Interconnection Metering Cases

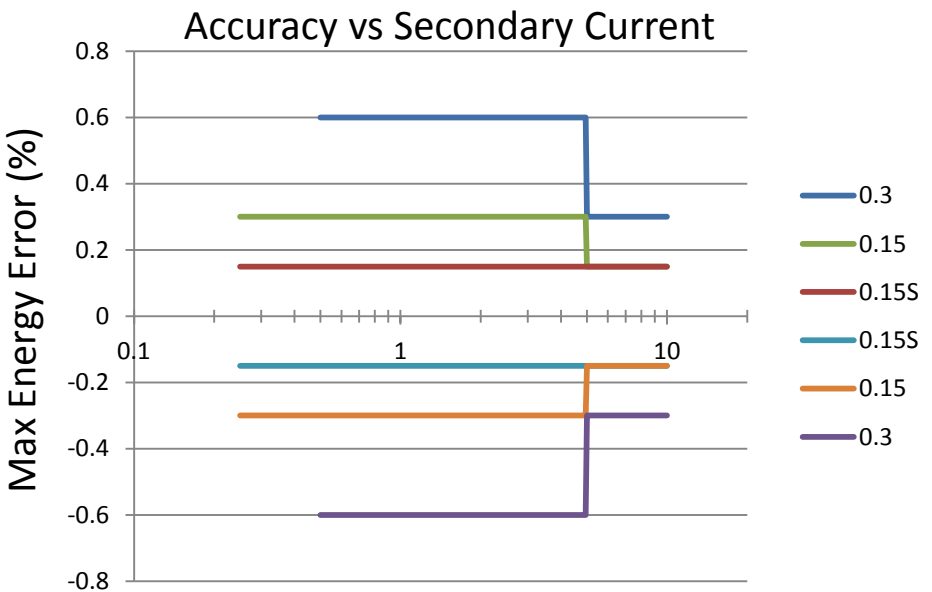
And Random Examples from one utility

Overview

- CT Accuracy & Range of Operation
- Example Cases
  - Large Merchant (over 100 kV & over 40 MW)
  - Transmission Interconnection
  - Transmission Check Meter
  - Distributed Generation (less than 100 kV & under 20 MW)
- Point of Interconnection / Metered Data

Current Transformer Accuracy

Meter Accuracy
Based on Ratio & Phase Angle Errors



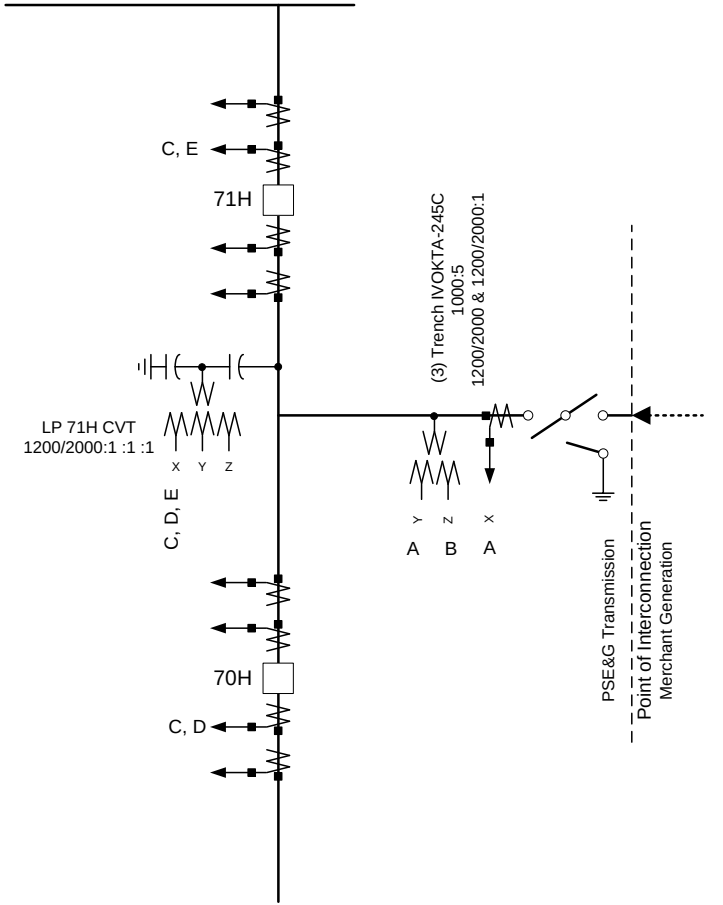
Relay Accuracy
Based on Ratio Error only

- C and T Relay Accuracy Class
  - 3% @ 5 amps if ratio > 250:5
- X Accuracy Class
  - 1% @ 5 amps
- Standard requires that Accuracy apply to full secondary winding only. (Taps are undefined.)

What is installation typical Current? What fraction of CT Max Continuous Current?

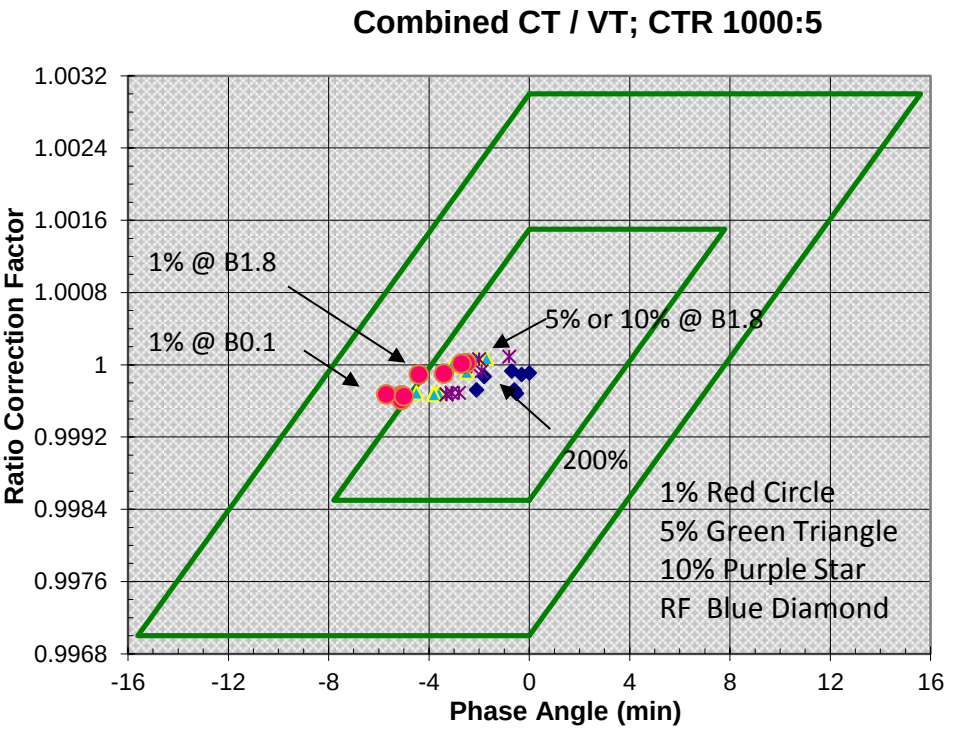
Large Merchant Generation

	Settlements	Operational
Designation	A	C
CT Ratio	1000:5, RF 2	(2) 3000:5
CT Accuracy	0.15S, B-1.8	C-800
VT	Inductive	CVT
VT Ratio	1200:1	2000:1
VT Accuracy	0.15	0.3
Measurement	C12.20, 0.2CA	RTU, Direct Current & Voltage
Peak Observed Load	710 MW ~1780 amps	



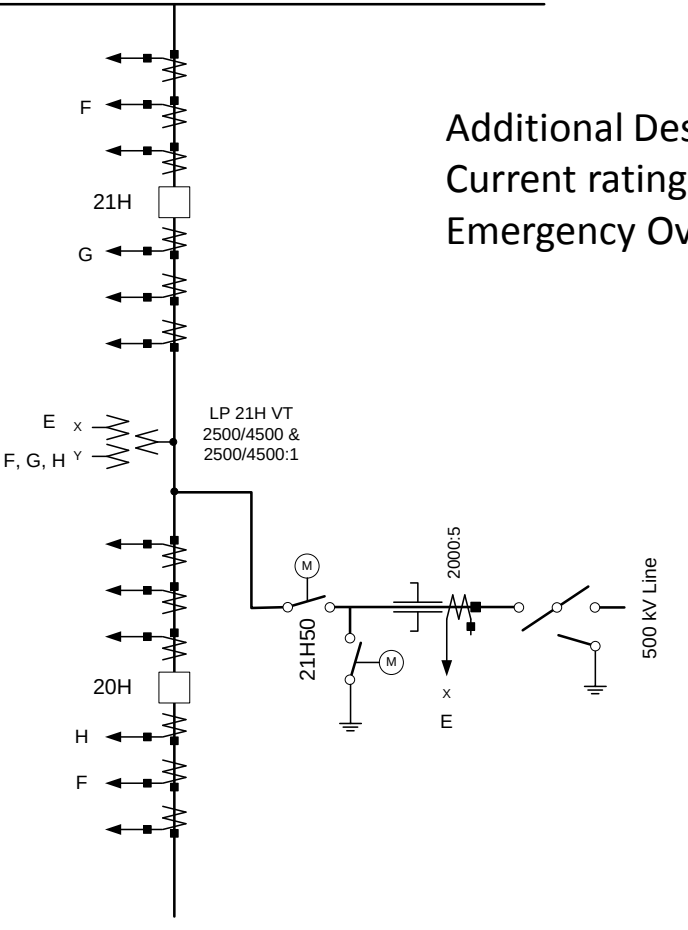
Large Merchant Generation

- This is the best CT accuracy test results we can point to.
- Lower Turns ratio (for smaller connection) would not have low end performance this good.
- With a TF of 240,000 – 1% of 1000 amps is 4 MVA



Transmission Interconnection

	Settlements	Operational
Designation	E	F
CT Ratio	2000:5, RF 2	(2) 3000:5
CT Accuracy	0.15, B-0.9	C-800
VT	Inductive	Inductive
VT Ratio	2500:1	4500:1
VT Accuracy	0.3 Z, 0.15 Y	0.3 Z, 0.15 Y
Measurement	C12.20, 0.2CA	RTU, Direct Current & Voltage
Peak Observed Load	1167 MW ~1348 amps	



Additional Design Criteria:
Current rating for
Emergency Overload (4 hr)

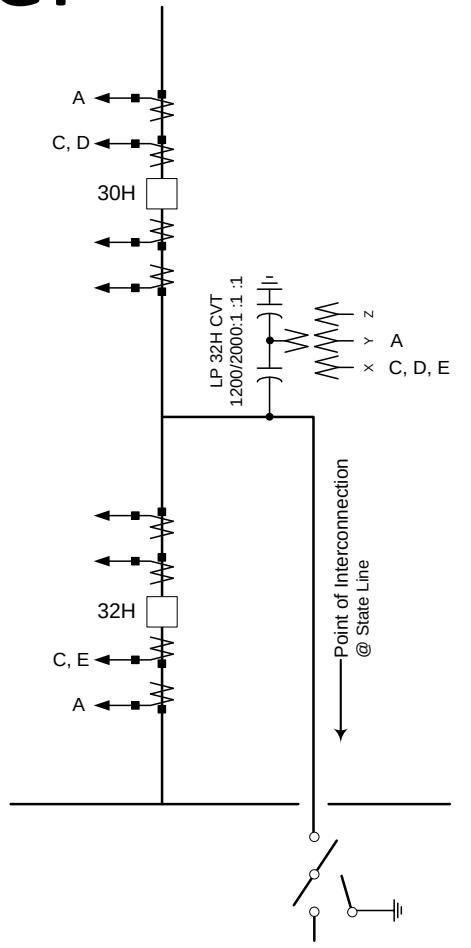
Transmission Check Meter

Line crosses Utility & ISO boundaries.

Meter of Record at other end of line.

Additional Design Criteria: Current rating for Emergency Overload (4 hr)

	Settlements	Operational
Designation	A	C
CT Ratio	(2) 3000:5 MR, 2000:5	(2) 3000:5 MR, 2000:5
CT Accuracy	C-800	C-800
VT	CVT	CVT
VT Ratio	1155:1	2000:1
VT Accuracy	0.3	0.3
Measurement	C12.20, 0.2CA	RTU, Direct Current & Voltage
Peak Observed Load	591 MW ~1483 amps	



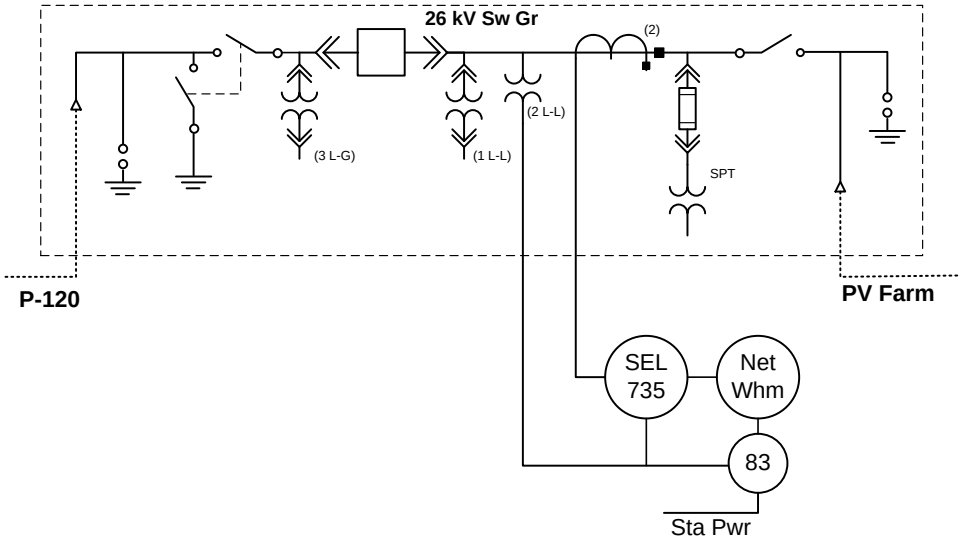
Distributed Generation

- Connection voltages
  - 69 kV, 26.4 kV 13.2 kV, 480 volts
- System Sizes
  - 500 kW thru 20,000 kW
- Generation Source
  - Rotating Generator
    - Gas
    - Landfill Gas
    - Combined Heat & Power
    - Co Gen (Heat used for Industrial Process)
  - Photo Voltaic
  - Storage
  - Fuel Cell

- Not Transmission
- Real Time data Required by PJM for participation in Capacity Market

Distributed Generation

	Settlements	Operational
Designation	Net Whm	SEL - 735
CT Ratio	75:5, RF 2.2	75:5, RF 2.2
CT Accuracy	0.3, B-0.9	0.3, B-0.9
VT	Inductive	Inductive
VT Ratio	240:1	240:1
VT Accuracy	0.3 Y	0.3 Y
Measurement	C12.20, 0.2CA	C12.20, 0.2CA
Inverter Capacity	6.8 MW ~149 amps	



Point of Interconnection

POI

- POI may have different interpretations
  - Ownership of Equipment
  - Maintenance Responsibility
  - Operational Control
  - Effective Point of Sale

Can Language or Context clarify the meaning of requirements

Metered Data

- Settlements Data
  - MWh, provision for MVARh
  - Effectively at POI
  - NJ SREC Rules
- Real Time Data
  - MW, MVAR, Voltage
  - Effectively at POI
  - Some Times at Generator