

# Metering Fundamentals

---

**Gina E. Craan**

Manager, Market Training, *New York Independent System Operator*

## **Accounting & Billing Workshop**

February 2021

WebEx

# Session Objectives

- **Identify the role of a Meter Authority**
- **Name the two types of Meter Authorities**
- **State the meaning of the following terms:**
  - Control Computer System
  - Telemetry
  - Revenue Quality Metering
  - Revenue Quality Real-Time Metering
  - Performance Tracking System (PTS) Data
  - Sub-Zone
  - Settlement Data Exchange (SDX)

# Session Objectives cont'd

- Identify two types of metering devices used to measure and record energy usage and instantaneous demand
- Describe how meter data from real-time and hourly revenue meters are used in financial settlements

# Roles

# Metering Fundamentals

## ■ Meter Authority (MA)

- An entity that is responsible for the calibration, maintenance, operation, and reporting of metered data from an electric revenue meter used in the wholesale electricity markets administered by the NYISO (*i.e., a Member Systems or Meter Services Entity*)

# Metering Fundamentals

## ■ Member Systems

- The eight Transmission Owners that comprised the membership of the New York Power Pool, which are:
  - Central Hudson Gas & Electric Corporation
  - Consolidated Edison Company of New York, Inc.
  - New York State Electric & Gas Corporation
  - Niagara Mohawk Power Corporation d/b/a National Grid
  - Orange and Rockland Utilities, Inc.
  - Rochester Gas and Electric Corporation
  - Power Authority of the State of New York
  - Long Island Lighting Company d/b/a Long Island Power Authority

## ■ Meter Services Entity

- An entity registered with the ISO and authorized to provide metering and meter data services, as applicable, to a Demand Reduction Provider, DSASP Provider, Aggregator, Responsible Interface Party or Curtailment Service Provider.

# Terms

# Metering Fundamentals

## ■ Control Computer System

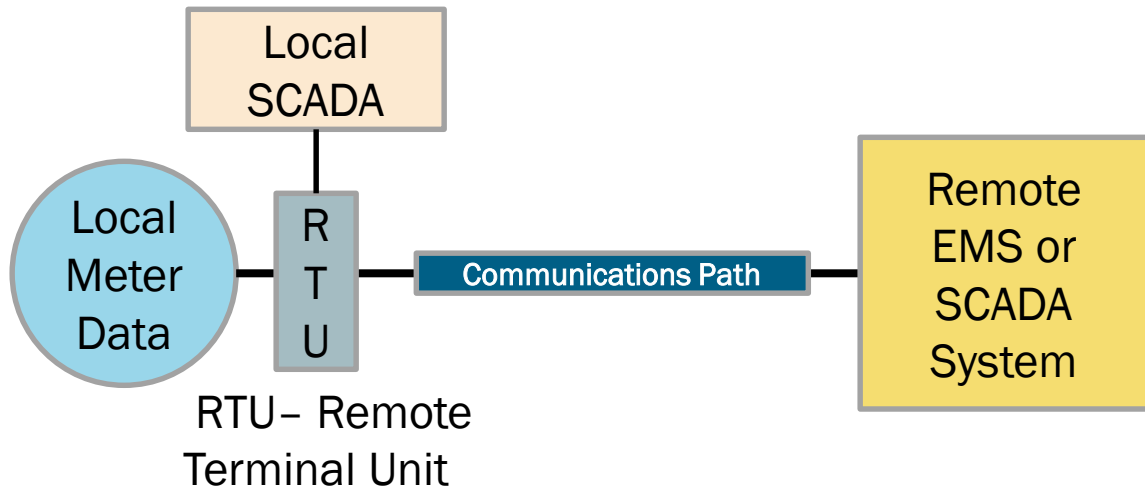
- The real-time computer used to monitor and control the power system.
- These systems are often referred to as SCADA (supervisory control and data acquisition) systems or;
  - SCADA/AGC (SCADA automatic generation control) systems
  - Energy Management Systems (EMS)
- Individual Transmission Owners may call their systems by other names, such as Power Control System.



# Metering Fundamentals

## ■ Telemetry

- Process of collecting meter data and transmitting the data over a communications path to another location



# Metering Fundamentals

- **Revenue Quality Metering**
  - Use of Electric Revenue Metering Systems to provide data for energy billing purpose
  - The components of these systems are approved by both the TO and the New York State (NYS) Public Service Commission (PSC) for revenue settlements
- **Revenue Quality Real-Time Metering**
  - An accurate metering system that satisfies American National Standards Institute (ANSI) C12 requirements for electrical energy billing purposes
  - Approved for use by both the TO and the NYS PSC

## ■ Performance Tracking System (PTS) Data

- Actual energy injections are measured in real-time and telemetered to the NYISO typically every six seconds
- Real-time telemetry, which is a component of the real-time settlement, and is used by the NYISO for initial billing and final settlement if no other values are available
- NYISO uses both the PTS data and the hourly MWh data reported by the MA to compute real-time interval level and hourly billing

# Metering Fundamentals

## ■ Sub-Zone

- Sub-region of a New York Control Area (NYCA) Locational-Based Marginal Pricing (LBMP) zone controlled by a single transmission owner
- Sub-zones are defined and metered to allow allocation of energy to load

## ■ Settlement Data Exchange ("SDX")

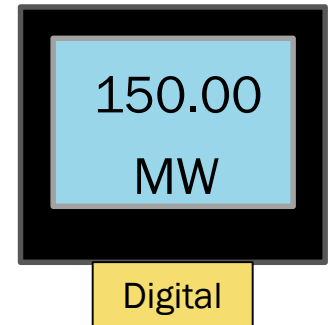
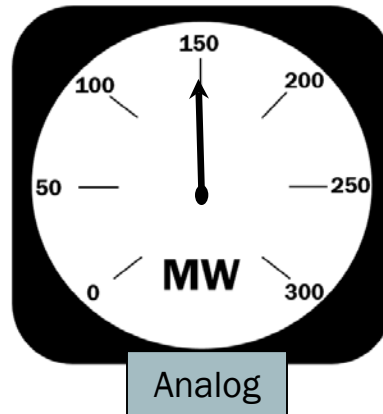
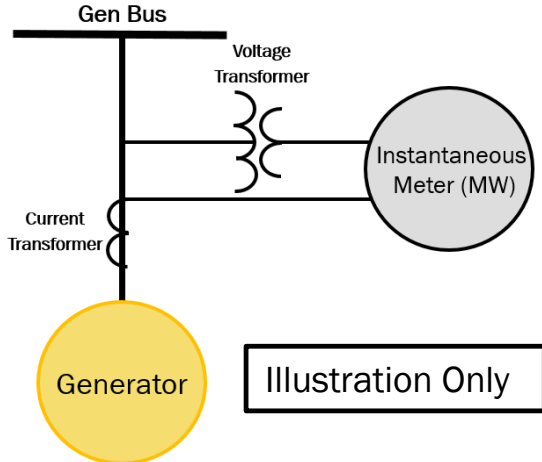
- A web-enabled application for the upload and download query functions related to hourly tie line, generation, Sub-Zone, and load bus data

# Meters Used for Settlements

# Types of Electrical Metering

## ■ Instantaneous Meter (Demand Meter)

- A meter designed to display/record the real-time or instantaneous value of power (kW or MW)
- Typically not revenue grade metering
- Meter reading represents real-time energy being produced or consumed, varies with changes

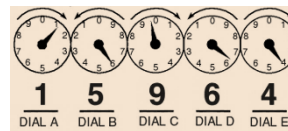
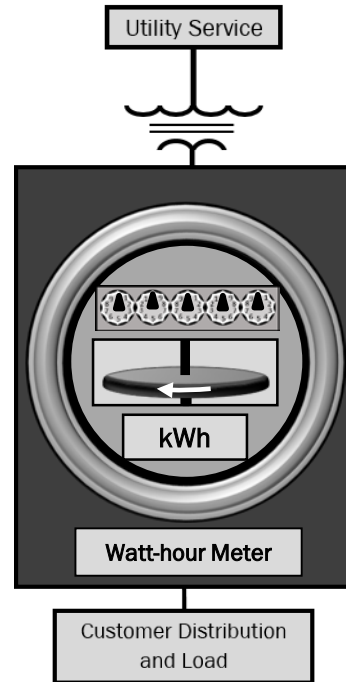


Instantaneous Meters (IM)

# Types of Electrical Meters

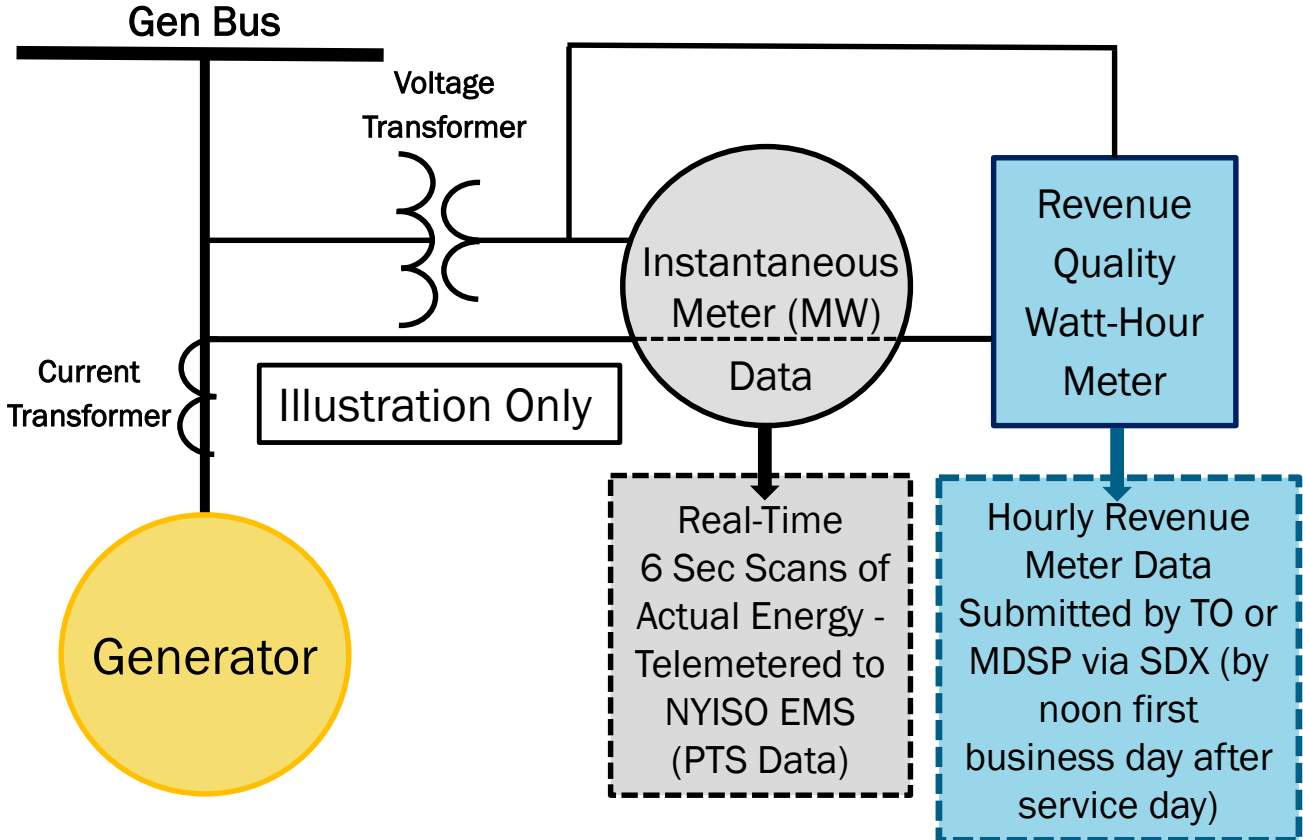
## ■ Watt-hour Revenue Meter

- Watt-hour meters are often used for billing purposes
- Meter indicates the amount of energy consumed over time
- The dials record the total usage of kWh
- Some meters are digital or a combination of mechanical and digital
- Not all watt-hour meters have a time stamp to indicate usage per a set time period (concept of interval or time of use)



This Month kWh	15964
Last Month kWh	15123
<b>Total Usage kWh</b>	<b>841</b>

# Meters for Settlement - Gens





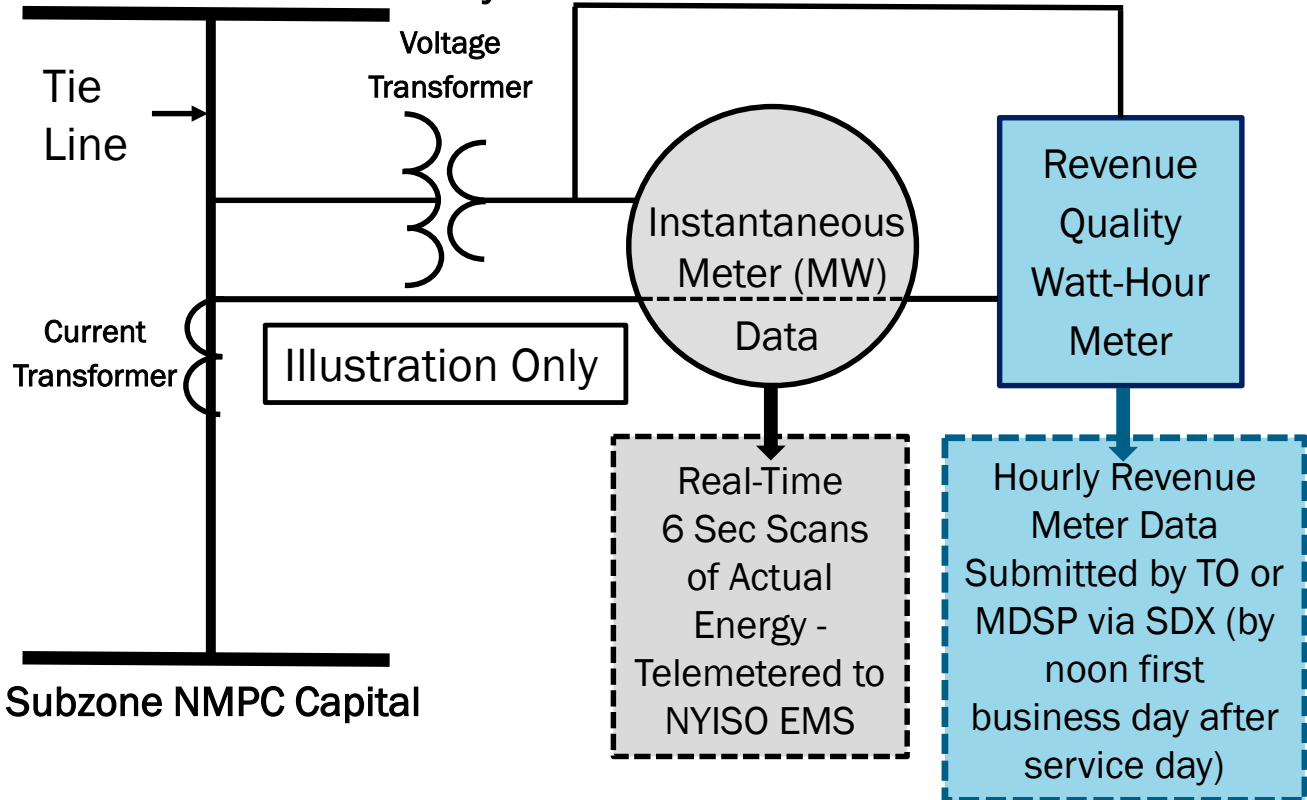
# Metering Requirements for Energy Storage Resources (ESRs)

## ■ Metering Requirements

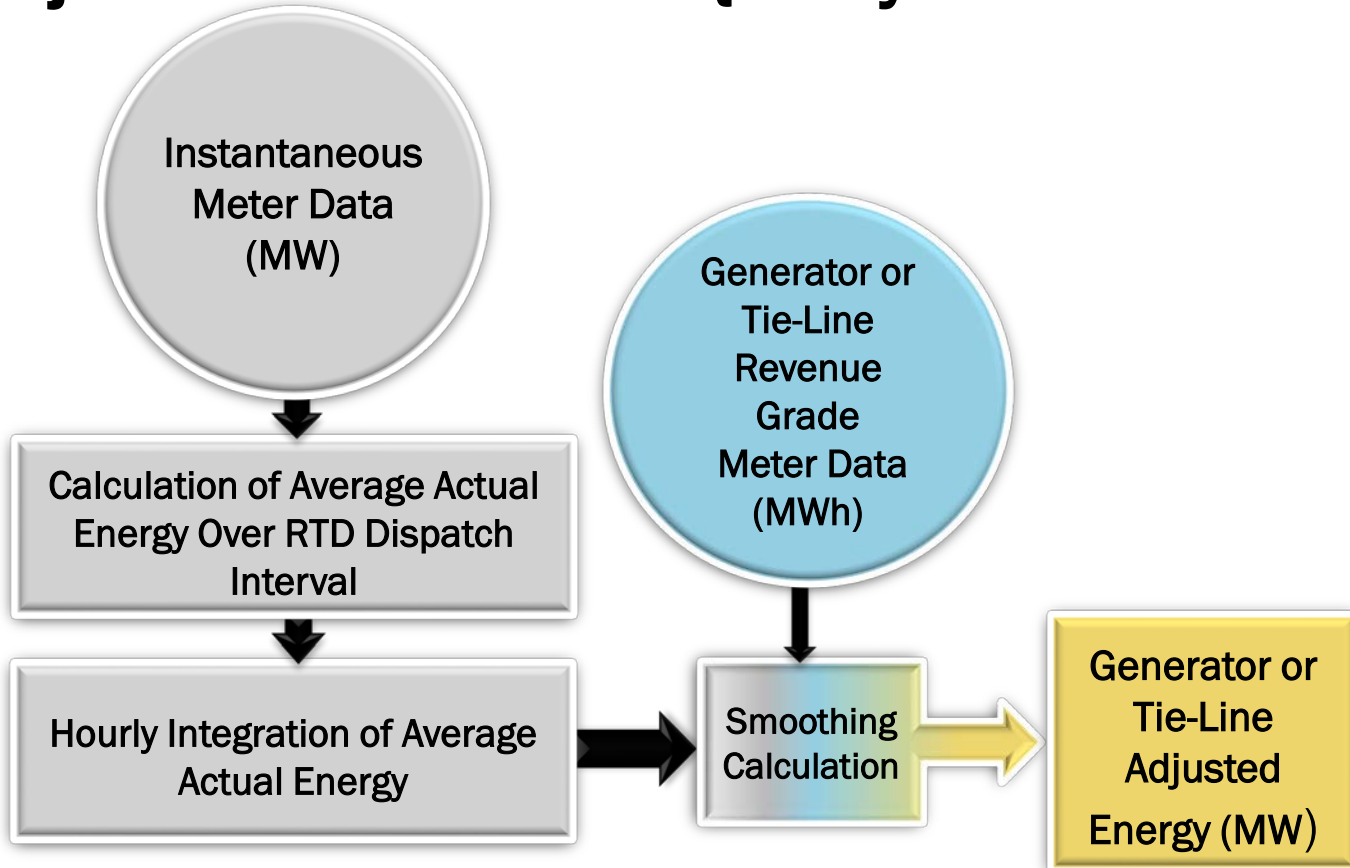
- Provide direct metering regardless of physical location
  - Meters must:
    - Be approved by Metering Authority
    - Provide revenue-quality metering information
    - Provide six-second telemetry
    - Comply with minimum acceptable accuracy standards
- Submit dual channel hourly meter data
  - Separate fields for Injection MW and Withdrawal MW vs. single net MW value
  - Results in less distortion of values
- Provide Energy Level (MWh) telemetry in RT

# Meters for Settlement – Tie Lines

Subzone NMPC Mohawk Valley



# Adjustment of Actual Energy Injections to Revenue Quality Meter



# Calculation of Gen Average Actual Energy Over RTD Interval

Time	MW	Time	MW	Time	MW	Time	MW	Time	MW
01:00:00	10	01:01:00	9.9	01:02:00	10	01:03:00	10	01:04:00	10
01:00:06	10	01:01:06	10	01:02:06	10	01:03:06	10	01:04:06	10
01:00:12	10.1	01:01:12	10.0	01:02:12	10.1	01:03:12	9.9	01:04:12	10.1
01:00:18	10.2	01:01:18	9.9	01:02:18	10.2	01:03:18	10	01:04:18	10
01:00:24	10.1	01:01:24	10	01:02:24	10.1	01:03:24	10.1	01:04:24	9.9
01:00:30	10	01:01:30	10	01:02:30	10	01:03:30	10	01:04:30	9.8
01:00:36	10.2	01:01:36	9.9	01:02:36	9.9	01:03:36	10.1	01:04:36	9.9
01:00:42	10	01:01:42	10	01:02:42	10	01:03:42	10	01:04:42	10
01:00:48	9.9	01:01:48	10	01:02:48	10	01:03:48	9.9	01:04:48	10
01:00:54	10	01:01:54	10	01:02:54	10.1	01:03:54	10	01:04:54	10

Average Actual Energy over RTD Interval = 10.0060 MW

# Hourly Integration of the Generators

## Average Actual Energy – Example 1

Date Time	Gen Average Actual Energy (MW) for RTD	Length of RTD Interval/3600	Energy Injected per Dispatch Interval
08/19/2018 01:00	10.0060 X	300/3600 =	0.83383
08/19/2018 01:05	10.0040	300/3600	0.83367
08/19/2018 01:10	10.0045	300/3600	0.83371
08/19/2018 01:15	10.0000	300/3600	0.83333
08/19/2018 01:20	10.0010	300/3600	0.83342
08/19/2018 01:25	10.0000	300/3600	0.83333
08/19/2018 01:30	9.9990	300/3600	0.83325
08/19/2018 01:35	10.0001	300/3600	0.83334
08/19/2018 01:40	10.0000	300/3600	0.83333
08/19/2018 01:45	10.0010	300/3600	0.83342
08/19/2018 01:50	10.0000	300/3600	0.83333
08/19/2018 01:55	10.0020	300/3600	0.83350
	Average = 10.0015	↔	Σ = 10.0015

Note: If the RTD Intervals are all the same, 5 Minutes (300s), then the Average =  $\Sigma$

# Hourly Integration of the Generators

## Average Actual Energy – Example 2

Date Time	Gen Average Actual Energy (MW) for RTD	Length of RTD Interval/3600	Energy Injected per Dispatch Interval
08/19/2018 01:00	10.0060	300/3600	0.83383
08/19/2018 01:05	10.0040	300/3600	0.83367
08/19/2018 01:06	10.0045	60/3600	0.16674
08/19/2018 01:15	10.0000	540/3600	1.50000
08/19/2018 01:20	10.0010	300/3600	0.83342
08/19/2018 01:25	10.0000	300/3600	0.83333
08/19/2018 01:30	9.9990	300/3600	0.83325
08/19/2018 01:35	10.0001	300/3600	0.83334
08/19/2018 01:40	10.0000	300/3600	0.83333
08/19/2018 01:45	10.0010	300/3600	0.83342
08/19/2018 01:50	10.0000	300/3600	0.83333
08/19/2018 01:55	10.0020	300/3600	0.83350
Non-Time Weighted Average = 10.0015			$\Sigma = 10.00117$

Note: If the RTD Intervals are not all the same, then the Average  $\neq \Sigma$

# Compute Gen Adjusted Energy

$$\begin{array}{l} \text{Generator} \\ \text{Adjusted} \\ \text{Energy} \end{array} = \begin{array}{l} \text{Generator} \\ \text{Average Actual} \\ \text{Energy for RTD} \\ \text{Interval} \end{array} \times \frac{\begin{array}{l} \text{Generator Hourly} \\ \text{Revenue Meter Energy} \end{array}}{\begin{array}{l} \text{Hourly Integration of} \\ \text{the Generators} \\ \text{Average Actual} \\ \text{Energy}^* \end{array}}$$

\* Value is time-weighted based on RTD Interval length

# Generator Adjusted Energy

Date Time	Gen Average Actual Energy (MW) for RTD	Gen Rev. Meter Energy (MW)	Gen Adjusted Energy (MW)
08/19/2018 01:00	10.0060	10.0010	10.0055
08/19/2018 01:05	10.0040	10.0010	
08/19/2018 01:10	10.0045	10.0010	
08/19/2018 01:15	10.0000	10.0010	
08/19/2018 01:20	10.0010	10.0010	
08/19/2018 01:25	10.0000	10.0010	
08/19/2018 01:30	9.9990	10.0010	
08/19/2018 01:35	10.0001	10.0010	
08/19/2018 01:40	10.0000	10.0010	
08/19/2018 01:45	10.0010	10.0010	
08/19/2018 01:50	10.0000	10.0010	
08/19/2018 01:55	10.0020	10.0010	
Hrly Integration of Avg Actual Energy = 10.0015			

$$10.0060 \times \frac{10.0010}{10.0015}$$



# Generator Adjusted Energy

Date Time	Gen Average Actual Energy (MW) for RTD	Gen Rev. Meter Energy (MW)	*Gen Adjusted Energy (MW)
08/19/2018 01:00	10.0060	10.0010	10.0055
08/19/2018 01:05	10.0040	10.0010	10.0035
08/19/2018 01:10	10.0045	10.0010	10.0040
08/19/2018 01:15	10.0000	10.0010	9.9995
08/19/2018 01:20	10.0010	10.0010	10.0005
08/19/2018 01:25	10.0000	10.0010	9.9995
08/19/2018 01:30	9.9990	10.0010	9.9985
08/19/2018 01:35	10.0001	10.0010	9.9996
08/19/2018 01:40	10.0000	10.0010	9.9995
08/19/2018 01:45	10.0010	10.0010	10.0005
08/19/2018 01:50	10.0000	10.0010	9.9995
08/19/2018 01:55	10.0020	10.0010	10.0015

\* The Gen Adjusted Energy will be a billing determinant in the Balancing Market Energy Settlements

# ESR Generator Adjusted Energy

- Example:

## Dual Channel Metering

	RTD Avg Actual Injection MW	RTD Avg Actual Withdrawal MW	RTD Adjusted Injection MW	RTD Adjusted Withdrawal MW	Final Adjusted MW
:00	10	0	10.4854	0.0000	10.4854
:05	10	0	10.4854	0.0000	10.4854
:10	10	0	10.4854	0.0000	10.4854
:15	10	0	10.4854	0.0000	10.4854
:20	10	0	10.4854	0.0000	10.4854
:25	1.5	-2	1.5728	-1.9024	-0.3296
:30	0	-5	0	-4.7561	-4.7561
:35	0	-6	0	-5.7073	-5.7073
:40	0	-7	0	-6.6585	-6.6585
:45	0	-7	0	-6.6585	-6.6585
:50	0	-7	0	-6.6585	-6.6585
:55	0	-7	0	-6.6585	-6.6585
	4.2917	-3.4167	4.5000	-3.2500	1.2500
Revenue Meter MWH	4.5000	-3.2500			
Adjustment Ratio	1.0485	0.9512			

VS.

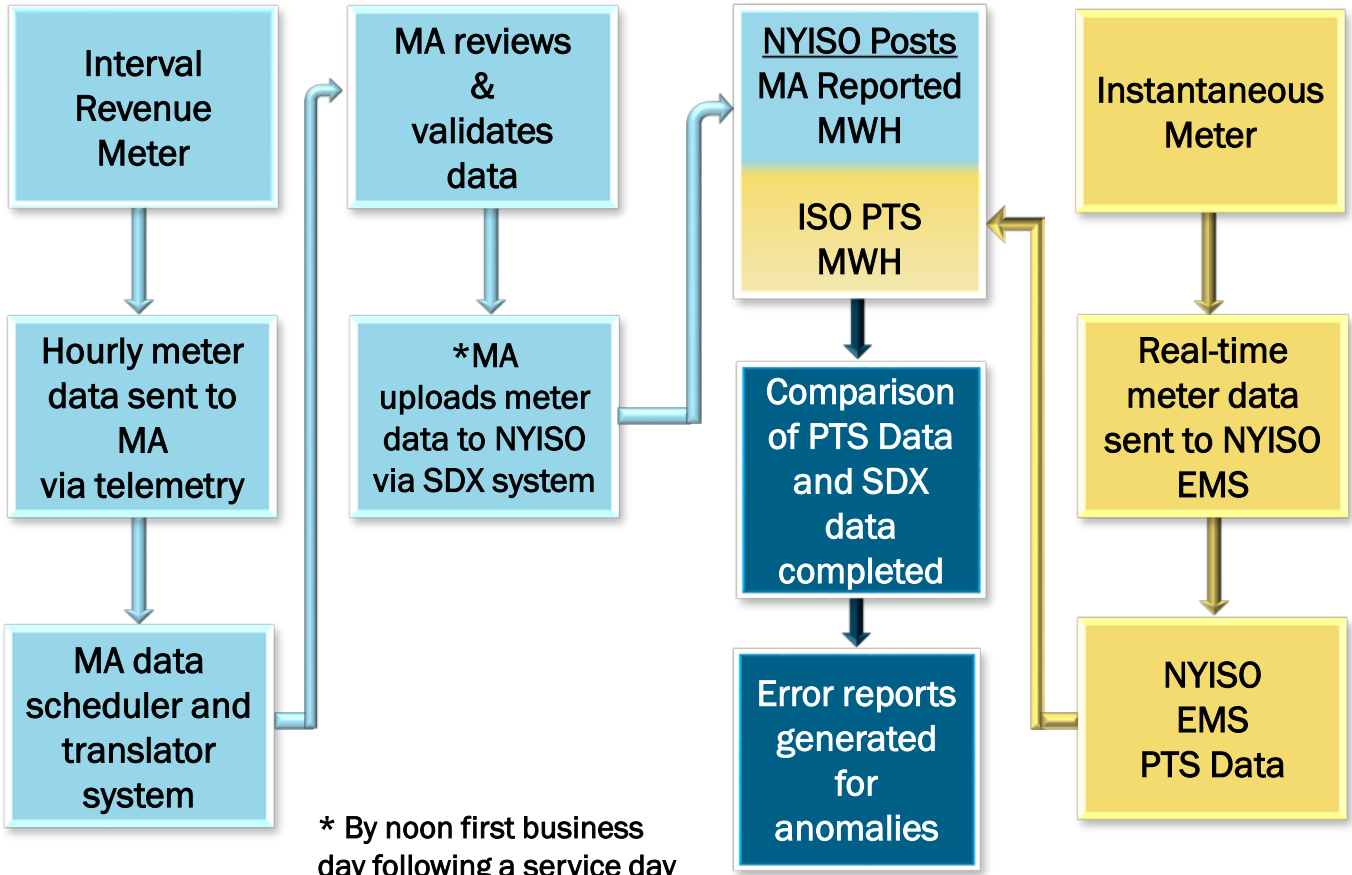
## Single Net Meter

	RTD Avg Actual MW	RTD Adjusted MW
:00	10	14.2857
:05	10	14.2857
:10	10	14.2857
:15	10	14.2857
:20	10	14.2857
:25	-0.5	-0.7143
:30	-5	-7.1429
:35	-6	-8.5714
:40	-7	-10.0000
:45	-7	-10.0000
:50	-7	-10.0000
:55	-7	-10.0000
	0.8750	1.2500
Revenue Meter MWH	1.2500	
Adjustment Ratio	1.4286	

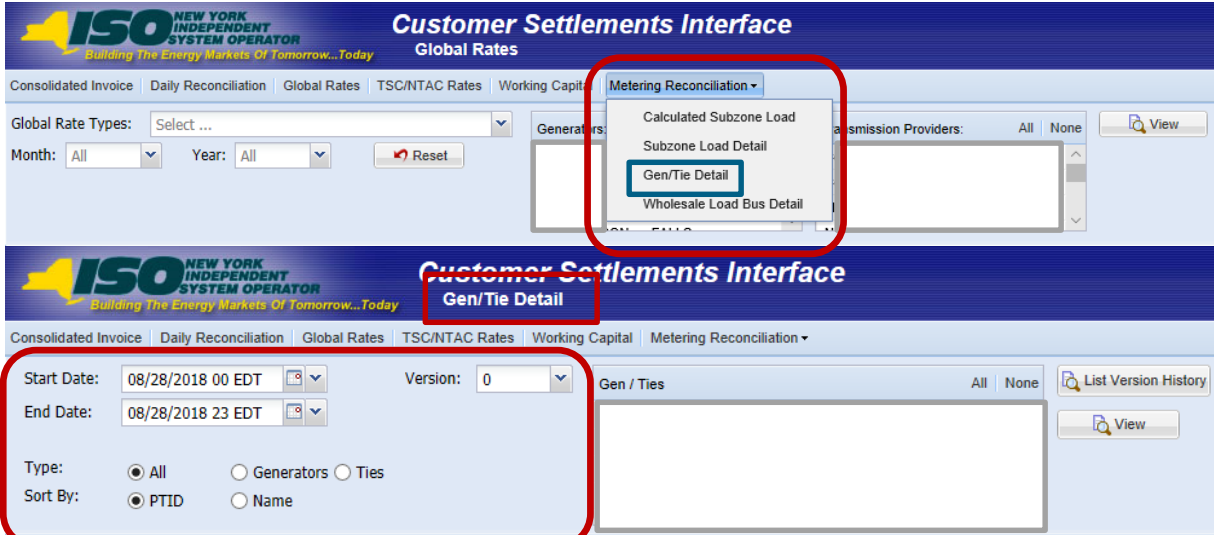


# Meter Data in CSI

# Meter Data in CSI



# Meter Data in CSI



The image shows two screenshots of the Customer Settlements Interface (CSI) web application. The top screenshot displays the 'Global Rates' section with a 'Metering Reconciliation' dropdown menu open, highlighting the 'Gen/Tie Detail' option. The bottom screenshot shows the 'Gen/Tie Detail' page with search filters highlighted by a red box. The filters include date ranges, version selection, and type/sort options.

**Customer Settlements Interface - Global Rates**

Consolidated Invoice | Daily Reconciliation | Global Rates | TSC/NTAC Rates | Working Capital | Metering Reconciliation

Global Rate Types: Select ...

Month: All | Year: All | Reset

Metering Reconciliation Menu:

- Calculated Subzone Load
- Subzone Load Detail
- Gen/Tie Detail**
- Wholesale Load Bus Detail

**Customer Settlements Interface - Gen/Tie Detail**

Consolidated Invoice | Daily Reconciliation | Global Rates | TSC/NTAC Rates | Working Capital | Metering Reconciliation

Start Date: 08/28/2018 00 EDT | Version: 0

End Date: 08/28/2018 23 EDT

Type:  All |  Generators |  Ties

Sort By:  PTID |  Name

Gen / Ties | All | None | List Version History | View

Please select the dates to view associated data

# Meter Data in CSI

Hourly Revenue Meter Data submitted by MA through SDX

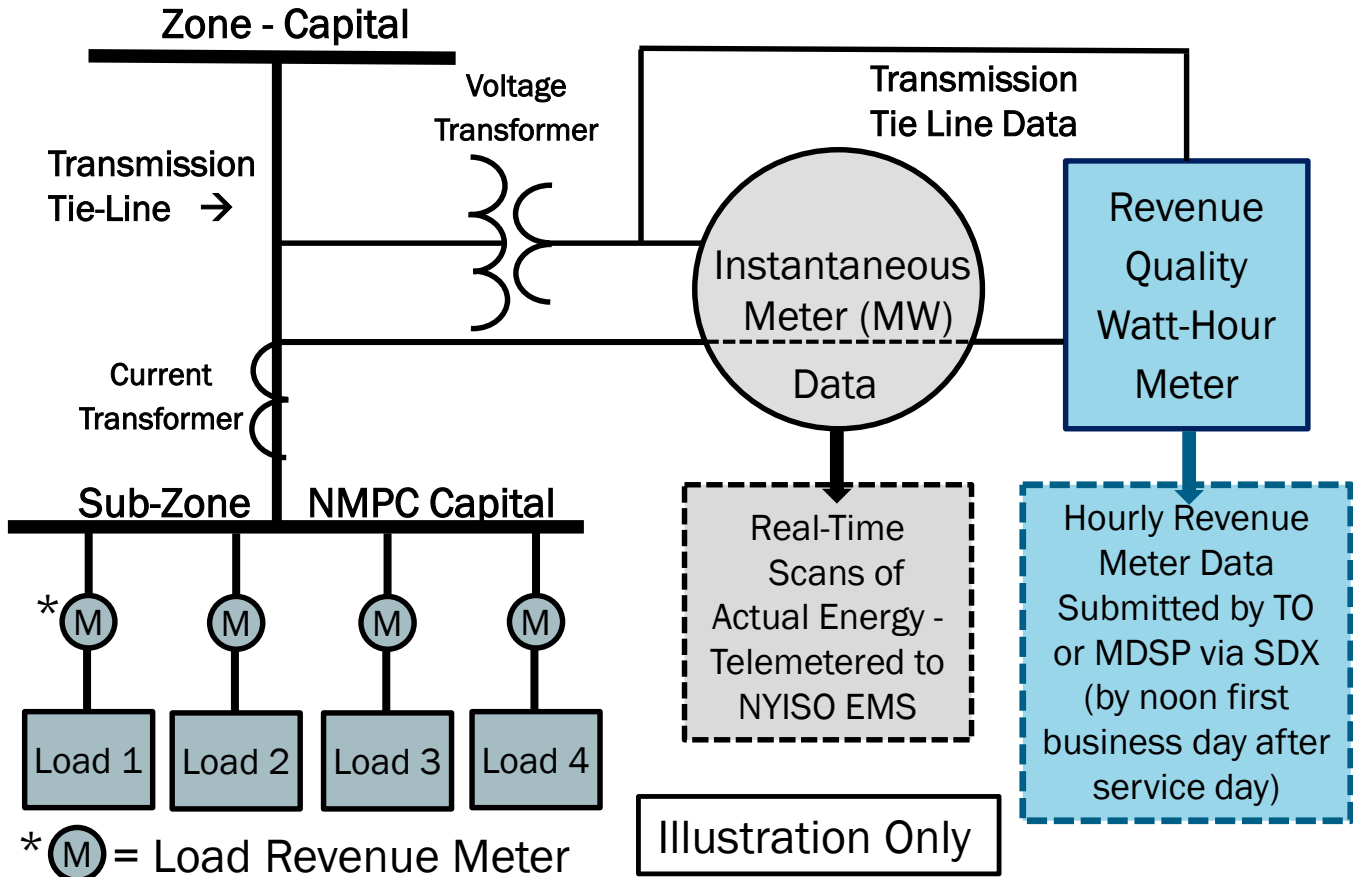
**Legend:** †  $\geq \pm 5\%$  and  $< \pm 10\%$  Anomaly   ‡  $\geq \pm 10\%$  Anomaly   \* Null PTS Value Anomaly

Time ▲	Ptid	Ptid Name	Type	MA Reported MWH	ISO PTS MWH
08/28/2018 07:00:00...			GEN	0.0000	0.0000
<b>☒ Date/Time: 08/28/2018 08:00:00 EDT</b>					
08/28/2018 08:00:00...			GEN	0.0000	0.0000
<b>☒ Date/Time: 08/28/2018 09:00:00 EDT</b>					
† 08/28/2018 09:00:00...			GEN	21.1200	19.6583
<b>☒ Date/Time: 08/28/2018 10:00:00 EDT</b>					
08/28/2018 10:00:00...			GEN	41.1600	40.0917

Hourly Integration of the Generators Average Actual Energy from Real Time Metering

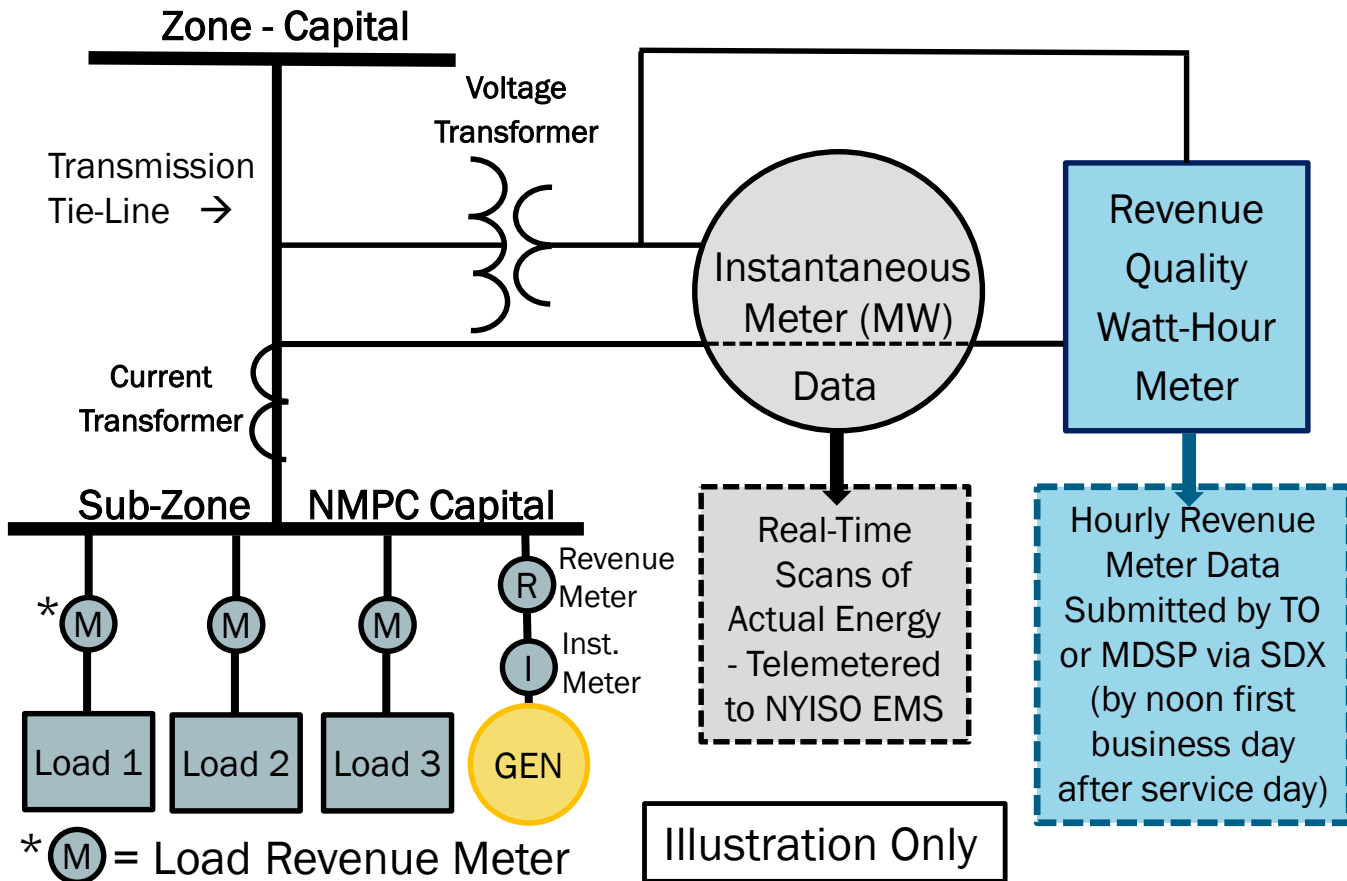
# Estimating Sub-Zonal Load

# Estimating Sub-Zonal Load





# Estimating Sub-Zonal Load



# Estimating Sub-Zonal Load

- First determine electricity consumed in the sub-zone (withdrawals)
  - Use real-time metering data from:
    - Transmission Tie-Line(s)
    - Injections by Generator(s)
- **Sub-Zonal Load = Net Transmission Tie-Line Flows + Net Generation Injected – Sub Zonal Transmission Losses**
- **Calculation performed for each RTD Interval**

# Meter Data Schedules

# Meter Data Schedules

**Markets & Operations**

**Billing & Settlements**

**Billing & Settlements**

**Meter Data Review**

**2018 Daily Lock-Down Schedules**

**2018 Hourly Tie-Line, Generator, and LSE Bus Meter Data Review, Revision, & Lock-down Schedule**

**2018 Hourly Tie-Line, Generator, and LSE Bus Meter Data Review, Revision, & Lock-down Schedule**

**Metering Contacts as of February 2017**

**Meter Data Management Protocols-Revised 9/15/11**

**Customer Settlements Interface Login**

Select the link below to login to the Customer Settlements Interface Application. Please Note: You will need a digital certificate to access this application.

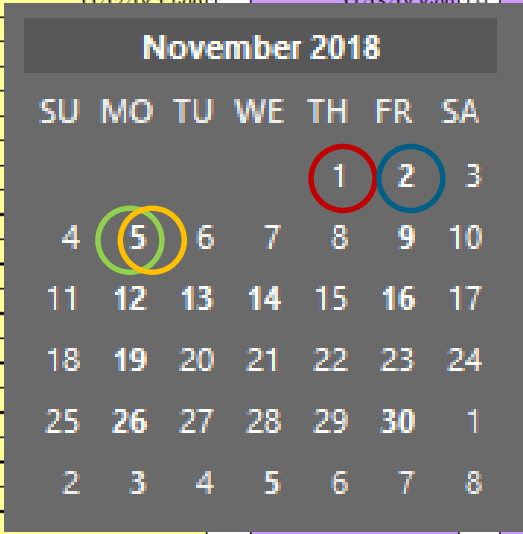
Login To Customer Settlements Interface >>

Type	Document Name	Modified
	<a href="#">2018 Daily Lock-Down Schedules</a>	01/25/2018
	<a href="#">2017 Hourly Tie-Line, Generator, and LSE Bus Meter Data Review, Revision, &amp; Lock-down Schedule</a>	10/30/2017
	<a href="#">2018 Hourly Tie-Line, Generator, and LSE Bus Meter Data Review, Revision, &amp; Lock-down Schedule</a>	10/30/2017
	<a href="#">Metering Contacts as of February 2017</a>	02/06/2017
	<a href="#">Meter Data Management Protocols-Revised 9/15/11</a>	09/19/2011

# Daily Lock-Down Schedule

## Daily Lock-down Schedule - Initial Month - November 2018

Billing Day	Day	Lock-down for Daily Advisory	Day	Unlock For Updates	Day	Re-Lock After Updates	Day
11/1/2018	TH	11/2/18 12:00	F	11/5/18 8:00	M	11/5/18 16:00	M
11/2/2018	F	11/5/18 12:00	M	11/7/18 8:00	W	11/7/18 16:00	W
11/3/2018	S	11/5/18 12:00	M	11/7/18 8:00	W	11/7/18 16:00	W
11/4/2018	S	11/5/18 12:00	M	11/7/18 8:00	W	11/7/18 16:00	W
11/5/2018	M	11/6/18 12:00	T	11/8/18 8:00	TH	11/8/18 16:00	TH
11/6/2018	T	11/7/18 12:00	W	11/9/18 8:00	F	11/9/18 16:00	F
11/7/2018	W	11/8/18 12:00	TH	11/13/18 8:00	T	11/13/18 16:00	T
11/8/2018	TH	11/9/18 12:00	M	11/13/18 8:00	T	11/13/18 16:00	T
11/9/2018	F	11/12/18 12:00	T	11/15/18 8:00	TH	11/15/18 16:00	TH
11/10/2018	S					11/15/18 16:00	TH
11/11/2018	S					11/15/18 16:00	TH
11/12/2018	M					11/15/18 16:00	TH
11/13/2018	T					11/16/18 16:00	F
11/14/2018	W					11/19/18 16:00	M
11/15/2018	TH					11/19/18 16:00	M
11/16/2018	F					11/21/18 16:00	W
11/17/2018	S					11/21/18 16:00	W
11/18/2018	S					11/21/18 16:00	W
11/19/2018	M					11/26/18 16:00	M
11/20/2018	T					11/26/18 16:00	M
11/21/2018	W					11/28/18 16:00	W
11/22/2018	TH					11/28/18 16:00	W
11/23/2018	F					11/28/18 16:00	W
11/24/2018	S					11/28/18 16:00	W
11/25/2018	S					11/28/18 16:00	W
11/26/2018	M					11/29/18 16:00	TH
11/27/2018	T					11/30/18 16:00	F
11/28/2018	W					12/3/18 16:00	M
11/29/2018	TH					12/3/18 16:00	M
11/30/2018	F					12/5/18 16:00	W



# Review, Revision, and Lock-Down

## Hourly Tie-line, Generator, and LSE Bus Meter Data Review, Revision, And Lock-down Schedule

Billing Month	November 2018
Initial Invoice Date	December 7, 2018
Period for Tie-line & Generator Metering Revision Submission by Meter Authorities Begins	December 13, 2018
Period to Challenge Tie-line & Generator Metering <i>Only Through Written Request</i> Begins	January 14, 2019*
Period to Challenge Tie-line & Generator Metering Data Ends (Day-55)	January 31, 2019
Tie-line & Generator Metering Precluded From Further Revisions (Day-60)	February 5, 2019
LSE Bus Metering Data for 4-Month True-up Due From Meter Authorities (Day-70)	February 15, 2019
4-Month True-up LSE Metering Posted For Review (Day-75)	February 20, 2019
4-Month True-up LSE Metering Revisions Suspended for Invoice Processing	March 4, 2019*
4-Month True-up Advisory LSE Metering Posted For LSE Review & Challenge** (Day-90)	March 7, 2019
Period to Challenge LSE Bus Metering Data for 4-Month True-up Ends (Day-100)	March 18, 2019
LSE Bus Metering Data for 4-Month True-up Precluded from Further Revisions (Day-105)	March 22, 2019
4-Month True-up LSE Metering Revisions Suspended Due to Invoicing (Day-120)	April 5, 2019
Close-out Settlement LSE Metering Due From Meter Authorities (Day-130)	April 16, 2019
Close-out Settlement LSE Metering Posted For Review & Challenge** (Day-135)	April 22, 2019*
Period to Challenge LSE Metering Ends (Day-145)	May 1, 2019
Close-out Settlement LSE Metering Data Finalized (Day-150)	May 6, 2019

\* Any deadline that falls on a Saturday, Sunday or holiday for which the NYISO is closed is observed on the NYISO's next business day.

\*\* Generator & tie-line meter data is excluded from challenge.

# Metering Fundamentals

## ■ Reference Material

- NYISO Revenue Metering Requirements Manual
  - Meter Authorities Roles – Section 4.3
  - Metering Terminology – Section 1.2
  - Metering System Equipment – Section 2.2
  - Meters for Settlement – Section 4.1 and 4.4
- NYISO Control Center Requirements Manual
  - Metering Terminology – Section 1.1
  - Metering System Equipment – Section 3.1
- NYISO Accounting and Billing Manual
  - Meters for Settlement – Section 3.2.1 and 4.1.3
  - Estimating Sub-Zonal Load – Section 3.2.2
  - Meter Data Schedules – Section 3.2
- NYISO Billing and Settlement Services – Lockdown Schedules
  - 2018 Daily Lock-Down Schedules
  - 2018 Hourly Tie-Line, Generator, and LSE Bus Meter Data, Review, Revision, & Lock-Down Schedule