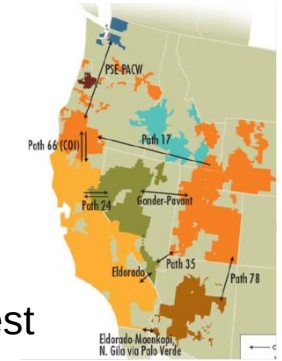
Improving the grid using PI

Naren Koka (PI Support)
Eric Henlon (Grid Modernization)

APS by the Numbers

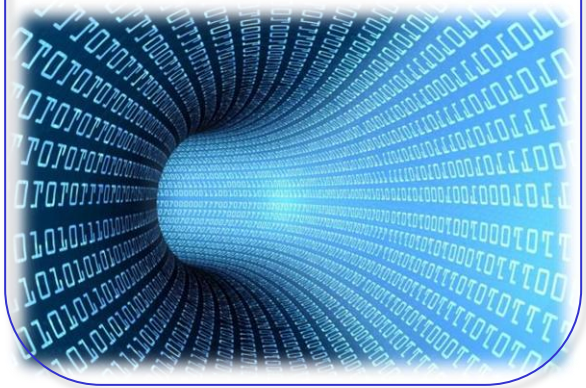
- Arizona's largest and longest serving utility
  - Serving Arizona since 1886
- Service Territory
  - 11 out of 15 counties
  - 1.2 Million Customers (89% residential)
  - 34,646 square miles
- Peak Demand ~ 7,300 MW
- 33,000 miles of transmission, distribution lines and cable
- The second largest generation fleet in the western US
  - Palo Verde NGS, primary source of electricity in Southwest
- Solar Capacity ~ 950 MW
  - 4th largest in the nation
  - 50% of solar portfolio is distributed
  - Pioneer in solar research since 1970s
- Recently joined the CAISO Energy Imbalance Market



Program Goals

Time Series Data

Historize Data
Provide Context
Easy Access



Historical data in context

Monitoring

Situational Awareness
Consistent Visualization
Supported Apps

Supported applications

Self Service

Easy Access
Training
User Groups

Trained users solving problems

PI at APS

Infrastructure

150+ Servers
7 sub systems

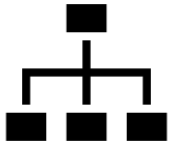
Data

160+ Interfaces
1.2 million tags

Applications

18

Context



Distribution
Generation

Training

225+

Trading

Weather Data
PCI Data
EIM Data

Renewables

2 Wind Farms
11 Solar

Generation

2 Coal [9 Units]
7 Gas/Oil [33 Units]
1 Nuclear [3 Units]
45 Wells

Transmission

893 Substations
3,508 Lines
1,474 Transformers
5 Paths
72 Interchanges

Distribution

1245 Feeders
485 Sub XFMR
230 High Pen Fdr (DG)
40 Network Protectors

Adv Grid

500 REG / CAP
1100 CFI
2 BESS

Engaging Users

Define Applications

Work with Stakeholders
Iterative Approach
Review Priority & Value

Training

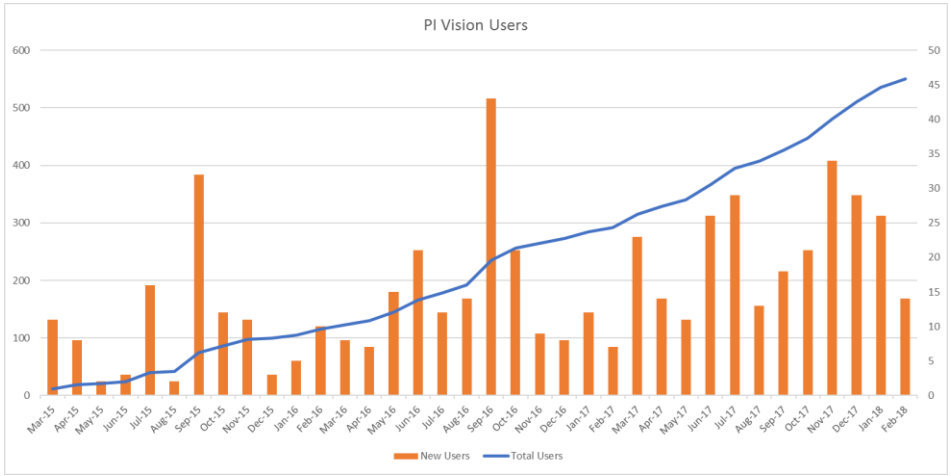
User Focused
Introduction to PI
Business Focused Training

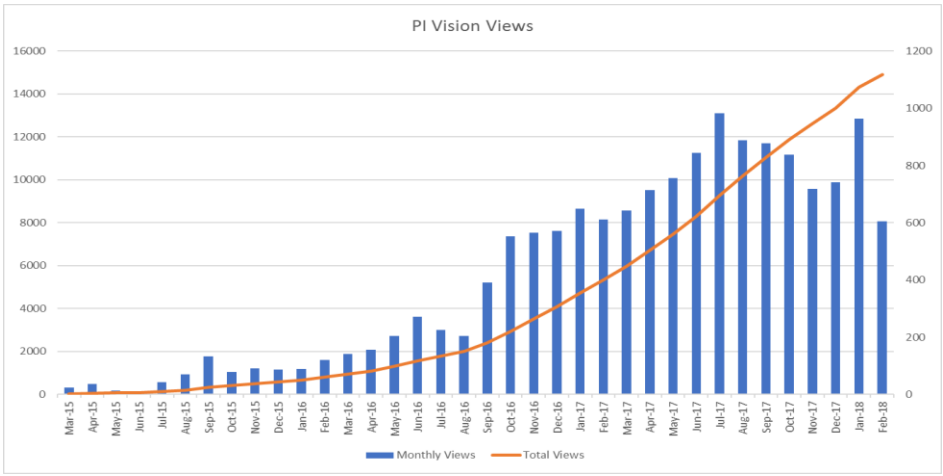
User Groups

Share Success and Ideas
Provide Feedback

OSIsoft.

Growing Self Service





95 owners
548 users

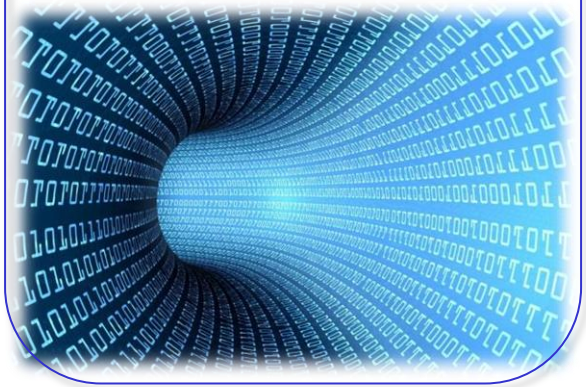
500+ Displays

15,000 Views

Program Directions

Time Series Data

Maintain Infrastructure
Acquire Dist Gen (Solar) data
Adding Smart Devices
ADMS Integration



Monitoring

Feeder Analytics
Volt Var Management
Reliability

Self Service

Transmission AF Model
Generation Unit Models
Business Focused Training
Additional Tools

Grid Modernization at APS

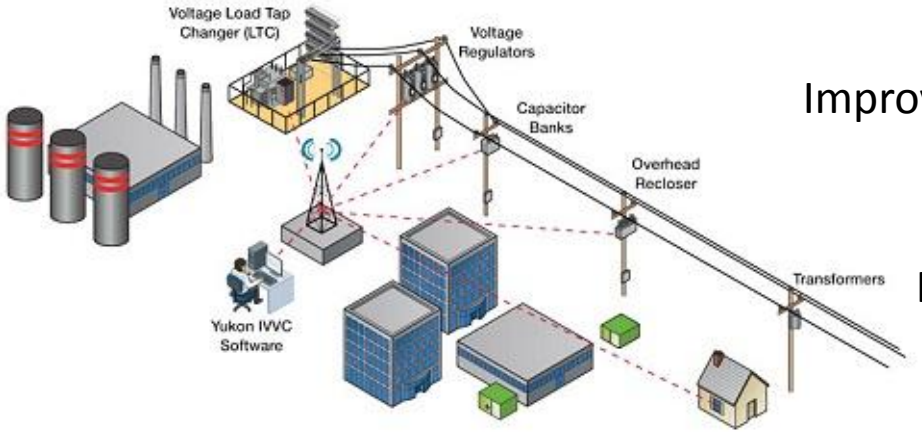
Areas of Focus

Control Power Quality

Monitor faults

Monitor performance

Impact of Distributed Gen (DG)



Benefits

Improved reliability

Improved efficiency

Reduced capital

Power Quality Improvements

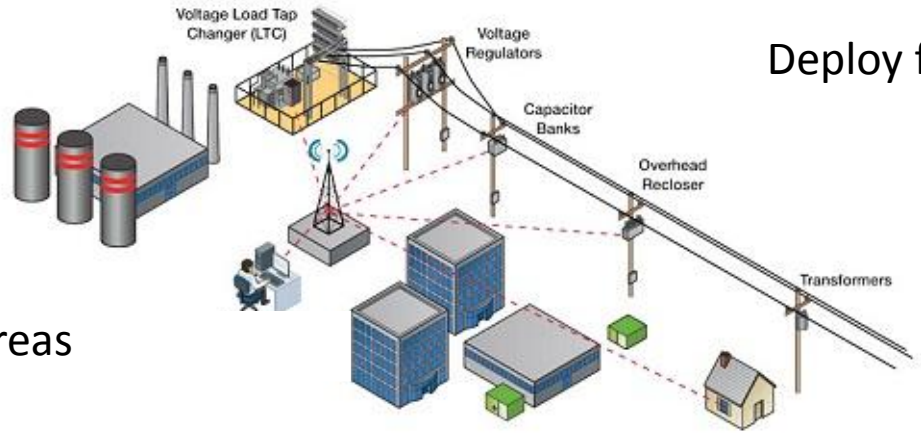
Challenges

Roof top solar growing

Lack of visibility

Long feeders in rural areas

Open loop control of CAP



Solution

Deploy field measurement

Volt, Var control

Notification of issues

Visibility, situational awareness

DATA ACQUISITION

Data captured from head end systems

CONDITION MONITORING

Monitor voltage and device health
Capture events

NOTIFICATION

Proactive identification of issues

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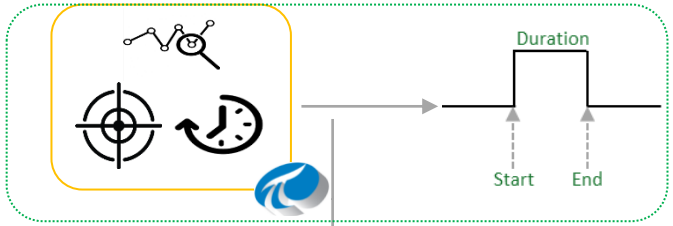

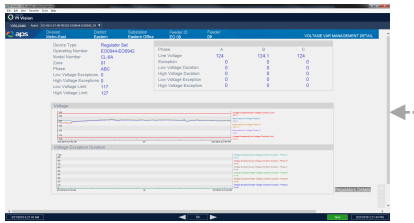

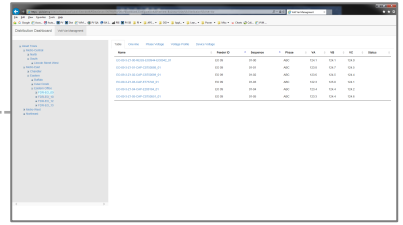

DASHBOARD, ANALYSIS

VISIBILITY

View device and feeder details

OPERATIONAL INTELLIGENCE

Overview of voltage by feeder
Select additional views

PERFORMANCE

Frequency, duration and impact
Top 10 lists

- Asset Trees
  - Metro-Central
    - North
    - South
      - Lincoln Street West
  - Metro-East
    - Chandler
    - Eastern
      - Buffalo
      - Cave Creek
      - Eastern Office
        - FDR-EO_09
        - FDR-EO_10
        - FDR-EO_12
        - FDR-EO_13
  - Metro-West
  - Northeast

Table | One-line | Phase Voltage | Voltage Profile | Device Voltage

Name	Feeder ID	Sequence	Phase	VA	VB	VC	Status
EO-09-3-Z1-00-REGS-EO0944-EO0942_01	EO 09	01-00	ABC	124.1	124.1	124.0	
EO-09-3-Z1-01-CAP-CS750588_01	EO 09	01-01	ABC	123.8	124.7	124.5	
EO-09-3-Z1-02-CAP-CS750589_01	EO 09	01-02	ABC	123.6	124.5	124.4	
EO-09-3-Z1-03-CAP-E773743_01	EO 09	01-03	ABC	122.3	125.0	124.1	
EO-09-3-Z1-04-CAP-E208184_01	EO 09	01-04	ABC	123.4	124.4	124.2	
EO-09-3-Z1-05-CAP-CS750551_01	EO 09	01-05	ABC	123.3	124.4	124.6	

https://pivision-q/VoltVar/Dashboard?Label=Extended&PIDataServer=ENTPI&PIAFDB=PIDashboard_Configuration&AFElement=Business+Units%5cDistribution%5cVolt+Var

Volt Var Managment

File Edit View Favorites Tools Help

Google Acce... Auto... PV Dist VVM ... PV QA BA I... PBI PV SB PI APS ... OSI Appl... Lear... Power Misc Charts Cali... VVM ...

Distribution Dashboard

Volt Var Managment

- Asset Trees
  - Metro-Central
    - North
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Table | One-line | Phase Voltage | Voltage Profile | Device Voltage

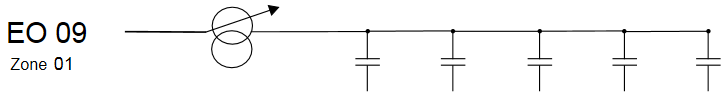
OSIsoft PI Vision

New Display | APSC\ZX0400

VVM-1-Line Asset: Zone01

Ad Hoc Display

aps | Division: Metro-East | District: Eastern | Substation: Eastern Office | Feeder: 9 | Zone: 01 | VOLTAGE VAR MANAGEMENT 1-LINE



	EO0944-EO0942	CS750588	CS750589	E773743	E208184	CS750551
Phase A	124	123.7	123.5	122.2	123.4	123.3
Phase B	124.1	124.5	124.5	124.9	124.4	124.4
Phase C	124	124.3	124.4	124.1	124.2	124.5
Volt Exception						
Low	0	0	0	0	0	0
High	0	0	0	0	0	0

3/21/2018 6:12:14 AM | 8h | Now | 3/21/2018 2:12:14 PM

https://pivision-q/VoltVar/Dashboard?Label=Extended&PIDataServer=ENTPI&PIAFDB=PIDashboard_Configuration&AFElement=Business+Units%5cDistribution%5cVolt+Var

Volt Var Managment

File Edit View Favorites Tools Help

Google Acce... Auto... PV Dist VVM ... PV QA BA I... PBI PV SB PI APS ... OSI Appl... Lear... Power Misc Charts Cali... VVM ...

Distribution Dashboard

Volt Var Managment

- Asset Trees
  - Metro-Central
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  - Metro-West
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Table | One-line | Phase Voltage | Voltage Profile | Device Voltage

OSIsoft PI Vision

New Display | 156 | APSC\ZX0400

VVM - Phase Trend Asset: Zone01

Ad Hoc Display

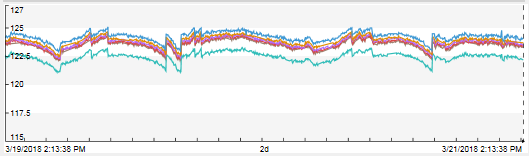
aps

Division	District	Substation	Feeder ID	Zone
Metro-East	Eastern	Eastern Office	EO 09	01

Voltage Var Management Phase Trend

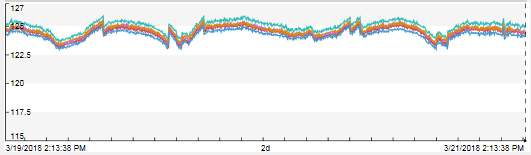
EO 09
Zone 01

Phase A

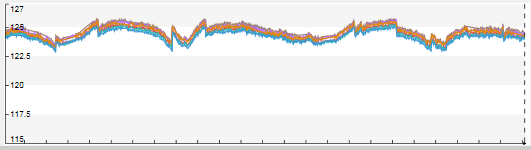


EO0944-EO0942
CS750588
CS750589
E773743
E208184
CS750551

Phase B



Phase C



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aps

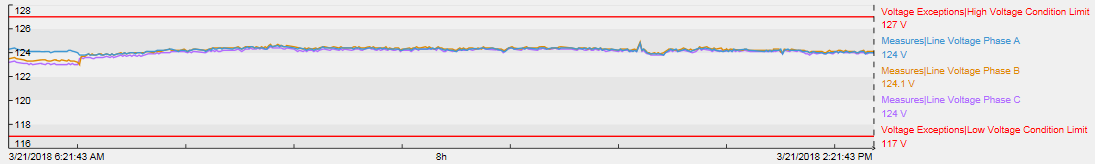
Division	District	Substation	Feeder ID	Feeder
Metro-East	Eastern	Eastern Office	EO 09	09

VOLTAGE VAR MANAGEMENT DETAIL

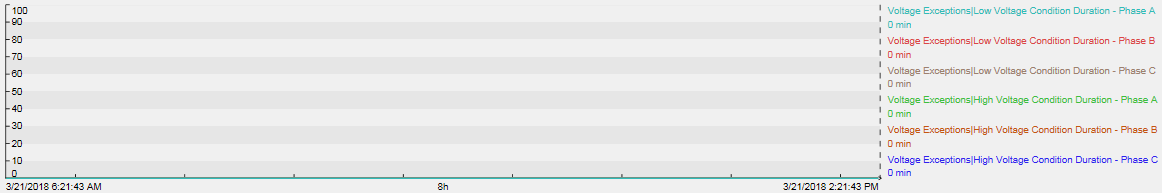
Device Type	Regulator Set
Operating Number	EO0944-EO0942
Model Number	CL-6A
Zone	01
Phase	ABC
Low Voltage Exceptions	0
High Voltage Exceptions	0
Low Voltage Limit	117
High Voltage Limit	127

Phase	A	B	C
Line Voltage	124	124.1	124
Exception	0	0	0
Low Voltage Duration	0	0	0
High Voltage Duration	0	0	0
Low Voltage Exception	0	0	0
High Voltage Exception	0	0	0

Voltage



Voltage Exception Duration



Regulators Details

Building the Solution

Collaboration

Start with the end in mind

Product management approach

Iterative approach

Adoption

Planned releases (roadmap)

Proactive identification of issues

Use to validate device provisioning

Replaced manual reports

Added > 100 feeders, 500 devices

Sustaining Value

Integrated into device deployment

Incorporating system maintenance

Focus on continuous improvement

$

Power Quality Summary

Creating a sustainable energy future for Arizona

We safely and efficiently deliver reliable energy to meet the changing needs of our customers

CHALLENGE

Improve power quality and visibility of the distribution system.

- Aging system.
- Addition of roof top solar.
- Lack of visibility.

SOLUTION

Implemented volt var control with PI to provide operational intelligence and visibility.

- Acquired volt var information in PI.
- Monitored voltage / device health.
- Provide visualization, notification.

RESULTS

A distribution system that works in alignment with APS power quality objectives.

- Improved decisions about the addition, placement of devices.
- Reduced response time to operational issues and improved collaboration.
- Improved tools for maintaining the overall system.

Lessons Learned

- AF is a critical component
- PI adoption takes work
- PI Governance is required
- Partnerships are key

Speakers

- **Naren Koka**
- Naren.Koka@aps.com
- PI Support
- APS

- **Eric Henlon**
- Eric.Henlon@aps.com
- Technology Program Consultant
- APS

Questions

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

State your **name & company**

Please remember to…

Complete the Online Survey for this session

Merci

谢谢

Danke

Спасибо

Gracias

Thank You

감사합니다

ありがとう

Grazie

Obrigado