

**denison**  
CONSULTING GROUP

# Why Power Quality Matters

*The more you know the more you can make a difference*

# Today's Agenda

## Why Power Quality Matters

- Focus on Business Drivers - Trends and Issues

## Power Basics – Brief Refresher

- Standard Definitions
- Causes and Symptoms of Poor Power Quality
- Impact of Poor Power Quality

## TQM Approach to PQEM

- From Floor to the Cloud in 3 Easy Steps
- Delivery Challenges, Issues, and Impact

## Software Demo and PQ HMI Discussion

## Discussion



# Why Power Quality Matters

## Consumption Usage, Patters and Trends

Energy is the largest unmanaged industrial expense

30% US energy consumption, 70% growth by 2035

Over 60% of Fortune 100 companies public announcements

2015 UN Climate Change Initiative, less than 15% use software\*

Many not tracking to targets

30-70% unplanned downtime due to PPQ (\$\$\$) \*\*

**Energy management can result in substantial savings**

Source: US Energy Information Agency\*  
Rockwell Automation\*\*

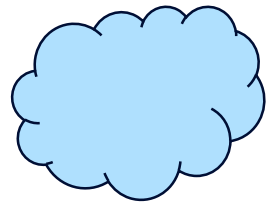
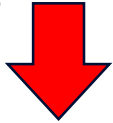


# Why Power Quality Matters

*Focusing on the Business Drivers*

Operations Costs

Disruptions



Preventive maintenance

OEE and asset life

OXE

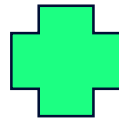
Quality



Regulations

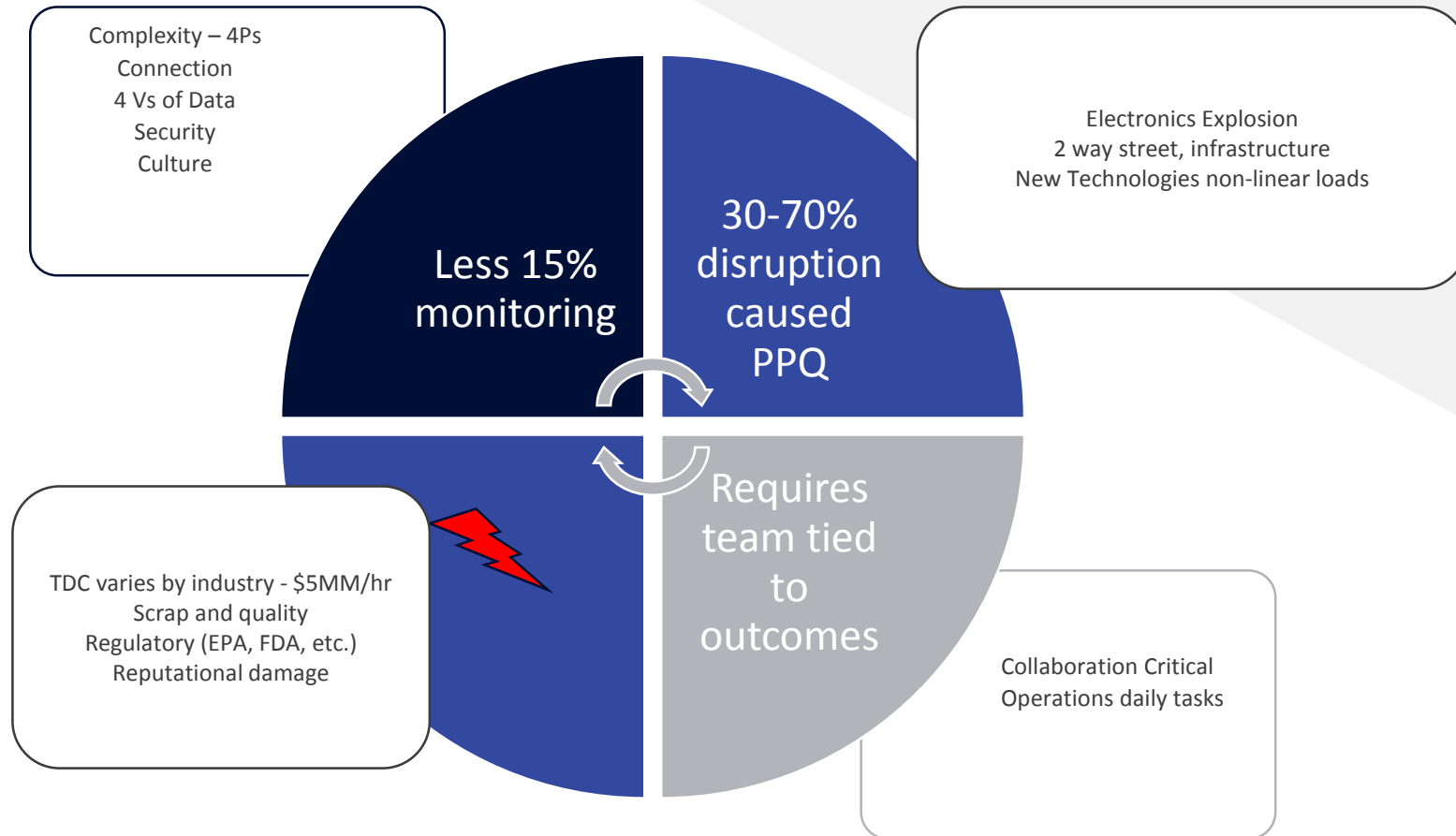


???

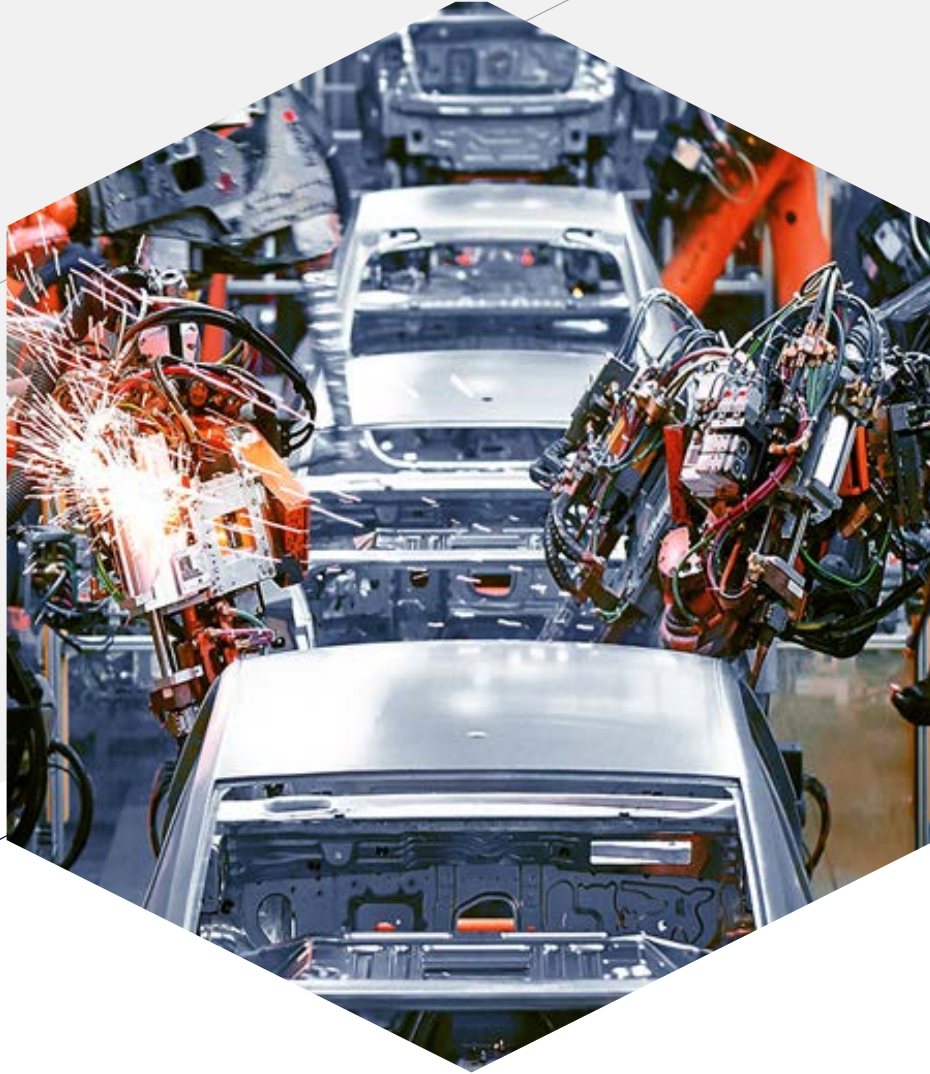


# Why Power Quality Matters

*Current Realities and Operator Challenges*







## Basics of Power Quality

*Power Basics and the Causes, Symptoms and Impact of PPQ*

# Power Quality Basics

*Applicable Standards*

IEEE 1159 into facility

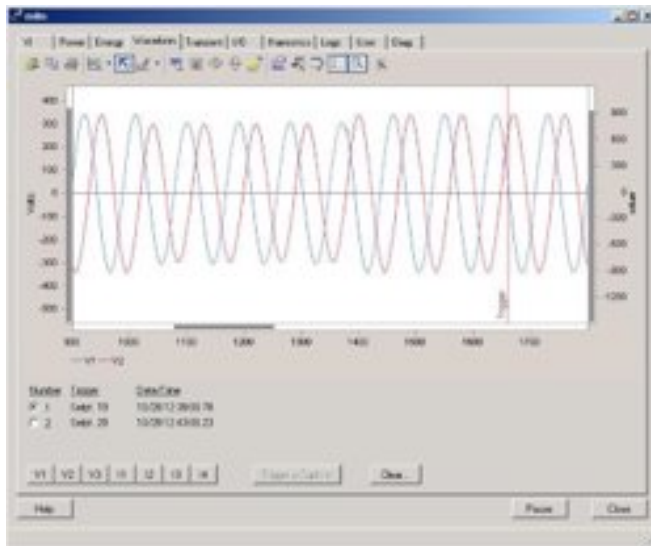
IEEE 1134 within facility

ISA 18.2 Alarming of events

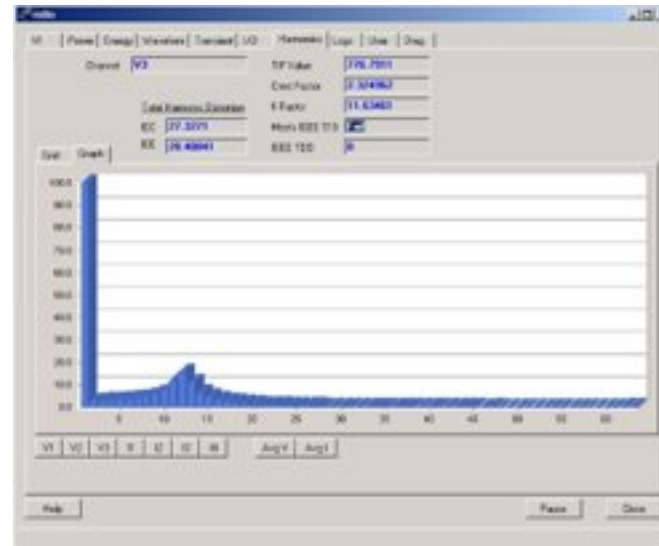
**ISA 101 HMI visualize and act**

# Power Quality Event Types

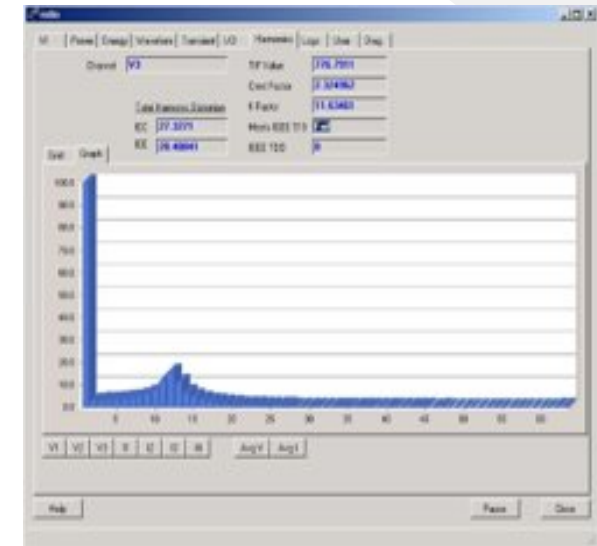
*Sample of Power Quality Event Types*



Voltage Sag/Swell



Harmonics

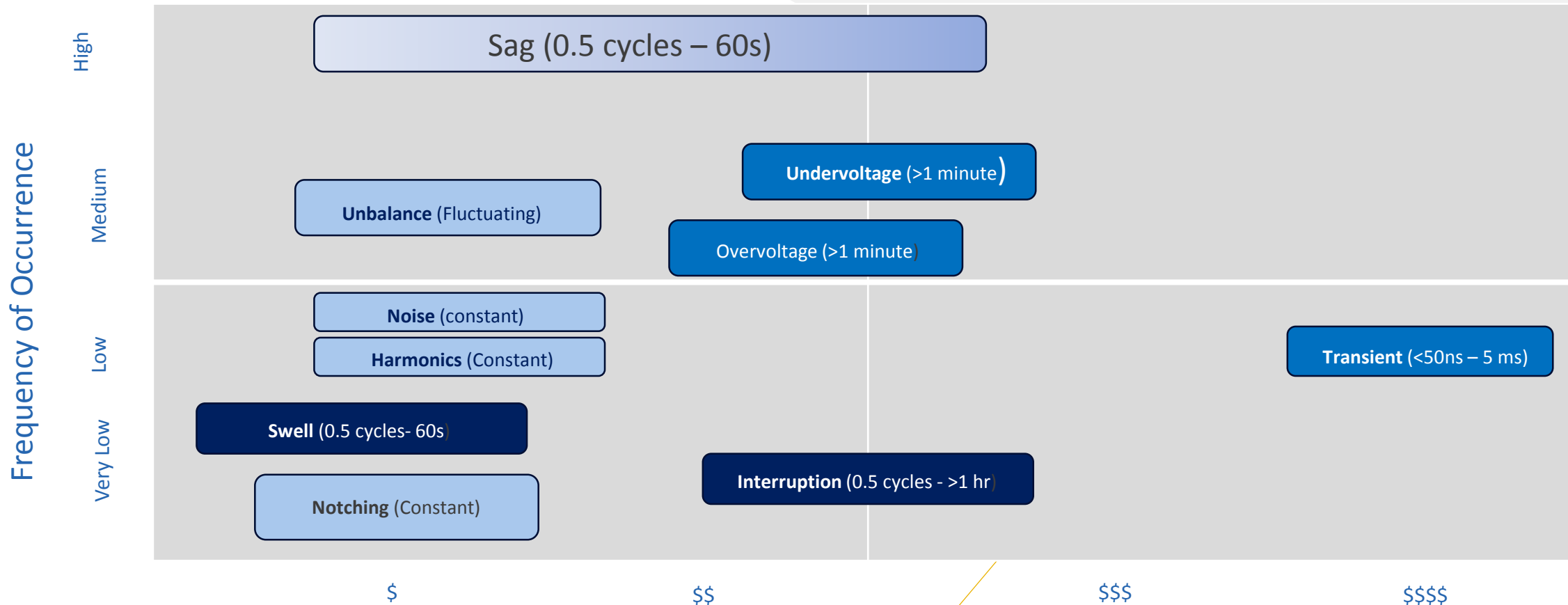


Transient



# Cost of Poor Power Quality

*Voltage Sags Largest Culprit*



# Power Quality Basics

## *The Traditional and New Culprits of PPQ*

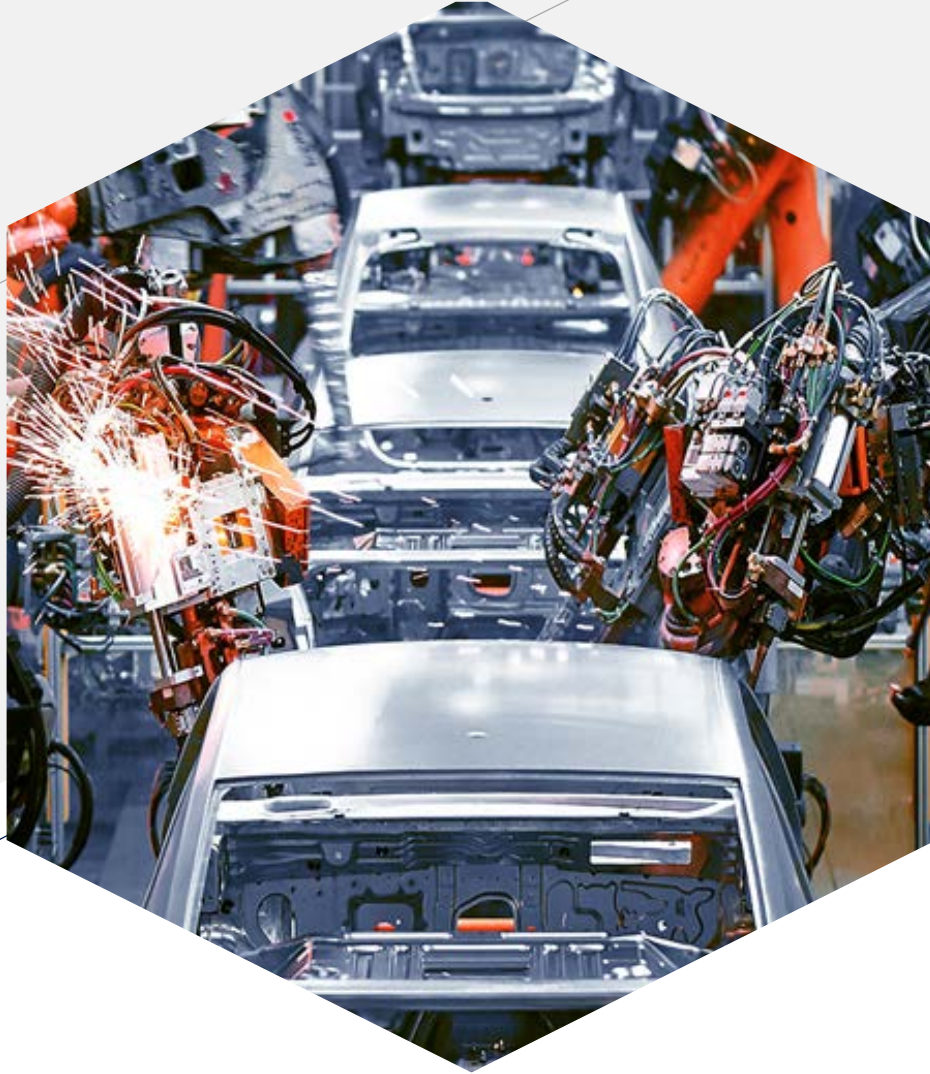
Mostly random events – weather, cars, construction, trees, animals, Gladys Kravitz

Starting of large loads, motors, poor connections and grounding

Immediate and long-term damage to sensitive equipment

Explosion of Deployed Technologies (VFDs, LED)

**Increasing Prevalence of PQ Events and Issues**



## **TQM Approach to Power Quality**

*Putting Power in your Pocket*


# Step 1: Comprehensive Assessment

*Roadmap to Real-Time PQ Monitoring*



# Step 2: Connect, Collect, Visualize

**Menu**



MCCs

Notification

Open HDV

576 - 602.00

576 - 603.00

Quality

576 - 603.00

576 - 602.00

576 - 603.00

576 - 602.00

576 - 603.00

576 - 602.00

576 - 603.00

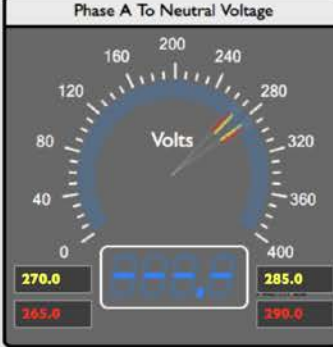
576 - 602.00

576 - 603.00

576 - 602.00


576 - 603.00

**Phase A To Neutral Voltage**




270.0    285.0  
265.0    290.0

**Phase A To Phase B Voltage**



460.0    490.0  
455.0    494.0

**Phase A Amps**



150.0  
180.0

**Average Volts/Amps**

888.88 v

Average Line to Neutral

888.88 v

Average Line to Line

888.88 A

Amperage

**Statistics**

Frequency 88.88 Hz

Total kW 88.88 kW

Total kVA 888.88 kVA

Power Factor 8.888

PF Lead Lag



Voltage % Unbalance 883.30 %

Current % Unbalance 888.27 %

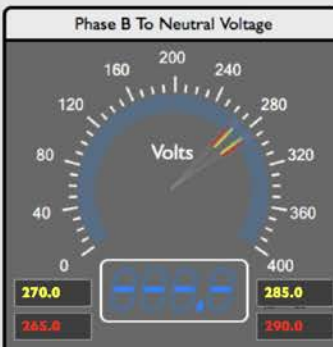
**Communication**

Network Connection ■

Power Monitor ■





**Phase B To Neutral Voltage**




270.0    285.0  
265.0    290.0

**Phase B To Phase C Voltage**



460.0    490.0  
455.0    494.0

**Phase B Amps**



160.0  
170.0

**Average THD**

883.78 %

Average Line to Neutral

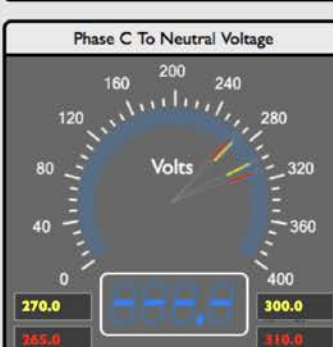
882.75 %

Average Line to Line

883.28 %


Amperage

**Phase C To Neutral Voltage**




270.0    300.0  
265.0    310.0

**Phase C To Phase A Voltage**



475.0    489.0  
465.0    494.0

**Phase C Amps**



160.0  
170.0

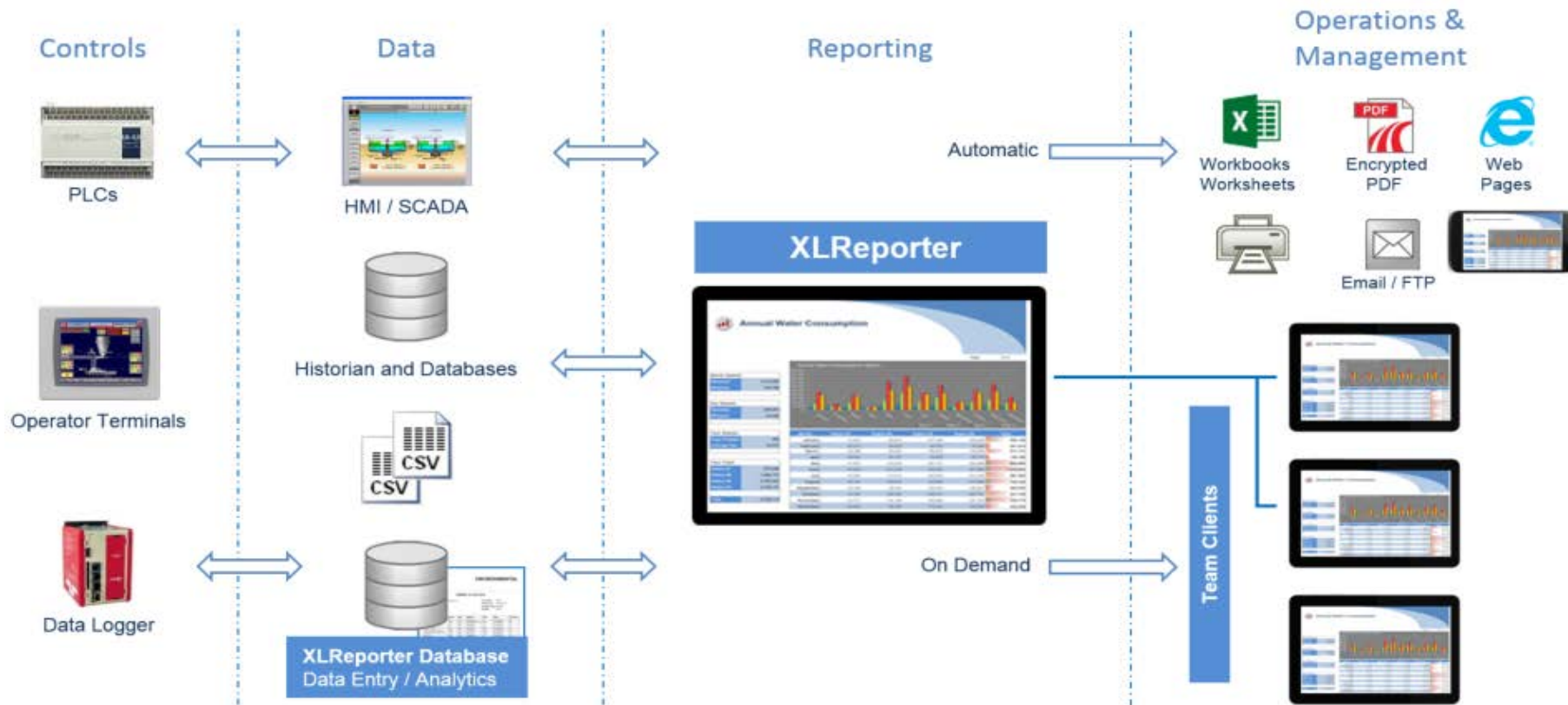
**Alarms**

History   Active   Unacked   **Current**   Shelved   Disabled   Configured

There are no alarms that match the current filter

## Step 3: Customized Reporting and Actions

Waveform Capture and More



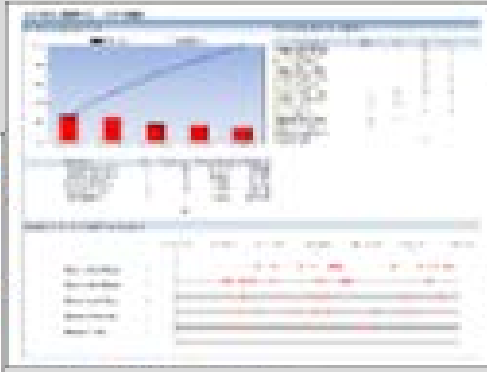
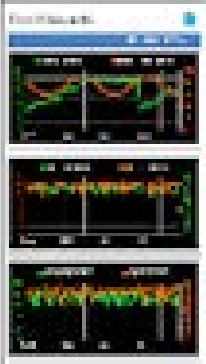


# How Value Is Presented

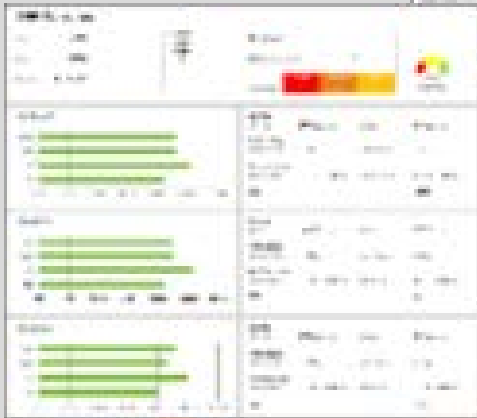
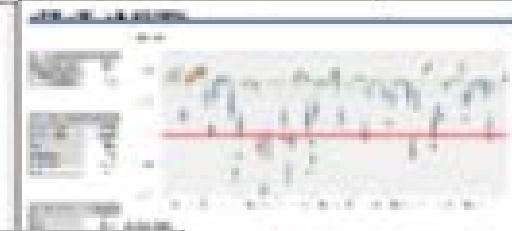
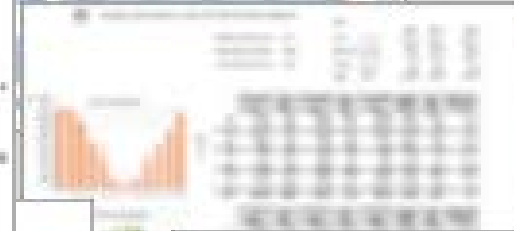
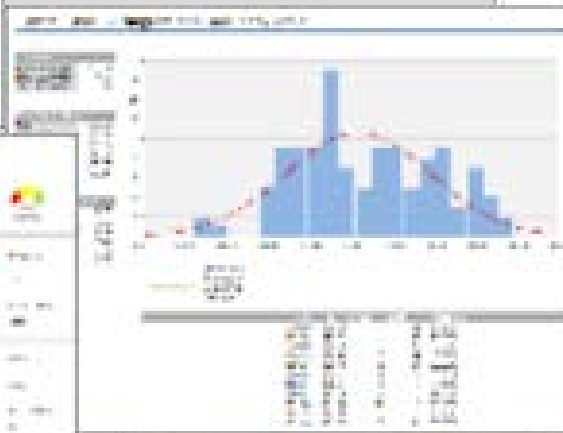
ISA 101 (2015) Human Machine Interface

- Industry Standard Philosophy, Guide, Format
- Design of the customizable HMI – design meets operations
  - Uses network to communicate RTU/PLC – 4 Vs
  - Questionnaires, interviews, workshops - KPIs
  - Diagrams (PFDs and P&ID) used as source documents\*
  - Displays – navigation hierarchy, realms, scope, security
- Think Big Engine – scale, evolve, custom, open standards
  - Alerts, Alarms and Notifications (Hierarchy, time, link)
  - Historian, trends, reporting, alarming, backup, security

**HFE and Cognitive Brain – launch pad**



A data table with multiple columns and rows, containing numerical and text data. The table is organized into several sections.



A data table with multiple columns and rows, containing numerical and text data. The table is organized into several sections.



A data table with multiple columns and rows, containing numerical and text data. The table is organized into several sections.

# Value Delivered

Power in Your Pocket

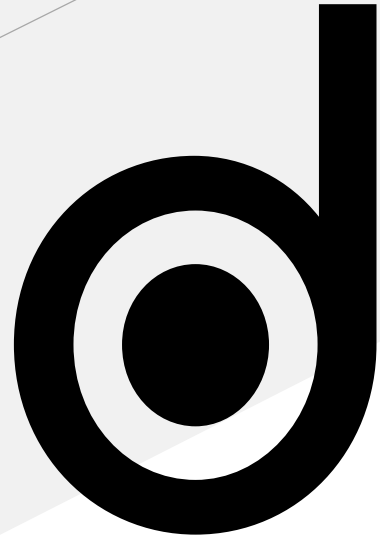
- KPI Reports, Dashboards and Templates
  - Alarm Reporting (trend, severity, type, custom)
  - Efficiency Reporting (OEE, OXE)
  - 1159 Power Quality Reporting (into the plant)
  - PQ Impact – Health and Diagnostics Reporting
  - Custom Reporting
- User Support Critical – know the Ws
  - If user don't like, recognize, understand – they won't use
- Evolution Path – from Basic to Advanced Analytics
  - How can the HMI be used to display other insights?
  - Correlation of data – root cause analysis
  - Advanced analytics (predictive and preventive diagnostics)

# To the Clouds

PQ in the Cloud is a Game Changer

- Amazon – A Data Company
- Chambers 2014 World Economic Forum
- PQ + Data = Today's Manufacturing Home Run
- Cloud Based Hosted Services
  - Fast delivery of services, 3 legged stool critical
  - Rapid ROI (CapEx, OpEx)
  - Focus on core competencies, outsource experts to allow team focus
- What's In Store for Tomorrow
  - Quickly moving to advanced analytics (predictive / preventive)
  - Beyond Pareto, OXE

**Focus on the value drivers – the solutions become clear**



**denison**  
CONSULTING GROUP

## Thank You!



Dianne Denison and Matt Moore, PE



(717) 386-5159



[dianne@denisonconsultinggroup.com](mailto:dianne@denisonconsultinggroup.com);  
[matt.moore@denisonconsultinggroup.com](mailto:matt.moore@denisonconsultinggroup.com)



[DenisonConsultingGroup.com](http://DenisonConsultingGroup.com)