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Prescription for Success: PI System Health Monitoring

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Agenda

- Intros
- History of the growth of PI within VELCO
- Value of PI to VELCO
- Health of a PI System
- Tools and Technologies
- AF Templates
- AF Structure
- Notifications Alerts
- PI Vision Displays
- Best Practices for Effective Monitoring
- Conclusion

Intros



- VELCO was formed in 1956 when Vermont's local utilities joined together to establish the nation's first statewide, "transmission only" company to create and maintain an interconnected electric transmission grid
- Owned by Vermont's 17 distribution utilities
- VELCO manages
 - 738 miles of transmission lines
 - 13,000 acres of rights-of-way
 - 55 substations, switching stations and terminal facilities
 - Equipment that enables interconnected operations with Hydro-Québec
 - Fiber optic communication networks that monitor and control the electric system and serve as a key link for Vermonters' high-speed data internet access



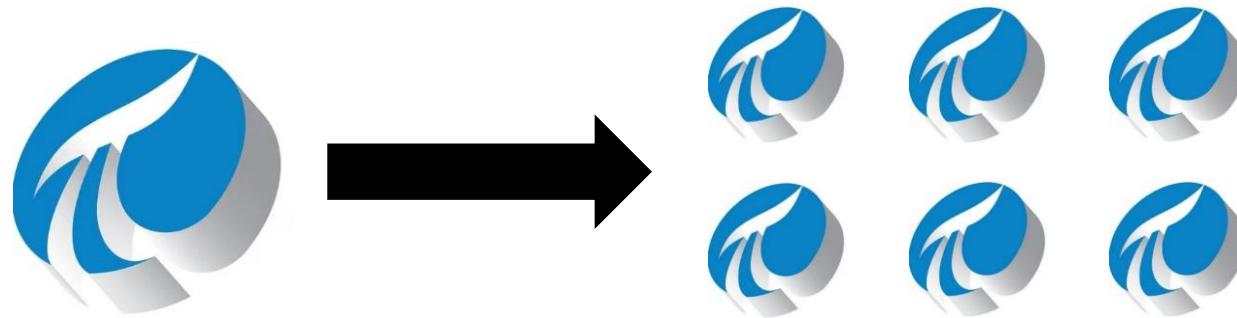


Intros

- DLL Solutions has been providing expert PI Integration services since 1998
- Specializing in expertly integrating AVEVA products
- Helping customers to optimize operations, drive growth and empower businesses to make data-driven decisions.

History of the growth of PI within VELCO

- VELCO has used PI for 23 years
- Starting from one PI Server growing to a PI Community Agreement customer
- Large infrastructure to provide solution with systems on-prem and in the cloud
- Need to monitor entire infrastructure
- This was discussed in the “VELCO Community Agreement” presentation in AVEVA World 2021



Power Accounting Efficiencies and Customer Service

Challenge

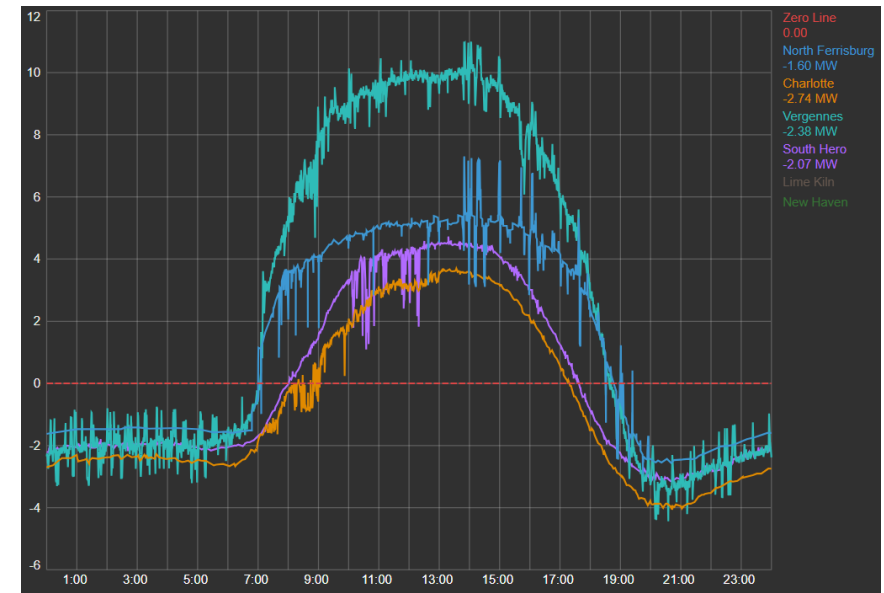
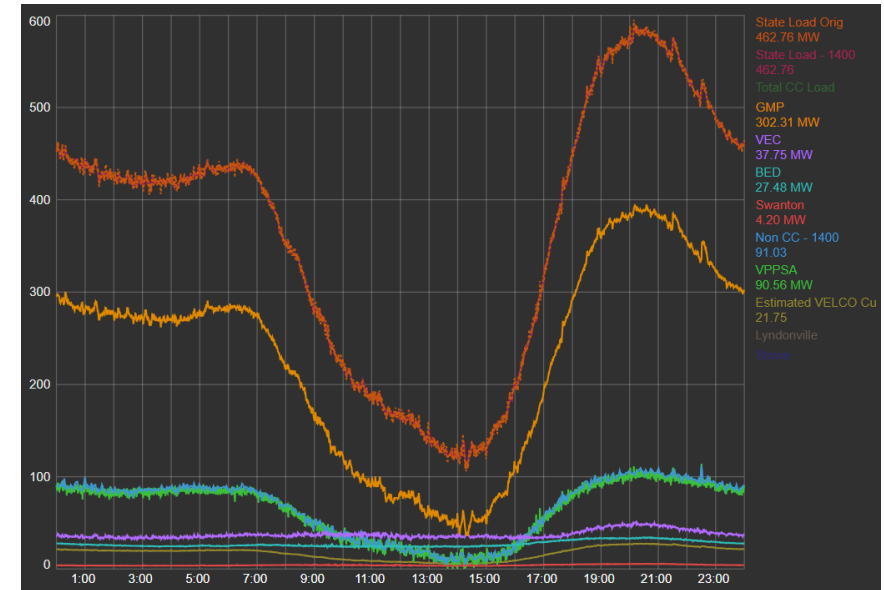
- VELCO provides power accounting services to Distribution Utilities, and Distribution Utilities need to see the PI data to know how much power they are receiving from the transmission network. Historically, VELCO employees have generated an Excel report and emailed the report to the Distribution Utility users.

Solution

- Set up a PI System for Power Accounting users and the Distribution Utilities to freely access their own data on their time.

Results

- **Saves time and money with person-hours**
- **Provide self-service model for customers to access data**
- **Reduces at least 20 hours/month**



Operational Insights and Analysis Near Real-Time

Challenge

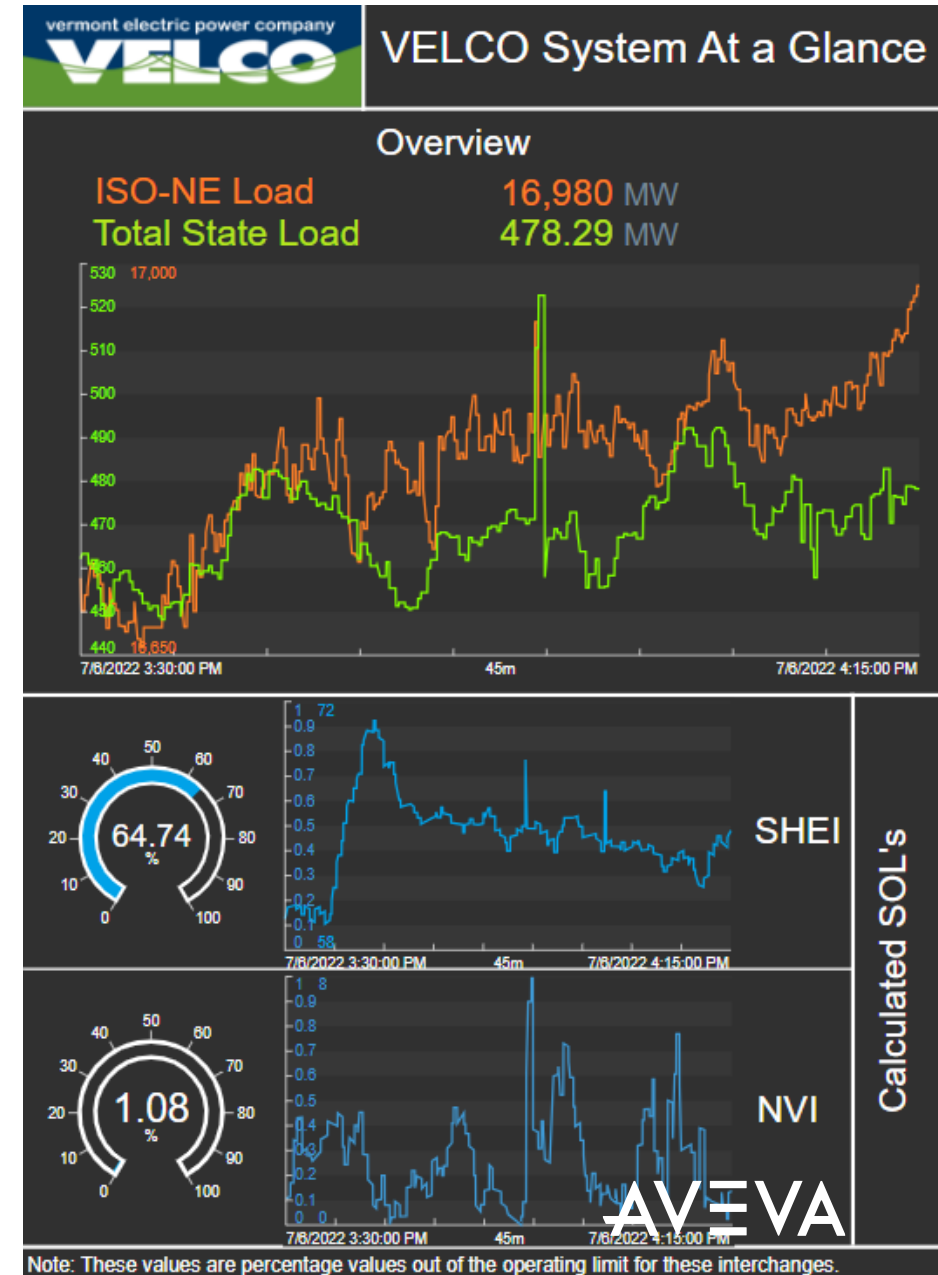
- VELCO Operations is responsible for the real-time reliability of the high voltage transmission network. Although operators monitor generation (Conventional, Wind, Solar, Hydro), system load (ISO-NE Load, Total State load), and interchange (Importing and Exporting) in SCADA/EMS, engineers and other departments lacked near-real time insight into potential issues operators were encountering due to lack of access.

Solution

- Set up a PI Vision Display that summarizes what the VELCO Operator sees, specifically the Generation, System Load, and Interchange values, how those values impact NERC System Operating Limits (SOL's).

Results

- **Improved situational awareness and insight for engineers, planners, and other technical stakeholders**
- **Enhanced event detection of potential issues linked to grid transformation, i.e., distributed energy resource tripping in response to contingencies**



Value of PI to VELCO

- VELCO success stories
 - System One Line monitoring
 - Automation of data retrieval for power planning
 - Radio site monitoring
 - Automate Statewide reporting on health of radio system
 - EMS team support
 - Leverage historical data to support compliance with TOP 001-5, R21
 - System Planning
 - These Engineers utilize historical real-time flows and voltages on a regular basis
- VELCO success stories
 - Physical Security Surveillance for Substations
 - Enhances capabilities to monitor the physical security assets within the substations
 - Operational Engineers leverage data for compliance requirements
 - We can provide evidence that no System Operating Limits were exceeded during an incident
 - System Protection Maintenance Interval Extension
 - Evidence of protection system monitoring to support PRC-005 compliance

Ensure VELCO has full utilization of PI System in a healthy state

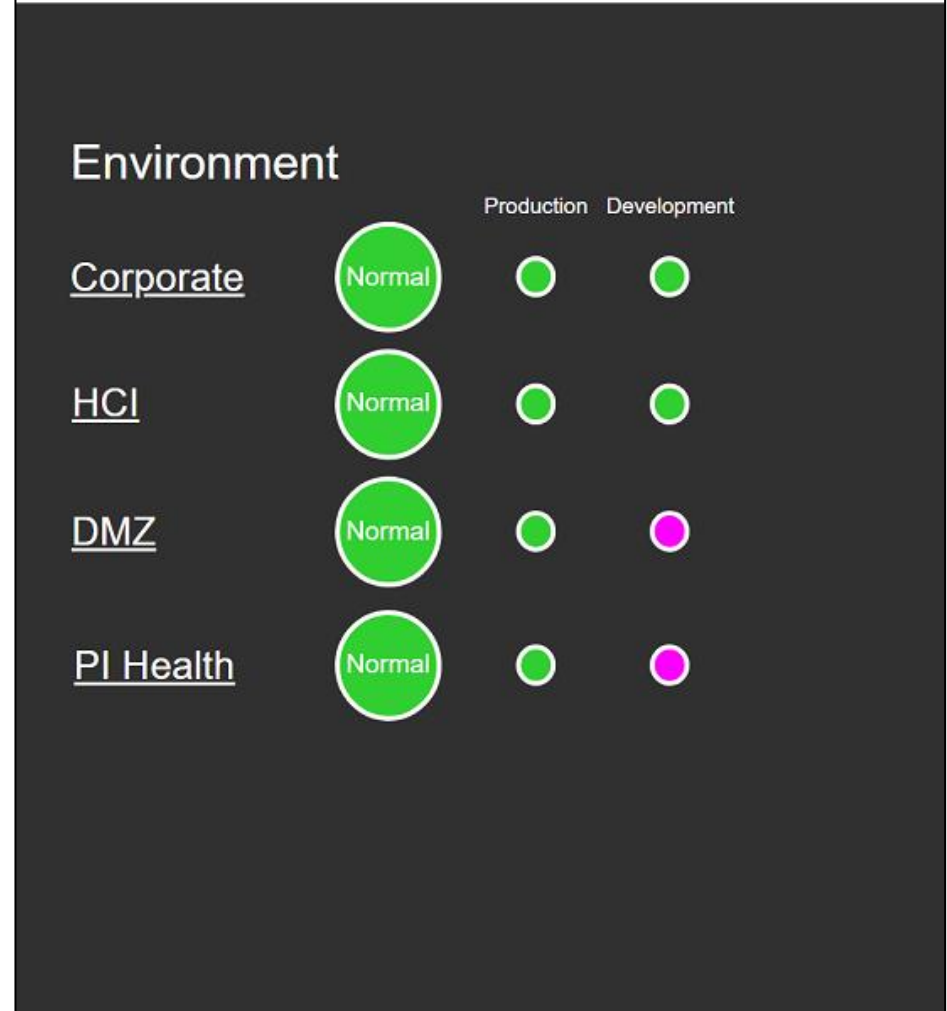
Challenge

- VELCO has numerous areas dependent upon PI. Ensuring the seamless operation of the PI System is of paramount importance to our organization's data infrastructure. The PI System serves as the backbone of our data management and analytics processes, enabling us to gather, analyze, and derive critical insights from our industrial processes and systems. Therefore, it is imperative that the PI System always remains in a state of operational readiness.

Solution

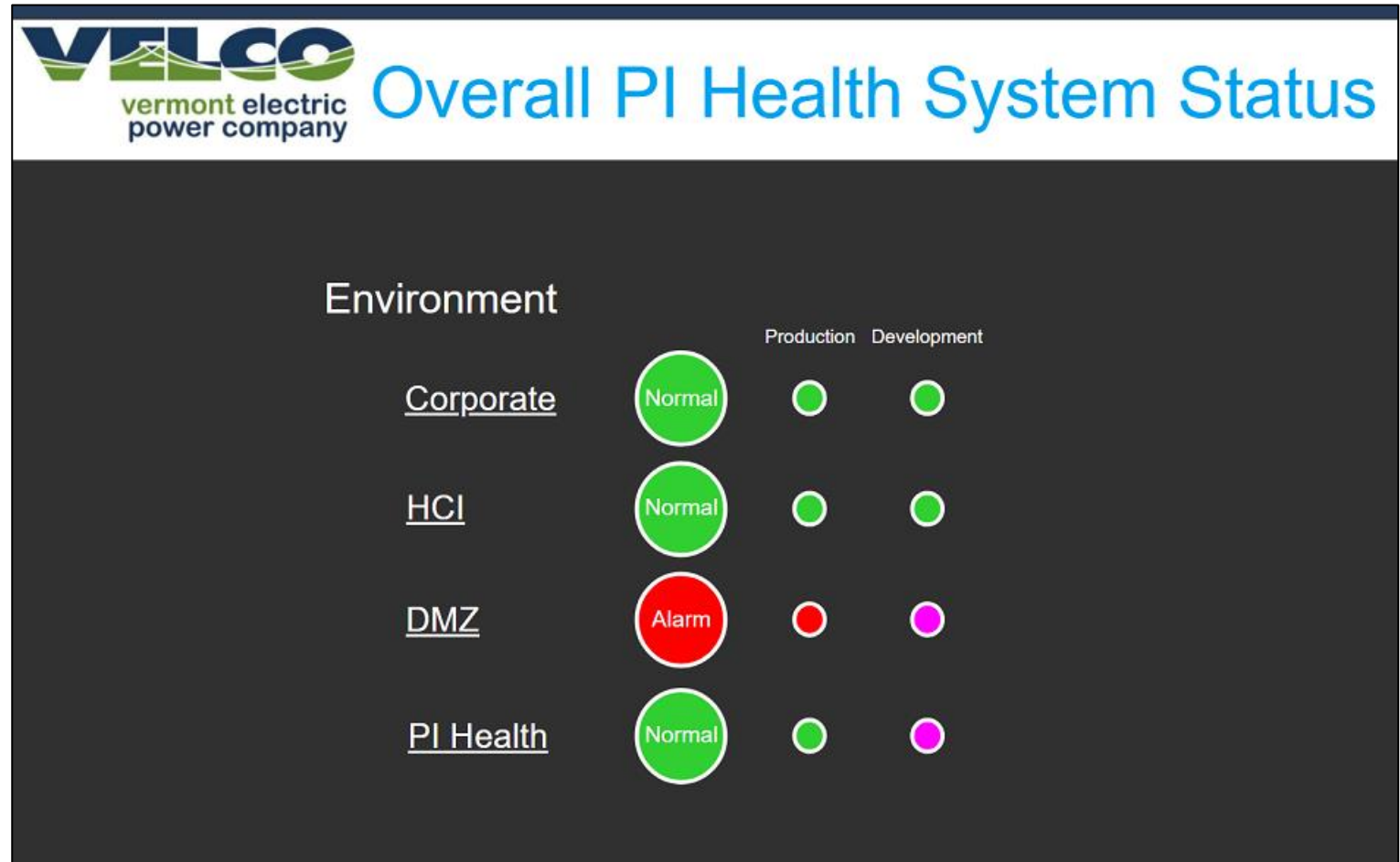
Results

Overall PI Health System



Health of a PI System

- What is a healthy PI System
 - Data flowing
 - Successfully storing the data
 - No corruptions
 - No significant errors
 - Capacity to continue doing this
 - Users can access data freely
- Benefits of monitoring PI
 - Ensure data availability and integrity
 - Detect and prevent potential issues
 - Timely resolution of issues
 - Optimize system performance
 - Proactive decision-making based on real-time insights

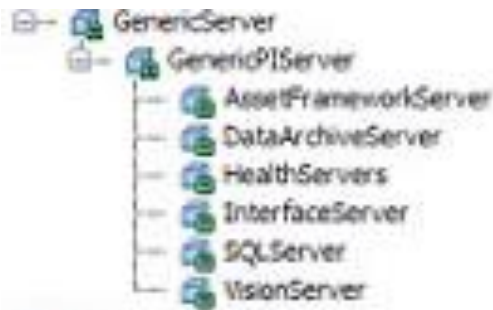


Tools and Technologies

- PI PerfMon Interface
 - Collect data
- PI Interface Health points
 - Monitor the health of the interfaces
- AF Templates
 - Standardize data collection, creates tags and set up PI Analyses
- PI Analyses
 - Turn data into information
- PI Notifications
 - Send alerts when issues arise
- PI Vision
 - View data and assess current status

AF Templates

- Standardize the monitoring of each system
- Create the tags automatically
 - PI PerfMon Interface
 - PI Analysis Outputs
- Elements will contain
 - PI Analyses
 - PI Notifications
 - PI Vision Displays



The screenshot shows the 'GenericServer' application with a list of templates. The main window has a filter bar and a table with columns: Name, Description, and Default Value. A sub-window titled 'AssetFrameworkServer' is open, showing a detailed list of templates for that server. The sub-window also has a filter bar and a table with columns: Name, Description, and Default Value.

Name	Description	Default Value
AF Server Health	Health: Is the service healthy?	
Analysis Service AP Values Written	APValues Written: Number of AP values published since st...	0
Analysis Service Analyses In Error	Analyses In Error: Number of analyses currently in error	0
Analysis Service Analyses Running	Analyses Running: Number of running analyses	0
Analysis Service Analyses Suspended	Analyses Suspended: Number of suspended analyses	0
Analysis Service Cache Hit Count	Cache Hit Count: The total number of data access calls th...	0
Analysis Service Cache Missed Count	Cache Missed Count: The total number of data access calls...	0
Analysis Service Evaluation Count	Evaluation Count: Number of successful evaluations since ...	0
Analysis Service Evaluation Error Count	Evaluation Error Count: Number of evaluation errors since ...	0
Analysis Service Evaluation Out Of Order Skipped Count	Evaluation Out of Order Skipped Count: Number of evalua...	0
Analysis Service Evaluation Skipped Count	Evaluation Skipped Count: Number of skipped evaluations ...	0
Analysis Service Event Frames Written	Event Frames Written: Number of Event Frames published ...	0
Analysis Service Events Cached	Events Cached: Number of events currently in the data ca...	0
Analysis Service Events Processed	Events Processed: Number of events retrieved by the dat...	0
Analysis Service Maximum Latency	Maximum Latency: Maximum amount of time in milliseconds...	0ms
Analysis Service Recalculation Requests Completed	Recalculation Requests Completed: Number of recalculatio...	0
Analysis Service Recalculation Requests Queued	Recalculation Requests Queued: Number of recalculatio...	0
NormalizedStatusbook	Normalized status book into analytic logs for specific metrics	
Notification Service Failed Sends	Failed sends: The total number of failed send attempts sin...	0
Notification Service History Updates	History updates: The total number of history updates sent...	0
Notification Service Notification Rules In Error	Notification Rules in error: The total number of notificat...	0
Notification Service Running Notification Rules	Running notification rules: The total number of running not...	0
Notification Service Sends In Progress	Sends in progress: The number of send attempts currently...	0
Notification Service State Changes Observed	State changes observed: The total number of notification...	0
Notification Service Stopped Notification Rules	Stopped notification rules: The total number of stopped no...	0
Notification Service Successful Sends	Successful sends: The total number of successful send att...	0
Notification Service Total Sends	Total sends: The total number of attempts to send messag...	0
Notification Service Total updates Processed	Total updates processed: The number of total changes rec...	0
PI Buffer Subsystem Buffer Sessions Active	Buffer Sessions Active: Number of active buffer sessions [...]	0
PI Buffer Subsystem Buffer Sessions Offline	Buffer Sessions Offline: Number of inactive buffer sessio...	0
PI Buffer Subsystem Buffer Sessions Total	Buffer Sessions Total: Number of initialized buffer sessio...	0
PI Buffer Subsystem Events In Error	Events In Error: Number of events not processed locally b...	0
PI Buffer Subsystem Events Rejected	Events Rejected: Number of events rejected by the buffer	0
PI Buffer Subsystem Health	Health: health (OK (warning) 2=Minor 3=Critical)	
PI Buffer Subsystem Out Of Order Events Rate	Out-Of-Order EventsRate: Rate of out-of-order events rec...	0 events/sec
PI Buffer Subsystem Point Count	Point Count: Number of local points with cached configura...	0
PI Buffer Subsystem Point Edit Rate	PointEditRate: Rate of new points and point edits receiv...	0 events/sec
PI Buffer Subsystem Points With Fail Error	Points With Fail Error: Total number of points received er...	0
PI Buffer Subsystem Queue Capacity	Queue Capacity: The estimated time (in secs) that PI buf...	0
PI Buffer Subsystem Queue File Count	Queue File Count: Total number of queue files in all sess...	0
PI Buffer Subsystem Queue Reset Failure Count	Queue Reset Failure Count: Total number of times corrup...	0
PI Buffer Subsystem Queue Write Errors	Queue Write Errors: Number of failed writes to all sessio...	0
PI Buffer Subsystem Total API Buffered Events	Total API Buffered Events: Number of events in all API buf...	0
PI Buffer Subsystem Total Events Sent Rate	Total Events SentRate: Rate of events successfully sent to...	0 events/sec
PI Buffer Subsystem Total Queue Writes Exclusive Rate	Total Queue Writes ExclusiveRate: Rate of events written ...	0 events/sec
PI Buffer Subsystem Total Queue Writes Rate	Total Queue WritesRate: Rate of events written to all sess...	0 events/sec

AF Structure

- Plan out a good AF structure
 - Leads to organized data
 - Brings context to data
 - Standardization
 - Scalability

Filter	Value	Time Stamp
Template: NormalizedStatus		
NormalizedStatusTagLabel	[REDACTED]	1/1/1970 12:00:00 AM
VersionEnabled	True	1/1/1970 12:00:00 AM
Template: GeneralServer		
Memory Available Mbytes	6297 MB	8/22/2023 10:28:50 AM
Memory pages/sec	0	8/22/2023 10:28:50 AM
Memory Percent Committed Bytes In Use	38.291 %	8/22/2023 10:28:50 AM
NetData	0	1/1/1970 12:00:00 AM
NormalizedStatus	Normal	8/22/2023 10:28:40 AM
Paging File % Usage	5.1673 %	8/22/2023 10:11:15 AM
Paging File % Usage Peak	6.7668 %	8/22/2023 10:19:03 AM
Processor % Processor Time	5.191 %	8/22/2023 10:28:50 AM
System Processes	73	8/22/2023 10:28:28 AM
System Processor Queue Length	0	8/22/2023 10:28:40 AM
System Threads	1091	8/22/2023 10:28:50 AM
Terminal Services Active Sessions	0	8/22/2023 10:14:15 AM
Terminal Services Disactive Sessions	2	8/22/2023 10:14:15 AM
Terminal Services Total Sessions	2	8/22/2023 10:18:50 AM
Template: DataArchiveServer		
NormalizedStatus	Normal	8/22/2023 10:18:25 AM
PI Archive Subsystem Archive Count	1457	8/22/2023 10:18:50 AM
PI Archive Subsystem Archive Load Index	1	8/22/2023 10:13:05 AM
PI Archive Subsystem Archived Events Rate	2033.4	8/22/2023 10:28:50 AM
PI Archive Subsystem Archiving Flag	Archiving	8/22/2023 10:18:25 AM
PI Archive Subsystem Available Primary Records Count	206817	8/22/2023 10:12:40 AM
PI Archive Subsystem Config Events Call Rate	14.707	8/22/2023 10:28:50 AM
PI Archive Subsystem Config Max Unflushed Events Per ...	250	8/22/2023 10:18:25 AM
PI Archive Subsystem Corrupted Archives Count	0	8/22/2023 10:18:25 AM
PI Archive Subsystem Current Max Unflushed Events Per ...	250	8/22/2023 10:18:25 AM
PI Archive Subsystem Empty Archive Count	0	8/22/2023 10:11:00 AM
PI Archive Subsystem Event Queue Reader Delay	0	8/22/2023 10:28:40 AM
PI Archive Subsystem Events Read Rate	40707	8/22/2023 10:28:50 AM
PI Archive Subsystem Failed Archive Shift Flag	Normal	8/22/2023 10:18:25 AM
PI Archive Subsystem Failed Events Rate	0	8/22/2023 10:18:25 AM
PI Archive Subsystem File Management Queue Size	0	8/22/2023 10:18:25 AM
PI Archive Subsystem Flush Queue Size	0	8/22/2023 10:11:30 AM
PI Archive Subsystem Flushed Events Rate	2294.2	8/22/2023 10:28:50 AM
PI Archive Subsystem Out Of Order Events Rate	0	8/22/2023 10:28:50 AM
PI Archive Subsystem Overflow Data Record Rate	16.46	8/22/2023 10:28:50 AM
PI Archive Subsystem Overflow Index Record Rate	0	8/22/2023 10:28:45 AM
PI Archive Subsystem Primary Archive Average Events ...	124	8/22/2023 10:18:05 AM
PI Archive Subsystem Primary Archive Flushed Events R...	1111	8/22/2023 10:18:05 AM
PI Archive Subsystem Primary Archive Index Records	6370	8/22/2023 10:19:50 AM
PI Archive Subsystem Primary Archive Number	1093	8/22/2023 10:11:00 AM
PI Archive Subsystem Primary Archive Percent Used	33 %	8/22/2023 10:14:05 AM
PI Archive % Available Primary Archive Record Allocation	0	8/22/2023 10:11:00 AM

Notification Alerts

- Allows for early detection of issues and real-time awareness
- Leads to reduced downtime
- Plan for predictive maintenance

The PI Data Archive Collective on [REDACTED] is not in a good state. This started on 8/9/2023 3:34:05 PM Eastern Daylight Time (GMT-04:00:00). This node is the Secondary node in the collective.

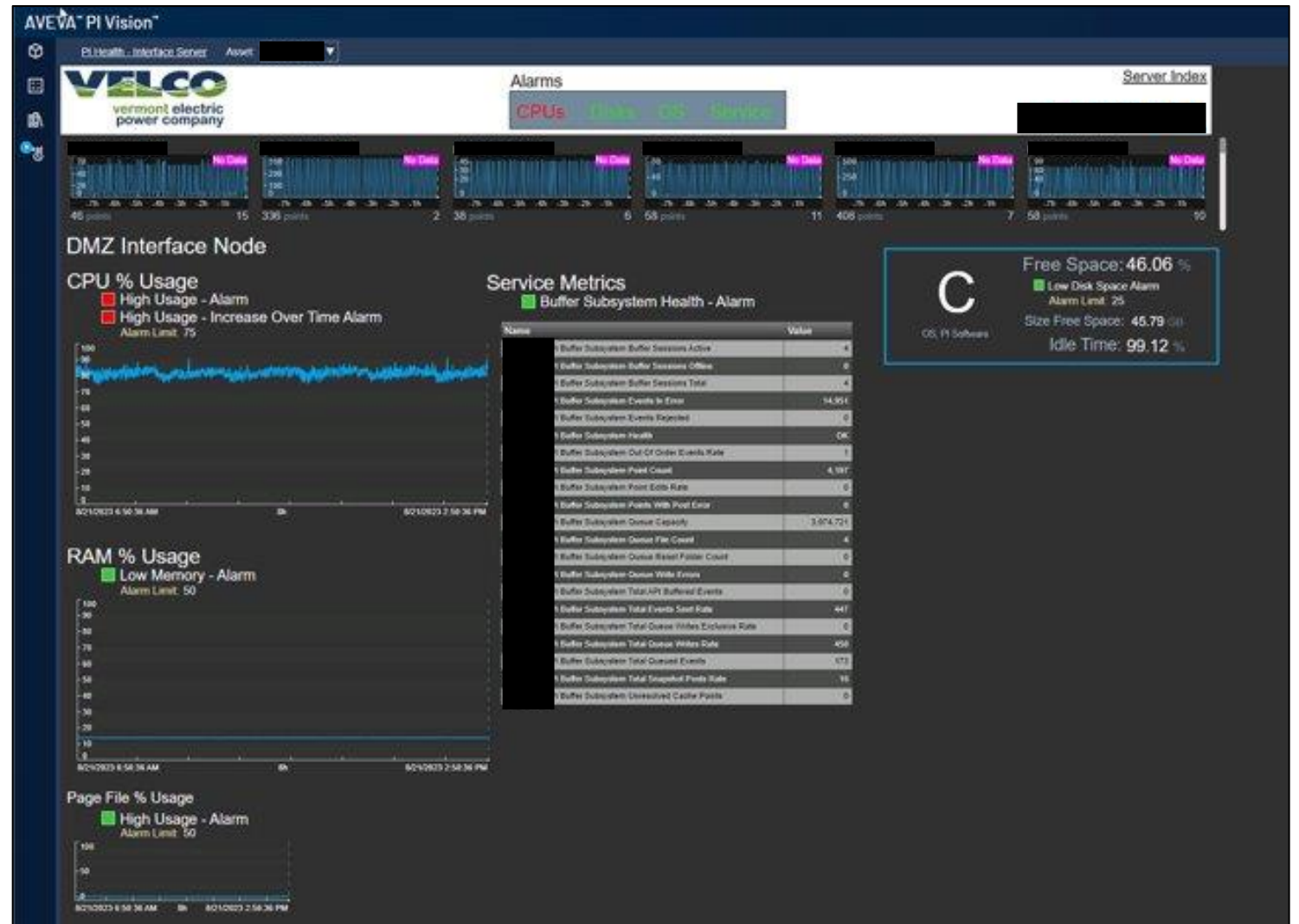
Please investigate the cause of the issue and reach out to any necessary personnel in order to resolve the issue.

PI Vision Displays

- Supports real-time visualization
- Customizable dashboards
- Trend analysis
- Event visualization



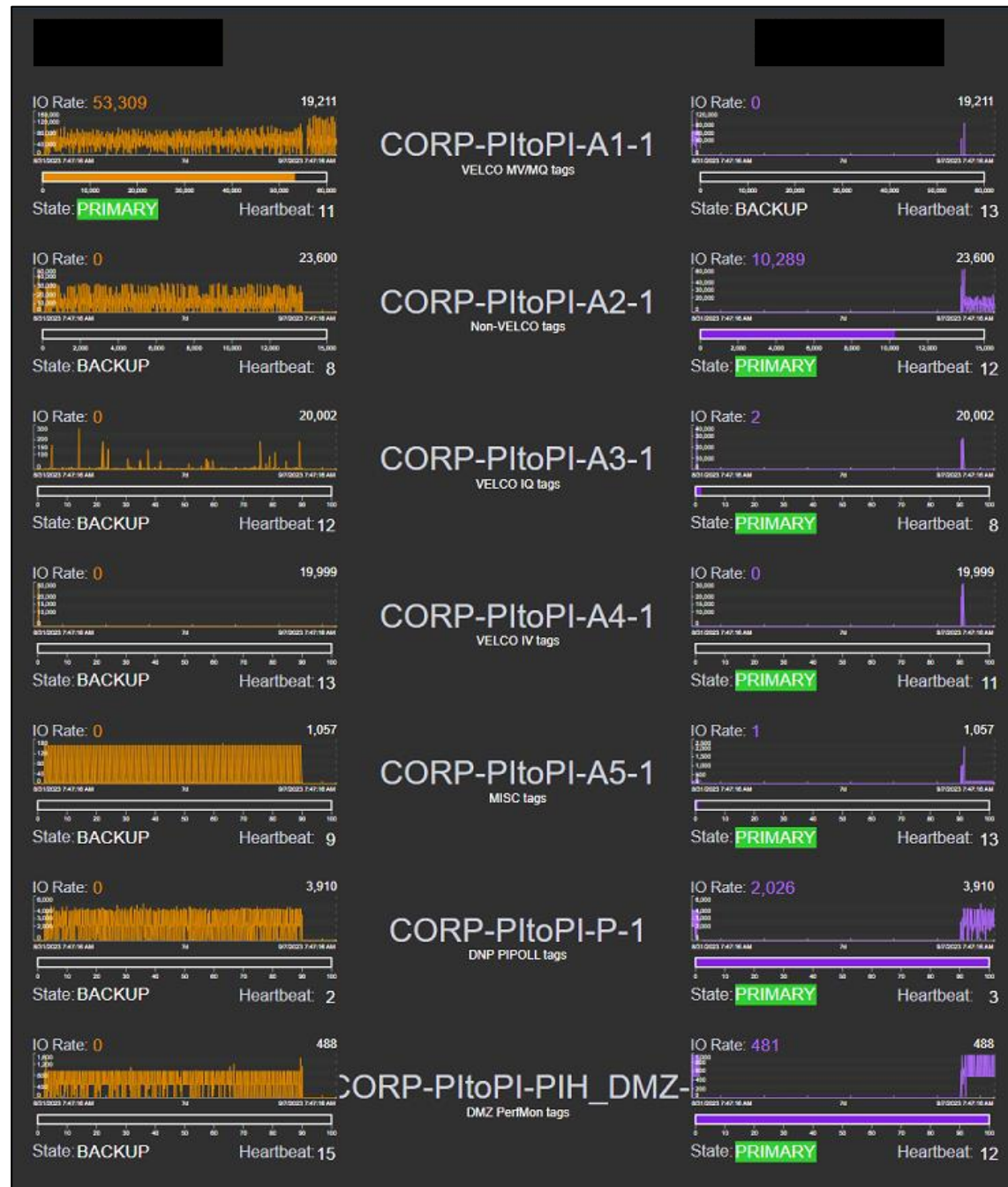
PI Vision Displays



PI Vision Displays



PI Vision Displays



Ensure VELCO has full utilization of PI System in a healthy state

Challenge

- VELCO has numerous areas dependent upon PI. Ensuring the seamless operation of the PI System is of paramount importance to our organization's data infrastructure. The PI System serves as the backbone of our data management and analytics processes, enabling us to gather, analyze, and derive critical insights from our industrial processes and systems. Therefore, it is imperative that the PI System always remains in a state of operational readiness.

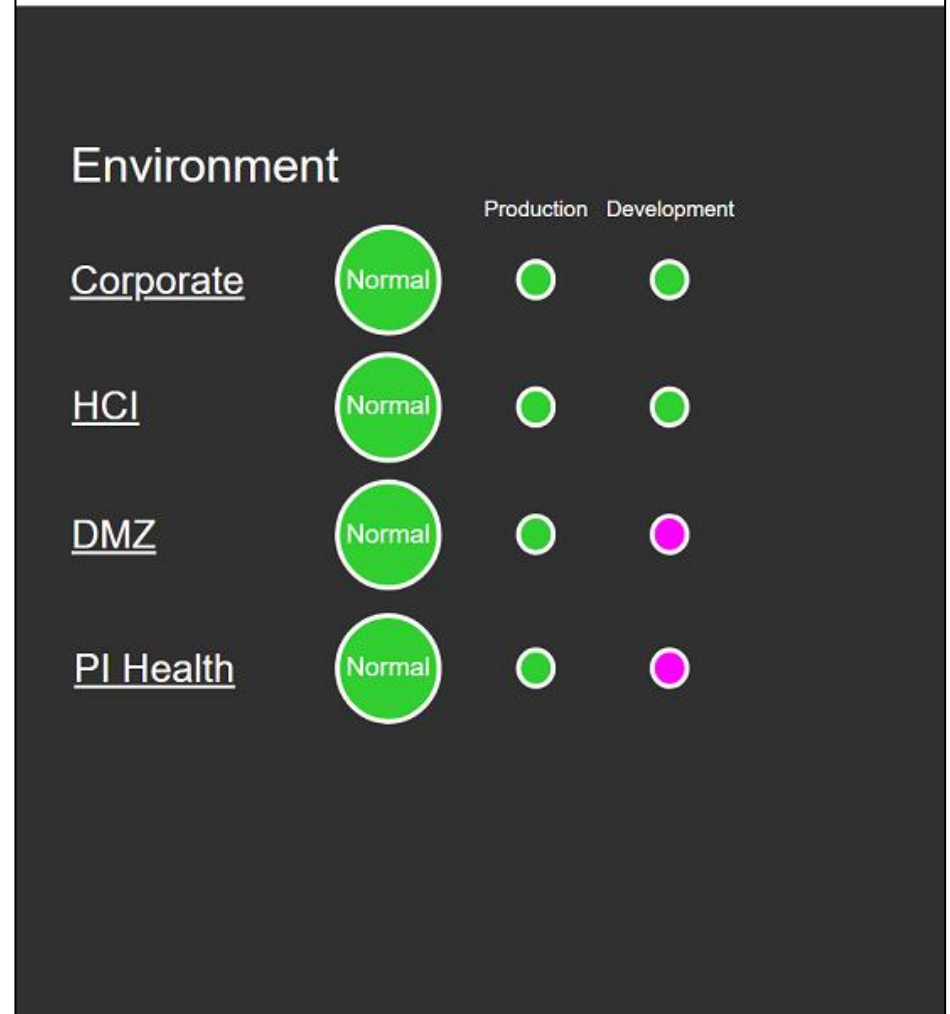
Solution

- Set up a PI System used to help monitor the status of the entire PI Environment and be able to alert if things go wrong

Results

- **Ensure data availability and integrity**
- **Detect and prevent potential issues**
- **Optimize system performance**
- **Proactive decision-making based on real-time insights**

Overall PI Health System



Best Practices for Effective Monitoring

- Keep system up to date for best performance
- Set up baselines to detect changes
- Enable real-time monitoring
- Set thresholds and alerts
- Perform in-depth health checks at regular intervals
- Documentation
- Review monitoring practices



Conclusion

- Value of PI System for VELCO
 - PI has been critical for the operation of VELCO
 - Keeping it running is of the utmost importance
- Next steps
 - Investigate incorporating new monitoring tools into the PI Health Monitoring System
 - Review current monitoring practices
 - Investigate new technologies to incorporate to help improve monitoring



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Questions?

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State your name and company.



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