The Power of Digitization:
Implementing a PQM system on a WWTP (Metro Vancouver)

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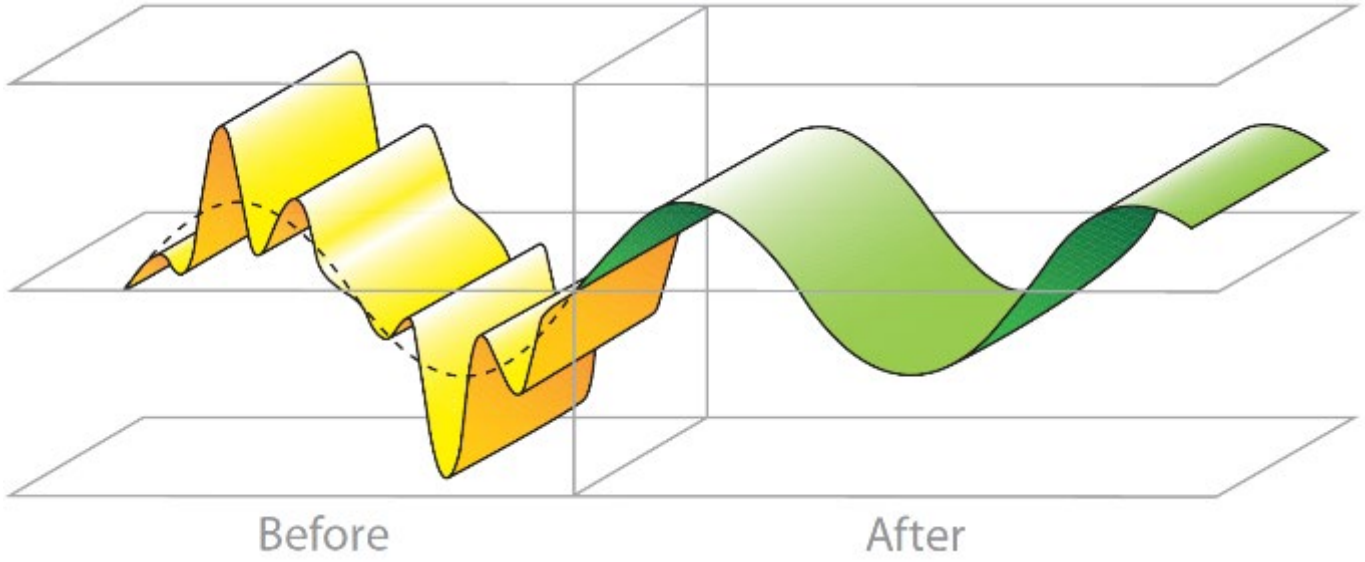
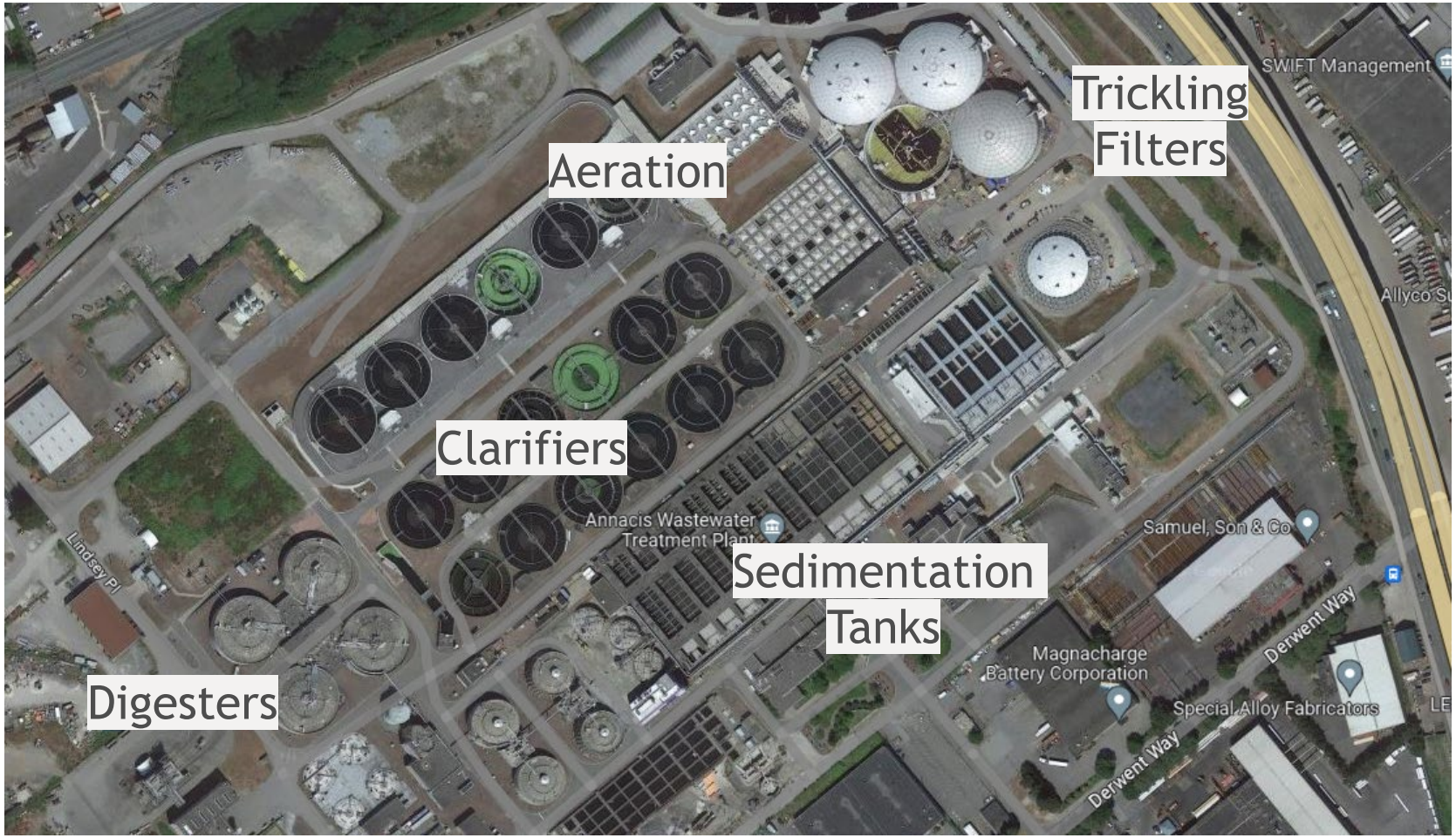
Agenda

1. Why
2. What
3. How

Power Quality Monitoring System



Annacis Island WWTP



Equipment

- Pumps
- Fans
- Drives
- Automation
- Lab equipment

Power

- Good Power

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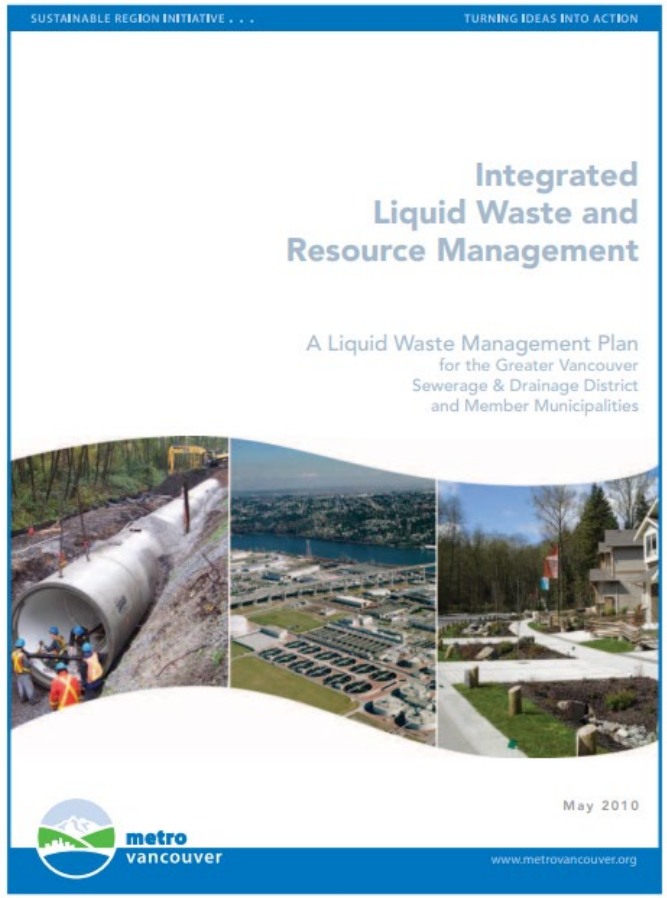
Liquid Waste Management Plan - 2010

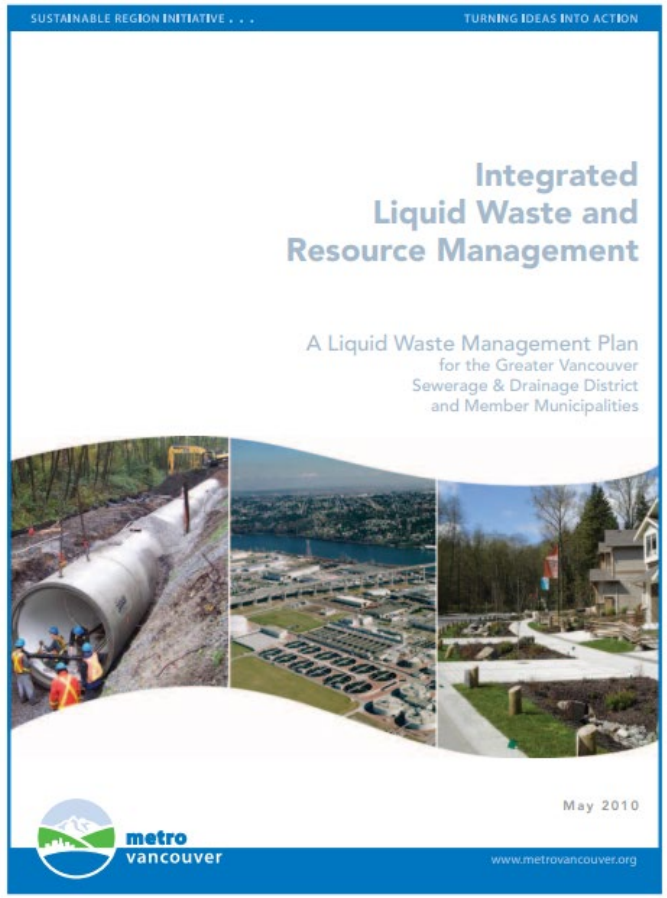


Goal 1: Protect public health and the environment

Goal 2: Use liquid waste as a resource

Goal 3: Effective, affordable and collaborative management

Liquid Waste Management Plan - 2010



Goal 1: Protect public health and the environment

STRATEGY 1.3

Reduce environmental impacts from liquid waste management to a minimum

Metro Vancouver and municipalities will maintain and operate their liquid waste infrastructure, make improvements to meet evolving regulatory requirements and reduce risks to the environment

METRO VANCOUVER WILL:

System Operation and Maintenance

1.3.1 Develop and implement operational plans for sewerage and wastewater treatment facilities to ensure infrastructure reliability and optimal performance. *Ongoing*

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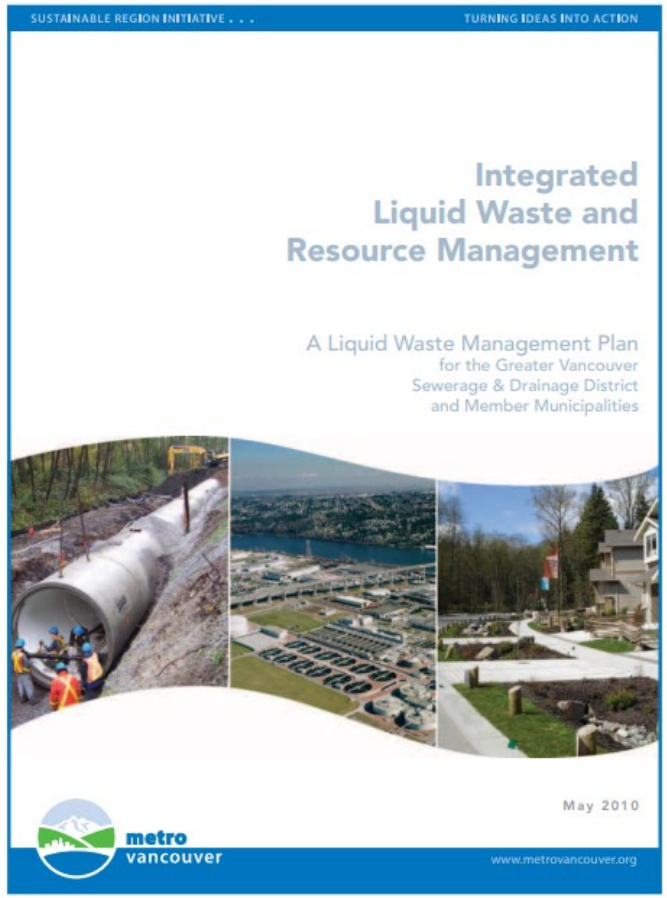
Liquid Waste Management Plan - 2010



Goal 2: Use liquid waste as a resource

STRATEGY 2.1

Pursue liquid waste resource recovery in an integrated resource recovery context

METRO VANCOUVER WILL:

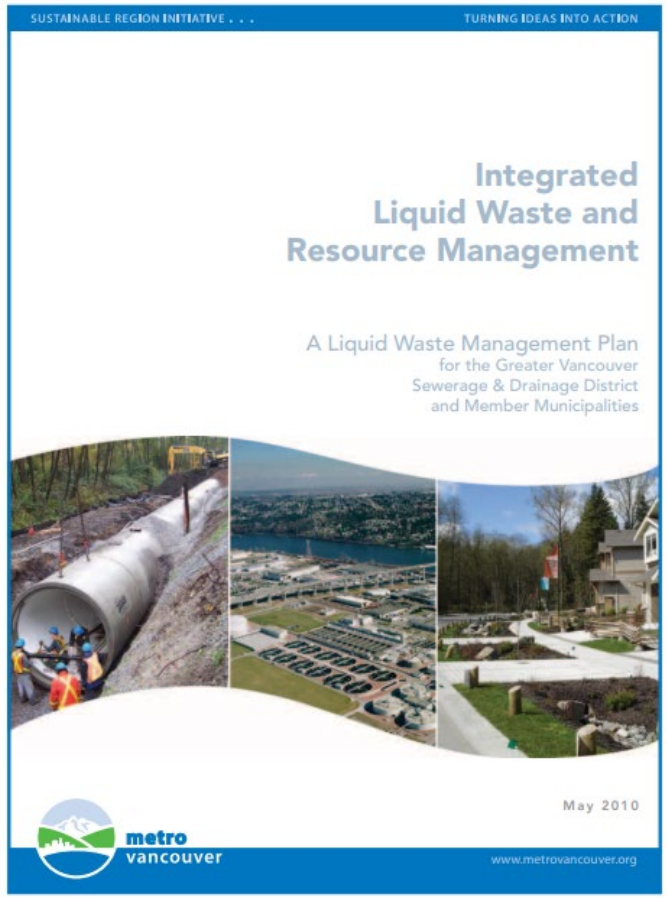
2.1.1 Assess each sewerage area using an integrated resource recovery business case model that: *2012*

(a) evaluates opportunities to expand the recovery of energy, nutrients and water from the liquid waste system

ENERGY

Gas from wastewater treatment processes is turned into electricity and heat for use in treatment plants

Liquid Waste Management Plan - 2010



Goal 3: Effective, affordable and collaborative management

STRATEGY 3.2

Use innovative approaches and technologies

This plan seeks improvement through innovation, using local research and development and adapting successes from elsewhere, to address pollutants of emerging concern, improve wastewater treatment, implement more sustainable stormwater management practices and reduce long-term financial burdens.

METRO VANCOUVER WILL:

3.2.1 With financial support from provincial and federal governments and the University of British Columbia, develop the Annacis Island Sustainability Academy to support innovative research and demonstration projects in liquid waste management. *Facility by 2011*

3.2.2 Collaborate with local and senior governments, academic institutions and industry in research on wastewater treatment technology and stormwater management and associated demonstration projects, training and development of educational toolkits. *Ongoing*

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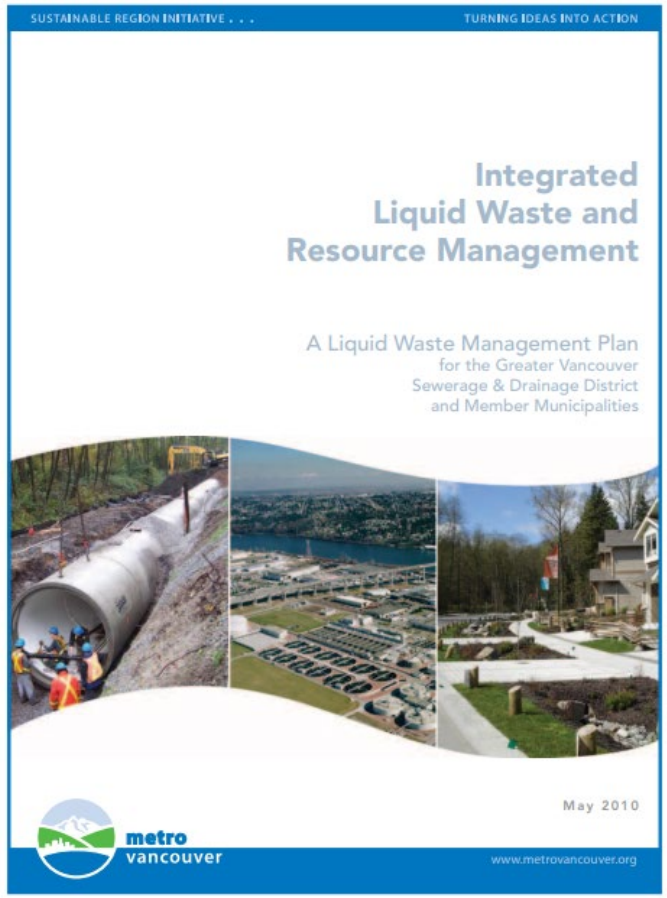
Liquid Waste Management Plan - 2010



Goal 1: Protect public health and the environment

Goal 2: Use liquid waste as a resource

Goal 3: Effective, affordable and collaborative management

8. Bypass conditions that occur at wastewater treatment plants will be reported out in the annual quality control report. The report on each activity will include a description of the event, cause, environmental effect and monitoring that occurred and any mitigation measures undertaken to prevent reoccurrence and remediate detrimental environment effect.

Minister of Environment, Terry Lake, 2011

2021 – Environment Management and Quality Control Annual Report

TABLE 3.4 ANNACIS ISLAND WWTP – CATEGORY 1 EVENTS REPORTED TO THE MOECCS

Plant	Date	Description	Quantity Discharged	Duration	Probable Cause	Mitigation Measures	Potential Environmental Effects
Annacis Island	Apr 21	Secondary clarifier influent discharge	Approximately 15,110 litres	20.2 minutes	Power disruption stopped operation of a sump pump installed in a manhole to collect intermittent flow of secondary clarifier influent to another portion of the plant for treatment.	Restored power to sump pump installed at the manhole.	Adverse effects to flora and to aquatic and terrestrial habitats were not observed. Fauna were not observed.
Annacis Island	May 27	Discharge of treated wastewater that may not have been fully disinfected **	2.05 million litres	6.02 minutes	Loss of power from BC Hydro.	Not applicable	The applicable Health Canada Recreational Water Quality Guidelines were predicted to have been met at designated primary recreation areas. The applicable BC MOECCS Water Quality Guidelines for fecal coliforms were predicted to have been met at known registered water license diversion points. The applicable BC MOECCS Ambient Water Quality Guideline for chlorine were expected to have been met in the Fraser River.*

TABLE 4.3 IONA ISLAND WWTP – CATEGORY 1 EVENTS REPORTED TO THE MOECCS

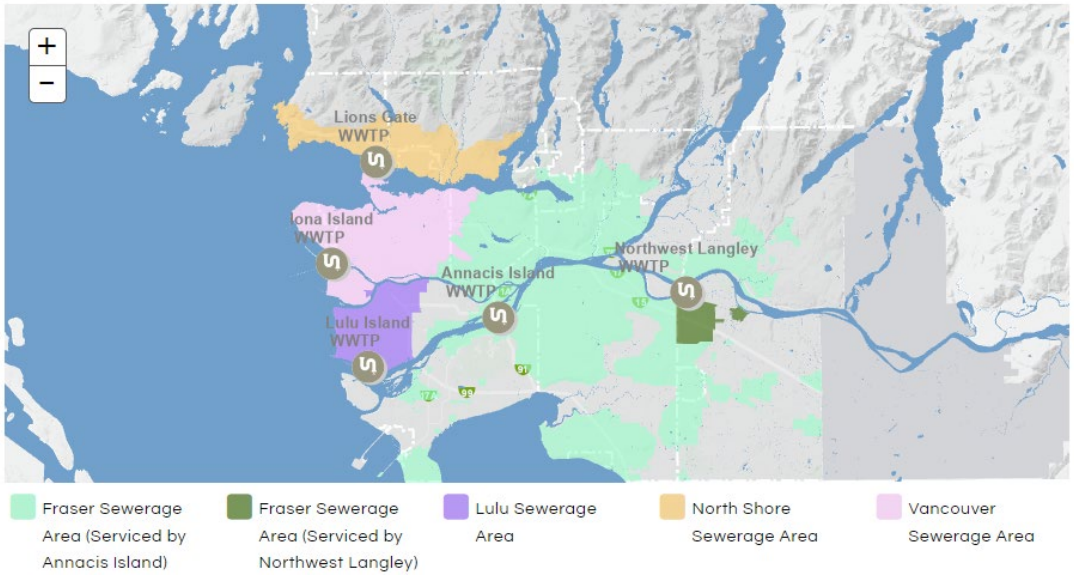
Plant	Date	Description	Quantity Discharged	Duration	Probable Cause	Mitigation Measures	Potential Environmental Effects
Iona Island	Jan 3	Municipal wastewater discharge	Approximately 62,000 litres	1311.8 minutes	Heavy rainfall caused intermittent leaks from the effluent conduit.	Repaired leaks at expansion joints.	The applicable water quality guidelines for the protection of estuarine or marine aquatic life we met. Adverse effects to flora and to aquatic and terrestrial habitats were not observed. Fauna were not observed.
Iona Island	Jan 12	Municipal wastewater discharge	Approximately 2,090,000 litres	106.6 minutes	Reset of a backup communication device unexpectedly affected electrical system, resulting in power interruptions which led to emergency closure of WWTP influent gates.	Restored power. Completed pipeline inspection. Confirmed that no overflows were noted in other areas.	The applicable water quality guidelines for the protection of estuarine or marine aquatic life we met with the exception of pH. It is unclear if observed pH is attributable to the overflow event, or to freshwater inputs to the Fraser River North Arm at sampling site from nearby Musqueam Creek, which are anticipated to be slightly more acidic than

PQM - Project History

1. MV – RFP – 2017

Power Quality Monitoring System

The PQM system will be used for power quality monitoring, disturbance investigation, and energy management monitoring and data recording, for installation at key locations throughout the five Wastewater Treatment Plants (WWTP) electrical distribution systems in the Metro Vancouver area.



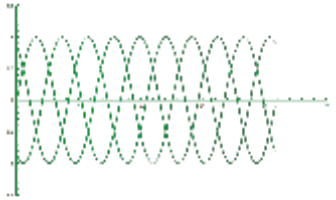
Power Quality - Definition

- Power Quality is the degree to which both the utilization and delivery of electric power affects the performance of electrical equipment.

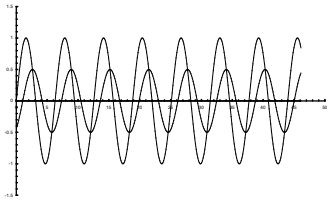
- Any deviation to the magnitude or frequency of the ideal sinusoidal voltage waveform can be regarded as a Power Quality disturbance.

- Performance measures and operating guidelines for electrical equipment may be defined in standards, policies and procedures (IEEE, IEC 61000 4-30, etc)

Power Quality - Waveforms

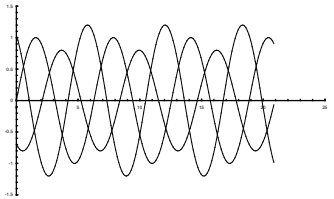


3-phase balanced

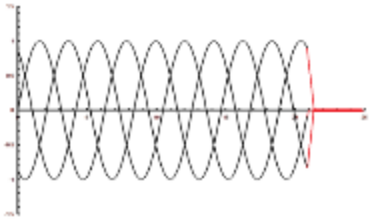


Power Factor

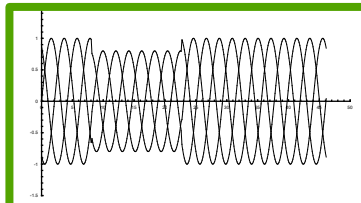
Harmonics



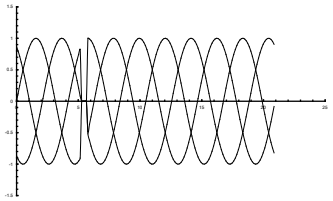
Phase unbalance



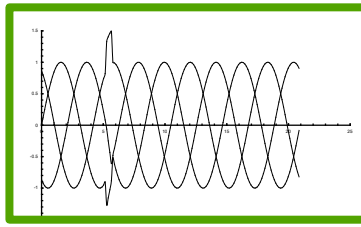
Blackout



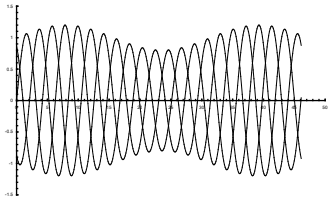
Sags/swells
(usually from the grid)



Notches



Transient
(Spike)



Flicker
(usually from inside the facility)

Noise

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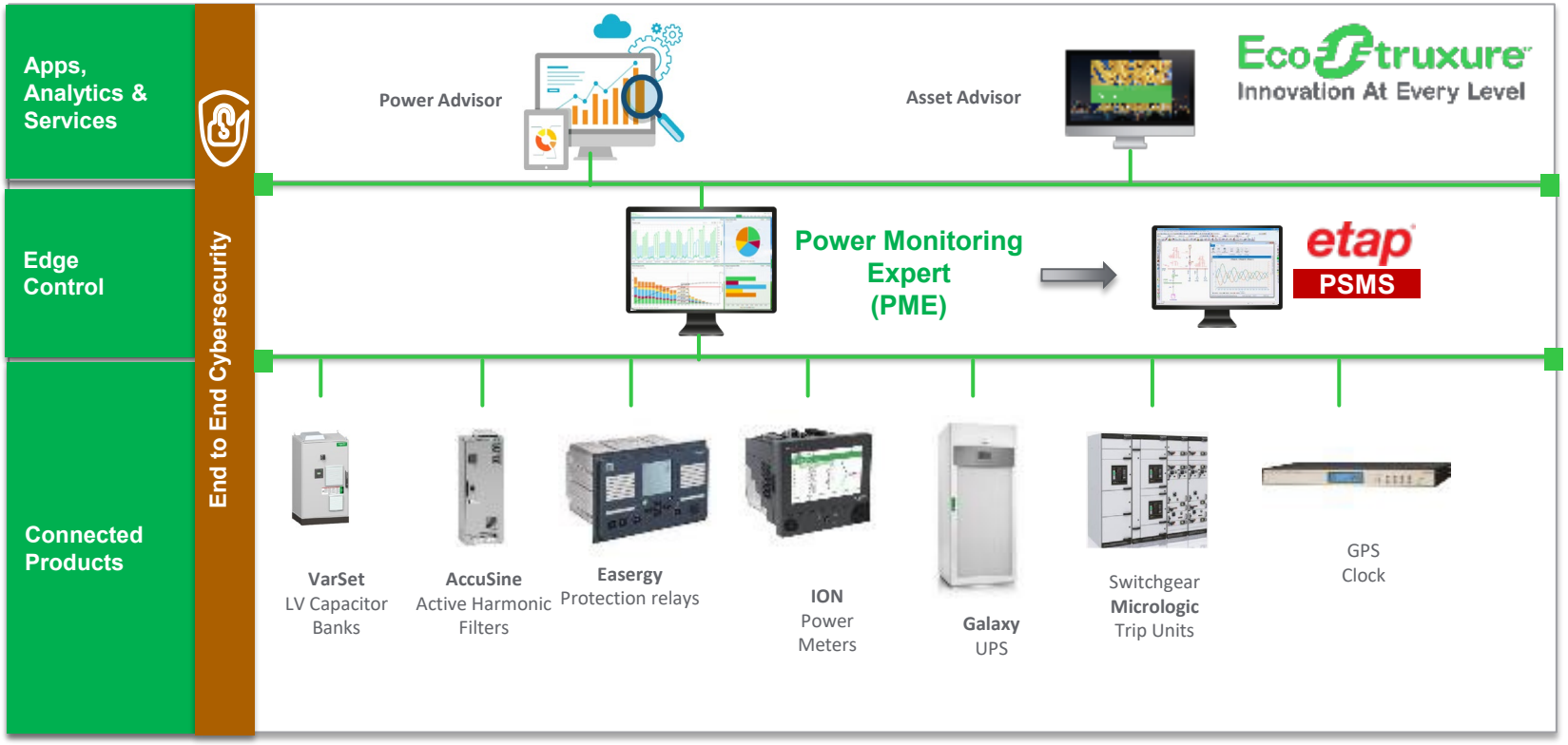
Power Quality Monitoring System



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Advance Power Quality Analysis Meter

ION7650
PQ Meter

ION9000
PQ Meter

- Real Time Monitoring
- Advanced power quality analysis
  - Disturbance Detection: Sag/Swell/Transients
  - Disturbance Direction Detection: Upstream / Downstream
  - Waveform Captures
  - Harmonic Monitoring
  - IEEE 519
  - IEC 61000-4-30
- Time Synchronization -> 1 ms
- Revenue accuracy
- Multiple communications options
- Control capabilities
- Trending and forecasting

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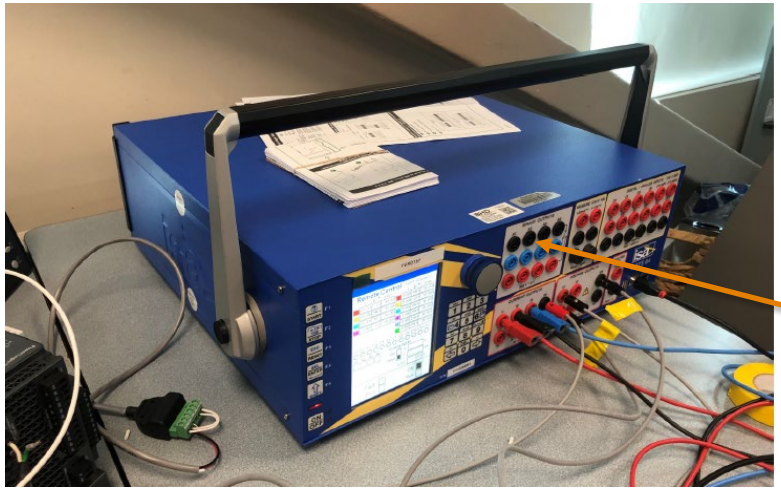
PQM – FAT

GPS

PQM Servers

ION9000 Power Meters



Test kit

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PQM – Site Equipment

ION9000
Power Meter

ION7650
Power Meters

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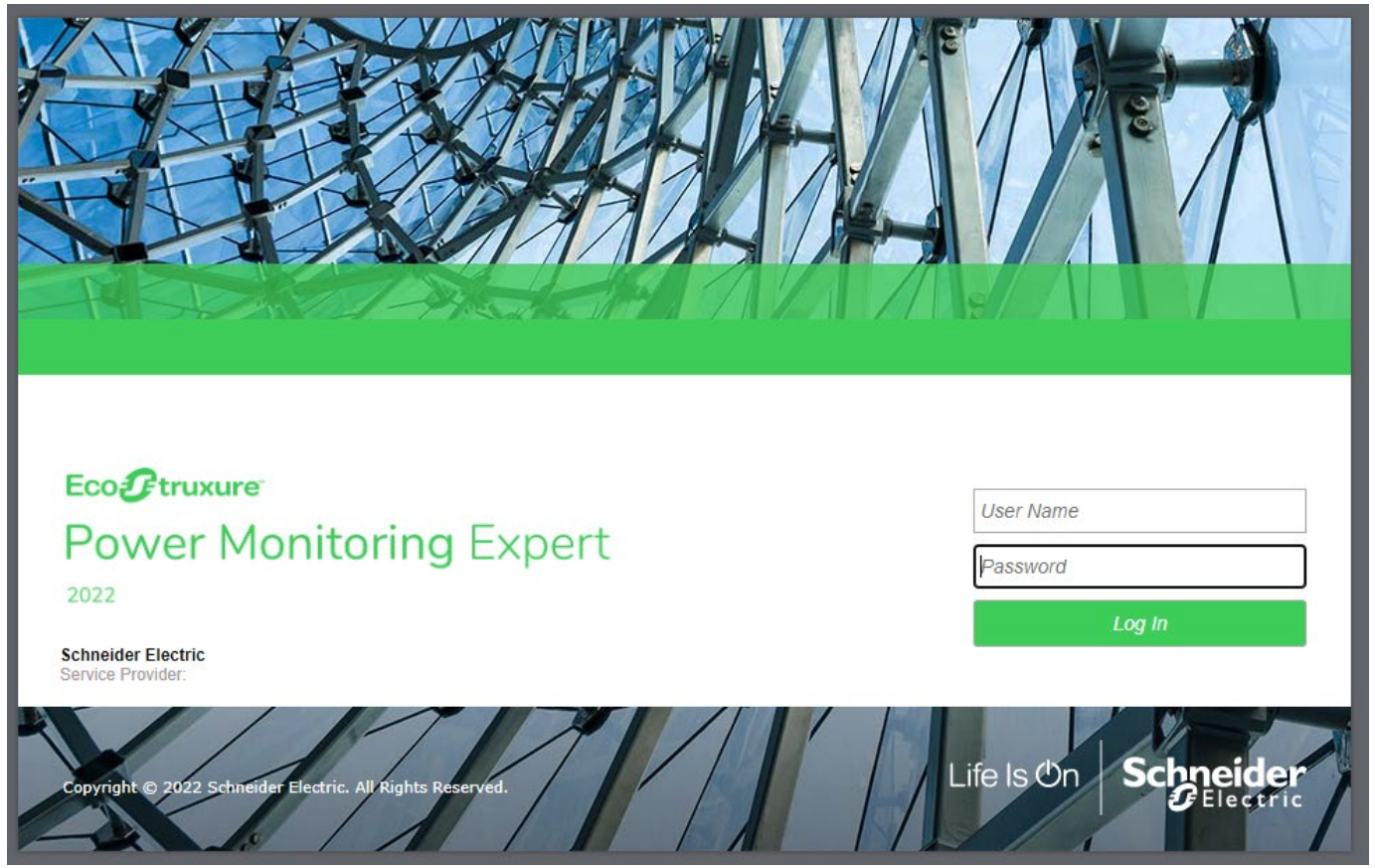
PQM Interface

Power Monitoring Expert gives insight into electrical system health and energy efficiency



- Open, scalable architecture
- Convert data into action
- Modular digital applications
- Energy visualization and analysis tools

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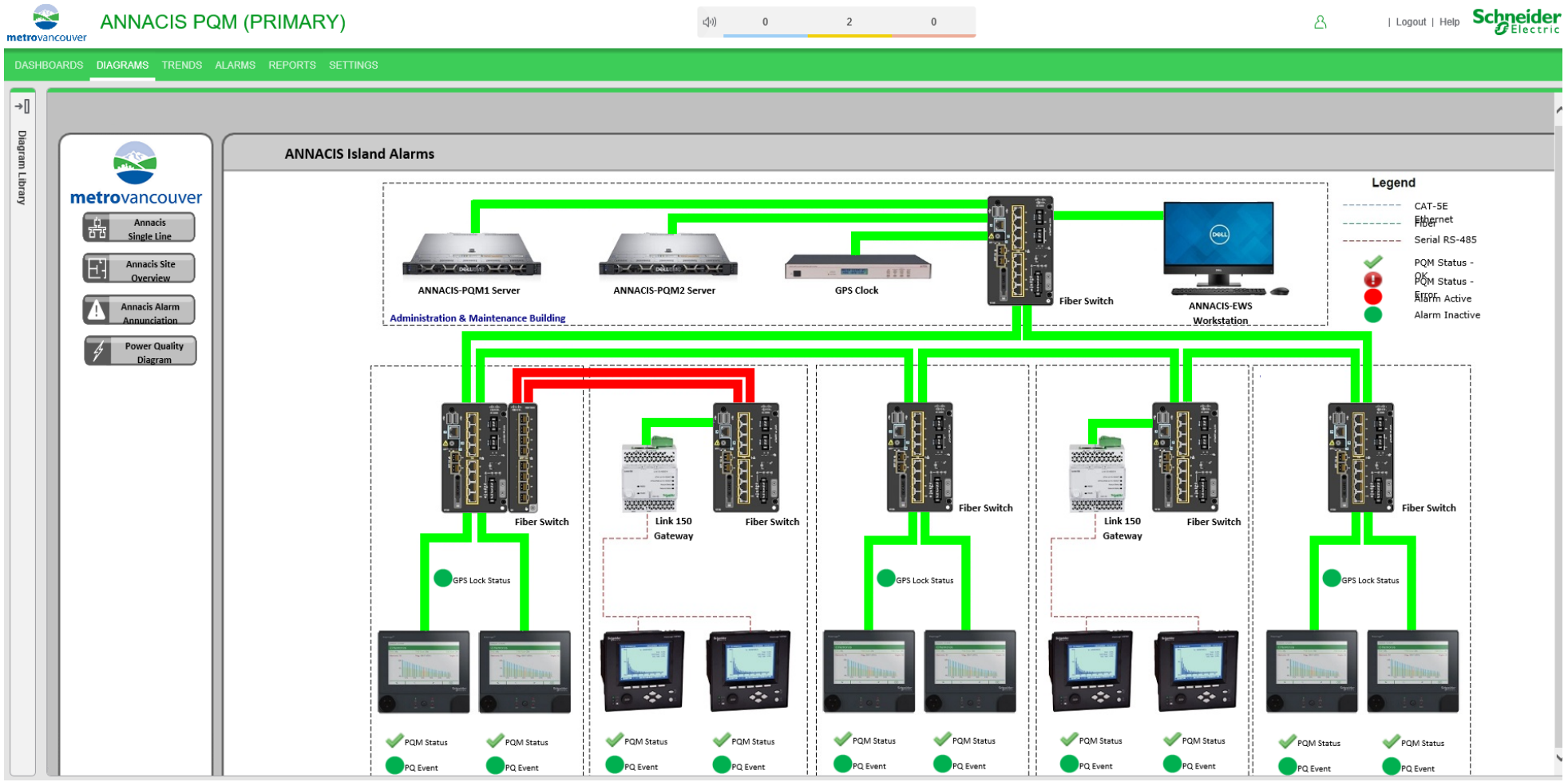
PQM – Real Time Monitoring - Comms



Power Monitoring Expert (PME)

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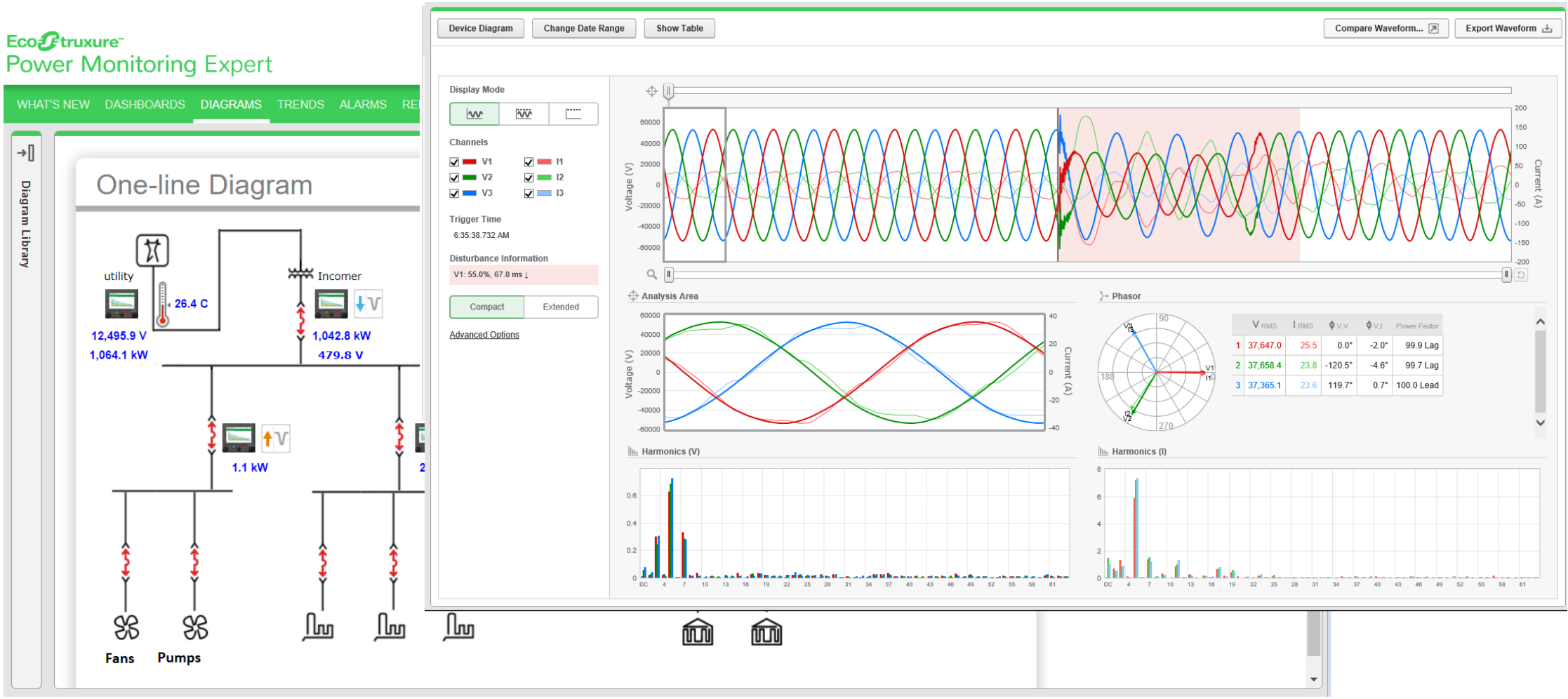
PQM – Real Time Monitoring



Power Monitoring Expert (PME)

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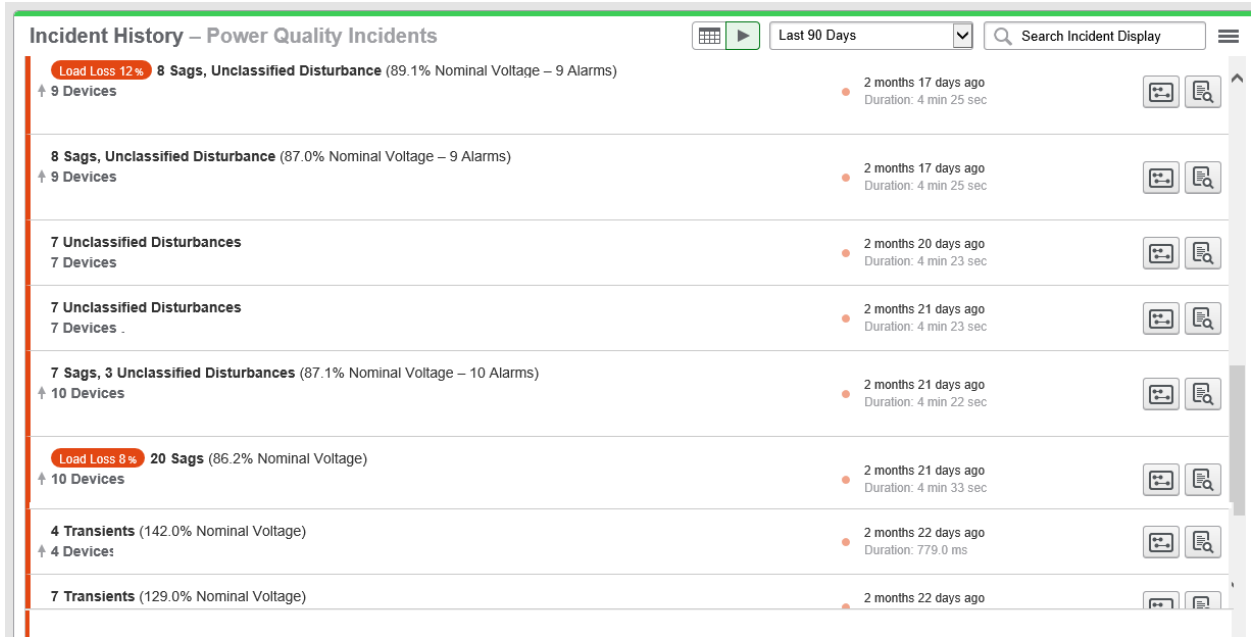
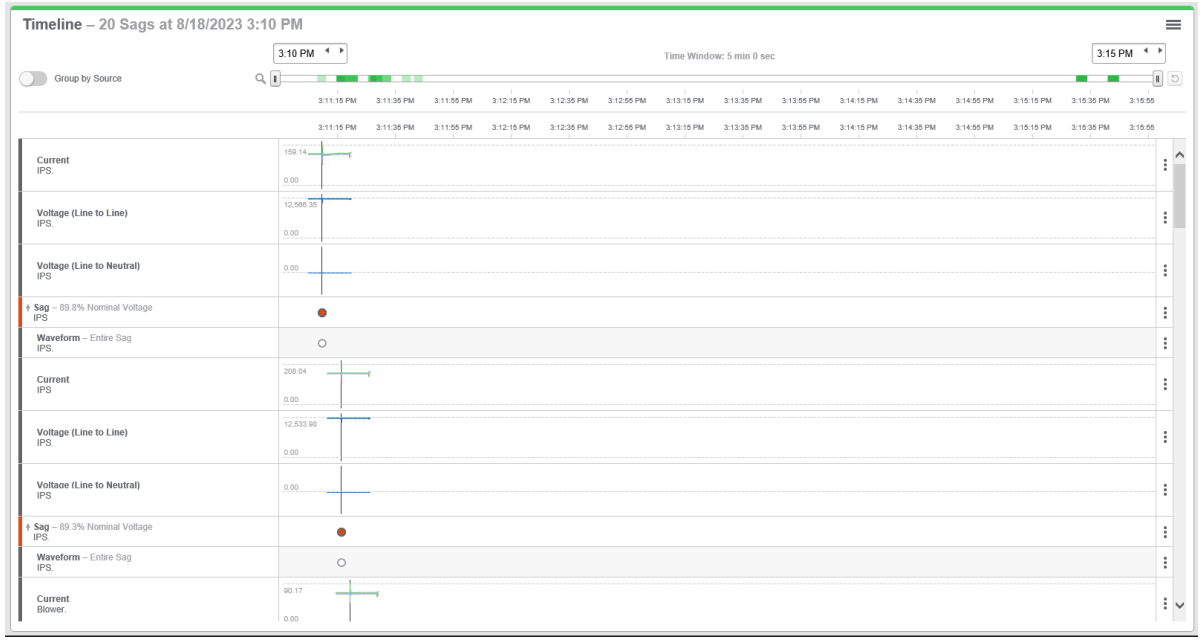
PQM – Power Event Analysis





Power Monitoring Expert (PME)

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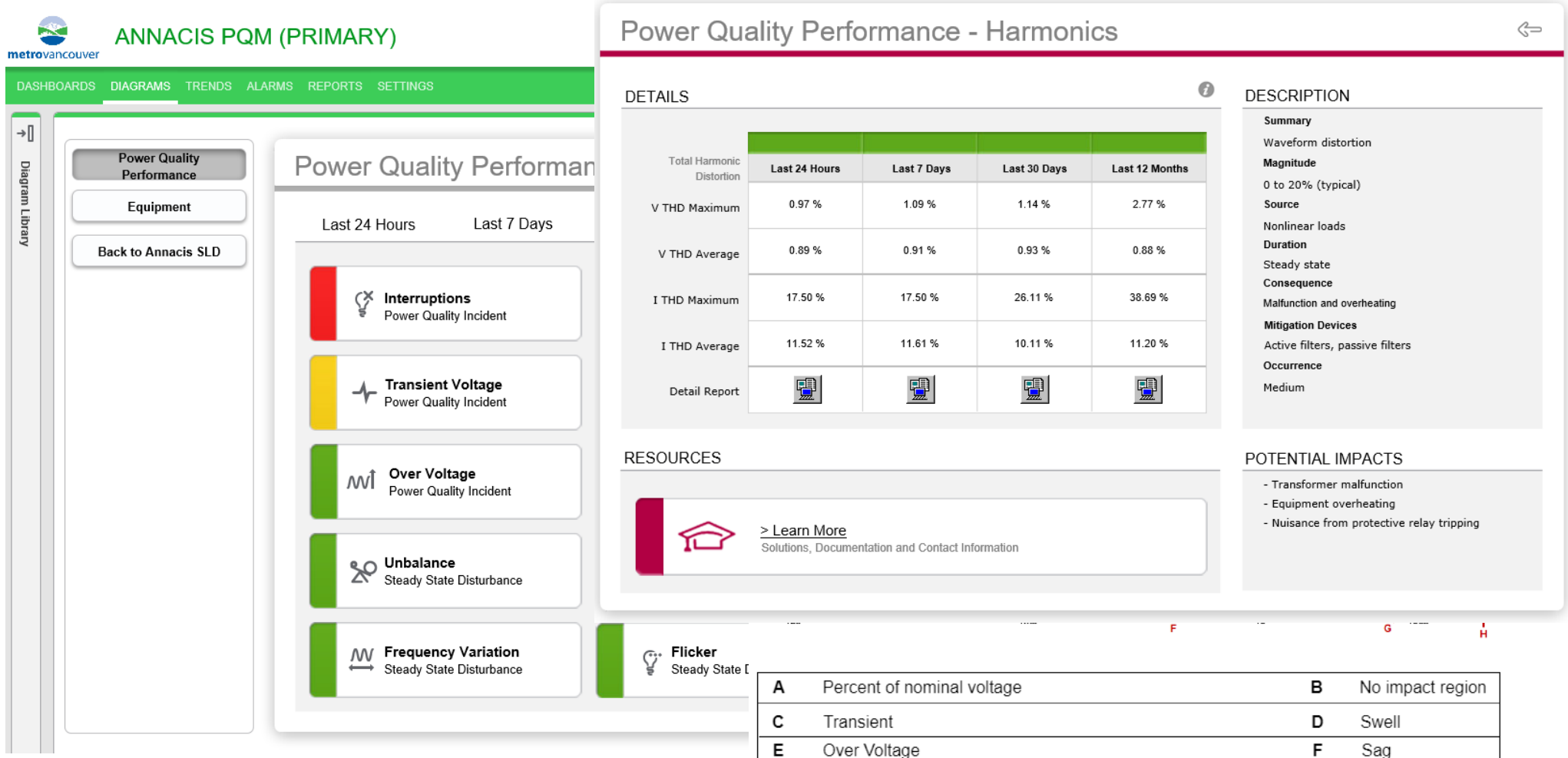
PQM – Real Time Monitoring



Power Monitoring Expe

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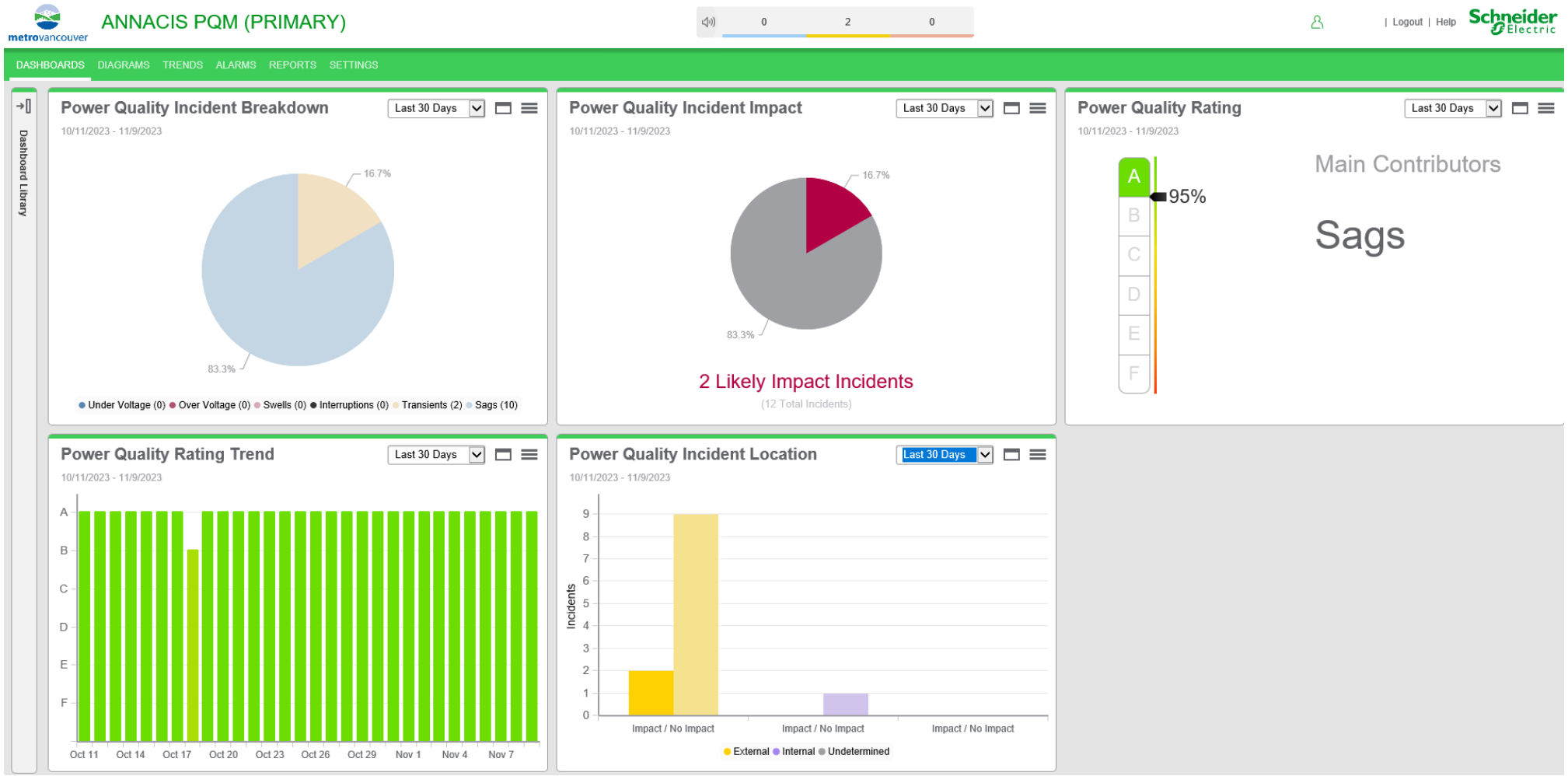
PQM – PQ Dashboard



Power Monitoring Expert (PME)

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PQM – Reports

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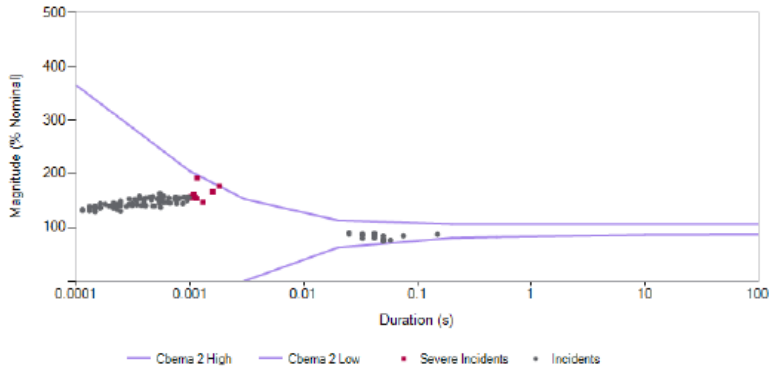
Power Quality

1/1/2023 12:00:00 AM - 11/10/2023 12:00:00 AM (Server Local)

Summary

Number of Incidents	135
Incident Interval	20 seconds
Number of Disturbances	341



Worst Disturbance per Incident

ID	Incident Time	Meter	Type	Phase	Duration (s)	Magnitude (%)
1	1/19/2023 4:58:13 PM	69kV	Transient	V3	0.000358	158.00
2	1/19/2023 5:36:56 PM	69kV	Transient	V3	0.000113	133.00
3	1/20/2023 4:58:23 PM	69kV	Transient	V2	0.000813	155.00
4	1/22/2023 11:06:34 PM	69kV	Sag	V1	0.150	86.75
5	1/23/2023 7:03:01 AM	69kV	Transient	V1	0.000553	163.00
6	1/23/2023 4:18:46 PM	69kV	Transient	V2	0.000928	156.00

Schneider Electric

Waveform Report – 69kV

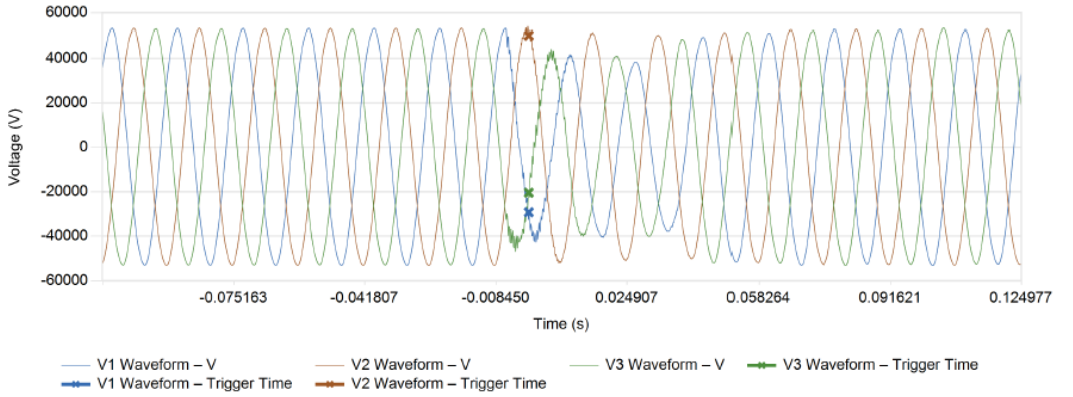
1/1/2023 12:00:00 AM - 11/10/2023 12:00:00 AM (Server Local)

Data Warnings

No data warnings.

69kV_Substation.MET_80_004C – 1/1/2023 11:40:41 AM

First Point: 1/1/2023 11:40:41.209 AM Trigger Point: 1/1/2023 11:40:41.318 AM Sampling Rate: 7676 Hz



Power Monitoring Expert (PME)

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PQM – Energy Dashboard

Power Monitoring Expert (PME)

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Lessons Learned

1. Collaborative approach – consultant, technology partner, end user
2. Proper planning is key: specifications, hardware, FAT, execution
3. Documentation
4. Ownership - Champion
5. Training
6. Regular touch points – System Health and Maintenance


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