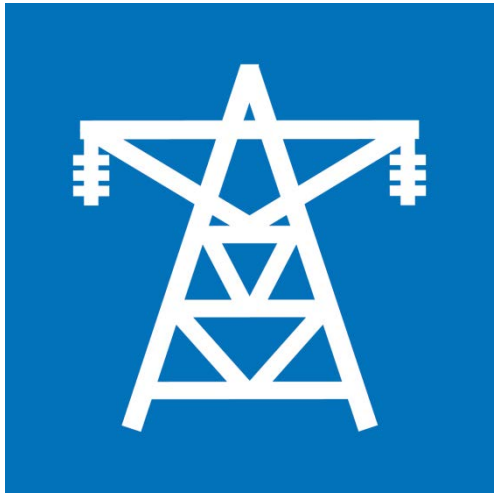


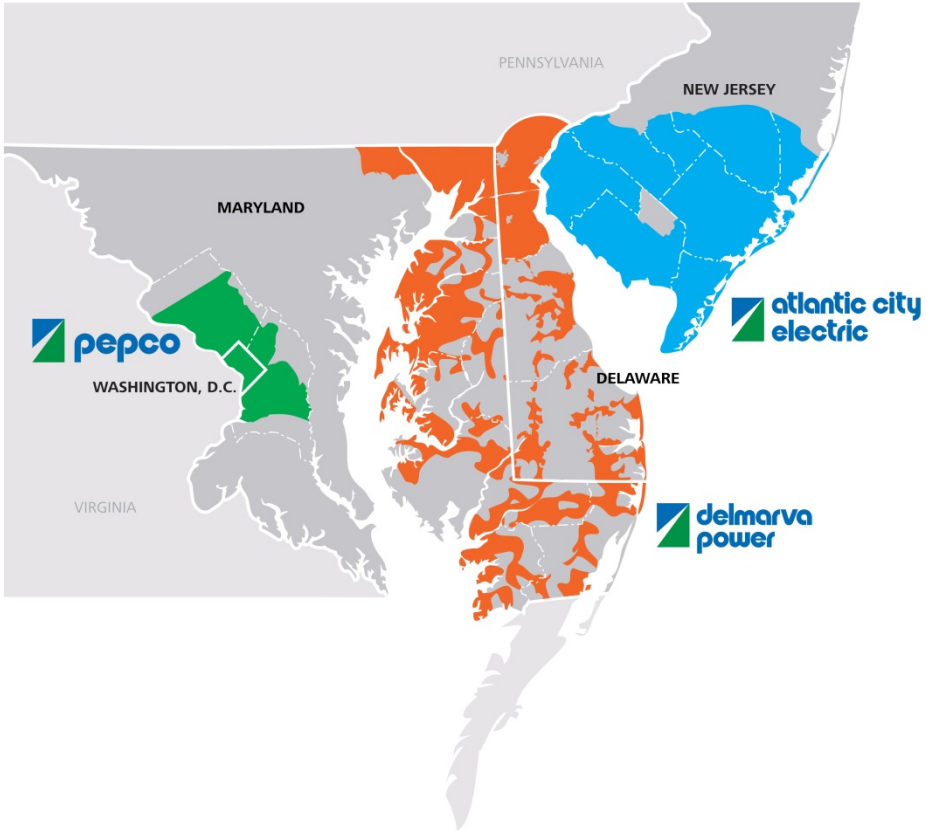
Conservation Voltage Reduction and Smart Meters

Presented by **Timothy Schwarz, PE**

Pepco Holdings, Inc

Pepco Holdings, Inc. Quick Facts

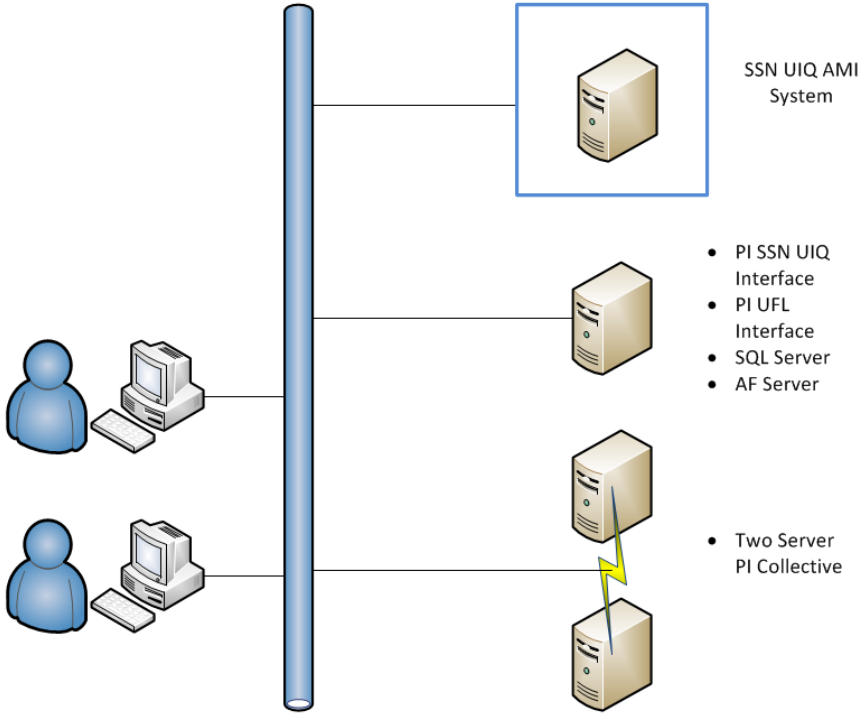
- Incorporated in 2002
- Service territory:
  8,340 square miles
- Customers served
  - Atlantic City Electric:
    - 545,000 – electric
  - Delmarva Power:
    - 503,000 – electric
    - 125,000 – natural gas
  - Pepco:
    - 793,000 – electric
- Total population served:
  5.6 million



Project Driver

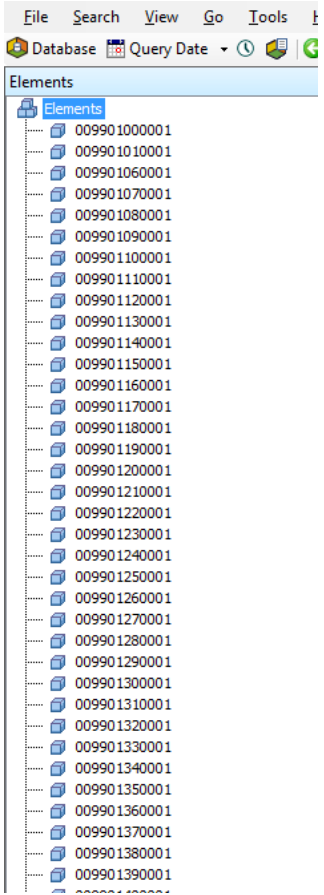
- Conservation Voltage Reduction (CVR) pilot mandated by the Maryland Public Service Commission
  - CVR is a reduction in energy consumption that results from a reduction in source voltage
  - Not all loads benefit from CVR
    - Constant impedance loads result in lower energy consumption with lower voltage (incandescent lights)
    - Constant power loads offer no savings since reduction in voltage will just result in higher currents
      - This could be more problematic than helpful since it could reduce equipment life
- Realize benefits from AMI (Automated Metering Infrastructure) smart meters

PI System Architecture



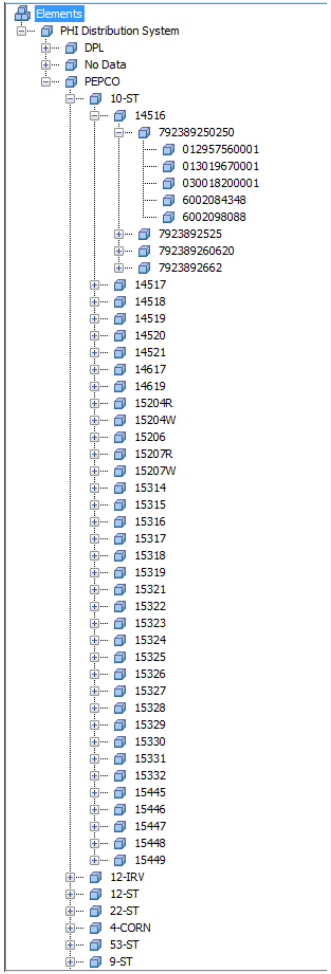
PI System Architecture

- PI AMI Interface processes tab-separated files from the AMI system to automatically create the PI Tags and the AF elements/attributes
  - AF elements are stored in a flat structured database
- PI UFL Interface processes comma separated files from the AMI system to load the actual value data into the PI Tags
- PI Tags and AF Elements are indexed according to the service point ID
  - Unique identifier for each customer meter
  - This allows for constant voltage profiles for customers regardless of meter swaps
- PI was built out for all PHI AMI customers for a total of 1.4M elements (NJ doesn't allow AMI meters)



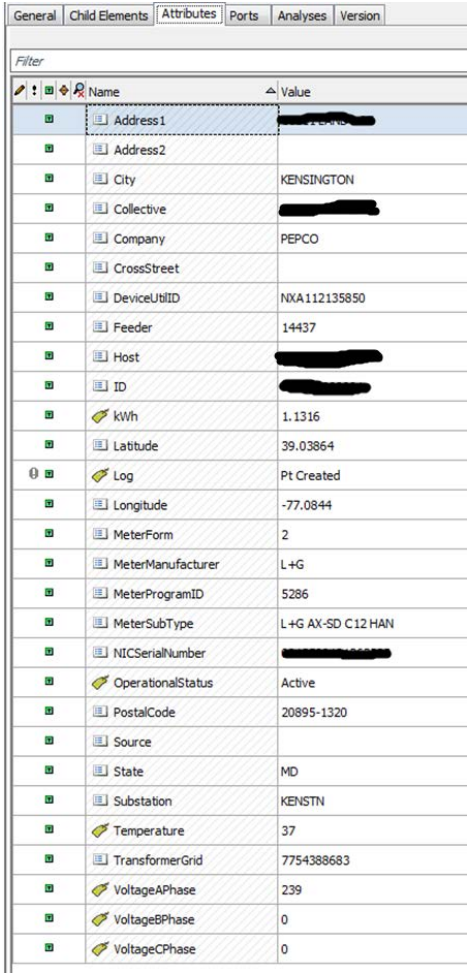
PI System Architecture

- Utilize PI AF SDK to build a hierarchical AF database
  - Structure format is Company, Substation, Feeder, Transformer, Customer
  - Allows for easing searching/navigating in the core PI Client tools
- Program runs weekly and updates the hierarchical database with data in the flat database
- Since the customer information isn't perfect, we utilize a "No Data" hierarchy as a catch-all for customers that cannot be mapped to a particular substation/feeder



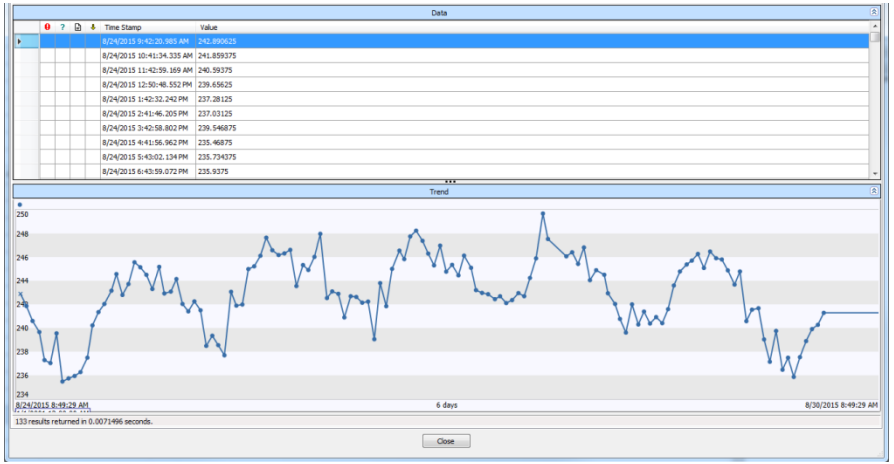
PI Server Data

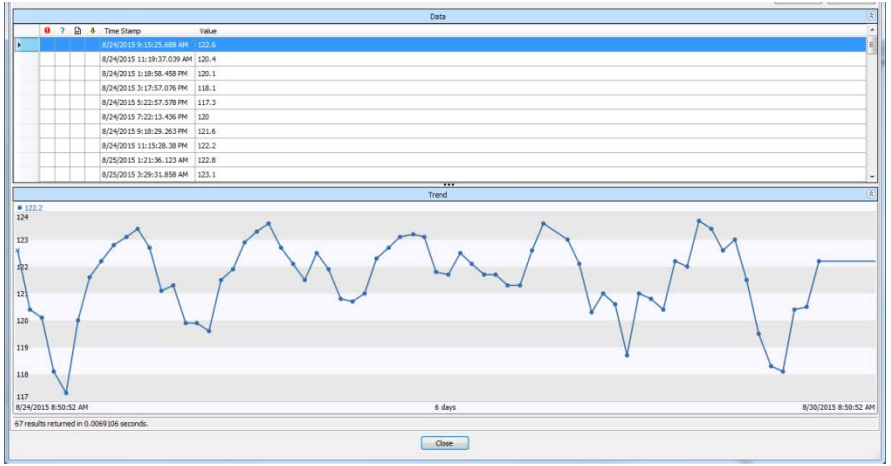
- The data coming from the AMI meters is very different from normal SCADA data
  - SCADA utilizes a four second scan compared to hourly or fifteen minute AMI data
- Users in SCADA environments typically query data with a specific purpose in mind
  - i.e. look at a trend for an overloaded facility, plot substation voltage, etc.
- The users in the AMI environment want to see customers that have experienced voltage excursions
  - This requires developing custom reports that query the entire PI System and output the results to some usable format



PI Server Data

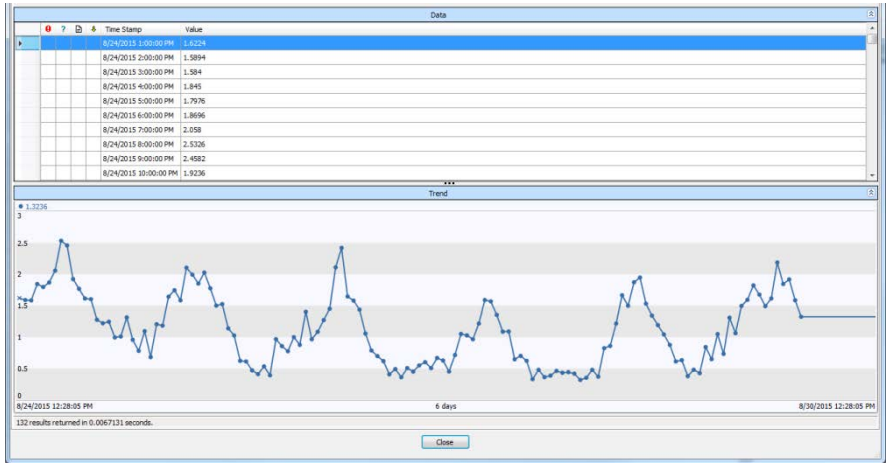
- The voltage data received from the meters is not normalized and represents the actual delivered service voltage (240V, 120/208V, 277/480V, etc.)
  - This can make the reporting and querying difficult when finding excursions due to many scales
- PHI has custom built voltage exception report logic for each meter manufacturer/type
  - Even voltage values in the same meter type can be different nominal voltage depending on the service voltage

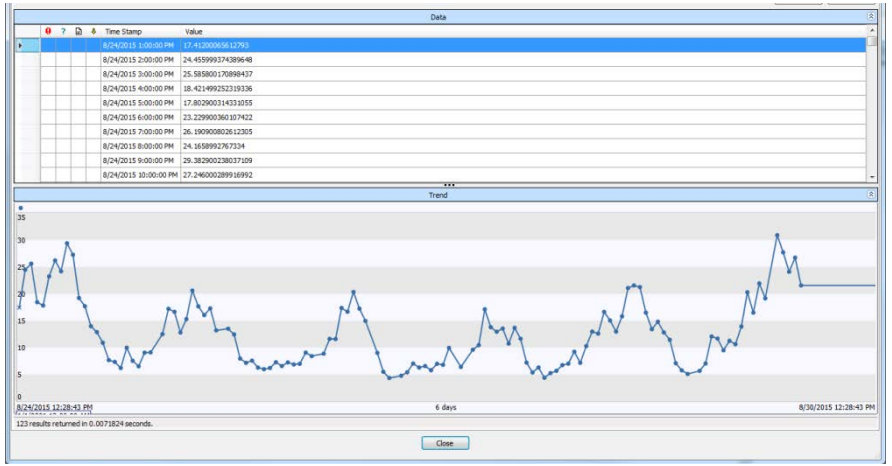




PI Server Data

- KWh data is received for each meter type
- Utilize PI AF-SDK to roll up the kWh data for customers to transformer, roll up transformer kWh to feeder
- Collaborative effort with OSIsoft to develop rollup code due to the process to input data into the PI System from our meter system
  - The data could come in late for non-communicating meters
  - Our data comes into the PI System in bulk
  - Our code looks back several days to sum up the kWh and store the data into the PI Server



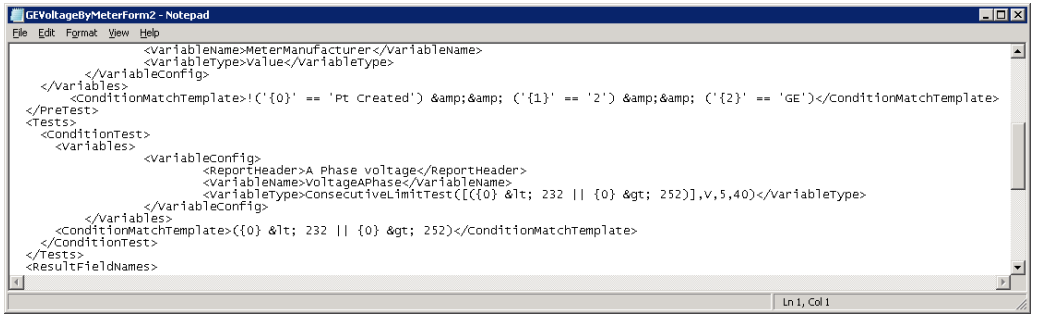


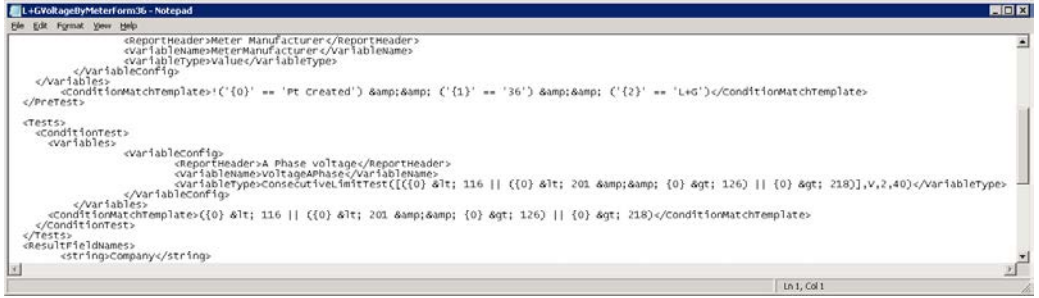
Data Extraction and Reports

- AMI data is different than normal SCADA data
  - Requires the system to tell you to look at something
- Massive amount of data
  - Built the system for 1.4M meters with approximately 9M PI Tags
  - Collecting data for only a subset of the tags
  - Regular voltage (every hour or every two hours) and kWh (every hour or every 15 minutes) for the CVR impacted customers (approximately 200k customers)
  - Periodically do full system scan for a one time instantaneous voltage read during peak conditions
- Custom daily reports
  - Developed voltage exception reports and transformer overload reports
  - Utilizing the PI AF-SDK
  - Reports are uploaded to a SharePoint server for users to access

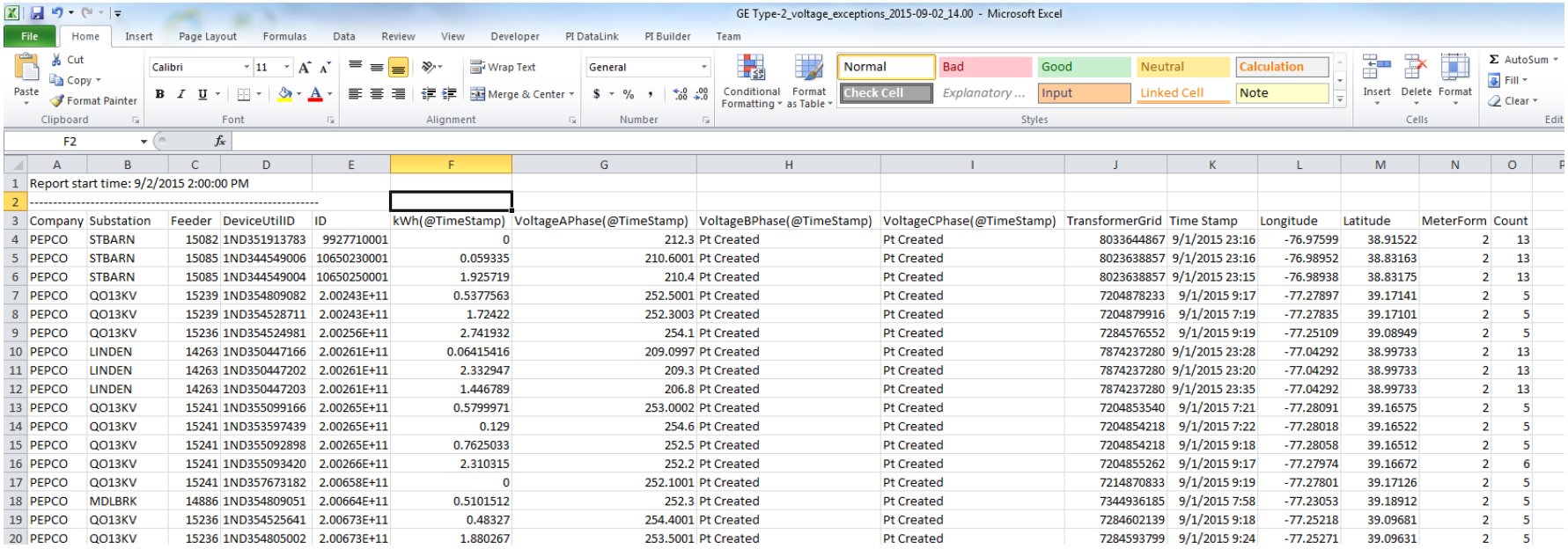
Data Extraction and Reports

- Voltage exception report will list the customers who have had voltage deviations outside a defined range
- Different meter types can have many different acceptable ranges due to the service voltage difference
- Look for several consecutive excursions to trigger inclusion to the report
  - Based on frequency of the meter voltage read (1 hour or 2 hour frequency)



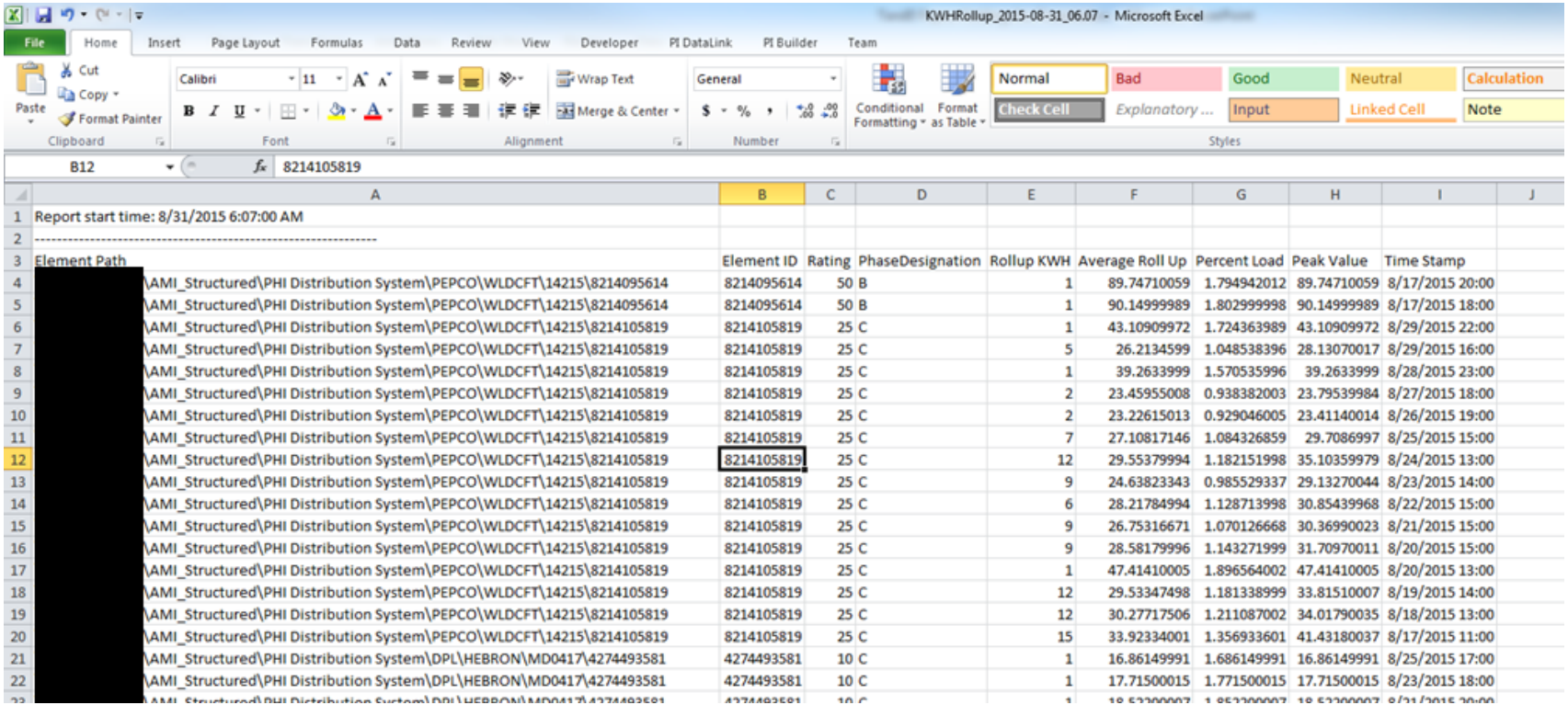


Data Extraction and Reports



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Report start time: 9/2/2015 2:00:00 PM														
2	----------														
3	Company	Substation	Feeder	DeviceUtilID	ID	kWh(@TimeStamp)	VoltageAPhase(@TimeStamp)	VoltageBPhase(@TimeStamp)	VoltageCPhase(@TimeStamp)	TransformerGrid	Time Stamp	Longitude	Latitude	MeterForm	Count
4	PEPCO	STBARN	15082	1ND351913783	9927710001	0	212.3	Pt Created	Pt Created	8033644867	9/1/2015 23:16	-76.97599	38.91522	2	13
5	PEPCO	STBARN	15085	1ND344549006	10650230001	0.059335	210.6001	Pt Created	Pt Created	8023638857	9/1/2015 23:16	-76.98952	38.83163	2	13
6	PEPCO	STBARN	15085	1ND344549004	10650250001	1.925719	210.4	Pt Created	Pt Created	8023638857	9/1/2015 23:15	-76.98938	38.83175	2	13
7	PEPCO	QO13KV	15239	1ND354809082	2.00243E+11	0.5377563	252.5001	Pt Created	Pt Created	7204878233	9/1/2015 9:17	-77.27897	39.17141	2	5
8	PEPCO	QO13KV	15239	1ND354528711	2.00243E+11	1.72422	252.3003	Pt Created	Pt Created	7204879916	9/1/2015 7:19	-77.27835	39.17101	2	5
9	PEPCO	QO13KV	15236	1ND354524981	2.00256E+11	2.741932	254.1	Pt Created	Pt Created	7284576552	9/1/2015 9:19	-77.25109	39.08949	2	5
10	PEPCO	LINDEN	14263	1ND350447166	2.00261E+11	0.06415416	209.0997	Pt Created	Pt Created	7874237280	9/1/2015 23:28	-77.04292	38.99733	2	13
11	PEPCO	LINDEN	14263	1ND350447202	2.00261E+11	2.332947	209.3	Pt Created	Pt Created	7874237280	9/1/2015 23:20	-77.04292	38.99733	2	13
12	PEPCO	LINDEN	14263	1ND350447203	2.00261E+11	1.446789	206.8	Pt Created	Pt Created	7874237280	9/1/2015 23:35	-77.04292	38.99733	2	13
13	PEPCO	QO13KV	15241	1ND355099166	2.00265E+11	0.5799971	253.0002	Pt Created	Pt Created	7204853540	9/1/2015 7:21	-77.28091	39.16575	2	5
14	PEPCO	QO13KV	15241	1ND353597439	2.00265E+11	0.129	254.6	Pt Created	Pt Created	7204854218	9/1/2015 7:22	-77.28018	39.16522	2	5
15	PEPCO	QO13KV	15241	1ND355092898	2.00265E+11	0.7625033	252.5	Pt Created	Pt Created	7204854218	9/1/2015 9:18	-77.28058	39.16512	2	5
16	PEPCO	QO13KV	15241	1ND355093420	2.00266E+11	2.310315	252.2	Pt Created	Pt Created	7204855262	9/1/2015 9:17	-77.27974	39.16672	2	6
17	PEPCO	QO13KV	15241	1ND357673182	2.00658E+11	0	252.1001	Pt Created	Pt Created	7214870833	9/1/2015 9:19	-77.27801	39.17126	2	5
18	PEPCO	MDLBRK	14886	1ND354809051	2.00664E+11	0.5101512	252.3	Pt Created	Pt Created	7344936185	9/1/2015 7:58	-77.23053	39.18912	2	5
19	PEPCO	QO13KV	15236	1ND354525641	2.00673E+11	0.48327	254.4001	Pt Created	Pt Created	7284602139	9/1/2015 9:18	-77.25218	39.09681	2	5
20	PEPCO	QO13KV	15236	1ND354805002	2.00673E+11	1.880267	253.5001	Pt Created	Pt Created	7284593799	9/1/2015 9:24	-77.25271	39.09631	2	5

Data Extraction and Reports



	A	B	C	D	E	F	G	H	I	J
1	Report start time: 8/31/2015 6:07:00 AM									
2	----------									
3	Element Path	Element ID	Rating	PhaseDesignation	Rollup KWH	Average Roll Up	Percent Load	Peak Value	Time Stamp	
4	[redacted]\AMI_Structured\PHI Distribution System\PEPCO\WLDCFT\14215\8214095614	8214095614	50	B	1	89.74710059	1.794942012	89.74710059	8/17/2015 20:00	
5	[redacted]\AMI_Structured\PHI Distribution System\PEPCO\WLDCFT\14215\8214095614	8214095614	50	B	1	90.14999989	1.802999998	90.14999989	8/17/2015 18:00	
6	[redacted]\AMI_Structured\PHI Distribution System\PEPCO\WLDCFT\14215\8214105819	8214105819	25	C	1	43.10909972	1.724363989	43.10909972	8/29/2015 22:00	
7	[redacted]\AMI_Structured\PHI Distribution System\PEPCO\WLDCFT\14215\8214105819	8214105819	25	C	5	26.2134599	1.048538396	28.13070017	8/29/2015 16:00	
8	[redacted]\AMI_Structured\PHI Distribution System\PEPCO\WLDCFT\14215\8214105819	8214105819	25	C	1	39.2633999	1.570535996	39.2633999	8/28/2015 23:00	
9	[redacted]\AMI_Structured\PHI Distribution System\PEPCO\WLDCFT\14215\8214105819	8214105819	25	C	2	23.45955008	0.938382003	23.79539984	8/27/2015 18:00	
10	[redacted]\AMI_Structured\PHI Distribution System\PEPCO\WLDCFT\14215\8214105819	8214105819	25	C	2	23.22615013	0.929046005	23.41140014	8/26/2015 19:00	
11	[redacted]\AMI_Structured\PHI Distribution System\PEPCO\WLDCFT\14215\8214105819	8214105819	25	C	7	27.10817146	1.084326859	29.7086997	8/25/2015 15:00	
12	[redacted]\AMI_Structured\PHI Distribution System\PEPCO\WLDCFT\14215\8214105819	8214105819	25	C	12	29.55379994	1.182151998	35.10359979	8/24/2015 13:00	
13	[redacted]\AMI_Structured\PHI Distribution System\PEPCO\WLDCFT\14215\8214105819	8214105819	25	C	9	24.63823343	0.985529337	29.13270044	8/23/2015 14:00	
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16	[redacted]\AMI_Structured\PHI Distribution System\PEPCO\WLDCFT\14215\8214105819	8214105819	25	C	9	28.58179996	1.143271999	31.70970011	8/20/2015 15:00	
17	[redacted]\AMI_Structured\PHI Distribution System\PEPCO\WLDCFT\14215\8214105819	8214105819	25	C	1	47.41410005	1.896564002	47.41410005	8/20/2015 13:00	
18	[redacted]\AMI_Structured\PHI Distribution System\PEPCO\WLDCFT\14215\8214105819	8214105819	25	C	12	29.53347498	1.181338999	33.81510007	8/19/2015 14:00	
19	[redacted]\AMI_Structured\PHI Distribution System\PEPCO\WLDCFT\14215\8214105819	8214105819	25	C	12	30.27717506	1.211087002	34.01790035	8/18/2015 13:00	
20	[redacted]\AMI_Structured\PHI Distribution System\PEPCO\WLDCFT\14215\8214105819	8214105819	25	C	15	33.92334001	1.356933601	41.43180037	8/17/2015 11:00	
21	[redacted]\AMI_Structured\PHI Distribution System\DPL\HEBRON\MD0417\4274493581	4274493581	10	C	1	16.86149991	1.686149991	16.86149991	8/25/2015 17:00	
22	[redacted]\AMI_Structured\PHI Distribution System\DPL\HEBRON\MD0417\4274493581	4274493581	10	C	1	17.71500015	1.771500015	17.71500015	8/23/2015 18:00	

Summary and Takeaways

- The PI Server does a good job at storing the massive amount of data
- AMI data is very different from the SCADA data
- Have found multiple electric system problems that required immediate attention
- Reporting out of the PI System requires utilization of the PI AF-SDK
- Very cumbersome in general when handling such large amounts of data (large spreadsheets, files, databases, etc.)
- The PI Server behaves very well with vertical scale as opposed to horizontal scale
- Overall, the system has proved useful and has allowed us to build our CVR program and ensure customer voltages are within tolerance

Contact Information

Timothy Schwarz, PE

- trschwarz@pepco.com
- Lead Engineer
- Pepco Holdings, Inc.

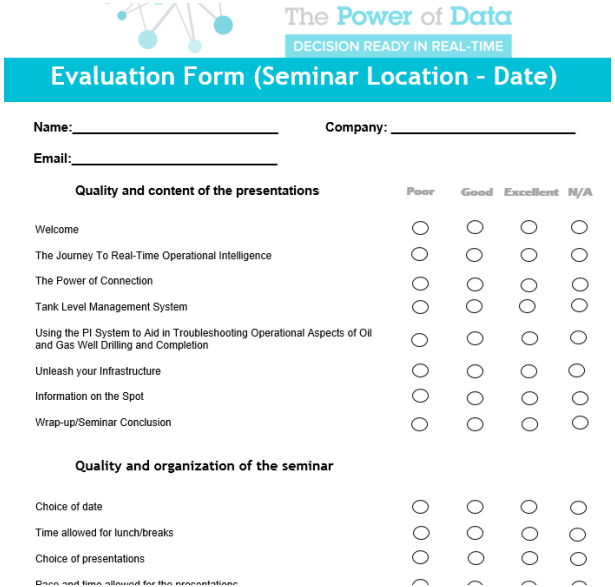
Questions

Please wait for the **microphone** before asking your questions

State your **name & company**

Please don't forget to…

Complete the Survey for this session



The Power of Data

DECISION READY IN REAL-TIME

Evaluation Form (Seminar Location - Date)

Name:_____ Company: _____

Email:_____

Quality and content of the presentations	Poor	Good	Excellent	N/A
Welcome	○	○	○	○
The Journey To Real-Time Operational Intelligence	○	○	○	○
The Power of Connection	○	○	○	○
Tank Level Management System	○	○	○	○
Using the PI System to Aid in Troubleshooting Operational Aspects of Oil and Gas Well Drilling and Completion	○	○	○	○
Unleash your Infrastructure	○	○	○	○
Information on the Spot	○	○	○	○
Wrap-up/Seminar Conclusion	○	○	○	○

Quality and organization of the seminar				
Choice of date	○	○	○	○
Time allowed for lunch/breaks	○	○	○	○
Choice of presentations	○	○	○	○
Pace and time allowed for the presentations	○	○	○	○

감사합니다

谢谢

Danke

Gracias

Merci

Thank You

ありがとう

Спасибо

Obrigado