Fulfilling Nuclear Emergency Preparedness Data needs with PI.

By
Paul Sunderland
&
Kevin Rumbaugh

Contents

- Company background
- What is Emergency Planning
- Examples of PI data use
- Qualifying PI
- Conclusions

Who is Exelon Nuclear?

- Exelon was formed by the merger of ComEd (in Chicago) and PECO (in Philadelphia) in October of 2000
- Nuclear operations are organized into two Regional Operating Groups (ROGs)
- MidWest ROG consists of Braidwood, Byron, Clinton, Dresden, LaSalle, and Quad Cities nuclear stations

Role of Emergency Preparedness

- Overview
- Role of the site TSC
- Role of the EOF

Consolidation of EOF

Exelon SM
Nuclear

- Central EOF implemented in 1999
- MWROG corporate office moved to new building in 2001
- Central EOF for all MWROG plants custom built into new space
- Clinton station incorporated into central EOF
- Desired effective data displays for EP needs

MWROG EOF

Exelon SM
Nuclear

MWROG EOF

Exelon SM
Nuclear

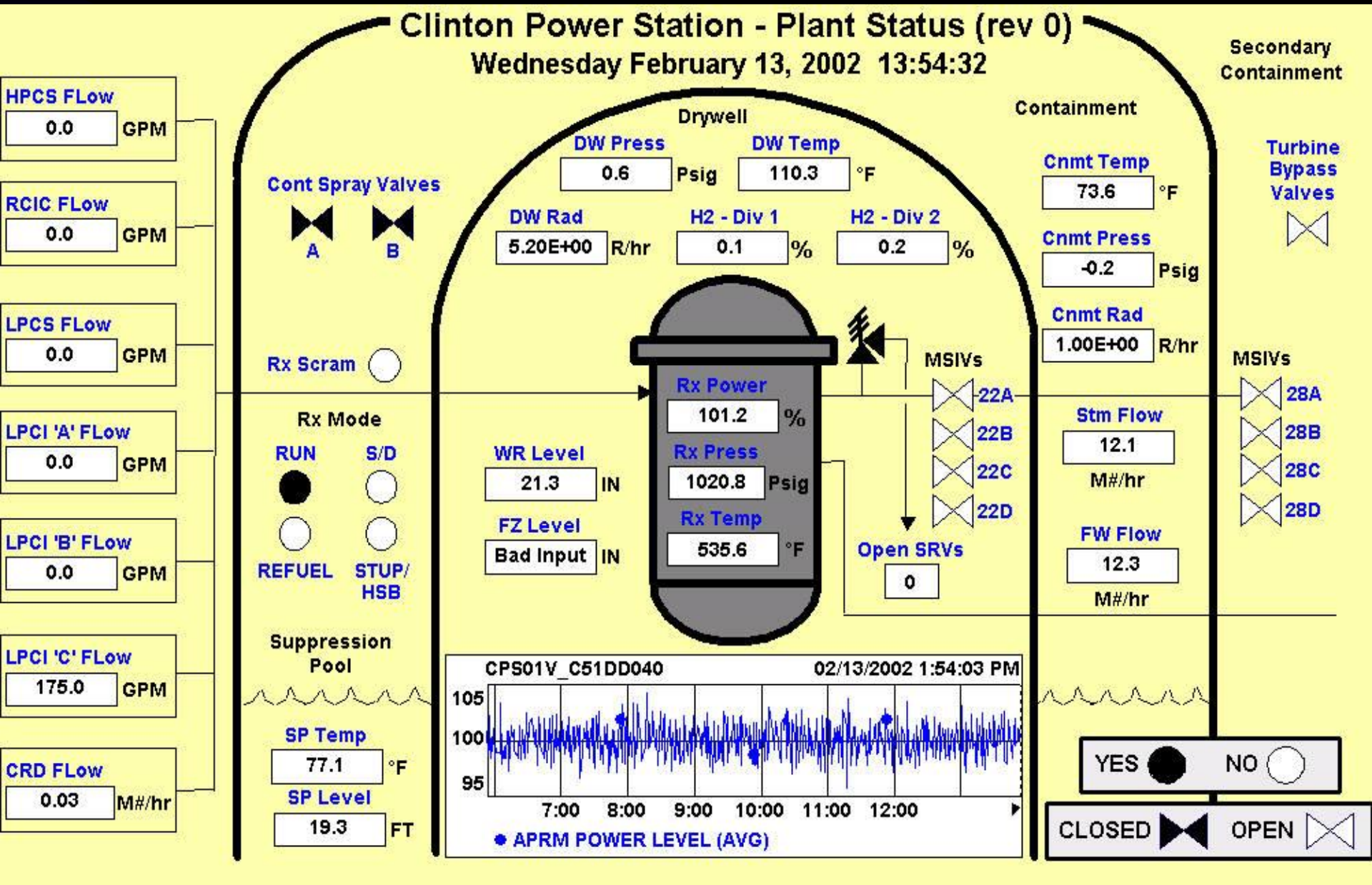
Exelon SM
Nuclear

And Next...

LIVE DATA FROM EXELON

EP Plant Status

Exelon Nuclear

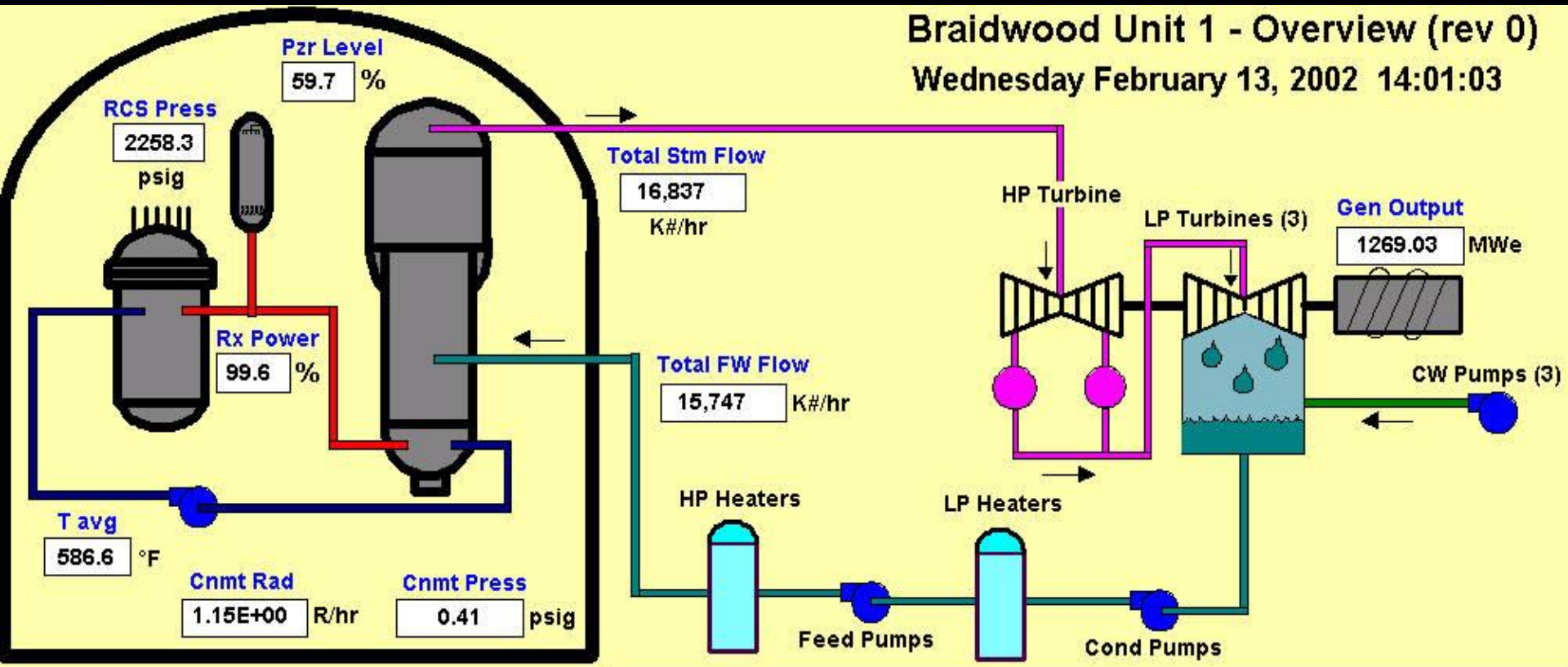


EP Plant Overview

Exelon SM
Nuclear

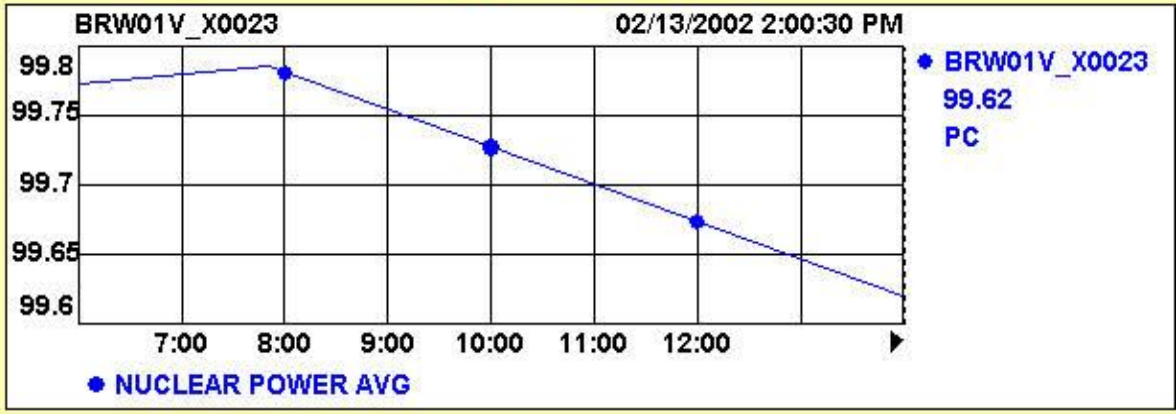
Braidwood Unit 1 - Overview (rev 0)

Wednesday February 13, 2002 14:01:03



Steam Generators

	Pressure (psig)	NR Lvl (%)	Stm Flow (K#/hr)	FW Flow (K#/hr)
Lp 'A'	998.1	61.5	4,145	4,019
Lp 'B'	1000.5	61.3	4,133	3,959
Lp 'C'	999.6	61.6	4,145	3,995
Lp 'D'	996.9	61.0	4,165	3,963



EP Effluent Release

Exelon Nuclear

Effluent Release Parameters (rev 0)

Dresden Station

Wednesday February 13, 2002 14:05:03

U2/3 Chimney (Elevated Release)				Reactor Bldg Vent (Ground Level Release)			
Noble Gas Release Rate				Noble Gas Release Rate			
LOW 1.94E+01 µCi/s	Lo	5.48E-07	µCi/cc	LOW 6.14E+01 µCi/s	Lo	6.86E-07	µCi/cc
	Mid	0.00E+00	µCi/cc		Mid	Bad Input	µCi/cc
Flow 3.26E+02 kcfm	Hi	3.09E-03	µCi/cc	Flow 1.89E+02 kcfm	Hi	Bad Input	µCi/cc
15 Minute Avg Meteorology	C	S-Class		U1 Chimney (Elevated Release)			
	Elevated		Ground Level	Noble Gas Release Rate			
Wind Speed	10.8	mph	9.2 mph	Bad Bad µCi/s	Lo	8.10E-07	µCi/cc
	5.0	m/s	4.2 m/s		Mid	Bad Input	µCi/cc
Wind From	256.6	Deg	259.5 Deg	Flow 9.10E+00 kcfm	Hi	Bad Input	µCi/cc

Drywell Radiation (R/hr)

U2 3.73E+00 U3 2.76E+00

Isolation Condenser (mR/hr)

U2 9.72E+02 Low Bad Input U3

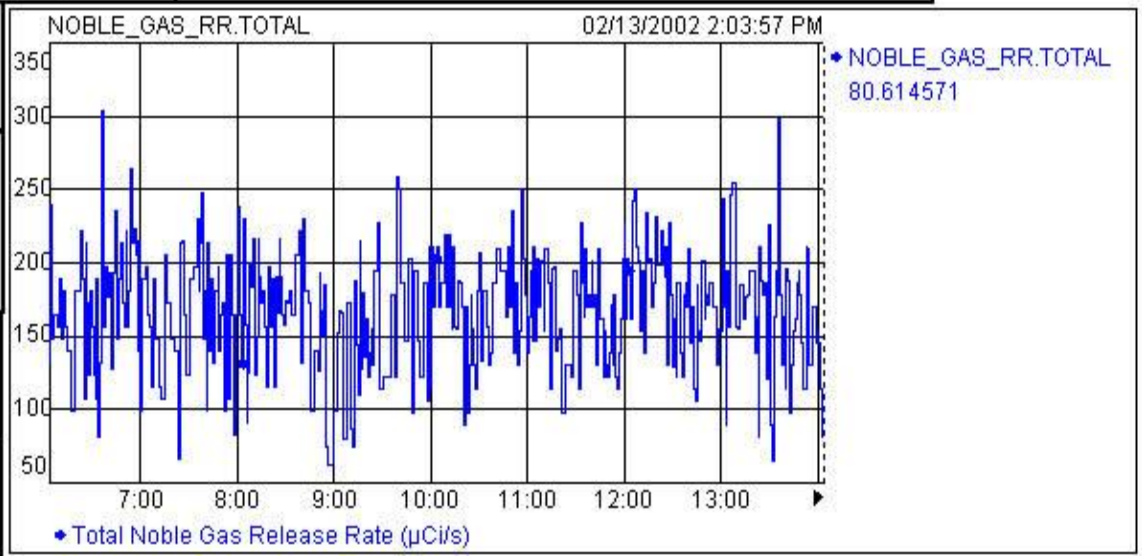
U2 2.72E-01 High Bad Input U3

SPDS Effluent Radiation (µCi/s)

U2 3.98E+02 U3 3.98E+02

Total Noble Gas Release Rate

8.06E+01 µCi/s



EP EAL Parameters

Exelon SM Nuclear

EAL PARAMETERS (rev 0)

Quad Cities Station - Unit 2

Wednesday February 13, 2002 15:21:25

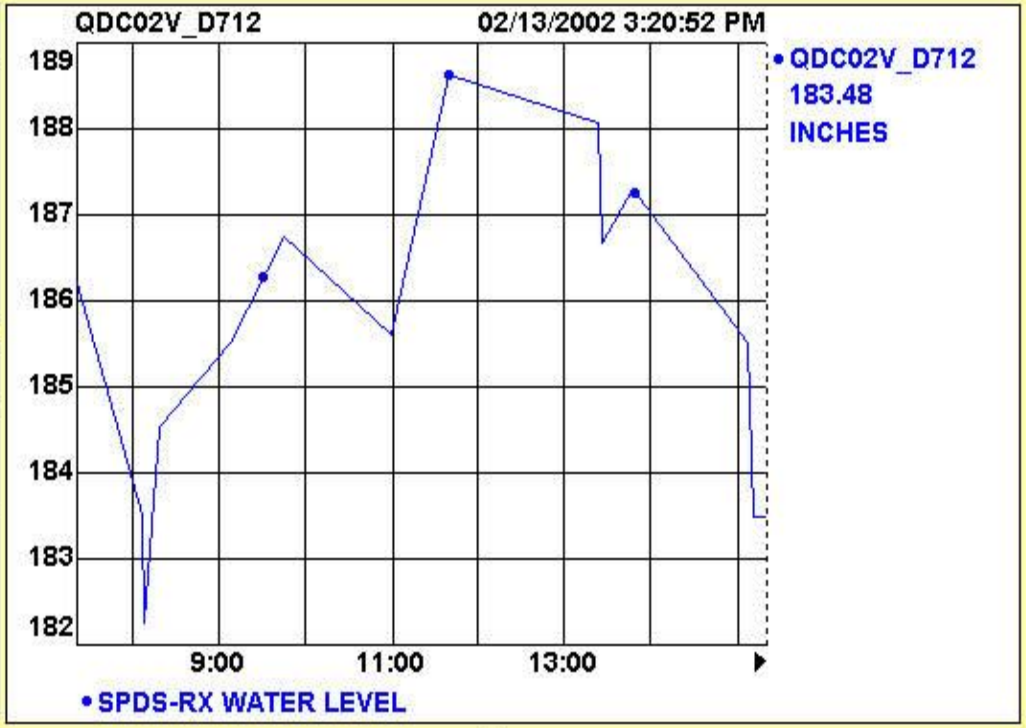
Reactor Coolant System (RCS)		
Rx Power	0.00	%
Rx Press	0.5	Psig
Rx Level	183.48	Inches

MAIN STEAM		
MSL RAD	21.16	mR/hr

HI-HI ALARM

A ☐ W624 B ☐ W625

C ☐ W626 D ☐ W627



DRYWELL		
Pressure	0.02	Psig
Temp (MAX)	84.91	Deg F
RAD (MAX)	1.07E+00	R/hr
Hydrogen	10.54	%

TORUS		
Pressure	4.28	Psig
Temp	62.26	Deg F
Level	9.05	Feet
Hydrogen	Bad Input	%

RADIATION MONITORS		
MCR	0.09	mR/hr
Refuel Floor	18.53	mR/hr
Torus Area	14.69	mR/hr
HPCI Room	2.35	mR/hr
RCIC Room	2.39	mR/hr

Previous EP Access to Data

- Previous data system was in house developed Point History system that had one minute data resolution
- The system was showing its age and was not going to work under WIN2000 without large effort
- Flexibility and data rate was not up to modern standards
- Was not at recently acquired Clinton plant

Why use PI?

- PI systems already in place for engineering use at 5 of 6 plants in the MWROG
- Several years of faithful use as ‘information only’ tool
- ProcessBook meant better displays could be developed with ease
- Commercial availability meant we didn’t have to maintain base system

Components of PI used

- Selected data points needed for ERO plan were identified and compression settings verified
- About 100-120 data points per plant were identified
- PI Performance equations were used for some calculations, including several that were ‘C’ programs on Sun under Point History system

Components of PI used cont.

- **PI Totalizer used to calculate averages/deviations, for example 15 minute standard deviation of wind direction**
  - $\sigma_\theta = \arcsin(\varepsilon)[1+0.1547*\varepsilon^3]$
  - where $\varepsilon = [1-((1/N*\Sigma\text{Sin}(\theta i))^2+(1/N*\Sigma\text{Cos}(\theta i))^2)]^{1/2}$
- **Visual C PI-API applications written to perform some functions previously running on a Sun with Point History system**
- **Standardized ProcessBook displays created for various functions and to provide common look and feel across the plants**

Qualified PI Data

- Quality assurance is very important to nuclear
- A graded software quality approach is used
- PI system data was previously ‘information only’ and could not be used at the primary means to satisfy technical specifications or to ensure regulatory compliance
- Software quality level was raised for the data and components used for EP

Qualified PI Data cont.

- Data points identified as important for use by EP were tested end to end, documented and locked down to prevent accidental changes
- PI Performance Equations, Totalizer points, and PI-API apps used were extensively tested with known inputs and expected outputs to ensure correct operation
- Each PI Display was documented and tested to ensure correct points were being displayed

Qualified PI Data cont.

- Full suite of documents required for QA level produced for each item
- Document set included: Requirements, Test Plan, Test Procedure, and Test Reports
- Guidelines of existing SQA process utilized

Next Steps

- Plan to perform first EP drill with new system in April
- Migration of ERDS and State data feed to PI from Point History system

Conclusions

- You can use PI for qualified data needs in nuclear and other applications
- Spend more time upfront carefully defining requirements to minimize rework

Questions???

- Kevin Rumbaugh
  - kevin.rumbaugh@exeloncorp.com
- Paul Sunderland
  - paul.sunderland@exeloncorp.com