Business Rules for M&V for Residential DR in Energy and Capacity Markets

Demand Response Subcommittee

July 30, 2014

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- Issue
  - Current M&V methods for residential customers are based on legacy DLC programs from 20 years ago
- Proposed Solution
  - Interval metered customers: use actual meter data (status quo)
  - Non-interval metered customers: use real-time sample

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Definitions

- Direct load control (DLC) – ability of CSP to directly curtail end use device at end use customer without intervention from end use customer
- Contract – agreement between end use customer and CSP for CSP to perform DLC and offer it as DR in the relevant PJM market
- Enrolled customer – A customer who has a contract with CSP, and for whom CSP has the physical ability to perform DLC
- Registered Customer – An enrolled customer who is registered with PJM
- Sample – customers selected from the registered population of non-interval metered customers who have interval meters installed for the purpose of settling all registered customers
- Population – registered customers
- e.g. A CSP may have 50,000 enrolled customers, but only 45,000 registered customers

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Interval Metered Customers

- No change in status quo for meter data collection
- Actual hourly meter data for all customer is used
- Not eligible to participate in sampling

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- Real-time sample
  - Random sample of customers with interval meters
  - Hourly data from sample is scaled to population data
  - After data is scaled to population, processes are same as interval metered customers

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- Sample design will satisfy 10% precision at 90% confidence
- Interval meters
  - EDC meter level (entire premise/EDC account number) – status quo
  - Meter accuracy – status quo (2%, ANSI compliance, etc.)

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- Sample size determination
  - Less than 10% error at 90% confidence level
  - Approximate sample size of 150 (using sample data PJM currently has access to)
  - Based on variance study for each sample
  - Based on variance of meter data
  - PJM may amend requirements for variance study after more experience is gained

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Variance Study Requirements

- At least 75 randomly selected participants
- 4 weeks of contiguous hourly meter data
- Data collection during season that end use device is in use/will be curtailed
  - e.g. June – September for ACs

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$n = 75 = \text{Number of sampled meters}$

$X_{it} = \text{Meter reading for customer } i \text{ at time } t$

- Calculate the mean and variance across all customers for each minute

$$Mean(X_t) = \overline{X_t} = \frac{1}{n}\sum_{i=1}^{n} X_{it}$$

$$Var(X_t) = s_{X_t}^2 = \frac{1}{n}\sum_{i=1}^{n} (X_{it} - \overline{X_t})^2$$

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- Calculate the sample size necessary to get 10% error at 90% confidence for each hourly interval:

$$M_t = \left(\frac{Z_{\alpha/2}}{e}\right)^2 \frac{s_t^2}{\overline{X_t}^2}$$

Where:

$Z_{\alpha/2} = 1.645 = \text{critical value at } 90\% \text{ confidence } (\alpha = 0.1)$

$e = 0.1 = \%\ \text{error}$

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- Sample size required:
  - Average across all one minute intervals to obtain sample size that will have 10% precision at 90% confidence

$$M = \frac{1}{T}\sum_{t=1}^{T} M_t$$

Where:

T = total number of one minute time intervals

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- Separate samples
  - EDC
  - End use device/device grouping
    - e.g. AC, water heater, both
  - Curtailment algorithms
    - e.g. 50% cycling, 100% cycling, thermostat set point
  - Different switches with same curtailment algorithm
    - Necessary if switch capability is substantially different
    - e.g. 1985 switches with operability of 60% and 2010 switches with operability of 90% require separate samples. Similar switches with same algorithm from 2010 and 2014 do not need additional sample.

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- Sample stratification
  - Control device size in 2 groups roughly at median
    - e.g. median AC size is 3.1 kW, stratification by AC size < 3.1 kW and > 3.1 kW
    - Based on sum of device sizes at EDC account level
  - Geographic Stratification
    - PJM discretion, based on size, variability within region, etc.
    - e.g. AEP wide program would likely require geographic stratification, RECO probably not
  - CSP may propose alternate stratification to reduce variance
  - PJM will adjust stratification requirements as experience is gained to reduce sample size

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- Annual sample calibration
  - Based on annual sample variance update
  - Proportion of each stratum in the sample must be within +/- 1 sample of population proportion
    - e.g. Sample size = 150 customers

      Population proportion stratum A= 20%

      Stratum A should be 30 customers

      does not need to be recalibrated if 29 – 31 customers
  - Replacements if necessary must be randomly selected, maintain strata integrity, etc.
  - If population is expanded in non-random manner, sample must be expanded appropriately

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- 2 way communication
  - Performance factor for each event based on actual population operability
  - Inoperable switch in sample
    - Sample size > requirement: do not report load data from in-operable switch
    - Sample size < requirement: must report load data from switch
  - Can repair faulty switch in sample or population at any time

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Switch Operability – 1 way

- 1 way communication
  - Must report data from all switches, even if inoperable
  - Cannot repair failed switches until:
    - Repair faulty switches in population
    - OR Reselect entire sample
    - Includes any system/device that would cause end-use device not to reduce load properly in the population
  - Metering and metering communication
    - Can be fixed in sample
    - Includes only systems/devices that would not affect load reduction in population
    - Component that is related to both metering and switching cannot be repaired
  - Switch failures in sample must be reported to PJM within 2 business days

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- NAESB Validating, Editing & Estimating (VEE) Protocol
  - EEI Uniform Business Practices for Unbundled Electricity Metering Volume II, 12/5/2000
- Must follow NAESB VEE protocol.
- If 2 intervals or more are missing for 1 meter
  - If still enough meters to satisfy sample size: do not submit data from meter
  - If less than sample requirement - data from that meter must be submitted as PLC value for all intervals

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Churn

- CSP must submit initial list of customers
  - EDC account number and address
- Replacement
  - Customer who moves from their premises
  - Customer who terminates their own contract with CSP for participation in DLC
- Replacement for IM
  - Economic – any customer
  - Capacity – must be randomly selected
- Replacement for NIM
  - Replacement customer must be randomly selected to maintain integrity of strata

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Churn II

- CSP must maintain a list of all replacements and furnish to PJM within 2 business days of request
  - e.g. PJM requests the list on Tuesday, CSP must submit the list created on Monday of registered customers for Tuesday. CSP must do this by COB Thursday.
- CSP must maintain list of customers for each offer for 2 years from date of offer (economic) or event (capacity)
- Total number of registered customers must be accurate on location in eLRS before an offer is submitted (economic)

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- Number of customers offered cannot exceed number of registered customers
- Partial resource offer:
  - Offered customers must be randomly assigned from pool of all registered customers

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- CSP must maintain list of:
  - registered customers (daily) – determined day before operating day
  - offered customers (for all eMKT offers) – determined before offer is submitted
  - cycled customers – for all events – determined immediately after cycling is initiated based on actual customers who are cycled
- Data to be furnished to PJM within 2 business days of request
- If data cannot be furnished in timely manner, or number of customers falls below registered/committed value without reporting:
  - CSP may referred to MMU for review
  - Deficiency penalties may be assessed
  - Registered value may be reduced and offered value capped

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- M&V Plan
  - Annual
  - Details of variance study
  - Meter qualification
  - Meter quality assurance
  - Data validation, error correction protocol
  - Sample selection and stratification detail
  - PJM to publish template

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- PJM will report results 1 year after participation for transparency

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- Issue: Residential customers with class average PLCs may not get full credit for load reduction if larger than average
- Actual example (all per participant):

	PLC (kW)	Compliance
Class average	1.5	0.4 kW under
Individual	2.8	0.2 kW over

- Affected EDCs
  - 17 EDCs currently participating in DLC
  - 3 investor owned EDCs use class average
    - Projected to be 1 EDC in 3 years
  - 5 munis/co-ops do not compute PLC or use class average

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- Solution: Modified GLD
  - GLD is used for compliance
  - Load reduction not limited by PLC
  - Addback is not limited by PLC
  - Eligible customers
    - Residential
    - no PLC
    - No individual data in PLC
      - Individual = scaled to monthly or hourly data

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