

SLD Review Update - CT Ratio Issues

Revenue Metering Subcommittee Meeting

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- q Numerous SLDs have been submitted by MSPs to register “New Metering Installations” using CT ratios that have not been properly sized to meet the requirements of the Wholesale Revenue Metering Hardware Standard, 6.9.1
- q IESO Metering Audits of “New” and “Existing” metering installations have also identified multiple locations where CTs have been incorrectly sized or the load/generation pattern has changed dramatically since initial CT installation
- q IESO compiles a summary report on a quarterly basis that counts the number of hours per month that each I²h channel operates at less than 0.25 A²h of CT secondary current (0.5 A)

Why are IESO Staff Reviewing CT Ratios at Time of SLD Review?

q IESO's objectives at time of SLD review is to:

- **Reduce the number of “NEW” metering installations registered with over-sized CTs and reduce the number of times an MMP is faced with the cost of replacing “NEW” CTs**
- **Identify “EXISTING” metering installations with CTs that are now operating outside of their approved accuracy range to ensure that both the MSP and the MMP have evaluated the facility's current normal load/generation pattern and are aware that the CTs should be replaced at the first reasonable opportunity**

Where is this Typically an Issue?

- q **Generating Stations**
 - Station Service (SS) loads behind an RWM where CTs have been sized to Generator Maximum Rated Output only
 - Need to measure SS loads accurately when Generator is not injecting to grid
- q **New Transformer Stations**
 - Initial load level is low (especially spring and fall) and
 - CTs have been sized for both
 - ü ultimate TS load and
 - ü contingency situations at a DESN with one transformer out of service
- q **Existing Metering Installations undergoing Substantial Upgrade**
 - 2 or more Instrument Transformers being replaced
 - ü Blondel Compliance
 - ü Existing ITs are Non-MC Approved
 - ü Customer service entrance equipment upgrade or replacement
 - Facility's load/generation has "seasonal variation" or
 - LDC boundary meter used for backup supply
- q **These Metering Installations require CTs that have been designed to operate accurately over a wide dynamic range**

q A “New Metering Installation” is:

- any metering installation for which “major components were ordered or procured **AFTER** May 17, 2000”; and
- Registered with the IESO by an MSP using the “Declaration of Compliance” (IMO Form 1298)

PART 2.—DECLARATION

The undersigned acknowledges having read and understood the provisions of the *Market Rules* and of relevant *IESO* documents regarding the conditions that a *metering installation* has to meet in order to be deemed “compliant” and thus suitable for participation in Ontario’s Energy Market. In light of the above, the undersigned declares that no non-compliant items that would require an exemption, as defined in the *Market Rules* or other relevant *IESO* documents, have been identified at the time of this declaration. The undersigned therefore declares that the *metering installation* pertaining to the above facility is indeed compliant and thus suitable for registration with the *IESO*.

q An “Existing Metering Installation” is:

- any metering installation that was “in service on **April 17, 2000**”; or
- any metering installation for which “major components were ordered or procured **BEFORE** May 17, 2000”; and
- Registered with the IESO by an MSP using the “Alternative Metering Installation Standard Checklist” (IMO Form 1042)

q Wholesale Revenue Metering Hardware Standard requirements for NEW INSTALLATIONS:

6.9 Instrument Transformer Ratios – New Instrument Transformers

6.9.1 Selection of Current Transformer Ratios

Current transformer ratios shall be selected according to the following factors:

- a. the maximum sustained primary current in a current transformer shall not exceed the primary tap multiplied by the continuous current Rating Factor (RF) of the current transformer; and
- b. the minimum sustained primary current during **normal operation** shall not be less than 10% of the primary tap, for ANSI 0.3 accuracy class; or
- c. the minimum sustained primary current during **normal operation** shall not be less than 5% of the primary tap, for the “proposed guideline” of ANSI 0.15 accuracy class ³.

q **MSP Obligations** in Chapter 6, Appendix 6.1, 1.3.2.27 require for both “New” and “Existing” Metering Installations:

6

- 1.3.2 Each *metering service provider* shall, in respect of each *metering installation* in respect of which it is the *metering service provider*:
- 1.3.2.27 ensure that the *metering installation* is suitable for the range of operating conditions to which it will be exposed and that all equipment within the *metering installation* operates within the limits established for such equipment in this Chapter and in any policy or standard established by the *IMO* pursuant to this Chapter.

q WRMHS requires:

9. Parallel Connected Current Transformer Secondaries

9.2 Existing Installations

9.2.1 IMO Approval

Where parallel connected current transformer secondaries existed within *facilities* constructed before the *Market Rules* come into effect, approval shall be obtained from the *IMO* to continue use within the *IMO-administered market*.

9.2.2 Requirements for Approval

The requirements for approval are:

- m. current transformers shall not operate below 10% of the secondary ampere rating under normal operating conditions;

q Market Manual 3.6, Table 1-1, Items 11, 13 requires MSP to show on the SLD at the time of registering a metering installation:

- **CT ratios, (Available and In-Use) and**
- **Continuous Current Rating Factor (RF)**
 - ü **RF = 1.5 is typical**
 - ü **RF commercially available from 1.0 to 3.0, rarely 4.0 max.**
- **ANSI Accuracy Class on CT Nameplate**
 - ü **Must agree with MC NOA information**
 - ü **May also confirm extended accuracy range testing done by the Manufacturer where CTs have been built to the 0.15S or 0.15 Draft IEEE CT standards**

IESO Staff CT Ratio Analysis at Time of SLD Review

- q Full load Amps based on Power Transformer MVA rating and/or secondary main breaker rating compared with nominal CT Ratio and RF.**
- q MV-90 Load Duration Curve used to review load history of existing metering installations at time of SLD submission for Registration of the “NEW” or “Substantially Upgraded” metering installation**

Example of CT Accuracy Range Existing Conditions

q 2 Element Legacy Metering installation

- VTs 4200:120 Volts
- 0.3 ANSI Class CT's 600:5, RF 1.5
- CT low limit = $10\% \times 600 = 60$ Amps
- CT maximum limit $1.5 \times 600 = 900$ Amps
- Historical Peak load 408 Amps

Site Equipment Ratings and Historical Load Information

| Review of Ultimate Service Entrance Loading Scenarios | | | |
|--|--|----------------------------------|-----|
| | Facility: | Customer 'A' CTS | |
| | Power Transformer Ratings: | T2 | |
| | Capacity: | 3,000.0 kVA | ONS |
| | Max. Rated Secondary Current: (@ Nominal Voltage) | 416.4 Amps | |
| | Secondary Breaker Operating Designation: | T2 Main | |
| | Service Entrance Nominal Ratings: | | |
| | Voltage: | 4,160 Volts | |
| | Current: | 600 Amps | |
| | Power Factor: | 100.0% | |
| | % of Main Breaker Loading allowed by ESA: | 80.0% | |
| | Equivalent Peak Current: | 480.0 | |
| | ESA Approved Load on Breaker: | 3,458.6 kVA | |
| | Review of MV-90 Past Year's Load History: | | |
| | Recent Peak Demand (15 min, previous 12 months): | 2,937 kVA | |
| | Power Factor at Time of Peak Demand: | 89.2% | |
| | Calculated Equivalent Current: | 407.6 Amps | |

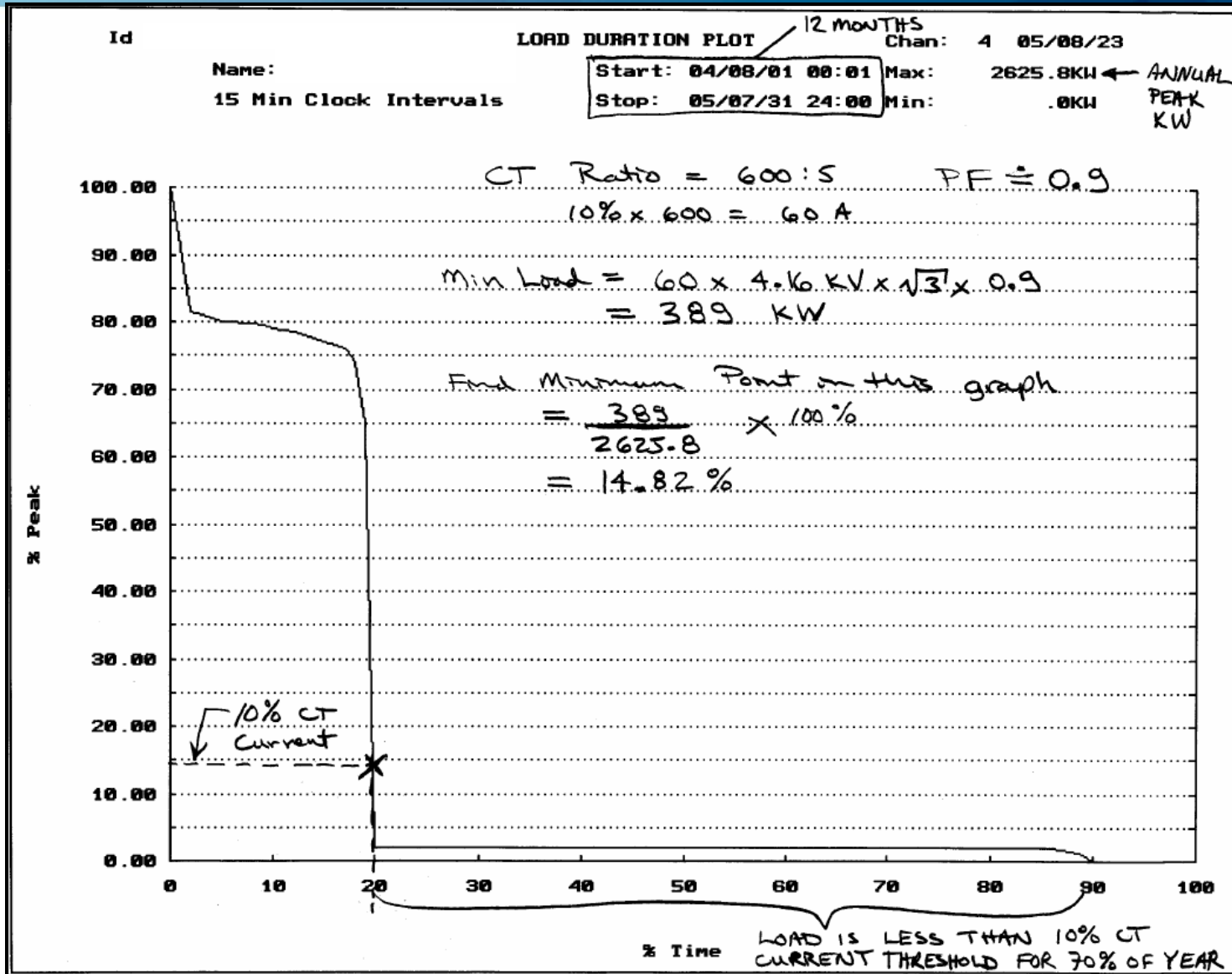
Existing CT Accuracy Range Limits

Analysis of 2 Element Metering Installation Accuracy Range

| Instrument Transformer Characteristics: | | | |
|--|-----------|-----------|-------|
| | Primary : | Secondary | Ratio |
| Potential Transformer | 4,200.0 | 120.0 V | 35 |
| Current Transformer | 600.0 | 5.0 A | 120 |
| Thermal Rating Factor | 1.5 | | |
| Assumed Power Factor: (for all cases) | 0.9 | | |

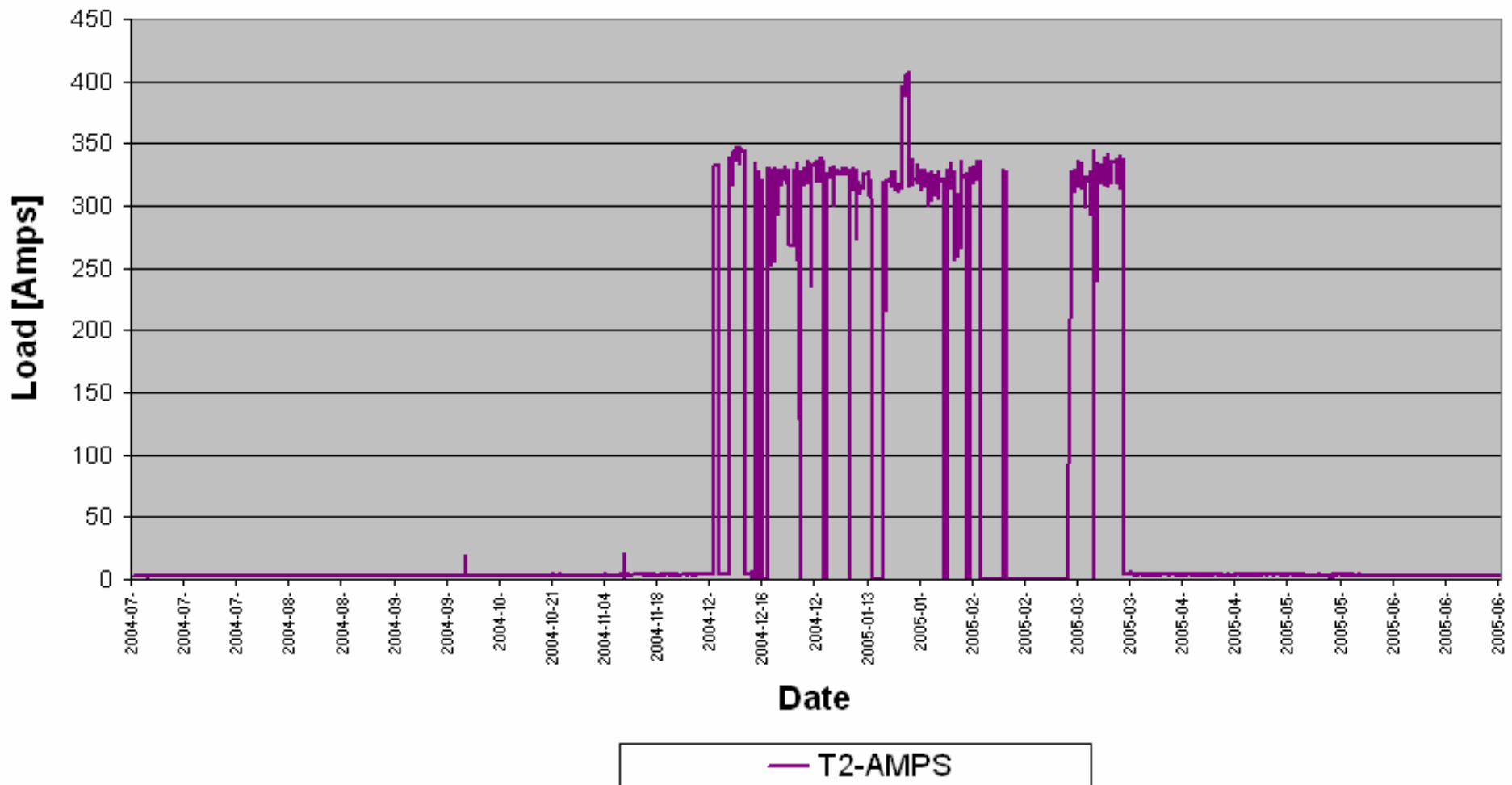
| | | MEASUREMENT CANADA APPROVED ACCURACY RANGE | | | | | | | |
|-----------------------|--------------------------------------|--|-------|---------|---------|---------|---------|--|----|
| | | RF | | | | | | | |
| Case 4. | | | | | | | | | |
| % of Rated PT Voltage | 3 Phase Voltage | | | | | | | | |
| 100.0% | 4,200.0 | | | | | | | | |
| | % of CT Rated Current: | 10.0% | 25.0% | 50.0% | 75.0% | 100.0% | 150.0% | | RF |
| | Equivalent Primary Current [A]: | 60.0 | 150.0 | 300.0 | 450.0 | 600.0 | 900.0 | | |
| | Equivalent Primary Demand Load [kW]: | 392.8 | 982.1 | 1,964.1 | 2,946.2 | 3,928.3 | 5,892.4 | | |

Seasonal Load MV-90 Load Duration Curve



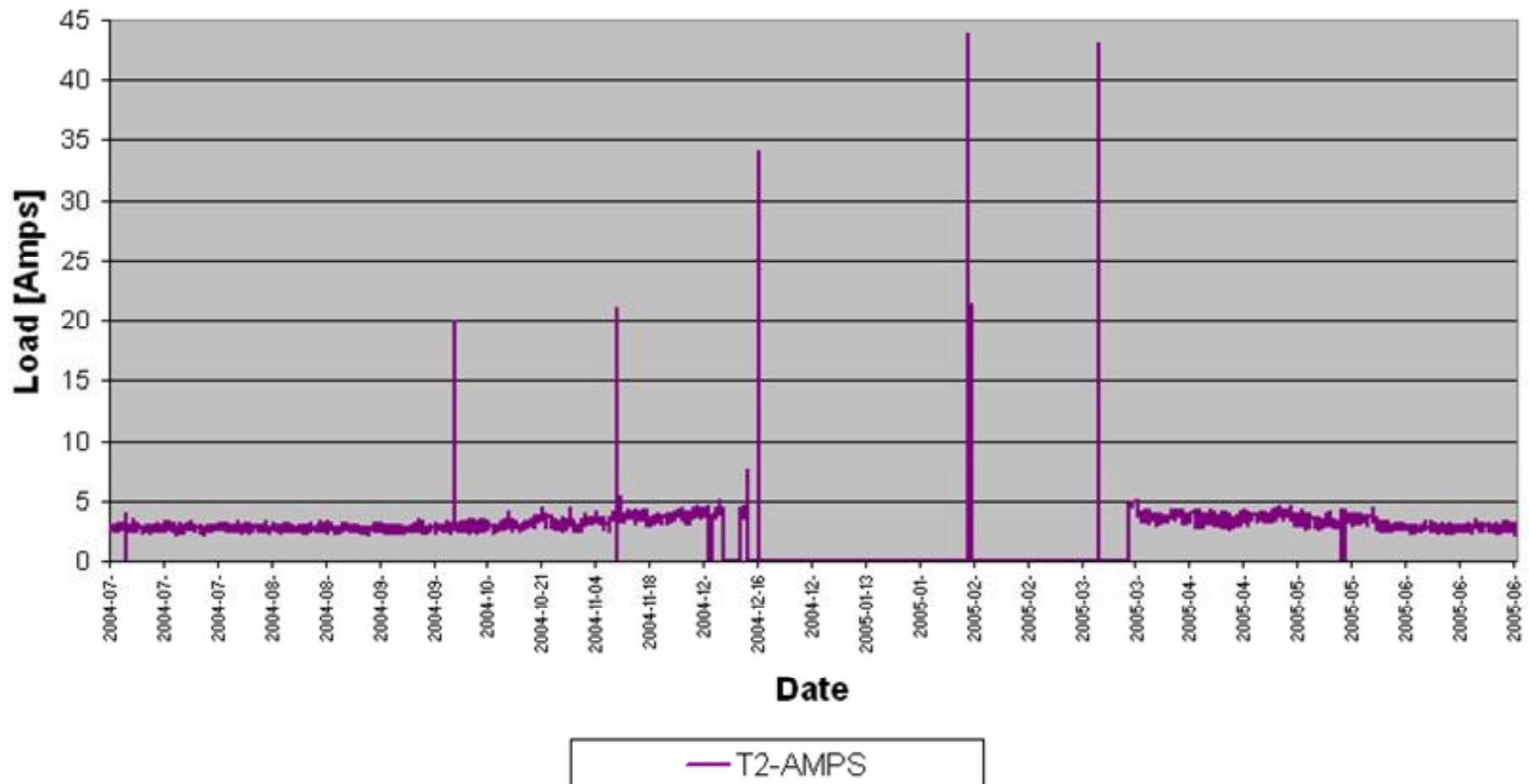
Seasonal Load 400+ Amp Winter Peak

Review of Historical Loads at Customer TS



"Off Season" Load – 0 to 45 Amp for 70% of Total Annual Hours

Review of Historical Loads at Customer TS During Periods Where Major Loads are OFF



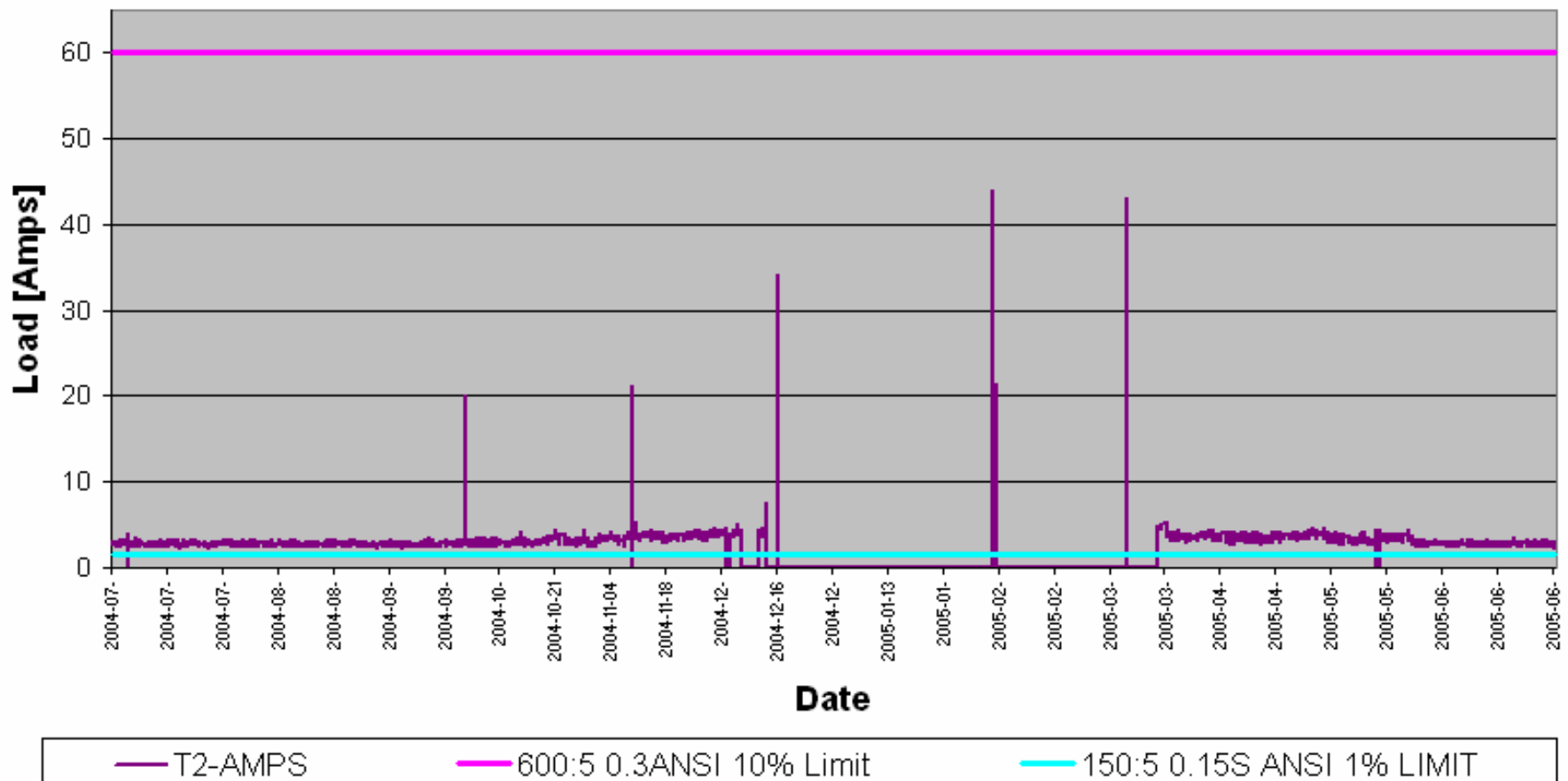
Facility Requires CTs with an Accuracy Range of 1.5 to 450 Amps

- Extended accuracy range, Class 0.15S CTs, 150:5 RF 3.0 would provide the necessary accuracy range

Analysis of 2 Element Metering Installation Accuracy Range

| Instrument Transformer Characteristics: | | | | | | | | | | |
|--|-----------------|-----------|--|------|-------|-------|-------|-------|--------|--|
| | Primary : | Secondary | Ratio | | | | | | | |
| Potential Transformer | 4,200.0 | 120.0 V | 35 | | | | | | | |
| Current Transformer | 150.0 | 5.0 A | 30 | | | | | | | |
| Thermal Rating Factor | 3.0 | | | | | | | | | |
| Assumed Power Factor: (for all cases) | 0.9 | | | | | | | | | |
| | | | IEEE CLASS 0.15S EXTENDED ACCURACY RANGE | | | | | | | MEASUREMENT CANADA APPROVED ACCURACY RANGE |
| | | | | | | | | | | RF |
| Case 4. | | | | | | | | | | |
| % of Rated PT Voltage | 3 Phase Voltage | | | | | | | | | |
| 100.0% | 4,200.0 | | | | | | | | | |
| % of CT Rated Current: | | | 1.0% | 5.0% | 10.0% | 25.0% | 50.0% | 75.0% | 100.0% | 300.0% |
| Equivalent Primary Current [A]: | | | 1.5 | 7.5 | 15.0 | 37.5 | 75.0 | 112.5 | 150.0 | 450.0 |
| Equivalent Primary Demand Load [kW]: | | | 9.8 | 49.1 | 98.2 | 245.5 | 491.0 | 736.6 | 982.1 | 2,946.2 |

Review of Historical Loads at Customer TS During Periods Where Major Loads are OFF



Proposed Definition of “Normal Operation”

- q **The facility’s historical load (or generation) pattern over an extended period of time, (typically the most recent year), which the MMP deems is likely to be repeated in the future.**

The periods within the past year when the load (or generation) is truly zero are irrelevant and therefore are excluded from the analysis for establishing compliance with the Wholesale Revenue Metering Standard - Hardware Section 6.9.

- q **The ideal CT ratio is one that has been selected for the load to be within 10% and 100%* RF of the CT (ANSI 0.3 accuracy class) nominal range during normal operation.**
- q **MSPs can also take advantage of the expanded accuracy range offered by the IEEE Draft 0.15 and 0.15S accuracy class CTs for applications requiring a wider dynamic range.**
- q **A judicious selection of the revenue metering CT’s nominal current ratio and Continuous Current Rating Factor (RF) is required to ensure the CTs are providing accurate output current signals throughout the full dynamic range required by the facility’s load (and / or generation) pattern.**

Confirmation by RMSC of “Normal Operation” Definition

- q IESO staff are seeking RMSC members concurrence on this definition of “Normal Operation”

- q We are also trying to raise the awareness of this issue with both MSPs and MMPs to ensure that:
 - CT Ratios specified for “NEW Metering Installations” are selected on the basis of a thorough analysis of the “Normal Operation” of the facility; and
 - Any “Existing Metering Installations” with incorrectly sized CTs will be upgraded with CTs that have been properly specified (CT Ratio and RF) to meet the **“Normal Operation”** requirements of the facility at the first reasonable opportunity
 - Many of the meter upgrade projects now being completed by MSPs will also require an IT upgrade (elimination of MC Dispensation List) over the next 6 years. MSPs need to ensure replacement CTs selected for these upgrades have correctly specified CT Ratios and RF