Request for Proposal

Operational Data Store
RFP 2008-1114

November 14, 2008

Cornerstone Hydro Electric Concepts

Table of Contents

Section 1: Background

1.1 Introduction

To create a conservation culture in Ontario and make the Province a North American leader in energy efficiency, the Government has taken action to facilitate a number of key initiatives, including the introduction of flexible, time-of-use pricing for electricity, and a target reduction in Ontario's energy consumption of 5% by 2007.

The attached documentation sets out the procedural and technical requirements for the submission of proposals to Cornerstone Hydro Electric Concepts (CHEC), for its Operational Data Storage (ODS) requirements as per the enclosed specifications; as well as the substantive contractual terms that govern the relationship between parties upon award of the contract.

CHEC members have been working collaboratively through the planning and preparation stages for the Smart Meter Initiative. CHEC is an association of electricity distribution utilities modeled after a cooperative to share resources and proficiencies as the Ontario electricity industry continues its transformation.

The mission of CHEC is to be recognized as the premier LDC Cooperative in the province, by meeting or exceeding member expectations through the sharing of services, opportunities, knowledge and resources. The values of CHEC include the sharing of resources, both intellectual and technical, enabling members to deliver value to their customers and shareholders ensuring competitiveness in the marketplace. Together the mission and value statements represent lofty but attainable goals for CHEC members. Collaboratively CHEC represents over 110,000 residential end points in Ontario and is comprised of the following member utilities:

Centre Wellington Hydro Ltd.
COLLUS Power Corp.
Grand Valley Energy Inc.
Innisfil Hydro Distribution Systems Ltd.
Lakefront Utilities Inc.
Lakeland Power Distribution Ltd.
Midland Power Utility Corporation
Orangeville Hydro Limited
Orillia Power Distribution Corporation
Parry Sound Power Corporation
Rideau St. Lawrence Distribution Ltd.
Wasaga Distribution Inc.
Wellington North Power Inc.
Westario Power Inc.

1.2 Provincial Context for Project

As part of its energy conservation effort, the Ontario government has made a commitment to replace all existing meters (5 million) with smart meters by 2010. Phase One utilities have fulfilled their commitments to install 1 million smart meters by Dec 31, 2007 which assisted the government in exceeding their interim goal of 800,000 by Dec 31, 2007. Focus now shifts to the Phase Two implementation of a Smart Meter Network.

The underlying premise behind the provincial mandate to install these meters is to educate customers on their consumption habits and implement new rate structures that will encourage load shifting and conservation of energy, thereby reducing the requirement for increased power generation capabilities. To this end, the province, by way of the Independent Electricity System Operator (IESO), will be implementing a centralized Meter Data Management / Repository to aggregate utility data from the multiple AMI systems being implemented across Ontario. The IESO has created validation rules, and synchronization processes to control data and ensure that data is complete and suitable for billing.

It should be noted that CHEC members fully support this endeavour on behalf of the IESO and the province of Ontario, and that the interests of the RFP document are not related to those of the IESO and the centralized MDM/R. The Operational Data Storage requirements discussed herein are for the purpose of storing AMI Data being collected by CHEC's AMI systems, for which there is no provision in the centralized system to store and further utilize to implement operational efficiencies that will now become possible through the implementation of this new metering infrastructure.

1.3 CHEC's Approach to Smart Metering

With respect to the Provincial government's Smart Metering Initiative, CHEC has taken a collaborative approach to becoming educated on this mandate by working with other Ontario utilities and advocacy groups. CHEC hopes to evaluate Bidders as objectively as possible with the end goal of selecting the best-fit provider for an ODS, thereby allowing CHEC members to achieve their goals, as well as those of the provincial Smart Meter mandate.

Along with satisfying the provincial mandate of measuring "how much electricity a customer uses each hour of the day, and to use that data to charge customers an energy price that varies depending on when the electricity was consumed" (OEB Smart Meter Plan; January 26, 2005; page i); CHEC members will also implement the Smart Meter Network to improve overall efficiency within each members respective service territory.

CHEC would like to reiterate their support for the IESO MDM/R system that is being implemented, and that the utilities will look to the ODS to support their needs for the introduction of efficiencies that become possible through the use of Operational data that is available through the AMI system. Due to the possibility that the centralized system may one day accommodate these needs, and in keeping with the utility's desire to minimize duplication in utility infrastructure, combined with the relative infancy of Operational Data Storage systems, the utilities will procure a system that is established in the Application Service Provider (ASP) model, allowing the system to grow with the utility needs, but also provide flexibility with regards to term; in the event that the centralized system is able to accommodate the operational needs as well as billing requirements, the utilities would support (and move to) the IESO model.

1.4 Smart Meter Terminology

For the purposes of this procurement process, and within this Request for Proposal document, CHEC has opted to utilize the terminology as defined by the Ministry of Energy in their *Functional Specification for an Advanced Metering Infrastructure Version 2* (dated July 5, 2007), Section 3, *Definitions.* For reference, this document has been included herein as Appendix "A".

1.5 Other Terms

1) ***MDM/R:*** Within this document the acronym MDM/R has been used in reference to the centralized Meter Data Management / Repository that is owned and operated by the Independent Electricity System Operator (IESO). Currently the IESO is working to integrate Smart Meter Data from systems that were installed in Phase One of the Ontario Smart Meter Initiative.
2) ***ODS:*** Within this document the acronym ODS will be used in reference to the Operational Data Storage Services being sought in (potentially) a temporary capacity for the purposes of auditing and validating smart meter data until such time that the centralized repository is in place. At that time CHEC members will make a business decision whether or not to continue utilizing the ODS based on the functionality that is available in ODS compared to that currently in place with the MDM/R. For example, at this time it is not clear whether MDM/R will be used to store operational information. If CHEC members are able to implement efficiencies as a result of the operational data being received from the installed AMI systems, it may be in CHEC members' best interests to continue utilizing ODS.

3) ***Bidder*** shall refer to the vendor proposing a solution to this RFP document.
4) ***Vendor*** shall refer to the successful Bidder. The term Vendor will be used when stating future requirements, to be performed only by the successful Bidder.

1.6 Key Dates

Below is the expected timeline that CHEC will be following during the evaluation of available ODS solutions. CHEC reserves the right to adjust these dates as needed. All Bidders will be notified if any of the following dates are altered. As can be seen, it is the intention of CHEC members to make their decision by January 30, 2009.

Dates of Significance

RFP released by CHEC:	**November 14, 2008**
Bidder Response with Intention to Bid:	**November 21, 2008**
Final Questions Due:	**November 28, 2008**
Answers to Questions:	**December 5, 2008**
Closing Time (RFP Due):	**3:00pm EST December 12, 2008**
Vendor Presentations:	**January 5 - 9**
RFP Decision:	**January 30, 2009**

Section 2: Instruction to Bidders

2.1 Bid Documents

This Request for Proposals (RFP), establishes the system products and services that CHEC members wish to acquire. This bid document is the basis upon which CHEC seeks firm proposals from selected Bidders and upon which proposals will be evaluated. The documents are:

1) This RFP (a .pdf document), including Appendices that are integral to it.
2) CHEC_ODS_RFP_PricingFunctionality_Nov2008.xls, a Microsoft Excel workbook. This file allows for entry of pricing information, as well as confirmation of compliancy with the required regulations, and will heretofore be referred to as the Pricing Spreadsheet.

2.1.1 Pricing and Compliancy Spreadsheet

The Pricing spreadsheet will allow for the Bidder to enter their pricing information in a standard format, as well as allow the Bidder to attest to their product's functionality. As per Section 2.4 *Proposal Format Instructions*, any hard copies of the pricing submission should be submitted in a separate envelope, marked "PRICE OFFER".

The following tabs are included within the Pricing and Compliancy Spreadsheet:

1) ODS_Functionality: This tab requires completion by the Bidder, and will act as their product functionality statement providing detailed information on product capabilities.
2) Pricing_Option1_ASP: This tab requires completion by the Bidder
3) Pricing_Option2: This tab is optional. If the Bidder feels that a pricing format apart from that provided in the Pricing_Option1_ASP tab will better represent their product offering, they may complete the Option 2 tab. **NOTE: In the event that the bidder chooses to complete Pricing Option 2, the utilities will still require a completed Option 1 tab.**

2.2 Intention to Bid

Recipients of this RFP are asked to inform CHEC of their intention to bid by completing the template form found in Section 2.19 *Proposal Forms*, and by submitting this form by the date shown in Section 1.6 *Key Dates*. Recipients that express intention to bid will be included in all correspondence (if any) during the bidding process. Please provide full contact information and expression of intention via the provided form to the CHEC member contact as per instruction in Section 2.19.1 *Intention to Bid Form*.

2.3 Submission Requirements

1) A complete proposal will consist of an original and seven (7) copies of each of
   a) The proposal forms,
   b) The Bidder's Response document (including all associated attachments),
   c) Pricing spreadsheet: CHEC_ODS_RFP_PricingFunctionality_Nov2008.xls; a Microsoft Excel workbook,
   d) Accompanying the Bidder's Response document should be the proposal forms provided in Section 2.19 *Proposal Forms*,
   e) The required format of the Bidder's Response document is outlined in Section 2.4 *Proposal Format Instructions*,
   f) The Pricing and Compliancy spreadsheet will allow for the Bidder to enter their pricing information in a standard format, as well as allow the Bidder to attest to their product's functionality,
   g) A soft copy of all of the above forms and documents should also be provided on one CD.

2) The original hard copy shall be clearly identified as "ORIGINAL"; the remainder (i.e. seven copies) shall be marked as "COPY". In the event of discrepancy between the copies of the Response, the one marked "ORIGINAL" shall prevail. Each Bidder's Response shall consist of the required documents with the required number of copies of all commercial information, including pricing, terms and conditions and exceptions (if applicable). Faxed or late proposals will not be accepted. Proposals must be sealed and marked clearly quoting the proposal number referred to on the cover sheet of the proposal documents. The use of any means of delivery of a proposal shall be at the risk of the Bidder.
3) Any Bidder wishing to provide additional information other than what is requested in the proposal documents must place such additional information in a separate section marked Supplementary Information, as per Section 2.4 *Proposal Format Instructions*. Any Additional Information or any unsolicited value-added alternatives may, in CHEC's absolute discretion, be given due consideration, or not.
4) CHEC member utilities shall not be liable for, nor shall they reimburse any Bidder for costs incurred in the preparation of proposals, or any other services or samples that may be requested as part of the evaluation process.
5) The Proposal Forms shall be signed under the Corporate Seal of the Bidder, by the duly authorized signing officer(s). All submitted pages shall be initialled by such officer(s).

2.4 Proposal Format Instructions

Where information has been requested through this RFP, the Bidder's Response should clearly indicate the RFP section number that the Response pertains to. The Bidder's Response should be organized according to the following sections:

1) Section 1 of the proposal will contain the Bidder's Executive Summary, no more than two pages in length that introduces the Bidder and highlights key features of the proposal.
2) Section 2 of the Proposal **should be provided in a separate envelope which has been clearly marked "PRICE OFFER".** This section will contain the summary pages pertaining to the Price Offer, contained within the Pricing and Compliancy Spreadsheet. The Bidder's detailed itemized pricing information for all goods or services is to be contained within the Pricing Spreadsheet which is to be included with the Response in its entirety as well as within this section. Any alternative pricing offers may also be included within the Pricing Spreadsheet, by adding tabs as needed. All pricing shall be expressed in Canadian currency, exclusive of taxes. If your originating currency is not Canadian, the currency exchange that was used to calculate the price in Canadian currency is to be provided.
3) Section 3 of the proposal will contain the functionality statement that is included within the Pricing Spreadsheet as the following tab: ODS_Functionality.
4) Section 4 of the proposal will contain all requested information regarding the Bidder (CHEC RFP Section 4: *Bidder Company Information*) in the order presented in this document, with the numbering used in this document.
5) Section 5 of the Bidder's proposal will contain the requirements of Section 5 of this RFP Document (Section 5: *ODS Solution Technical Requirements*), in the order presented in this document, with the numbering used in this document.
6) Section 6 of the Bidder's proposal will contain any additional documentation that the Bidder decides to provide regarding their offering.

2.4.1 Proposal Format Example: Section 5

Within Section 5: *ODS Solution Technical Requirements* of the RFP, an indicator has been included with the subsection heading to indicate the requirement of the Bidder to provide information pertaining to the functionality of their product (with regards to the section requirements), or a statement of compliancy AND information pertaining to the functionality of their product with respect to the requirement of the section.

(I) When an (I) has been included with the section heading, CHEC members require Information regarding the proposed system's functionality, and the methodology utilized to satisfy the RFP requirement.

(C) When a (C) has been included with the section heading, CHEC members require a statement of compliancy from the Bidder. Within the Submission documentation, the Bidder is required to state the proposed product's compliancy with the requirement by stating Fully Compliant, Partially Compliant, or Not Compliant. In instances where the product is Partially Compliant, or Not Compliant, the Bidder is required to state their plans (complete with development time line) to bring their product into compliancy.

(CI) When a (CI) has been included with the section heading, CHEC members require both a statement of compliancy, and Information regarding the proposed system's functionality, and the methodology utilized to accommodate the RFP requirement.

The method with which the Bidder provides information and compliancy statements is detailed within the individual sections, as well as within the Pricing and Compliancy Spreadsheet.

SAMPLES of response for Section 5: *ODS Solution Technical Requirements*, demonstrating that the section numbering from this document is to be retained, and that each section should be included, and shall include within it a statement of compliance (which is also included in spreadsheet form in the Pricing and Functionality Spreadsheet).

5.5.6 Reporting: Custom Queries (C)

The ODS will be capable of executing custom queries to accommodate any areas where standard reports are not available.

Vendor's declaration of compliance: **Fully Compliant**

5.9 Scalability (CI)

The Bidder must describe its proposed ODS data model demonstrating the model's flexibility and scalability to deliver cumulative and interval metering over the next ten years. The system should be designed for a minimum of 250,000 customers, assuming 2 years of online interval data and 7 years off-line data storage. Please specify the methodology for data storage and retrieval.

Vendor's declaration of compliance: **Fully Compliant**

Vendor's Functionality Statement: The ODS system being proposed has been implemented in several deployments (in other markets) of 300,000+ meters, with the largest deployment being 500,000 meters. In addition to these live deployments, the system has been volume tested to more than 1.5 million meters. While these large deployments are all electric AMI deployments, we have deployed the system in some smaller cooperatives 80,000+ meters which are multi-commodity (electric, water, and gas). We believe that together, these experiences demonstrate the scalability required to be successful in the Ontario marketplace. References have been included which can speak to these experiences.

2.5 Adjustments / Substitutions

1) A proposal may be altered by a Bidder only by submitting another proposal at any time up to the Closing Time. Adjustments by telephone, facsimile, telegram or letter to a proposal already submitted will not be considered. The last proposal received by CHEC's designee shall supersede and invalidate all proposals previously submitted by the Bidder for this RFP.
2) During the period prior to the Closing Time, changes made by CHEC members to the proposal documents will be issued by CHEC to the Bidders as written addenda. The Bidder shall list in its proposal all addenda that were considered in the preparation of its proposal.
3) No substitutions or deviation from the Specifications, Proposal Form or General Conditions of Contract will be permitted without CHEC's approval in writing.

2.6 Complete Bid

Bidders are requested to submit bids that are complete and unambiguous without the need for additional explanation or information. CHEC members reserve the right to make a final determination as to whether a bid is acceptable or unacceptable solely on the basis of the bid as submitted, and proceed with bid evaluation (or not) without requesting further information from any Bidder. If CHEC members deem it desirable and in their best interest, CHEC may, in its sole discretion, request from any Bidder or Bidders additional information clarifying or supplementing any submitted bid.

2.7 Clarifications

Upon the issuance of this RFP to Bidders, and continuing through the submission date, all questions or other communications with CHEC shall be by email only:

chec@util-assist.com

CHEC members will respond to the question in writing, with both the question and response provided to each Bidder that has declared intention to bid. No response will be made to questions submitted after November 28, 2008.

2.8 Grounds for Disqualification

It is a requirement of this RFP document that Bidder's submitting proposals for evaluation complete the Pricing Spreadsheet including the ODS_Functionality tab and format their bid submission according to Section 2.4 *Proposal Format Instructions*. CHEC reserves the right to reject any incomplete bids (as per Section 2.6 *Complete Bid*).

NOTE: Where functionality (within the ODS_Functionality tab of the Pricing Spreadsheet) has been misrepresented, CHEC reserves the right to disqualify the Bidder from further evaluation of the RFP.

2.9 Post Bid Meeting

CHEC members reserve the right to invite any or all Bidders to make an in-person presentation regarding the proposed ODS solution. CHEC may request Bidder's assistance in arranging visits to other installations where Bidder has deployed the solution.

2.10 Withdrawal of Proposal

Bidders will be permitted to withdraw their proposal unopened after it has been submitted if such a request is received by the designee of CHEC in writing, prior to the Closing Time.

2.11 Bid Inconsistencies

Any provisions in Bidder's proposal that is inconsistent with the provisions of this Request for Proposals, unless expressly described in the proposal as being exceptions, are deemed waived by the Bidder. In the event the order is awarded to Bidder, any claim of inconsistency between the proposal and this RFP will be resolved in favour of this RFP unless otherwise agreed to in writing by CHEC.

2.12 Bidder's Statement of Understanding

By submitting a response to this RFP, Bidders acknowledge the following:

1) The Bidder acknowledges that it has carefully examined, understands and accepts the proposal documents, has carefully examined the requirements contained in the proposal documents and hereby submits an offer according to the requirements set forth in this proposal.
2) It is understood that this proposal, if it has not been withdrawn in accordance with Section 2, subsection 2.10 *Withdrawal of Proposal*, is irrevocable and shall remain open for acceptance by CHEC for a period of ninety (90) working days following the opening of the proposals.
3) It is further understood by the Bidder that if CHEC accepts its proposal, then the Bidder is bound by the Contract and agrees to provide the goods and/or services upon the terms and conditions of the Contract
4) The Bidder acknowledges and agrees that all quantities shown in the proposal documents are approximate only. Quantities may be subject to increase, decrease, or total deletion in the event that CHEC determines in its absolute discretion that such change is required.
5) While CHEC has used considerable efforts to ensure an accurate representation of information in this Request for Proposal, the information contained in this Request for Proposal is supplied solely as a guideline for Bidders. The information is not guaranteed or warranted to be accurate by CHEC, nor is it necessarily comprehensive or exhaustive. Nothing in this Request for Proposal is intended to relieve Bidders from forming their own opinions and conclusions with respect to the matters addressed in this Request for Proposal.

2.13 Proposal Evaluation

1) All proposals shall be opened after the Closing Time in the presence of CHEC's Representative or another individual designated to open the proposals by CHEC. The opening will not be public.
2) In determining the contract award, the lowest proposal will not necessarily be accepted, and CHEC reserves the right to accept or reject any or all proposals in its absolute discretion. Further, proposals may be accepted or rejected in total or in part.
3) The Evaluation Committee will review proposals and will then carry out interviews with selected Bidders for clarification as required.
4) It is anticipated that a written contract will be negotiated immediately after the successful Bidder has been notified. If a contract cannot be negotiated within thirty (30) days of notification, CHEC may, at its sole discretion at any time thereafter, terminate negotiations with that Bidder and either negotiate a contract with the next qualified Bidder or choose to terminate the Request for Proposal process and not enter into a contract with any of the Bidders.

2.14 Award of Contract

1) The Bidder acknowledges that CHEC reserves the right, privilege, entitlement and absolute discretion, and for any reason whatsoever to:
   a) Cancel this Request for Proposals at any time, either before or after the Closing Time;
   b) Accept a proposal which is not the highest scoring proposal submission, or reject a proposal that is the highest scoring proposal even if it is the only proposal received;
   c) Accept the proposal deemed most favourable to the interests of CHEC or that may provide the greatest value advantage and benefit to CHEC based upon but not limited to price, ability, quality of work, service, past experience, past performance and qualification;
   d) Accept or reject any and all proposals, whether in whole or in part;
   e) Award any part of any proposal; or
   f) Accept or reject any unbalanced, irregular, or informal proposals.
2) The Bidder acknowledges that CHEC will evaluate proposals using an internal scoring method as referenced in section 2.13 *Proposal Evaluation* and other criteria which CHEC deems relevant, even though such criteria may not have been disclosed to the Bidder. By submitting a proposal, the Bidder acknowledges CHEC's rights under this section and absolutely waives any right, or cause of action against CHEC and its consultants, by reason of CHEC's failure to accept the proposal submitted by the Bidder, whether such right or cause of action arises in contract, negligence, or otherwise.
3) Contract award, if any, will be communicated by written notification from CHEC to the successful Bidder. The successful Bidder, if any, in the presence of the designate, must sign the Contract Agreement in triplicate (3), within seven (7) Working Days of written notification of acceptance.
4) Bidders whose proposals have been rejected by CHEC will be notified within thirty (30) days of the award date.
5) The successful Bidder shall provide CHEC with a designated inside customer service representative. Any disputes and/or queries with respect to the Contract will be directed to the CHEC representative, whose decisions with respect to any matter under dispute shall be final and binding.

2.15 Freedom of Information

Proposals submitted to CHEC become the property of CHEC and, as such, are subject to the *Freedom of Information and Protection of Privacy Act*, R.S.O. 1990, c. F.31, as amended.

2.16 Ownership of Data

CHEC shall own all data collected by the AMI system, and subsequently stored by the ODS. Data collected and stored by the system shall not be used for any purpose without the approval of CHEC.

2.17 Proposal Evaluation Criteria

CHEC will evaluate proposals using an internal scoring method that weights various parameters to give the CHEC Smart Meter Team insight into the strengths of each proposal relative to CHEC's needs. CHEC's internal scoring method values the following proposal attributes (order of presentation does not reflect priority):

Figure 1 Proposal Evaluation Criteria

Proposal Evaluation Criteria	Section	% Total Points
Project Overview	3	
Bidder Information	4	
ODS Functionality	5	
General Data Management Requirements		
Performance Service Levels		
System Integration		
Meter Event Manager		
System Disaster Recovery Planning		
ODS System Reporting		
Scalability		
ODS System Security		
Perspectives expressed by reference utilities		
Section 3 through 5 inclusive:		**60%**
Pricing Weighting:		**40%**
Total		**100%**

Along with the Bidder's company information, and statements of understanding regarding the project, the answers to sections 3 through 5 will represent 60% of the total weighting of the RFP. Pricing submitted will represent 40% of the total weighting of the RFP. Bidders will be selected for further discussion based on the Team's judgment, developed using the scoring method. CHEC reserves the rights to alter its internal scoring method and to exercise whatever judgment it deems in the best interests of CHEC in selecting an ODS solution provider.

2.18 Payment

When the Vendor has completed all work in accordance with the terms of the contract documents, the Vendor shall submit to CHEC a request for final payment. The request for final payment shall constitute a waiver of all claims by the Vendor except for claims specifically listed in the request. CHEC will make payment within forty-five (45) days of receipt of a request for payment.

Vendor's submission of its request for final payment shall constitute its warrant that the Vendor has to the best of its knowledge fully completed all work included in the Contract and has fully paid for labour, materials, equipment, services, taxes and all other costs and expenses resulting from this Contract.

2.19 Proposal Forms

Within this section, there are two forms required for submission. The first form is found in Section 2.19.1 *Intention to Bid Form*; the intention of this form is to allow the vendor to provide a standard email Response to CHEC designee to notify CHEC of the Bidder's intent to respond to the RFP.

2.19.1 Intention to Bid Form

The procedure to be utilized for this form is to copy and paste the following content into an email, and send the email to:

chec@util-assist.com

according to the time line as established by Section 1.6 *Key Dates*.

INTENTION TO BID NOTIFICATION FORM

PROPOSAL NO. 2008-1114

Intention to Bid:
Please allow this email to represent " Insert Company Name Here " intention to respond to RFP 2008-1114.

Contact for communication regarding bid: _____
Contact phone number: _____
Contact email address: _____

We acknowledge the requirement for our ODS solution to, at minimum, audit the performance of the installed AMI to assist CHEC in making certain the AMI meets the Ministry of Energy's minimum functional requirements as outlined in the document *Functional Specification For An Advanced Metering Infrastructure Version 2* (dated July 5, 2007). Our proposal will include the required compliance statements and documents to properly express our ability to meet these requirements. We also acknowledge the Submission Deadline is 3:00 PM Eastern Time on December 12, 2008.

2.19.2 RFP Submission Form

The procedure to be utilized for this form is to print the following pages to be included with the RFP submission, which should be addressed to:

Attn: Ms. Ruth Tyrell
CHEC Group
c/o Orangeville Hydro
400 C Line
Orangeville, ON L9W 2Z7

according to the time line as established by Section 1.6 *Key Dates*.

Cornerstone Hydro Electric Concepts

Proposal Number: **RFP 2008-1114**

FOR: OPERATIONAL DATA STORAGE SYSTEM & SERVICES

THIS PROPOSAL IS SUBMITTED BY:_____

ADDRESS:

TELEPHONE: FAX NO.:

BIDDER G.S.T. No.:

PERSON(S) SIGNING ON BEHALF:_____(print)

POSITION(S) OF THE PERSON(S):_____(print)

To CHEC, Hereafter called "Owner":

I/WE _____ the undersigned declare:

1. THAT no Person(s), Firm or Corporation other than the one whose signature(s) of whose proper officers and the seal is or are attached below has any interest in this proposal or in the contract proposed to be taken.

2. THAT this proposal is made without any connections, knowledge, comparison of figures or arrangements with any other company, firm or person making a proposal for the same work and is in all respects fair and without collusion or fraud.

   THE Bidder insures that no Owner and or employee of Owner, is, or has become interested, directly or indirectly, as a contracting party, partner, stockholder, surety or otherwise howsoever in or on the performance of the said contract, or in the supplies, work or business in connection with the said contract, or in any portion of the profits thereof, or of any supplies to be used therein, or in any monies to be derived there-from.

3. THAT the several matters stated in the said proposal are in all respects true.

4. THAT I/WE have carefully examined the requirement(s), as well as all the Instructions to Bidders, Project Overview, ODS Technology – Technical Requirements, proposal Forms, and Appendices relating thereto, prepared, submitted and rendered available by the Owner and hereby acknowledge the same to be part and parcel of any contract to be let for the work therein described or defined.

5. THAT I/WE do hereby propose and offer to enter into a contract to deliver all work as described or implied therein including in every case freight, duty, exchange, G.S.T. and P.S.T. in effect on the date of the acceptance of proposal, and all other charges on the provisions therein set forth and to accept in full payment therefore, the sums calculated in accordance with the actual measured quantities and unit prices set forth in the proposal herein.

6. THAT Addendum/Addenda No. ___ to ___ inclusive relate to the said contract and Bidder hereby accepts and agrees to the same as forming part and parcel of the said contract.

7. THAT additions or alterations to or deductions from the said contract, if any, shall be made in accordance with the prices stated in the Schedule of Items of Unit Prices in strict conformity with the requirements of the Contract.

8. THAT this offer is irrevocable and open to acceptance until the formal contract is executed by the awarded Bidder for the said requirement(s) or Sixty (60) working days, and unit prices for as long as stated elsewhere in the document, whichever event first occurs and that the Owner may at any time within that period without notice, accept this proposal whether any other proposal has been previously accepted or not.

9. THAT the awarding of the contract, by the Owner is based on this submission which shall be an acceptance of this proposal.

10. THAT I/WE also understand that the Owner reserves the right to accept or reject all or part of this proposal or any other and also reserves the right to accept other than the lowest proposal.

The undersigned affirms that he/she is duly authorized to execute this proposal.

BIDDER'S SIGNATURE AND SEAL:

NAME: _____ _____
(Please Print) (Signature)

POSITION: _____

WITNESS
NAME: _____ _____
(Please Print) (Signature)

POSITION: _____

(If Corporate Seal is not available, documentation should be witnessed)

DATED AT THE _____ THIS _____
(City/Town) (Day)

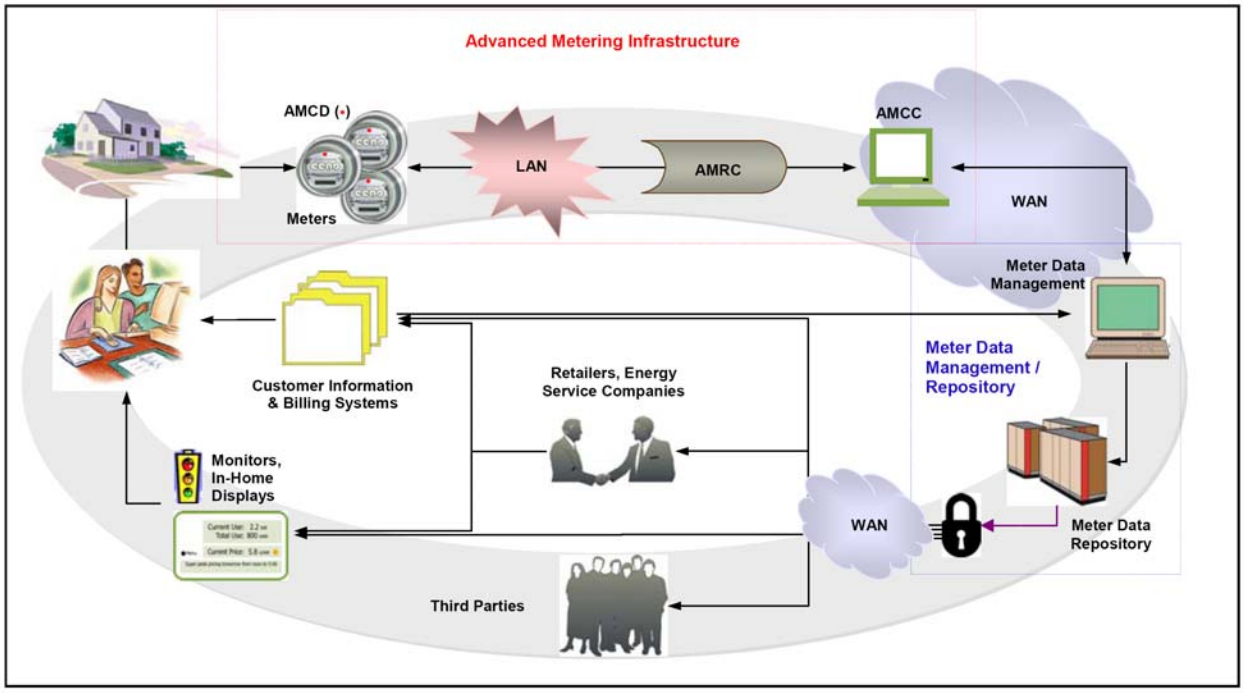
DAY OF _____ 2008.
(Month)

Section 3: Project Overview

3.1 Smart Metering Infrastructure – AMI Landscape

The Advanced Metering Infrastructure (AMI) which CHEC is installing is meant to satisfy the requirements of the provincial Smart Meter Initiative (SMI), which is hoped to contribute to the creation of a conservation culture in Ontario. The metering and associated infrastructure (i.e. AMCDs, AMRCs, and AMCC) will be owned and operated by CHEC, and the centralized Meter Data Management/Repository (MDM/R) will be owned and operated by the Independent Electricity System Operator (IESO). There are performance requirements detailing success rates for data collection from the AMI infrastructure, and time requirements within which the data must be provided to the centralized MDM/R. Following is a diagram depicting the data flow for the Ontario Smart Meter landscape.

Figure 2: Ontario Smart Metering System Data Flow



Performance requirements for the AMI have been specified within the Ministry of Energy document entitled *Functional Specification for an Advanced Metering Infrastructure Version 2* (dated July 5, 2007), which has been provided for reference as Appendix "A". As discussed within this document the AMI system includes the Advanced Metering Communication Devices (AMCD), the Local Area Network (LAN), Advanced Metering Regional Collector (AMRC), the AMI Wide Area Network (AMI WAN) and an Advanced Metering Control Computer (AMCC). The system will provide the infrastructure within which date and time stamped hourly meter reads are remotely collected and transmitted daily to CHEC's AMCC, and which will eventually be sent to the centralized Meter Data Repository (MDM/R) through the MDM/R Wide Area Network (MDM/R WAN).

The MDM/R functions include collecting and storing data, processing it for TOU and CPP billing, and making it accessible to consumers and to LDC's in accordance with their billing cycles. The data will also be made available to retailers, energy service companies and other interested parties in a manner that protects the privacy of consumers.

As discussed in Section 1.3 *CHEC's Approach to Smart Metering*, CHEC members are currently engaged in a project to install Smart Metering in all residential and commercial locations by December 2010. Presently CHEC has a total of over 110,000 residential and commercial customers, with smart meter installation commencing 2009.

Planning for the Commercial and Industrial component of the smart meter initiative is currently being developed and is not part of the current deployment. However, Bidders are welcome to provide comments on their ODS offering for Commercial/Industrial data, and budgetary pricing may be provided separately should the Bidder decide to do so. Desirable Commercial and Industrial analytical tools have been described in Section 5.4 *Commercial and Industrial Data,* and the Bidder's information regarding these functionality components can be provided as per the Section format instructions included in Section 2.4 *Proposal Format Instructions*, however Bidders are to understand that the immediate requirements of CHEC are for a residential ODS solution to audit the performance of the AMI. The intent of the ODS is NOT to replicate any functions currently in place within the centralized MDM/R. CHEC looks to the ODS to facilitate the implementation of operational efficiencies (currently the centralized MDM/R does not accept operational metering data).

3.2 CHEC's Operational Data Storage Requirements

Section 3.1 *Smart Metering Infrastructure – AMI Landscape* outlines the requirements placed on CHEC in order to meet the provincial mandate.

The Operational Data Storage requirements being procured through this RFP document are considered (at this time) to be exclusive of the requirements being placed upon the IESO centralized MDM/R. The solution that is of interest to CHEC through this process will be utilized to audit the performance of the AMI infrastructure currently being installed, and to store operational data that may be of future use to CHEC. It is CHEC's understanding that these functionality components are standard to ODS solutions, and may not form part of the MDM/R functionality. CHEC would like to clearly express that their intention is NOT to duplicate infrastructure being implemented by provincial entities, but rather to ensure that the AMI infrastructure being deployed by CHEC will satisfy the needs of the Ontario Energy Board (i.e. the Regulator).

3.3 CHEC's Smart Metering Initiative: Current Environment

3.3.1 Description of Environment

For reference, we have also included the following information pertaining the CHEC's back office systems.

UTILITY	CIS:	Meters	Projected AMI Install:
Centre Wellington Hydro Ltd.	Harris Northstar	4,500	August 10, 2009
COLLUS Power Corp.	Harris Northstar	11,500	June 22, 2009
Innisfil Hydro	Harris	12,000	March 16, 2009
Lakefront Utilities Inc.	Harris	7,000	February 2, 2009
Lakeland Power Distribution Ltd.	Harris Northstar	7,000	April 6, 2009
Midland Power Utility Corporation	Harris v5.2.19	5,000	June 15, 2009
Orangeville / Grand Valley	Advanced	8,000	September 21, 2009
Orillia Power Distribution Corporation	Harris v5.2.19	9,000	March 2, 2009
Parry Sound Power Corporation	Harris v5.2.19	2,500	March 2, 2009
Rideau St. Lawrence Distribution Ltd.	Harris	4,500	April 27, 2009
Wasaga Distribution Inc.	Advanced	9,500	October 5, 2009
Wellington North Power Inc.	Harris Northstar	2,500	June 29, 2009
Westario Power Inc.	SAP	14,500	February 2, 2009

3.3.2 AMI Service Level Agreement

The AMI network has been deployed in such a manner as to accommodate the following performance levels:

i. Percent of hourly (interval) readings captured: 98% in 24 hours
ii. Percent of daily (register) readings captured: 98% in 24 hours
iii. In addition to the above requirements, 99% of all readings (99% of register, and 99% of interval) are required in 72 hours (rolling statistic), and 99.5% of all readings (99.5% of register, and 99.5% of interval) are required in 30 days (calendar statistic). These requirements will demonstrate the Bidder's ability to acquire the readings that were missed in 24 hours, over the subsequent time periods (i.e. continued commitment to acquire as many readings as possible).
iv. Percent of meters communicated within 24 hours: 99.9% (while it is conceded that some meters may be difficult to communicate with, and therefore acquire 100% of the readings 100% of the time, the aim of this statistic is to show that 99.9% of meters can be reached on a daily basis).

This information has been provided as one of the critical functions of the ODS will be to audit the performance of the AMI to ensure that these Service Levels are being satisfied.

3.4 Scope of Work

CHEC, through this RFP, is seeking a cooperative and mutually beneficial relationship with a ODS provider which will allow CHEC to successfully fulfill their regulatory requirements for data collection. That is, it is anticipated that the ODS services being procured will enable CHEC to ensure the performance requirements as documented in Section 3.3.2 *AMI Service Level Agreement* are being satisfied. Knowledge of AMI performance statistics will provide CHEC with the knowledge that sufficient AMI infrastructure has been deployed (or not), such that the performance expectations can be met.

Additionally, AMI systems provide data which can enable CHEC to implement operational enhancements for their customer base. Given that the AMI deployment is in its infancy, CHEC is not in a position to make use of all of the data that is acquired through the system at this time. However, it is CHEC's goal to establish the ODS system such that this information can be stored now, and utilized at a later time.

It is CHEC's intention to implement commercial and industrial applications as appropriate in the future. Planning for this application is ongoing, and no timelines for implementation are available at this time. Therefore, this request for proposal for ODS solutions will address CHEC's requirements for smart metering in residential applications only. However, Bidders should be aware that commercial and industrial applications will be installed in the future, and if the Bidder also provides a solution for commercial and industrial applications, the response may also address this solution distinctly segregated from the solution provided for residential application, if possible. If the proposed solution is applicable for commercial and industrial customers with no modifications, the Bidder shall identify such.

As stated within Section 1.3 *CHEC's Approach to Smart Metering*, it is the intent to procure the ODS solution in an ASP model to mitigate the risk associated with purchasing a license for software which may become redundant due to the ongoing development of the centralized MDM/R. CHEC supports the work of the IESO, and the use of the centralized system, and look to use the ODS to facilitate the introduction of Operational Efficiencies during the period in which these functions are unavailable through the centralized system.

CHEC considers the following list of services as required to successfully satisfy the intent of this RFP:

- Project management, system design, commissioning and training
- System security (i.e. detailed security parameters to protect all information collected)
- Service levels and value added services
- Applicable costs, pricing and rates
- Provide the technical expertise required to establish communications between the AMCC and CHEC's back office systems
- Establish an understanding of the demarcation point
- Describe the technology roadmap for the proposed system/technology

Section 4: Bidder Company Information

4.1 Financial / Business Stability

1) What is the current size (number of employees), turnover rates for last three (3) years, and location(s) of the Bidder's company?
2) Number of employees assigned to application development and support.
3) What is the current financial condition of the Bidder's company? Provide supporting documentation and annual reports for the last three years. If the company is privately held, supply sufficient information to document the company's financial status.

4.2 Experience providing same or similar products & services

1) How many years has the Bidder been in business?
2) How long has the Bidder been providing ODS solutions?
3) How long has the proposed solution been deployed and implemented in the field excluding any period of time for which it was in a Beta Test status?
4) Describe the Bidder's primary line of business and the percentage of its business derived from the sale of ODS solutions and associated services.
5) Bidders should identify and describe services they could offer CHEC as part of the Contract that would support environmentally responsible business practices.
6) Bidders are to provide data to support their safety record such as corporate safety statistics, internal safety record, WSIB rating, injury rate or injury severity. In addition, Bidders must provide documentation supporting their commitment to safety within their facilities and design of products.

4.3 Contract Manager

The Bidder is asked to acknowledge the requirement to designate a Contract Manager, who shall have the authority to handle and resolve any technical issues, disputes or contractual issues in a timely manner. The Bidder should describe the Contract Manager's experience with managing projects of a similar size and scope, including timelines, and results if applicable. Response should include the Contract Manager's and any other related team member's Curriculum Vitae (CV).

4.4 Perspectives expressed by references

To ensure long-term viability and maintenance of the system, the selected Bidder must be a proven vendor in the area of application software and therefore the following information is requested:

1) Provide a list of at least three (3) references (contact names and phone numbers) for companies using the Bidder's proposed system to perform the same or similar application(s) as the one(s) described in this RFP for the past three (3) years.

Section 5: ODS Solution Technical Requirements

5.1 General Data Management Requirements (I)

CHEC is seeking an AMI specific ODS that is designed to store meter data and provide isolation of business processes and business systems from the details of metering and meter data collection, in a multi-vendor, multi-technology environment.

Any ODS proposed by the Bidder shall allow for the application of consistent processes and the maintenance of consistent interfaces independent of how, when, or where various meter reading technologies are deployed. This is intended to simplify and significantly reduce the likelihood of errors in business processes that utilize meter data. It should also allow for the most cost-effective AMI meter reading technologies to be deployed, without affecting downstream processes.

Bidder is to propose a fully capable ODS system able to manage the ongoing collection of all cumulative and interval meters for electricity, and potentially water and gas, as required by CHEC's current structure and operational responsibilities.

The ODS shall utilize a relational and fully versioned database that provides for long-term data storage of register, interval, tamper, outage, and meter event data. The system will provide for business process integration, and be accessible by all business and analytical systems, and readable by users of meter data throughout the utility. The ODS should have the ability to collect energy data streams from physical metered channels, endpoints, or modules, or calculate it as needed. The data should be linked together in flexible relationships that are managed over time.

The ODS data model should provide isolation of users from the day-to-day details of meter reading data collection processing. However, the ODS shall still provide access to those details for the systems and users that require it.

5.2 System Integration (I)

Systems of interest with regards to system integration include CIS systems, Outage Management Systems (OMS), and AMI and other meter reading data collection systems. Bidders are asked to provide a listing of these systems which can currently integrate with the proposed solution. While these systems are of immediate interest, it is expected that CHEC members will investigate the integration of GIS, WFM systems, WEB presentment OMS and other utility data systems in the future. Bidders are invited to provide any information they deem relevant to these interests.

5.2.1 Interaction with AMI (CI)

The ODS solution shall provide the following functionality with regards to the handling of data as provided by the AMI infrastructure:

i. AMI data insertion into the ODS will be dynamic.
ii. The system will store data in the original time increments as provided by the AMI system (ie. RAW AMI data including missing intervals and bad data).
iii. The system will store validated register and interval data in any time increment (ie. Intervals of 1 minute, 2 minute, 5 minute, 15 minute, etc.).
iv. Data storage will be energy independent and the ODS will be capable of storing and processing readings from all registers of all AMI endpoints (endpoints can include electric, water, and gas meters, with all available data from each meter).

v. Hourly reads in the system must retain the precision of the meter, to a minimum precision of 10 Watt hours (.01 kWh) for each residential electric data register (interval or otherwise). Bidder is requested to also provide detail regarding the precision of data storage for Commercial/Industrial metering (i.e. It is expected that the ODS would retain the precision of the meter regardless of the number of decimal points.)
vi. The system will accommodate "Request and Response" brokering to/from multiple AMI systems.

Bidders are required, as per Section 2.8 *Grounds for Disqualification* to provide written acknowledgement of the requirement for the proposed solution to be currently capable of these functions for the Sensus AMI system.

5.2.2 Other Meter Reading Data Collection Systems (I)

In addition to the acquisition of Data from the AMI, the ODS shall handle meter data from multiple sources, such as handheld, mobile, fixed network, etc. The ODS will allow the integration of multiple advanced meter reading technologies from multiple suppliers. CHEC will require the ability to seamlessly deploy multiple technologies in conjunction with traditional meter reading methods, and the ability to merge modern and traditional meter reading methods and technologies without impacting or modifying downstream billing processes. This ability is considered of value given that CHEC continues to manually collect meter read data while they deploy their AMI network.

The ODS solution shall have the functionality to emulate and manage schedules, cycles, and routes of manual meter reading operations to allow transition of legacy meter reading tasks, including the functionality to:

i. Process cycle/route-based meter reading systems, such as handheld (i.e. Itron MV-RS) or automated meter reading technology (i.e. Itron ERT enabled electromechanical meters),
ii. Process non-cycle/route-based meter reading systems, such as two-way remote reading technologies (i.e. MV-90 interval data collection from POTS enabled communication modules),
iii. Manage schedules such that the ODS will request all of the meter reading required for a given billing (readings may actually be obtained from multiple systems and/or technologies),
iv. Maintain information about which system is used to obtain readings for each meter so that a given request can be broken into individual requests for each meter reading system,
v. Functionality to create partial or full routes when returning readings to the billing system and combine multiple commodities, i.e. water and gas, into a single meter reading route for field collection and return data to the ODS system.
vi. The ODS should maintain performance statistics for each meter reading system and for the system as a whole.

Given that the ODS can perform the functions listed above, in an effort to retain consistency in the presentation of data, CHEC requires that: time references in data presented must be based on the local time zone and use Daylight Savings Time. Any data that is presented that is not validated should be clearly indicated as such. For further validation requirements, see Section 5.3 *Validation, Editing and Estimation (VEE)*.

5.2.3 Customer Information System (CI)

The system should accommodate "Request and Response" Brokering To/From Multiple Customer Information Systems (CIS). Some of the CIS systems commonly utilized in the Ontario market include:

- Advanced
- Cayenta

- Daffron
- Harris NorthStar
- Harris 5.2.19.x
- HTE
- Peoplesoft
- SAP
- SPL

Bidders are requested to specify the CIS systems for which an interface currently exists, and whether there is a cost to implementing the interface that will be required for CHEC member's CIS systems. In the event that the ODS cannot interface with the CIS systems being used by CHEC (reference Section 3.3.1 *Description of Environment*), the Bidder is asked to provide a high level overview of their system's ease of customization.

As part of the synchronization that is required between ODS and CIS, it is expected that the proposed solution will allow for new or changed customer, account, site ID, and service point information, and that this information will be imported from the external Customer Information System (CIS) en masse or upon completion of service orders.

CHEC anticipates using the ODS to test the IESO Billing Request file format that will be utilized by the centralized MDM/R. If Bidders have experience in this regard, documentation should be included in the response.

5.2.3.1 Wholesale Settlement Calculations (I)

CHEC is interested in whether the system is capable of performing Wholesale Settlement Calculations with billing output files for CIS. If this option is not currently available, please detail the development path.

5.2.3.2 Export Capabilities (I)

In addition to the interface required to directly integrate CIS data, CHEC is interested in the proposed solution's ability to export data in XML format, and the Itron MVRS handheld format. Bidders are requested to provide information explaining their current functionality in this regard, as well as any associated costs to accommodate these requirements if they are not currently available. If incremental costs are not stated, it is CHEC's assumption that costs for this functionality is included in the system pricing (i.e. functionality is considered standard).

5.2.4 Outage Management System (CI)

It is expected that the proposed solution will allow for receipt and display of outage related events from the AMI. CHEC is interested in having these capabilities performed by the ODS system, thereby allowing improved restoration and other outage related services. With the information available from AMI it is expected that the dispatching process for field service crews will be streamlined.

Bidders are requested to provide a listing of interfaces available to integrate the proposed ODS with CHEC's OMS (reference Section 3.3.1 *Description of Environment*). If an interface is not currently available, Bidders should specify the estimated costs associated with the creation of the required interface. In addition to a list of interfaces, Bidders are asked to provide some details regarding past implementations and a list of references with regards to the integration of OMS.

5.2.5 Work Force Management (WFM) (I)

CHEC expects that initially all data will be imported from CIS. However, as the deployment of AMI continues, CHEC will require that the system allow new or changed data to be imported from the workforce management system at the completion of meter-related service orders. The system will allow configuration data to be synchronized on a daily basis using batch files, and should allow real-time transactions to be performed with web-based APIs. The ODS system should also have the ability to interface to the WFM system and automatically create service orders in events where a field visit is required.

5.2.6 3rd Party Interfaces (I)

The ODS must provide a robust, industry standard means for extracting data so that the data can be presented to other 3rd party applications. In addition to CIS, OMS, WFM, other 3rd party applications might include GIS, WEB products, Theft Analysis tools, Load Forecasting/Profiling tools, etc. Bidders are requested to provide detailed information regarding their experience integrating to 3rd party applications.

The system should contain Application Program Interfaces (APIs) for third party applications. The system should not have a load limitation to API's (multi-threaded). If there is a load limitation to API's, please indicate what the limitation is.

The ODS solution should contain the flexibility and functionality to load, change, correct, and view configuration data through use of the following tools:

i. Service Oriented Architecture (SOA) Bus;
ii. XML configurable import APIs (batch or real time);
iii. XML configurable export APIs (batch or real time);
iv. comma delimited file (CSV) exports (batch)
v. configuration attributes reports.

5.3 Validation, Editing and Estimation (VEE) (CI)

All meter data received by the ODS will be subjected to VEE processes. At this time, CHEC requires an ODS solution to process residential AMI data, and the VEE rules for this class of customer have been published by the IESO (*Meter Data Management and Repository (MDM/R) VEE Standard for the Ontario Smart Metering System Issue 1.0*; Attached as Appendix "B").

Bidders are expected to follow this validation process, and as part of this RFP are expected to provide a statement of compliancy that this process will be the standard implemented.

NOTE: As stated in Section 1.2 *Provincial Context for Project* it is NOT CHEC's intention to duplicate infrastructure. CHEC fully supports the intended integration with the centralized MDM/R; VEE according to the IESO rules is required so that validated data is available for CHEC's operational data requirements (i.e. load studies, etc.).

5.3.1 Data Aggregation and Analysis (CI)

The ODS will contain utility analytical tools to enable the aggregation of interval data units into billing determinant format/buckets as required by the CHEC CIS. This will include TOU buckets as provided by the OEB Regulated Price Plan (RPP), Critical Peak Pricing (CPP), and aggregated monthly consumption files for Market Participants.

In addition to data aggregation the ODS calculation engine shall also support advanced calculation capabilities including (but not limited to) the netting of bi-directional meters (enabling net-billing of bi-directional meters), auditable change tracking, the calculation of the maximum demand for any requested customers; when data is requested the proposed ODS solution will calculate (rather than utilize stored values) and calculations will be fully versioned. In addition, the ODS will fully version all formula definitions for calculated channels and registers, and track changes over time as well as corrections. If formulas change over time, the ODS will use the appropriate formula in calculations for each time period.

5.3.2 Ancillary Meter Functions

The ODS application will include the facility to trigger on-demand reads and provide the capacity for revenue protection (theft prevention). To aid in analytical capabilities, we want to ensure that the ODS has the ability to perform comparison scenarios with meter data (i.e. analyze the metering load at a transformer by creating a virtual meter with the load at the homes to perform a comparison and determine losses that exceed a certain prescribed level). The Bidder is to describe how their solution will provide these services.

5.4 Commercial and Industrial Data (I)

As per Section 3.1 *Smart Metering Infrastructure – AMI Landscape* and Section 3.4 *Scope of Work*, CHEC requires a residential ODS solution, however it is a future expectation that Commercial and Industrial data will be aggregated and analyzed within the proposed system.

Bidders are requested to provide details regarding any functionality specific to Commercial and Industrial Metering that have not been explained through responses to other sections within Section 5: *ODS Solution Technical Requirements* of this document.

5.5 ODS System Reporting (I)

To accommodate the provincial requirements for data management CHEC requires that reads missing from the previous 24-hour reporting period ending at midnight must be logged and reported through the system by 6:00 am the following morning. CHEC requires that the ODS make the following reports available according to the same timeline:

- Error,
- Process,
- Event,
- Administration,
- Interactive Graphic and Load Data,
- Statistical,
- Register,
- Manually Edited data, and
- Custom reports utilizing report writers (Crystal, COGNOS, etc).

Bidders are asked to provide description and examples of the above listed reports, and identify whether the information is provided through manually dispatched reports, or automatically dispatched reports.

It is CHEC's preference that the ODS, where possible, accommodate reporting requirements through Exception Reporting. Certain DASHBOARD functions have been identified herein which CHEC has determined would be of particular value in assisting staff with the management of the ODS functions, with the ongoing operational maintenance of AMI, and with the schedule maintenance associated with billing functions.

5.5.1 DASHBOARD: AMI SLA (AMI Performance Levels) (CI)

The ODS, by way of data validation, should be capable of determining the performance levels of the AMI network. We have included the required AMI performance levels in Section 3.3.2 *AMI Service Level Agreement* for reference. As per Section 2.8 *Grounds for Disqualification*, Bidders are required to complete compliancy statements regarding their capacity to perform the necessary audit functions.

It is CHEC's preference that the results of said audits can be displayed graphically, within one screen, or a portion of an Operations screen, demonstrating (at a glance) that the AMI is performing to the required levels and that the ODS functionality allow for the ability to generate emails on exception to advise users when the SLA has not been met. In the event that the AMI is encountering problems, the user should be able to click on the interactive DASHBOARD function and be provided with additional information to explain the problems being encountered (i.e. list of meters not reporting, etc).

If the Bidder does not have a DASHBOARD function to provide this information this should be clearly stated. In this case the Bidder should provide information regarding the level of exception reporting that is inherent to the system, and which might be utilized to determine the level of performance of the installed AMI.

5.5.2 DASHBOARD: Operational Data/Indicators/Events (CI)

It is CHEC's preference that the events produced by the AMI system (outage notification, restoration notification, tamper information, hi/lo voltage indicators, etc) can be displayed graphically, within one screen, or a portion of an Operations screen. In the event that the AMI is encountering problems, the user should be able to click on the interactive DASHBOARD function and be provided with additional information to explain the problems being encountered (i.e. list of meters experiencing power outage, events received to indicate tamper, etc)

If the Bidder does not have a DASHBOARD function to provide this information this should be clearly stated. In this case the Bidder should provide information regarding the level of exception reporting that is inherent to the system, and which might be utilized to efficiently capture events being produced by the AMI.

5.5.3 DASHBOARD: Billing Schedule Maintenance (CI)

It is CHEC's preference that ODS will be able to graphically display, within one screen, or a portion of a billing screen, the current status of the billing schedule. Required information would include cycles billed, cycles pending billing, cycles which have completed validation within the ODS, and cycles being read, as well as the scheduled dates associated with these processes.

If the Bidder does not have a DASHBOARD function to provide this information this should be clearly stated. In this case the Bidder should provide information regarding the level of exception reporting that in inherent to the system, and which might be utilized to efficiently capture events being produced by the AMI.

5.5.4 Reporting: Multiple Systems (I)

It is expected that the operational and performance reporting requirements described through Section 5.5 *ODS System Reporting* will be possible across all meter reading technologies that have been integrated within the ODS, and the ODS will track which meters are to be read by each meter reading technology and the progress of these systems as they deliver data. The ODS will be able to report on the quantity, quality, and timeliness of collected data.

5.5.5 Reporting: Graphing (I)

It is expected that the ODS will provide the ability to produce data graphs and reports for all metered and calculated channels. The system will be flexible, including such functionality as the ability to perform calculations at the time of producing graphs and reports (i.e. the graph or report will calculate and display the result). All graphs and reports shall be viewed within the ODS application user interface, as well as contain the functionality to enable data export to spreadsheets, or be transportable to other electronic file format, and saved as images for use in external reports, etc. Reports will be required to be run in either online or batch mode.

5.5.6 Reporting: Custom Queries (C)

The ODS will be capable of executing custom queries to accommodate any areas where standard reports are not available. The successful Bidder will be required to provide full database documentation (i.e. Data Model Diagrams, Table Relationships, Field Definitions).

As part of their submission, the Bidder should provide a description of how the service is managed in terms of assisting the End-User to understand the data base structures and relationships, the creation/promotion of optimal data queries, and the prevention of machine degradation due to the use of unoptimized queries.

5.5.7 ODS Access

CHEC requires that the system be configured in a "Thin Client" so that utility users can access and view data, and as a means to download data in spreadsheet format for ad hoc analysis. Bidder should provide detailed information pertaining to the flexibility and functionality of the proposed solution in this regard, and clearly define the software components residing on the server side and any software components residing on the client side.

5.6 Meter Event Manager (I)

The Bidder should describe their solution’s event management capabilities with regards to receiving, storing, filtering, normalizing, and transferring event data received from any/all meter reading systems. Event data can include power loss, power restore, tamper, tilt, low battery alarms, sags/swells, etc. Event messages from different meters and/or reading systems will be standardized by the ODS solution so that a downstream outage management system can receive the same message for “power off” or “power on” regardless of which meter reading data collection system returned said event. All events received will be stored in the ODS database.

The ODS shall also provide power outage event filtering, such that the downstream outage management system receives only relevant event types, such as power off and power on that are more current than some predefined time period. Event reporting for a given meter shall also be filtered temporarily by the ODS during meter installation and/or scheduled maintenance such that false outages are not transferred to outage management.

5.7 ODS System Disaster Recovery Planning (CI)

The ODS system must reside in Canada, have adequate system redundancy, and the ODS service provider will have recovery planning such that hardware failure at any level of the ODS system will not result in any system downtime lasting more than 2 hours, with no loss in data.

More severe disasters, resulting from more than simple hardware failure (eg. building fire or telecommunications interruption), will be recovered from within 24 hours, with no loss in data. The recovery plan may include having access to a backup ODS server located at a geographically separated site (at least 50 km) and means to publish data on the back-up server. The ODS system provider's disaster recovery plan will include a worst-case provision to ensure that no data is lost.

The Bidder's response should include details regarding the disaster recovery planning that will accommodate both levels of disaster recovery (i.e. 2 hour and 24 hour recovery).

5.8 ODS Performance Service Levels (CI)

AMI Vendors deploying systems in CHEC's service area are expected to perform to the following service levels:

- Percent of hourly (interval) readings captured: 98% in 24 hours
- Percent of daily (register) readings captured: 98% in 24 hours
- In addition to the above requirements, 99% of all readings (99% of register, and 99% of interval) are required in 72 hours (rolling statistic), and 99.5% of all readings (99.5% of register, and 99.5% of interval) are required in 30 days (calendar statistic). These requirements will demonstrate the Vendor's ability to acquire the readings that were missed in 24 hours, over the subsequent time periods (i.e. continued commitment to acquire as many readings as possible).
- Percent of meters communicated within 24 hours: 99.9% (while it is conceded that some meters may be difficult to communicate with, and therefore acquire 100% of the readings 100% of the time, the aim of this statistic is to show that 99.9% of meters can be reached on a daily basis).

It is CHEC's expectation that the ODS system will be able to definitively determine whether the AMI network is satisfying these requirements. The ODS system provider should provide sufficient details to explain how their solution will be able to corroborate the AMI's performance to these service level expectations.

In addition to substantiating the AMI service levels, it is expected that the ODS will provide:

- 99.7% uptime (i.e. 2 hours per month downtime)
- Validated data files within 12 hours (interval data)
- Meter events files within 24 hours
- Alarm notification files immediately (given that the AMI can provide this data, the ODS is expected to filter/scrub alarms against known service orders from CIS)

5.9 Scalability (CI)

The Bidder must describe its proposed ODS data model demonstrating the model's flexibility and scalability to deliver cumulative and interval metering over the next ten years. The system should be designed for a minimum of 250,000 customers, assuming 2 years of online interval data and 7 years off-line data storage. Please specify the methodology for data storage and retrieval.

5.9.1 Ongoing Resource Requirements

Bidders should indicate to CHEC the expected level of resources that is expected to be required for ongoing operation of the proposed ODS solution. CHEC expects that the ODS solution will be managing their entire electric meter population by end 2010. Assuming a meter population growth resulting for the implementation of gas and/or water AMI, the Bidder should explain how the required resources would be expected to change (or not), beyond 2010.

5.10 ODS System Security (CI)

It is essential that the ODS system have, as a minimum, end-to-end protection against cyber attack and unauthorized intrusions. The Bidder should describe how its ODS ensures against loss or tampering of data. Security requirements are needed to manage the level of access users have, and the Bidder's ODS solution should meet the following minimum standards:

i. The system will contain System Administration and Security Management functions
ii. The system shall support tiered user access levels, to ensure separation of access according to the user's roles and responsibilities.
iii. The system will allow access (with appropriate permissions) to Raw AMI data, VEE formatted data, and Manually Edited data.
iv. Read-only access shall be provided for accessing data by customer, by Site-ID account, or by meter for users for whom those are the reference points, including the ability to reference and search by historical IDs or names and effective dates after changes have been made.
v. All corrections of errors with these entities should also be maintained within the ODS. Functionality should exist to allow comparisons between versions, and also allow previous versions to be restored. For all changes and correction made, information about who (or what system) made the change, when the change was made, and why the change was made shall be maintained and made available through the use of audit logs.
vi. The ODS should be able to integrate to an LDAP directory service for user authentication. This provides the user credentials required for controlling access to the LDC system resources (eg. networks and servers for both external and internal users).

Section 6: Price Submission Requirements

Please note that all documentation must reflect current capabilities. Any future capabilities must be stated as such, and a development schedule outlined.

Describe in detail the pricing for the systems proposed. Detail any assumptions made in the proposed solution and pricing. All of this information should be included within the Pricing and Functionality Spreadsheet. **As per Section 2.4 *Proposal Format Instructions*, any hard copies of the pricing submission should be submitted in a separate envelope, marked "PRICE OFFER".**

In addition to the minimum functionality required by the Ministry of Energy, CHEC is interested in the ability to support load control devices, and multi-utility meters, as this capability is in line with both the intent of the Ministry of Energy, and the service goals of CHEC members. Therefore, in addition to the current data collection requirements outlined in Section 3.3.2 *AMI Service Level Agreement*, CHEC expects to increase non-scheduled data communications to the network. These anticipated communications would in all likelihood include only specific areas, and affect low volumes of meters during any one communication.

6.1 Pricing and Compliancy Submission

The Pricing Spreadsheet allows for the Bidder to provide two options for the proposed ODS Infrastructure:

1) Within the tab labelled "Pricing_Option1_ASP" Bidders are required to submit pricing (Capital and 15 year Operating costs) for the proposed ODS Solution, as per the requirements of this RFP document (i.e. ASP model, with capability to accept Sensus AMI network data, perform AMI audit, etc.).
2) Within the tab labelled "Pricing_Option2" Bidders have the option to provide pricing alternative to that provided through Option 1. **NOTE: Pricing Option 1 is required, Pricing Option 2 is optional.** Currently the tab is structured for a license bid price submission, however the Option 2 tab has been provided in the event that Bidders feel that Pricing outside of an ASP model can better represent their model, and will allow Bidders to be creative in demonstrating the value of their solution (i.e. Bidders are free to modify the tab to demonstrate such options as higher upfront capital to allow decreased O&M costs, etc.).

6.2 Incremental Costs

In addition to the Pricing Options described in Section 6.1 *Pricing and Compliancy Submission*, Bidder's are required to submit the incremental cost for any functionality that is discussed in their proposal which does not come standard with their product. If an incremental cost is not provided, it is CHEC's understanding that the functionality comes standard with the product being proposed.

Section 7: Contract Terms and Conditions

7.1 Commencement of Contract Time

The successful Vendor shall be notified by CHEC of acceptance of the Vendor's Submission by CHEC sending a Purchase Order. The Vendor shall acknowledge receipt within ten days of the date of sending of the Purchase Order.

The Contract Time shall commence to run on the effective date indicated in the Purchase Order. Vendor shall start to perform the work on the date when the Contract Time commences.

7.2 Vendor Claims

All claims of the Vendor and all questions relating to the interpretation of the Contract, including all questions as to the acceptable fulfillment of the Contract on the part of the Vendor and all questions as to compensation, shall be submitted in writing to the CHEC Project Manager for determination.

All such determinations and other instructions of CHEC will be final unless the Bidder shall file with CHEC a written protest, stating clearly, and in detail the basis thereof, within fifteen (15) calendar days after CHEC notifies the Bidder of any such determination or instruction. CHEC will issue a decision upon each such protest within fifteen (15) calendar days and its decision will be final. Work will not be undertaken until a written final decision is rendered.

7.3 Changes in the Work

CHEC, without invalidating the Contract, may direct the Vendor to perform extra work or make changes in the work, provided that all changes or additions form an inseparable part of the work contracted for. Vendor shall make such changes or additions only after receipt of written instructions to do so from CHEC. If such changes or additions cause an increase or decrease in the cost of the Contract, or in the time required to complete the Contract, the adjustment to the contract price or time frames shall be as set out in the Change Order and the Contract shall be modified accordingly.

When a change is ordered, a change order shall be executed by CHEC and the Vendor before any change order work is performed. Any increase or decrease in the contract price and the time required for the completion of the contract work due to a change order shall be specifically set out in the change order. All terms and conditions contained in the Contract documents shall be applicable to change order work. The amount of any increase or decrease shall be added to or subtracted from the contract price as appropriate.

7.4 Delays & Extension of Time

If the Vendor is delayed at any time in the progress of the work by any act or neglect of CHEC, or any cause beyond the Vendor's reasonable control, he shall file with CHEC a notification that an extension of the Contract period is required.

The CHEC Project Manager shall review said notice and to the extent that the Vendor can reasonably demonstrate to CHEC Project Manager that it shall be delayed in its fulfillment of these terms and conditions and other obligations of this transaction due to a cause beyond its control, a reasonable extension period shall be granted.

7.5 Termination of Right to Proceed

CHEC may, in writing, terminate this Contract in whole or in part at any time, either for CHEC's convenience or for the default of the Vendor. Upon such termination, all data, plans, specifications, reports, estimates, summaries, completed work and work in process, and such other information and materials as may have been accumulated by the Vendor in performing this Contract shall, in the manner and to the extent determined by CHEC, become the property of CHEC. If the termination is for the convenience of CHEC and without default by the Vendor, an equitable adjustment for the Vendor's direct costs and profit for work actually performed shall be made by mutual agreement between the Vendor and CHEC. No amount shall be allowed for anticipated profit on unperformed services. Any expense incurred because of cost of completion by CHEC is chargeable to and shall be paid by the Vendor. The total liability to the Vendor shall be limited to the Contract value less the value of any equipment, material or completed services retained by CHEC member utilities.

Default occurs if the Vendor (1) abandons the work called for hereunder, (2) files a voluntary petition in bankruptcy or fails to obtain dismissal of an involuntary petition in bankruptcy within sixty (60) days after the filing thereof or has a Receiver/Trustee appointed, (3) becomes insolvent, (4) assigns this Contract or sublets any part of the work hereunder without prior written permission of CHEC, (5) repudiates the Contract, (6) allows liens to be filed against property of CHEC, (7) fails to meet or perform its obligations hereunder after five days notice or continues in chronic default of its obligations, (8) disregards laws, ordinances, rules and regulations related to the Contract and the work or disregards instructions of CHEC, (9) fails to complete the work in accordance with the Contract.

7.6 Right to Operate Unsatisfactory Equipment

If the operation or use of the materials or equipment after delivery and/or installation does not comply with the technical requirements set out in the Contract Documents to CHEC, CHEC shall have the right to operate and use such materials or equipment until such deficiency can be reasonably corrected provided that the period of such operation or use pending correction shall not impede or delay the ability of the Vendor to perform corrections. Such operation and use shall not constitute an acceptance of any part of the work, nor shall it relieve Vendor of any requirements of the Contract, nor shall it act as a waiver by CHEC of any requirement of the Contract.

7.7 Casualty Insurance

Before commencing work under this contract the Vendor at his own expense shall submit Certificates of Insurance, providing evidence acceptable to CHEC indicating that the Vendor has obtained and will maintain insurance for the duration of the contract. The following requirements apply to all Certificates of Insurance:

1) The insurance shall be written by an insurer acceptable to CHEC,
2) The insurance shall be primary to any coverage carried by CHEC.
3) The Vendor further agrees to provide CHEC with an executed Certificate of Insurance before commencement of work, and with written copies of the insurance policies at any time upon the written request of CHEC.
4) The Certificate of Insurance shall be an original copy signed by an authorized representative of the insurance carrier(s). (Note – faxed copies may be accepted initially to be followed up by originals in a reasonable length of time.)
5) The Certificate of Insurance shall provide that no less than 30 days advance notice will be given in writing to CHEC prior to cancellation, termination or alteration of the insurance coverage. CHEC shall be named as an additional insured on each General Liability Insurance Policy and any Excess Liability Policy or Umbrella Policy used to meet the required general liability limits.

The types of coverage and minimum limits are as follows:

1) GENERAL LIABILITY*
    a) $4,000,000 each occurrence
    b) $6,000,000 general aggregate
2) . AUTOMOBILE LIABILITY*
    a) Bodily injury $1,000,000 per person
    b) $1,000,000 per accident
    c) Property damage $500,000 or
    d) Combined Single Limit $1,000,000

** A blanket, umbrella, and/or excess liability policy(s) may be utilized to increase limits to the desired level(s).*

7.8 Subcontractors

CHEC reserves the right to refuse to permit any person or organization (subcontractor) to participate in the work covered by this Contract, such refusal shall not be unreasonably imposed. No subcontract shall relieve the Vendor of any liabilities or obligations under the Contract, and the Vendor agrees that Vendor is fully responsible to CHEC for the acts and omissions of Vendor's subcontractors and of persons employed by them. Vendor shall require every subcontractor to comply with the provisions of the Contract.

7.9 Payment

Payment shall be made based upon completion of the performance milestones itemized below.
Vendor shall submit to CHEC a request for payment for each milestone that has been met. Payment for each milestone shall also be contingent on successful completion of the preceding milestones.

1) Fifteen percent (15%) of the contract price will be paid after the successful Acceptance Test, which requires delivery and integration of the system head-end.
2) Twenty five percent (25%) of the contract price will be paid after delivery of 35% of the communication infrastructure and 35% of the new meters and other customer premises equipment.
3) Twenty percent (20%) of the contract price will be paid upon successful installation, operation and route Acceptance of the equipment described in (2) above and delivery of an additional 30% all equipment on CHEC's system.
4) Twenty percent (20%) of the contract price will be paid upon successful installation, operation and route Acceptance of the equipment described in (3) above and delivery of all remaining system elements.
5) Twenty percent (20%) upon completion of system installation, Acceptance of all routes, and delivery of all documentation, judged by CHEC to be acceptable, in any event not longer than 90 days after complete installation.

CHEC will make payment within thirty (30) days of receipt of a request for payment, if above conditions are met.

When the Vendor has completed all work in accordance with the terms of the Contract Documents, the Vendor shall submit to CHEC a request for final payment. The request for final payment shall constitute a waiver of all claims by the Vendor except for claims specifically listed in the request.

Vendor's submission of its request for final payment shall constitute its warrant that the Vendor has to the best of its knowledge fully completed all work included in the Contract and has fully paid for labour, materials, equipment, services, taxes and all other costs and expenses resulting from this Contract.

7.10 Acceptance

These terms and conditions becoming binding when the Vendor's Submission chosen for acceptance by CHEC is given written notice of acceptance of the submission.

No modification hereof and no condition stated by Vendor in accepting or acknowledging this order, which is in conflict or inconsistent with, or in addition to the terms and conditions set forth herein, shall be binding upon CHEC unless accepted in writing by CHEC.

7.11 Shipments

Vendor shall mail Bill of Lading and Shipping Memo to destination, and CHEC's Project Manager.

Vendor shall notify the CHEC Project Manager promptly if unable to make shipment. Shipments shall be made to multiple destinations in CHEC's service territory for logistical convenience. Such shipment instructions will be stated in the purchase contract that will be developed between the selected Vendor and CHEC.

7.12 Prices

Vendor agrees that prices are firm unless otherwise noted, and Vendor warrants that said prices do not exceed the prices allowed by any applicable Federal, Provincial or Local regulation.

7.13 Compliance with Laws

Vendor warrants that in performing work under this order Vendor will comply with all applicable laws, rules and regulations of governmental authorities and agrees to indemnify and save CHEC harmless from and against any and all liabilities, claims, costs, losses, expenses, and judgments arising from or based on any actual or asserted violation by the Vendor of any such applicable laws, rules and regulations.

7.14 Patents

Vendor agrees to protect and save harmless CHEC from all costs, expenses or damages, arising out of any infringement of claim or infringement or Patents in CHEC's use of material or equipment furnished pursuant to this order.

7.15 Assignment

Vendor agrees that neither this order nor any interest herein shall be assigned or transferred by Vendor except with the prior written approval of CHEC.

7.16 Substitution

No substitution will be permitted under this order except on specific written authority of CHEC's Project Manager.

Appendix A

Ministry of Energy (MoE) Functionality Specification for an Advanced Metering Infrastructure Version 2 (Dated July 5, 2007)

FUNCTIONAL SPECIFICATION

FOR AN

ADVANCED METERING INFRASTRUCTURE

VERSION 2

July 5, 2007

FUNCTIONAL SPECIFICATION

FOR AN ADVANCED METERING INFRASTRUCTURE

Table of Contents

FUNCTIONAL SPECIFICATION

FOR AN ADVANCED METERING INFRASTRUCTURE

1.0 APPLICATION OF SPECIFICATION

This Specification sets the required minimum level of functionality for AMI in the Province of Ontario for residential and small general service consumers where the metering of demand is not required. This Specification is not intended to apply to net metering applications.

2.0 FUNCTIONAL SPECIFICATION

2.1 Deployment

This Specification shall be met regardless of the size or scope of the AMI deployment by a distributor.

2.2 Minimum Functionality

2.2.1 As a minimum:

2.2.1.1 AMI shall collect Meter Reads on an hourly basis from all AMCDs deployed by a distributor and transmit these same Meter Reads to the AMCC and MDM/R, as required, in accordance with these Specifications; and

2.2.1.2 A Meter Read shall be collected, dated and time stamped at the end of each hour (i.e. midnight as represented by 24:00).

2.2.2 The date and time stamping of Meter Reads shall be recorded as year, month, day, hour, minute (i.e. YYYY-MM-DD hh:mm).

2.2.3 All meters shall have a meter multiplier of one (1).

2.2.4 Distributors shall provide the MDM/R with the service multiplier for transformer-type meters.

2.3 Performance Requirements

2.3.1 Collection and Transmission of Meter Reads:

2.3.1.1 AMI shall successfully collect and transmit to the AMCC and MDM/R at least 98.0% of the Meter Reads from all AMCDs deployed by a distributor in any Daily Read Period.

2.3.1.2 Meter Reads unsuccessfully collected or transmitted shall not be due to the

same AMI component (including, without limitation, any AMCD) during any three (3) month consecutive time period.

2.3.1.3 AMI shall be able to collect and transmit Meter Reads during its operating life without requiring a field visit.

2.3.2 Transmission Accuracy: Over the Daily Read Period, 99.9% of the Meter Reads received by the AMCC shall contain the same information as that collected by all AMCDs deployed by the distributor.

2.3.3 AMI shall be capable of providing Meter Reads with a precision of at least 10 Watt-hours (0.01 kWh).

2.4 Technical Requirements

2.4.1 When an AMI includes AMRCs, the AMRCs shall have the ability to store meter data to accommodate the performance requirements in section 2.3.1.

2.4.2 Time Synchronization:

2.4.2.1 AMI shall be operated and synchronized to Official Time, as set by the National Research Council of Canada.

2.4.2.2 AMI shall have the capability of adjusting for changes due to local daylight savings time.

2.4.2.3 AMI installed within a distributor's service area shall have the capability of accommodating more than one (1) time zone.

2.4.2.4 Time synchronization shall be maintained in the AMI to the specified accuracy parameters set out in section 2.4.3.1 following a loss of power.

2.4.2.5 All Meter Reads shall adhere to accurate time synchronization processes to ensure an accurate accounting of electricity consumption at each meter.

2.4.3 Time Accuracy:

2.4.3.1 At all times, time accuracy in the AMI shall not exceed a ±1.5 minute variance from the time established in section 2.4.2.1.

2.4.3.2 AMI shall be able to prove that time accuracy does not exceed the permitted time variance identified in section 2.4.3.1.

2.4.4 Loss and Restoration of Power:

2.4.4.1 AMI shall detect and identify the interval in which a loss of power occurred during a Daily Read Period.

2.4.4.2 AMI shall detect and identify the interval in which power was restored following a loss of power.

2.4.5 Environmental Tolerances: All AMI components (except the AMCC) shall operate and meet the requirements in these Specifications within a temperature range of minus thirty degrees Celsius (–30° C) to positive sixty-five degrees Celsius (+65° C), and within a humidity range of zero percent (0%) to ninety-five percent (95%) non-condensing.

2.5 Advanced Metering Communication Device (AMCD)

2.5.1 Installation Within the Meter:

2.5.1.1 The AMCD shall not impair the ability of the meter to be visually read.

2.5.1.2 Meters in which an AMCD is installed shall be able to be installed in existing meter sockets or enclosures.

2.5.1.3 AMCD shall meet or exceed ANSI standards to withstand electrical surges and transients.

2.5.2 Labelling:

2.5.2.1 The AMCD shall be permanently labelled with:

(1) Legally required labelling;

(2) Manufacturer's name;

(3) Model number;

(4) AMCD identification number;

(5) Input/output connections;

(6) Date of manufacture; and

(7) Bar code for tracking and inventory management.

2.5.3 When installed at a consumer's location, the meter shall visibly display, as a minimum, the AMCD identification number, meter serial number and LDC badge number for the meter.

2.5.4 The AMCD shall be able to be initialized or programmed during, or prior to, field installation.

2.6 Transmission of Meter Reads

2.6.1 All Meter Reads collected during the Daily Read Period shall be received by the AMCC and transferred to the MDM/R no later than 5:00 a.m. local time following the Daily Read Period.

2.6.2 Meter Reads are not required to be transmitted in a single transmission and may be transmitted as frequently as necessary in order to meet the requirements in section 2.6.1.

2.6.3 AMCC shall transfer the information identified in section 2.6.1 using an approved protocol and file structure.

2.7 Advanced Metering Regional Collectors (AMRC)

2.7.1 LAN Communication Infrastructure:

2.7.1.1 The spectrum allocation and wattage of the radio signal used by an AMI shall not impede neighbouring frequencies.

2.7.2 When an AMI includes AMRCs:

2.7.2.1 The AMI shall provide for the continuous powering of AMRCs regardless of their location and placement.

2.7.2.2 All AMCDs shall be able to collect and transmit Meter Reads when one or more AMRC has a loss of power.

2.7.2.3 Memory and software parameters shall be maintained at all AMRC during a loss of power, whether by the provision of backup/alternate power or other solution.

2.8 Advanced Metering Control Computer (AMCC)

2.8.1 Each AMCC shall have the ability to store a rolling sixty (60) days of Meter Reads.

2.8.2 A distributor shall not aggregate Meter Reads into rate periods or calculate consumption data from the Meter Reads collected through its AMI either in its AMCC or any other component.

2.8.3 The AMCC shall be able to perform basic operational verification of Meter Reads received before transmitting these Meter Reads to the MDM/R.

2.9 Customer Account Information

2.9.1 Distributors shall provide initial information associated with customer accounts to the MDM/R on a date to be determined.

2.9.2 On an ongoing basis, distributors shall provide information associated with any change to the initial information identified in section 2.9.1 to the MDM/R at a frequency to be determined.

2.9.3 Information to be provided to the MDM//R pursuant to sections 2.9.1 and 2.9.2 is to be determined.

2.10 Monitoring & Reporting Capability

2.10.1 The AMI shall have non-critical reporting functionality and critical reporting functionality as required in this section 2.10. Information generated from this reporting functionality shall be available to the MDM/R.

2.10.2 Non-critical reporting:

2.10.2.1 At the completion of every Daily Read Period and following a transmission of Meter Reads, the AMCC shall generate a status report that includes information regarding anomalies and issues affecting the integrity of the AMI or any component of the AMI including information related to any foreseeable impact that such anomalies or issues might have on the AMI's ability to collect and transmit Meter Reads.

2.10.2.2 In addition to section 2.10.2.1, the AMCC shall generate reports:

(1) Confirming successful initialization of the AMCD's installed in the field;

(2) Confirming data linkages among an AMCD identification number, LDC badge number, serial number and customer account;

(3) Confirming that the MDM/R has successfully received notification of any changes to customer account information;

(4) Confirming that the AMCC has successfully made changes to customer account information following receipt of same from the MDM/R;

(5) Confirming the successful collection and transmission of Meter Reads or logging all unsuccessful attempts to collect and transmit Meter Reads, identifying the cause, and indicating the status of the unsuccessful attempt(s) pursuant to section 2.3.1;

(6) Confirming the accuracy of the Meter Reads received by the AMCC pursuant to section 2.3.2;

(7) Confirming that all Meter Reads have a precision of at least 10 Watt-hours (0.01 kWh) pursuant to section 2.3.3;

(8) Confirming whether the Meter Reads acquired within the Daily Read Period are in compliance with the time accuracy levels identified in section 2.4.3;

(9) Confirming whether time synchronization within the AMI or any components of the AMI has been reset within the Daily Read Period;

(10) Identifying the intervals in which a loss of power occurred and at which power was restored, following a loss of power;

(11) Addressing the functionality of the AMCD communication link, including status indicators related to the AMCD and AMRC;

(12) Identifying suspected instances of tampering, interference and theft;

(13) Flagging potential network, meter and AMCD issues; and

(14) Identifying any other instances that impact or could potentially impact the AMI's ability to collect and transmit Meter Reads to the AMCC and/or MDM/R on a daily basis.

2.10.2.3 Following a transmission of Meter Reads or at the completion of every Daily Read Period, the information in section 2.10.2.2 (5) shall be stored and used by the AMCC to assess compliance with the requirement specified in section 2.3.1.2.

2.10.2.4 The reports generated in sections 2.10.2.1 and 2.10.2.2 shall be made available to the MDM/R with a frequency to be determined.

2.10.3 Critical reporting:

Critical events are defined to include any AMI operational issue that could adversely impact the collection and transmission of Meter Reads during any Daily Read Period.

2.10.3.1 The AMI shall identify and report the following to the distributor:

(1) AMCD failures;

(2) AMRC failures;

(3) Issues related to the storage capacity of any component of the AMI;

(4) Communication links failures;

(5) Network failures; and

(6) Loss of power and restoration of power.

2.10.3.2 The reports generated in section 2.10.3.1 shall be made available to the MDM/R.

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.

2.12 Proven Technology

2.12.1 The AMI shall be a technology that has been proven to reliably comply with these Specifications.

2.13 Regulatory Requirements

2.13.1 The AMI shall meet all applicable federal, provincial and municipal laws, codes, rules, directions, guidelines, regulations and statutes (including any requirements of any applicable regulatory authority, agency, board, or department including Industry Canada, the Canadian Standards Association, the Ontario Energy Board and the Electrical Safety

Authority) (collectively, "**Laws**"). For greater certainty, the AMI shall meet all applicable Laws that are necessary for the measurement of data and/or the transmission of data to and from the consumers within the Province of Ontario, including Laws applicable to metering, safety and telecommunications.

2.14 Water or Natural Gas Meter Reads

2.14.1 The AMI should be capable of supporting an increased number of Meter Reads associated with the reading and transmission of water and/or natural gas meters through additional ports on the AMCD, through optionally available multi-port AMCDs, or through additional AMCD/AMRC devices that are compatible with operating on the AMI. When procuring AMI, distributors shall obtain an indication of the capabilities of the proposed AMI to read water and natural gas meters, indicating the makes and models of such meters that can be read, and any requirements for retrofitting them.

3.0 DEFINITIONS

Within this Specification the following words and phrases have the following meanings:

"AMCC" is an advanced metering control computer that is used to retrieve or receive and temporarily store Meter Reads before or as they are being transmitted to the MDM/R. The information stored in the AMCC is available to log maintenance and transmission faults and issue reports on the overall health of the AMI to the distributor.

"AMCD" is an advanced metering communication device that is housed either under the meter's glass or outside the meter. It transmits Meter Reads from the meter directly or indirectly to the AMCC.

"AMI" means an advanced metering infrastructure. It includes the meter, AMCD, LAN, AMRC, AMCC, WAN and related hardware, software and connectivity required for a fully functioning system that complies with this Specification. With some technologies, an AMI does not include AMRCs. An AMI does not include the MDM/R.

"AMRC" is an advanced metering regional collector that collects Meter Reads over the LAN from the AMCD and transmits these Meter Reads to the AMCC.

"consumer" or "customer" means a person who uses, for the person's own consumption, electricity that the person did not generate.

"distributor" has the meaning provided in the *Ontario Energy Board Act, 1998*.

"Daily Read Period" means the 24-hour period for collecting Meter Reads, subject to the two periods annually during which changes to and from daylight savings time take place. The Daily Read Period ends at 12:00 midnight of each day.

"LAN" means a local area network, the communication network that transmits Meter Reads from the AMCD to the AMRC.

“meter multiplier” is the factor by which the register reading must be multiplied to obtain the registration in the stated units.

“Meter Read” is a number generated by a meter that reflects cumulative electricity consumption at a specific point in time.

“MDM/R” means the meter data management and meter data repository functions within which Meter Reads are processed to produce rate-ready data and are stored for future use.

“Specification” means these functional specifications.

“transformer-type meter” means a meter designed to be used with instrument transformers.

“WAN” means a wide area network, the communication network that transmits Meter Reads from the AMRC to the AMCC or, in some systems from the AMCD directly to the AMCC, and from the AMCC to the MDM/R.

Appendix B

Meter Data Management and Repository (MDM/R) VEE Standard for the Ontario Smart Metering System Issue 1.0

STANDARD

Meter Data Management and Repository (MDM/R)

VEE Standard for the Ontario Smart Metering System

Issue 1.0

This document provides the Standards for Validation, Estimation, and Editing of Meter Read Data performed by the MDM/R for the Ontario Smart Metering System

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Status of this Standard

This document was placed under formal change control on March 20, 2008 with the posting of Issue 1.0. However, as of this date, portions of Sections 3, 4, 5, 6 and 7 pertaining to Commercial & Industrial metering are still under review and may be subject to revision. These sections have been highlighted in "yellow".

Document ID	IESO_STD_0078
Document Name	Meter Data Management and Repository (MDM/R) - VEE Standard for the Ontario Smart Metering System
Issue	Issue 1.0
Reason for Issue	VEE Standard issued under formal change control.
Effective Date	March 20, 2008

Document Change History

Issue	Reason for Issue	Date
0.1	Draft VEE Standard for discussion with SMSIP Working Group	January 3, 2007
0.2	Updated and presented to the SMSIP Working Group Sub-committee	January 8, 2007
0.3	Updated and presented to the SMSIP Working Group Sub-committee	January 12, 2007
0.4	Updated with SMSIP Working Group Sub-committee	January 14, 2007
0.5	Updated with Input from Sub-committee members	January 25, 2007
0.6	Updated with Information from the MDM/R Detail Design Document Version 1.9	March 15, 2007
0.7	Updated to incorporate changes per the review of the VEE Sub-Committee	March 19, 2007
0.8	Update of Table 7-5 Default VEE Services Configuration	March 22, 2007
0.9	General revision to reflect additional detail provided in Version 2.0 of the Detailed Design	March 7, 2008
1.0	Document placed under formal change incorporating input of the SMSIP Working Group VEE Sub-Committee	March 20, 2008

Related Documents

Document ID	Document Title	Issue
Ontario Regulation 440/07	*Functional Specification for an Advanced Metering Infrastructure – Version 2*	July 5, 2007
Ontario Energy Board	*Distribution System Code*	Last Revised on June 27, 2007
MDM/R Detailed Design	*Meter Data Management and Repository MDM/R V1.0 Detailed Design Version 2.0*	March xx, 2008
IESO_SPEC_9027	*MDM/R V1.0 Technical Interface Specifications Version 2.3*	30 November 2007
SME_SPEC_0001	*MDM/R V1.0 Reports Technical Specifications Version 2.6*	14 February 2008
Ontario Energy Board Smart Meter Implementation Plan	*Draft Report of the Board For Comment*	November 9, 2004
SOR/86-131	*Electricity and Gas Inspection Regulations*	January 28, 2008

Table of Contents

List of Figures

List of Tables

Table of Changes

The following is a summary of changes to this document from Issue 0.8 dated March 22, 2007.

Reference (Section and Page)	Description of Change
Title Page	• Revised document title
Related Documents	• Updated reference to AMI Function Specification • Updated reference to Distribution System Code • Updated reference to MDM/R Detailed Design Document • Added references to MDM/R Technical Interface Specifications and MDM/R Reports Technical Specifications • Added reference to the Electricity and Gas Inspection Regulations
Section 1, pages 1-3	• Updated role of the OEB as described in the Introduction • Added assumptions regarding net metering and metering for all classification of generators • Updated description of Section 2
Section 2, pages 7-14	• Expanded description of AMI Quality and Completeness tests and Data Quality flags • Relocated and updated new Section 2.3.1 from Section 3 • Relocated and updated new Section 2.3.2 from Section 4 • Added new Section 2.3.3 providing descriptions of Data Collection and VEE Reports
Section 3, pages 15-22	• General re-organization of this section for clarity (changes not tracked) • Update throughout to describe ‘message’ validation services • Update of descriptions of all validation checks to provide greater specificity • Added initial draft of validation services for C&I metering
Section 4, pages 23-29	• General re-organization of this section for clarity (changes not tracked) • Update throughout to describe ‘message’ estimation routines • Update of descriptions of all estimation routines to provide greater specificity • Added initial draft of estimation services for C&I metering
Section 5, page 33	• Added initial draft of editing support for C&I metering
Section 6, pages 35-37	• Update of descriptions of Billing Validation Sum Check to provide greater specificity • Added initial draft of estimation services for C&I metering

Section 7, pages 39-52	• General re-organization of this section for clarity (changes not tracked) • Update throughout to describe 'message' validation and estimation routines • Update of descriptions of all validation and estimation parameters to provide greater specificity • Update of descriptions of Billing Validation Sum Check parameters to provide greater specificity • Additions to VEE Services tabulation to reflect additional parameters • Added placeholder for C&I metering VEE Services
Section 7.2, Table 7-5, pages 50-51	Updates to validation parameters for default VEE Services based on review and input by the SMSIP Working Group VEE Sub-Committee • Confirmed application of the Maximum Demand Check to VEE Services 02, 03, 04, 05, 06, and 07 by setting 'Maximum Demand Check' check service parameter to "Y" • Confirmed application of the Consecutive Zeros Check to VEE Services 02, 03, 04, 05, 06, and 07 by setting 'Consecutive Zeros Check' check service parameter to "Y" Updates to estimation parameters for default VEE Services based on review and input by the SMSIP Working Group VEE Sub-Committee • Disabled Linear Interpolation for VEE Services 03, 04, 05, 06, and 07 setting 'Max Interpolation Minutes' to zero • Confirmed use of Register Read Scaling for VEE Services 03, 04, 05, 06, and 07 setting 'Register Read Allocation' parameter to "Y" • Confirmed use of Newest Like Day for VEE Services 03, 04, 05, 06, and 07 setting 'Newest Like Day Method' parameter to "Newest Like Day" and 'Newest Like Day Limit' parameter to "1" day • Confirmed use of Class Load Profile estimation only for VEE Service 07 – Seasonal establishing the following parameter settings: o 'Use Class Load Profiles' = "Y" o 'Class Profile ADU Min Days' = 5 days o 'Class Profile ADU Oldest Day' = 30 days o 'Class Profile ADU Newest Day' = 1 day Established initial Billing Validation Sum Check parameter settings based on review and input by the SMSIP Working Group VEE Sub-Committee • For VEE Services 01 and 02 o 'BillingSumCheck' = "N" • For VEE Services 03, 04, 05, 06, and 07: o 'BillingSumCheck' = "Y" o 'BillingSumCheckFail Action' = "Value" o 'MaxRegisterRange' = "1" hour o 'NoRegRead Action' = "Fail" o 'ThresholdType' = "Ratio" o For 03, 04, 07 'ThresholdValue' = "0.010" (i.e. 1%) o For 05 and 06 'ThresholdValue' = "0.005" (i.e. ½ %)

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1. Introduction

This document has been prepared in consultation with the sub-committee members of the SMSIP Joint Working Groups as a draft Validation, Estimation and Editing (VEE) Standard for further consideration by the Joint Working Group.

The OEB does not envision approving the VEE rules developed by the IESO SMSIP Working Group. The Board does expect that, at a minimum, the rules would comply with 5.3.2 and 5.3.3 of the *Distribution System Code*.

1.1 Purpose

The purpose of this document is to establish a province wide validation, estimation standard and editing guideline for Meter Read data collected for electricity smart meters in the province of Ontario.

1.2 Scope

The scope of this document is the validation and estimation and editing standards for smart metering used for the following:

- Residential or small general service consumers where the metering of demand is not required for single phase and three phase installations either self-contained or transformer type meters.
- Commercial and Industrial consumers where the metering of demand is required for single phase and three phase installations either self-contained or transformer type meters involving multiple channel and multiple data type metering.

1.3 Who Should Use This Document

This document should be used by Local Distribution Companies, Advance Metering Infrastructure Operators, and the Smart Metering Entity for use in applying the VEE services described herein.

1.4 Assumptions and Limitations

- Wholesale metering installations registered with the IESO are not subject to the VEE services described in this document.
- Net metering and the metering for all classifications of generators are outside the current scope of the MDM/R and the VEE Services described in this document.

- Missing meter read data that requires estimation or editing will not be reported by the MDM/R for customer presentation.

- The sub-committee members of the SMSIP Joint Working Groups preference would be that weather normalization factors be applied to estimated Meter Reads. This MDM/R functionality is not being anticipated in the initial implementation of the MDM/R unless directed by the Ontario Energy Board. Future stages of MDM/R implementation may support this functionality.

- VEE Services provided by the MDM/R shall apply only to Smart Meters that conform to the criteria described in the *Functional Specification for an Advance Metering Infrastructure*.

- The VEE Services described in this document shall only be applied to physical Service Delivery Points.

1.5 Conventions

The standard conventions followed for this document are as follows:

- The word “shall” denotes a mandatory requirement,
- Title case is used to highlight process or component names; and
- *Italics* are used to highlight publication, titles of procedures, letters and forms

1.6 Roles and Responsibilities

Role of the Smart Metering Entity

The role of the Smart Metering Entity will be the configuration and maintenance of VEE Services to be applied to Meter Read data transmitted to the MDM/R by LDCs across the province of Ontario. VEE Services beyond a set of default VEE Services may be configured by the MDM/R Administrator to support additional LDC needs. Any such additional VEE Services will be available to all LDCs.

Role of Local Distribution Companies

The role of the local distribution company shall be to apply the available VEE Services appropriately to all Service Delivery Points within their service territory.

LDC’s will be responsible to validate all Meter Read data that has been identified by the MDM/R as “Needs Validation or Editing” (NVE).

1.7 How This Document Is Organized

This document is organized as follows:

- **Section 2** of this document provides an overview of the Application of the Validation, Estimation, and Editing Standards; the AMI to MDM/R Interface, and MDM/R Data Collection and Reporting Services.

- **Section 3** of this document provides a description of Validation Standards for residential or small general service consumers where the metering of demand is not required and commercial and industrial consumers where the metering of demand is required including meters involving multiple channels and multiple data type metering installations.

- **Section 4** of this document provides a description of Estimation Standards for residential or small general service consumers where the metering of demand is not required and commercial and industrial consumers where the metering of demand is required including meters involving multiple channels and multiple data type metering installations.

- **Section 5** of this document provides a description of Editing Guidelines for residential or small general service consumers where the metering of demand is not required and commercial and industrial consumers where the metering of demand is required including meters involving multiple channels and multiple data type metering installations.

- **Section 6** of this document provides a description of the Billing Quantity Validation Services for residential or small general service consumers where the metering of demand is not required and commercial and industrial consumers where the metering of demand is required including meters involving multiple channels and multiple data type metering installations.

- **Section 7** of this document provides a description of the Validation, Estimation and Editing services for residential and small commercial consumers, commercial and industrial consumers where the metering of demand is required including meters involving multiple channels and multiple data type metering installations.

1.7.1 Definition of Terms used in this Document

Within this document the following words and phrases have the following meanings:

"**AMCC**" means the Advanced Metering Control Computer that is used to retrieve or receive and temporarily store Meter Reads before or as they are being transmitted to the MDM/R. The information stored in the AMCC is available to log maintenance and transmission faults and issue reports on the overall health of the AMI to the LDC.

"**AMI**" means the Advanced Metering Infrastructure, it includes the meter, Advanced Metering Communication Device (AMCD), Local Area Network (LAN), Advanced Metering Regional Collector (AMRC), Advanced Metering Control Computer (AMCC), Wide Area Network (WAN), and related hardware, software, and connectivity required for a fully functioning data collection system. An AMI does not include the MDM/R.

"AMCD" is an Advanced Metering Communication Device that is housed either under the meter's glass or outside of the meter. It transmits Meter Reads from the meter directly or indirectly to the AMCC.

"AMRC" is an Advanced Metering Regional Collector that collects Meter Reads over the local area network from the AMCD and transmits these Meter Reads to the AMCC.

"**Billing Quantity**" refers to consumption data that has been through VEE and is ready for use in billing.

"**Billing Multiplier**" is a factor that shall be applied to Meter Reads from metering installations where instrument transformers including current transformers (CT) and potential transformers (PT) are installed. For transformer type metering installations this factor shall be the product of the current transformer ratio, the potential transformer ratio and the meter multiplier. All conforming Smart Meters shall have a meter multiplier of one (1) in accordance with the Functional Specification for an Advanced Metering Infrastructure. Transformer loss factors for primary installations shall not be included in the determination of this factor.

Where no external instrument transformers are installed such as for self-contained meters this factor shall be one (1) in accordance with the *Functional Specification for an Advanced Metering Infrastructure*.

"Commercial and Industrial customers" refers to commercial and industrial consumers where the metering of demand for billing purposes is required.

"**Consumer**" or "**customer**" refers to residential or small general service consumers where the metering of demand is not required.

"**Daily Read Period**" means the 24-hour period for collecting Meter Reads, subject to the two periods during which changes to and from Daylight Savings Time take place. The Daily Read Period commences at 12:00 midnight of each day.

"**kWh**" means kilowatt-hour.

"**LDC**" means a Local Distribution Company, which is a LDC, as defined in the Ontario Energy Board Act, 1998.

"**Meter Read**" is a number generated by a meter that reflects cumulative electricity consumption at a specific point in time. (The Meter Read and related data will be reported to the MDM/R at a specific Service Delivery Point).

"**Meter Read Block**" is used by the MDM/R for validation and estimation purposes. All validation and estimation functions are based on acting upon a set of contiguous intervals bounded by a start register read and a stop register read. In some instances a Meter Read Block the data will span two or more Meter Transfer Blocks. For a Meter Transfer Block consisting of interval consumption data with a register reading at the end of a set of interval consumption data, the start register read for the Meter Read Block will be the immediately preceding (contiguous) stop register read.

"Meter Transfer Block" is a set of data transferred from an AMCC (or other system) to the MDM/R relating to meter reads for a specific Universal SDP ID. A Meter Transfer Block is a set of interval consumption data with a register reading at the end of the set of interval data, or a set of interval register reads for a number of contiguous intervals.

"**MDM/R**" means the meter data management and meter data repository functions within which Meter Reads are processed to produce Billing Quantity data and the storage of data for future use.

"**SDP**" means the Service Delivery Point at which delivery is metered or calculated. The SDP is the point at which billing occurs based on input from one or more smart meters.

"**VEE**" means validation, estimating and editing of Meter Reads to identify and account for missed and inaccurate reads used to derive billing data.

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2. Application of the VEE Standards

The Validation, Estimation and Editing Standards offer a series of checks that can be performed against a Meter Transfer Block. Several of the Validation and Estimation checks have variable configurable parameters. These parameters allow for the configuration of the actions taken should the Meter Transfer Block fail the various validation and/or estimation checks.

This section provides a description of the application of these standards by the Smart Meter Entity in establishing default VEE Services or specific VEE Services necessary to support additional LDC needs.

This section also provides a description of the AMI to MDM/R Interface including the quality and completeness tests that are expected to be performed by the Advance Metering Infrastructure prior to the transmission of meter read data to the MDM/R, and MDM/R Data Collection and Reporting Services.

2.1 Application of Standards

The diversity of consumer types, load usage patterns, geographic location, and other variables within Ontario necessitate the creation of a number of VEE Services. Multiple VEE Services will provide the ability to modify the validation and estimation parameters to better meet the VEE needs of a consumer group.

Default VEE Services offered to LDCs will be administered by the Smart Metering Entity and will be available for use throughout the province via the MDM/R.

Creation, maintenance and administration of any additional LDC specific VEE Services once created by the Smart Meter Entity shall be made globally available to all LDCs via the MDM/R.

2.2 AMI – MDM/R Interface

2.2.1 Quality and Completeness Tests Performed by the AMI

It is expected that certain quality and completion tests are performed by the AMI systems prior to the Meter Read data being sent to the MDM/R. Test results are in the form of interval data flags associated with the Meter Reads, in a particular Meter Transfer Block being sent to the MDM/R. These types of tests are listed below:

- Pulse Over Flow Check;
- Test Mode Check;
- Meter Diagnostic Check;

- Reverse Energy Check;
- Time Change Check; and
- Loss and Restoration of Power

Pulse Overflow Check

Pulse Overflow conditions are normally a result of improper scaling factors within the meter, improper instrument transformer sizing or a meter hardware failure. A meter sets a Pulse Overflow flag when the energy consumption in an interval exceeds the range of the interval. This flag generally indicates a serious problem with the meter installation or the meter itself. These metering conditions must be physically investigated and corrected by the LDC.

The AMI System must be capable to analyse and identify the intervals for this condition and flag them with a "PulseOverflow" flag prior to providing the Meter Read Data to the MDM/R. The MDM/R inspects Meter Read Blocks received with this condition and validates the data, estimates the data or flags it for verification or editing by the LDC based on the VEE Service parameter.

Test Mode Check

The Test Mode condition is normally performed at the metering installation by a metering technician. This test requires the meter to be placed in a test mode and possibly have a simulated load condition applied to the meter to verify the meter's accuracy. The AMI System identifies the interval(s) where the usage is recorded by the meter in a Test Mode and provides this information to the MDM/R. Intervals received and flagged with a "test mode" indicator will be validated, estimated or flagged for verification or editing by the LDC based on the VEE Service parameter.

Meter Diagnostic Check

The AMI System may be capable to identify intervals for various meter diagnostic problem existing prior to providing the Meter Read data to the MDM/R. The Meter Read Blocks provided to the MDM/R with such conditions may be validated, estimated or flagged for verification or editing by the LDC based on the VEE Service parameter.

Reverse Energy Check

The AMI System may be capable to identify intervals for reverse energy condition exists prior to providing the Meter Read Data to the MDM/R. The Meter Read Blocks provided to the MDM/R with such conditions may be validated, estimated or flagged for verification or editing by the LDC based on the VEE Service parameter.

Time Change Check

Time change checks are performed within the AMI system to verify that the components used for data collection are within the acceptable time thresholds as described in the, "*Functional Specification for an Advanced Metering Infrastructure*." The Time Change Flag indicates that the meter time was adjusted during the interval and the interval may be either shorter or longer than the specified interval at which the data is to be collected. Meter Read Blocks provided to the MDM/R with time change flags may be validated, estimated or flagged for verification or editing by the LDC based on the VEE Service parameter.

Loss and Restoration of Power

Loss of power is a condition where the supply of electricity to the AMCD and/or AMRC has occurred. This failure could be as a result of a LDC distribution supply failure or the operation of an electricity disconnect prior to the AMCD and/or AMRC device.

Restoration of power is a condition where the supply of electricity to the AMCD and/or AMRC has been re-established.

The AMI system shall detect and identify the interval(s) in which a loss of power occurred and identify the interval(s) in which the restoration of power occurred. These interval flags made available to the MDM/R are required to assure accurate validation and estimation of data for each SDP.

2.2.2 Data Quality Flags Provided by the AMI

AMI systems may provide additional data quality flags that will be recognized by the MDM/R and recorded as part of the meter data record.

Data quality flags do not represent validation tests but simply set data quality flags and failure codes in the MDM/R Meter Data Database. Data quality flags are applied as part of the meter data collection process. The data quality flags that are transferred vary by AMCC type and may set corresponding MDM/R flags. In addition to the quality and completeness test flags used for validation, the MDM/R will store the following data quality flags.

Partial Data

The MDM/R inspects each interval for a partial data flag. The 'PARTIAL_INTERVAL' flag is set in the Meter Data Database of each interval for which the AMCC reports a partial data condition.

Short Interval

The MDM/R inspects each interval for a short interval flag. The 'SHORT_INTERVAL' flag is set in the Meter Data Database of each interval for which the AMCC reports the interval to be shorter than the specified interval at which the data is to be collected.

Long Interval

The MDM/R inspects each interval for a long interval flag. The 'LONG_INTERVAL' flag is set in the Meter Data Database of each interval for which the AMCC reports the interval to be longer than the specified interval at which the data is to be collected.

Data Collection Estimation

The MDM/R inspects each interval for a data collection estimation flag. The 'DC_DATA_ESTIMATION' flag is set in the Meter Data Database for each interval for which the AMCC reports the interval has been estimated outside the MDM/R as part of the data collection process. This flag sets the Validation Status to EST (estimated) and sets the Change Method to EXT (external – indicating estimation performed external to the MDM/R). Other Validation checks work normally and can re-set the Validation Status; failure codes, and estimation Change Method on failure of such tests.

2.3 MDM/R Data Collection and Reporting Services

2.3.1 Meter Read Data Validation During Loading

These services are performed immediately upon receipt of the Meter Transfer Block from either an AMCC, manual input or other system(s). The AMCC generates the Meter Transfer Block file that is transferred to the MDM/R. The MDM/R will process the files through a series of processes as outlined in the table below.

Type	Description	Pass	Fail
Syntactic Check	The structure of the file is validated against the appropriate file format for the specific AMCC.	• Acknowledgement back to LDC or AMI Operator. • Continue Processing Data.	• The LDC or AMI Operator is notified of rejected data records flagged as invalid.
Semantic Check	The content of the file is checked for validity and to determine whether a power outage, power restoration, or meter rollover has occurred.	• Continue Processing Data • Power outage, restoration, and meter rollovers are flagged	• The LDC or AMI Operator is notified of rejected data records flagged as invalid
Other Meter Read Data Loading Services			
Application of CT/PT Multiplier	Interval consumption data is multiplied by the CT/PT Multiplier set for each SDP through the synchronization process. Register reads are stored “as received” and no multiplier is applied		
Calculation of Interval Consumption from Register Reads	In the event that the AMCC only delivers register reads, the MDM/R calculates the corresponding interval consumption data prior to loading data into the Meter Data Database. Interval consumption data is stored at the same granularity of the Meter Read data as received from the AMCC (e.g. Meter Read data received at 5-minute intervals will be stored as 12 values). The register reads are also stored. The CT/PT Multiplier is applied when creating the associated interval consumption data. Register reads are stored “as received” and no multiplier is applied.		
Treatment of Missing Reads and Zero Reads	Zero reads are stored as an actual Meter Read of zero. Missing reads are detected by the MDM/R, stored as zero and flagged as ‘No-Data’ but may be estimated during VEE.		

Table 2-1 Pre-VEE Processes

2.3.2 Meter Read Data Transmission

The following sections describe the sets of data that may be transmitted from the various AMCC technologies to the MDM/R. These data sets are defined as Meter Transfer Blocks. Also described is the application of message validation and estimation services to the Meter Read Block as used by the MDM/R for validation and estimation.

"**Meter Transfer Block**" is a set of data transferred from an AMCC (or other system) to the MDM/R relating to Meter Read data for a specific SDP. A Meter Transfer Block is a set of interval consumption data with a register reading at the end of the set of interval data (see Figure 2-1), or a set of interval register reads for a number of contiguous intervals (see Figure 2-2).

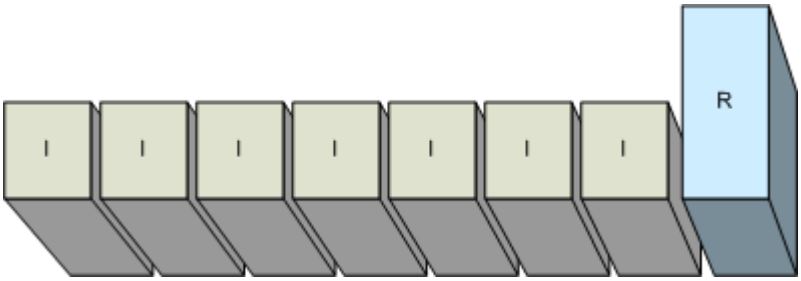

Figure 2-1 Cumulative Interval Consumption with a Stop Register Read

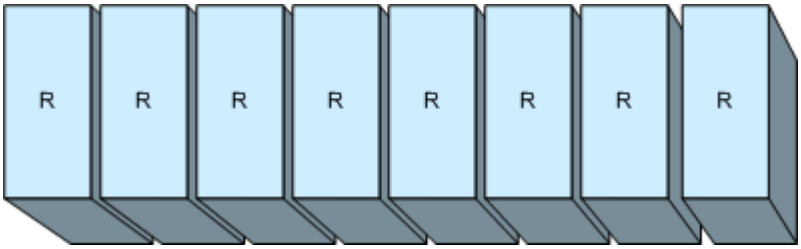

Figure 2-2 Register Reads For Each Interval

"**Meter Read Block**" is used by the MDM/R for validation and estimation purposes. Certain validation and estimation functions are based on acting upon a set of contiguous intervals bounded by a start register read and a stop register read. In some instances a Meter Read Block (see Figure 2-3) may span two Meter Transfer Blocks. For a Meter Transfer Block consisting of interval consumption data with a register reading at the end of a set of interval consumption data, the start register read for the Meter Read Block will be the immediately preceding (contiguous) stop register read.

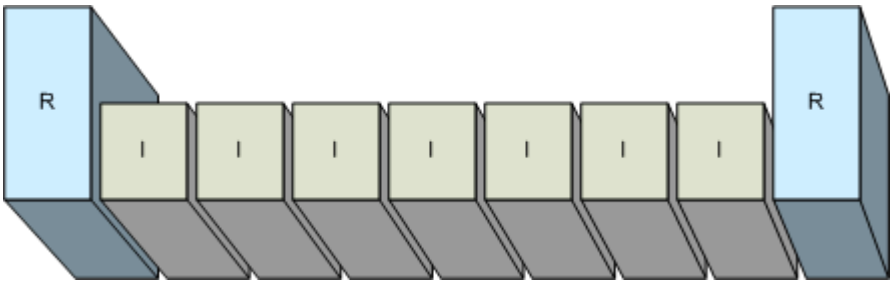

Figure 2-3 Interval Consumption with Start and Stop Register Reads

A Meter Transfer Block may be transmitted comprised of a stop register read only, with no associated interval consumption (see Figure 2-4). Such register read transmissions will be stored in the Meter

Data Database but will not trigger any validation algorithm or estimation algorithm for the estimation of the missing intervals.

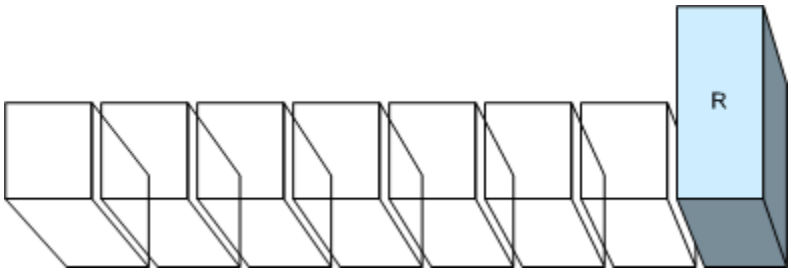

Figure 2-4 Stop Register Read Only, with No Interval Consumption

In Figure 2-5 the start register read (on the left) and subsequent interval consumption (below in grey) are stored in the MDM/R. Interval flags check; Maximum Demand Check, and Spike Check will be performed and if estimation is called for by the VEE Service, estimation will be attempted. The Sum Check will not be performed on the initial Meter Transfer Block. The new Meter Transfer Block contains a stop register read (on the right) but no interval consumption data. As with Figure 2-4 this register read transmission will be stored in the Meter Data Database but will not trigger any validation algorithm or estimation algorithm for the estimation of the missing intervals.

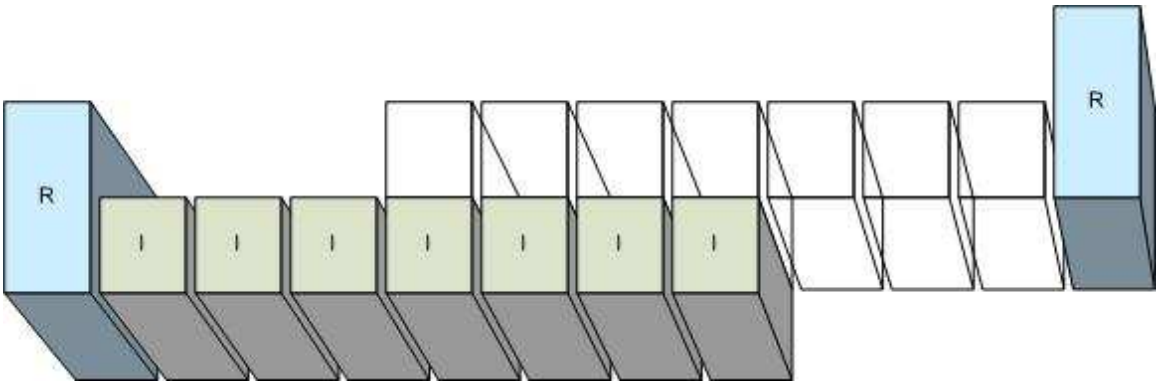

Figure 2-5 Meter Change with Incomplete Intervals

A Meter Transfer Block may be transmitted comprised of interval consumption only, with no associated stop register read (see Figure 2-6). Interval flags check; Maximum Demand Check, and Spike Check will be performed and if estimation is called for by the VEE Service, estimation will be attempted. The Sum Check will not be performed.

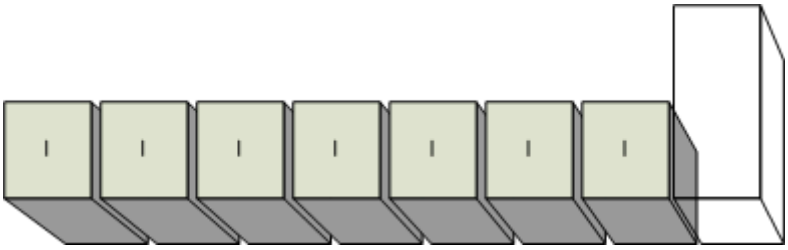

Figure 2-6 Interval Consumption with no Stop Register Read

In Figure 2-7 the stop and start register reads already exist in the MDM/R but with either no interval consumption data or perhaps estimated consumption data in between. The new Meter Transfer Block (below, grey) may provide, for example, edits to replace missing values or actual reads to replace estimated reads. This provides the LDC with the ability to send in edited meter reads or actual meter reads to fill in the gap between two register reads.

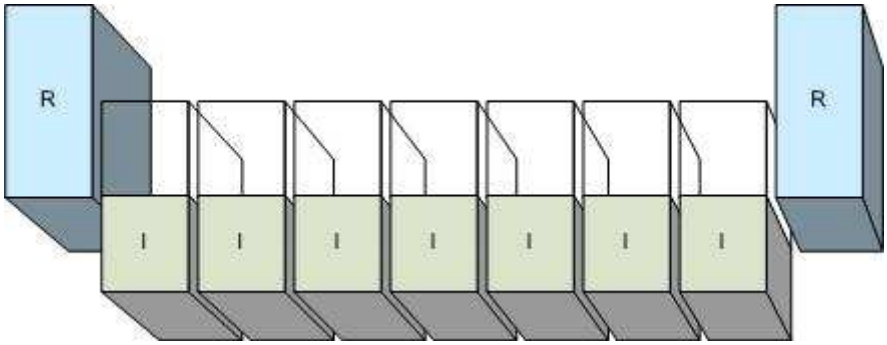

Figure 2-7 Edits Performed between Register Reads

2.3.3 Data Collection and VEE Reporting

The MDM/R provides daily reporting of the data collection processes and generates operational reports that detail the results. Complete specifications for these reports can be found in the MDM/R V1.0 Reports Technical Specifications. The data collection reports are as follows:

- DC01: Daily Read Status Report – providing a total count of meters for which data was received in the prior day segmented by AMCC type.
- DC02: Excessive Missing Reads Report – identifying meters that have failed to transmit register data for more than five days in a 10-day window.
- DC03: Interim Read Validation Failure Report – identifying *Meter Read* data files that have failed the incoming validation process for *Meter Read* data delivered to the MDM/R between midnight and the daily morning deadline for receipt of data for the prior *Daily Read Period* 'N'.
- DC13: Final Read Validation Failure Report – identifying *Meter Read* data files that have failed the incoming validation process for *Meter Read* data delivered to the MDM/R during the entire previous day 'N+1'.
- DC04: Missing Reads Detail Report – providing a listing of those meters for which data was not received for the most recent *Daily Read Period* 'N'.
- DC05: Daily Data Collection Report – providing a total count of meters for which data was received in the prior day segmented by AMCC type and read age.

- DC06: Interim AMCC Data Collection Summary Exception Report – providing a summary of all exceptions encountered during the processing of *Meter Read* data files delivered to the MDM/R between midnight and the daily morning deadline for receipt of data for the prior *Daily Read Period* 'N'.
- DC16: Final AMCC Data Collection Summary Exception Report – providing a summary of all exceptions encountered during the processing of *Meter Read* data files delivered to the MDM/R during the entire previous day 'N+1'.
- DC07: Interim AMCC Data Collection Detailed Exception Report – providing a listing of all exceptions encountered during the processing of *Meter Read* data files delivered to the MDM/R between midnight and the daily morning deadline for receipt of data for the prior *Daily Read Period* 'N'.
- DC17: Final AMCC Data Collection Detailed Exception Report – providing a listing of all exceptions encountered during the processing of *Meter Read* data files delivered to the MDM/R during the entire previous day 'N+1'.

The MDM/R also provides daily reporting of the validation and estimation processes and generates operational reports that detail the results. Complete specifications for these reports can be found in the MDM/R V1.0 Reports Technical Specifications. The VEE reports are as follows:

- VE01: Interim Validation Failure Detail Report – providing a listing of all meters where Meter Transfer Block data has failed one or more of the validation checks for Meter Read data files delivered to the MDM/R between midnight and the daily morning deadline for receipt of data for the prior Daily Read Period 'N'.
- VE11: Final Validation Failure Detail Report – providing a listing of all meters where Meter Transfer Block data has failed one or more of the validation checks for Meter Read data files delivered to the MDM/R during the entire previous day 'N+1'.
- VE02: Interim Estimation Failure Detail Report – providing a listing of all meters where Meter Transfer Block data could not be estimated and the reason why for Meter Read data files delivered to the MDM/R between midnight and the daily morning deadline for receipt of data for the prior Daily Read Period 'N'.
- VE12: Final Estimation Failure Detail Report providing a listing of all meters where Meter Transfer Block data could not be estimated and the reason why for Meter Read data files delivered to the MDM/R during the entire previous day 'N+1'.
- VE03: Missing Interval Aging Report – providing a listing of those meters for which data was not received within the previous 3 calendar days.
- VE04: VEE Summary Report – providing summary number counts for the results of the validation; estimation; and verification/editing processes.

– End of Section –

3. Validation Standards

Validation is applied by the MDM/R in two ways: 1) data validation performed during loading of Meter Read data and 2) by the application of Daily Validation Services. Meter Read data validation during loading is applied to Meter Transfer Blocks received from all Smart Metering installations. The Daily Validation Services are applied in accordance with VEE Services defined for the type of consumer and metering installation. Daily Validation Services are configured to identify Meter Reads that fall outside of acceptable tolerance(s) and anomalies recorded by the meter.

The following sections describe the Meter Read data validation during loading, and the missing read checks.

- Validation Services for Residential or Small General Service Consumers, and
- Validation Services for Commercial and Industrial Consumers with the metering of demand with multiple channel metering.

3.1 Residential or Small General Service Consumers

Validation must be based on the characteristics of the data on hand. The list of checks and criteria itemized in the following sections shall be applied during validation of data collected by the AMI and transmitted to the MDM/R for consumers where the metering of demand is not required.

Validation will be performed for each Meter Transfer Block received from the AMI as part of Message Validation Services for residential or small general service consumers.

3.1.1 Message Validation Services

Validation Services are performed immediately upon completion of the Meter Read data load validation services for each applicable Meter Transfer Block. These services are performed on Meter Transfer Blocks received from the AMI or other systems. The validation checks performed on each Meter Transfer Block are referred to as message validation services.

Message validation service checks must be performed at the appropriate point in the data processing cycle of the MDM/R. Without strict adherence to the processing cycle, the validation service may fail resulting in invalid data. Some of these quality and completion checks must be performed by the AMCC and are described in section 2.2 of this document. Other validation checks within the MDM/R can be performed any time after data collection and before Billing Quantity generation. Billing Validation processes act upon the output from the Billing Quantity generation process and are described in Billing Validation Services section 6 of this document.

3.1.2 Overall Control

This parameter determines whether or not any validation and estimation is undertaken. If set to 'N' (No) then none of the following tests are undertaken. If the parameter is set to 'Y" (Yes), then all of the following tests that are enabled are undertaken.

Validation Check Sequence – Validation checks are performed in the following order:

1. Missing Intervals Check
2. Interval Flags Check
    a. Test Mode Check
    b. Pulse Overflow Check
    c. Time Change Check
    d. Meter Diagnostic Check
    e. Reverse Energy Check
3. Maximum Demand Check
4. Spike Check
5. Sum Check
6. Consecutive Zeros Check

3.1.3 Missing Intervals Check

The validation process identifies any gaps in interval consumption data within a Meter Transfer Block or between Meter Transfer Blocks and flags these gaps for Estimation or for verification/editing by the LDC based on the VEE Service parameter. Intervals for which a power outage is detected are not flagged as missing.

Power Outage Detection Within a Meter Transfer Block – This power outage detection algorithm identifies sections of missing intervals (i.e. 'NO_DATA' intervals) within a Meter Transfer Block that are part of a power outage. This algorithm for power outage detection is:

1. Within the Meter Transfer Block contiguous 'NO_DATA' intervals on either side of an "Outage" interval are flagged as 'POWER_OFF' and the 'NO_DATA' flag is cleared in these intervals.

2. An "Outage" interval is defined as:

    a. An interval with the 'POWER_OFF' flag set,
    OR

    b. An interval with the 'POWER_ON' flag set.

The "Outage" interval definition addresses data collection systems that may not set a power outage flag for an interval that contains a power restore event. A power restore event ('POWER_ON') in an interval implies that a power outage state ('POWER_OFF') was true at some point in the interval.

Power Outage Detection Between Meter Transfer Blocks – This power outage detection algorithm identifies sections of missing intervals between Meter Transfer Blocks that are part of a power outage. This algorithm for power outage detection is:

1. If the first interval of the of the current Meter Transfer block has a 'POWER_ON' flag set, get the interval record from the Meter Data Database for the last interval received prior to the start of the current Meter Transfer block

    a. If the last prior interval from the Meter Data Database has a 'POWER-OFF' flag set to 'Y', the section of missing intervals between Meter Transfer Blocks is part of a power outage. In this case set the 'POWER_OFF' flag to 'Y' and the interval value to '0' for every missing interval between the last prior interval and the start of the current Meter Transfer Block.

    b. If the 'POWER_OFF' flag is not set for the last prior interval from the Meter Data Database, the section of missing intervals between Meter Transfer Blocks is NOT part of a power outage. In this case set the 'NO_DATA' flag to 'Y' for every missing interval between the last prior interval and the start of the current Meter Transfer Block.

3.1.4 Interval Flags Check

The Interval Flags Check handles all single-interval checks – checks that can be done without comparing intervals to other intervals. This includes the Missing Intervals Check described above as well as the validation checks described below.

Test Mode Check

The MDM/R inspects each interval for a Test Mode Flag. An interval with the Test Mode flag set fails validation only if the interval consumption is non-zero. If zero usage is recorded for the intervals in which the meter was in test mode, (i.e. meter was bypassed during testing) this data is considered valid.

Many meters will register 0 interval consumption while in test mode, thus if the meter records usage in test mode, the data does not represent actual Customer consumption.

This test can be configured to validate with the failure flagged (i.e. soft failure), estimate, or require verification/editing.

Pulse Overflow Check

The MDM/R inspects each interval for a Pulse Overflow Flag. A meter sets a Pulse Overflow flag when the energy consumption in an interval exceeds the range of the interval. This flag generally indicates a serious problem with the meter installation or the meter itself.

This test can be configured to validate with the failure flagged (i.e. soft failure), estimate, or require verification/editing.

Time Change Check

The MDM/R inspects each interval for a Time Change flag. The Time Change Flag indicates that the meter time was adjusted during the interval and the interval may be either shorter or longer than the specified interval at which the data is to be collected. The Time Change flag is maintained since intervals with Time Change are not used in Demand computations.

This test can be configured to validate with the failure flagged (i.e. soft failure), estimate, or require verification/editing.

Meter Diagnostic Check

The MDM/R inspects each interval for a Meter Reset Flag. The meter read interface adaptor maps the meter diagnostic flags from each individual type of device to the Meter Reset Flag a part of the Data Collection process. (Reference MDM/R Technical Interface Specifications, Meter Read Interface – for each AMI technology.)

Meter diagnostic error flags generally indicate a serious meter problem but may not necessarily indicate that the interval data is erroneous.

This test can be configured to validate with the failure flagged (i.e. soft failure), estimate, or require verification/editing.

Reverse Energy Check

The MDM/R inspects each interval for a Reverse Rotation Flag.

This test can be configured to validate with the failure flagged (i.e. soft failure), estimate, or require verification/editing.

3.1.5 Maximum Demand Check

The Maximum Demand Check is a conditional test enabled or disabled for each specific VEE Service by a “check” product parameter.

The MDM/R compares each interval consumption value against the Maximum Demand Value specified in the VEE Service parameter. Interval values represent fully scaled kWh quantities including the CT/PT Multiplier. The Maximum Demand Value is in fully scaled kW.

The Maximum Demand Value (in kW) is divided by the number of intervals per hour (intervals/hr) providing an energy equivalent Maximum Interval Value (in kWh per interval). Each interval consumption value (in kWh) is then compared to the Maximum Interval Value. Interval consumption values greater than the Maximum Interval Value will fail the Maximum Demand Check and the ‘Maximum Demand Action’ will be performed.

This test can be configured to validate with the failure flagged (i.e. soft failure), estimate, or require verification/editing.

3.1.6 Spike Check

The Spike Check is a conditional test enabled or disabled for each specific VEE Service by a "check" product parameter.

The MDM/R may perform a spike check on each Meter Transfer Block to identify intervals with high consumption relative to the surrounding intervals. The spike check validation is performed as follows:

- Identify the highest and Nth highest interval values where N is a VEE Service parameter. The default value for N is 3.
- If the highest interval has already failed a prior validation check, then spike check is not performed.
- If the highest interval is less than or equal to the configurable Spike Check threshold, skip the spike check. The Spike Check Threshold value is specified in kWh units. The Spike Check Threshold is set in the VEE Service parameters.
- If the Nth highest interval is less than or equal to the configurable Spike Check threshold, skip the spike check. Otherwise, subtract the Nth highest interval from the highest interval and divide by the Nth highest interval. The algorithm is as follows:
  (highest interval - Nth highest interval)/Nth highest interval)
- The MDM/R will apply the following pass/fail criteria to the data set:
  - If ((highest interval - Nth highest interval)/Nth highest interval) <= threshold (a configurable value) the interval passes the spike check.
  - If ((highest interval - Nth highest interval)/Nth highest interval) > threshold (a configurable value), the interval fails the spike check and the 'Spike Check Action will be performed.

This test can be configured to validate with the failure flagged (i.e. soft failure), estimate, or require verification/editing.

3.1.7 Sum Check

The Sum Check is a conditional test enabled or disabled for each specific VEE Service by a "check" product parameter.

The Sum Check is performed after other validation checks and will only be performed if the Meter Transfer Block passes the Missing Intervals Check and all intervals have passed the previous validation tests flagged as validated (including "soft fail" intervals).

The MDM/R performs a sum check on the Meter Read Block. Should the absolute value of the Sum Check difference exceed the threshold this validation fails, and all interval records in the Meter Transfer Block will be flagged with the failure.

- The Meter Transfer Block must include at least one Register Read with a timestamp that is between the earliest and the latest interval timestamps in the Transfer block, i.e. the register read occurred during one of the intervals in the block. The Register Read with a timestamp at the end of a Meter Transfer Block is defined as the End Read. For the purposes of this

Sum Check the timestamp for the End Read is defined to be the reading at the end of the interval in which the reading was taken.

- Intermediate Register Read Conversion to End Read – A by-product of validation is that the Validator calculates the End Read from the Intermediate Register Read (IRR) value if all of the intervals between the two are valid. An Intermediate Register Read is defined as a Register Read with a timestamp that is between the earliest and the latest interval timestamps in the Transfer block. IRR conversion is performed using the following logic:
  IF:
  End Read is null AND Intermediate Register Read is null, do not perform Sum Check
  IF:
  End Read is null AND Intermediate Register Read is NOT null, calculate End Read from Intermediate Read and the sum of the valid intervals between the Intermediate register Read and the end of the Meter Transfer Block
  IF:
  End Read is not null, use End Read supplied as part of the Meter Transfer Block
- The Sum Check test will retrieve the most recent register reading and interval data from the Meter Data Database. This register read is defined as the Start Read and for the purposes of the Sum Check its timestamp is defined as the end of the interval in which if occurred.
- The Sum Check will subtract the Start Read from the End Read and compute the difference. If the value is negative the meter register has "rolled over" and 1×10^N will be added to the negative difference value where N is 4, 5 or 6 whichever will results in a positive value. The N reflects the number of meter register digits. For example add 100,000 to the negative difference value for a 5 dial meter.
- Sum Check failure is determined as follows. The sum of the interval consumption for intervals between the Start Read and End Read is divided by the CT/PT Multiplier and compared to the un-scaled register read difference. If the absolute value of the difference is greater than the Msg Sum Check Threshold, the 'Msg Sum Check Action' will be performed.

  $$|(\sum \textit{Interval values / CTPT Multiplier}) - (\textit{RR\_Difference})| > \textit{Msg Sum Check Threshold}$$

  Note: When used with different CT/PT Multipliers, this algorithm tests that the tolerance is within the unscaled register readings. For example, if the CT/PT Multiplier was 80.0 and the Msg Sum Check Threshold was also 1.0, the Sum Check would test that the dial reading was within 1, meaning that the kWh was within 80.
- Meter Change and CT/PT Multiplier Change Detection – Because of the logic leading up to a Sum Check, it is not expected that a meter change event or CT/PT Multiplier change event would be the cause of a Sum Check failure. Nevertheless, if a sum check fails, the Validator does check for a meter change and/or CT/PT Multiplier value change event before reporting a sum check failure.
  A Sum Check failure is disregarded if a meter change or CT/PT Multiplier relationship change occurred anywhere in the time span delimited by a Start Read time and End Read time relative to the dataset being evaluated.

This test can be configured to validate with the failure flagged (i.e. soft failure), or require verification/editing. The 'estimate' action is not available for the Sum Check.

3.1.8 Extra-Message Checks

The Consecutive Zeros Check acts on data beyond the Meter Read data contained in a Meter Transfer Block.

Consecutive Zeroes Check

The Consecutive Zeros Check is a conditional test enabled or disabled for each specific VEE Service by a "check" product parameter.

A "Zero Interval" is defined as an interval where:

- Interval Value = 0
- NO_DATA is false (i.e. the 0 value is not the result of Missing Intervals)
- POWER_OFF is false
- POWER_ON is false

The MDM/R checks the Meter Transfer Block for consecutive zero values. The Consecutive Zeros Check is performed as follows:

IF there is at least one contiguous section of Zero Intervals in the dataset equal to or longer than 'Consecutive Zeros Threshold' THEN:

- Set 'ZER' bit in each Zero Interval FAIL_CODE
- Take action specified by 'Consecutive Zeros Action'

IF the dataset contains one or more trailing Zero Intervals, query Meter Data Database for count of adjacent later Zero Intervals. If the count of adjacent later Zero Intervals + count of leading Zero Intervals is longer than 'Consecutive Zeros Threshold' (hours) THEN:

- Set 'ZER' bit in each leading Zero Interval FAIL_CODE
- Take action specified by 'Consecutive Zeros Action'

IF the dataset contains one or more trailing Zero Intervals, query Meter Data Database for count of adjacent later Zero Intervals. If the count of adjacent later Zero Intervals + count of leading Zero Intervals is longer than 'Consecutive Zeros Threshold' (hours) THEN:

- Set 'ZER' bit in each trailing Zero Interval FAIL_CODE
- Take action specified by 'Consecutive Zeros Action'

A Consecutive Zeros Check does not flag prior or later intervals that are discovered in the Meter Data Database to be part of a consecutive zeros failure.

This test can be configured to validate with the failure flagged (i.e. soft failure), estimated, or require verification/editing.

3.2 Commercial and Industrial Consumers with metering of Demand (Multiple channel metering)

Data collection for Commercial & Industrial metering is expected to provide measurement data beyond the kWh data and associated register readings provided by metering used for Residential and Small General Service Customers where metering of demand is not required.

The MDM/R adaptors used for C&I Customers must be able to support kWh, kW, kVA, kVAh, kVAR, and kVARh along with associated registers.

3.2.1 Message Validation Services available to C&I Metering

Message validation services used for Residential and Small General Service Customers will also be available for use for C&I Customers.

3.2.2 Additions to Validation Services to Support C&I

The following validation check specific to C&I meters will be supported by the MDM/R.

kVARh Check

The kVARh check is performed to identify intervals where reactive load (kVARh) is present and active load (kWh) is not, indicating a suspicious usage pattern and possible meter malfunction. This check is only required when both kWh and kVARh are used for billing. If kVARh data is available but not used for billing, the check is optional. This check may be done on either consumption or pulse data, provided the data scaling is consistent throughout the period

– End of Section –

4. Estimation Standards

The MDM/R Estimation Standards applies a method that is operationally manageable and maintainable and is fair to Residential and Small General Service Customers where the metering of demand is not required, and Commercial and Industrial customers with the metering of demand is required.

The MDM/R Estimation Standard is consistent with the standard described in the "Ontario Energy Board, *Distribution System Code*, Last revised on June 27, 2007 (Originally Issued on July 14, 2000)" Section 5.3.2, specifically:

> "A distributor shall establish a VEE process according to local practice that is fair and reasonable and provides assurance that correct data is submitted to the settlement process."

This section provides a description of the application of the MDM/R Estimation Standards to:

- Residential or small general service consumers where the metering of demand is not required for single phase and three phase installations either self-contained or transformer type meters.
- Commercial and Industrial consumers where the metering of demand is required for single phase and three phase installations either self-contained or transformer type meters involving multiple channel and multiple data type metering.

4.1 Residential or Small General Service Customers

Estimation standards described in this section of the document refer to residential or small general service consumers where the metering of demand is not required. While other methods may arguably provide more accurate estimates the solution chosen uses historical data from a SDP to provide estimates that are representative of historical consumption at that SDP while providing computationally manageable overhead for 4.5 million meters or more.

4.1.1 Message Estimation Routines

Gaps or errors in interval data may be estimated by the MDM/R as they are identified in the validation process. Estimation for filling gaps between Meter Transfer Blocks is limited by the 'Max Estimation Days' parameter and gaps that exceed this value are not estimated. These estimations are performed on interval records marked as 'data requires estimation' by the validation processing.

Message estimation does not extend beyond the most recent Meter Transfer Block received. The Billing Validation process will call exception handling processes that will attempt use estimation to complete interval data that is missing at the end of a Billing Period. This includes extrapolation[1] of

[1] Billing Validation Extrapolation is a deferred delivery component – reference Component 27, MDM/R Change Request MCR No. 003.

interval data and associated reframing to generate complete Billing Quantities to the required End Date.

4.1.2 Linear Interpolation

If a section of data needing estimation is less than 'Max Interpolation Minutes' in length (e.g. 60 minutes) then this estimation uses linear interpolation to compute the interval values. If the 'Max Interpolation Minutes' is set to zero this method is not used.

Use point-to point linear interpolation to estimate the data using before and after endpoints, where:

1. Endpoints must be intervals with a validation status of 'validated' (VAL) including "soft fail" intervals. Intervals containing a power failure cannot be used as end points for linear interpolation.
2. If the section occurs in the middle of the Meter Transfer Block, the "first point" is the last valid interval before the section, and the "second point" is the first valid interval after the section.
3. If the section occurs at the beginning of the Meter Transfer Block, use the last interval from the historical data as the first point if the historical data is available and valid.

If before and after endpoints are not available, the interval(s) requiring linear interpolation will be flagged as PTS (i.e. no endpoints) with a validation status of 'needs verification or editing' (NVE).

4.1.3 Historic Estimation

If the section of data needing estimation is more than the 'Max Interpolation Minutes' and less than the 'Max Estimation Days' then estimation will be performed by averaging intervals from like day types to create a Daily Profile for the period to be estimated. A Daily Profile is a ranked list of valid reference days and the interval consumption value for each interval in the Daily Profile is simply the average of the interval values for the reference days.

If the section of data to be estimated exceeds 'Max Estimation Days' the intervals will be flagged as 'GAP' with a validation status of 'needs verification or editing' (NVE).

Use the average of selected reference days to estimate interval consumption data as follows:

- Only "validated" intervals can be used. Valid intervals are defined as those that have a validation status of VAL (including "soft fail" intervals and intervals that have been "verified" i.e. change method code 'VER'). Estimated intervals with a validation status of (EST) cannot be used.
- Data from days with a power failure cannot be used. Power failures can cause irregular usage patterns, resulting in data that is not typical for the Customer.
- The earliest possible reference date is calculated as the 'Oldest Like Day' before the section of data needing estimation.
- The latest possible reference date is calculated as either:
    a. The 'Newest Like Day' past the last day in the section of data needing estimation, or

b. The last day of the same billing cycle as the last day in the section of data needing estimation.

- Reference days are chosen to be of the like day type that are closest chronologically to the data needing estimation, regardless of seasonal crossover. Currently, like days can include days behind an account change.[2] This may include days after the day requiring estimation. When two potential like days are equidistant from the day requiring estimation the 'before' day is selected over the 'after' day.

There are two steps to the historic estimation process and these are described below:

1) Develop an average Daily Profile for each period to be estimated:

   a) Find the 'Number Like Days' (e.g. five) "same day of the week" reference days with valid data closest in time to each section of data needing estimation based on the rules listed in the previous section. If the section needing estimation is a holiday, the "same day of the week" is the closest Sunday. Calculate the average Daily Profile for each day type to be allocated using the selected reference days. If 'Number Like Days' same day of the week are not available, calculate the average Daily Profile using fewer reference days. For example if the section of data to be estimated is on a Tuesday and the 'Number Like Days' is five, select the five closest Tuesdays. If five Tuesdays are not available select four, if not then three, then two, then one.

   b) If no "same days of the week" reference days are available, look for the 'Number Like Days' "like" days that are closest chronologically to the section of data needing estimation. For example, if the intervals needing estimation are on Tuesday, use Monday, Wednesday, and Thursday. Only use weekdays with weekdays; only use weekends with weekends; use only Sundays or holidays with holidays. Calculate the average Daily Profile using up to 'Number Like Days' reference days (e.g. from one to five as available).

   c) If there is no valid "same day of the week" or "like" reference days and 'Use Class Load Profile" is set to "N", the data may not be estimated and is flagged as NLK (NO_LIKE_DAYS) with a validation status of 'needs verification or editing (NVE).

2) Use the average Daily Profile to estimate the usage data:

   The estimated value for each interval is simply the average interval value from the calculated Daily Profile. The average interval value from the Daily Profile is considered "raw estimated data" and is subject to Register Read scaling if the 'Register Allocation' parameter is set to 'Y' for the VEE Service.

The MDM/R will normalize the representative profile so that the consumption for the Daily Read Period is the same as for the daily read profile to be estimated. The profile could at some future point also be normalized for weather factors but weather factors will not be supported unless directed by the Ontario Energy Board.

Note that this method does not assume that the historical days are a good match for the profile of the Meter Read Block being estimated and implicitly assumes that no large changes in consumption behavior have occurred. The technique generates estimates that are typical of recent behavior as opposed to trying to match historical usage to the profile of the Meter Read Block being estimated.

[2] Account Specific Historical Information Algorithm is a deferred delivery component – reference Component 35, MDM/R Change Request MCR No. 013.

4.1.4 Class Load Profile

The MDM/R supports estimation using a single specified Class Profile for each VEE Service. These Class Profiles may be applied optionally to each VEE Service. The MDM/R Administrator loads the Class Load Profiles into the appropriate interval channels in the MDM/R. One Class Load Profile channel for each VEE Service is defined.

Setting the 'Use Class Profile' parameter to "Y" enables Class Load Profile estimation. It can then be used in two situations:

- The most common intended use case of Class Load Profile estimation is as a fallback estimation option for intervals that cannot be historically estimated because of NO_LIKE_DAYS. The historical estimation algorithm will set a flag on a dataset if an interval has a NO_LIKE_DAYS failure. After the dataset has been fully processed by the historical estimation algorithm, the flag is checked, and if it is set, the ClassLoadProfiler is called to estimate all intervals in the dataset that have NO_LIKE_DAYS failures.

- Alternatively, Class Load Profile can be configured to be used instead of historical estimation, by setting the 'Number Like Days' parameter to '0'. In this case, all sections of NE (needs estimation) intervals in a dataset that are NOT linear interpolation are estimated using Class Load Profile.

Class Load Profile estimation consists of two steps described below.

1. Initialization. At the level of the section of data needing estimation, a Class Profile is initialized using the channel reference specified by the 'Class Profile Channel' parameter for the VEE Service associated with interval data being estimated; and the Start Time and End Time of the section of data needing estimation.

    a. The Class Profile is loaded for a given time period. Class Profiles are always loaded in 24-hour midnight-to-midnight time chunks (to set up for subsequent Average Daily Usage scaling). A section of data needing estimation that contains less than a full day of data will trigger a full day of Class Profile data that covers the dataset time period. A section of data needing estimation that contains intervals that span more than one day will trigger multiple days of Class Profile data to be loaded to cover all the days represented in the dataset.

    b. If the Class Profile is successfully loaded (all expected Class Profile intervals are found in the database), an attempt is made to scale the Class Profile interval values using the **Average Daily Usage** of the interval channel. The scaler sums up the interval data values in the class profile and divides by the number of days in the class profile to obtain the Average Profile Daily Usage in kWh per day. The Average Daily Usage is then obtained for the interval channel (see algorithm description below). The scaling factor is then calculated as:

    scalingFactor = Average Daily Usage / Average Profile Daily Usage

    c. If a scaling factor is successfully calculated, each interval of the "raw class profile interval data" is scaled as:

    scaledIntervalValue = rawIntervalValue * scalingFactor

2. For each interval in the section of data needing estimation obtain the estimated interval from the ClassLoadProfiler, and set the change method code based on whether the Class Profile has been scaled:

   If scaled, change method set to 'Class Load Profile, scaled with ADU' (ESE)

   If not scaled, change method set to 'Class Load Profile, unscaled' (ESD)

The **Average Daily Usage** (ADU) for the interval channel is obtained by querying the Meter Data Database for register reads, and calculating the Average Daily Usage using the first two register reads that meet the criteria for use as endpoints in the ADU calculation.

Register reads are queried over the time period delimited by the "Class Profile ADU Newest Read" (# of days) after the End Time of the section of data needing estimation, and going backwards through the "Class Profile ADU Oldest Read" (# of days) prior to the Start Time of the section of data needing estimation.

Beginning with the most recent register read and working backwards in time, the list is searched for the first pair of register read values (designated as RR1 at RR1Time; RR2 at RR2Time) that meet the following criteria:

- The register reads must be separated by at least "Class Profile ADU Min Days" full days, and
- Both register reads must have been obtained from the same meter with the same active CT/PT Multiplier value, and
- Neither of the register reads can be estimated (ESTIMATED_METHOD must be NULL).[3]

If there is a Meter or CT/PT Multiplier change between RR1Time and RR2Time, the earlier register read of the pair is re-designated as RR2 and a search is performed for an earlier register read (RR1) that meets the criteria above within time period delimited by the "Class Profile ADU Newest Read" and the "Class Profile ADU Oldest Read".

If a valid register read pair is NOT obtained by this search, the Average Daily Usage cannot be calculated and the Class Profile is not scaled.

If a valid register read pair is obtained, they are first run through the Dial Rollover algorithm to adjust for possible dial rollover between the readings, and the Average Daily Usage (ADU) in kWh per day is calculated as follows:

$$ADU = (((RR2 - RR1)*CTPT\ Multiplier) * (seconds\text{-}per\text{-}day)) / (RR2Time - RR1Time)$$

Loading Class Profile Data – The MDM/R Administrator loads the Class Profile data into the appropriate interval channels in the MDM/R. One Class Profile channel for each VEE Service is defined. The Class Profile data is maintained in an Interval Data channel. The standard class profile is a 60 Minute Interval Data, kWh channel. Class Profile interval data must be provided in advance of any period that is to be estimated by the Class Load Profile estimation process. This means that

[3] Estimation of Register Reads is not performed by the MDM/R.

the interval data must be provided for several weeks or months into the future. Generally a Class Profile is available for a full year.

4.1.5 Register Read Scaling

Register Read Scaling is applied to sections of intervals after they have been populated with raw estimated data using either the historical or class load profile estimation methods. Before scaling, each section of estimated intervals is first checked to determine if a meter change has occurred during the section. If so, the section is divided into meter-specific sections and each meter-specific section is scaled separately. If a meter change is detected, the algorithm checks for CT/PT Multiplier changes within the dataset time period, and the sections belonging to the different meters are scaled separately using appropriate CT/PT Multiplier values. If there is a gap between the two meter relationships, the estimated intervals in that gap are left unscaled.

Historic estimation and Class Load Profile estimation will operate with and without register reads. The VEE Service parameter “Register Allocation” determines if the register reads will be used to scale the “raw estimated data” from historical estimation or the “raw class profile interval data” from Class Load Profile estimation. When register reads are available before and after the gap being estimated and ‘Register Allocation’ is set to “Y”, the estimated interval values will be adjusted so that the sum of the intervals (actual and estimated) between the register reads is equal to the difference in register reads.

Intervals estimated using historical estimation with register read scaling are recorded in the Meter Data Database with a validation status of ‘estimated’ (EST) and a change method code ESC.

Intervals estimated using Class Load Profile estimation with register read scaling are recorded in the Meter Data Database with a validation status of ‘estimated’ (EST) and a change method code ESF.

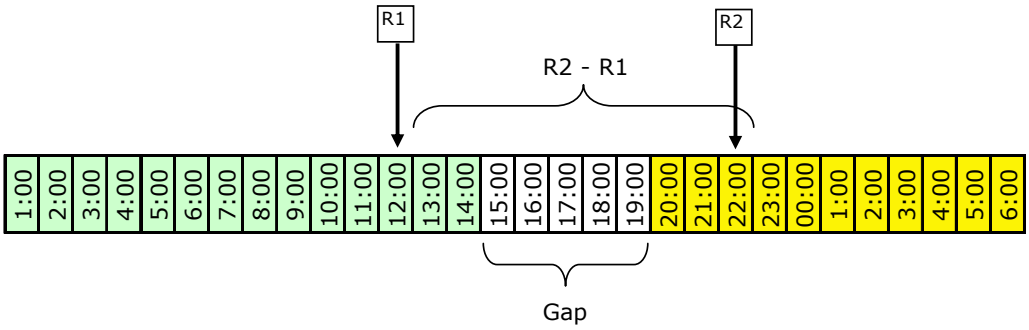

Figure 4-1 Estimation with Register Reads

As shown in Figure 4-1 register reads used in estimations are deemed to have occurred at the end of the interval in which they occurred. This assumption allows register reads to be used regardless of their alignment to the Meter Transfer Block or an interval boundary.

Although the AMCC interface requires that interval data is always accompanied by a register read, should register reads not be available on both sides of the gap being estimated or if 'Register Allocation' is set to "N" the "raw estimated data" are not adjusted and are used as the estimate.

Intervals estimated using historical estimation without register read scaling are recorded in the Meter Data Database with a validation status of 'estimated' (EST) and a change method code ESB.

Intervals estimated using Class Load Profile estimation without register read scaling are recorded in the Meter Data Database with a validation status of 'estimated' (EST) and a change method code ESD.

4.2 Commercial and Industrial Consumers with metering of Demand (Multiple channel metering)

4.2.1 Message Estimation Services available to C&I Metering

The estimation algorithms used for C&I metering must require that all channels be present for estimation. In the event that one of more channels, but not all channels, are present for the same time interval, the estimation should fail. In effect, all non-register channels must be estimated simultaneously and in concert of each other. The absence of a single channel implies a serious meter failure and must be able to be configured for manual verification.

Message estimation services used for Residential and Small General Service Customers will also be available and applied to all channels for C&I metering and will include:

- Linear Interpolation, and
- Historic Estimation

Class Load Profile estimation is not proposed or expected to be required as the profiles for individual installations will vary drastically from location to location.

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5. Editing Guidelines

The MDM/R provides a Graphical User Interface (GUI) for performing manual verification and editing on Meter Read data. Upon notification of Meter Read data that Needs Verification/ Editing, the LDC will use the GUI to perform such verification or editing.

The OEB has provided some guidance for editing as described in the November 9, 2004 *Ontario Energy Board Smart Meter Implementation Plan, Draft Report of the Board For Comment*. Specifically:

> "When meter data is adjusted during the estimating process, there is always some risk that the estimated value will differ from actual consumption. Every effort must be made to ensure each estimate reflects accrual consumption to the extent possible. And to the extent possible, the risk of error should be born by the distributor."

The above principle may be applied by each LDC when editing meter read data.

5.1 Residential or Small General Service Customers

5.1.1 Manual Editing and Verification

Where actual interval consumption data is not available and automated estimation processes have not been successful, the LDC may be required to manually inspect and approve interval consumption data or to manually edit the values. The flowchart in Figure 5-1 describes this process.

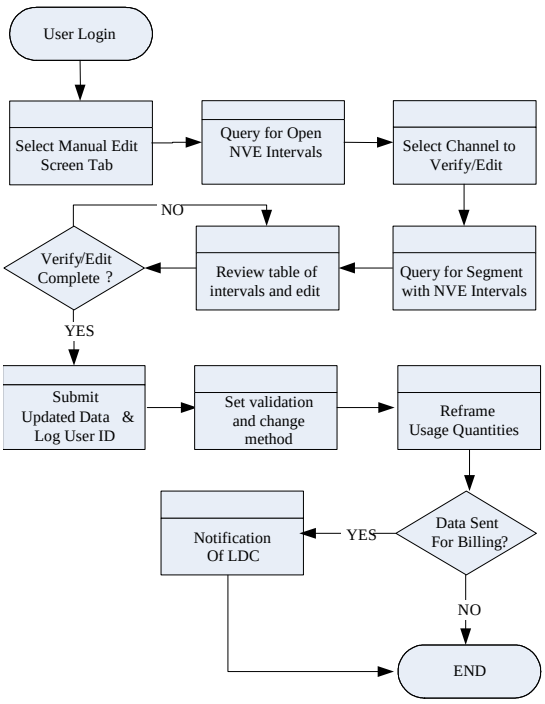

Figure 5-1 Manual Verification and Editing Flow

Locating Channels for Manual Editing

When validation checks result in interval consumption data being marked as data Needs Verification/Editing (NVE) the process automatically creates a record which contains the start and end times of the intervals that need manual verification and/or editing. An LDC user with appropriate permissions may generate a list of all such records and navigate to the interval channels that require attention.

Verifying or Editing Intervals

The LDC user may change interval consumption values in the GUI. When completed, the user submits the updated interval consumption data set. If the interval consumption data value is not changed the records are simply marked with validation status of Validated (VAL) and change method of Verified. If the interval consumption data values were changed (edited) they are marked with Validation Status set to Estimated (EST) and change method set to Edited (EDT). Intervals that are verified or edited in this process are updated in the Meter Data Database. The previous interval consumption data records are moved to the Prior Version table to maintain interval history.

Updating Billing Quantities After Editing

Channels that have been manually verified or edited in this process will be automatically reframed in order to update or complete the values in the Meter Data Database Usage table. Reframing is triggered as the interval consumption data version is updated. The LDC is notified where Billing Quantities have already been sent to the LDC based on prior interval consumption data versions.

5.2 Commercial and Industrial Consumers with Metering of Demand (Multiple channel metering)

5.2.1 Editing Support for C&I Metering

The editing functionality for meter data received from C&I metering must support the editing of all channel data (e.g.: kW, kVA, kVAR, kVAh and kVARh) simultaneously on the same screen.

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6. Billing Validation Services

Billing Validation takes place as Billing Quantities are assembled for delivery to the LDC or its agent as defined by the Data Delivery Service. Billing Validation is configured as part of the overall configuration of a Data Delivery Service including association with each VEE Service.

Billing Validations are performed on the data prior to producing Billing Quantity data. The Billing Validation process includes performing a sum check on the Billing Quantities over the period for which Billing Quantities are being provided.

The Billing Validation process will call exception handling processes that will attempt to use estimation to complete interval data that is missing during the Billing Period. This includes extrapolation[4] of interval data and associated reframing to generate complete billing quantities to the required End Date of the billing period. The extrapolation capability will be implemented consistent with the recommendation of the members of the SMSIP Joint Working Groups.

The Check Sum validation on Billing Quantity data will be performed by the MDM/R. SDPs identified as having this flag will be reported to the LDC to investigate and resolve.

6.1 Residential or Small General Service Customers

6.1.1 Billing Validation Sum Check

Prior to delivery of Billing Quantities for each SDP, the MDM/R performs the billing period validations. The Billing Validation Sum Check is configured as part of the Data Delivery Service parameters including association with a VEE Service. The MDM/R will perform the following billing validation tests once per billing request, as the Billing Quantities are prepared for export.

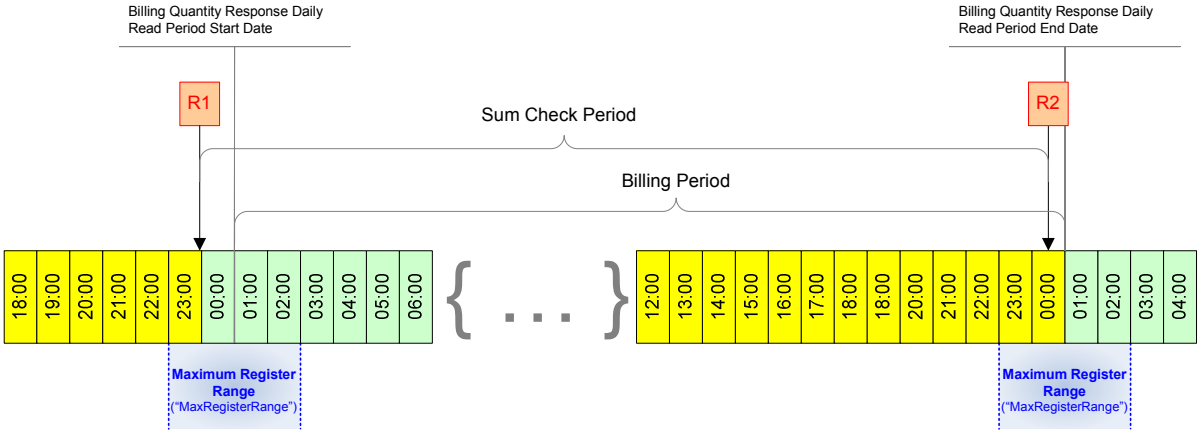

Figure 6-1 Billing Validation Sum Check on Billing Period

[4] Ibid Footnote No. 1.

The Billing Validation Sum Check is performed by comparing the total consumption of the Billing Quantity Response with the difference between the register read values nearest to the start and end points of the billing period as shown in Figure 6-1. Discrepancies may be the result of inaccuracies in manual meter data verification or editing activities.

The Billing Validation Sum Check accounts for the meter multiplier and applicable CT and VT ratios assigned to the SDP through synchronization (CT/PT Multiplier attribute) and meter register rollover and meter changes (using the First and Last Meter register readings taken at the time of the meter change and communicated through the synchronization process). The Billing Validation Sum Check requires two register readings. The first must be within 'MaxRegisterRange' hours of the Start of the billing period, the second within 'MaxRegisterRange' hours of the End of the billing period. If these register values are not available the Billing Validation Sum Check may be marked as a Billing Validation Sum Check failure or Billing Validation Sum Check skipped.

If the difference calculated above is greater than the 'ThresholdValue' for the VEE Service the Billing Validation Sum Check has failed.

The Billing Validation Sum Check 'ThresholdValue' is set specifically for the Data Delivery Service associated with each VEE Service. The threshold value above which the Billing Validation Sum Check fails may be expressed for each Data Delivery Service as one of:

1. 'Ratio' – the Sum Check is determined by comparing the absolute value of the total Billing Quantity consumption subtracted from the register reads difference divided by the register read difference to an allowable ratio i.e. the 'ThresholdValue', or
2. 'Value' – the Sum Check is determined by comparing the absolute value of the total Billing Quantity consumption subtracted from the register reads difference to a maximum kWh value i.e. the 'ThresholdValue'.

The register read difference (RR2 – RR1) is determined by RR2Time within the 'MaxRegisterRange of the Billing Quantity Response End Date and RR1Time within the 'MaxRegisterRange' of the Billing Quantity Response Start Date.

The threshold value when using the threshold type 'Ratio' is expected to be set at or below the error permitted under the dispute provisions of the Electricity and Gas Inspection Regulations. When using the threshold type 'Value' the threshold value is expected to be the maximum value of one interval period in kWh.

The Billing Validation Sum Check process accounts for CT/PT Multiplier when comparing the difference between the register read values and the total consumption of the Billing Quantity Response.

Billing Quantities for SDPs that fail the Billing Validation Sum Check may still be reported but the record will be flagged with the Billing Validation Sum Check failure code, alternatively the Billing Quantities may be nullified and the record(s) reported with the Billing Validation Sum Check failure code. The Billing Validation Sum Check is performed as soon as the billing process acquires complete data for the billing period in order to provide the LDC the opportunity to address sum check failures prior to the close of the billing window as defined by the 'LatestReportDays' parameter of the Billing Quantity process.

6.2 Commercial and Industrial Consumers with Metering of Demand (Multiple channel metering)

Billing validation services used for Residential and Small General Service Customers will also be available for use for C&I Customers.

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7. VEE Services

7.1 Overview of Message Validation and Estimation

Figure 7-1 illustrates the high-level flow of the message validation and message estimation processes. The initial step in the process is to determine the VEE Service that is to be used for the Meter Transfer Block. The process flow is then as follows:

1) Message Validation Checks - Interval consumption data in the Meter Transfer Block is checked against the criteria defined in the VEE Service parameters. Each interval within the Meter Transfer Block is assigned an outcome. The four outcomes supported are:

    a) Validated – the consumption in the interval passed all tests and is acceptable for billing and recorded with a validation status of 'validated' (VAL) in the Meter Data Database.

    b) Validate/Flag – the consumption in the interval has failed some validations but is acceptable for billing – these are soft validation failures. This data is flagged as having failed validations and recorded with a validation status of 'validated' (VAL) in the Meter Data Database. Soft validation failures are recorded as flag and failure codes on each interval record.

    c) Estimate – the consumption in the interval is incomplete or has failed validation, this data is passed on for automated estimation. This information will be recorded with a validation status of 'needs estimation' (NE) in the Meter Data Database but will not be made available for billing purposes until estimation is completed. These are hard validation failures.

    d) Verify/Edit – the consumption in the interval that is incomplete or has failed validation checks configured for manual verification or editing, this data is recorded with a validation ststus of 'needs verification or edit' (NVE) in the Meter Data Database pending manual processing. This information will not be made available for billing purposes until verification and editing is completed. These are hard validation failures.

2) Message Estimation Routines – Interval consumption data that has failed validation as incomplete (e.g. missing intervals) or having failed validation tests configured for estimation may be estimated according to processes defined by the VEE Service parameters. Register reads are not estimated. Estimated interval consumption data is then recorded with a validation status of 'estimated' (EST) in the Meter Data Database and flagged with a Change Method code indicating the type of estimation performed. Estimated interval consumption data is available for framing and the production of Billing Quantities.

3) Manual Verification or Edit – Consumption values for intervals that requires manual intervention is recorded with a validation status of 'needs verification or edit' (NVE) in the Meter Data Database. This data remains in this state and is not usable for billing until manual verifications or edits have been completed.

4) Interval consumption data for which the VEE Service is "No Validation" is recorded with a validation status of 'not validated' (NV) in the Meter Data Database and made available for billing.

5) Validated data; validated/flagged data; estimated data; verified or edited data, and 'not validated' data is available for daily Framing and the production of Billing Quantities.

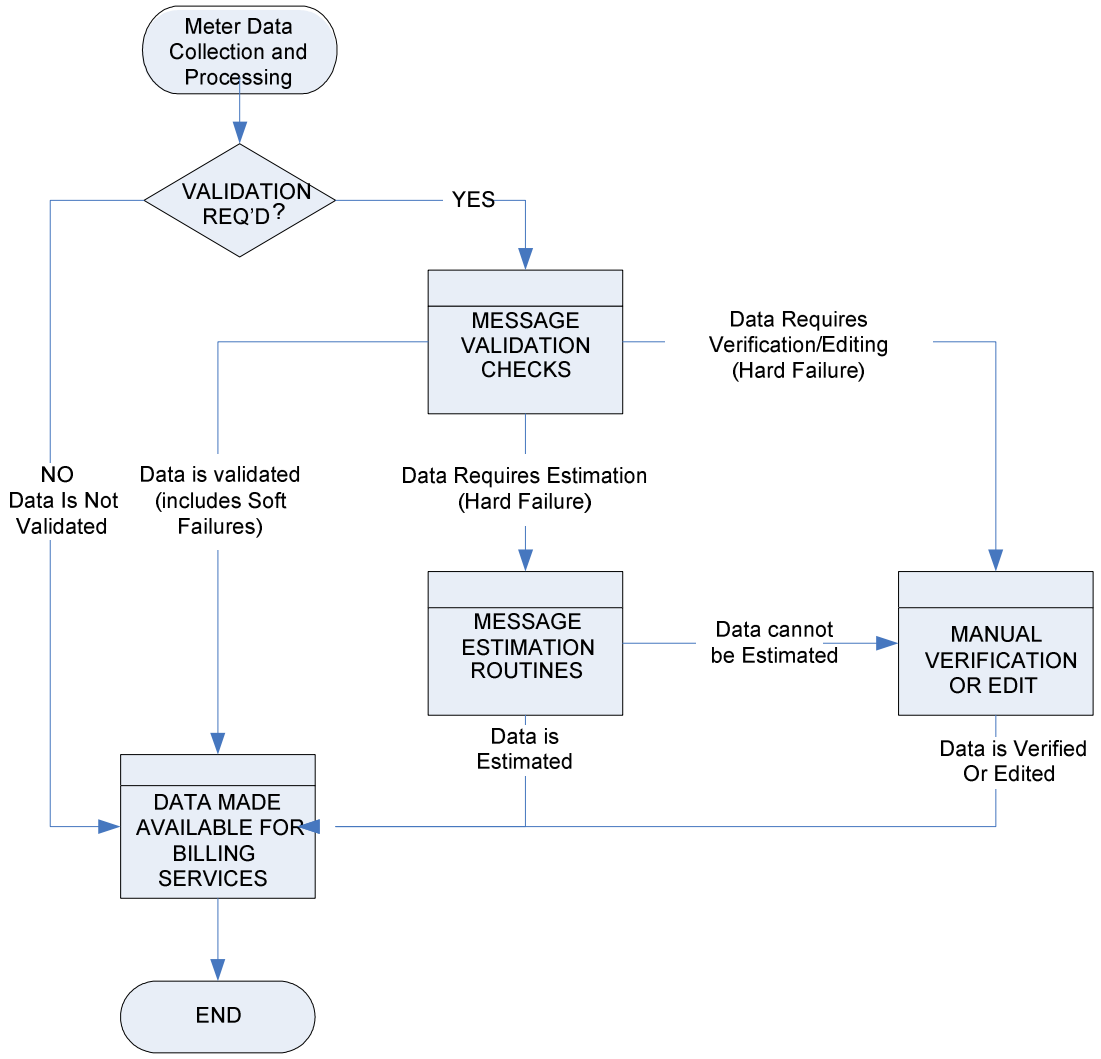

Figure 7-1 VEE Sequence as Meter Transfer Block is Received

7.1.1 Message Validation Checks

Table 7-1 below provides the parameters and descriptions for the message validation checks that are undertaken against each Meter Transfer Block. The columns in the table have the following meanings:

- **Validation Checks –** the nature of the validation test or check
- **Parameter –** the parameter that is set when the VEE Service is configured
- **Valid Value** – the allowable values of the parameter. For parameters labeled as 'Action' these are the values available for configuration to set the action when the validation check is deemed to have failed.

- **Description** – description of the parameter.

For each of the validation checks where an action is taken (as noted in the Parameter column in Table 7-1) one possible outcome is available based upon the configuration value chosen. Up to three configurable values may be available:

- **Validate/Flag –** Upon validation test failure interval consumption data is acceptable for billing. This data is flagged as having failed validations and stored in the Meter Data Database. These soft validation failures are recorded and reported to the LDC.
- **Estimate –** Upon validation test failure interval consumption data will not be made available for billing. This data is passed on for automated Estimation. These failures are recorded and reported to the LDC.
- **Verify/Edit –** Upon validation test failure interval consumption data will not be made available for billing. This data requires manual verification or editing and is saved in the Meter Data Database for manual processing. These failures are recorded and reported to the LDC.

All validation checks are undertaken for each interval, i.e. the process does not stop on encountering the first failure.

Validation Checks	Parameter	Valid Value	Description
Overall Control	Validation Enabled	Y/N	Indicates whether any validation or estimating is to be performed. If 'Y' validation is enabled If 'N' validation is disabled
Interval Flags Check			
Missing Intervals	Missing Intervals Action	Validate/Flag Estimate Verify/Edit	Indicates action to be taken for missing intervals. Flagged in the Meter Data Database as 'NO_DATA' and displayed in the GUI as 'Y' in the 'NoData' field.
Test Mode	Test Mode Action	Validate/Flag Estimate Verify/Edit	Indicates action to be taken on reporting of a test mode condition by the AMCC. Flagged in the Meter Data Database as 'TEST_MODE' and displayed in the GUI as 'Y' in the 'TestMode' field.
Pulse Overflow	Pulse Overflow Action	Validate/Flag Estimate Verify/Edit	Indicates action to be taken on reporting of a pulse overflow condition by the AMCC. Flagged in the Meter Data Database as 'PULSE_OVERFLOW' and displayed in the GUI as 'Y' in the 'Overflow' field.

Validation Checks	Parameter	Valid Value	Description
Time Change	Time Change Action	Validate/Flag Estimate Verify/Edit	Indicates action to be taken on reporting of a time change by the AMCC. Flagged in the Meter Data Database as 'TIME_CHANGE' and displayed in the GUI as 'Y' in the 'TimeChg' field.
Meter Diagnostic	Meter Reset Action	Validate/Flag Estimate Verify/Edit	Indicates action to be taken on reporting of a diagnostic error by the AMCC. Flagged in the Meter Data Database as 'METER_RESET' and displayed in the GUI as 'Y' in the 'MtrDiagError' field.
Reverse Energy	Reverse Rotation Action	Validate/Flag Estimate Verify/Edit	Indicates action to be taken on reporting of reverse rotation by the AMCC. Flagged in the Meter Data Database as 'REVERSE_ROTATION' and displayed in the GUI as 'Y' in the 'RevEnergy' field
Calculation Based Checks			
Maximum Demand	Maximum Demand Check	Y/N	Indicates whether to perform the maximum demand check on each interval. If 'Y' maximum demand is enabled If 'N' maximum demand is disabled
	Maximum Demand Action	Validate/Flag Estimate Verify/Edit	Indicates action to be taken if maximum demand check fails. Upon failure stored in the Meter Data Database as a bit sum 'FAIL_CODE' decimal value = 64 and displayed in the GUI as a decimal sum under 'FailCode'.
	Maximum Demand Value	Min: 0 Max: n/a Units: kW	Maximum demand value in kW for an interval
Spike Check	Spike Check	Y/N	Indicates whether to perform a spike check on the Meter Transfer Block. If 'Y' spike check is enabled If 'N' spike check is disabled
	Spike Check Action	Validate/Flag Estimate Verify/Edit	Indicates action to be taken if a spike check fails. Upon failure stored in the Meter Data Database as a bit sum 'FAIL_CODE' decimal value = 1 and displayed in the GUI as a decimal sum under 'FailCode'.

Validation Checks	Parameter	Valid Value	Description
	Spike Check Threshold	Min: 0 Max: n/a Units: kWh	Minimum value in kWh of highest interval required to perform spike check
	Spike Check Ratio	Min: 0.0 Max: n/a	Maximum ratio of highest to Nth highest interval value to pass spike check.
	Second Peak Rank	Min: 2 Max: n/a	2,3,4, … 'n' the order of the interval value to use in the spike check ratio test – e.g. 2nd highest value, 3rd, 4th, etc.
Sum Check	Msg Sum Check	Y/N	Indicates whether to perform a sum check on the Meter Transfer Block. If 'Y' sum check is enabled If 'N' sum check is disabled
	Msg Sum Check Action	Validate/Flag Verify/Edit	Indicates action to be taken on failure of sum check in a Meter Transfer Block. Upon failure stored in the Meter Data Database as a bit sum 'FAIL_CODE' decimal value = 2 and displayed in the GUI as a decimal sum under 'FailCode'.
	Msg Sum Check Threshold	Min: 0 Max: n/a Units: kWh	The threshold value for a Meter Transfer Block in kWh for which the Sum Check test will fail. This is a value in kWh before the CT/PT Multiplier.
Extra-Message Checks			
Consecutive Zeros	Consecutive Zeros Check	Y/N	Indicates if the consecutive zeros check is to be performed If 'Y' consecutive zeros is enabled If 'N' consecutive zeros is disabled
	Consecutive Zeros Action	Validate/Flag Estimate Verify/Edit	Indicates action to be taken on failure of consecutive zeros check. Upon failure flagged as 'ZER' on Reports VE01 and VE11.
	Consecutive Zeros Threshold	Number of intervals	Number of consecutive intervals with zeros allowed. NOTE: The specification of the threshold value as a number of intervals requires that a different VEE Service be defined for meters of different interval length.

Table 7-1 Message Validation Check Parameters and Descriptions

7.1.2 Message Estimation Routines

Gaps or errors in interval consumption data may be estimated by the MDM/R as they are identified in the validation process. Estimation for filling gaps between Meter Transfer Blocks is limited by the 'Max Estimation Days' parameter and gaps that exceed this value are not estimated.

Estimation does not extend beyond the most recent Meter Transfer Block received. The LDC is responsible for manually editing any Meter Read data where the Meter Transfer Blocks are not complete to the end of the billing period.

These estimations are performed on intervals recorded by the validation process with a validation status of 'NE' in the Meter Data Database.

Table 7-2 provides the parameters and descriptions for the message estimation that will be undertaken for intervals in each Meter Transfer Block that have been recorded as needing estimation. The columns in the table have the following meanings:

- **Estimation –** the nature of the estimation routine
- **Parameter –** the parameter that is set when the VEE Service is configured
- **Valid Value –** the allowable values of the parameter
- **Description –** description of the parameter.

Estimation Routine	Parameter	Valid Value	Description
Linear Interpolation	Max Interpolation Minutes	Min: 0 Max: n/a Units: minutes	Maximum number minutes that may be estimated using linear interpolation. Set to zero if linear interpolation is not allowed.
Overall Control	Max Estimation Days	Min: 0 Max: n/a Units: days	Maximum number of consecutive days that may be estimated either using Historic (Like Days) or Class Load Profile estimation.
	Register Allocation	Y/N	Determines if Historic estimations and/or Class Load Profile estimations are scaled using Register Reads at the start and end of the Meter Transfer Block.
Historic Estimation	Oldest Like Day	Min: 0 Max: n/a Units: days	Specifies the oldest day of historical data that may be used in historic estimation. The date established by this parameter is calculated in 24-hour increments relative to the Start Time of the first interval of a Meter Transfer Block needing estimation.

Estimation Routine	Parameter	Valid Value	Description
	Number Like Days	Min: 0 Max: n/a Units: days	Specifies the preferred (and maximum) number of reference days to use in calculating an historical estimation. Note: Setting this value to '0' effectively switches Historical estimation off. A '0' value is used when only Class Load Profile estimation is to be used for a particular VEE Service.
	Newest Like Day Method	'Newest Like Day' or 'Billing Cycle'	Provides for days after the day being estimated used as reference days. 'Newest Like Day' – use newer like days up to a 'Newest Like Day Limit' 'Billing Cycle' – use newer like days within a billing cycle.
	Newest Like Day Limit	Min: 0 Max: n/a Units: days	Used when 'Newest Like Day Method' is set to 'Newest Like Day'. Specifies the latest day of data that may be used in historical estimation. The date established by this parameter is calculated in 24-hour increments relative to the End Time of the last interval of a Meter Transfer Block needing estimation.
Class Load Profile	Use Class Profile	Y/N	Indicates if Class Load Profile estimation is to be performed. If 'Y' Class Load Profile is enabled If 'N' Class Load Profile is disabled
	Class Profile ADU Min Days	Min: 0 Max: n/a Units: days	Specifies the minimum separation between Register Reads used in calculating Average Daily Usage for Class Profile scaling
	Class Profile ADU Oldest Read	Min: 0 Max: n/a Units: days	Specifies the oldest day of Register Read data that may be used when calculating Average Daily Usage for Class Profile scaling
	Class Profile ADU Newest Read	Min: 0 Max: n/a Units: days	Specifies the latest day of Register Read data that may be used when calculating Average Daily Usage for Class Profile scaling
	Class Profile Channel	Channel Reference	If 'Use Class Profile' is set to "Y" this parameter must reference a valid channel containing reference interval data

Table 7-2 Message Estimation Routine Parameters and Descriptions

7.1.3 Validation and Estimation Outcomes

The MDM/R VEE Services generate meta-data relating to each specific interval consumption value and this meta-data is stored against interval records in the Meter Data Database. Table 7-3, Daily VEE Outcomes, lists the four validation statuses used to identify the state of an interval. Each state is further defined by the method used to modify an interval value and the validation test that failed. All Change Method Codes are recorded for each interval consumption value. Validation Failure Codes are set for all the VEE checks that fail for each interval.

Interval Validation Status	Change Method Codes	Validation Failure Code
NO VALIDATION (NV): No validation performed, data may be used as permitted.	**NULL**: Interval value not changed.	Not applicable
VALIDATED (VAL): Interval has been validated and is available for billing and other uses.	**NULL**: Interval value not changed. **VER**: Interval has been manually reviewed and verified for submission to billing.	Failure code(s) from validation failures as indicated in Table 7-1 NOTE: Failure code on validated interval is a Warning or Soft error
ESTIMATED (EST): Interval was estimated and is available for billing and other uses.	**ESA:** Interval value estimated using linear interpolation **ESB**: Interval value estimated using Historic estimation without Register Read scaling **ESC**: Interval value estimated using Historic estimation with Register Read scaling **ESD**: Interval value estimated using Class Load Profile estimation without scaling **ESE**: Interval value estimated using Class Load Profile estimation scaled using Average Daily Usage from register reads **ESF**: Interval value estimated using Class Load Profile estimation with Register Read scaling **ESG**: Interval value estimated using extrapolation **EDT:** Interval value has been manually edited. **EXT:** Interval value was estimated by an external system	Failure code(s) from validation failures as indicated in Table 7-1

NEEDS VERIFICATION/EDITING (NVE): Interval requires manual verification or editing and is not available for billing or other uses.	**NULL:** Null pending manual edit or verification then Validation Status changed to VAL or EST.	Failure code(s) from validation failures as indicated in Table 7-1

Table 7-3 VEE Outcomes

7.1.4 Billing Validation Sum Check

Table 7-4 provides the parameters and descriptions for the Billing Validation Sum Check that will be undertaken against each Billing Quantity Response. The columns in the table have the following meanings:

- **Validation Check** – the nature of the validation check
- **Parameter** – the parameter that is set when the VEE Service is configured
- **Valid Value** – the allowable values of the parameter
- **Description** – description of the parameter

Validation Check	Parameter	Valid Value	Description
Billing Validation Sum Check	BillingSumCheck	Y/N	Indicates whether to perform the Billing Validation Sum Check on the computed Billing Quantity. If 'Y' sum check is enabled If 'N' sum check is disabled
	BillingSumCheckFail Action	'Value' OR 'null'	Upon Billing Validation Sum Check failure: If set to 'Value' will provide Billing Quantity Response with computed values and error code If 'null' will provide Billing Quantity Response with 'null' values and error code
	MaxRegisterRange	Min: 0 Max: n/a Units: hours	Maximum period in hours to search for the register reads nearest the: Billing Quantity Response Daily Read Period Start Date and Billing Quantity Response Daily Read Period End Date

Validation Check	Parameter	Valid Value	Description
	NoRegRead Action	'Skip' OR 'Fail'	Action to take if register readings are not available. If 'Skip' Billing Validation Sum Check is not performed If 'Fail' Billing Validation Sum Check fails upon failure to find register reads
	Sync Mapping Code	Char (2) Specific usage: 01, 02, 03 … 30	The VEE Service to which the Data Delivery Service is to be associated.
	ThresholdType	'Ratio' OR 'Value'	The type of Billing Sum Check: If set to 'Ratio', a percentage based sum check is performed. If set to 'Value', a threshold based sum check is performed.
	ThresholdValue	Min: 0 Max: n/a Value of form: Number (1,3)	Threshold at which sum check passes or fails. If 'ThresholdType' is set to: 'Ratio' – then a percentage allowed for the sum check difference expressed as a ratio of the register read difference and the total Billing Quantity, e.g. 1% is 0.010 'Value' – then a value in kWh allowed for the actual sum check difference

Table 7-4 Billing Validation Sum Check Parameters and Description

7.2 VEE Services for Residential or Small General Service Customers

A VEE Service refers to a specific validation configuration in combination with a specific set(s) of estimation algorithms. A set of default VEE Services will be created that will enable Ontario LDCs to choose the VEE Services that are most appropriate for their consumers yet still provide a level of standardization across the province. The default VEE Services will be:

VEE Service, No Validation

This VEE Service does not perform any validation checks. This could be used when new SDPs are established in the MDM/R and the quality of data has not yet stabilized. This will allow for the collection of interval data in the MDM/R to be used for future estimation processes but will not create unnecessary notifications to the LDC until the data quality has stabilized. The SDPs using this VEE

Service will typically not be set to send Billing Quantities to the LDCs CIS system as the Meter Read data has not been validated.

VEE Service, No Estimation

This VEE Service could be used for any SDP where no automatic estimation is required. Any missing Meter Read data for a SDP using this VEE Service will require manual estimation or editing.

VEE Service, Residential

This VEE Service shall be used for the majority of residential consumers.

VEE Service, Residential – Electric Heat

This VEE Service can be used for residential electric heat consumers. These consumers typically display very unbalanced usage patterns between seasons.

VEE Service, Transformer Type

This VEE Service can be used for transformer type SDPs. These SDPs generally have a higher level of usage and the presence of Voltage and/or Current Transformers with a CT/PT Multiplier greater than 1 (one) require the need to have unique thresholds on some of the validation checks.

VEE Service, Small General Service

This VEE Service can be used for high usage consumers. This VEE Service has higher threshold values in the maximum demand validation check.

VEE Service, Seasonal

This VEE Service can be use for consumers that have no usage for extended periods of time.

Table 7-5 provides the configuration parameters applied for each of the default VEE Services described above. The configuration parameters for each default VEE Service are considered initial values. The efficacy of the configuration for each VEE Service will be demonstrated during testing and initial integrated operation of the MDM/R and AMI systems. The configuration for each VEE Service may be updated as the result of ongoing testing and operation of the Ontario Smart Metering System.

Parameter	No Validation	No Estimation	Residential	Residential – Electric Heat	Transformer Type	Small General Service	Seasonal
Sync Mapping Code	01	02	03	04	05	06	07
MESSAGE VALIDATION CHECKS							
Validation Enabled	N	Y	Y	Y	Y	Y	Y
Interval Flags Check							
Missing Intervals Action	N/A	Verify/Edit	Estimate	Estimate	Estimate	Estimate	Estimate
Test Mode Action	N/A	Validate/Flag	Validate/Flag	Validate/Flag	Validate/Flag	Validate/Flag	Validate/Flag
Pulse Overflow Action	N/A	Verify/Edit	Verify/Edit	Verify/Edit	Verify/Edit	Verify/Edit	Verify/Edit
Time Change Action	N/A	Validate/Flag	Validate/Flag	Validate/Flag	Validate/Flag	Validate/Flag	Validate/Flag
Meter Reset Action	N/A	Verify/Edit	Verify/Edit	Verify/Edit	Verify/Edit	Verify/Edit	Verify/Edit
Reverse Rotation Action	N/A	Validate/Flag	Validate/Flag	Validate/Flag	Validate/Flag	Validate/Flag	Validate/Flag
Maximum Demand Check							
Maximum Demand Check	N/A	Y	Y	Y	Y	Y	Y
Maximum Demand Action	N/A	Validate/Flag	Validate/Flag	Validate/Flag	Validate/Flag	Validate/Flag	Validate/Flag
Maximum Demand Value	N/A	50 kW	15 kW	25 kW	35 kW	50 kW	25 kW
Spike Check							
Spike Check	N/A	N	Y	Y	Y	Y	Y
Spike Check Action	N/A	N/A	Validate/Flag	Validate/Flag	Validate/Flag	Validate/Flag	Validate/Flag
Spike Check Threshold	N/A	N/A	7.5 kWh	15 kWh	20 kWh	25 kWh	7.5 kWh
Spike Check Ratio	N/A	N/A	50	50	50	50	50
Second Peak Rank	N/A	N/A	3	3	3	3	3
Sum Check							
Msg Sum Check	N/A	Y	Y	Y	Y	Y	Y
Msg Sum Check Action	N/A	Validate/Flag	Validate/Flag	Validate/Flag	Validate/Flag	Validate/Flag	Validate/Flag
Msg Sum Check Threshold	N/A	0.25 kWh	0.25 kWh	0.25 kWh	0.25 kWh	0.25 kWh	0.25 kWh
Consecutive Zeros Check							
Consecutive Zeros Check	N/A	Y	Y	Y	Y	Y	Y
Consecutive Zeros Threshold	N/A	336[5]	336	336	336	336	4380[6]
Consecutive Zeros Action	N/A	Validate/Flag	Validate/Flag	Validate/Flag	Validate/Flag	Validate/Flag	Validate/Flag

[5] Based on a one (1) hour interval meter and 14 days

[6] Based on a one (1) hour interval meter and 6 months

Parameter	No Validation	No Estimation	Residential	Residential – Electric Heat	Transformer Type	Small General Service	Seasonal
Sync Mapping Code	01	02	03	04	05	06	07
MESSAGE ESTIMATION ROUTINES							
Max Interpolation Minutes	N/A	0	0	0	0	0	0
Overall Control – Historic Estimation and Class Load Profile Estimation							
Max Estimation Days	N/A	0	15	15	15	15	45
Register Allocation	N/A	N	Y	Y	Y	Y	Y
Historic Estimation							
Oldest Like Day	N/A	0	30	30	30	30	0
Number Like Days	N/A	0	5	5	5	5	0
Newest Like Day Method	N/A	Newest Like Day	Newest Like Day	Newest Like Day	Newest Like Day	Newest Like Day	Newest Like Day
Newest Like Day Limit	N/A	0	1	1	1	1	1
Class Load Profile Estimation							
Use Class Load Profiles	N	N	N	N	N	N	Y
Class Profile ADU Min Days	N/A	N/A	N/A	N/A	N/A	N/A	5
Class Profile ADU Oldest Day	N/A	N/A	N/A	N/A	N/A	N/A	30
Class Profile ADU Newest Day	N/A	N/A	N/A	N/A	N/A	N/A	1
Class Profile Channel	N/A	N/A	N/A	N/A	N/A	N/A	Internal Siebel Ref
BILLING VALIDATION SUM CHECK							
BillingSumCheck	N	N	Y	Y	Y	Y	Y
BillingSumCheckFail Action	N/A	N/A	Value	Value	Value	Value	Value
MaxRegisterRange	N/A	N/A	1	1	1	1	1
NoRegRead Action	N/A	N/A	Fail	Fail	Fail	Fail	Fail
Sync Mapping Code	01	02	03	04	05	06	07
ThresholdType	N/A	N/A	Ratio	Ratio	Ratio	Ratio	Ratio
ThresholdValue	N/A	N/A	0.010	0.010	0.005	0.005	0.010

Table 7-5 Default VEE Services Configuration

7.3 VEE Services for Commercial and Industrial Consumers with metering of Demand (Multiple channel metering)

VEE Services for C&I customers will be configured based on existing and additional validation, estimation and editing functionality developed for the MDM/R and after consultation with the SMSIP Working Group VEE Sub-Committee.

– End of Document –