart meters for each customer class has been calculated to be $100.84 for Residential customer class and $250.86 for the GS < 50 kW customer class. This has provided an allocation factor of 82.13% for Residential customer class and 17.87% for the GS < 50 kW customer class to permit allocation of Returns and Amortization Amounts. Allocation by meters installed have resulted in an allocation factor of 91.96% for Residential customer class and 8.04% for the GS < 50 kW customer class to permit allocation of OM&A Amounts. In regards to allocation of PILS the Total Before PILS derives an allocation factor of 83.42% for Residential customer class and 16.58% for the GS < 50 kW customer class. After deductions of the Smart Meter Rate Adder Revenues of $6,705,705 and Carrying Charge of $212,586 from the Total Revenue Requirement Allocated, the Smart Meter True-up for Residential customer class is ($1,305,441) and for the GS < 50 kW customer class ($259,467).

Table 9-9, Smart Meter Disposition Rate (SMDR) Rider by Rate Class

Smart Meter Disposition Rate (SMDR) Rider by Rate Class			
	Residential	GS < 50 kW	Total
Allocation Factors			
Average Smart Meter Unit Cost	$ 100.84	$ 250.86	
Smart Meter Cost	$ 13,578,913	$ 2,954,880	$ 16,533,793
Allocation by Meters Costs	82.13%	17.87%	100.00%
Meters Installed	134,658	11,779	146,437
Allocation by Meters Installed	91.96%	8.04%	100.00%
Total Before PILS	$ 5,121,368	$ 1,017,914	$ 6,139,282
Allocation by Total Before PILS	83.42%	16.58%	100.00%
Revenue Requirement (Commencement to 2011) Allocated:			
Return (Deemed Interest and Return on Equity)	$ 1,998,783	$ 434,951	$ 2,433,734
Amortization	$ 2,380,763	$ 518,073	$ 2,898,837
OM&A	$ 741,822	$ 64,890	$ 806,711
Total Before PILS	$ 5,121,368	$ 1,017,914	$ 6,139,282
PILS	$ (655,594)	$ (130,305)	$ (785,899)
Total Revenue Requirement Allocated	$ 4,465,774	$ 887,609	$ 5,353,383
Allocation for Smart Meter True-up	83.42%	16.58%	100.00%
Smart Meter True-up:			
Total Revenue Requirement Allocated			$ 5,353,383
Smart Meter Rate Adder Revenues			$ (6,705,705)
Carrying Charge			$ (212,586)
Smart Meter True-up	$ (1,305,441)	$ (259,467)	$ (1,564,908)
Smart Meter Disposition Rate (SMDR) Recovery			
Meters Installed (Average)	134,764	11,880	146,644
Disposition	$ (0.81)	$ (1.82)	$ (0.89)

London Hydro is proposing that the Smart Meter True-up amounts by via a SMDR rate rider as a monthly fixed charge to be dispersed over a period of one year, commencing May 1, 2012 and ending April 30th, 2013. As determined in the Table above, London Hydro is requesting the Board to approve a Smart Meter Disposition Rate Rider of ($0.81) per metered Residential customer per month, and ($1.82) per metered GS < 50 kW customer per month.

9.5 Determination of Smart-Meter Incremental Revenue Requirement Rider

London Hydro is seeking a rate rider to recover the revenue requirement associated with projected 2012 smart meter investments. Board approved projected 2012 smart meter investments, as requested in this Application, will permit the calculation of a requested SMIRR. As London Hydro's next Cost of Service distribution rate application is currently scheduled for 2013, in which it is expected that smart meters will be incorporated in the rate base, London Hydro is proposing for a SMIRR that is a monthly fixed charge to be recovered over a period of one year, commencement May 1, 2012 and ending April 30th, 2013.

Table 9-10, Smart Meter Incremental Rate Rider (SMIRR) by Rate Class

Smart Meter Incremental Rate Rider (SMIRR) by Rate Class			
	Residential	GS < 50 kW	Total
Allocation Factors			
Average Smart Meter Unit Cost	$ 100.84	$ 250.86	
Smart Meter Cost	$ 13,584,560	$ 3,000,787	$ 16,585,347
Allocation by Meters Costs	81.91%	18.09%	100.00%
Meters Installed	134,714	11,962	146,676
Allocation by Meters Installed	91.84%	8.16%	100.00%
Total Before PILS	$ 3,625,280	$ 710,303	$ 4,335,583
Allocation by Total Before PILS	83.62%	16.38%	100.00%
Revenue Requirement (2012) Allocated:			
Return (Deemed Interest and Return on Equity)	$ 1,125,422	$ 248,602	$ 1,374,024
Amortization	$ 1,814,698	$ 400,861	$ 2,215,559
OM&A	$ 685,161	$ 60,839	$ 746,000
Total Before PILS	$ 3,625,280	$ 710,303	$ 4,335,583
PILS	$ 80,224	$ 15,718	$ 95,942
Total Revenue Requirement Allocated	$ 3,705,504	$ 726,021	$ 4,431,525
Smart Meter Incremental Rate Rider (SMIRR) Recovery			
Meters Installed (Average)	134,764	11,880	146,644
Recovery	$ 2.30	$ 5.10	$ 2.52

As determined in the Table 9-10 above, London Hydro is requesting the Board to approve a SMIRR of $2.30 per metered Residential customer per month, and $5.10 per metered GS < 50 kW customer per month. The proposed allocation basis of the 2012 revenue requirement, in the amount of $4,431,525, used the same methodology as that for the SMDR. No smart meter funding revenues or carrying charges are included in the calculations.

9.6 Customer Bill Impact

Table 9-11 below summarizes the rate riders being proposed in the Application. The table further compares these proposed fixed monthly rate charges to the present approved Smart Meter Funding Adder, which expired on April 30, 2012.

Table 9-11, Bill Impact Comparison to 2012 IRM Applied Rates

Rate Class	Consumption kWh	IRM 2012 Applied for Rate	Proposed $	Difference $	Total Bill Impact
RESIDENTIAL	800	$ 105.06	$ 106.57	$ 1.52	1.45%
GENERAL SERVICE LESS THAN 50 KW	2,000	$ 258.34	$ 261.67	$ 3.34	1.29%

* Currect Charges reflects the rate applied for in 2012 IRM Rate Application (EB-2011-0181

The bill impact with the comparison of proposed rates in this Application to applied for rates as in our 2012 IRM rate application (EB-2010-0181) are (1.5%) for Residential rate class and (1.3%) for GS < 50 kW rate class.

Table 9-12, Bill Impact Comparison to Current Rates

Rate Class	Consumption kWh	Current $	Proposed $	Difference $	Total Bill Impact
RESIDENTIAL	800	$ 106.93	$ 106.96	$ 0.03	0.03%
GENERAL SERVICE LESS THAN 50 KW	2,000	$ 260.32	$ 262.17	$ 1.85	0.71%

* Currect Charges reflects approved rates as per 2011 IRM Rate Application (EB-2010-0097

Table 9-12 above summarizes the bill impacts as a result of the rates charges requested in this Application. The bill impact with the comparison of proposed rate in this Application to current rates as approved in our 2011 IRM rate application (EB-2010-0097) are (0.03%) for Residential rate class and (0.71%) for GS < 50 kW rate class.

Table 9-13, Comparison of Proposed Rate Charges to Present Funding Adder

RESIDENTIAL	4/30/2012 Current	1 May 2012 Proposed	Difference $
Funding Adder to April 30, 2012	$ 1.46	$ -	$ (1.46)
SMDR	-	$ (0.81)	$ (0.81)
SMIRR	$ -	$ 2.30	$ 2.30
Smart Meter Rate Change	$ 1.46	$ 1.49	$ 0.03

GS < 50 kW	4/30/2012 Current	1 May 2012 Proposed	Difference $
Funding Adder to April 30, 2012	$ 1.46	$ -	$ (1.46)
SMDR	-	$ (1.82)	$ (1.82)
SMIRR	$ -	$ 5.10	$ 5.10
Smart Meter Rate Change	$ 1.46	$ 3.28	$ 1.82

* Currect Funding Charges reflects approved rates as per 2011 IRM Rate Application (EB-2010-0097

9.7 Stranded Meters

London Hydro is not requesting the recovery of Stranded Meter costs in this application in order to comply with recommendations contained in the Board's Smart

Meter Funding and Cost Recovery - Final Disposition (G-2011-001), issued December 15, 2011. These meters continue to be included in rate base for rate-making purposes, as is recommended by the Board in its Decision with Reasons in the Smart Meter Combined Proceeding (EB-2007-0063).

London Hydro intends to seek recovery of the Stranded Meters in the next cost of service application expected for 2013. The amortization expense for stranded meters continues to be recorded for over the remaining amortization period. These amortized expense amounts are recorded to account 5705 Amortization Expense.

The total number of conventional revenue meters that has been replaced by Smart-meters, as at December 31, 2011 totals 141,511. The approximate net book value of these conventional meters, as at December 31, 2011, is $3,511,000.

9.8 Other Matters

9.8.1 Copies of Commercial Agreements

London Hydro has not included copies of any Agreements associated with the Smart Meter Program, in this Application as evidence.

In following the Board's Smart Meter Funding and Cost Recovery – Final Disposition (the "2011 Guideline") Guideline (G-2011-0001) the guideline no longer requires the filing of the agreement(s). Rather, Section 3.5 states that in applications, "*A general description of contractual arrangements with the selected vendors should be provided*."

London Hydro submits that it has described the contractual arrangements undertaken in support of the Smart Meter Program in the Application, in compliance with the 2011 Guideline, and that the agreements are not necessary for this Application.

During these proceedings, if the Board has determined that specific copies of Agreements associated with the smart meter program vendors are necessary to be filed with the Board, London Hydro will comply as per Board's Practice Direction on Confidential Filings (the "Practice Direction").

However, we respectfully request that as these Agreements are associated with vendors which are engaged in competitive business and that possible disclosure of terms and pricing as contained in the Agreements could reasonably prejudice the economic interest, competitive position, and cause undue financial effect on these vendors, that the Board takes this into consideration when addressing the confidentiality of the filings.

If copies of the Agreements are so requested by the Board, London Hydro will file these confidential un-redacted versions of the Agreements to the Board Secretary, in a sealed envelope marked "Confidential".

London Hydro respectfully requests in the circumstances of having to provide copies of any agreements that they be kept confidential. Further, if copies of any agreements

are to be requested and provided to party's council and/or experts or consultants that they be executed under the Board's form and undertaking with respect to confidentiality. Further, that they comply with the Practice Direction, and be subject to London Hydro's right to object to the Board's acceptance of a Declaration and Undertaking from any party. We request that all parties comply with the requirements of the Board's Practice Direction on Confidential Filings (the "Practice Direction").

10 CONCLUSIONS

London Hydro recognizes that there are benefits to Smart-meters beyond simply billing the customer on time-of-use electricity rates. As may or may not be apparent, London Hydro has specifically chosen an integrated architecture for our corporate computer systems with a vision of Smart Grid and enhanced customer services in mind. Advanced metering infrastructure is viewed as the foundation to exploit these benefits in future.

London Hydro has demonstrated leadership in the assembly of an informal Smart-metering procurement consortium, the creation of a comprehensive Request for Proposal document, and the development of a fair and transparent procurement process by which more than 60 LDC's entered into procurement contracts for their respective AMI system. This achievement was formally recognized by the Ministry of Energy by specific reference to the London Hydro RFP within Ontario Regulation 427/06, *Smart Meters: Discretionary Metering Activity and Procurement Principles*.

The computer and communications systems necessary to transmit a customer's hourly energy consumption date from the Smart-meter through to production of a bill based on time-of-use electricity rates is more than the AMI component. This narrative document is intended to demonstrate that London Hydro employed appropriate procurement practices throughout the project and that the project management team was effective in the procurement and deployment of the various system elements required for a full solution.

In spite of careful project planning, this narrative document also highlights a number of circumstances largely outside of London Hydro's control that would eventually delay the transition of London Hydro's customers to time-of-use electricity billing. Whereas the original plan was for the summer of 2011, the project reality is Spring of 2012.

The proposed rate riders in this application have resulted in nominal rate changes in total of $0.17 per month. This rate change is based on the comparison of the current Smart Meter Funding Adder of $1.46 per metered customer per month and the proposed combined SMDR and SMIRR of $1.63 per meter per month (for combined *residential* and *general service < 50 kW* customers).

The customer bill impacts (in comparison to current rates) reflect minimum changes of 0.03% for *residential* class customers and 0.71% for *general service < 50 kW* customers. It is therefore appropriate that the Board approve the proposed rate riders and eliminate the funding adder for implementation effective May 1, 2012.

In summary, London Hydro respectfully submits that the costs necessary to fulfill its obligations under the provincially mandated Smart Meter initiative have been prudently incurred in accordance with Board guidelines and that the proposed rate riders are just and reasonable.

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