# Leveraging ION Meters at Hydro One

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# Overview

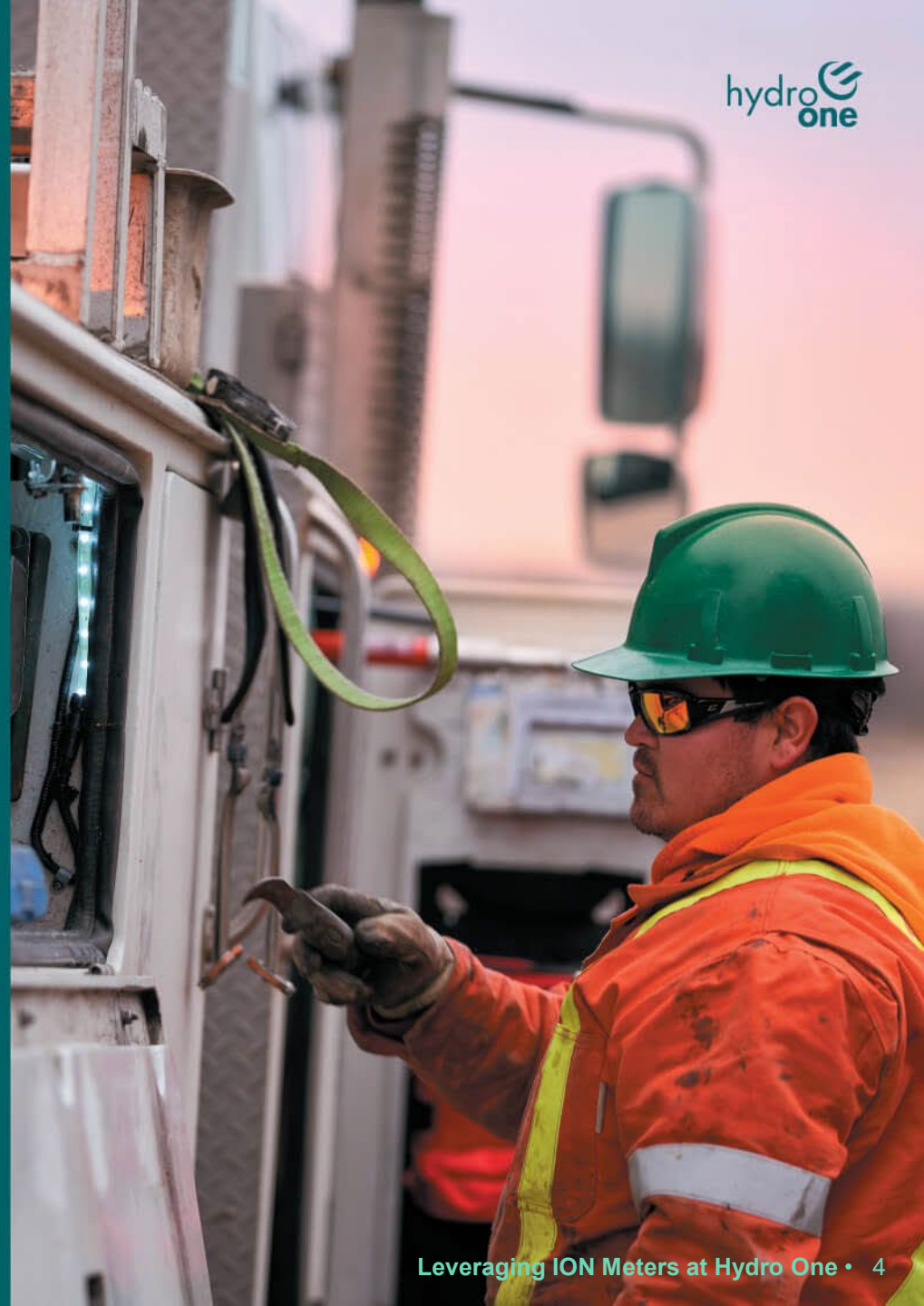
- Introduction to Hydro One AMIO
- Wholesale Revenue Metering
- Power Quality Metering
- Our PQ Architecture
- Power Monitoring Expert
- Common PQ Challenges
- Utilizing ION meters – Scenario 1
- Utilizing ION meters – Scenario 2

# Introduction to Hydro One AMIO

# Introduction to AMIO

Advanced Metering Infrastructure Operations (AMIO) is responsible for the full lifecycle of metering and AMI network operations, including:

- Procurement
- Validation Testing
- Regulatory Compliance
- Network Management
- Data Collection
- Standards & Planning



# About Us

## Network Equipment

### Equipment Management
- Managing asset and material management for devices and equipment
- Manage Life Cycle & Inventory Management for equipment
- Meter Sampling, inspection and certification in compliance with
- Measurement Canada Specifications
- Manage Purchasing, Shipping, Receiving and RMA
- Testing / Troubleshooting and Investigations / Vendor Evaluation

### Regulatory Compliance
- Distribution System Code, Retail Settlements Code, Measurement Canada Regulations (Electricity and Gas Inspection Act), ESA Reg. 22/04, CSA
- Measurement Canada Accredited
- Authorized to both inspect and certify devices for Measurement Canada
- Requires an up to date and comprehensive quality management system
- Audited annually by Measurement Canada to ensure compliance

## Centre of Excellence

### Asset Management / Investment Planning
- Meter Asset Planning

### Engineering
- Telecom 3rd level support
- Network 3rd level support
- Retail Meter Engineering Standards & Tech Specs
- Distribution Lines MTECH Support

### Metering Instrument Transformer (IT) Management
- PMU sizing and ordering
- New material MM updates

### Vendor Management
- Performance Tracking
- Issues Management

### Project and Program Management
- Operational Finance
- Quality Management & Documentation
- Project Reporting and Tracking

### Strategy & Roadmap
- AMI 2 Strategy
- Rate Filing Preparation

## Network and Data

### AMI Communication Network
- Monitor and manage the overall end-to-end performance of the AMI communication network, including design
- Triage communication failures and troubleshoot issues
- Manage equipment firmware upgrades and parameter changes
- Issue applicable service notifications when required (i.e., CMOs, check readings, Collectors, Repeaters, etc.)
- Manage Head End Systems and related software upgrades

### Data
- Monitor hourly meter data collected daily
- Manage data exported to other internal (CIS) and external (MDMR) systems
- Manage exception reports (Data collection, Validation & Estimation, Billing quantities)
- Manage meter data investigations received from Customer Care

## Complex Metering

### Retail Meters
- Management of Retail metering related work programs
- Management of exceptions related to meter configurations, data collection, and data validation & estimation
- Manage meter data investigations received from Customer Care

### Meter Service Provider (MSP) & Wholesale Meters
- HONI is a licensed Metering Service Provider (MSP)
- Manage Wholesale metering services in accordance with the IESO Market Rules and subject to HONI's MSP Metering Service Agreement (MSA)

### Power Quality
- Manage Hydro One's Power Quality monitoring system (data collection, analysis, new site integration, system maintenance)
- Provide expertise and support for Hydro One Power Quality tool end users


hydro one
255
Smart Network Services
Work Methods & Training


Form 2S - 240V
EQUIPMENT
UNDER
TEST


THERMOTRON
MILBANK MFG. CO.
METER
SOCKET


Sealed Stock


STATION 9
STATION 10
STATION 8

# AMI Complex Metering
# Wholesale Revenue Metering

# Metering Installations at Hydro One

**ION Usage within Hydro One:**

- **Wholesale → mix of 8600A, 8600C, 8650A & 8650C**
- **Retail → mix of 8600A & 8650A**


# Wholesale Installations

- 429 Wholesale Revenue Metering (WRM) Installations across Ontario:
  - 126 Transmission Stations
    → 290 MPIDs
  - 94 Distribution Stations
    → 139 MPIDs
- Wholesale metering must be performed by a registered Metering Service Provider (MSP)
- Hydro One MSP is among 17 MSPs registered with the Independent Electricity System Operator (IESO)
- IESO Market Rules provide detailed requirements for MSPs to follow and for the type of hardware to be used
- Online IESO (Appian) is where IESO keeps all Hydro One wholesale metering official records on. AMICM, Field P&C, P&C Engineering and TDS are responsible for these documents.

# Hydro One MSP Role

- Meter Installation Upgrades (Installation, Commissioning)

- Meter Registration
  - Single Line Diagrams
  - Declaration of Compliance
  - Emergency Instrument Transformer Restoration Plans
  - Measurement Error Correction
  - Site Specific Loss Adjustments
  - MIRT Files
  - Engineering Units Reports
  - Totalization Tables
  - Site Registration Reports
  - Station Service (not measured by a WRM)

- Meter Installation Maintenance

- Meter Troubleshooting and Replacement

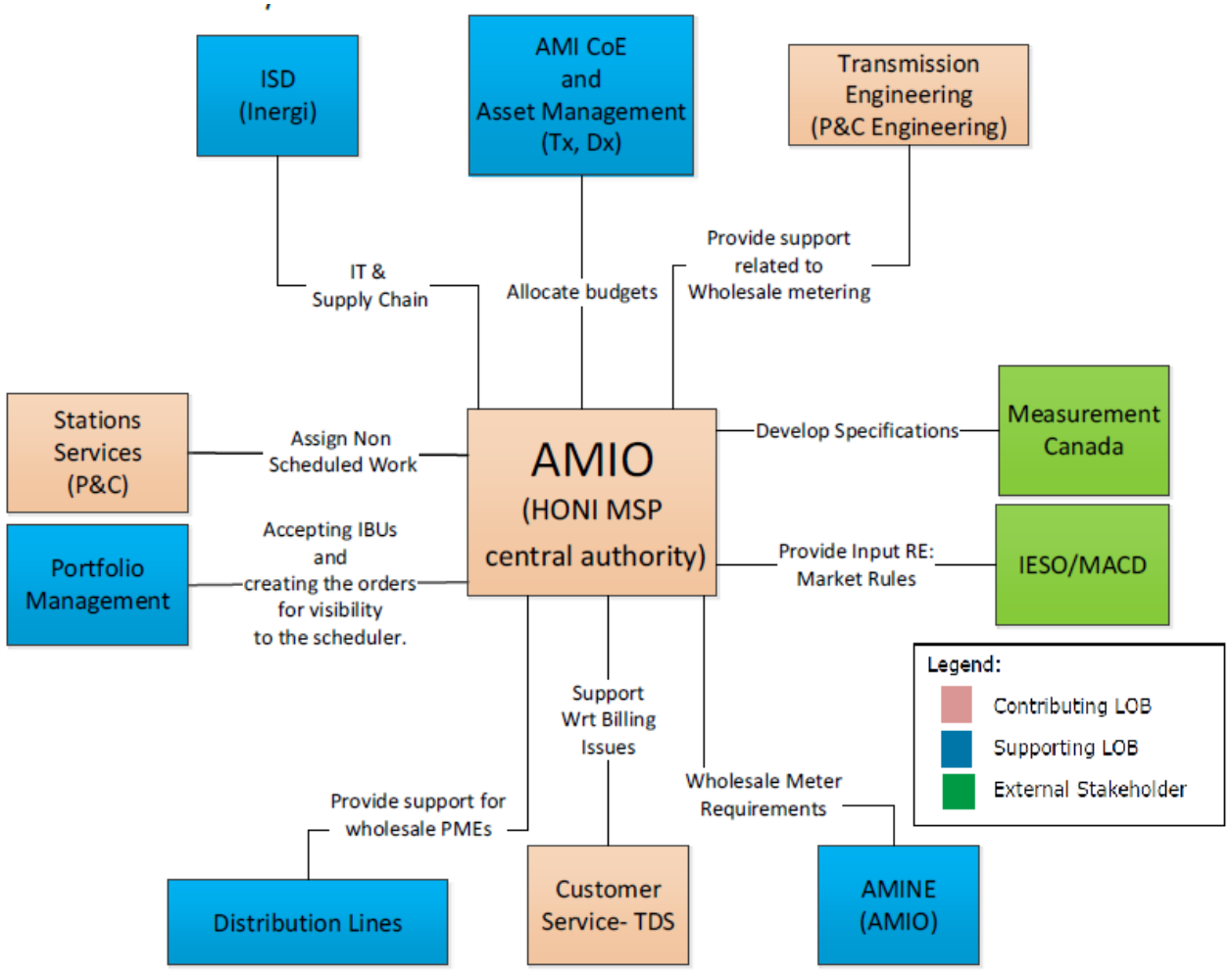
# Planned Work Programs

- Annual Meter Inspections (AMIs)
- 6 Year IT Spot Checks
- Meter Reseals
- IESO Tie Line Work
- Post Commissioning
- IESO Audits

# Responsive Work/Projects

- PCB IT replacements
- ABB IT replacements
- Westinghouse DVT150 replacements
- Emergency Instrument Transformer Restoration Plans (EITRPs)
- BGAN TCP/IP Communication Upgrade
- Win10 MISOR and ION Setup

# Functional Relationships



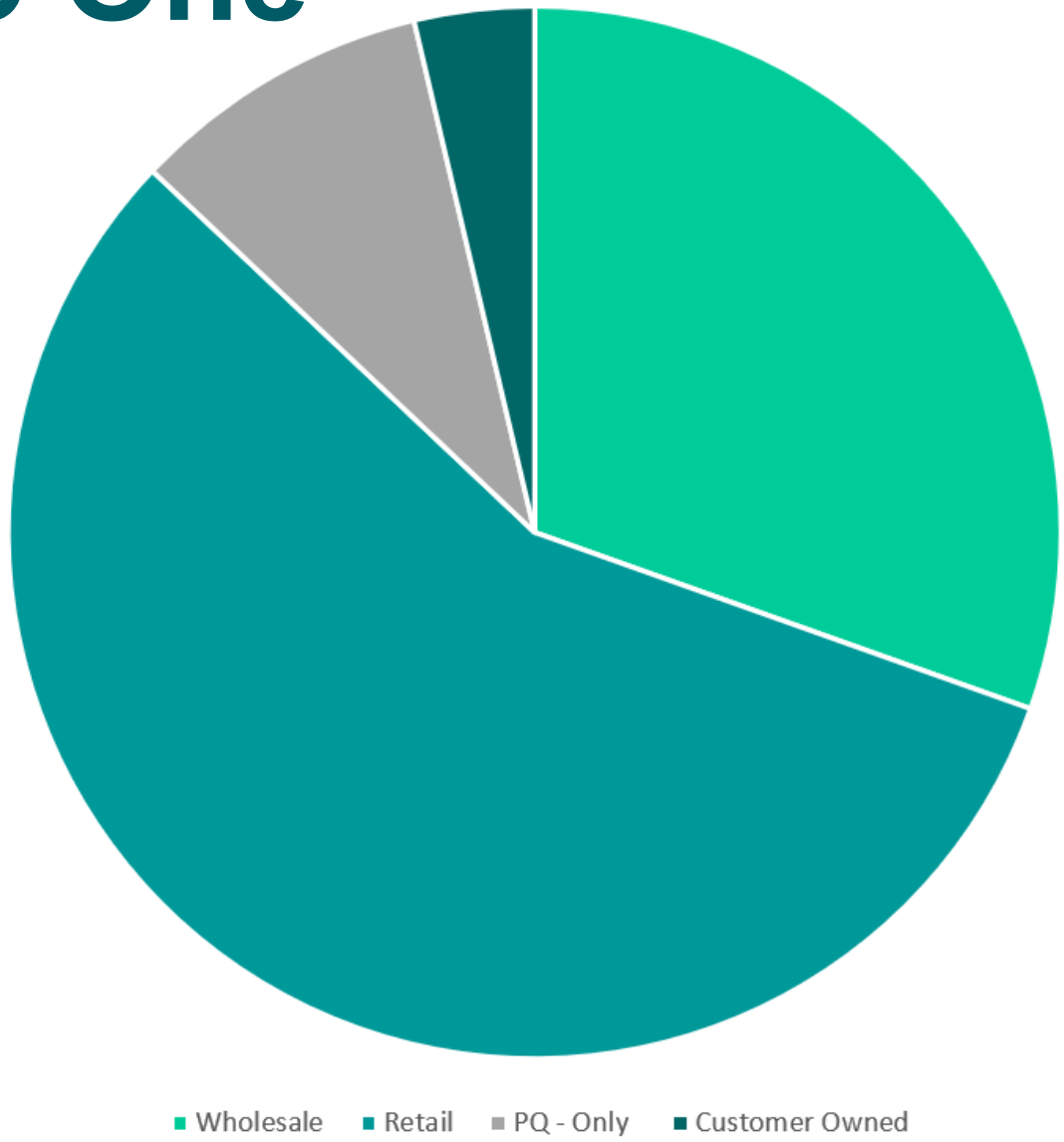

Station Services
Northern
Central
Eastern
Western
MARTINDALE TS
TROUT LAKE TS
HAWTHORNE TS
MERIVALE TS
ST. LAWRENCE TS
Georgian Bay
Lake Huron
ESSA TS
BRUCE A TS
CAMPBELLFORD SC
FRONTENAC TS
BELLEVILLE TS
CHERRYWOOD TS
BOWMANVILLE SS
RICHVIEW T.S.
LEASIDE TS
Lake Ontario
TRAFALGAR TS
MANBY TS
GTA
DETWEILER TS
BURLINGTON TS
ALLANBURG TS
SCOTT TS
BUCHANAN E.V. TS
Hamilton
Nanticoke
KEITH TS
Lake Erie
Legend
Work Centres
Kenora S.C.
Thunder Bay S.C.
TIMMINS TS
Lake Superior
MARTINDALE TS
TROUT LAKE TS
Scale of Kilometres
Produced by GIS Services
Date: November 2002

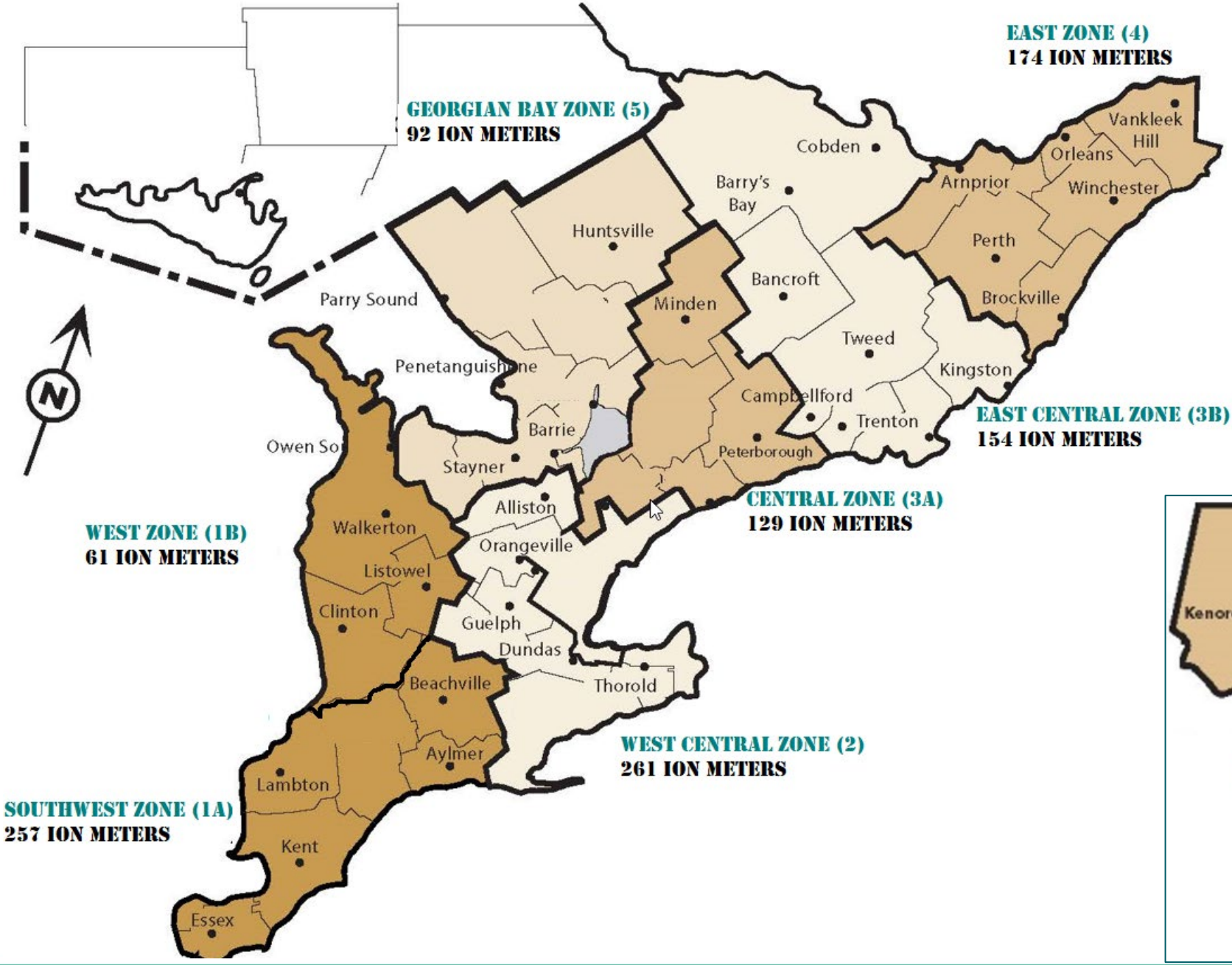
# AMI Complex Metering
# Power Quality Metering

# PQ meters at Hydro One

## ION 8650 and 8600 A type meters

- Wholesale – 421 (of the 429)
- Retail – 783
- PQ only – 128
- Customer Owned – 51




EAST ZONE (4)
174 ION METERS
GEORGIAN BAY ZONE (5)
92 ION METERS
Cobden
Barry's Bay
Arnprior
Vankleek Hill
Orleans
Winchester
Perth
Brockville
Huntsville
Bancroft
Minden
Parry Sound
Tweed
Kingston
Penetanguishene
Campbellford
Trenton
Barrie
Peterborough
Owen So
Stayner
Alliston
Orangeville
EAST CENTRAL ZONE (3B)
154 ION METERS
CENTRAL ZONE (3A)
129 ION METERS
WEST ZONE (1B)
61 ION METERS
Walkerton
Listowel
Clinton
Guelph
Dundas
Thorold
Beachville
Aylmer
Lambton
Kent
Essex
WEST CENTRAL ZONE (2)
261 ION METERS
SOUTHWEST ZONE (1A)
257 ION METERS
Dryden
Kenora
Moosonee
Geraldton
Fort Frances
Marathon
Kapuskasing
Thunder Bay
Timmins
Kirkland Lake
NORTHWEST ZONE (7)
87 ION METERS
New Liskeard
Algoma
Sudbury
Nipissing
NORTHEAST ZONE (6)
173 ION METERS

# PQ meters at Hydro One

**Threshold to qualify for an ION meter**

1. All Wholesale Revenue Meter (WRM) Installations (excluding tie-line meter-points)
2. Transmission (Tx) stations without WRM may have standalone PQ meters (non-revenue)
3. Distribution (Dx) Generation >250KW
4. Dx Load displacement >500KW
5. Dx Large distribution accounts >2MVA
6. Tx connected customers (optional)

# PQWeb Program

Tx connected customers have option to participate under the PQ Web program (customer owned metering is leveraged for PQ).

**Step 1**
**HONI and Customer**

Review details of site and meter

**Step 2**
**Customer**

Submit request to IESO

**Step 3**
**HONI**

Ships modem

**Step 4**
**MSP**

Installation

**Step 5**
**HONI**

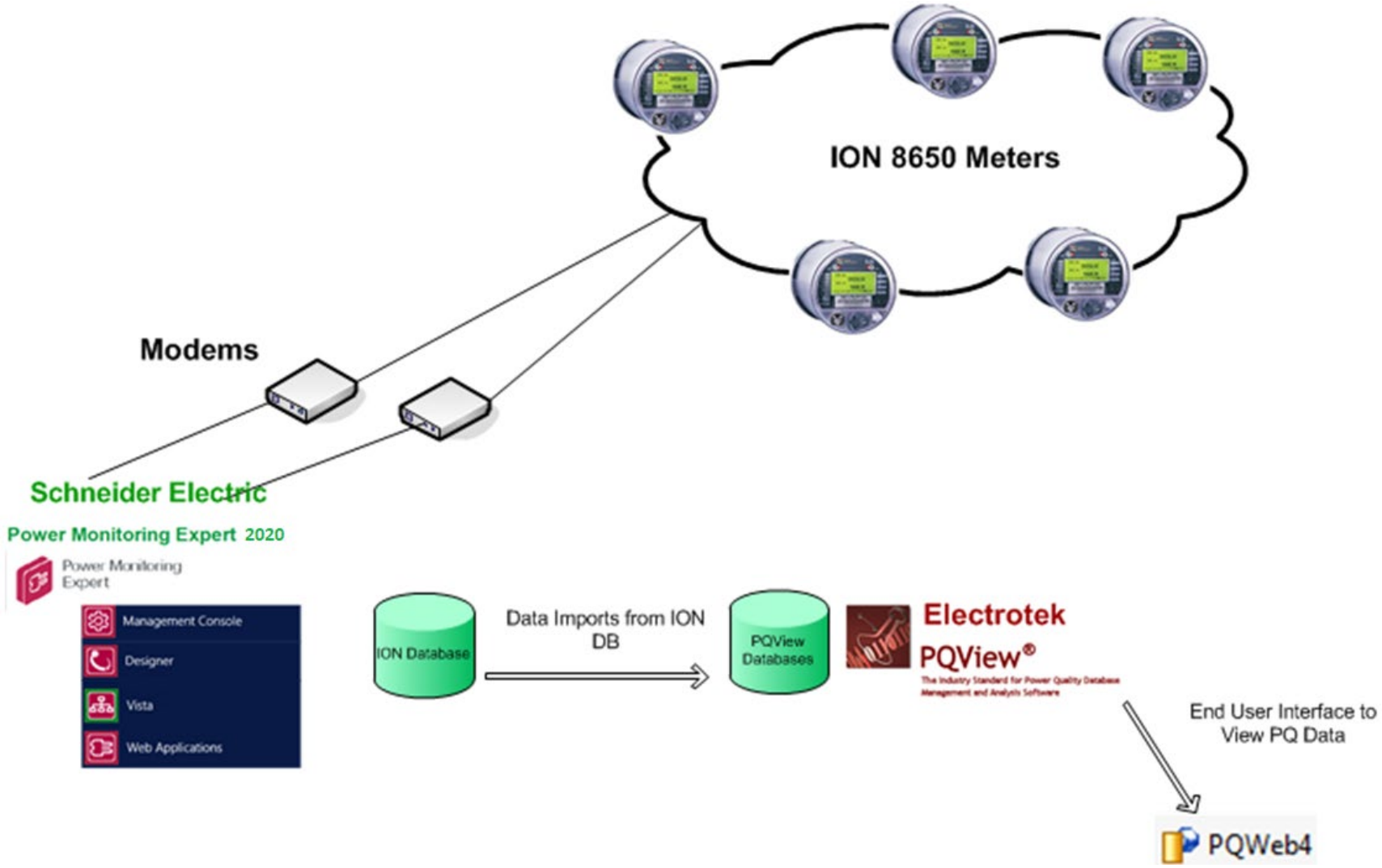
Test Communication

**Skip if**

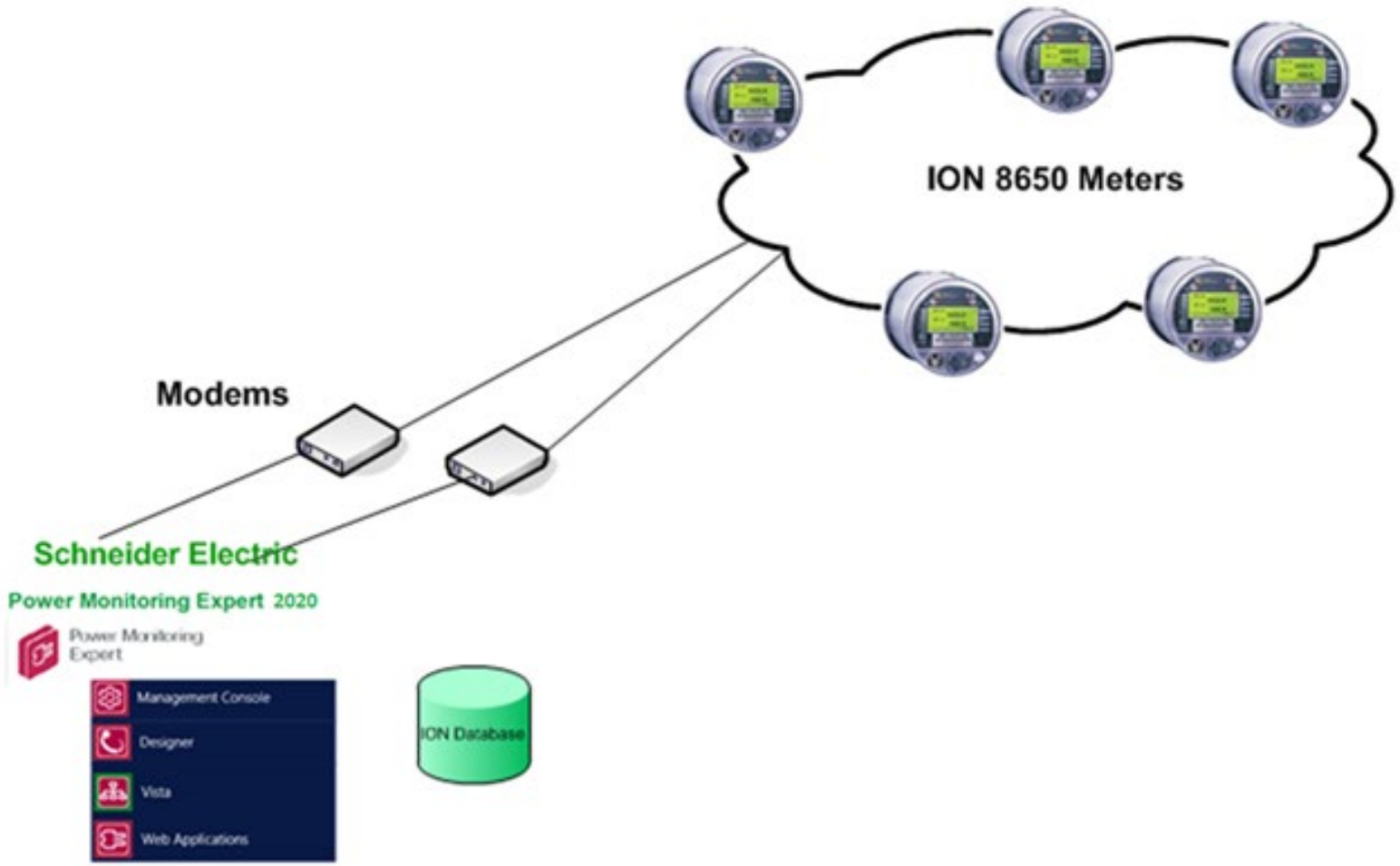
Established VPN with HONI

# Our PQ Architecture

# PQ Architecture



# PQ Architecture



# Power Monitoring Expert (PME2020)

# Power Monitoring Expert (PME 2020)

**Management Console**

**Designer**

**Vista**


**Web Application**

# Power Monitoring Expert (PME 2020)

## Management Console

Allows you to add and remove ION meter sites

- Add Ethernet, direct, or serial sites.
- This is where the data retrieval from the meters occur
- The retrieved data is stored in the Database Server
- Retrieved data can be used by other third-party applications (E.g., PQView)

# Power Monitoring Expert (PME 2020)

## Designer

A visual representation of the advance view of ION Setup.

- Allows you to configure setup registers and create frameworks on ION meter.
- You can see the links between various inputs and outputs.

# Power Monitoring Expert (PME 2020)

## Vista

Allows you to configure the interface that shows many measured quantities in the meter

- Set-up default view for end-user for all sites
- See data logs from various tables in the meter

# Power Monitoring Expert (PME 2020)

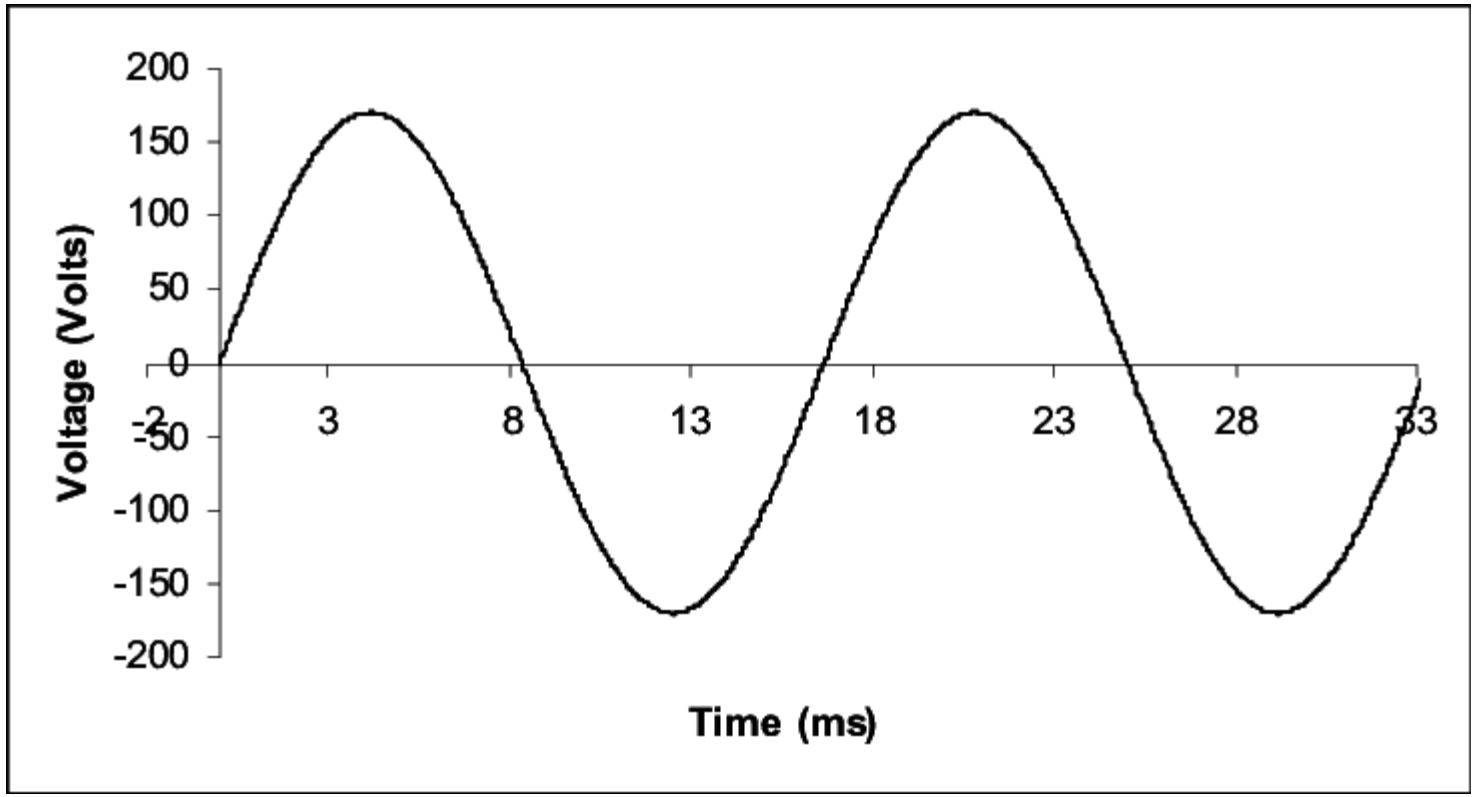

## Web Application

This is for the end-users

- Diagrams
- Dashboard
- Trends
- User Manager
- Configuring email alert

# Common PQ Challenges

# Ideal Scenario



# What aspects of Power Quality are monitored?

Following are some of the common PQ challenges:

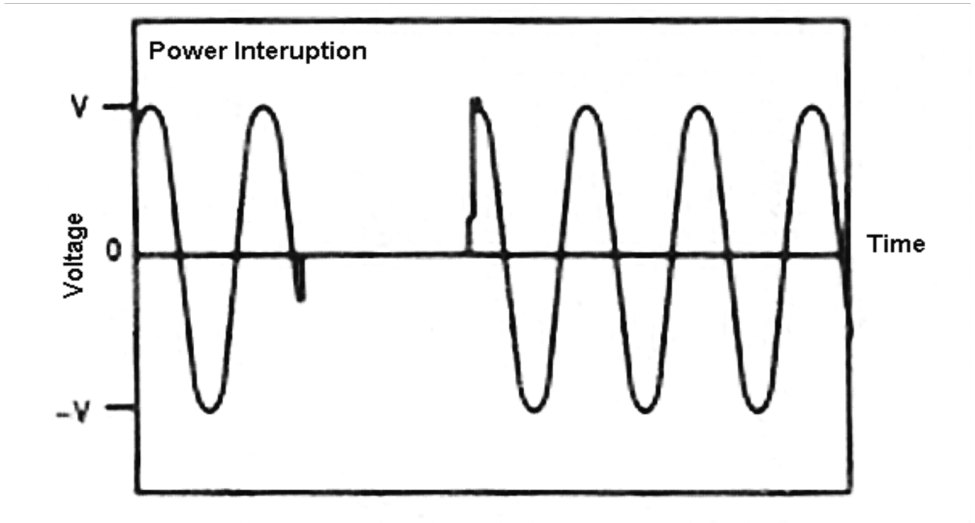
- Service Interruptions
- Voltage Sags
- Transients
- Harmonics
- Flicker

The ION meters help identify these issues using the event waveform.

# Service Interruption

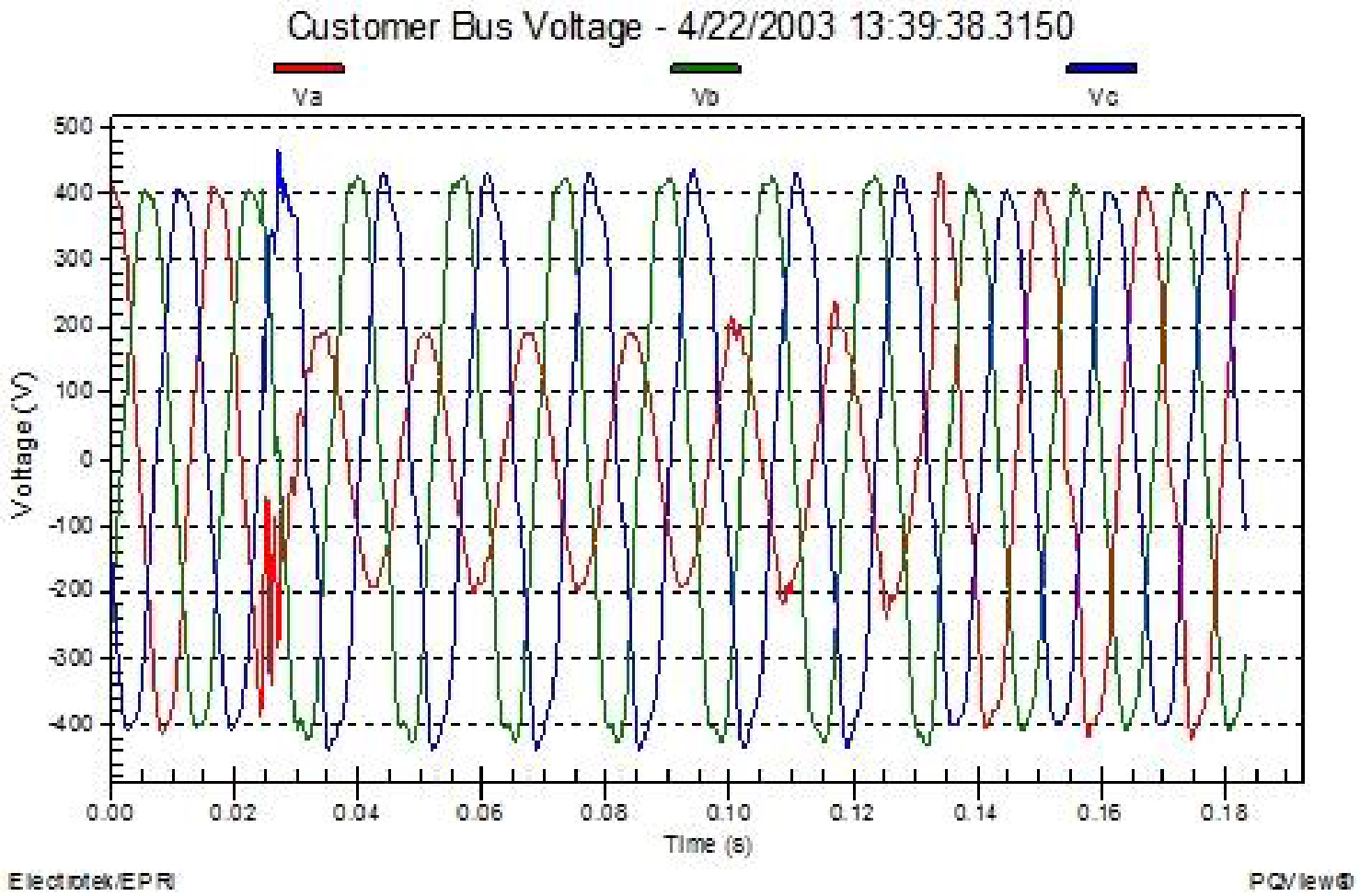
- Instantaneous (less than .5 sec)
- Momentary (.5 sec to 3 seconds)
- Temporary (3 seconds to 1 minute)
- Sustained Outage (Less than 10% voltage lasting more than a minute.)

Caused by faults or operation of protective devices.



# Voltage Sag

- Duration
  - 1 cycle to 120 cycles
- Caused by:
  - Faults on the system
  - Starting large loads



# Transients

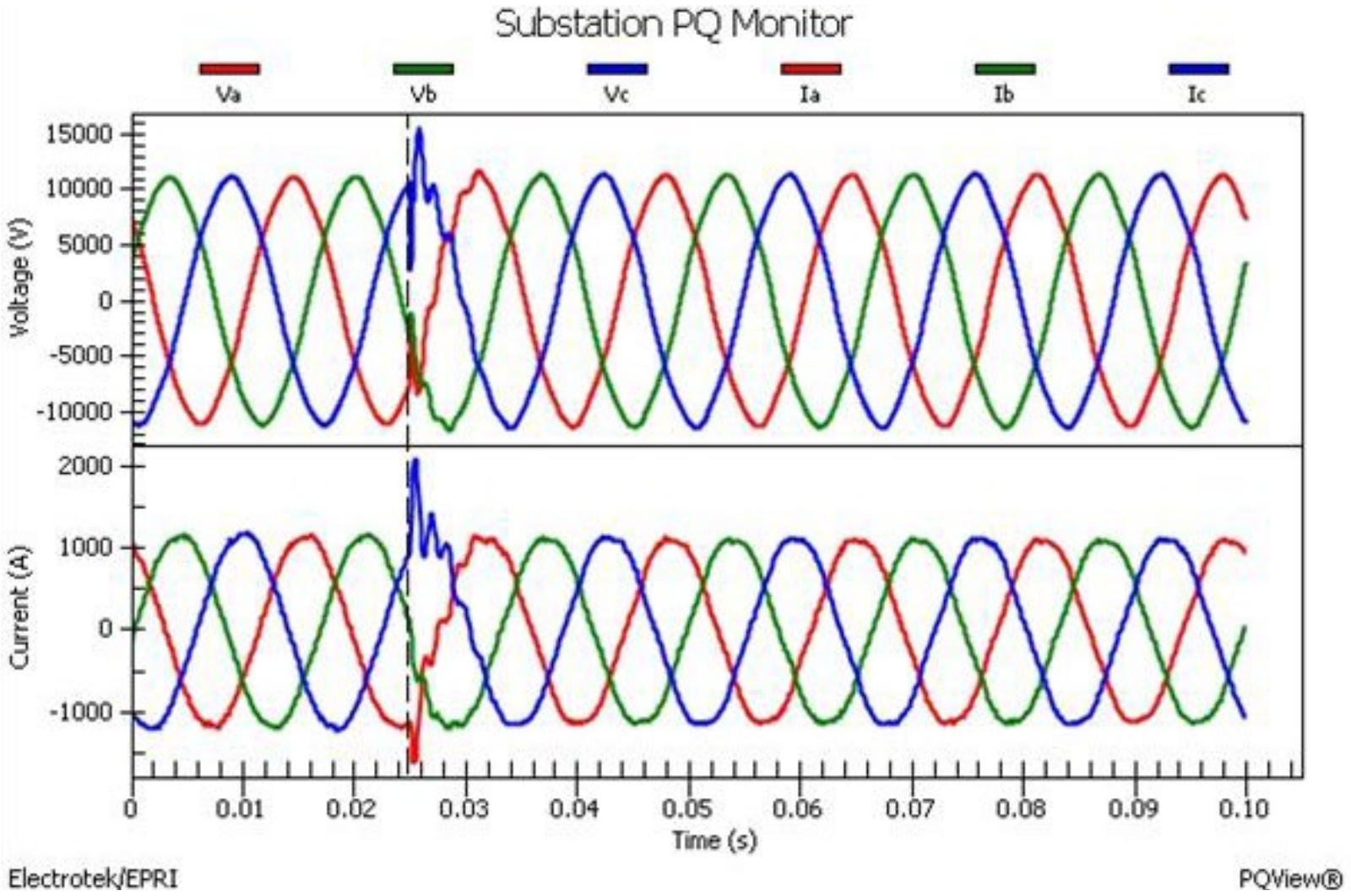
Causes:

- Equipment switching operations or lightning strikes
- Switching (energizing) of utility shunt capacitor banks

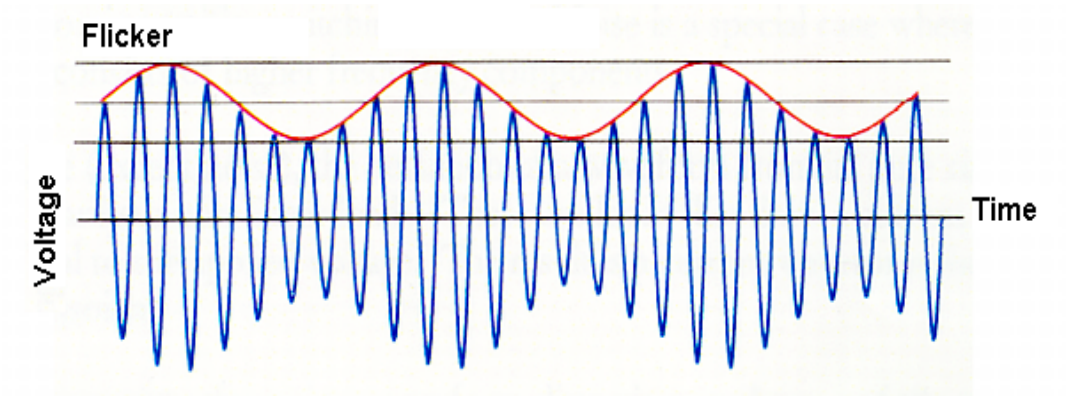
Impact:

- Equipment mis-operation and failure
- Nuisance tripping of power-electronic equipment

# Transients


Substation PQ Monitor
Va
Vb
Vc
Ia
Ib
Ic
15000
10000
5000
0
-5000
-10000
Voltage (V)
2000
1000
0
-1000
Current (A)
0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.10
Time (s)
Electrotek/EPRI
PQView®

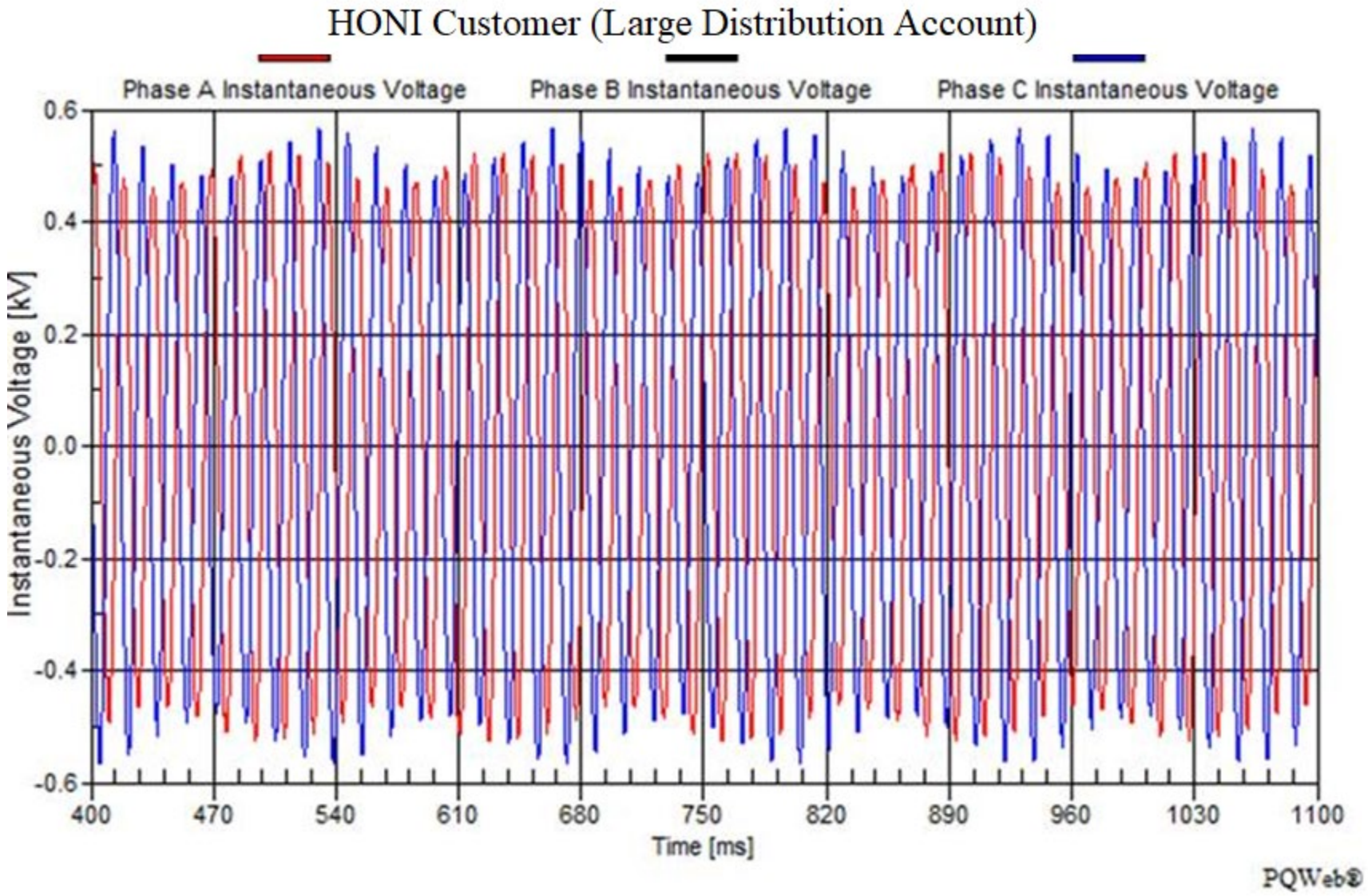
# Flicker




Cause:
Variation in amplitude of voltage caused by linear or non-linear loads drawing high and varying load currents

Impact:
- Visual irritation
- Equipment mis-operation/damage

# Flicker


HONI Customer (Large Distribution Account)
Phase A Instantaneous Voltage
Phase B Instantaneous Voltage
Phase C Instantaneous Voltage
Instantaneous Voltage [kV]
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
400
470
540
610
680
750
820
890
960
1030
1100
Time [ms]
PQWeb®

# Utilizing ION meters

## Scenario 1
## Customized monitoring

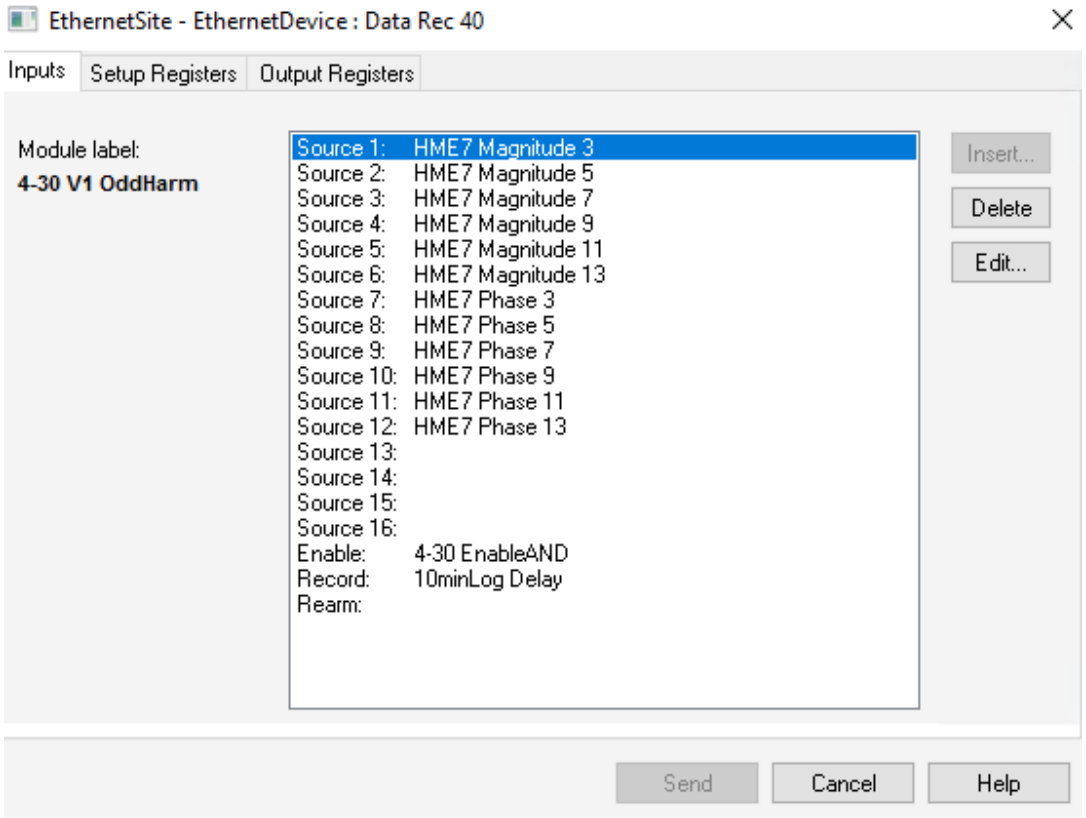
# Harmonics Logging

- HONI PQ Framework in ION meters does not have following harmonics logging
  - $3^{rd}$, $5^{th}$, $7^{th}$, $9^{th}$, $11^{th}$, $13^{th}$ (voltages and currents)
- Instantaneous values can be seen via ION setup or Vista
- In one instance, Hydro One Special Studies LOB requested to log these values for a specific site investigation
- Challenge
  - This requires **72** tables
    - Each odd harmonic = 6
    - Magnitude and phase table = 2
    - Voltage and Current = 2
    - Each phase = 3
    - **6 x 2 x 2 x 3 = 72**
  - Make the logs accessible for requester.

# Harmonics Logging

**Solution:**

Use Data Rec Module of your ION meter to create logs

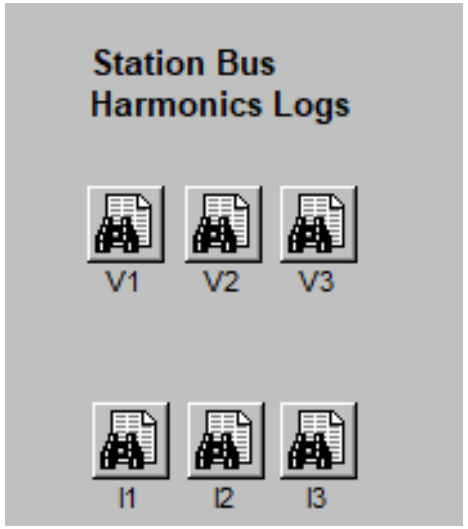




For instructions: See ION Reference Guide

# Harmonics Logging

**Solution:**

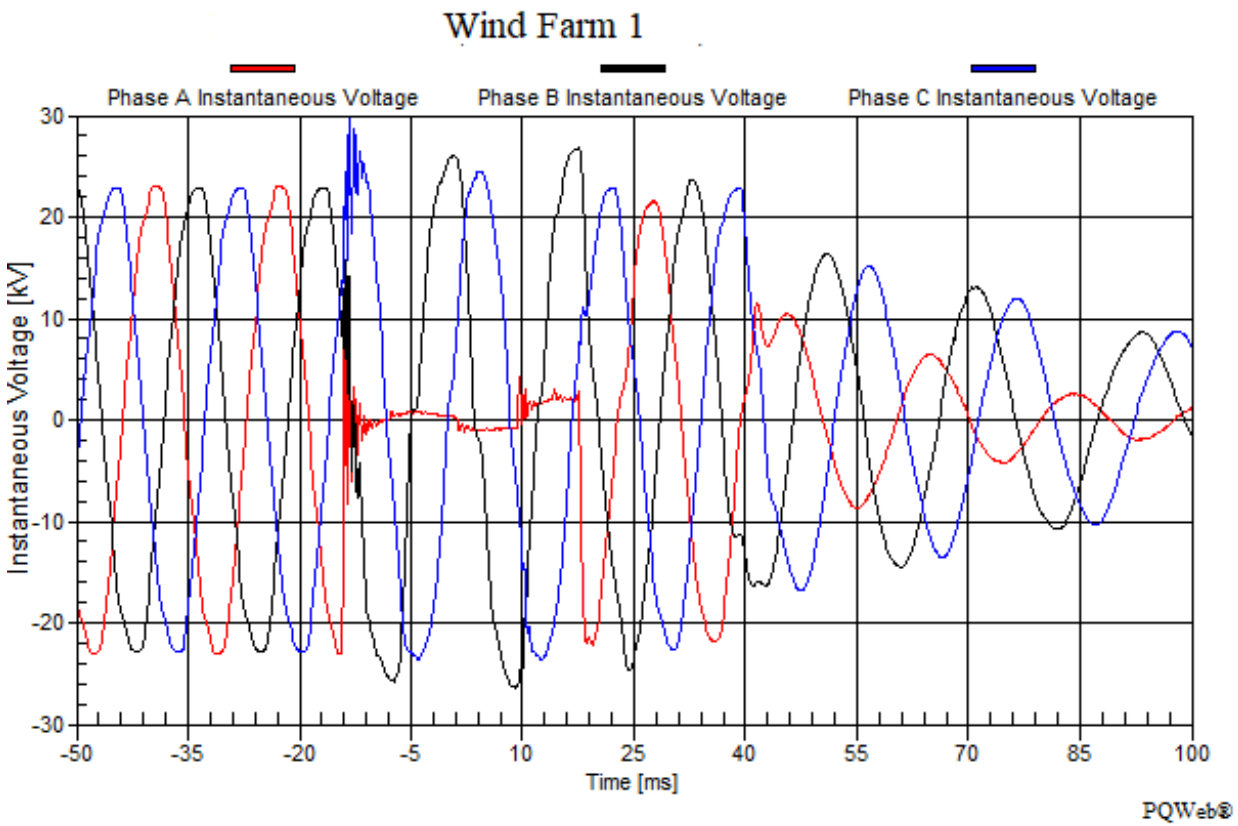
Use PME Vista to make logs accessible

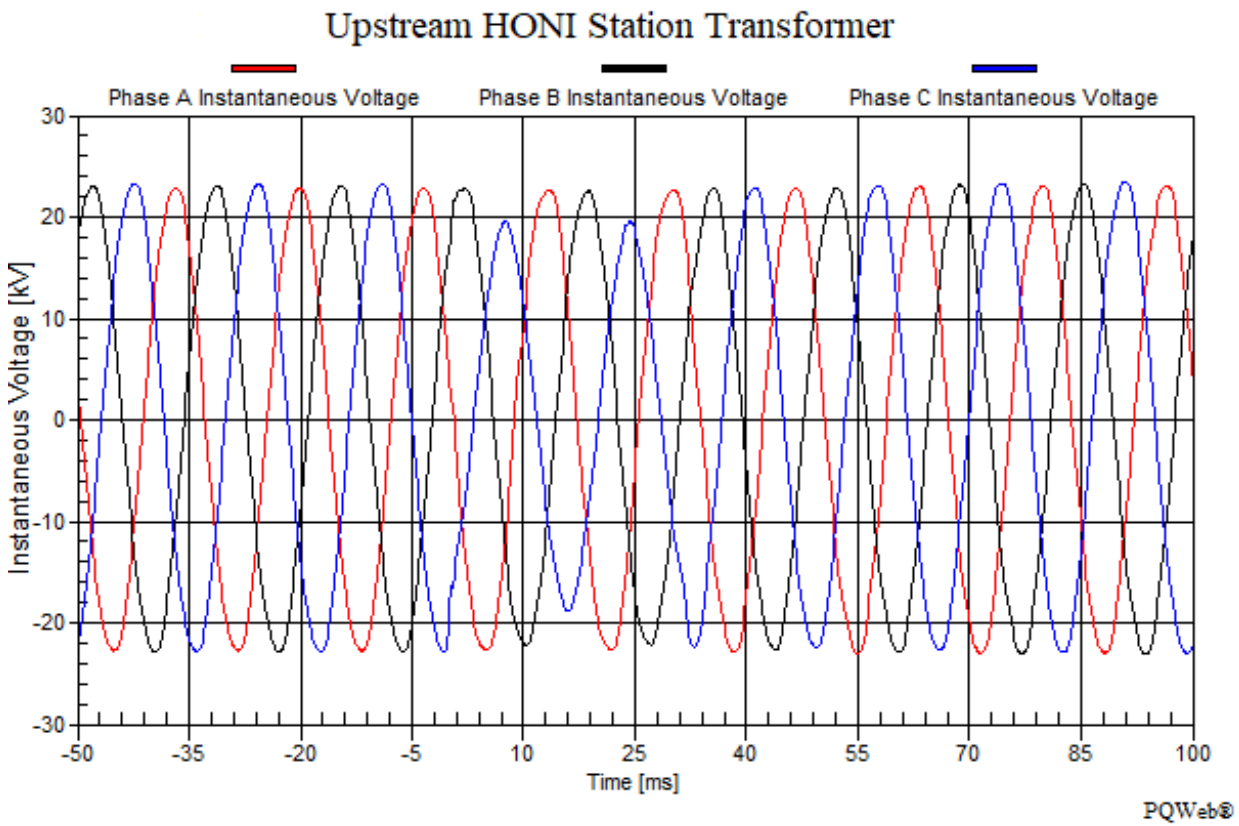


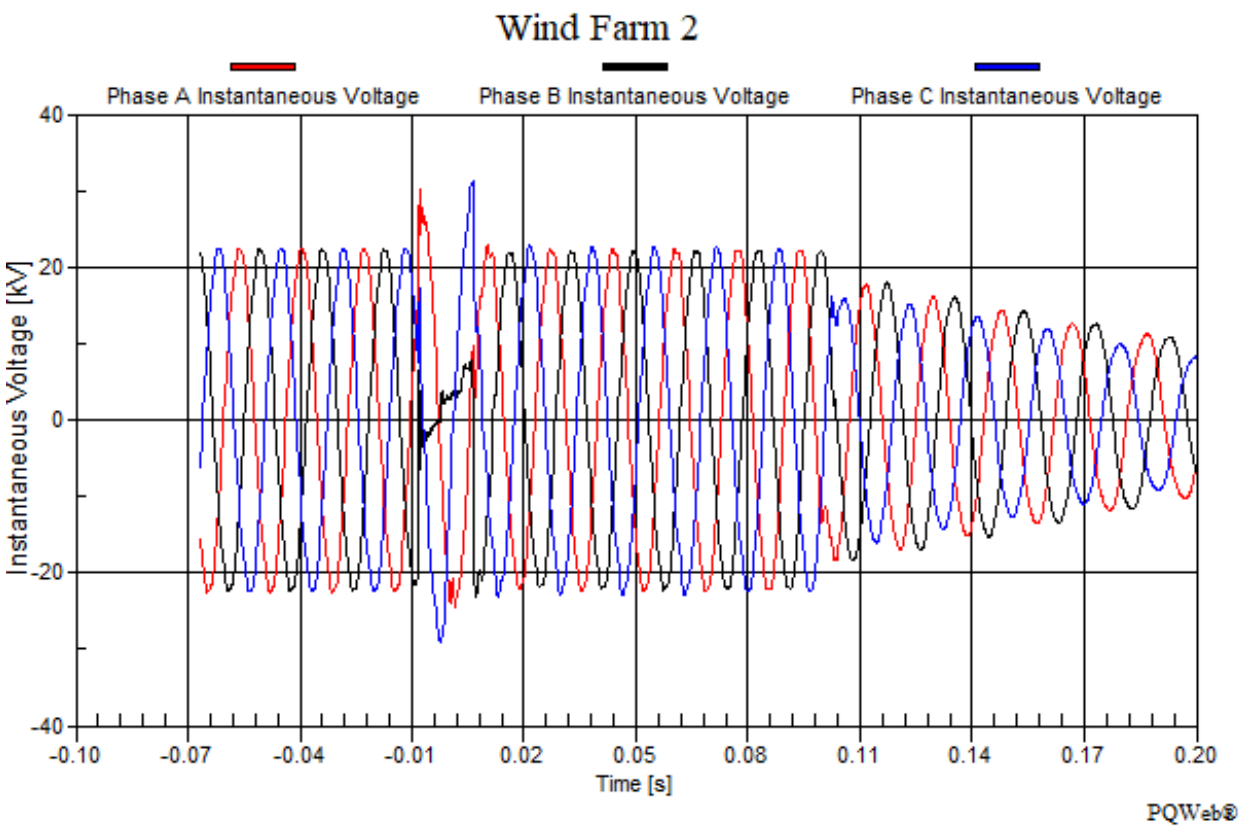

| Timestamp | HME7 Magnitude 3 | HME7 Phase 3 | HME7 Magnitude 5 | HME7 Phase 5 | HME7 Magnitude 7 | HME7 Phase 7 | HME7 Magnitude 9 | HME7 Phase 9 | HME7 Magnitude 11 | HME7 Phase 11 | HME7 Magnitude 13 | HME7 Phase 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10/20/2022 04:40:01.000 PM | 1.55 | 85.948 | 1.289 | -166.267 | 0.3 | -95.41 | 0.636 | 148.02 | 0.149 | 155.669 | 0.03 | -149.444 |
| 10/20/2022 04:30:01.000 PM | 1.532 | 85.99 | 1.274 | -166.332 | 0.298 | -95.006 | 0.642 | 148.452 | 0.138 | 156.864 | 0.03 | -141.17 |
| 10/20/2022 04:20:01.000 PM | 1.535 | 85.829 | 1.283 | -166.055 | 0.302 | -96.761 | 0.639 | 149.018 | 0.14 | 157.536 | 0.037 | -138.702 |
| 10/20/2022 04:10:01.000 PM | 1.53 | 85.927 | 1.283 | -165.37 | 0.313 | -97.07 | 0.641 | 148.834 | 0.14 | 157.704 | 0.042 | -132.865 |
| 10/20/2022 04:00:01.000 PM | 1.518 | 85.976 | 1.313 | -165.039 | 0.315 | -95.526 | 0.633 | 148.826 | 0.143 | 156.807 | 0.03 | -133.078 |
| 10/20/2022 03:50:01.000 PM | 1.502 | 86.549 | 1.309 | -164.856 | 0.312 | -94.006 | 0.633 | 148.894 | 0.14 | 155.823 | 0.03 | -127.163 |
| 10/20/2022 03:40:01.000 PM | 1.504 | 86.77 | 1.318 | -165.37 | 0.305 | -95.842 | 0.646 | 149.178 | 0.148 | 154.264 | 0.021 | -139.868 |
| 10/20/2022 03:30:01.000 PM | 1.502 | 86.59 | 1.294 | -164.954 | 0.286 | -94.095 | 0.654 | 148.697 | 0.146 | 158.848 | 0.021 | -124.259 |
| 10/20/2022 03:20:01.000 PM | | 86.456 | 1.256 | -165.178 | 0.281 | -92.064 | 0.653 | 149.38 | 0.13 | 159.753 | 0.03 | -110.421 |
| 10/20/2022 03:10:01.000 PM | 1.49 | 86.79 | 1.252 | -164.923 | 0.291 | -89.662 | 0.657 | 150.025 | 0.13 | 162.411 | 0.037 | -100.852 |
| 10/20/2022 03:00:01.000 PM | 1.496 | 87.321 | 1.313 | -165.727 | 0.314 | -95.427 | 0.644 | 150.03 | 0.142 | 156.151 | 0.021 | -129.388 |
| 10/20/2022 02:50:01.000 PM | 1.493 | 87.357 | 1.339 | -165.95 | 0.308 | -97.138 | 0.646 | 149.616 | 0.146 | 155.068 | 0.03 | -126.705 |
| 10/20/2022 02:40:01.000 PM | 1.488 | 87.621 | 1.302 | -165.089 | 0.324 | -91.768 | 0.648 | 150.724 | 0.146 | 158.105 | 0.03 | -123.161 |
| 10/20/2022 02:30:01.000 PM | 1.497 | 87.67 | 1.273 | -165.547 | 0.321 | -91.527 | 0.648 | 151.021 | 0.132 | 160.336 | 0.03 | -116.471 |
| 10/20/2022 02:20:01.000 PM | 1.489 | 86.983 | 1.288 | -164.991 | 0.333 | -93.144 | 0.641 | 151.52 | 0.137 | 159.641 | 0.03 | -120.451 |
| 10/20/2022 02:10:01.000 PM | 1.503 | 86.732 | 1.268 | -165.14 | 0.337 | -93.567 | 0.632 | 151.523 | 0.127 | 159.027 | 0.03 | -123.047 |
| 10/20/2022 02:00:01.000 PM | 1.505 | 86.953 | 1.263 | -164.552 | 0.342 | -90.109 | 0.646 | 151.406 | 0.142 | 160.398 | 0.037 | -117.208 |

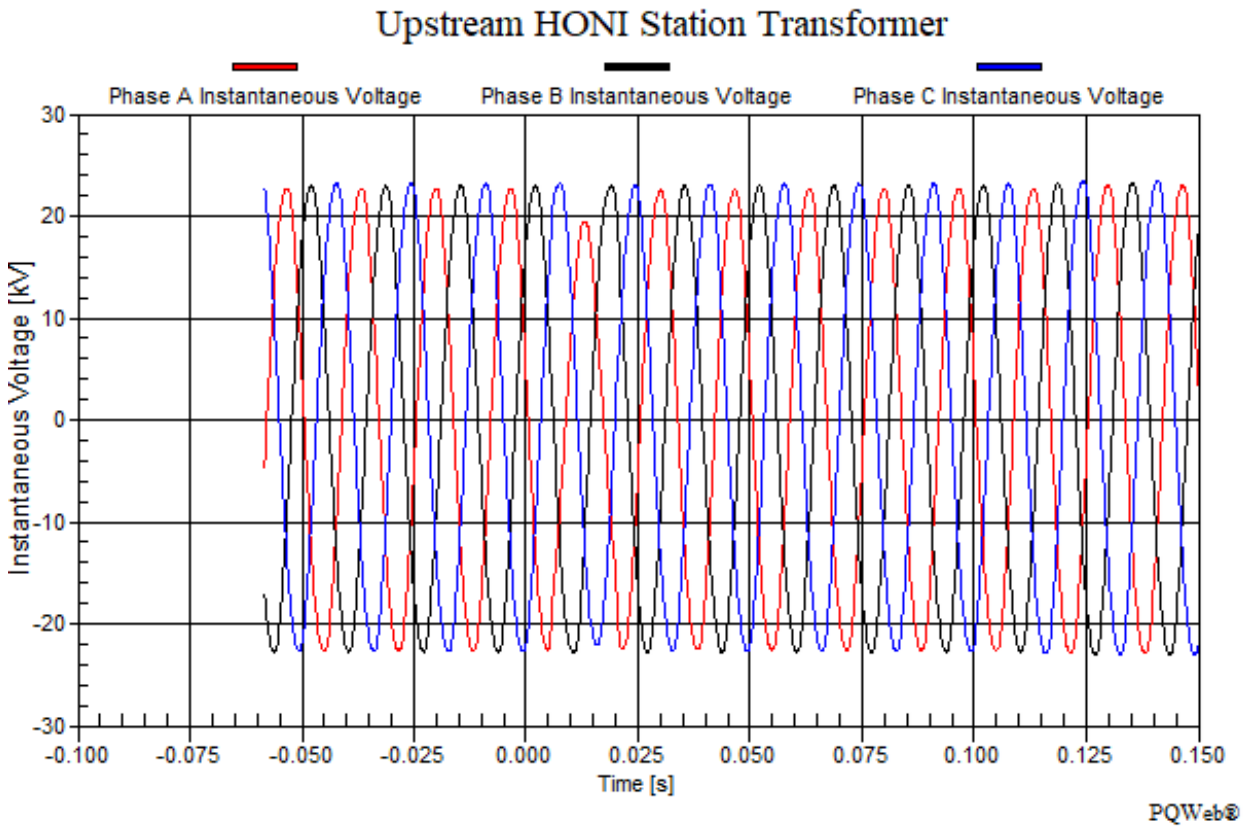
# Utilizing ION meters

## Scenario 2
## Identifying rare circumstances


Wind Farm 1
Phase A Instantaneous Voltage
Phase B Instantaneous Voltage
Phase C Instantaneous Voltage
Instantaneous Voltage [kV]
30
20
10
0
-10
-20
-30
-50
-35
-20
-5
10
25
40
55
70
85
100
Time [ms]
PQWeb®


Upstream HONI Station Transformer
Phase A Instantaneous Voltage
Phase B Instantaneous Voltage
Phase C Instantaneous Voltage
Instantaneous Voltage [kV]
30
20
10
0
-10
-20
-30
-50
-35
-20
-5
10
25
40
55
70
85
100
Time [ms]
PQWeb®


Wind Farm 2
Phase A Instantaneous Voltage
Phase B Instantaneous Voltage
Phase C Instantaneous Voltage
Instantaneous Voltage [kV]
40
20
0
-20
-40
-0.10
-0.07
-0.04
-0.01
0.02
0.05
0.08
0.11
0.14
0.17
0.20
Time [s]
PQWeb®


Upstream HONI Station Transformer
Phase A Instantaneous Voltage
Phase B Instantaneous Voltage
Phase C Instantaneous Voltage
Instantaneous Voltage [kV]
30
20
10
0
-10
-20
-30
-0.100
-0.075
-0.050
-0.025
0.000
0.025
0.050
0.075
0.100
0.125
0.150
Time [s]
PQWeb®

# Disadvantages of using ION meter

# $$$$$

## -End of List-

# Thank you

For more information, please contact us at

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and

Ali.Ahmed@HydroOne.com