Ginna PI Vision - π story

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Introduction

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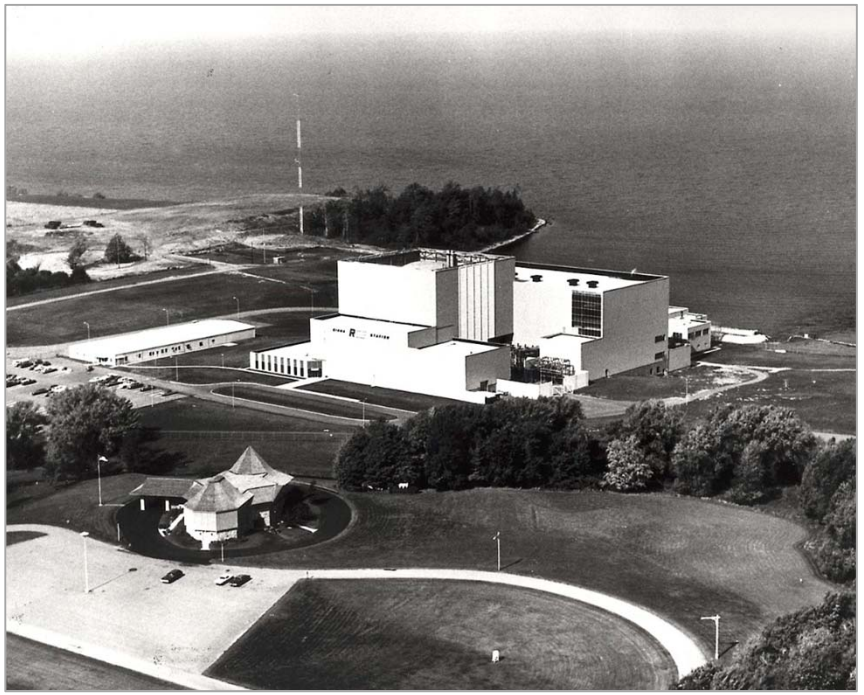
Vision of the PI System at R.E. Ginna

- **Robert Emmett Ginna Nuclear Power Plant (R.E. Ginna NPP)**, named after former Chief Executive of Rochester Gas & Electric, one of the nation's earliest advocates of using nuclear energy to generate electricity
- One of the 11 operating Exelon Nuclear power plants (~22.5 TW)
- The **R.E. Ginna NPP** is located along the south shores of **Lake Ontario**, 20 miles NE of Rochester NY
- **Ginna is one of the oldest nuclear power reactors still in operation** in US, having gone into commercial operation in **1970**, producing **610 MW** of electricity



Vision of the PI System – Beginning

- Started in **2016** with **Plant Process Computer** (PPC) **Update but** new PPC software version was **not compatible** with existing PPC archive files structure
  a) **Convert archives** to new version → required to write custom adaptation code
  b) **Keep legacy software** version around to view old archives → on isolated computer
  c) **Export archives** to different data historian → e.g. PI System
- **Ginna** has had only PPC data historian (R*Time) holding older files on tapes to utilize available disk space on aging PPC HW
- **Chose** option "**c**" – utilize PI System license & HW from retired Zion Nuclear Plant, opportunity for new data visualization

Vision of the PI System– Implementation

- The plan:
  - Use existing Exelon software to transfer data from PPC into the PI System
  - Utilize and take advantage of newer OSIsoft products for Ginna – PI Asset Framework (PI AF) to catalog plant assets, PI Vision to visualize data
- **Summer/Fall 2016** – staged server at Cantera, PI System installation and configuration – test the concept with ~100 tags & 2-3 with **live data**
- **Winter/Spring 2017** – expanded OSIsoft license, **completed tags configuration** (~3000 tags)
- **Mar-2017** – completed transfer of archived PPC data (last 5 years) into PI System & **PI Data historian goes live** along with updated PPC 
  - **Jun-2017** – server moved to Ginna, **user training #1** by Exelon+OSIsoft on a "**test group**" of about **15 Ginna users**
  - **Nov-2017** – **user training #2** on expanded group of another about **50 users** from engineering

Vision of the PI System– 5 Years Plan

- **During the 1st year** – continued to build PI AF with emphasis to use cases and plant operation priorities & we targeted individuals in need directly
  - **Popularized PI Data Historian** within corporation – **Exelon Operation Center @ Baltimore** (plant operation indicators for grid monitoring)
  - **Trained PI System Engineering Liaison** to assist with PI Vision introduction at Ginna
  - AF: Control Rods, Turbine Generators, Residual Heat Removals

- **During the 2nd year** – expanded and built **more PI Vision displays,** continued to expand PI AF, PI System became **dominant plant data historian source** for historical & real-time data
  - Implemented simple **data analyses** & **notifications**
  - Server refresh (more CPU + RAM + disk space)
  - AF: MET Data, Instrument Air, Reactor Protection, Generator Vibration Sensors

Presence (2019/2020)

- Provide **training PI System Operation Liaison** and introduce PI Vision to operation personnel (Control Room, AUX Operators – operator rounds)
- **Setting up operation training pilot** test group for PI Vision
- Building/**customizing training materials** (use cases)
- Evaluating test group's experience with PI Vision
  - **Adjust and then train** both licensed and non-licensed (AUX) operators
  - Use of examples from their daily tasks since these two groups would be using PI Vision in slightly different fashion given their plant operation functions

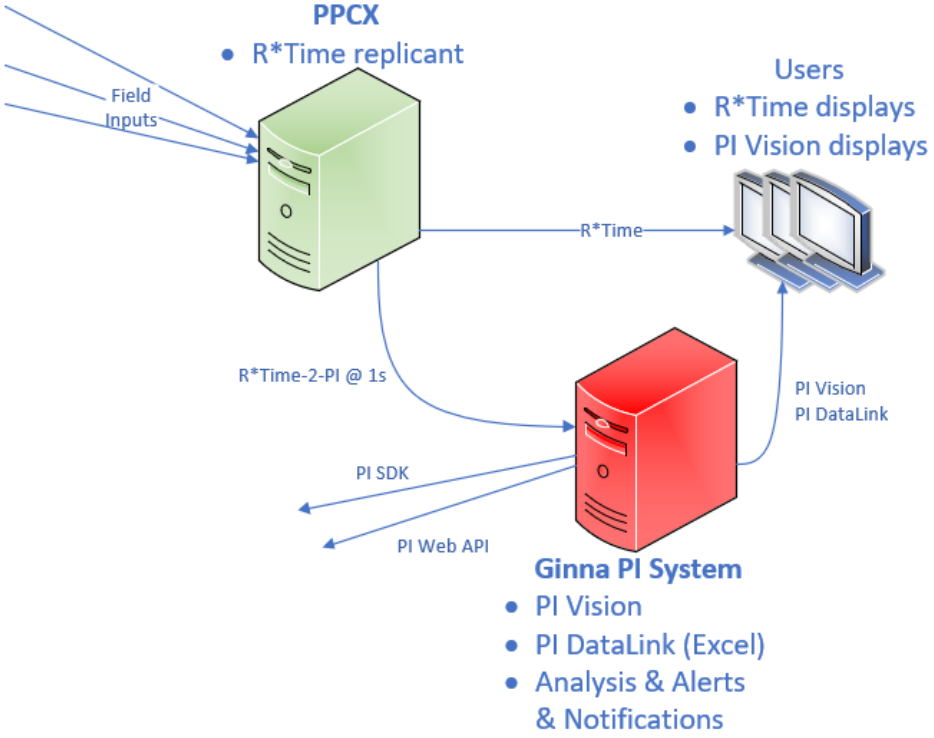
Future (2020/2021)

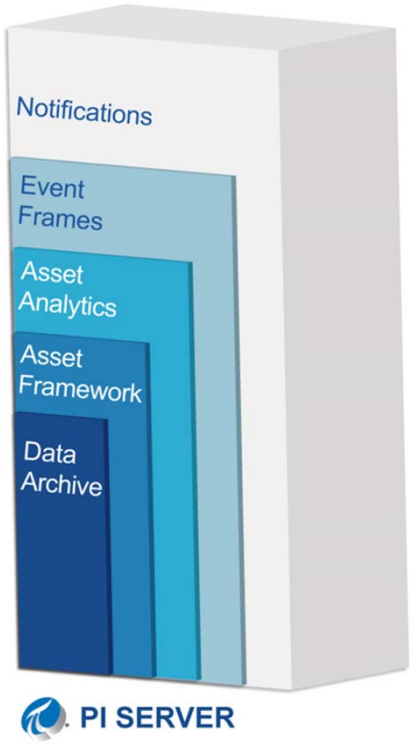
- Provide **training to PI System Shop Liaison** – assist with PI Vision introduction to other departments – “shops”
  - Integrated Maintenance Dept. (IMD), Fix It Now (FIN), Instrument & Control Electricians, Radiation Protection (RP), Emergency Preparedness (EP)
- Again **setup training pilot to test group**(s), build PI Vision training materials reflecting IMD/FIN/RP/EP daily tasks, **utilize more/new use cases**
- Work with IMD to **expand PI System** (more tags) to **aid troubleshooting of I/O DAS** issues related to PPC

Perspective (2021+)

- Vision of **PI Vision re-training periodically** (quarterly or annually) to refresh and retain application knowledge
- Development of **more sophisticated analysis-type displays** for engineering and other departments
- Development of **troubleshooting-type displays** for shops
- Continue using PI Vision, expanding PI AF, expanding system specific displays
- **Inspiration** for other Exelon Nuclear site(s)…
  - Environment setup/staging within a few days
  - PI AF construction and improvement is ongoing process

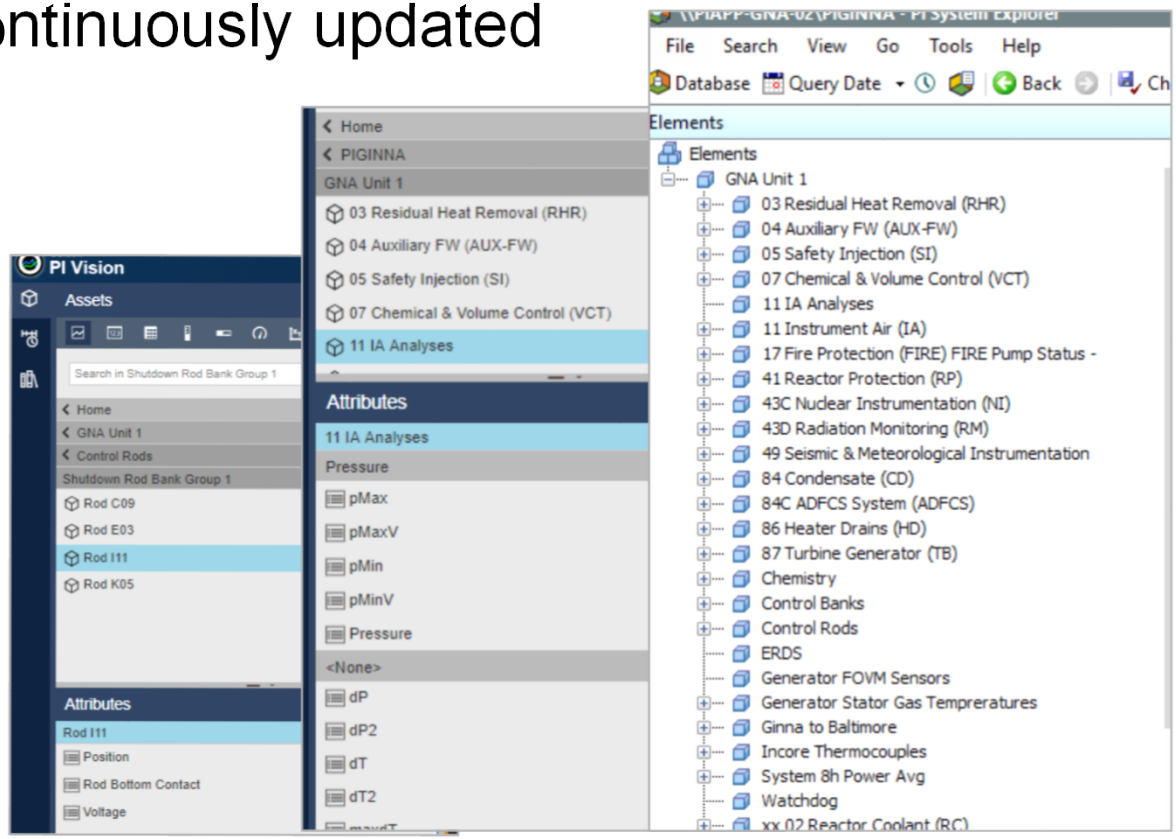
Data Flow / Configuration





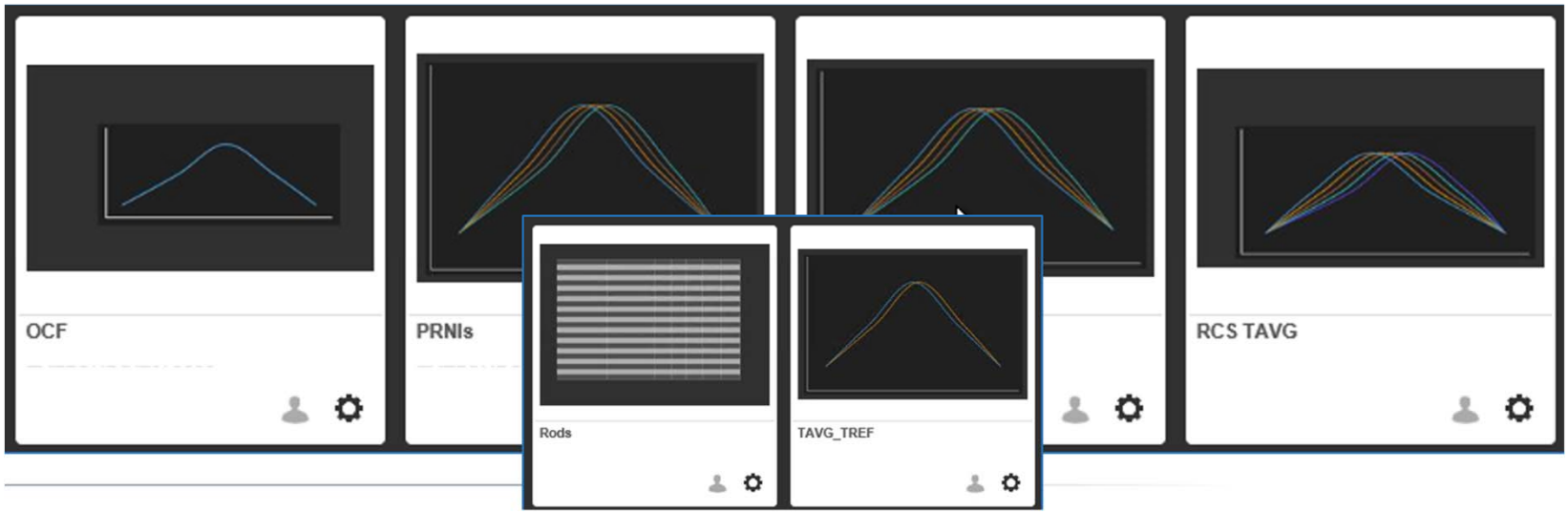
Asset Framework

- PI AF is being continuously updated to include more plant systems
- Driven by **users' demand** and **use cases**

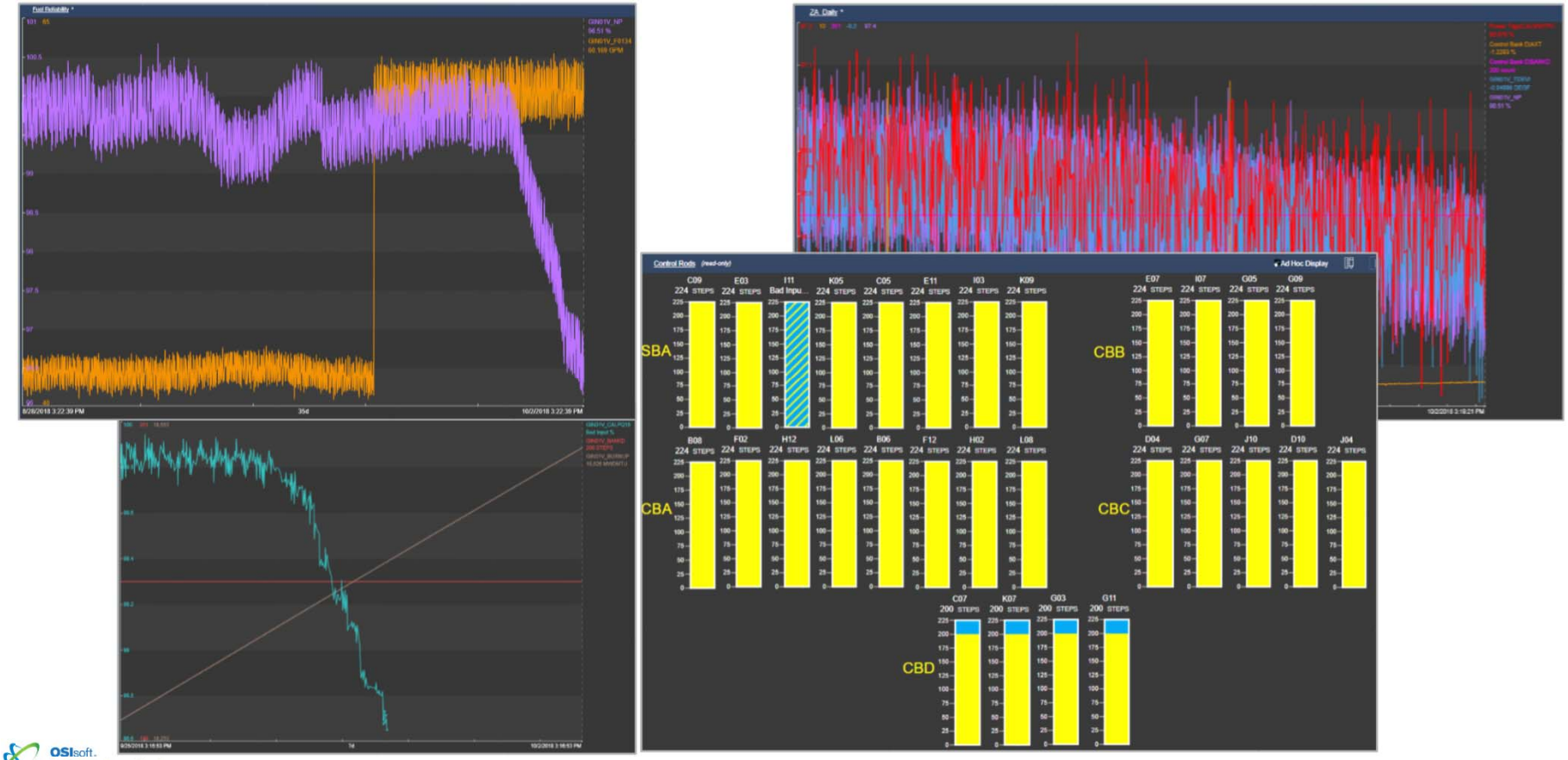


Asset Framework

- Once assets are configured, we continue to **design and build system-specific PI Vision displays** allowing users to take advantage of PI Vison during their day-to-day business
- Users are **encouraged to explore PI Vision capabilities** and create their own PI Vision displays



PI Vision Displays



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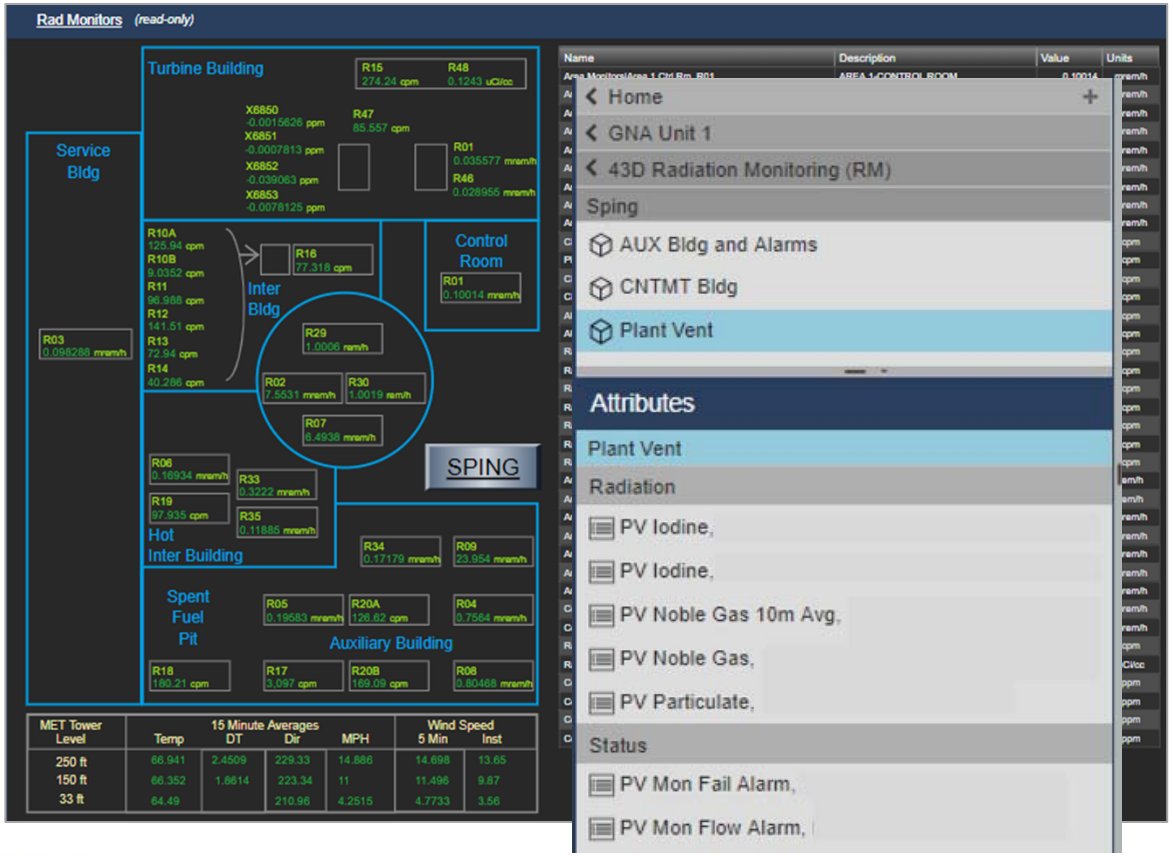
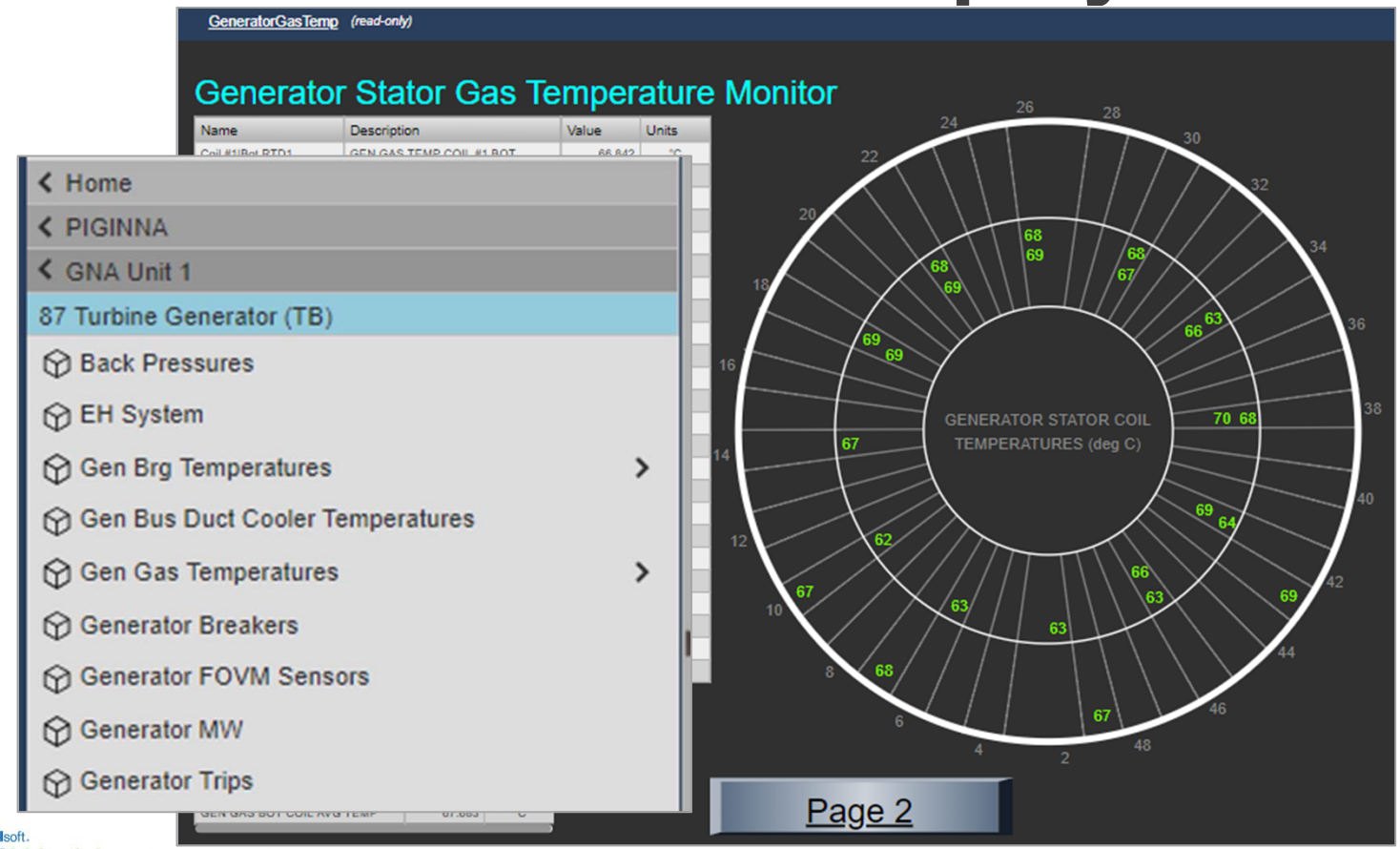


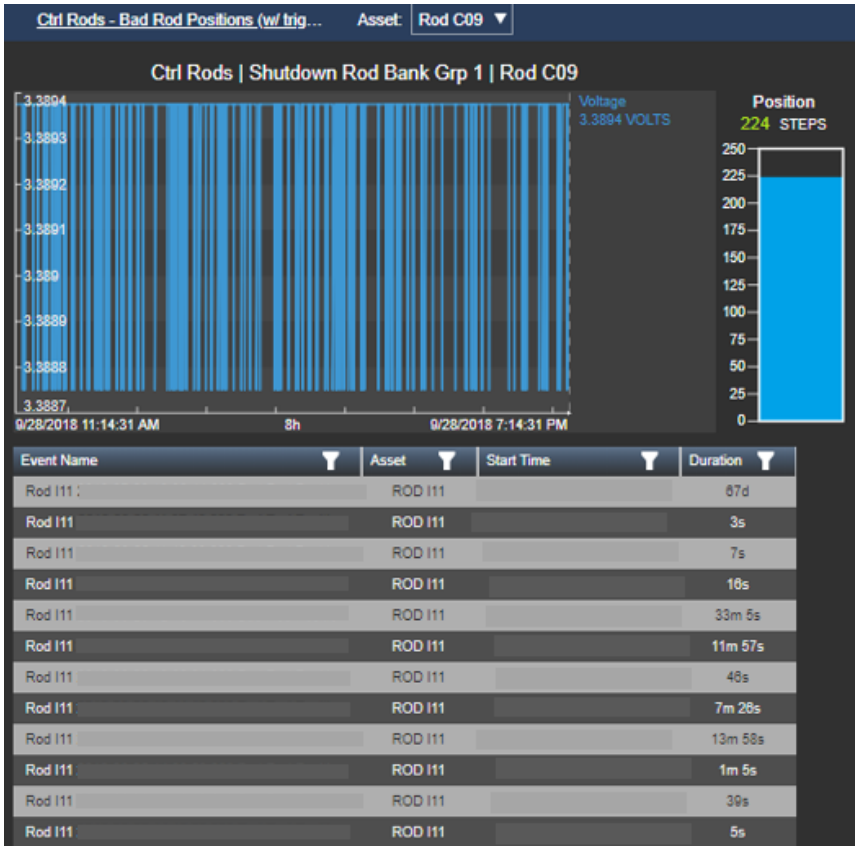
PI Vision Displays



Use Case: Rods Anomaly

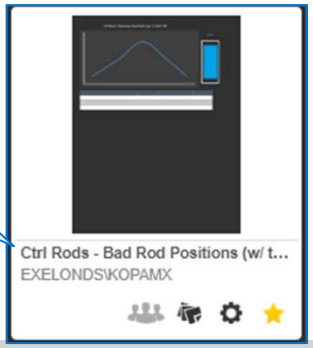
- Business investigated **sudden movements of rods** (appeared to step down)
- System Engineer (SE) needed to know **when** these movements occurred, **which rods** appeared to move in order **to make correlation** with changes of **plant parameters**
- Information was available in PPC but not easy to correlate and gather statistics
  - PI AF Asset → Analyses → email notifications
  - Backfill to past data (last 5 years)
  - Need to introduce more PPC points and PI tags (rods voltages)
- **Conclusion**: problem originated upstream in MRPI cabinets located in the containment; boards in MRPIs provide voltage readings to PPC DAS I/O and something was **causing fake voltage spikes**, which was exhibited as if rods were moving
  - Vendor to debug and install new monitoring equipment to scrutinize the source of spikes

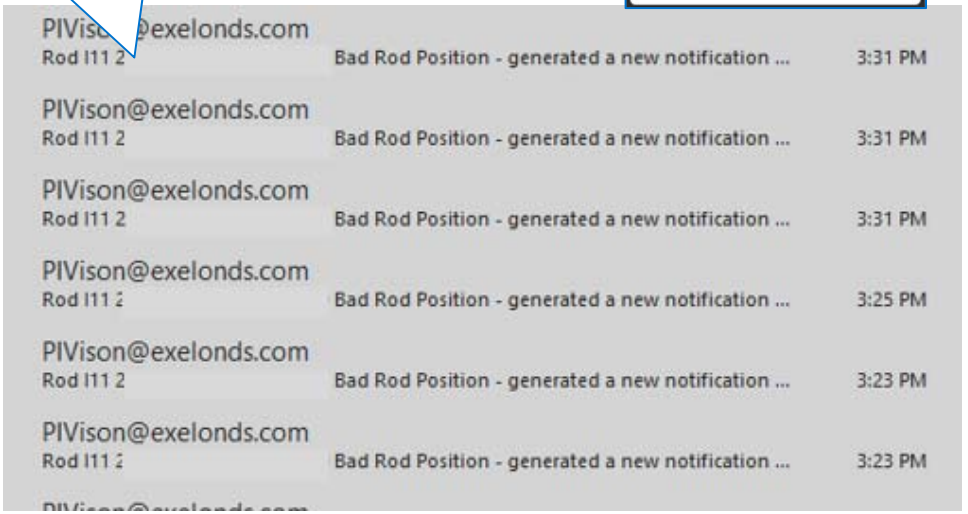
Use Case: Rods Anomaly



Display to track each rod position

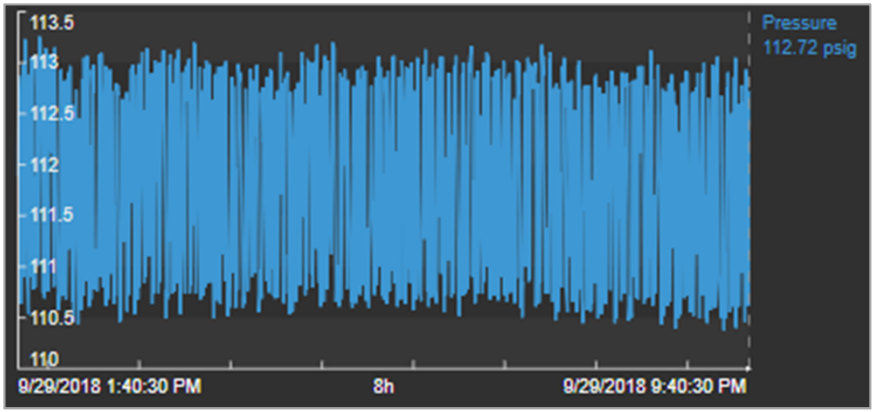
Automated email notification to system engineer

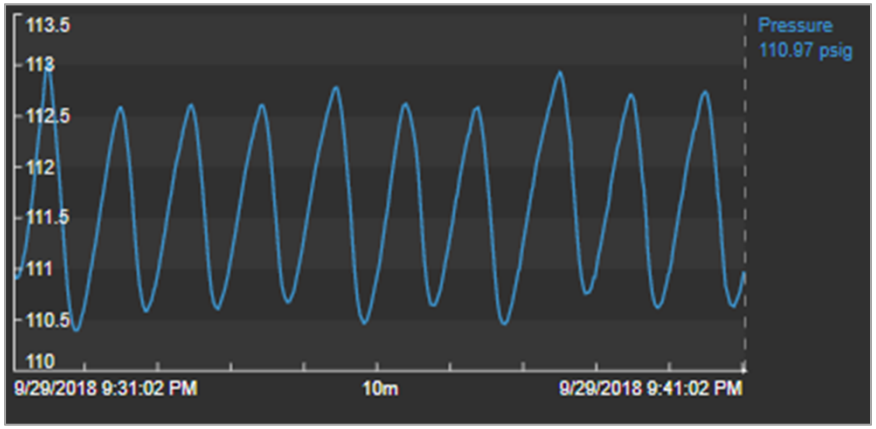




Use Case: Instrument Air

- Track **Instrument Air Header Pressure Leak**
- Looking for an **indication of a leak while it is still developing**
- Information available in PPC but sifting through historical data proven to be challenging
- Would it be possible to **detect the leak** looking at just **air header pressure in real time**?

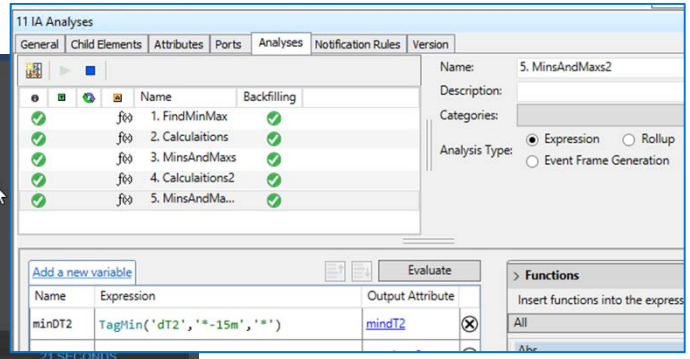




Use Case: Instrument Air

- When there is a leak the **slope of the air header pressure is different**
- Loosing pressure faster, taking longer to pressurize back to its nominal value

Use Case: Instrument Air



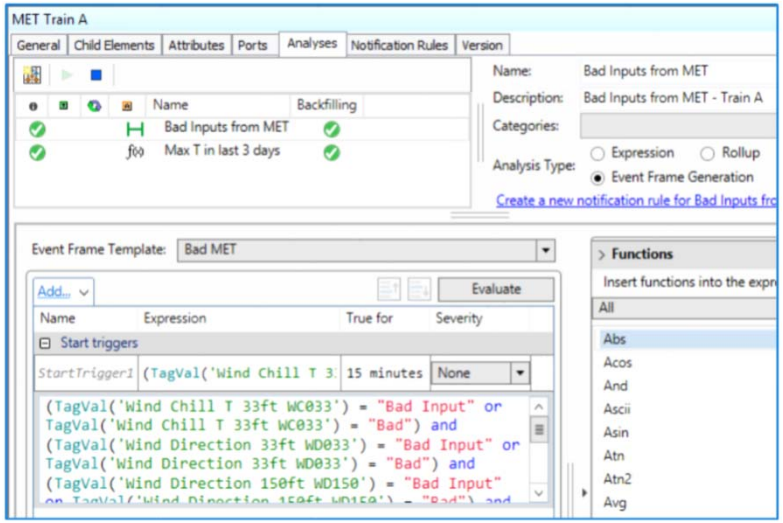
Example of analysis in action

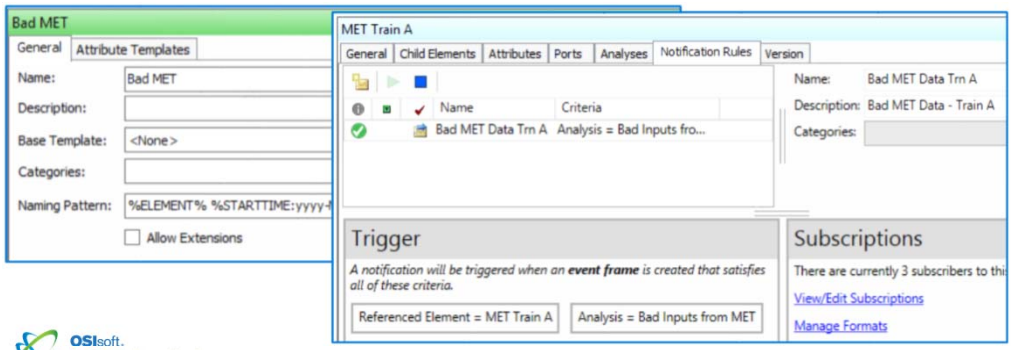
- leak in progress,
- longer pressurization back to nominal level which takes longer
- faster depressurization – takes less time to loose pressure

Use Case: MET Loss of Power

- MET (Meteorological Tower) **data to PPC intermittent interruptions** when power outage incidents occurred, during backup generators startup times (e.g. power lines down due to high winds)
- Need to know **which data train is affected** (A or B or both?), for **how long**, and **why**
- **Any common pattern**?
  - PI AF Asset → Analyses → email notifications
  - Backfill to past data (last 5 years)
- **Conclusion**: system engineer was able to relate these data flow interruptions to fiber converter intermittent power loss, which was interrupting socket connections for MET data flow & PPC data logger, resulting in no data in PPC. It took 2h 10min for the socket to re-connect. New UPS was introduced to sustain fiber convertors through unexpected power losses.

Use Case: MET Loss of Power





Use Case: MET Loss of Power

MET - No Data Events

Event Name		Asset	▲Start Time	End Time	Duration
Train A	)0 Bad MET	TRAIN A			2h 10m
Train B	)0 Bad MET	TRAIN B			2h 10m
Train B	0 Bad MET	TRAIN B			2h 10m
Train A	)0 Bad MET	TRAIN A			2h 10m
Train B	)0 Bad MET	TRAIN B			2h 10m
Train A	)0 Bad MET	TRAIN A			2h 10m
Train B	)0 Bad MET	TRAIN B			2h 10m
Train B	)0 Bad MET	TRAIN B			2h 10m
Train B	0 Bad MET	TRAIN B			2h 10m

Bad MET Data - Train B
Event Details Hyperlink

AF Server:
DB Name: GINNA
Event Frame Name: MET Train B 2018 Bad MET

Start Time:
End Time: 1
Event Notification Sent:

Checked list of triggered events – noticed commonality in event duration which is always the same: 2h 10min

	Asset	▲Start Time	End Time	Duration
	TRAIN B			1162d
	TRAIN A			1h
	TRAIN A			50m
	TRAIN A			1h 30m
	TRAIN B			2d 19h
Bad MET	TRAIN B			20m
Bad MET	TRAIN A			2h
Bad MET	TRAIN A			2h 10m
Bad MET	TRAIN B			2h 10m
Bad MET	TRAIN B			2h 10m
Bad MET	TRAIN A			2h 10m
Bad MET	TRAIN B			2h 10m
Bad MET	TRAIN A			2h 10m
Bad MET	TRAIN B			2h 10m

CHALLENGES

- Non-compatibility of new data historian SW vs. legacy one
- Conversion of legacy archives into new format / accessibility of old archives stored on tapes

SOLUTION

- Choose PI System as new site-wide historian compatible with new and legacy SW
- Utilize of existing HW and PI license
- IT initiative (level of effort), but emphasis on business buy-in and engagement

BENEFITS

- Eliminating one-off/unique solution within Exelon fleet
- Generalization and conversion to few types of data historians with simpler thus better & more efficient fleet-wide support
- Newer (modern) visualization tools and faster access to historical data
- Simpler/customizable asset monitoring, acceleration of root cause analyses

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