
HARDWARE
SOFTWARE
XPERT SERVICES
PREDICTIVE MONITORING SOLUTIONS FOR THE ELECTRICAL GRID
QUALITROL
Defining Reliability
QUALITROLCORP.COM | WHATSAPP – QUALITROLBOT - +91 9820169947

WHO WE ARE

Monitoring and protection for the global grid.

Established in 1945, Qualitrol ensures grid reliability and the transition from scheduled to condition based maintenance practices within the power generation and energy industry.

We are the largest and most trusted global provider of monitoring systems including sensors, monitors and software for wherever you are in your maintenance strategy.

Why Monitor?

Aging Infrastructure

IEEE estimates the average transformer age in North America is 43 years old

Unscheduled Power Outages

DOE estimates power outages cost to the NA businesses in excess of $50 billion annually

Rising Operation Costs

Operating expenses continue to escalate as O&M budgets shrink YOY

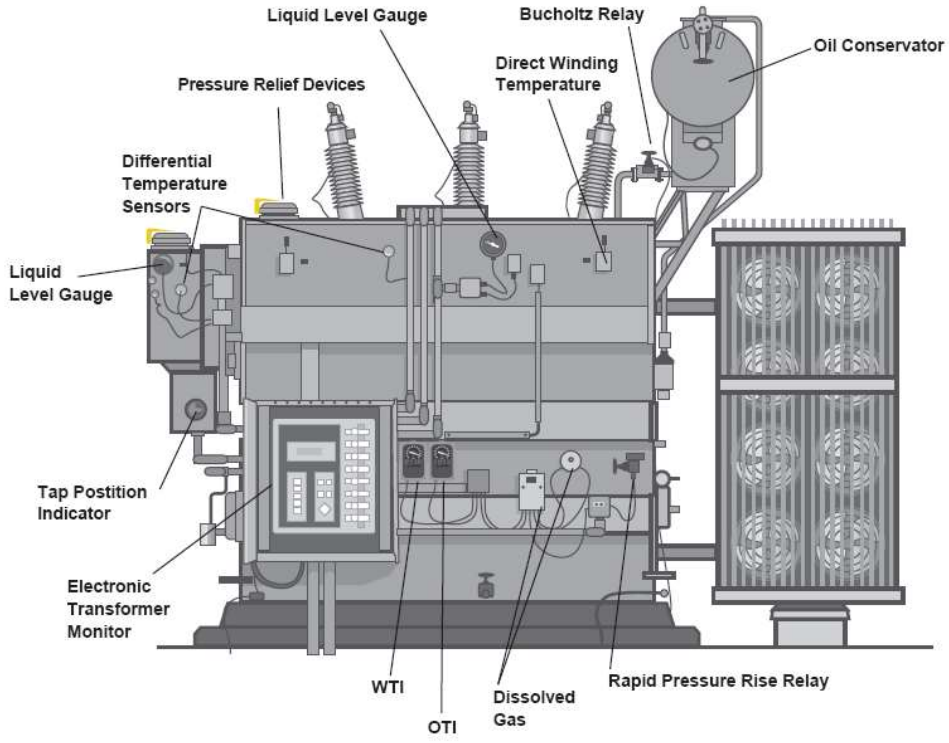
Make informed decisions on maintenance and asset priority ranking based on factual data

Condition Monitoring

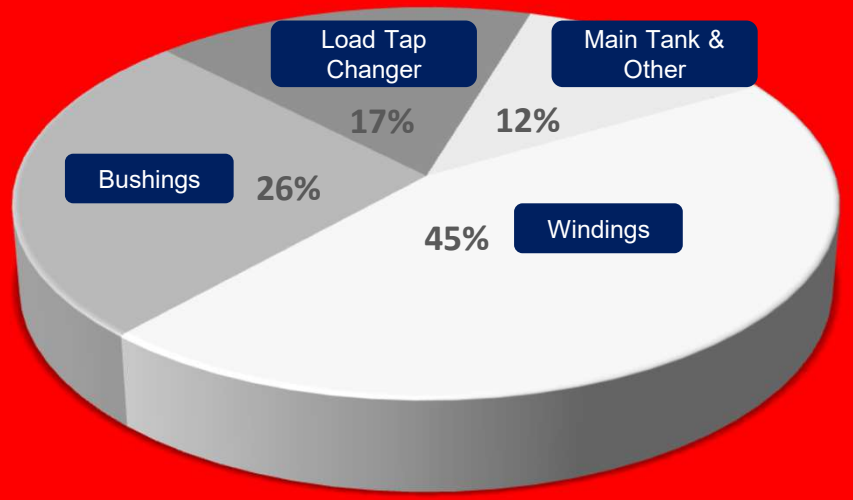
- Improve Grid
- Real-time Reliability
- Data-driven
- Asset Management

Importance of Online Monitoring

The most common transformer failures may manifest themselves over time and can be detected with multiple monitoring methods available today.



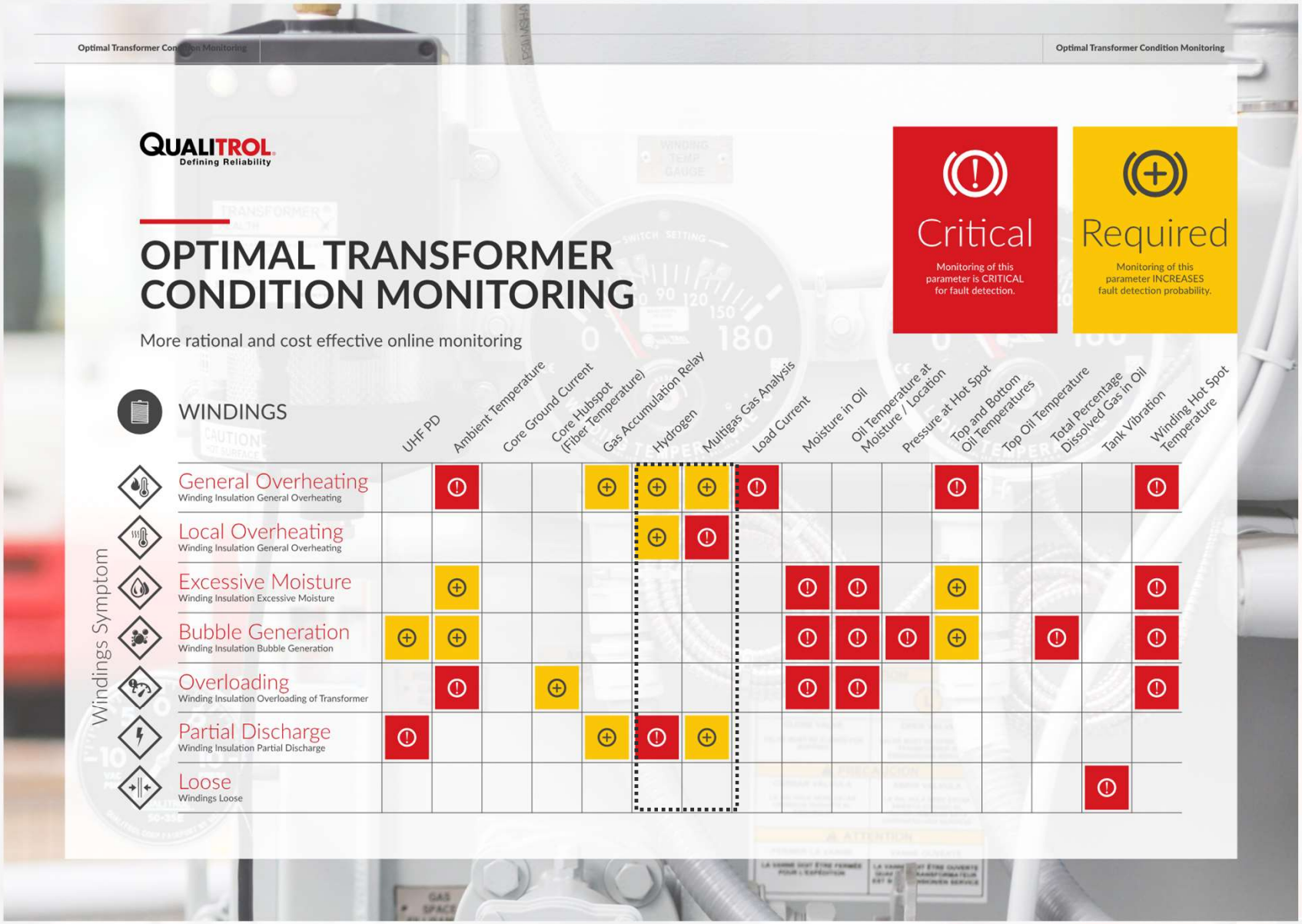
Common Transformer Failure Modes



Source: WG A2.37, Transformer Reliability Survey: Interim Report, No. 261 - April 2012 ELECTRA

Key Parameters to Monitor

- Temperature Changes; premature aging
- DGA; gas formation and accumulation
- Partial Discharge (PD)
- Bushing Health
- LTC Functionality
- Cooling System Health



FAILURE MODE

Optimal Transformer Condition Monitoring

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OPTIMAL TRANSFORMER CONDITION MONITORING

More rational and cost effective online monitoring

Critical
Monitoring of this parameter is CRITICAL for fault detection.

Required
Monitoring of this parameter INCREASES fault detection probability.

LTC ON LOAD TAP CHANGER

OLTC Symptom

	Tan Delta (Power Factor) Absolute Value & RoC	Capacitance Absolute Value & RoC	Bushing Temperature	Oil Pressure (OIP Bushings and LTC)	Dissolved Gases (Oil Bushings and LTC)	Partial Discharge	Moisture Model	Ambient Temperature	LTC Operational Model	LTC Motor Current	LTC Motor Power Consumption	LTC Motor Torque	LTC Temperature Differential	Vibro-Acoustic Model	Switching Time
Contact Coking OLTC Contact Coking				⊕	!	!		⊕					!		⊕
Motor Drive OLTC Motor Drive Issues									!	⊕	!			!	⊕
Excessive Arcing OLTC Excessive Arcing						!									
Insulation OLTC Weak Insulation					!	⊕									
Tap Movement OLTC Multiple Tap Movement						⊕			⊕	⊕	⊕	⊕	!	!	
Aging OLTC Aging								!	⊕	⊕	⊕				

FAILURE MODE

Optimal Transformer Condition Monitoring

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OPTIMAL TRANSFORMER CONDITION MONITORING

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Required
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BUSHINGS

Bushing Symptom

	Tan Delta (Power Factor) Absolute Value & RoC	Capacitance Absolute Value & RoC	Bushing Temperature	Oil Pressure (OIP Bushings and LTC)	Dissolved Gases (Oil Bushings and LTC)	Partial Discharge	Moisture Model	Ambient Temperature	LTC Operational Model	LTC Motor Current	LTC Motor Power Consumption	LTC Motor Torque	LTC Temperature Differential	Vibro-Acoustic Model	Switching Time
Overheating Bushing Overheating and Insulation Failure	!		!	+	+			+							
Insulation Decay Bushing Insulation Decay / Normal Aging	!		!		+		+	+							
Excessive Moisture Moisture in Bushings	+		!	+			!	+							
Bad Contact Bushing Bad Contact	!	!	!		+		!								
Partial Discharge Bushing Partial Discharge	+	!			+	!									
Short Circuit Bushing Short Circuit in Capacitive Layers		!													

FAILURE MODE

New Build's, preparing for the future :

Direct Temp. Measurement – Fibers, Partial Discharge couplers
2 drain valves for oil circulation - DGA
Cooling Efficiency – In/Oil Temp.
Accessories **ready for digitalization**
Breather unit - Regeneration Silica Gel
Bladder rupture detection

Basic Level 1: Planning & preparing

Digital Temp. monitoring: WTI, OTI, Hot-Spot Fiber, Cooling
Oil Level - Potentiometer
Load - Voltage and Current
OLTC Position & Operation Status
Single gas H2 with Moisture
All Accessories I/O's
Cooling control

Basic Level 2: + 1

Bushing Monitoring
- *TanD/ Power Factor & Capacitance*

OLTC
- *Oscillography*
- *Torque*
- *Contact wear*

Cooling efficiency & status
- *Motor Current*
- *Pump Current*
- *Operations Control & status*
- *Position*
- *Contact Wear*

TX Condition Status
- *All alarms condition status*

Dissolved Gases 3
- *TM3 – Acetylene, Ethylene & Methane*

Medium Level 3: + 2

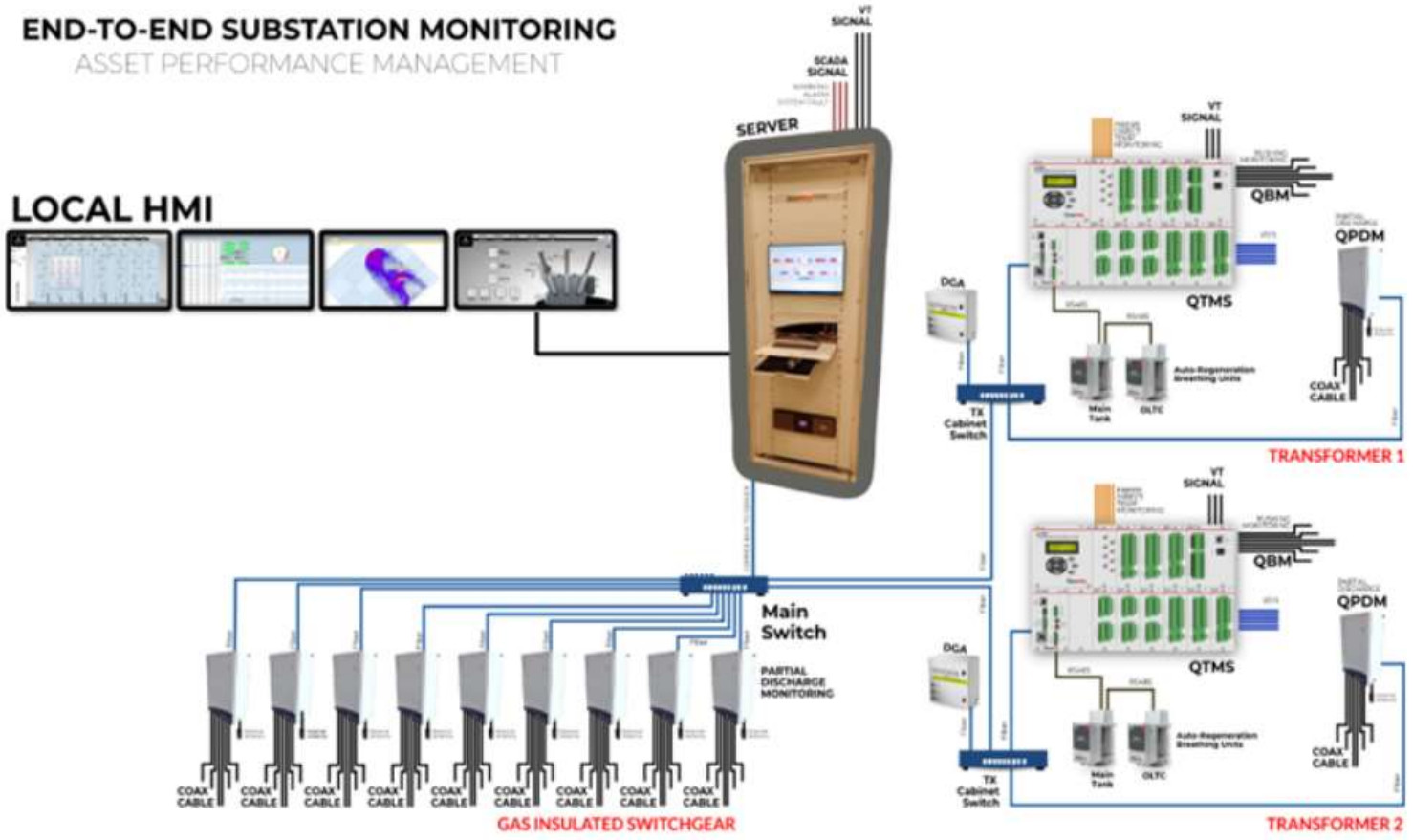
Dissolved Gases 8
- *TM8 > All 8 Fault Gases plus N2*

Top 4: + 3

Partial Discharge Monitoring
- *Between 2 to 4 Online Couplers*

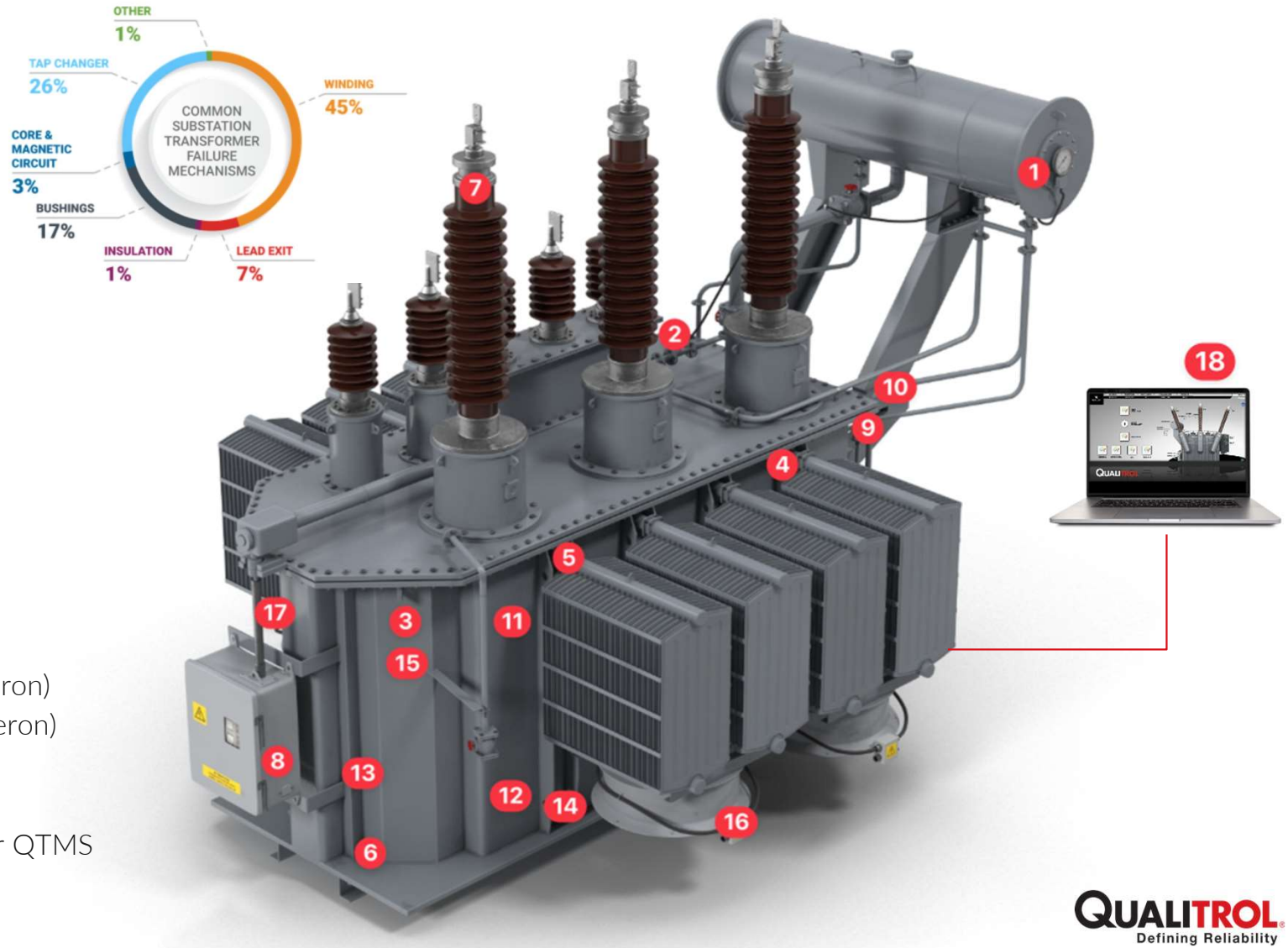
MONITORING SCALABILITY LEVEL & VISIBILITY

Asset Multi*Hardware



End To End Monitoring

1. Liquid Level Gauges
2. Pressure Relief Devices
3. Winding temp. Thermometers
4. Rapid Pressure Rise Relay
5. Flow Gauges
6. Pressure Vaccum Switches
7. Bushing Monitoring
8. OLTC Monitoring
9. Smart Breather
10. Smart Breather OLTC
11. Fiber Optic Temp. (Neoptix)
12. UHF Partial Discharge
13. Multi-Gas DGA Monitor (Serveron)
14. Single Gas DGA Monitor (Serveron)
15. AKM345 Thermometer
16. Cooling System Monitoring
17. Transformer Monitoring 509 or QTMS
18. APM Platform (SmartSUB)



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1 Thermometers

REMOTE MOUNT THERMOMETER — OTI/WTI™

- Bellow type measurement of OTI, WTIs
- 75+ years experience
- Up to 6 independent switches

REMOTE MOUNT THERMOMETER — 104/TR6000

- Bourdon tube capillary measurement of OTI, WTIs
- 40+ years experience
- Polar, stainless and C5M paint options

2 Pressure Relief Devices

LARGE PRESSURE RELIEF DEVICE — LPRD

- Pressure relief device with alarming capability
- Over 50 years field experience with over 500k installations
- Optional shield for oil diversion

EXTRA PRESSURE RELIEF DEVICE — XPRD

- Pressure relief device with alarming capability
- Patented 2x flowrate of the LPRD
- Built in shield for oil diversion and optional piping kits

3 Liquid Level Gauges

LARGE OIL LEVEL INDICATORS — AKM 44712

- Large dial face for easy viewing at a distance
- Lever or gear driven float arms with a high level of customization
- Up to 4 switches

LARGE OIL LEVEL INDICATORS — 032/042/045

- Magnetically coupled gear or lever driven float arms
- Custom dials and configurations available
- Up to 3 switches

4 Flow Gauge

FLOW INDICATORS — 092

- Magnetically coupled dial assembly and flange with adjustable vane
- Provides up to two switches for alarming capability

5 Fiber Optics

FIBER OPTIC TEMPERATURE MONITOR — 408

- Up to 16 channels for accurate fiber optic hot spot measurement
- 8 form C relays
- Available web server and multiple communication options

DIRECT WINDING MONITOR — 509 DW

- Up to 16 fiber optic sensors integrate with 509 ITM capability
- Cooling and LTC monitoring options available
- NERC compliant

6 Sudden Pressure/ RPRR

RAPID PRESSURE RISE RELAYS — 900/910

- Detection and alarming of sudden pressure rises
- Flange or thread mounting options for oil or gas space
- Original creator of technology

ELECTRONIC PRESSURE MONITOR — 930

- Electronic detection and alarming of sudden pressure rises
- Settable sensitivity
- Two out of Three logic options available

7 Partial Discharge

IN-HOUSE DEVELOPED PDM SENSORS — UHF Sensors

- Internal, Window and Drain Valve
- Protection from high transient signals
- Support in sensor location and sensitivity testing

PARTIAL DISCHARGE MONITOR — 609 PDM

- AI and NN based PD detection
- Real time trending of PD activity
- Expert Analysis display options
- IEC 61850 compliant – KEMA Certified

8 Bushing Monitor

BUSHING MONITOR ADAPTORS — 408

- Custom designed
- Double protection from transients
- Dual earth connections from bushing tap adaptor
- Relay alarms for protection failure

ON-LINE BUSHING MONITOR — QCM-T-BM

- Higher accuracy
- Programmable Alarm criterion
- Time trend of the bushing parameters
- Temperature compensation

OFFSHORE Xtreme

Hardened for Offshore Use

- Robust materials to survive saline environment
- Made of 316 stainless steel or C5M painted
- Conformal coated electronics options available

POLAR Xecution

Hardened for Polar Use

- Rated to -60°C
- Robust materials to survive harsh cold
- Additional heaters when required

9 Transformer Monitors

INTELLIGENT TRANSFORMER MONITOR — 505 ITM

- Up to 4 inputs
- 4 current loop outputs
- TransLife calculations based on IEEE calculations
- NERC compliant

INTELLIGENT TRANSFORMER MONITOR — 509 ITM

- Up to 8 inputs (16 with expansion module)
- 4 current loop outputs
- Cooling and LTC monitoring options available

10 Smart Breathers

SMART TRANSFORMER BREATHER — STB Series

- Maintenance free regenerating silica gel desiccant
- 1, 2, and 4 kg models available
- Bright LED alarm indication lights and color changing desiccant

SMART TRANSFORMER BREATHER — Offshore Xtreme

- Designed for harsh marine environments
- Enhanced materials made of stainless steel glass, and robust gaskets

11 DGA Monitors

SINGLE DISSOLVED GAS ANALYSIS — TM1

- Online hydrogen monitoring
- Alarm on PPM or Rate of Change
- Low cost of ownership with no membrane or consumables

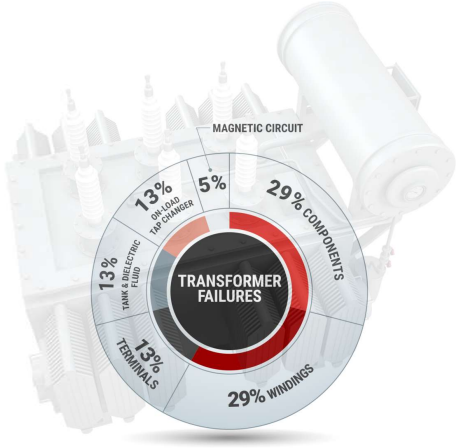
8 GAS DISSOLVED GAS ANALYSIS — TM8

- Correlates 8 fault gases, plus moisture in oil
- Supports IEC and IEEE diagnostic tools
- Software for fleet management

12 TMS

TRANSFORMER MONITORING SYSTEM — QTMS

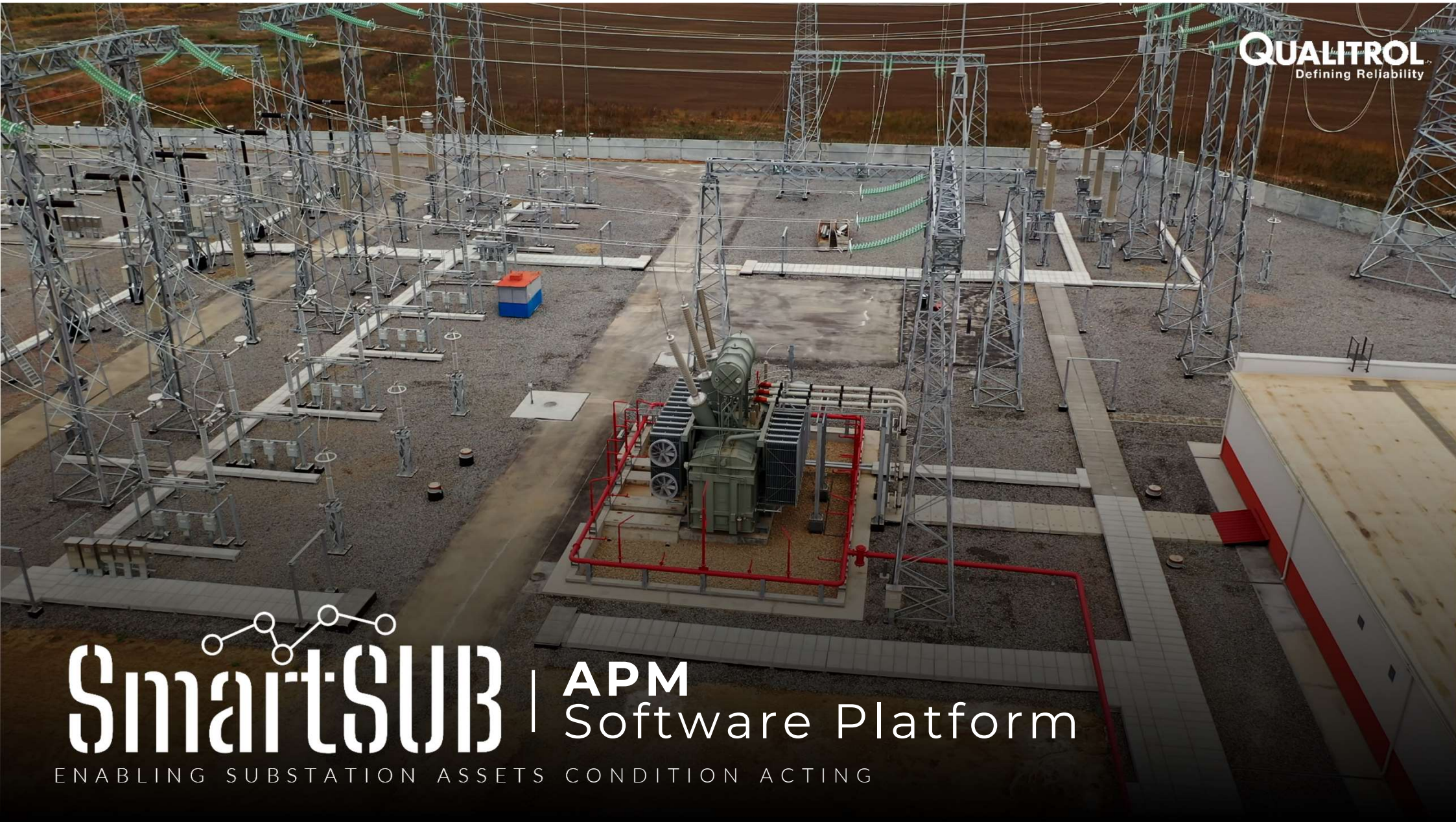
- Modular based, highly configurable transformer monitor
- Brings all smart sensor data into a central location
- Web based configuration



A COMPLETE AND FLEXIBLE PORTFOLIO

ATTENDING DIFFERENT LEVELS OF NEEDS

QUALITROLCORP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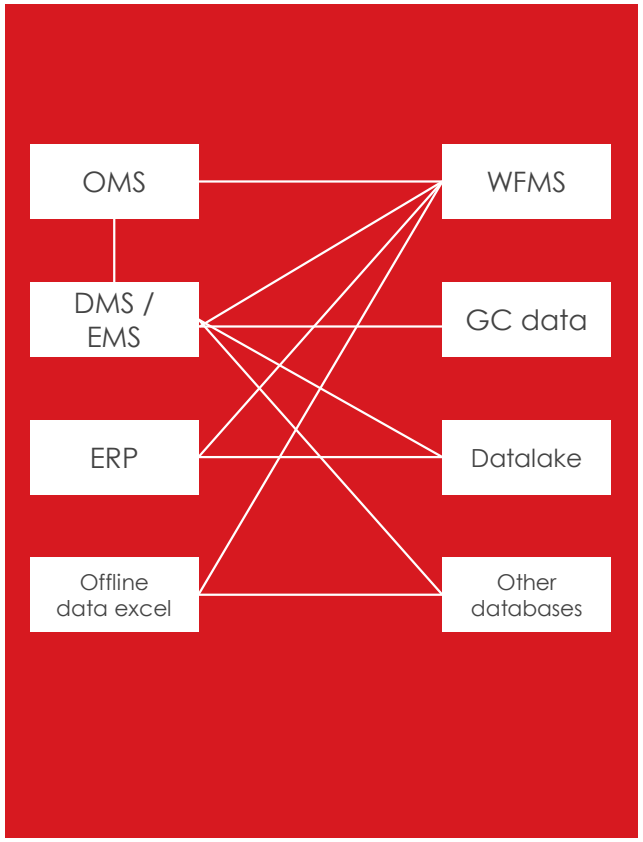
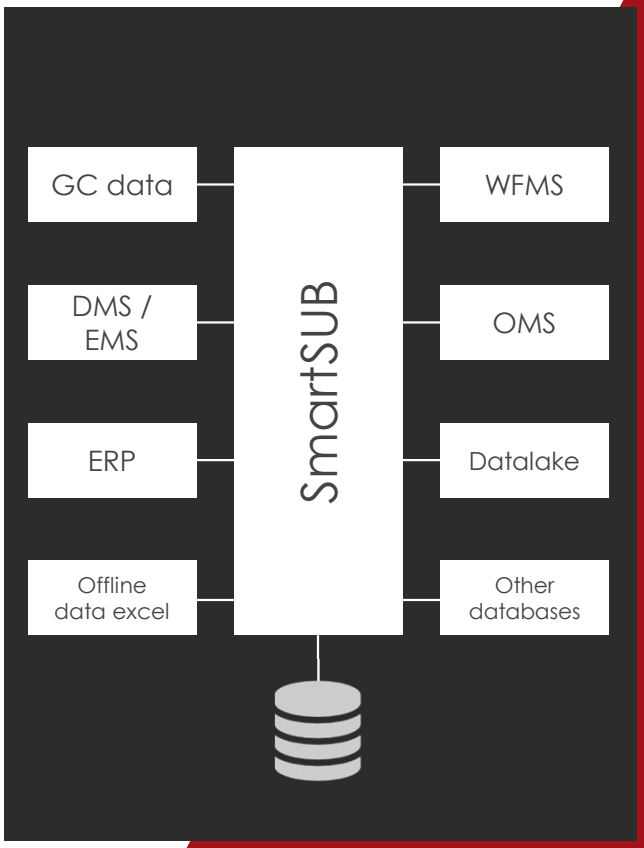
SmartSUB
APM
Software Platform
ENABLING SUBSTATION ASSETS CONDITION ACTING


END TO END SOLUTION
KNOW-HOW DOWNSTREAM
AND UPSTREAM, BEST
HARDWARE PORTFOLIO
WORLDWIDE
SmartSUB

CURRENT



FUTURE



Simplify!

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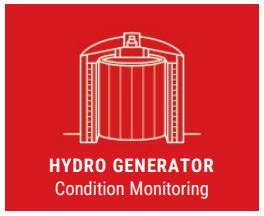
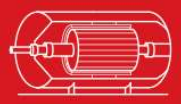
Defining Reliability



HYDRO GENERATOR
Condition Monitoring



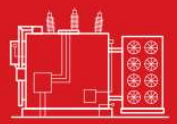
MOTORS/GENERATOR
Condition Monitoring

TURBINE GENERATOR
Condition Monitoring

POWER GRID
Condition Monitoring

CABLE
Condition Monitoring

SWITCHGEAR AND BREAKER
Condition Monitoring



TRANSFORMER
Condition Monitoring

VAULT TRANSFORMER
Condition Monitoring

IEC61850, IEC60870-104, DNP3.0, MODBUS, ETC

HISTORIAN | **SCADA** | **OFF-LINE** | **ON-LINE** | **LAB DATA** | **DATALAKE** | **WFMS** | **KPI**

SOAP 2.0 , OPC, XML sourced plugins, PI Web API (REST) utilising HTTP/HTTPS ,HATEOAS, JSR, JASON, CSV, Excel, XML, CIM , TOA, DTA, Power DB / **SCADA:** Schneider SCMS, ABB SCMS, GE – DCS, GE POWER-ON

INTEGRATION

SMARTSUB

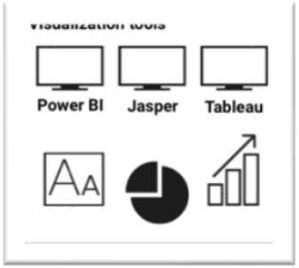
DATABASE

PROCESSING DATA
INTEGRATING & ORGANIZING
APPLY DIAGNOSTIC TOOLS
APPLY RULES ENGINE – ANALYTICS
APPLY MACHINE LEARNING
APPLY ASSET HEALTH & RISK INDEX
ALARMING (ASSET VISIBILITY)

WFMS
INTEGRATION
INTERFACE
WITH SAP,
MAXIMO,
CASCADE,
ACCRUENT

Dashboards
Asset Three
Specifics
Mapping
Vectors
KPI vs Impact
AHI & ARI

Other Visualization tools



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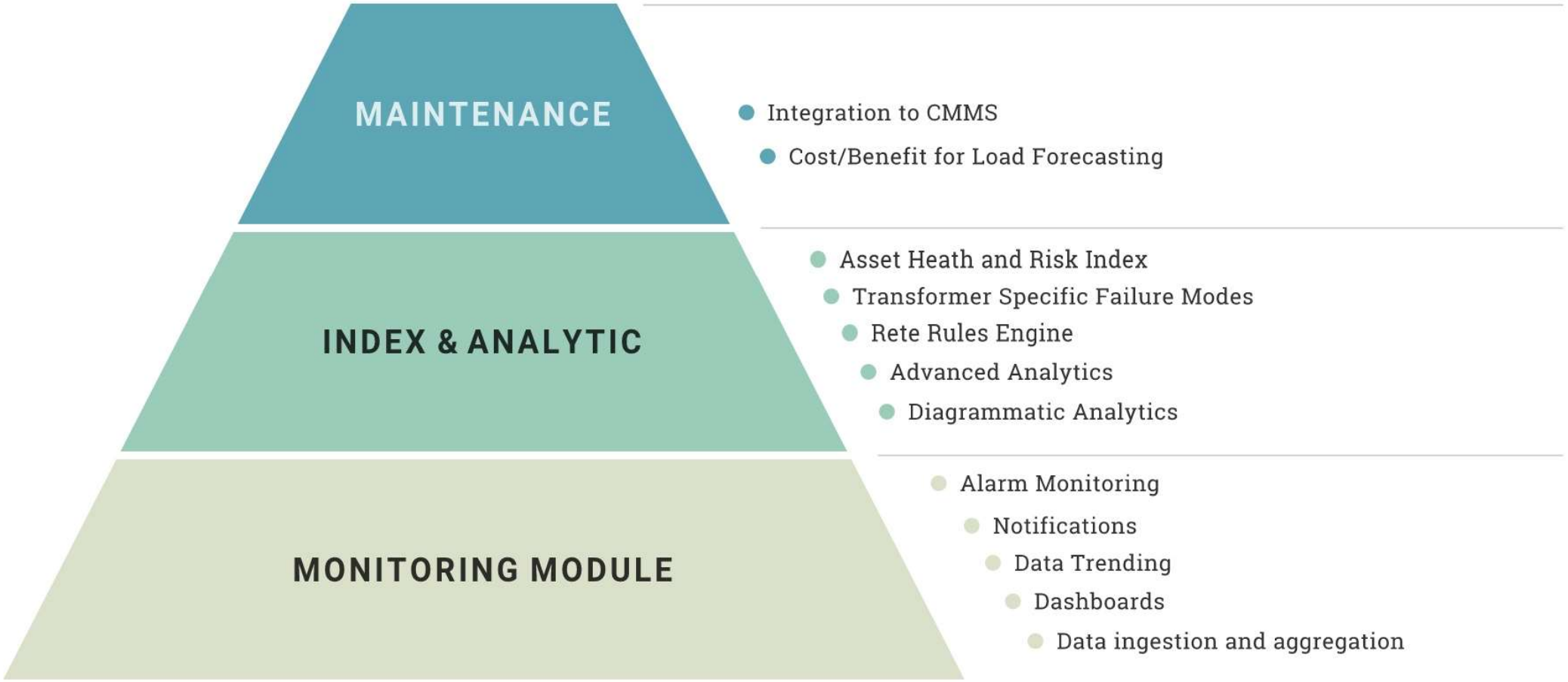
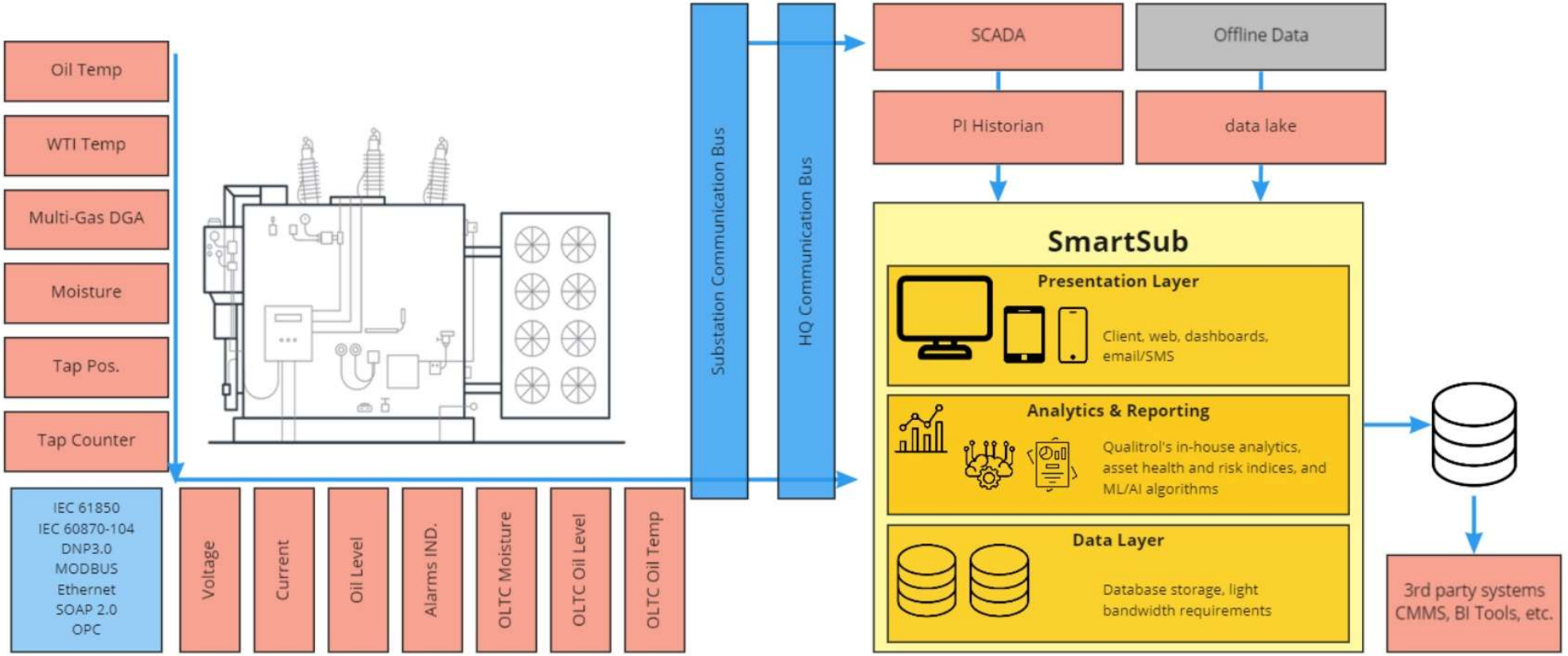
SmartSUB Modules



Monitoring Module

Goal is to create one platform to view all of your data.



Analytics

DIAGRAMMATIC

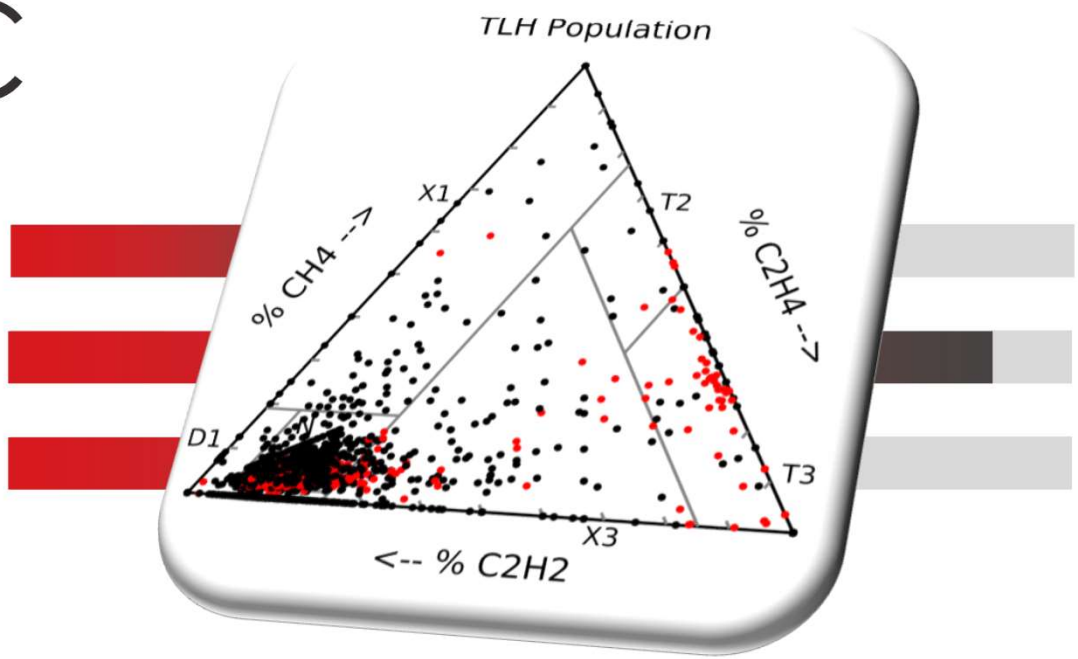
Rogers Ratio, Duval Polygons, etc.

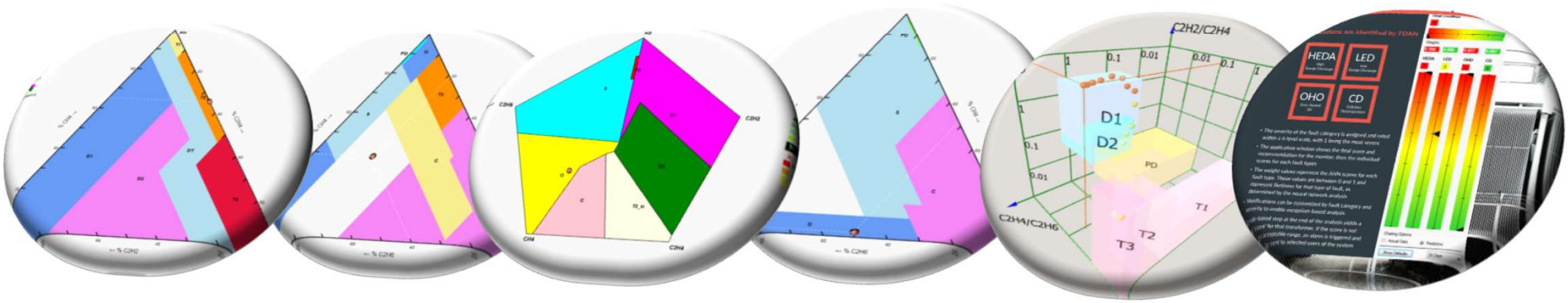
ALGORITHMIC

Single point algorithms and combinational algorithms.

DIAGRAMATIC

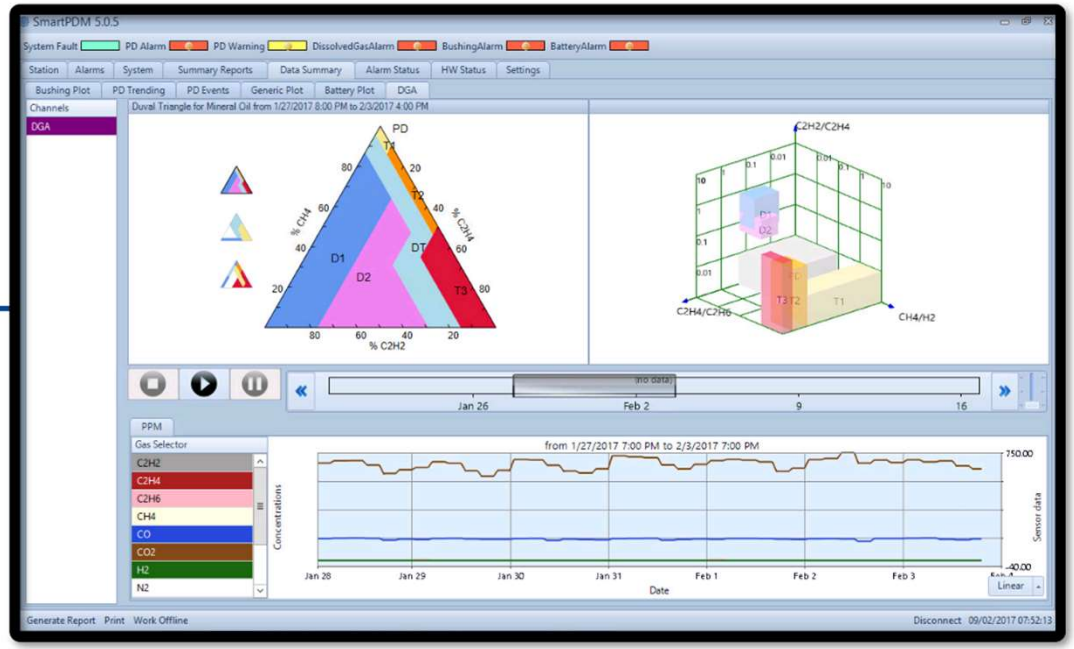
Visual indication with meaningful diagnostic tools, trends and record dynamically changing





Diagrammatic Analytics

We provide industry standard diagrammatic algorithms such as Duval Polygons and Roger's Ratio.



DGA

Ensuring Transformer Reliability Tracking in automated way

Physical and chemical properties of oil

Moisture Content

Total acid number (TAN)

Dielectric Strength

Power Factor

Dissolved Gas Analysis (DGA) | Off-line

Furanics (FFA)

Etc..

Dissolved Gas Analysis (DGA) | On-line
Moisture | On-line

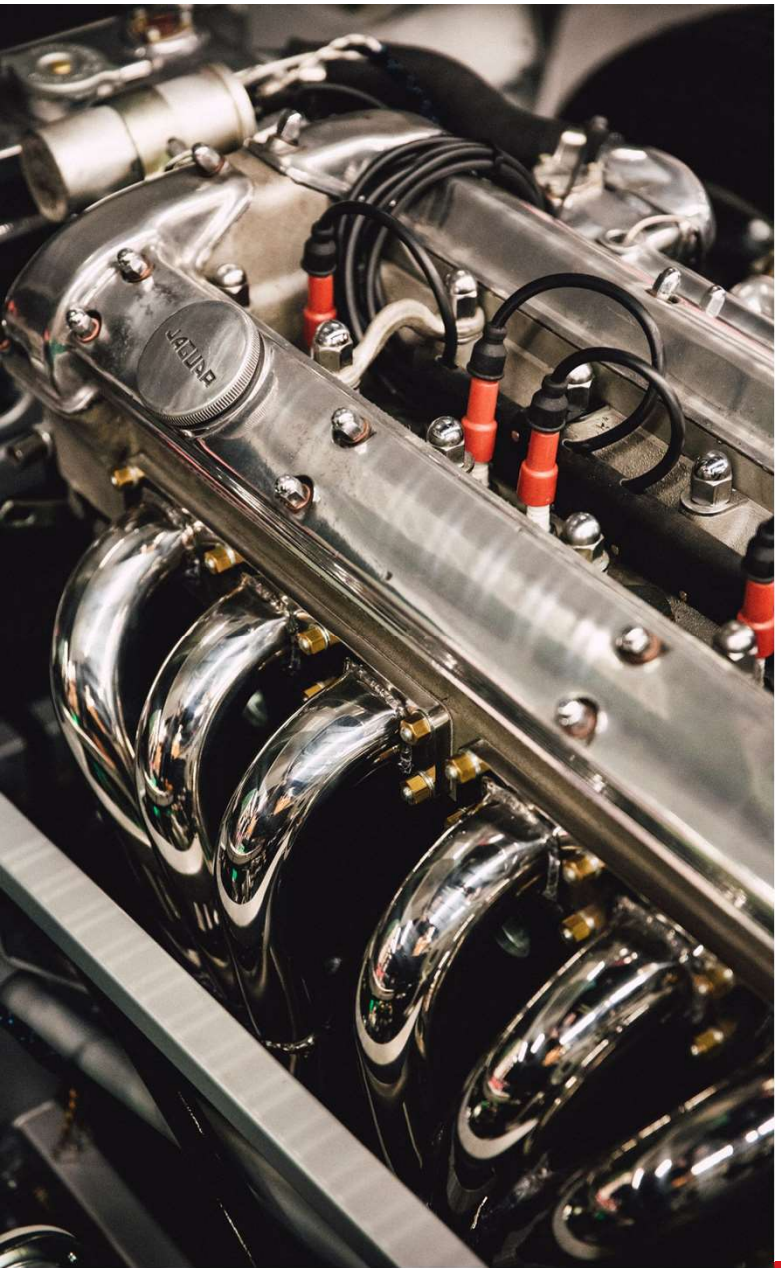
Algorithmic Analytics

FAILURE MODES

- Asset Specific
- Qualitrol Insights
- Industry Standard Calculations
- 3rd Party Plug-ins

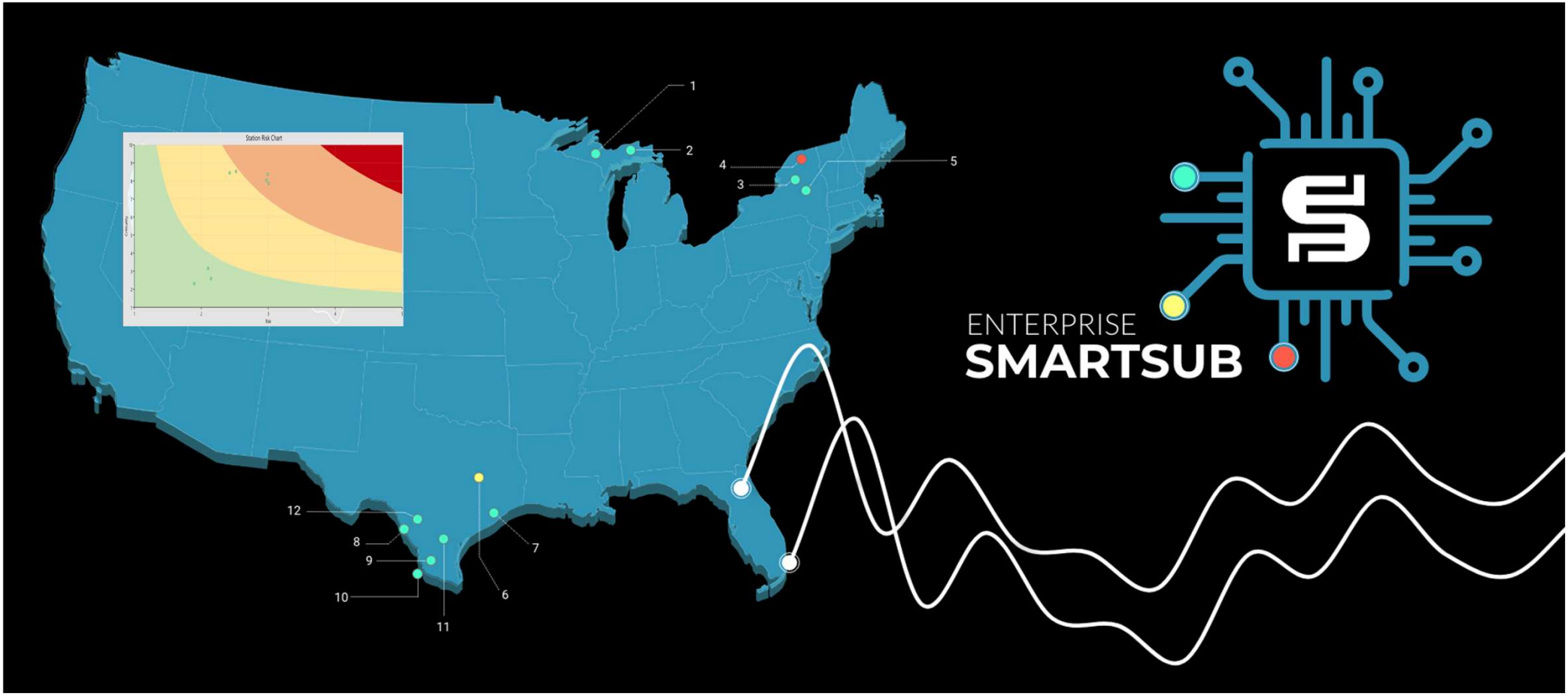
ADVANCED ANALYSIS

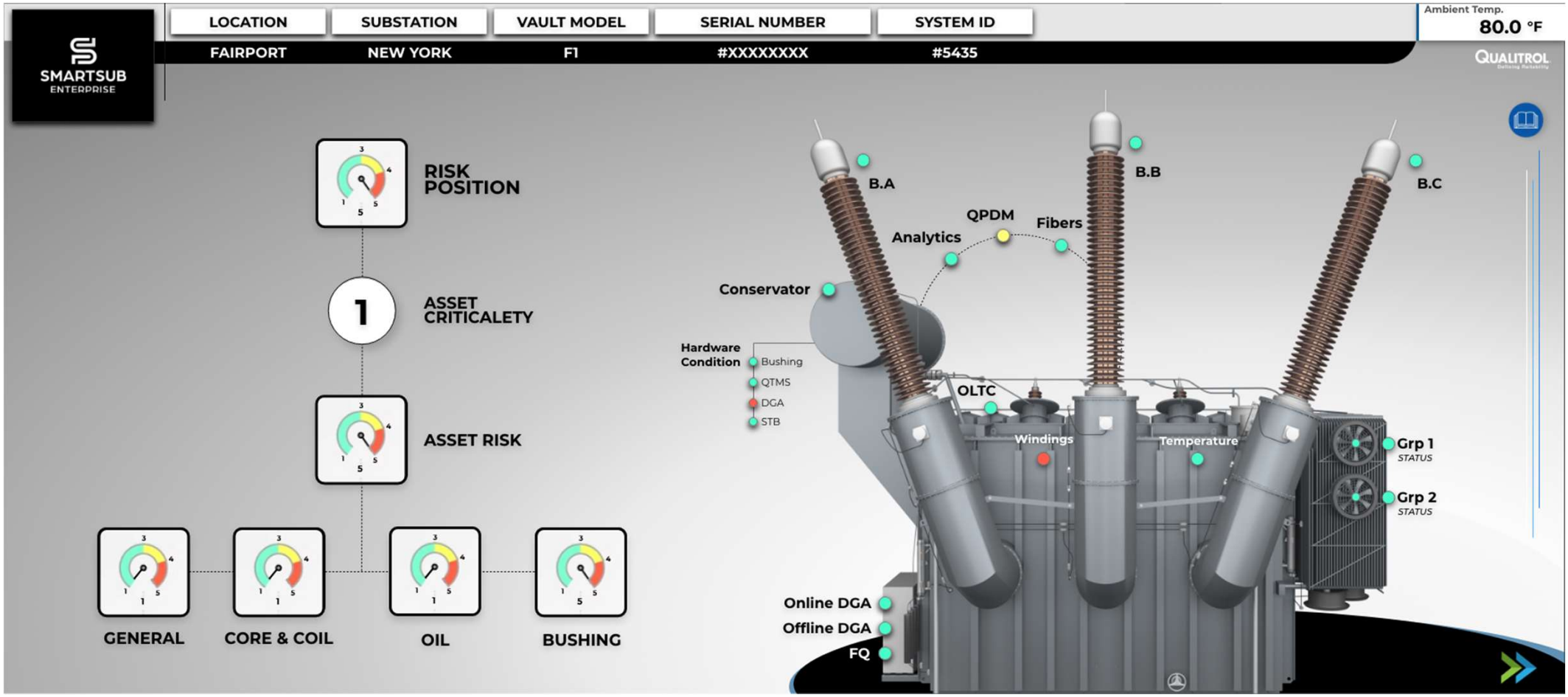
- Hybrid Classification System
- Time Series Pattern Matching & Predictive Analytics
- Odd Man Out Detection
- Asset Risk Index
- Analytics Integration Interface



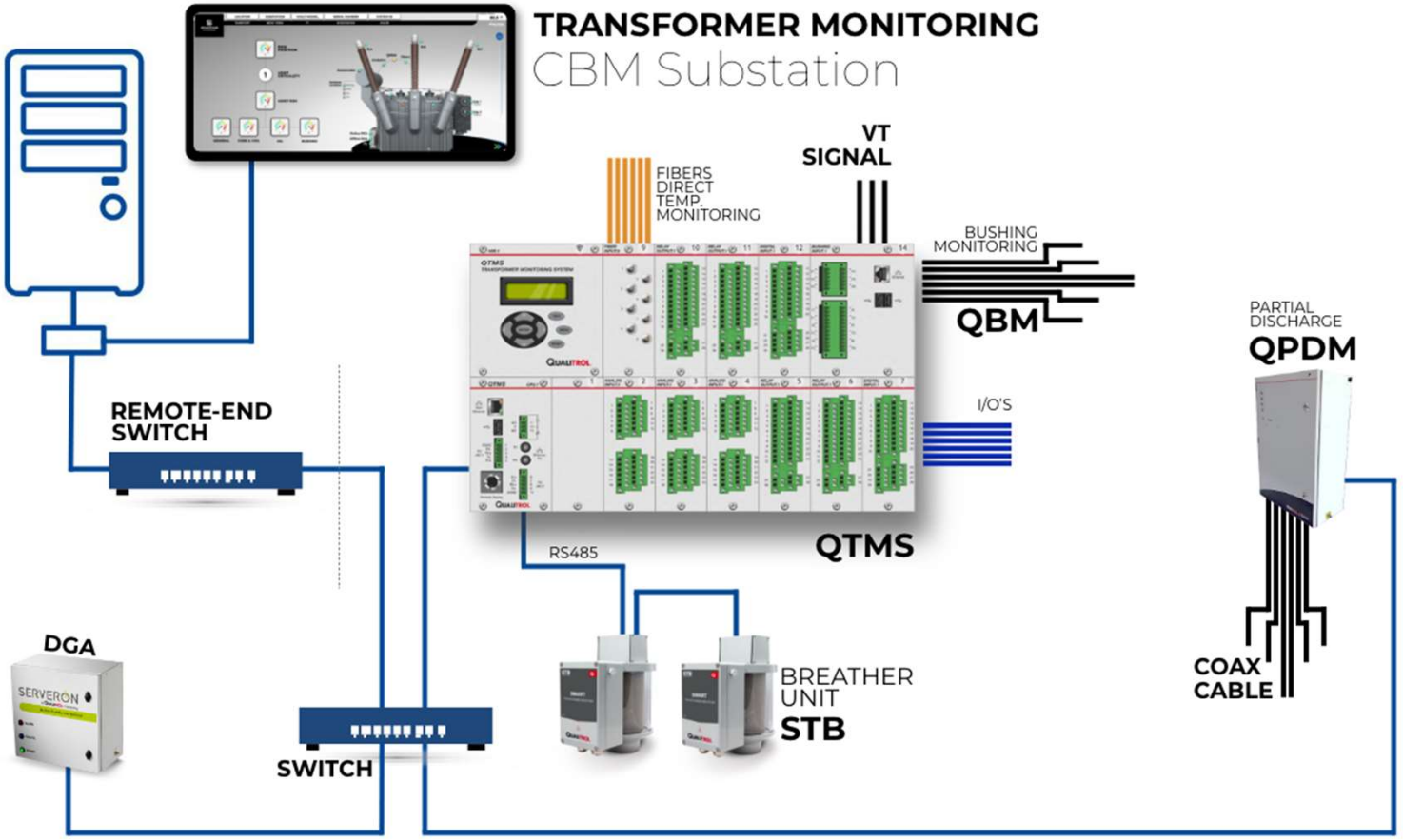
Transformer Failure Modes

IEEE CIGRE IEC		Qualitrol	
10 Transformer Components	65 Failure Modes	7 Transformer Components	42 Failure Modes


Station Risk Chart
1
2
3
4
5
6
7
8
9
10
11
12
ENTERPRISE
SMARTSUB

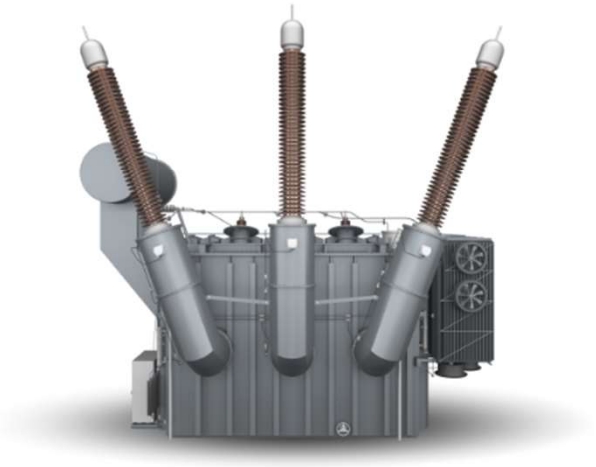

SMARTSUB
ENTERPRISE
LOCATION
SUBSTATION
VAULT MODEL
SERIAL NUMBER
SYSTEM ID
FAIRPORT
NEW YORK
F1
#XXXXXXXX
#5435
Ambient Temp.
80.0 °F
QUALITROL
RISK POSITION
1
ASSET CRITICALETY
ASSET RISK
GENERAL
CORE & COIL
OIL
BUSHING
B.A
B.B
B.C
QPDM
Analytics
Fibers
Conservator
Hardware Condition
Bushing
QTMS
DGA
STB
OLTC
Windings
Temperature
Grp 1
STATUS
Grp 2
STATUS
Online DGA
Offline DGA
FQ

TRANSFORMER MONITORING
CBM Substation



VARIABLES:

SmartSUB



COMPLETE SUBSTATION MONITORING ARCHITECTURE

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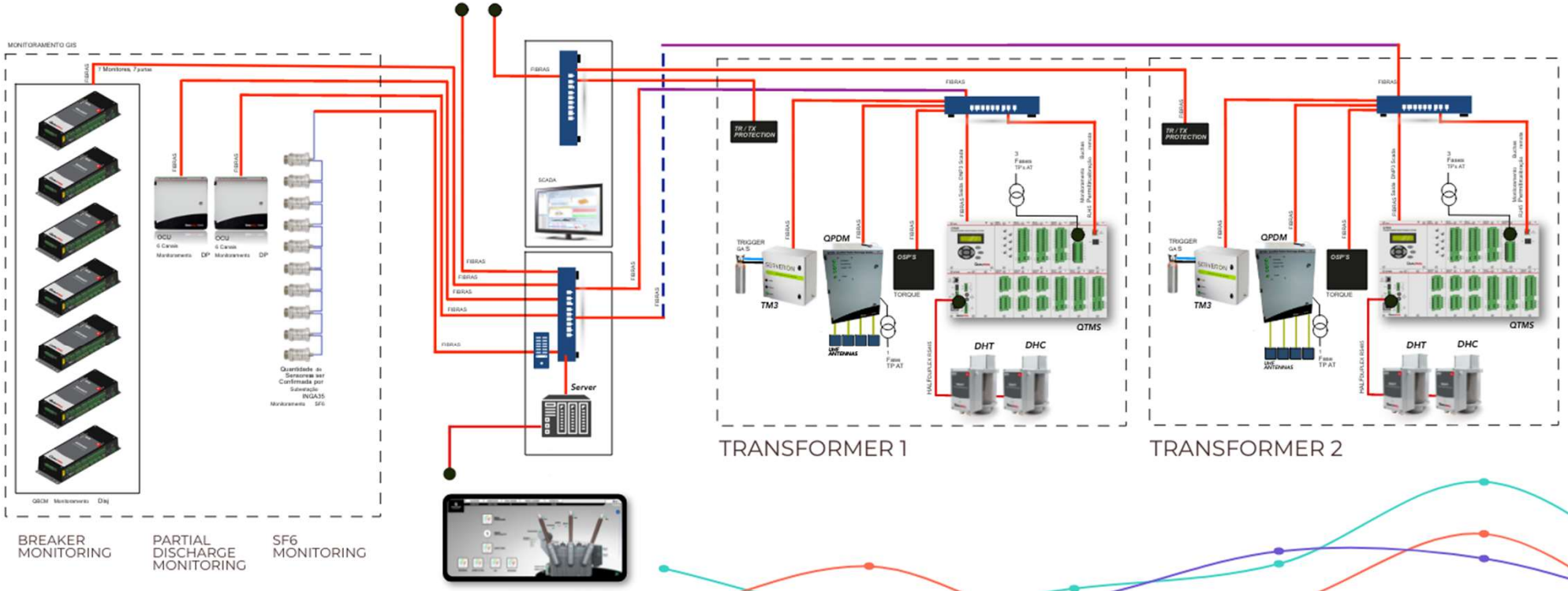

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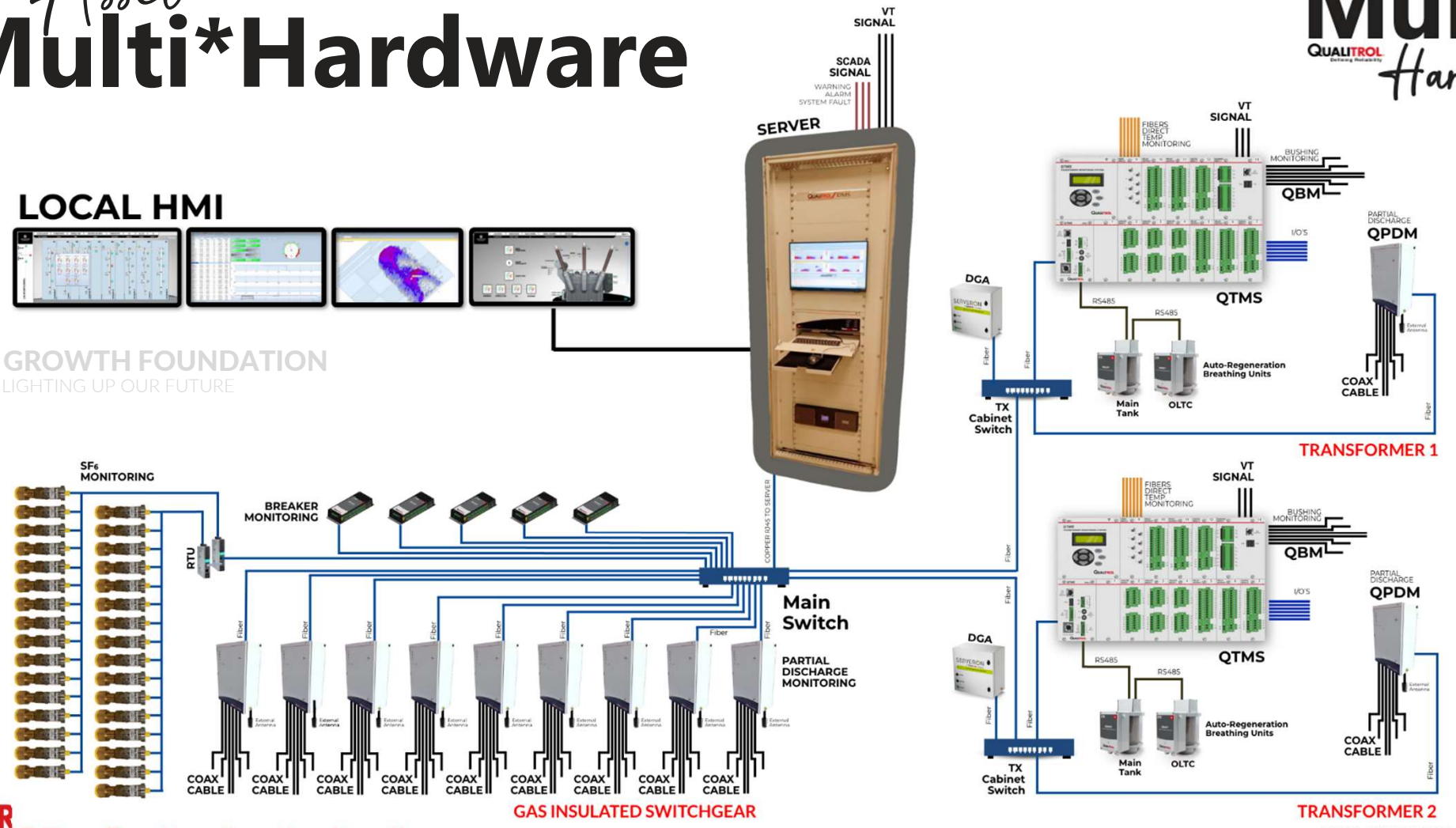
www.qualitrolcorp.com
Asset Health

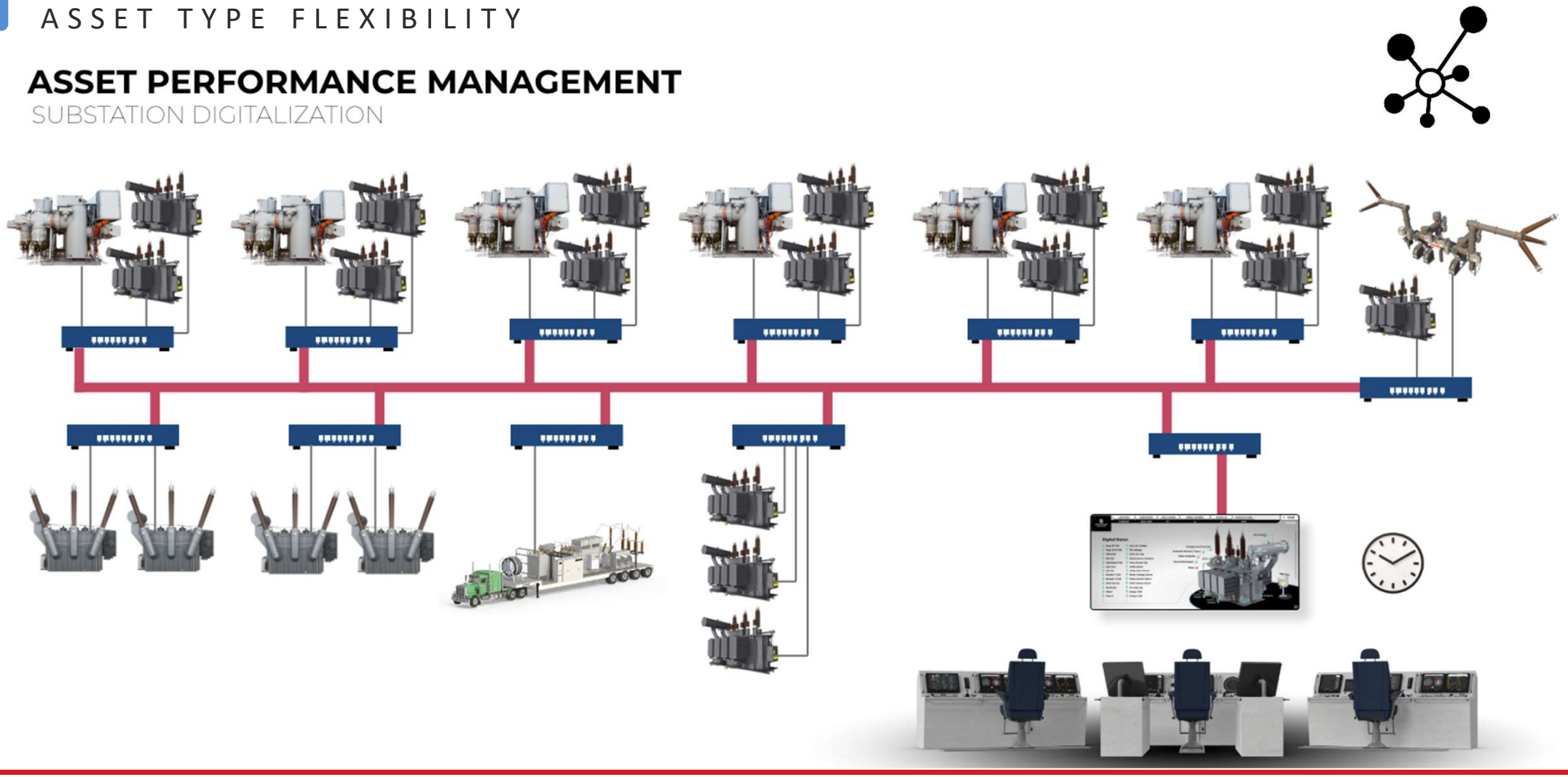
WWW.QUALITROLCORP.COM

Asset Multi*Hardware



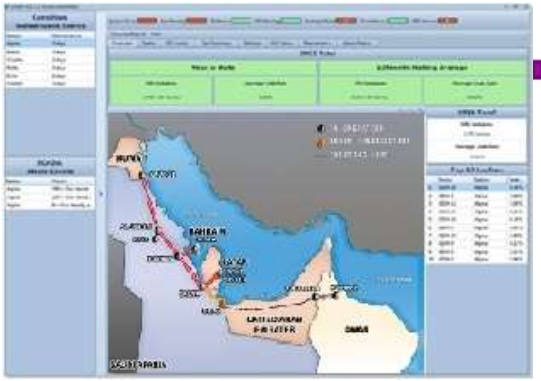
Structure

ASSET TYPE FLEXIBILITY

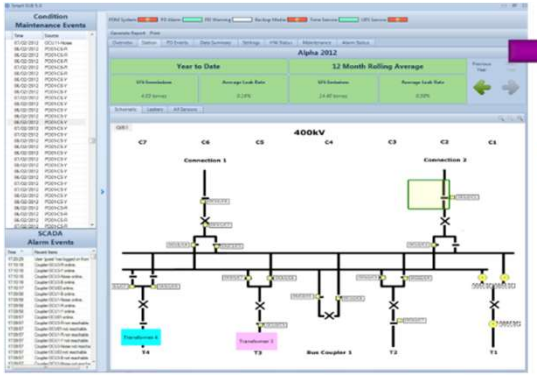


SmartSUB: Easy to use HMI

Intelligent Visualization

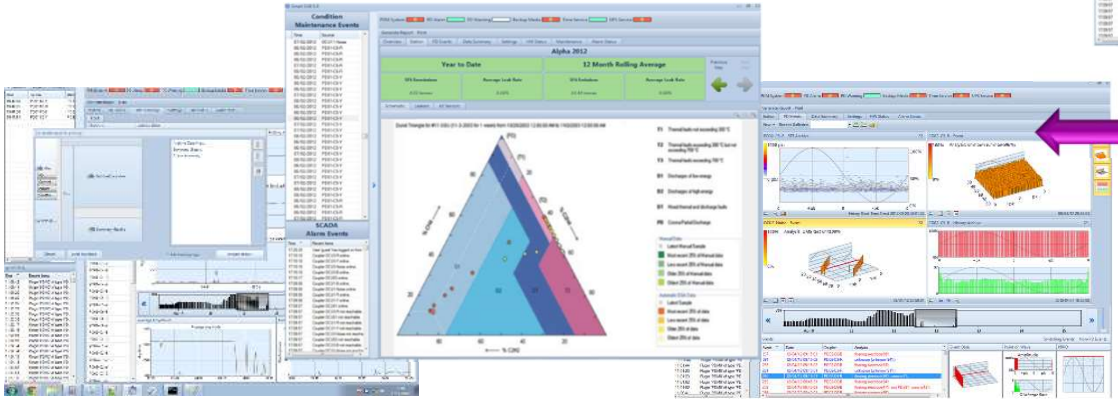


Country wide view: Showing all substations



Station level view: Line diagram showing assets

Asset Level View



Component level view: Showing all displays, data trends and other analysis for each parameter

Qualitrol vs Competition

QUALITROL

- Utility Industry focus
- Largest library of asset monitoring devices
- In-house experts with 100+ years combined experience
- Transformer failure mode fault identification
- Market leading PD analysis
- Single source enterprise view for all asset data
- ML and AI algorithms with a Rete Rules Engine 2.0

COMPETITION

- Generic approach to failures
- Industry agnostic approach to failures
- Focused on their brand only
- Unable to indicate failure modes
- Limited capabilities to add different asset types

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