Energy Market Settlements Education

John McComb

PJM Market Settlements

Generation:

- Single Gen pnode in Network Bus Model
- Aggregation of directly related pnodes into a single Markets Gateway Unit: (like a CC)
  - DA fixed weighted
  - RT variable Gen Telem weighted
- Aggregation of related pnodes into single RT only unit. (for example NEM)
  - fixed weighted definition
    - Or
  - Zonal or Residual EDC RT weighted

Load:

- Single Load pnode in Network Bus Model
  - aggregate definition = 100% of load bus
- Aggregation of directly related pnodes into a single fixed weighted definition.
  - Same definition DA & RT.

- Residual EDC, definition determined by:
  - SE solution after Nodal removed
  - DA daily def (using RT's prior week)
  - RT hourly variable (RT **S**tate **E**stimator)

RT Generation and RT Load reporting data flow

Customer Submissions

PJM eSuite

Energy Market Settlements

Revenue Quality Generation MWh

EDC Boundary Tie MWh

PowerMeter

Generator Owner's Settlements based on RT MWh reporting via PowerMeter

EDC's Territory Load MWh

Sum of InSchd for given EDC may not exceed PowerMeter Load

LSE controlled Metered Load MWh

EDC determined and or Metered Load MWh

InSchedule

Load Serving Entity's Settlement based on RT MWh report via InSchedule

Transmission Zones	RESIDUAL EDCs
AECO	AECO_RESID_AGG
	VINELAND_RESID_AGG
AEP	AEPAPCO_RESID_AGG
	AEPIM_RESID_AGG
	AEPKY_RESID_AGG
	AEPOHIO_RESID_AGG
APS	APS_RESID_AGG
ATSI	FEOHIO_RESID_AGG
	PENNPOWER_RESID_AGG
BGE	BGE_RESID_AGG
COMED	COMED_RESID_AGG
DAY	DAY_RESID_AGG
DEOK	DEOK_RESID_AGG

Transmission Zones	RESIDUAL EDCs
DOM	DOM_RESID_AGG
DPL	DPL_RESID_AGG
	DPLEASTON_RESID_AGG
DUQ	DUQ_RESID_AGG
EKPC	EKPC_RESID_AGG
JCPL	JCPL_RESID_AGG
METED	METED_RESID_AGG
PECO	PECO_RESID_AGG
PENELEC	PENELEC_RESID_AGG
PPL	PPL_RESID_AGG
	UGI_RESID_AGG
PSEG	PSEG_RESID_AGG
RECO	RECO_RESID_AGG
PEPCO	SMECO_RESID_AGG
	*There is no PEPCO RESID as non-SMECO Load in PEPCO is priced nodally at either PEPCO DC or PEPCO MD

In: **20** MWh

Gen **40** MWh

Out: **10** MWh

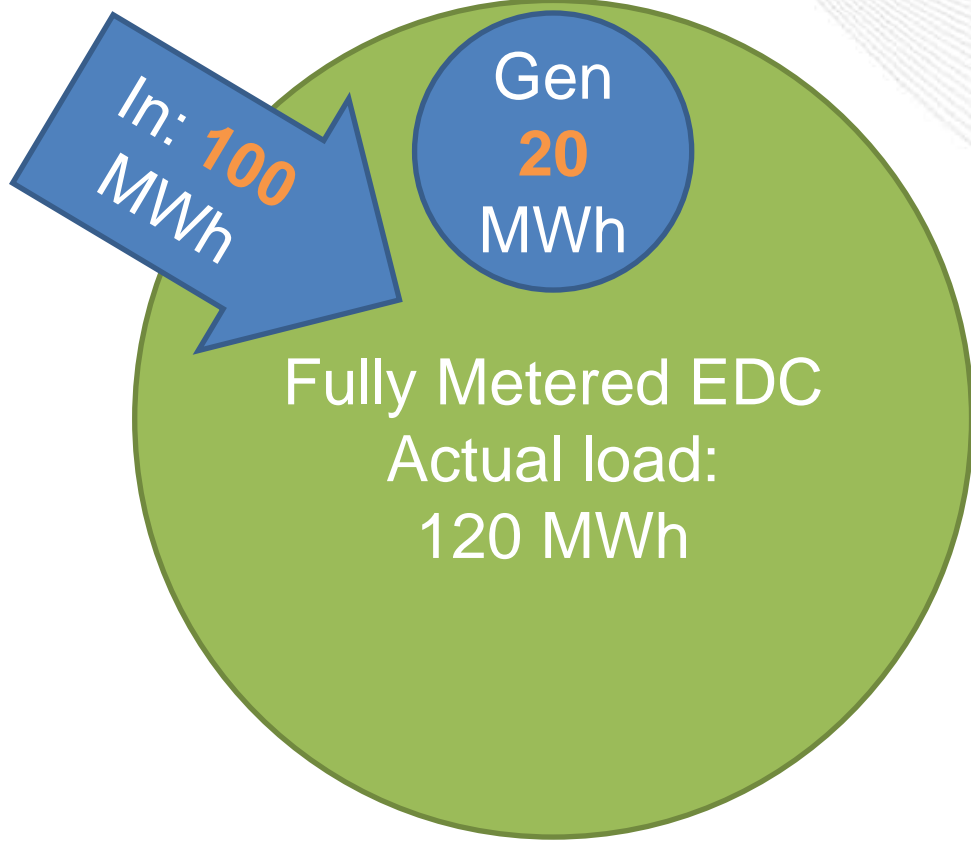Fully Metered EDC

Gen **30** MWh
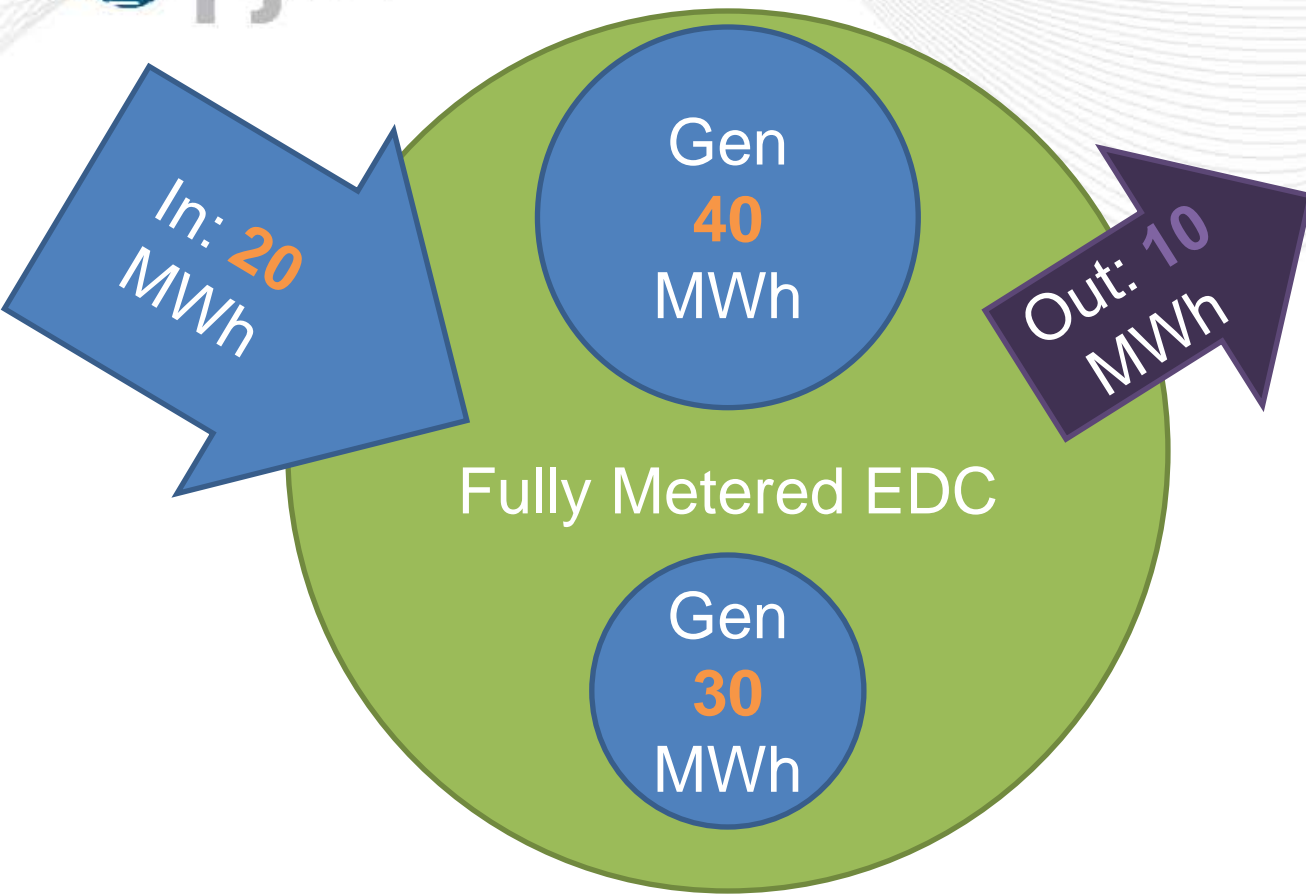
A Fully Metered EDC's Load, inclusive of losses, for an interval: = the sum of PowerMeter values:

- Net of Ties, that define the EDC's boundary
- Sum of Generation modeled as within the EDC
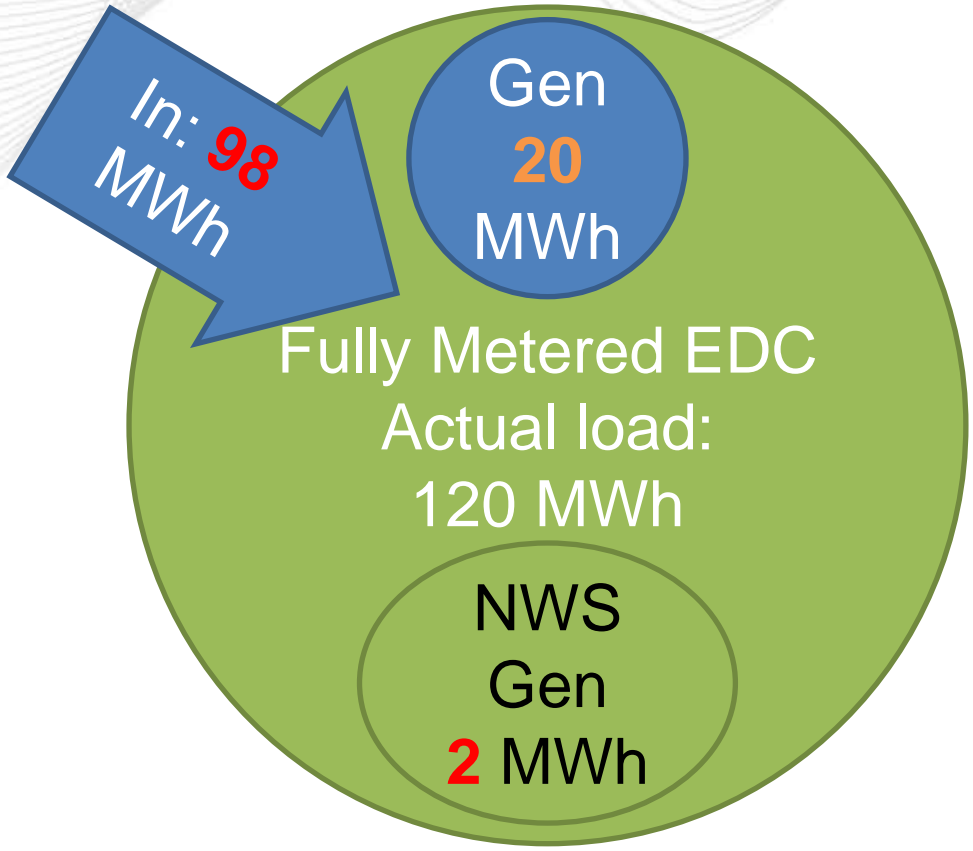- *(If an "Eastern" EDC, allocated share of PJM East 500kV Losses)*

Total EDC Load = 80MWh:
40MWh (gen) + 30MWh (gen) + 20MWh (in) – 10MWh (out)

Gen **20** MWh

In: **100** MWh

Fully Metered EDC
Actual load:
120 MWh

Gen **20** MWh

In: **98** MWh

Fully Metered EDC
Actual load:
120 MWh

NWS
Gen
2 MWh

Settled EDC Load = 120MWh:
20MWh (gen) + 100MWh (in)

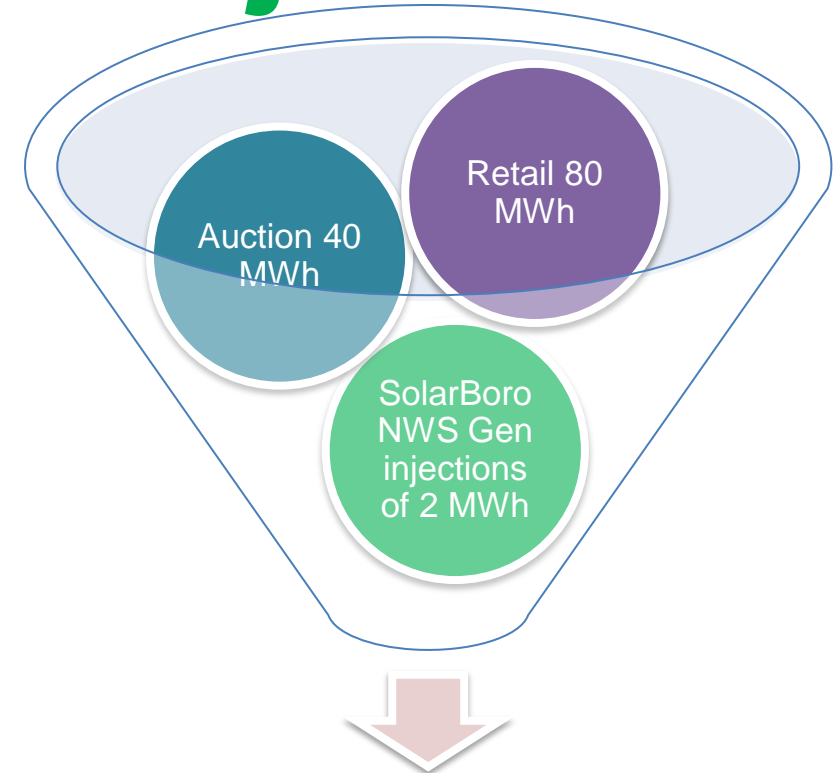Settled EDC Load = 118MWh:
20MWh (gen) + 98MWh (in)

- "Initial billing" = "Settlement A" : billing to LSEs calculated 3 days after the operating day
  - Members report to PJM via InSchedule RT Load MWh values by LSE
  - Submission deadline at 4pm two business days after operating day
    - For example Tuesday due by 4pm EPT on Thursday
  - LSEs with their own metering directly submit their own RT Load MWh
  - EDCs report majority of retail and auction related LSE RT Load MWh
  - Because final meter data can take more than 2 days to collect, in some cases Settlement A reporting is based on customer class load profiling
- "Load reconciliation" = "Settlement B" : true-up billing to LSEs two monthly bills later
  - EDCs report to PJM via InSchedule the delta between the RT Load MWh that were originally reported and what they determined the actual load really was
  - Submission deadline at midnight two months later, for example January Reconciliation values due by midnight between March 31st and April1st to be included on March Invoice.
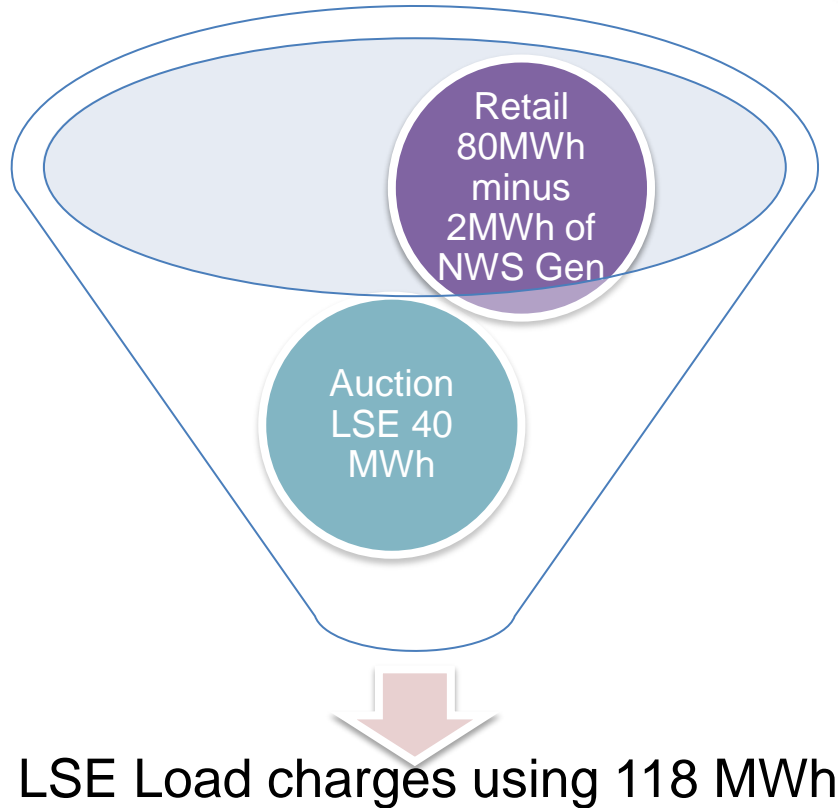
"Load Reducer" Settlement A

Retail 80MWh minus 2MWh of NWS Gen

Auction LSE 40 MWh
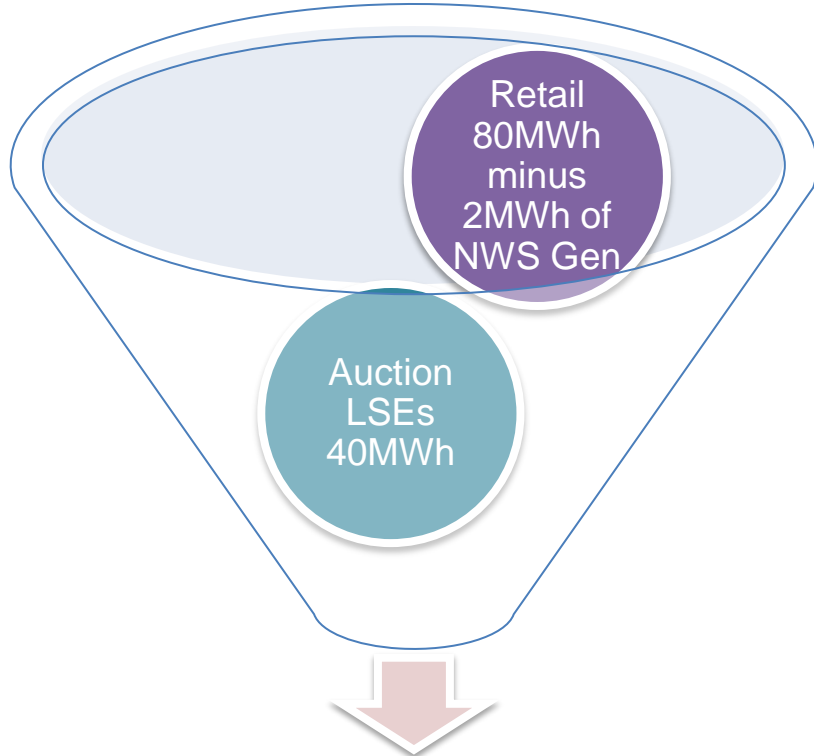
LSE Load charges using 118 MWh

1) If the 2MWh **NWS** was not exceeding related load then it is a load reducer that can be part of Settlement A

-There would be 118MWh of InSchedule load assigning RT MWh to the LSEs in the EDC so they are charged in our wholesale market in kind

-One of those LSEs has 2MWh less in load relative to what it would have been otherwise due to their **NWS** having reduced their load obligation

-Therefore they could have a "credit" in Settlement A, by virtue of having "less load"

2) Instead of the "credit" occurring in settlement A, it could instead be via Load Reconciliation's Settlement B...

- Reference results from the Net Energy Metering Senior Task Force

- http://www.pjm.com/committees-and-groups/closed-groups/nemstf.aspx

- Three options from NEMSTF Final report:
  – Adjust the load obligations of LSEs to reflect a net injection of energy / net consumption offset during a NEM billing cycle. **Circle back to the last four NonWholeSale Generation related slides.**

  – Creation of aggregate pnode to allow aggregation of hourly, interval metered NEMs that are below a certain threshold

  – Allow financial adjustment mechanism for non-hourly, non-interval metered NEMs, similar to the existing monthly meter correction process

- Options 2 & 3 would model a unit in PowerMeter, thus requiring a Gen Bus Pnode

- Modeling a unit in PowerMeter, requires a Generator pnode in the Network Bus Model

- A placeholder Gen Bus pnode "central" to a given collection of "**NWS**" units would be coordinated to be added to the network bus model

- The requesting member is tasked with coming up with an applicable aggregate definition to be representative of the collection of underlying generators

- Either a specific fixed weighted aggregate of representative pnodes in the bus model or choose to use a broad Zone or RESID_AGG location if applicable

- The place holder Gen Bus pnode's RT LMP is overridden in the PJM settlement system with the RT LMP of the designated aggregate

- "Units" modeled this way are not eligible for bidding into the Day-Ahead Market

Appendix : DA and RT LMP Settlements for Gen and Load in greater detail...

- PJM's DA Market engine solves DA LMP for all the pnodes in the Market
- Generators receive DA LMP settlement in given hour for their DA MWh cleared thru "eMKT" multiplied by the Unit's DA LMP of related Gen Bus Pnode(s)
- Nodal Load customers are charged at DA LMP for their cleared DA Demand MWh multiplied by the nodal location's DA LMP or related Load bus Pnode(s)
- Residual Priced Load customers are charge at DA LMP for their cleared DA Demand MWh multiplied by the given RESID_AGG location's DA LMP
  - DA Definition for RESID_AGG location for given day is fixed weighted based on the load distribution within from the day one week prior.   Load distribution is based on State Estimator solution

- RT MWh for Generators to be used in LMP settlements is reported to PJM via PowerMeter

- Generator's Balancing LMP settlement for given hour =
  - Unit's pnode's RT LMP * (RT PowerMeter MWh minus DA eMKT MWh)

- Key Point : to be treated as a Generating Unit in PJM's Wholesale Market requires a Gen Bus pnode in the Network Bus Model
  - In kind a related submission point is modeled in PowerMeter
    - A Markets Gateway Unit ID is also assigned, however DA Market bidding can be optional depending on unit type
      - For example, Energy Only / Not a PJM Capacity Resource

- RT MWh of Load, relative to LSEs in the PJM Market to be used in PJM settlements is reported to PJM via InSchedule
  - Submitted Inclusive of applicable losses, then de-rated by PJM for LMP billing
- The RT Load with Loss calculated by PowerMeter sets the overall EDC total
- For EDCs which manage their own default supplier auctions, the PowerMeter Load is the value which their InSchedule total can not exceed in given hour
- Some EDCs have PJM automatically allocate their Residual load to applicable Auction LSEs base on fixed %. (Residual Load = PwrMtr Load – InSchd Sum)
- Some EDCs are their own default supplier, in which case their Load is their Residual Load
- InSchedule submission deadline is 4pm EPT, two PJM Business days later
  - For example InSchd's for Tuesday are due by 4PM on Thursday

- Nodal Load Balancing LMP settlement for given hour =
  - Nodal RT LMP * (RT LoadwoLoss MWh minus DA Demand MWh)
- Nodal locations have fixed weighted aggregate definitions

- For RESID_AGG_LOAD, its RT Load Weight AVG LMP is not directly used in the Balancing LMP settlements for Congestion and Loss Charges

- Rather it occurs by individual load pnode bus, since the RT definition for the RESID_AGG is different each hour based on the State Estimator solution's load distribution

- Balancing Congestion and Loss settlement occurs by individual bus. =Sum for hour:
  Load Pnode's RT LMP * (RT Load allocated to pnode minus DA Demand DA def allocation)

- The magnitude of the difference between simulating using the overall RT LMP versus the actual bus-by-bus method is proportional to the spread of congestion and losses in given EDC, coupled with the bus by bus difference between DA and RT definition factors

- Circling back to Nodal Load, their locations have the same definitions for DA & RT, therefore they are not subject to this RESID_AGG specific implicit balancing affect

- **Changes to be simpler starting 2/1/2018 with 5Minute Settlements, using direct RT LMP. As will no longer calculate at underlying pnode level definitions**

- For most loads, true actual readings are not available in time for the two business day submission deadline for Settlement A:

- PJM Load Reconciliation billing allows for an additional two months to obtain final load values

- The Load Reconciliation deadline closes with the midnight that ends the two months later

  – For example Jan Recon values are due by midnight between March31st and April 1st

  – Load Recon Billing on the March invoice is relative to Jan Data

- EDCs report to PJM via InSchedule the delta between the RT Load that was originally reported and what they determined the actual load should have been

- The bus pnode level breakdown detail is available, via the Implicit Congestion and Loss Charge Detail report, under the Locational Congestion/Loss Details category in MSRS

- This report provides the granular calculation components behind the Implicit related column values in the Congestion and Loss Charge Summary reports in MSRS

- For participants wishing to fully simulate the pnode bus level implicit settlement calculations, additional posting are available…

- DA and RT Definitions for Zone/RESID aggregates can be retrieved via the Zonal Aggregate Definitions report under the Locational Congestion/Loss Details category in MSRS

- Aggregate definition factors for nodal locations are available via the Fixed Weighted-Average Aggregate Definitions posting on the public PJM website, from www.pjm.com, under Markets & Operations, under Energy Market, under LMP Model Information;

- http://www.pjm.com/markets-and-operations/energy/lmp-model-info/fwaad.aspx

- Note, due to the potentially massive size of the Implicit Congestion & Loss Charge Detail, and Zonal Aggregate Definition reports, both are limited to a single day per download request when manually selecting via MSRS