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CT Loading Assessment

Revenue Metering Standing Committee Meeting April 29, 2010

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Purpose

- To review and establish principles to assess conformance to the Wholesale Revenue Metering Standard – Hardware w.r.t. operating range of current transformers (CTs) in registered *metering installations* and to comply with the Chapter 6 of the *Market Rules*

Background

- Market Rules Chapter 6
  - Sec 4.1.1 – each metering installation shall have *instrument transformers* whose current transformers and voltage transformers meet or exceed the 0.3 accuracy class of ANSI standard C57.13
- Wholesale Revenue Metering Standard – Hardware
  - Sec 6.9.1 – (New installations) Current transformers 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 of the current transformer
    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
    c. the **minimum sustained primary current** during normal operation shall not be less than **5%** of the primary tap, for **ANSI 0.15** accuracy class
    d. the **minimum sustained primary current** during normal operation shall not be less than **1%** of the primary tap, for **ANSI 0.15S** accuracy class
- Wholesale Revenue Metering Standard – Hardware
  - Sec 6.9.1 – (New installations) Current transformers shall be selected according to the following factors
- Wholesale Revenue Metering Standard – Hardware
  - Sec 9.2.2 – (Existing Installations) Where parallel connected current transformer secondaries existed within *facilities* constructed before the *Market Rules* come into effect, approval shall be obtained from the *IESO* to continue use within the *IESO-administered market*.
    a. current transformers shall not operate below 10% of the secondary ampere rating under normal operating conditions

Current Practice

- Current practice analysis uses time based 80/20 rule
  - Not a good indicator of conformance to standards. Over one year duration, will only identify that nominal rated current is ≥ minimum % accuracy class threshold current for 80% of the time Link to Slide
- Suitability of CT Operation is reviewed at time of initial *MI* registration, and typically is reviewed at time of audit
- Why are we looking at practice today
  - RMSC members requested to look at better alternatives
  - External influences such as the Green Energy Act will place greater emphasis whether standards are met
  - To recognize and support new 0.15/0.15S high accuracy standards
- To define what "minimum sustained primary current" means
  - In theory it means above minimum % accuracy class threshold all or 100% of the time
  - In practice, a stakeholdered definition is required!
  - When CT operates below minimum sustained primary current then:
    → CT accuracy is undefined/unknown/not guaranteed
    → other components of the *MI* may also be affected which contributes to the overall inaccuracy

Alternative Approaches Considered

- % Energy
  - Best indicator of conformance to a standard
  - Does not necessarily demonstrate impact to the market
- At Risk $
  - Not a good indicator of conformance to a standard
  - But a better indicator of financial risk as result of not meeting a standard

	Conformance to Standard	Risk
Time	Good[1]	Good
Energy	Best	Best[2]
At Risk $	---	Best

[1]only when threshold is met

[2]if ratio is expressed in absolute value terms

- Other considerations when assessing conformance to a standard include:
  - Need to recognize "Standard of the Day"

Other Considerations

Thresholds need to recognize "Standard of the Day"

- Pre January 1, 2010
  - Numerous design standards and practices existed dating back to 1960's:

    - pre-Market Opening included both AMIS and DOC

    - 2008 upgrades: post 0.3 ANSI; post 0.3 ERT ANSI

- Post January 1, 2010
  - 0.15 accuracy standards formalized
  - Green Energy Act/Conservation
  - Adoption of best metering practices including: HAIT; RF; Multiple ratios; nominal ratio; load considerations; GEA conservation measures/culture

Proposal

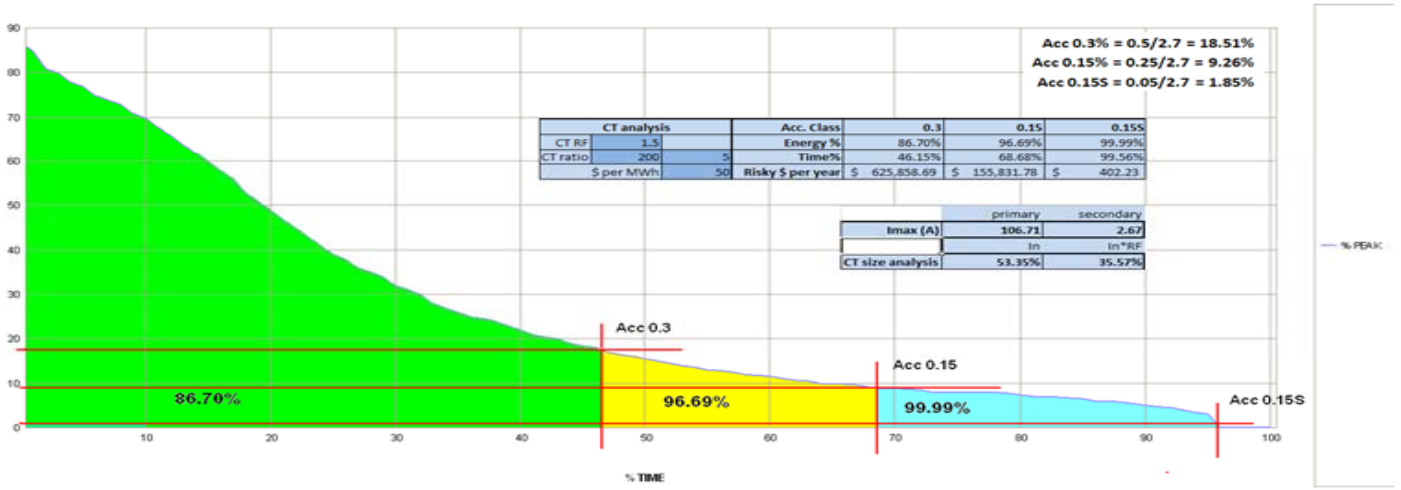
1. Adopt % Energy assessment standard to define "minimum sustained primary current"
2. Being proposed today is to consider:
   - % class Energy (kWh)
   - % out-of-class Energy (kWh)
   - Re-define assessment methodology
     - No longer will assess based on time
     - Adopt % energy method to assess compliance to standard
     - Class energy is that energy measured within X% of the total
3. Apply two energy thresholds:
   - Post Jan 1, 2010 at 90/10
   - Pre Jan 1, 2010 at 65/35

Examples

I. WIND TURBINE GENERATION STATION

Example # 1

In this example, the assessment parameters are presented as:



LOAD DURATION PLOT

Chan: 8

Start: 09/01/01 00:01

Stop: 09/12/31 24:00

5 Min Clock Intervals

Max: 2.7SQRTI2

Min: .0SQRTI2

0.3 class: 46.15% @ Current/Time criteria
86.70% @ Class kWh Energy criteria
$625,858 @ At Risk Dollars criteria

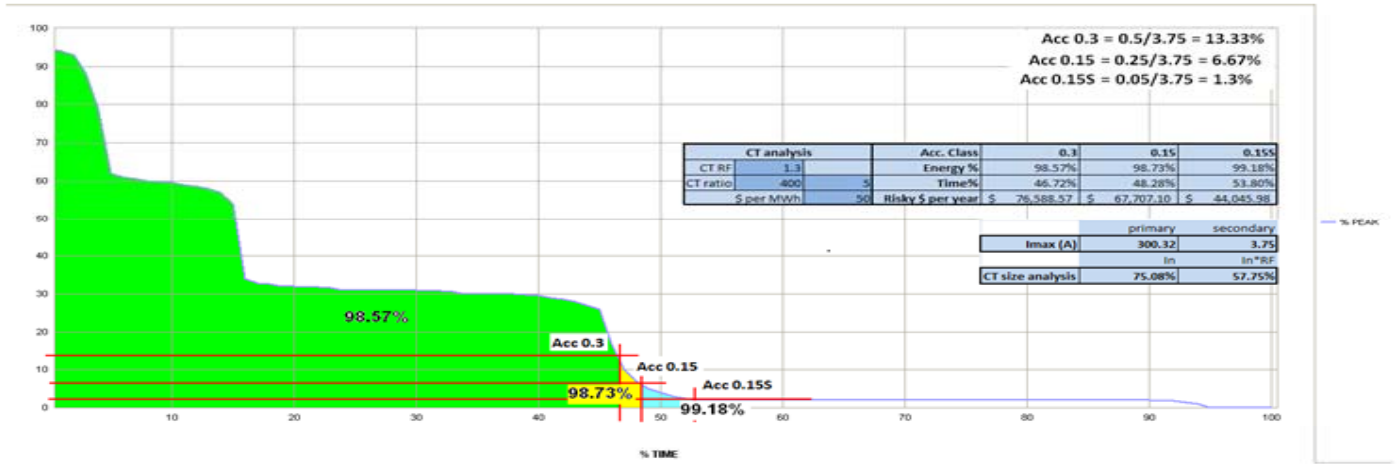
0.15 class: 68.68% @ Current/Time criteria
96.69% @ Class kWh Energy criteria
$155,831 @ At Risk Dollars criteria

0.15S class: 99.56% @ Current/Time criteria
99.99% @ Class kWh Energy criteria
$402 @ At Risk Dollars criteria

Examples

II. HYDRAULIC GENERATION STATION

Example # 2



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Max: 3.7SQRTI2
Min: .0SQRTI2

In this example, the assessment parameters are presented as:

0.3 class: 46.72% @ Current/Time criteria
98.57% @ Class kWh Energy criteria
$76,588 @ At Risk Dollars criteria

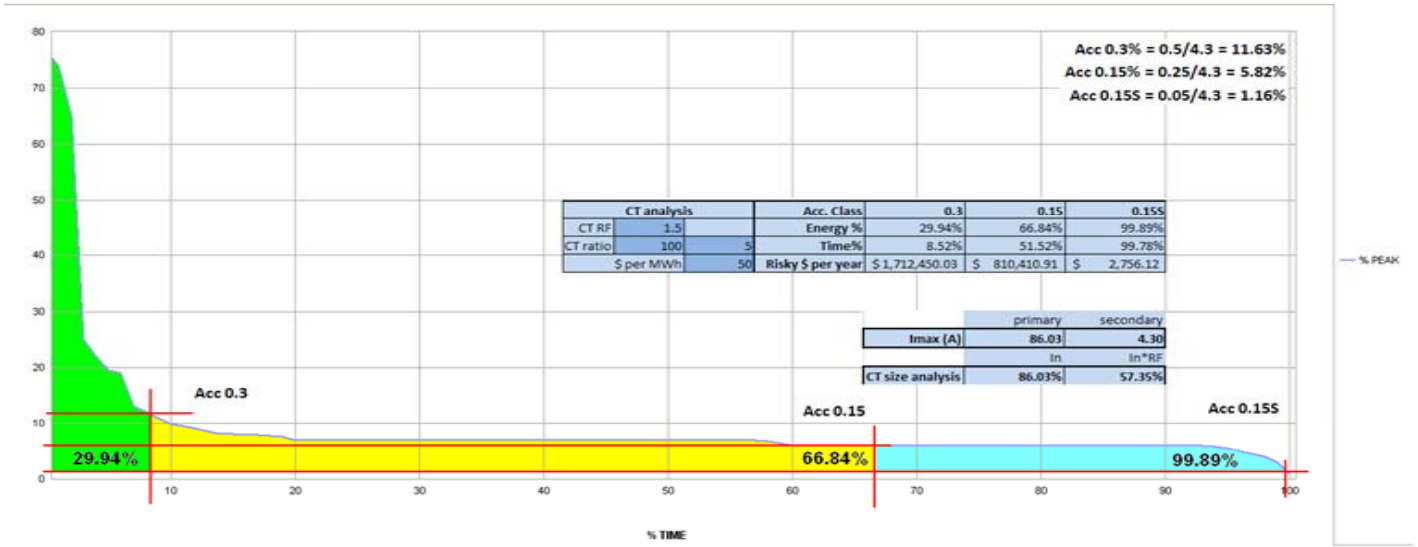
0.15 class: 48.28% @ Current/Time criteria
98.73% @ Class kWh Energy criteria
$67,707 @ At Risk Dollars criteria

0.15S class: 53.80% @ Current/Time criteria
99.18% @ Class kWh Energy criteria
$44,045 @ At Risk Dollars criteria

Examples

III. GENERATOR STATION SERVICE

Example # 3



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2010, FEB 10 3:04 PM
Max: 4.3SQRTI2
Min: .0SQRTI2

In this example, the assessment parameters are presented as:

0.3 class: 8.52% @ Current/Time criteria
29.94% @ Class kWh Energy criteria
$1,712,450 @ At Risk Dollars criteria

0.15 class: 51.52% @ Current/Time criteria
66.84% @ Class kWh Energy criteria
$810,410 @ At Risk Dollars criteria

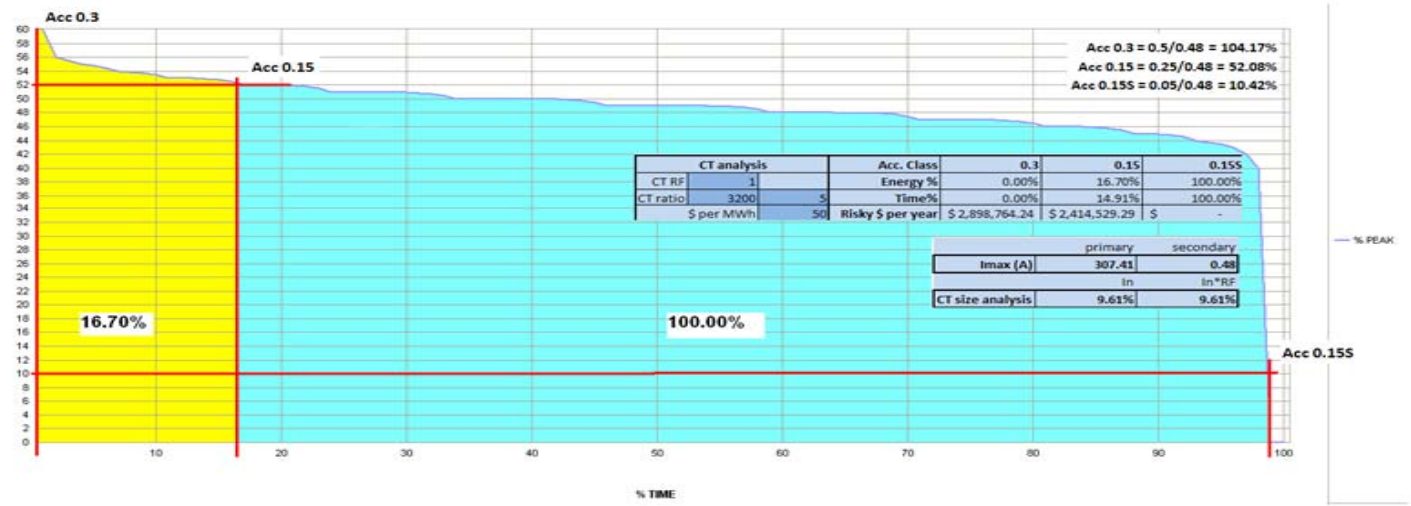
0.15S class: 99.78% @ Current/Time criteria
99.89% @ Class kWh Energy criteria
$2,756 @ At Risk Dollars criteria

Examples

IV. LDC TRANSFORMER STATION

Example # 4

In this example,



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Name:
5 Min Clock Intervals

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Stop: 09/12/31 24:00

Max: .9SQRTI2
Min: .0SQRTI2

In this example, the assessment parameters are presented as:

0.3 class: 0.0% @ Current/Time criteria
0.0% @ Class kWh Energy criteria
$2,898,764 @ At Risk Dollars criteria

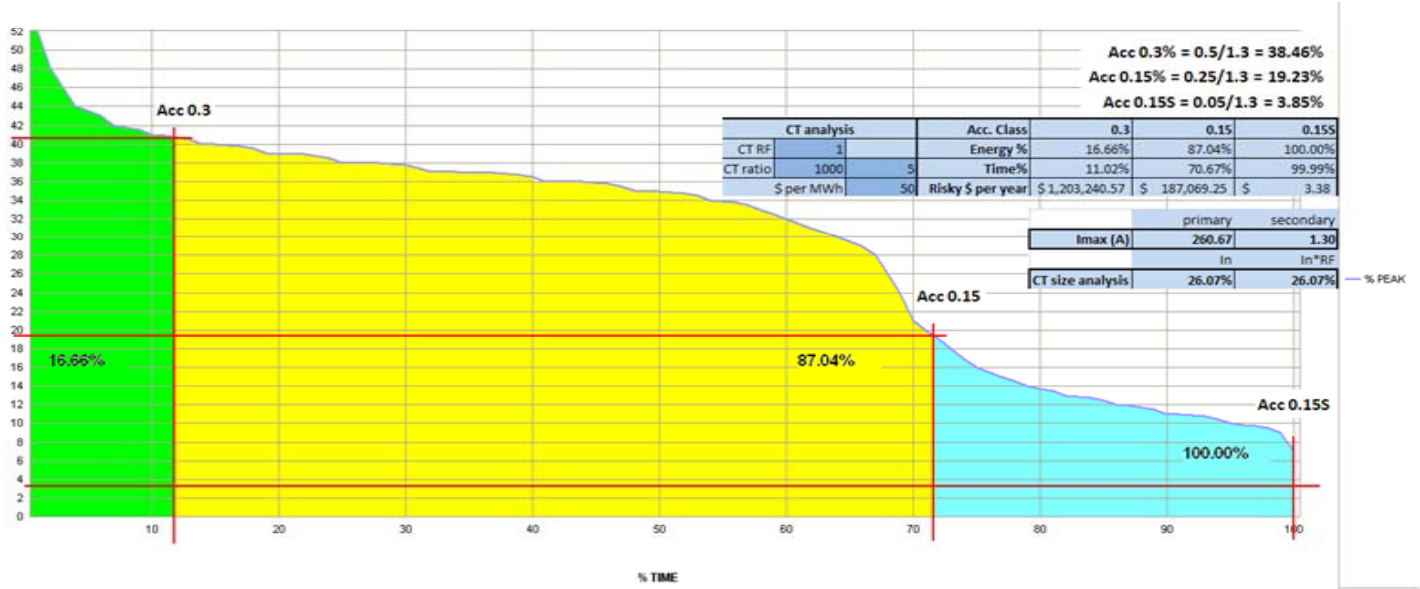
0.15 class: 14.91% @ Current/Time criteria
16.70% @ Class kWh Energy criteria
$2,414,529 @ At Risk Dollars criteria

0.15S class: 100% @ Current/Time criteria
100% @ Class kWh Energy criteria
Nil @ At Risk Dollars criteria

Examples

V. LARGE INDUSTRIAL CUSTOMER TRANSFORMER STATION

Example # 5a



CT analysis			Acc. Class	0.3	0.15	0.15S
CT RF	1		Energy %	16.66%	87.04%	100.00%
CT ratio	1000	5	Time%	11.02%	70.67%	99.99%
$ per MWh		50	Risky $ per year	$ 1,203,240.57	$ 187,069.25	$ 3.38

	primary	secondary
Imax (A)	260.67	1.30
	In	In*RF
CT size analysis	26.07%	26.07%

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5 Min Clock Intervals

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Stop: 09/12/31 24:00

Max: 1.3SQRTI2
Min: .0SQRTI2

In this example, the assessment parameters are presented as:

0.3 class: 11.02% @ Current/Time criteria
16.66% @ Class kWh Energy criteria
$1,203,240 @ At Risk Dollars criteria

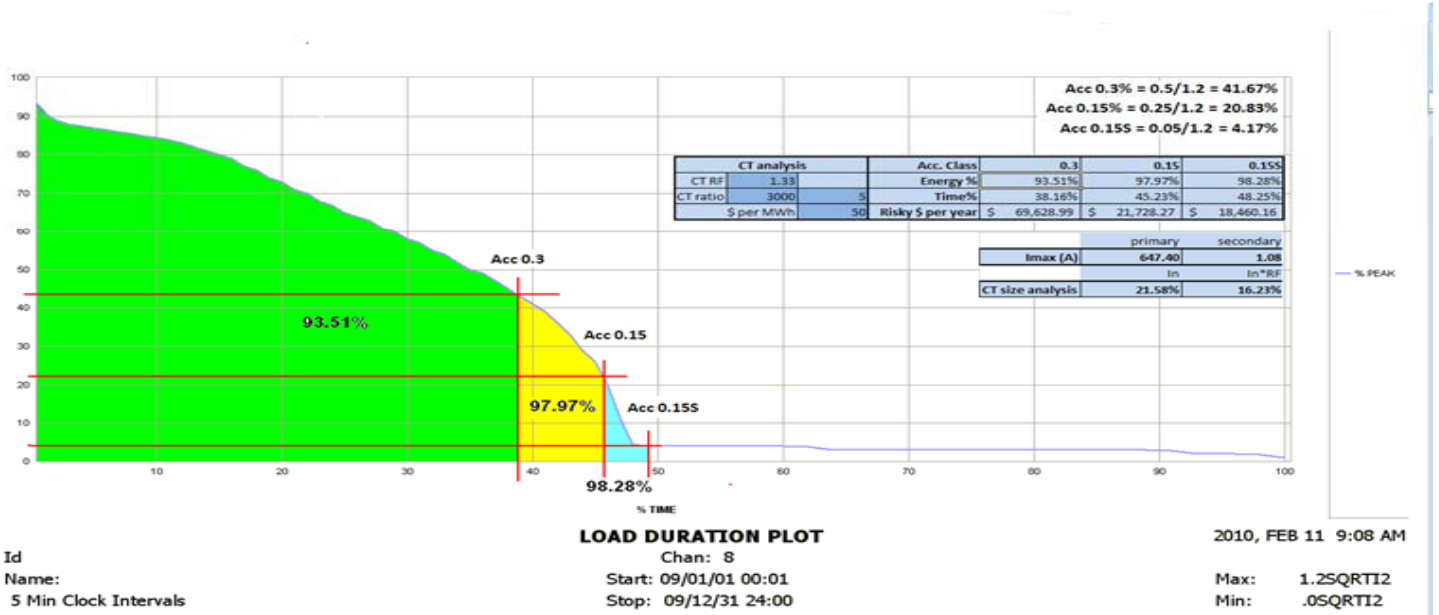
0.15 class: 70.67% @ Current/Time criteria
87.04% @ Class kWh Energy criteria
$187,069 @ At Risk Dollars criteria

0.15S class: 99.99% @ Current/Time criteria
100.0% @ Class kWh Energy criteria
$3.00 @ At Risk Dollars criteria

Examples

V. LARGE INDUSTRIAL CUSTOMER TRANSFORMER STATION

Example # 5b



In this example, the assessment parameters are presented as:

0.3 class: 38.16% @ Current/Time criteria
93.51% @ Class kWh Energy criteria
$69,629 @ At Risk Dollars criteria

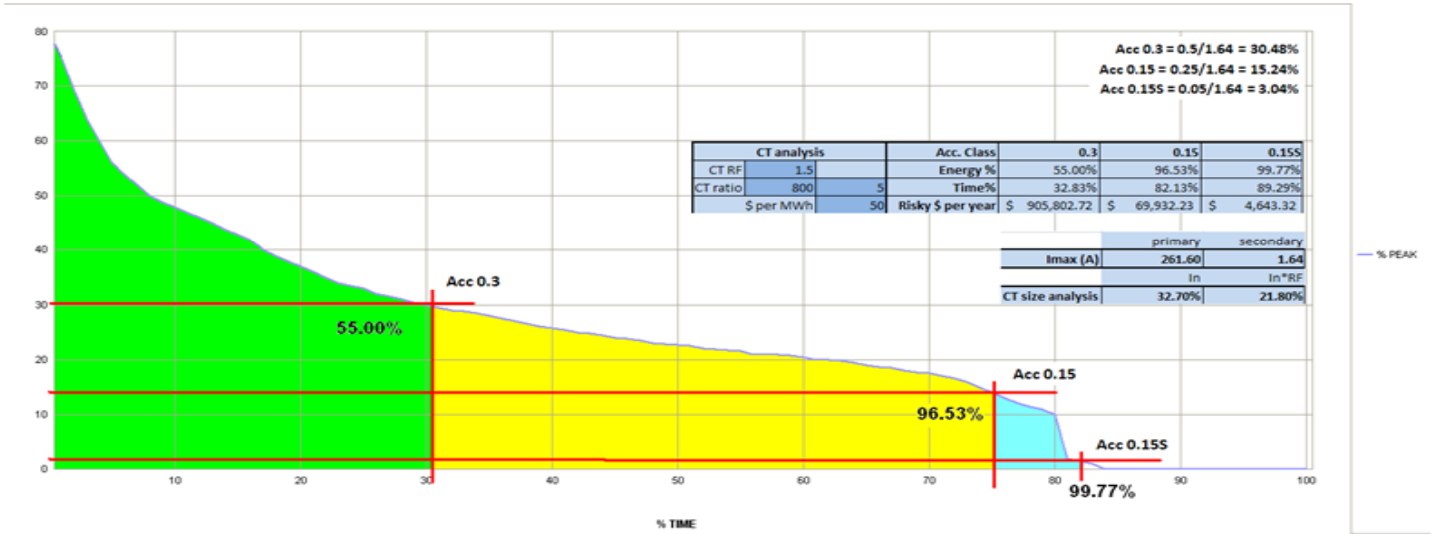
0.15 class: 45.23% @ Current/Time criteria
97.97% @ Class kWh Energy criteria
$21,728 @ At Risk Dollars criteria

0.15S class: 48.25% @ Current/Time criteria
98.28% @ Class kWh Energy criteria
$18,460 @ At Risk Dollars criteria

Examples

VI. LDC FEEDER/PME METER INSTALLATION

Example #6a



LOAD DURATION PLOT

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Stop: 09/12/31 24:00

2010, FEB 16 3:15 PM

Id

Name:

5 Min Clock Intervals

Max: 1.6SQRTI2

Min: .0SQRTI2

In this example, the assessment parameters are presented as:

0.3 class: 32.83% @ Current/Time criteria
55.00% @ Class kWh Energy criteria
$905,802 @ At Risk Dollars criteria

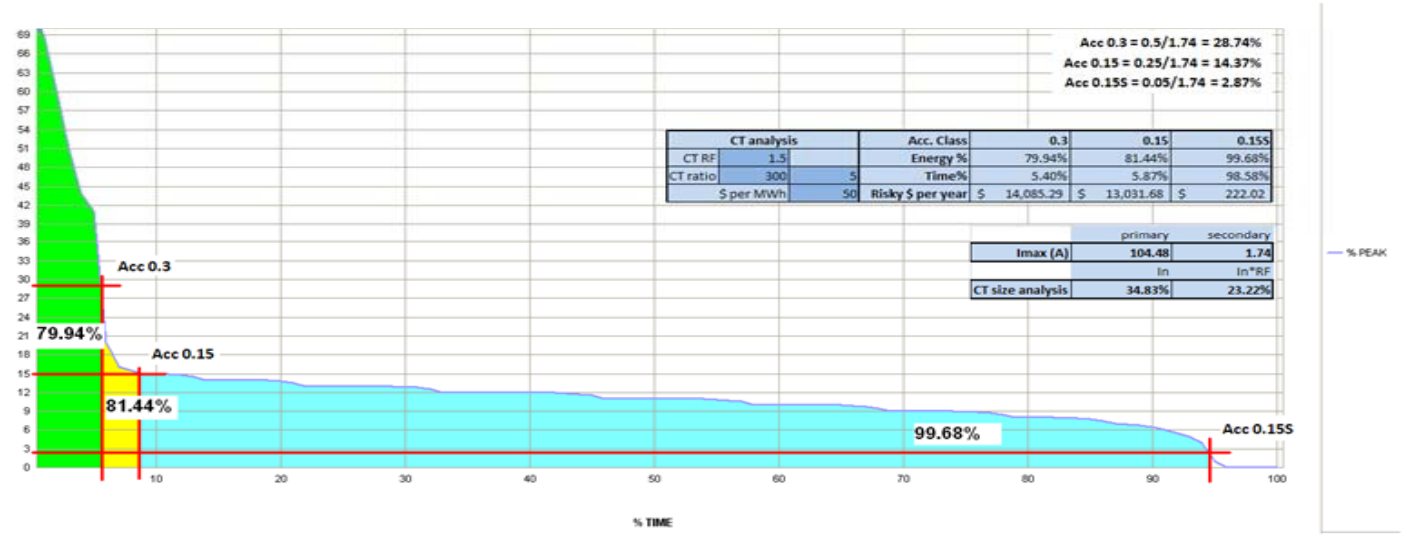
0.15 class: 82.13% @ Current/Time criteria
96.53% @ Class kWh Energy criteria
$69,932 @ At Risk Dollars criteria

0.15S class: 89.29% @ Current/Time criteria
99.77% @ Class kWh Energy criteria
$4,643 @ At Risk Dollars criteria

Examples

VI. LDC FEEDER/PME METER INSTALLATION

Example #6b



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5 Min Clock Intervals

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Stop: 09/12/31 24:00

Max: 1.6SQRTI2
Min: .0SQRTI2

In this example, the assessment parameters are presented as:

0.3 class: 5.40% @ Current/Time criteria
79.94% @ Class kWh Energy criteria
$14,085 @ At Risk Dollars criteria

0.15 class: 5.87% @ Current/Time criteria
81.44% @ Class kWh Energy criteria
$13,031 @ At Risk Dollars criteria

0.15S class: 98.58% @ Current/Time criteria
99.68% @ Class kWh Energy criteria
$222 @ At Risk Dollars criteria

Consideration for Design

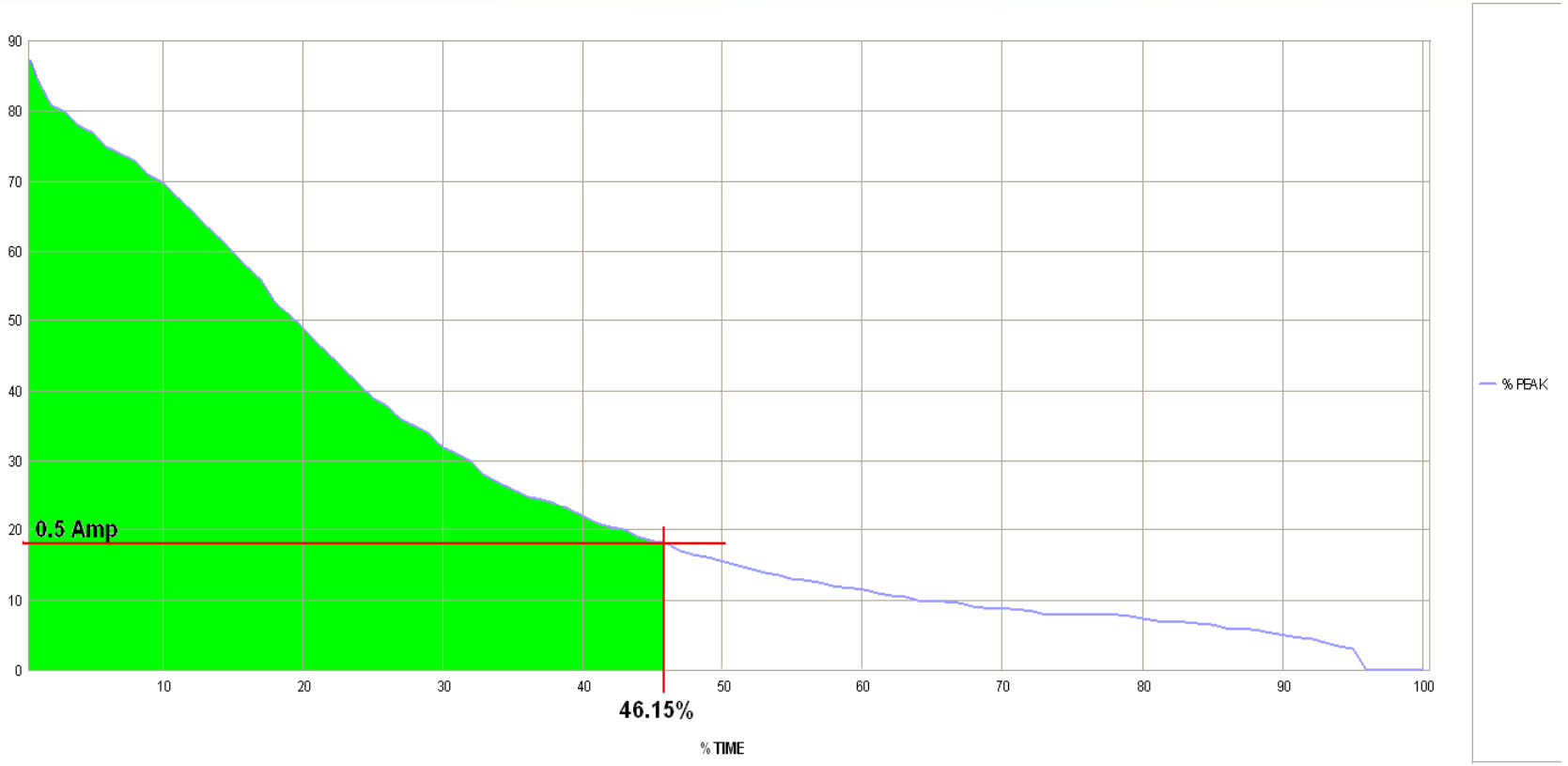
Designs must factor in and should consider:

- Nominal CT size required
- Design for projected load conditions by applying 90/10 energy based ratio for accuracy over the dynamic range
- Use CT rating factor (CCRF)
- Use appropriate ANSI standard to achieve the required accuracy rating

RMSC Stakeholdering

1. Agreement is being sought regarding moving from %Time based to %Energy based
2. Agreement is being sought to use two thresholds for PRE and POST when assessing CT operation
3. PRE threshold set to 65/35
4. POST threshold set to 90/10
5. Other considerations
6. Next steps???

Current Practice Example



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Max: 2.7SQRTI2

Min: .0SQRTI2