Update on VA Joint Working Group Activities

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Working Group Responsibilities

- The group's mandate is to address the potential inequity resulting from the various methods used in the determination of VA and VAhours in Canada.
  - Mandate expanded to include demand response type too
- Formed as a Joint Working Group by Measurement Canada and the CEA as a result of the new issue resolution process
- Reporting to the Electricity Policy Advisory Committee (EPAC)
  - Committee of Measurement Canada and CEA management formed as a result of the Electricity Trade Sector Review
- The group's recommendations must be approved by the EPAC and Measurement Canada, and undergo public consultation before they can become law
  - Measurement Canada has the final say

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Issue Resolution Process

- Based on the Standards Council of Canada (SCC) – National Standards System (NSS)
- Consensus based process involving representatives from Measurement Canada and the industry
- Used successfully in the gas industry
- Open process
  - Working group minutes and documentation posted on MC web site
- As issues arise, a formula (“impact filter”) is applied to determine the level of impact
  - Process used to address the issue is determined by the level of impact

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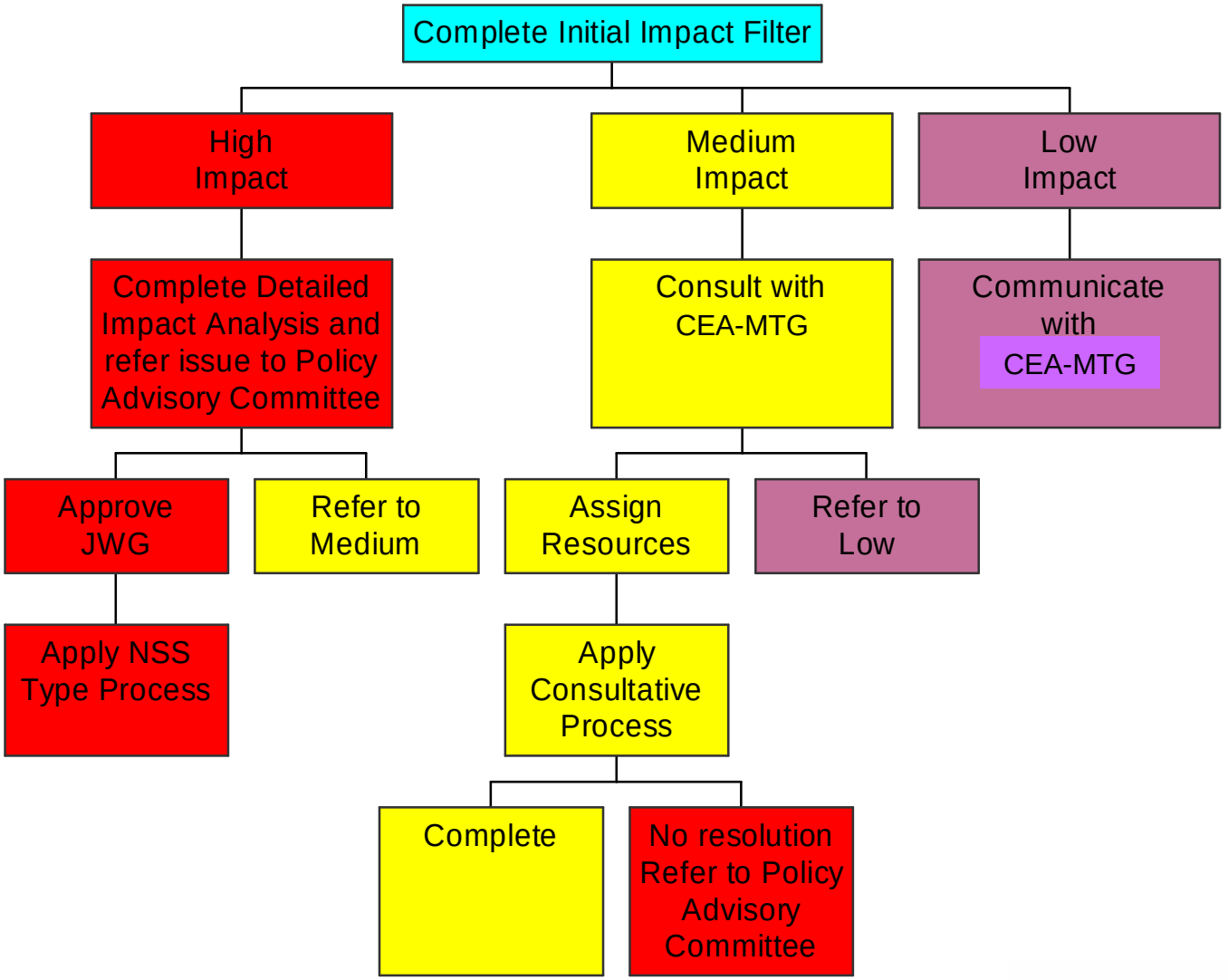
Issue Resolution Process



Currently Active Joint Working Groups

- Acceptance Sampling
  - Joint gas & electricity
- Calculating Legal Units of Measure Outside of Approved Devices (LUM)
- VA

VA Group Membership

- Measurement Canada representatives:
  - Luc Tessier, Program Development (chairman)
    - Replaced Mike Abraham in July 2006
  - Adnan Rashid, Engineering & Approvals
- Utility representatives:
  - Jean Joly, Hydro-Québec
  - Brent Hughes, BC Hydro
- Manufacturer representatives:
  - Subhas Chandra, Itron
  - Jeff Richardson, Elster

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Strategy

- The group's mandate is to address potential inequity, not to choose a single, ideal method
- The majority of members believe that there should be only one method that is legal for billing in Canada
  - 1 VA and 1 VAh should be the same everywhere in Canada, like a litre of gasoline or a watthour
  - If utilities do not wish to bill on the VA or VAh as defined by the JWG, they could consider other quantities

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Status

- Group has agreed on the recommendations in principle, but formal recommendations have not yet been published
- Next meeting November 22-24 2006
- The remainder of this presentation summarizes the expected recommendations
  - Note that these recommendations could change before they are published
  - Please wait until they are posted for consultation before commenting to Measurement Canada

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Identification of Variables

- The group has identified the variables in VA calculation methods that can affect the resulting value
  - Summation of elements in a polyphase circuit
  - Harmonic content
  - Calculation sources
  - VAR calculation method
  - Calculation frequency
  - Quadrants

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Summation of Elements in a Polyphase Circuit

- Recommendation: Vectorial
- Rationale:
  - Handbook says that vectorial summation more closely represents commodity cost, while scalar summation is more appropriate for determining distribution capacity
  - Scalar summation is problematic on a 2-element, 3-wire delta meter
  - Compatible with regulations for totalizing multiple services

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Harmonic Content

- Recommendation:
  - VA shall not include distortion power
  - Harmonic power is acceptable

Technical Aside: Harmonic Power & Distortion Power

- Harmonic Power is the result of multiplying each individual voltage harmonic with the like order current harmonic (dot product)
  - In order for harmonic power to be present, the same order harmonic must exist in both the voltage and current signal
  - Watthours calculated from individual voltage & current samples includes harmonic power
- Distortion Power is the result of multiplying each voltage harmonic with all different order current harmonics, including the fundamental (cross product)
  - Defined as $\sqrt{VA_{RMS}^2 - W^2 - VAR^2}$ in the presence of harmonics
  - RMS VA includes distortion power

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Harmonic Content

- Rationale:
  - The group recognizes that harmonics represent a cost to the utility, but there appears to be no fair way of allocating that cost to the customers who cause it
    - Including distortion power in VA amplifies the effects of harmonics
      - Penalty may be overly severe
    - Customers may not be responsible for harmonics present at their metering point
      - Unfair to charge a penalty if the customer did not cause the harmonics
    - More research is required to determine an appropriate way of allocating the cost of harmonics

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Harmonic Content

- Rationale (continued):
  - Large VA differences have been observed between meters that include both distortion & harmonic power and meters that include only harmonic power
  - Excluding distortion power approximates fundamental-only because harmonic power is usually very small
    - Fundamental-only is acceptable but requires a more expensive meter because harmonic power must be filtered out, so the group is not recommending fundamental-only at this time

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Calculation Sources

- Recommendation: VA shall be calculated from watts and vars
- Rationale:
  - Because RMS VA includes distortion power, the recommendation to exclude distortion power eliminates the option of calculating VA from RMS volts & amperes
  - Q/Qh was used historically due to technology limitations that no longer exist
    - No need for Q/Qh with modern metering technology
    - Q/Qh limited to PF range of 60º lag to 30º lead

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Frequency of Calculation

- Recommendation: The VA calculation shall be performed as often as the design permits
- Rationale: Performing the calculation as often as possible will provide the best response to changing loads
  - With VA being calculated from W & VAR, different results can be obtained under changing loads depending on how often the calculation is performed.
- Issue: How often is often enough?
  - More work needs to be done to determine a correlation between calculation frequency and difference in the resulting values

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VAR Calculation Method

- Recommendation: VAR should be calculated based on the $VI\sin\Theta$ definition
- Rationale:
  - under nonsinusoidal conditions, this includes harmonic power but not distortion power
- Issue:
  - No way to measure this VAR definition accurately on a simple meter under nonsinusoidal conditions
    - Most common methods of shifting the voltage 90º all introduce some inaccuracy in the harmonic power component
    - However, the group believes that these inaccuracies will have little impact on the total VAR value, due to the typically small levels of harmonic power

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Quadrants

- Recommendation: Q1 + Q4
- Rationale:
  - The recommendation that VA be calculated as often as possible means that VA will be determined based on continuous accumulation of instantaneous or incremental values. This precludes determination of VA in a manner which is dependant on the quadrant in which vars occur.
  - Many of the methods that result in a VA value dependant on quadrant (e.g. Qh) are due to historical technology limitations that do not exist in modern meters

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Quadrants

- Issue:
  - The proposed VA definition does not give utilities the option to differentiate between capacitive and inductive vars in the calculation of VA or kVAh.
    - If a utility wishes to offer its customers a credit or some other consideration for capacitive power factor, this can be facilitated by measuring kvarh

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Demand Response Type

- Recommendation: 15 minute sliding window with 3-minute sub-intervals
- Rationale for not using thermal/exponential demand:
  - Used only in Canada
  - Longer test time than block and sliding window
  - Complicated algorithm
  - Studies have shown that peak demand readings are similar to 15 minute sliding window with a sub-interval of 3 minutes or less.

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Demand Response Type

- Rationale for using 3-minute sub-intervals:
  - Peak demand readings similar to exponential demand
  - Peak splitting becomes much more difficult as the sub-interval decreases
    - Peak splitting results in inequity because customers who don't split peaks subsidize those who do
  - Can be calculated from load profile data without requiring excessive amounts of data storage and management
    - The group feels that 1-minute sub-intervals could be excessive

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Implementation Plan

- Modifications to Approval of Type requirements
- No changes to verification requirements
- Performance-based tests will be designed to verify compliance with the recommended algorithms
  - Measurement Canada will not approve the specific algorithm that the meter uses. Instead, they will approve the meter design based on the results of the performance-based tests.

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Grandfathering

- Electromechanical thermal demand meters will not be allowed to be re-installed in a billing application once they are removed from service
- All other previously approved meters that do not meet the new requirements may remain in service until the end of their useful life
  - It is expected that non-conforming meters that can be re-programmed to meet the new requirements will be re-programmed if the seal is broken for some other reason, but utilities will not be required to re-program them
- No requirement to remove existing meters from service to make them comply with the new requirements

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Summary

- One standard method of calculating VA and VAhours
- Phased in over the life of existing meters
- New requirements addressed in type approval