Smart Transportation Alliance

Digitizing railway power infrastructures
Optimising transit capacity
CBM, AHM, Predictive Maintenance

Laurent Poutrain – VIZIMAX INC
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VIZIMAX - Rugged Solutions for HV-MV Power

MEASURE

xMU - SAMU / PMU

- IEEE C37.118 / IEC 61850-90-5 / IEC 61850-9-2LE / IEC 61869-9 compliant, ModBus TCP/UDP,
- Standalone Analog Merging Unit - SAMU
- From PT & CT to Sampled Values (SV) and process bus in digital substations
- Dual concurrent reporting rates capable + Advanced Measurements

CONTROL

RightWON Satellite/Plus/Engine : Smart Substation Controller

- Automation + Monitoring + Alarm/Event management + Data gateway
- Full support of industrial, energy, power gen and utility protocols
- Integrated web HMI + local SCADA functionality

SWITCH

SynchroTeq System

- For new or existing HV CBs & MV switchgear, regardless of the makes
- Controlled switching and monitoring IEDs
- Inrush Current Limiters for power transformers & reactive loads
- Advanced switching of reactive loads in VAR compensation, Volt/VAR control, PFC, FACTS, in SVC, STATCOM and standalone applications

Highlights – VIZIMAX technologies

- Digitization of existing Railway Power Infrastructures
  - 50 Hz – 60 Hz and 16.7 Hz AC traction
  - AC substations in DC traction (rectifiers, converters)
- Control, monitor HV C/Bs & MV switchgear, regardless of the make
- Improve the C/B - swg lifespan and operator awareness
- **CBM, AHM, Predictive maintenance, Knowledge base**
- Lower risks of service interruption and critical failure
- Interoperable solutions for digital substations
- IEC61850-9-2LE / IEC61869-9 Analog Merging Unit & PMU

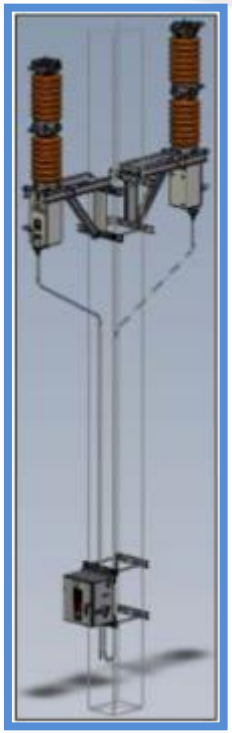
Primary and secondary equipment

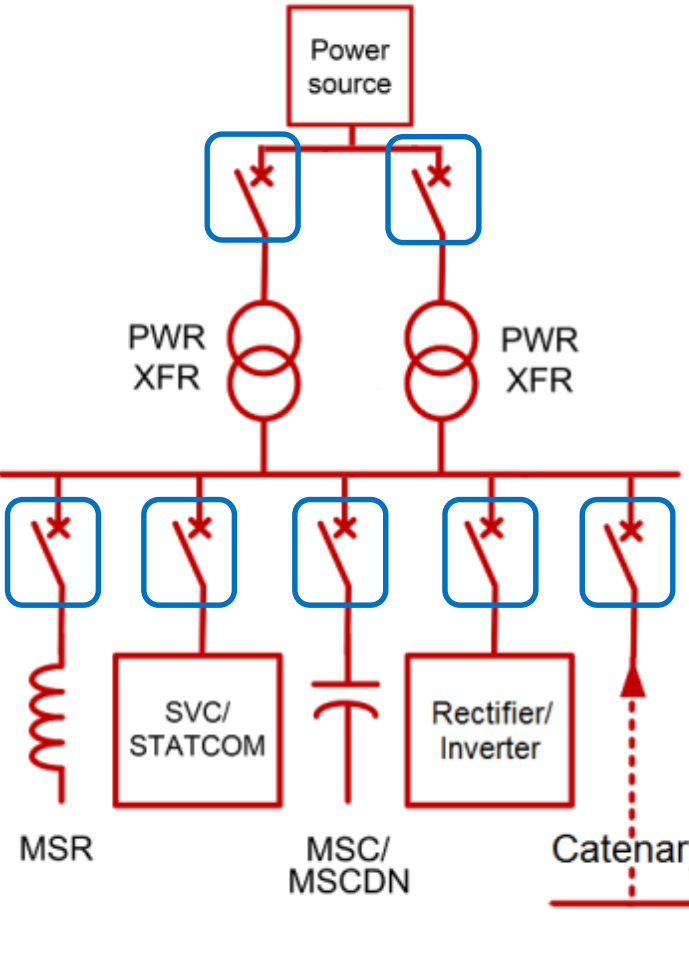
Critical assets for the continuity of service

- Power transformers
- Switchgear
- Capacitors
- Shunt reactors
- VAR Compensators

Digitizing…?

- Power transformers
- **Switchgear**
- Capacitors
- Shunt reactors
- VAR Compensators





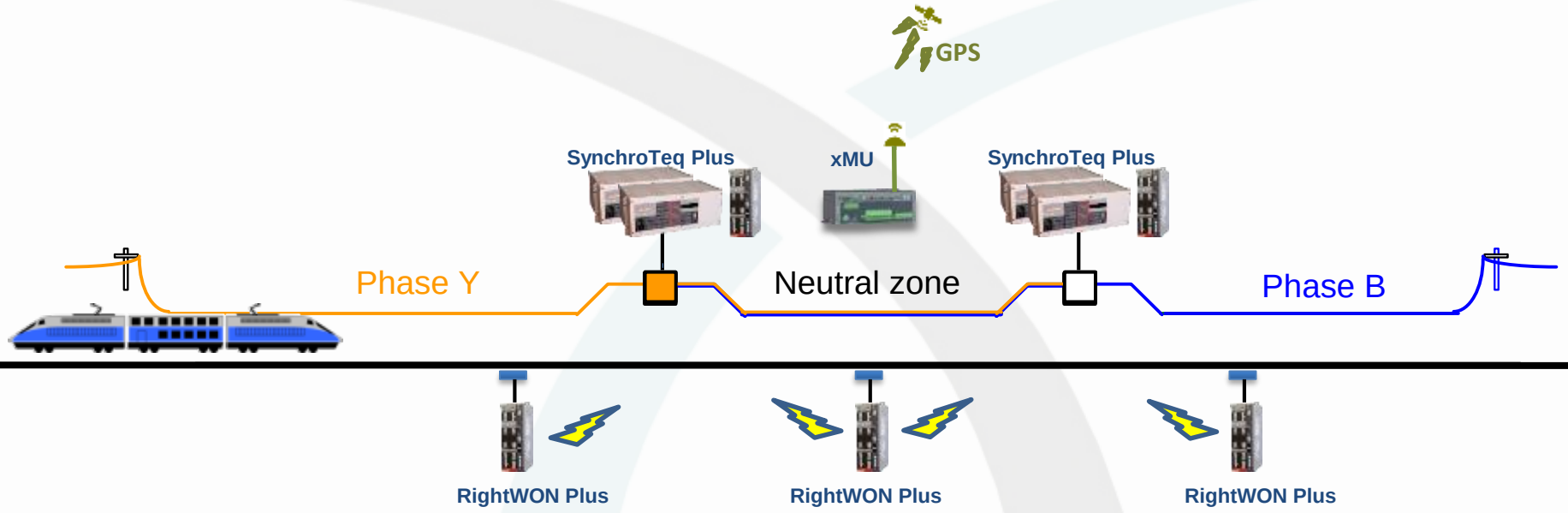
Digitizing railway power infrastructure

Outstanding objectives

- Limit TOTEX
- Increase transit capacity of mass-transit systems
- Decrease design and infrastructure costs
- Improve personnel safety and system availability
- **Predictive maintenance**
- **CBM, Asset Health Management, Knowledge Base**
- Enable large-scale deployments of GHG-free switchgear
- Grid code compliancy / security of energy supply
- Energy savings: AC traction and HST infrastructure
- Lower the risks of failure & service disruption (HST)

Optimising Transit Capacity - Neutral zone

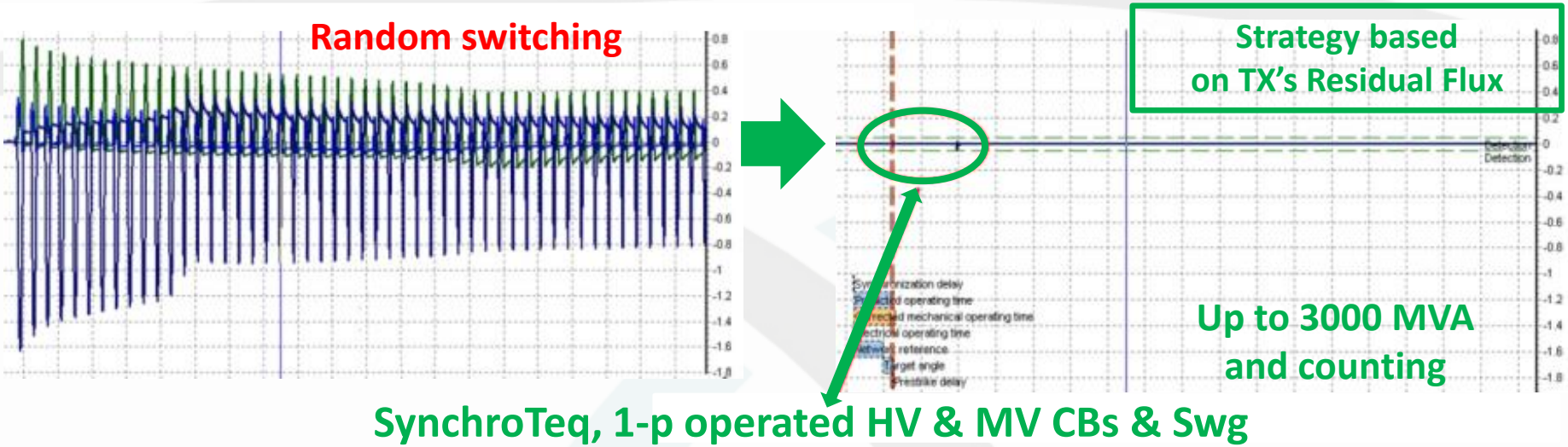
AC traction systems are made of multiple sections, each powered by a substation. Sections are isolated using “neutral zones”.



SNCF

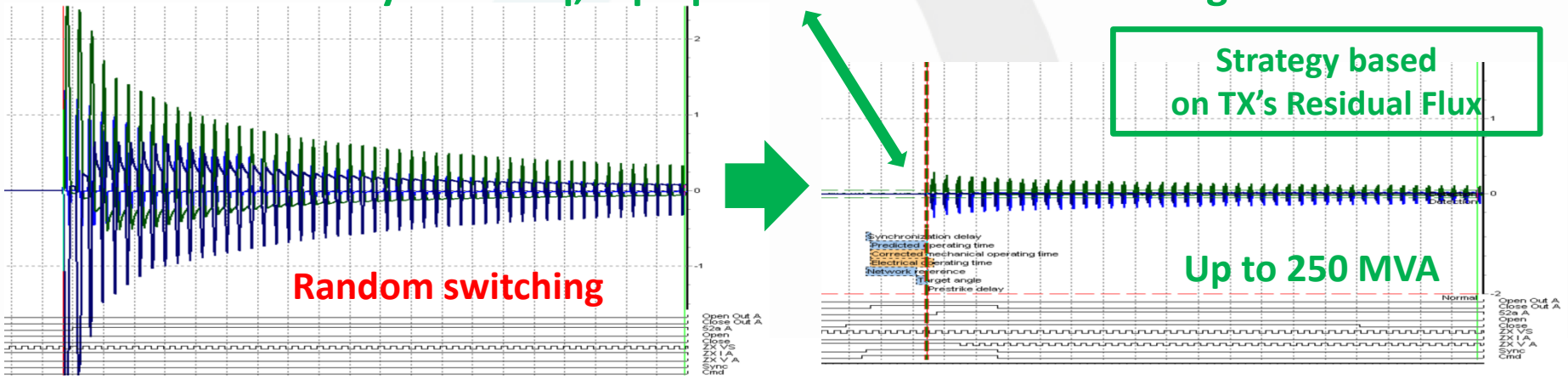
SynchroTrain®

Energizing MV & HV Transformers



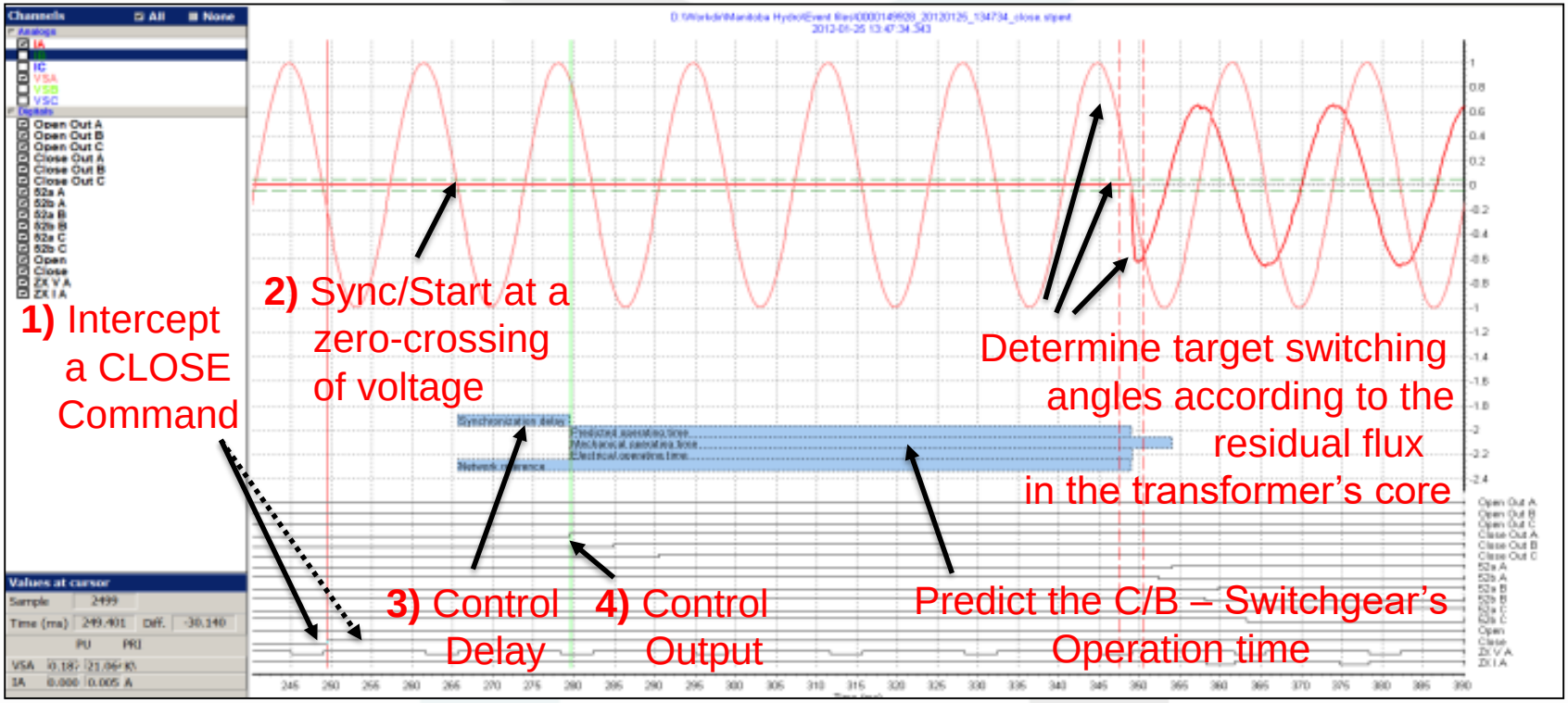
SynchroTeq, 1-p operated HV & MV CBs & Swg

SynchroTeq, 3-p operated HV & MV CBs & Swg



Energizing MV & HV Transformers

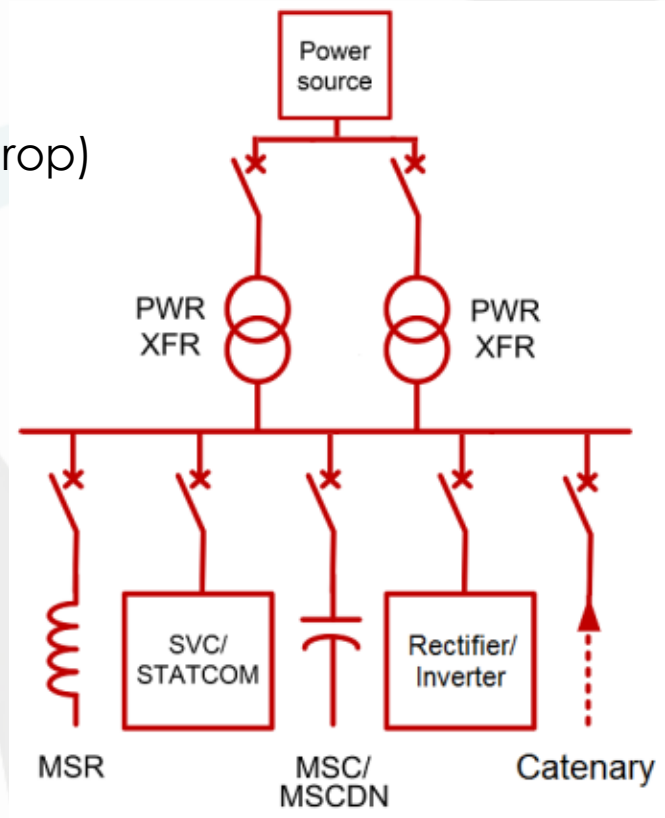
VIZIMAX SYNCHROTEQ – CONTROL AND MONITOR C/Bs



Digitized switchgear

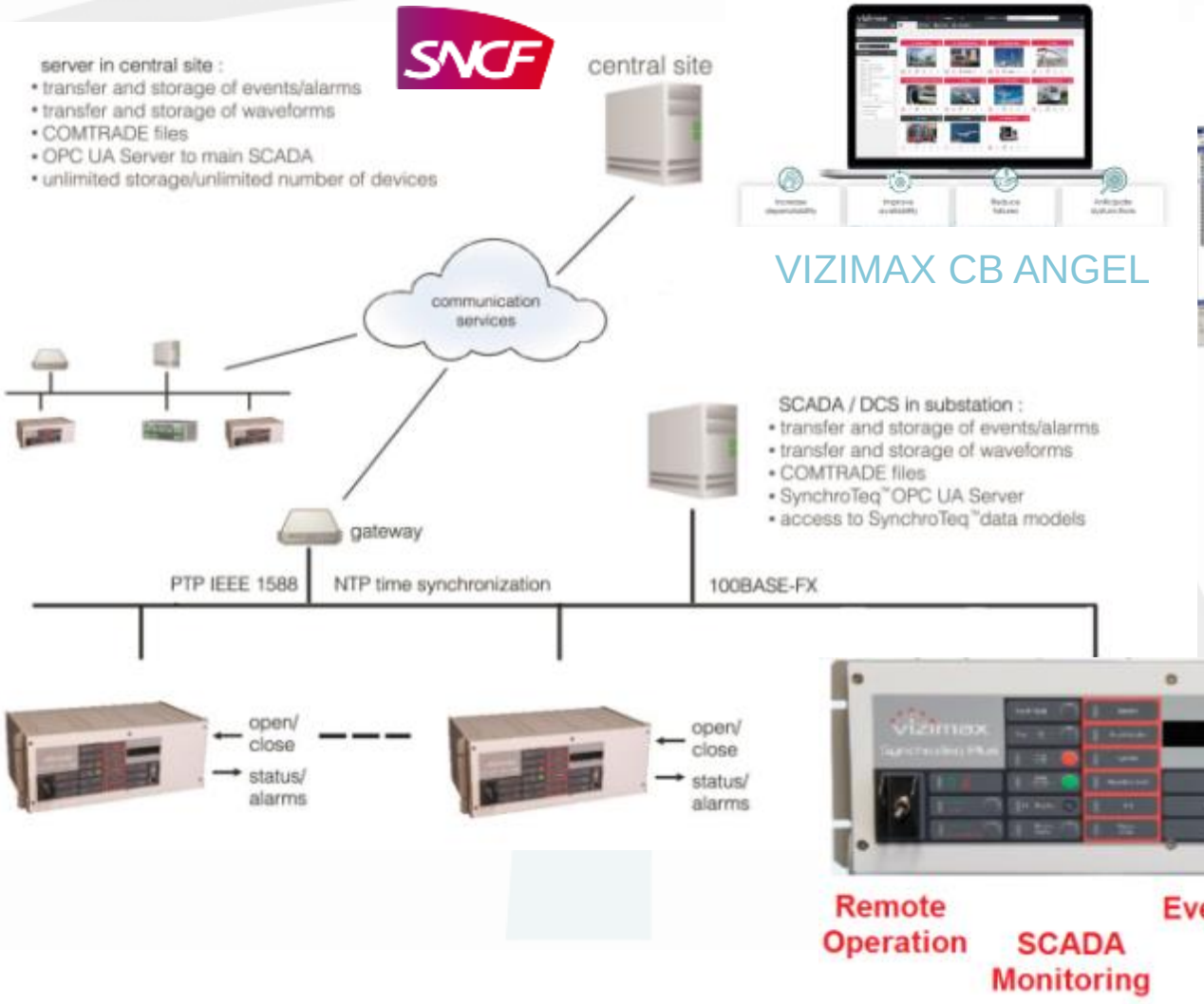
Technical & non-technical objectives – AC and DC traction

- Utility POC & traction **power transformers**
  - Mitigate inrush currents, avoid stresses
  - Meet grid code requirements (ie: voltage drop)
- **Capacitor banks** and **Filter** (MSC/MSCDN/FLT)
  - Mitigate inrush current + Fast-switching
  - Immediate availability: no need to wait
- Switching **shunt reactors** (MSR)
  - Avoid CB re-ignition and DC asymmetry
- Cost-effective VAR Compensation/PFC
  - Enable Hybrid-Statcom
- Switching **catenary**
  - Decrease overvoltage
  - Prevent "non-zero crossing current"



Limit TOTEX – Get the most out of existing assets
Improve personnel safety – Preserve apparatuses – Improve service life
Decrease maintenance costs – Monitor assets – Predictive maintenance

Digitized switchgear



VIZIMAX CB ANGEL

Remote Operation

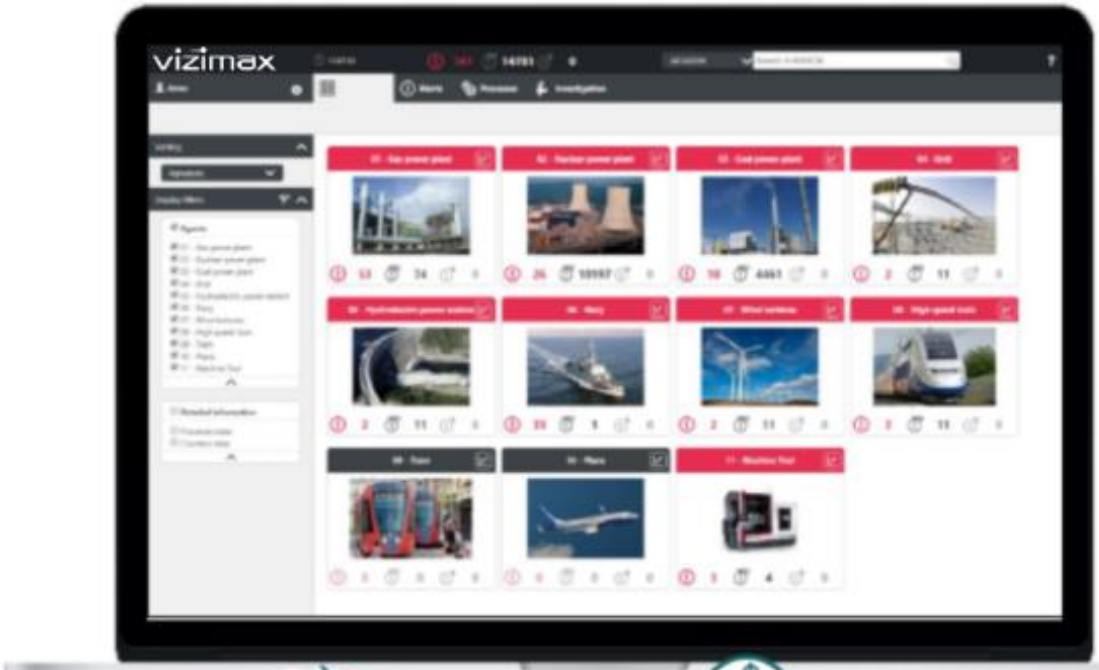
SCADA Monitoring

Event Journal Alarm

Web

CBM, AHM, Predictive Maintenance

VIZIMAX CB ANGEL WEB PORTAL



Increase dependability

Improve availability

Reduce failures

Anticipate dysfunctions

Powered by PREDICT

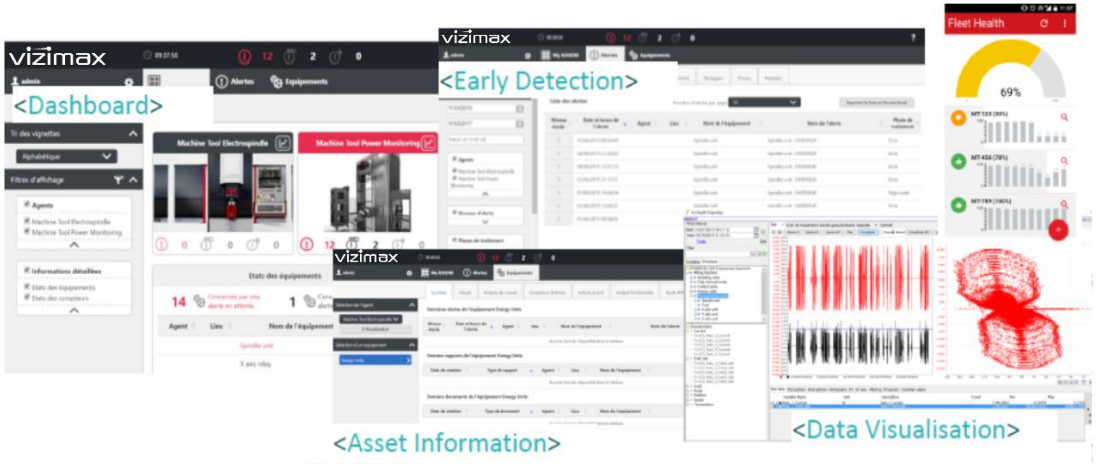
CBM, AHM, Predictive Maintenance

Data Science & Digital Technologies for Prognostic & Health Management

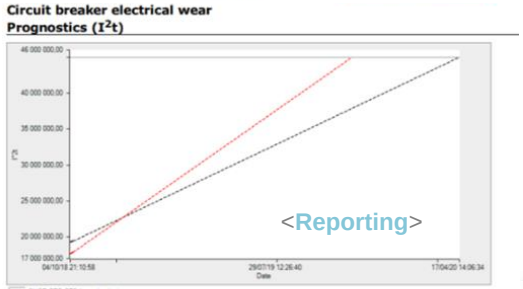
- Real-time Monitoring
- Prognostic / Anticipation
- Health Assessment
- In-depth Data Analysis

1 000+
Users

Efficiency



- Database + Knowledge-based System
- Individual and Fleet-wide approach of diagnostic



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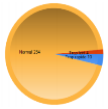


Device	Estimated date to reach 45000000
SNCF-SEC-SP4	14/11/2019 22:36:23
SNCF-SEC-SP2	17/04/2020 14:06:44

1+ Peta Bytes
Big Data

Scalability

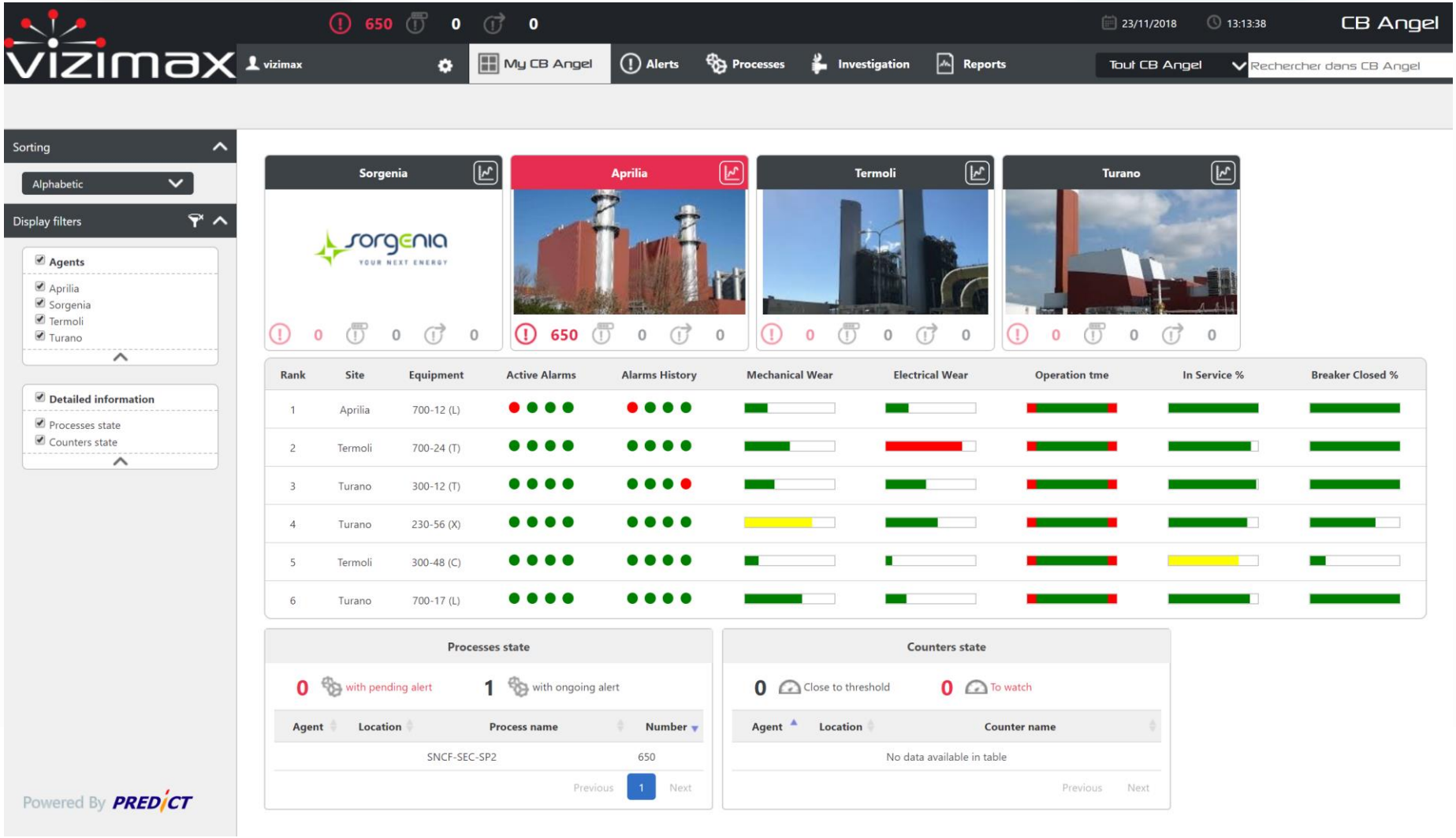
10+ year
Operating Lifetime

24h

Reliability

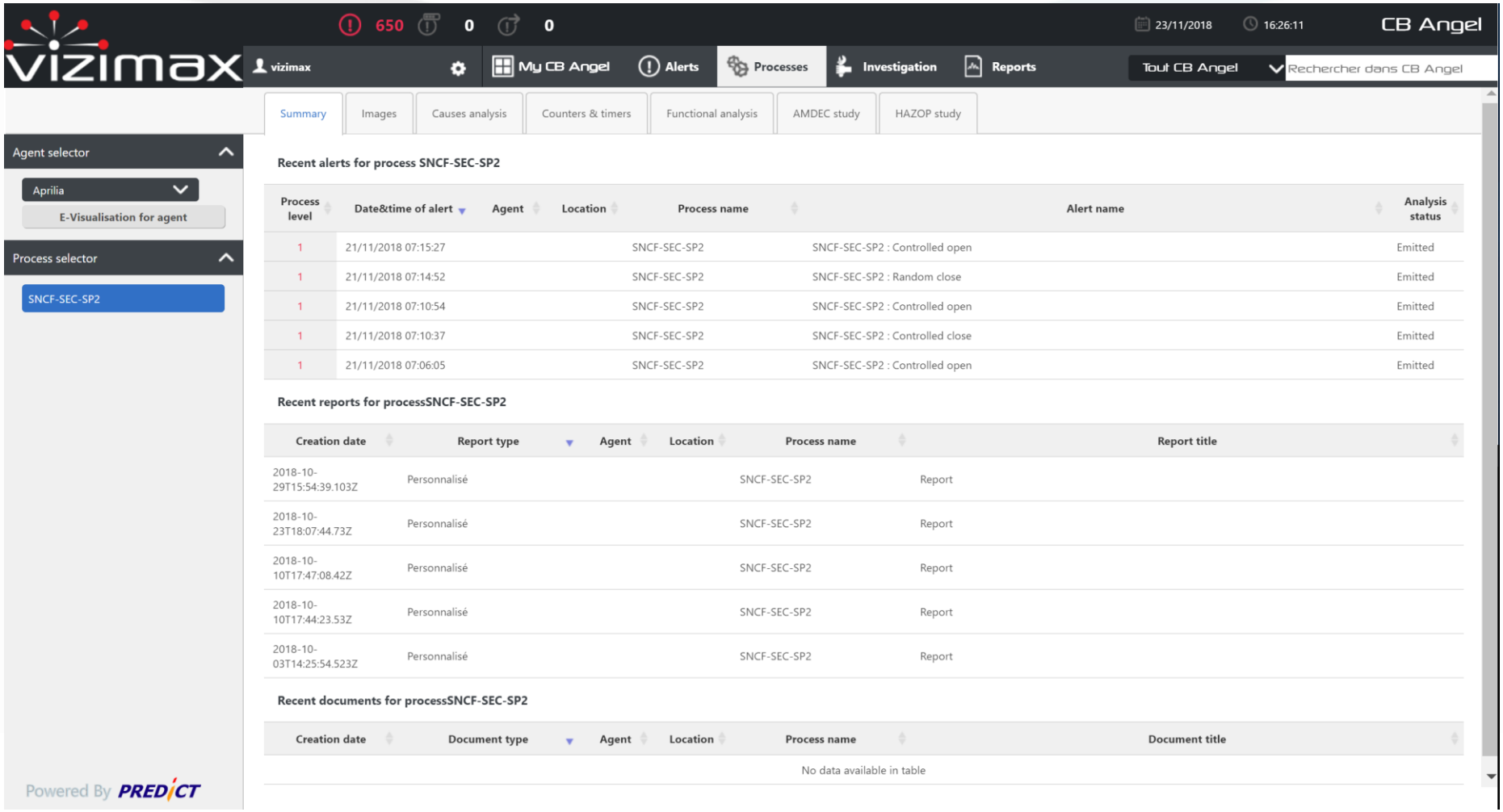
CBM, AHM, Predictive Maintenance

VIZIMAX CB ANGEL – CORPORATE DASHBOARD – KPIs



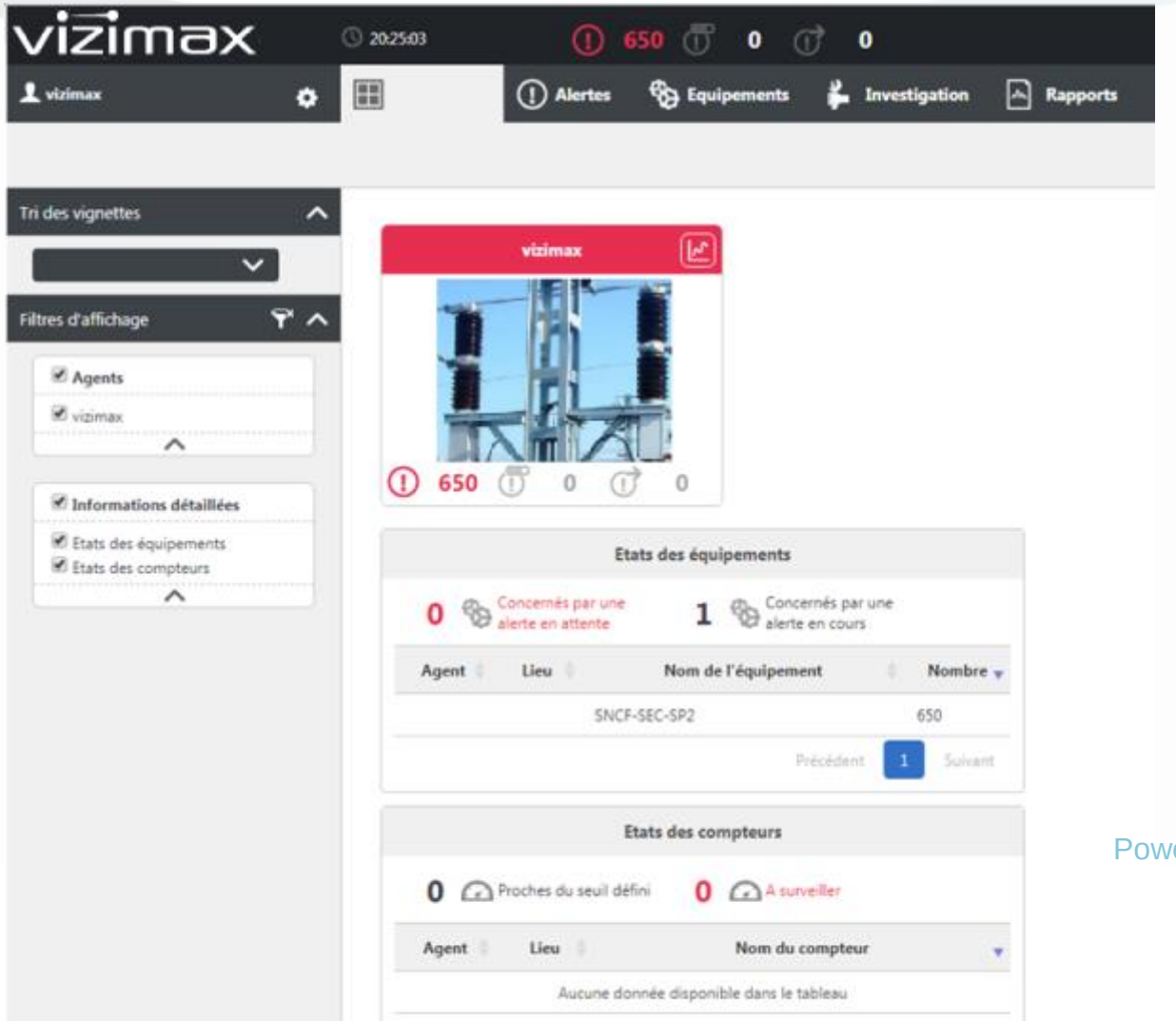
CBM, AHM, Predictive Maintenance

VIZIMAX CB ANGEL – MANAGE EQUIPMENT & FLEET



CBM, AHM, Predictive Maintenance

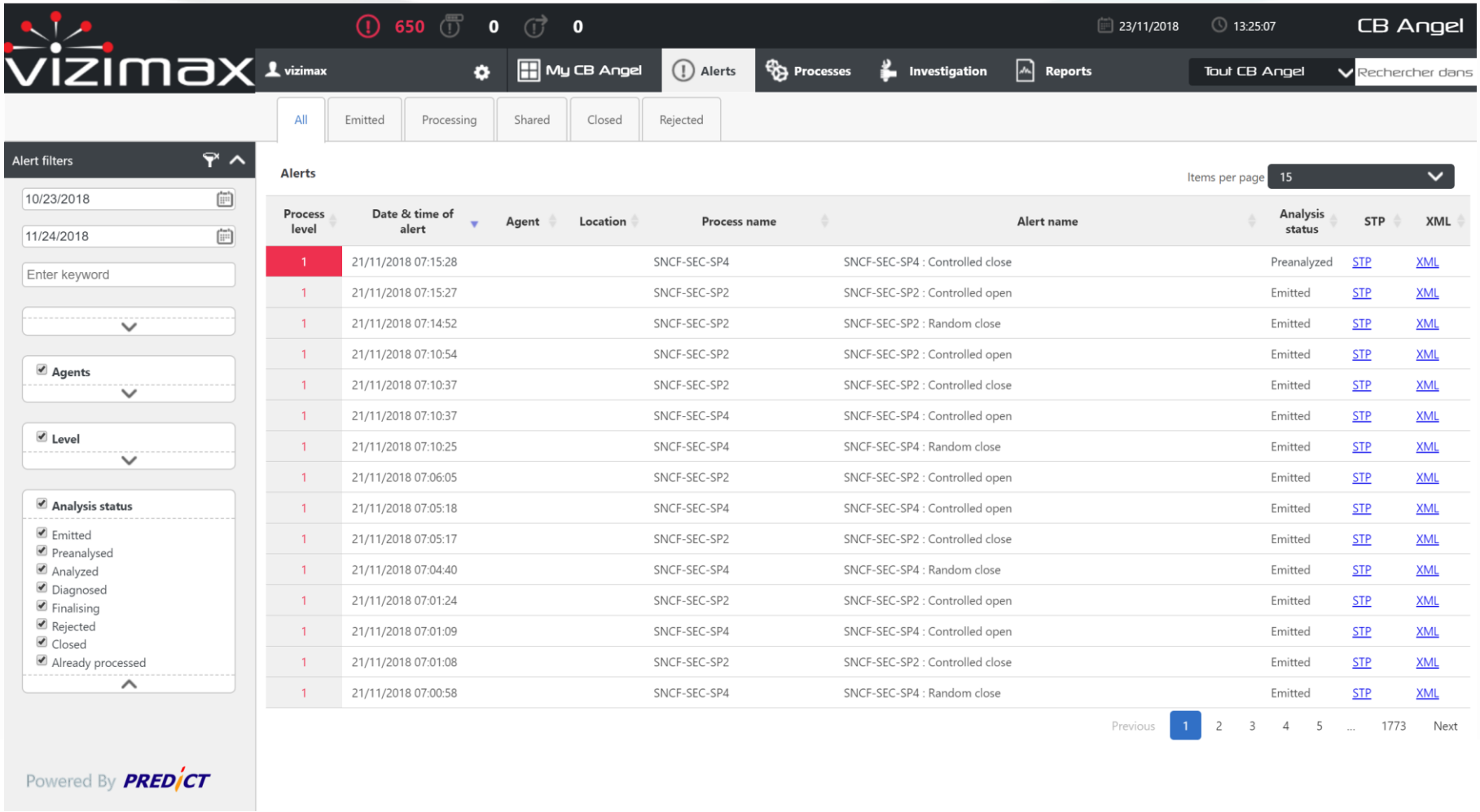
VIZIMAX CB ANGEL – EQUIPMENT DASHBOARD



Powered by PREDICT

CBM, AHM, Predictive Maintenance

VIZIMAX CB ANGEL – MANAGE ALERTS AND EVENTS



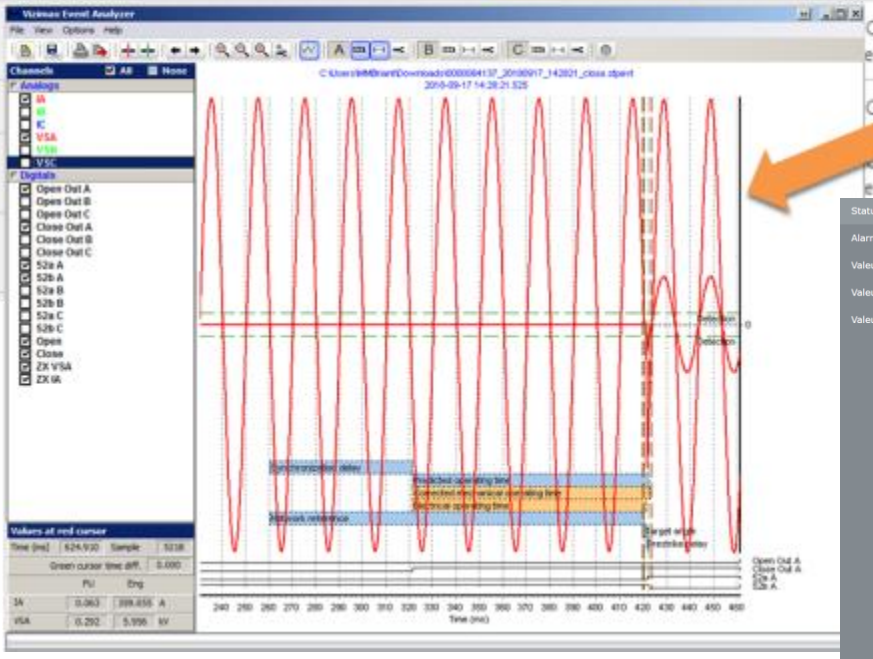
CBM, AHM, Predictive Maintenance

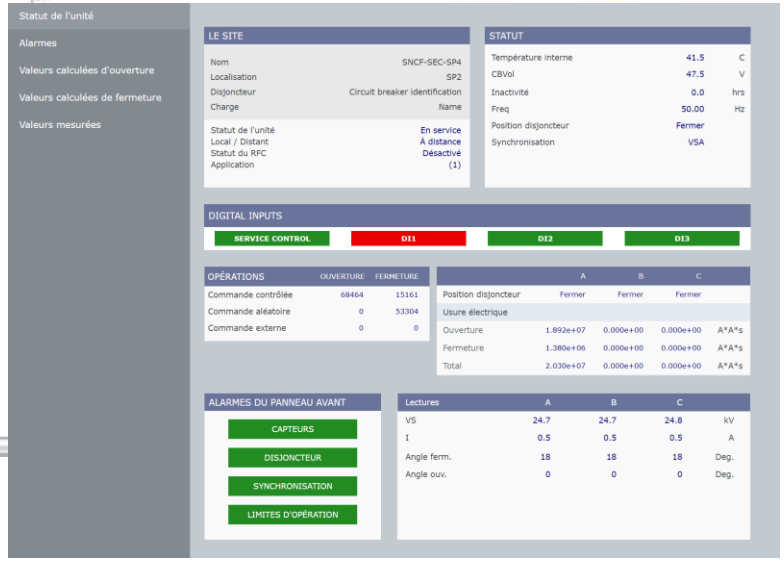
VIZIMAX CB ANGEL – SEAMLESS AGGREGATION OF CBM DATA

Liste des alertes

Nombre d'alertes par page: 10

Niveau équip.	Date et heure de l'alerte	Agent	Lieu	Nom de l'équipement	Nom de l'alerte	Phase de traitement	STP	XML
1	17/09/2018 20:28:42			SNCF-SEC-SP4	SNCF-SEC-SP4 : Controlled open	Emis	STP	XML
1	17/09/2018 20:28:21			SNCF-SEC-SP4	SNCF-SEC-SP4 : Controlled close	Emis	STP	XML
1					CF-SEC-SP2 : Controlled en		STP	XML
1					CF-SEC- ndom close	Emis	STP	XML
1					CF-SEC-SP4 : Controlled en	Emis	STP	XML
1								

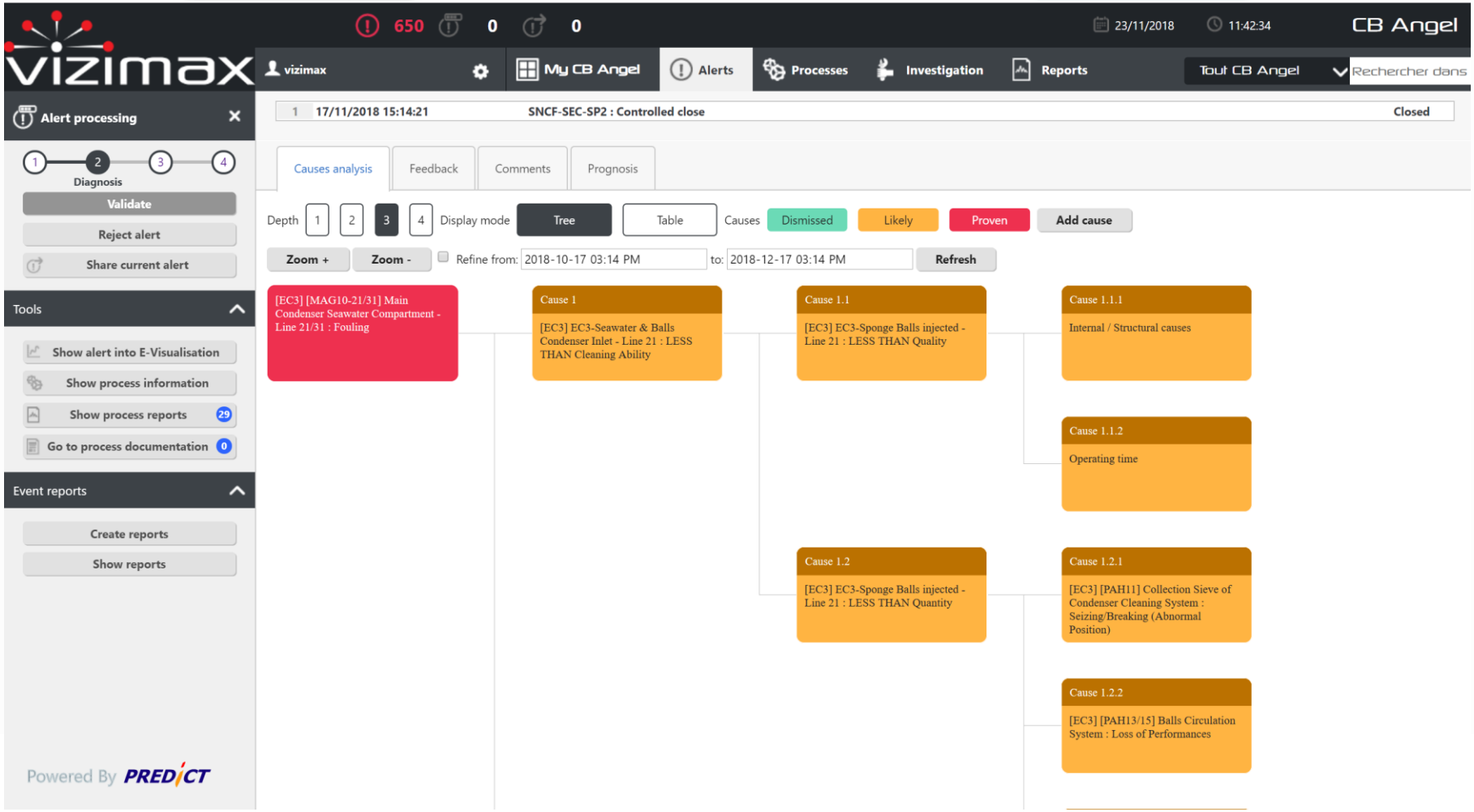




Powered by PREDICT

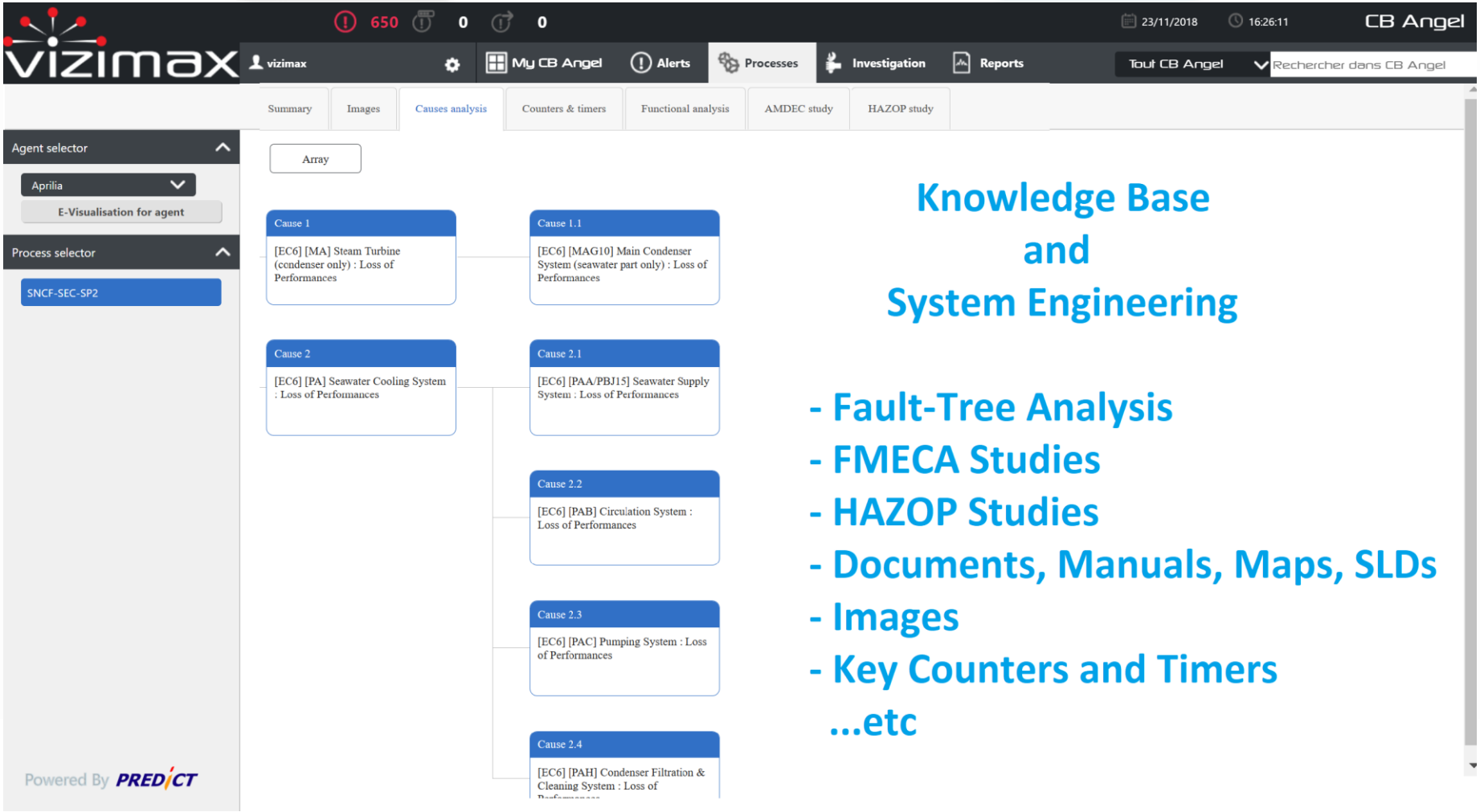
CBM, AHM, Predictive Maintenance

VIZIMAX CB ANGEL – GUIDED ALERT ANALYSIS



CBM, AHM, Predictive Maintenance

VIZIMAX CB ANGEL – MANAGE EQUIPMENT & FLEET



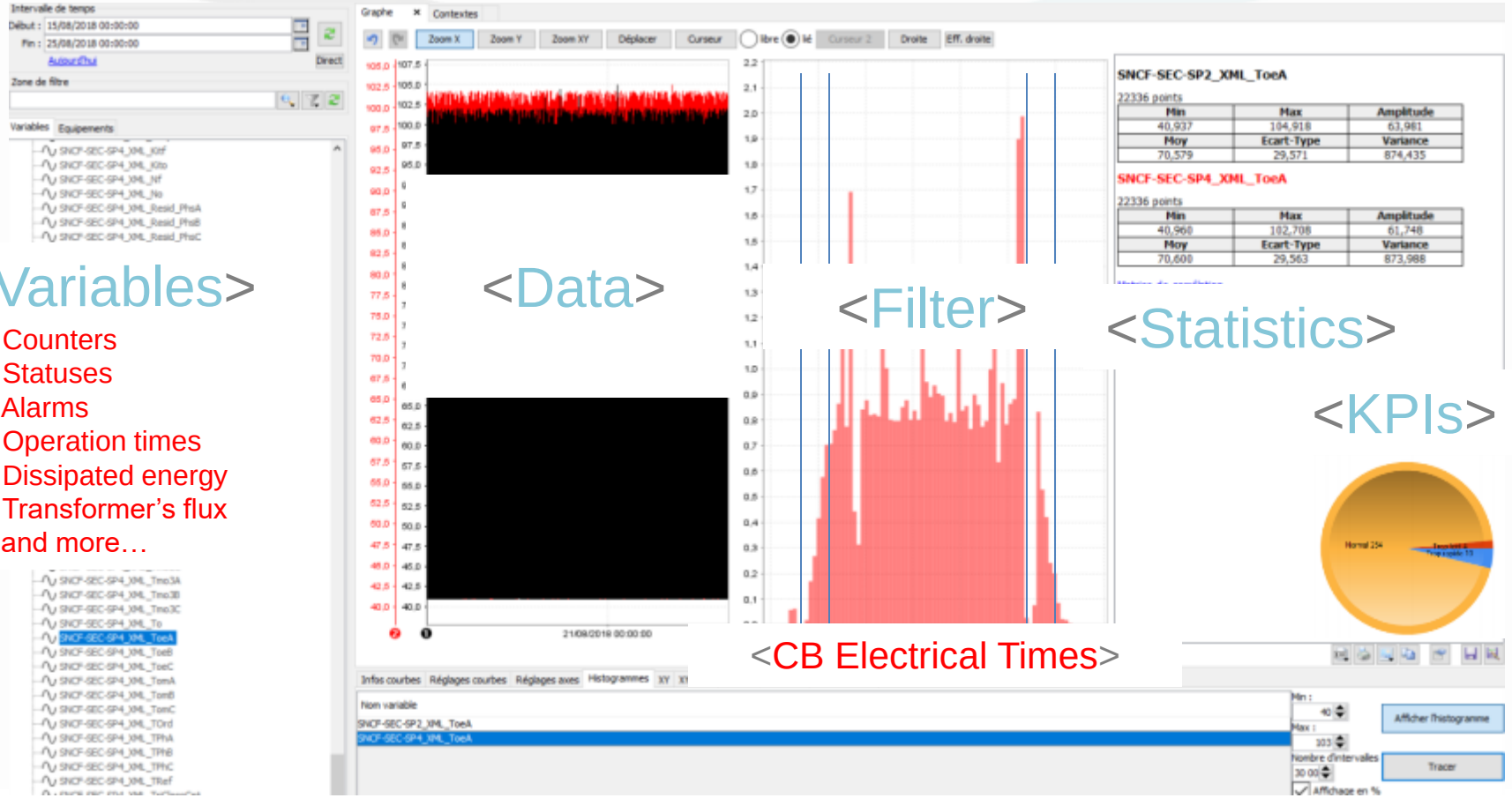
Knowledge Base
and
System Engineering

- **Fault-Tree Analysis**
- **FMECA Studies**
- **HAZOP Studies**
- **Documents, Manuals, Maps, SLDs**
- **Images**
- **Key Counters and Timers**

...etc

CBM, AHM, Predictive Maintenance

VIZIMAX CB ANGEL – FROM RAW DATA TO KPIs



<Variables>

- Counters
- Statuses
- Alarms
- Operation times
- Dissipated energy
- Transformer's flux and more…

<Data>

<Filter>

<Statistics>

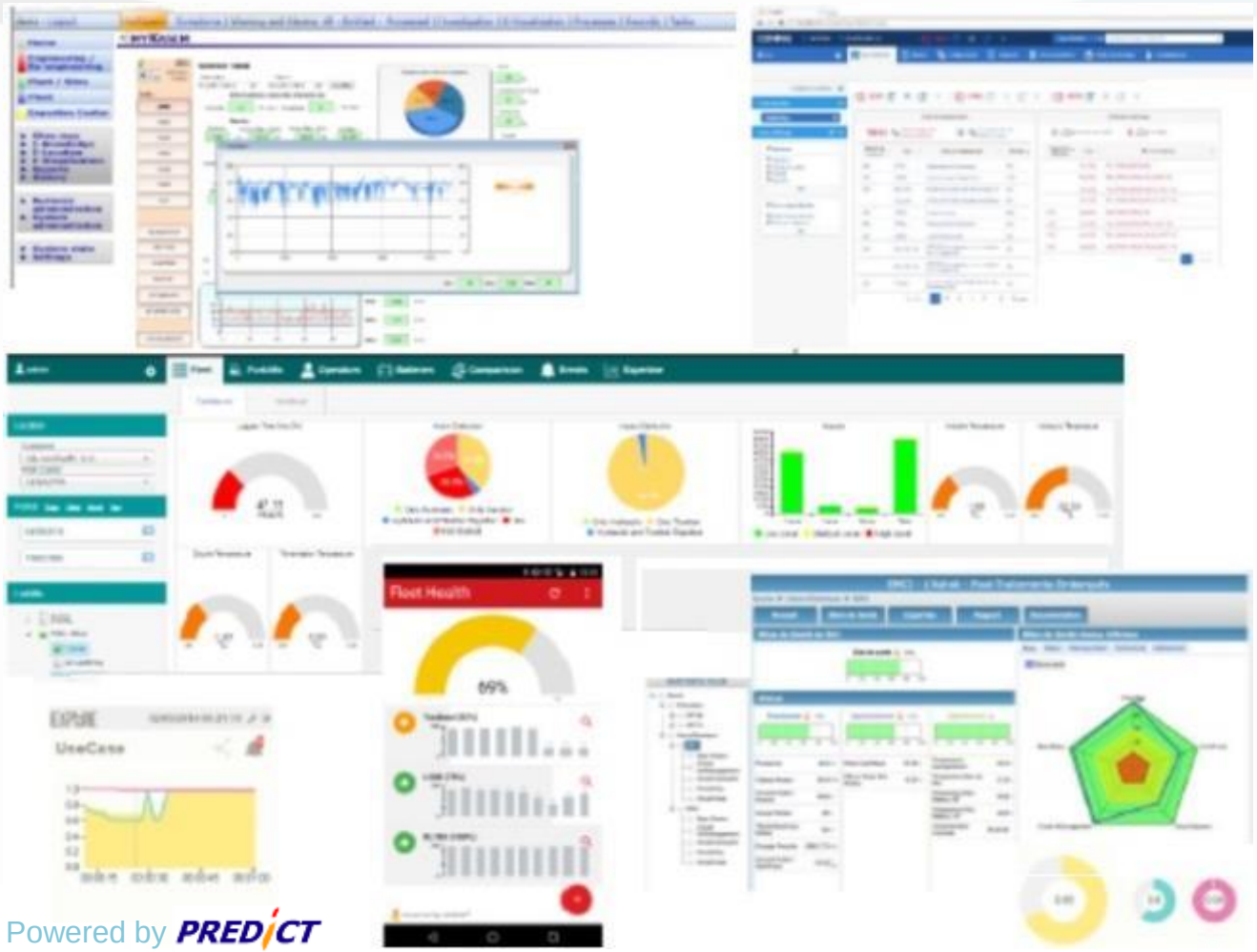
<KPIs>

<CB Electrical Times>

Powered by PREDICT

CBM, AHM, Predictive Maintenance

VIZIMAX CB ANGEL – ADVANCED REPORTING



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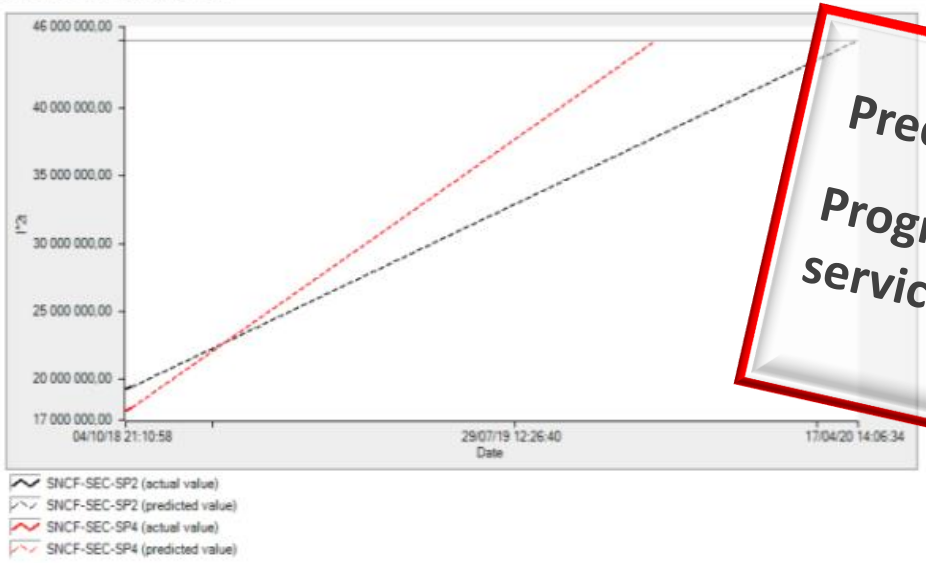
CBM, AHM, Predictive Maintenance

VIZIMAX CB ANGEL – ADVANCED REPORTING

vizimax ENERGY 3.0

SNCF

SNCF Synchrotrain
Circuit breaker electrical wear
Prognostics (I^2t)



Device	Estimated date to reach 45000000
SNCF-SEC-SP4	14/11/2019 22:36:23
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Predictive Maintenance

Prognostics – Remaining service life of switchgear

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CBM, AHM, Predictive Maintenance

VIZIMAX CB ANGEL WEB PORTAL REFERENCES

Defense, Naval, Aeronautics and Space

AIRBUS Defense & Space, AIRBUS Helicopters, BOURBON, CEA, Dassault Aviation, Minister of Defense, NAVAL Group, ORANO, SAFRAN Aircraft Engines, SPHEREA, THALES…

Power Energy (included Renewable Energy)

CEA, DALKIA, NAVAL Energies, EDF, EDP (PT), ENGIE (BE & NL), GE, HUST (CN), IBERDROLA (ES), INTERCONTROLE, JSPM, ORANO, PROET (PT), SINTEF (NO), STEG (TN)…

Powered by PREDICT

CBM, AHM, Predictive Maintenance

Data Science & Digital Technologies for Prognostic & Health Management

- Real-time Monitoring
- Prognostic / Anticipation
- Health Assessment
- In-depth Data Analysis

10+ year
Operating Lifetime

Reliability

1 000+
Users

Efficiency

1+ Peta Bytes
Big Data

Scalability

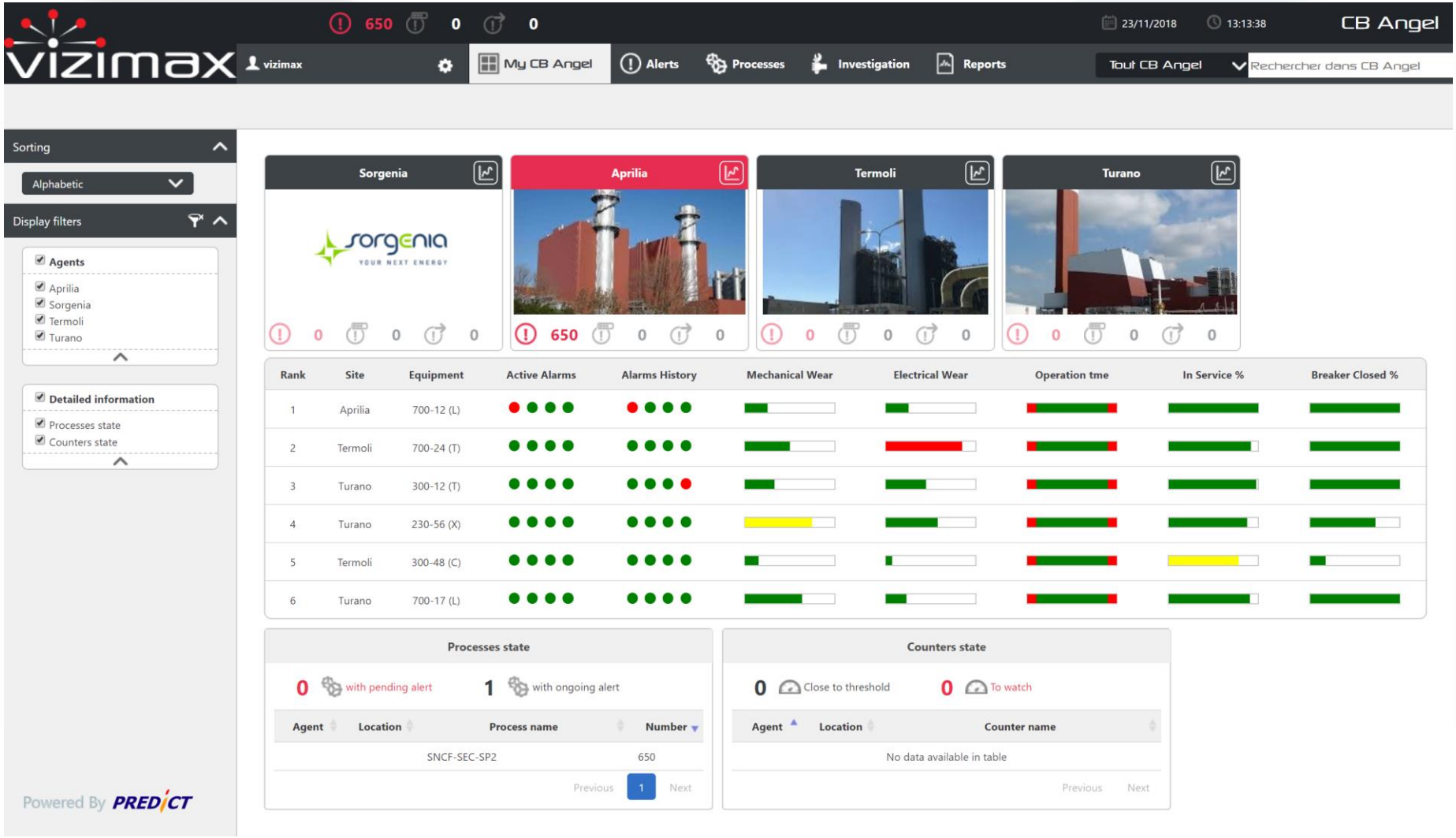
Powered by PREDICT

- Maintenance Solution dedicated to Industry
- Integration of Maintenance Methodology
- Model-based (physics of failure) + Data driven + Experience (empirical rules)
- Toolbox of 50 algorithms "Industry Proven"
- Workflow to solve problem from early detection to problem fixing and closure

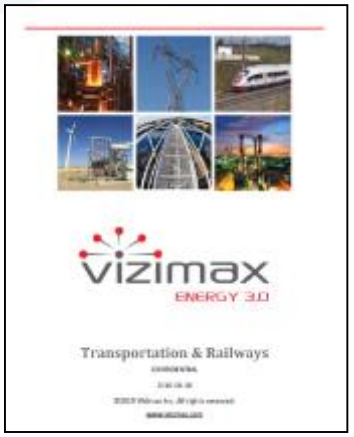
- Causality graphs for diagnostic of degradation
- Individual and Fleet-wide approach of diagnostic
- Experience and cases capitalisation for knowledge improvement
- Database + Knowledge-based System
- Integration, usage and update of HAZOP, FMECA, Fault-Tree…

CBM, AHM, Predictive Maintenance

VIZIMAX CB ANGEL WEB PORTAL



Discussion - Contacts



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José PAPI - S3 Innovation - j.papi@etelatar.com

Smart Transportation Alliance

THANK YOU FOR YOUR ATTENTION

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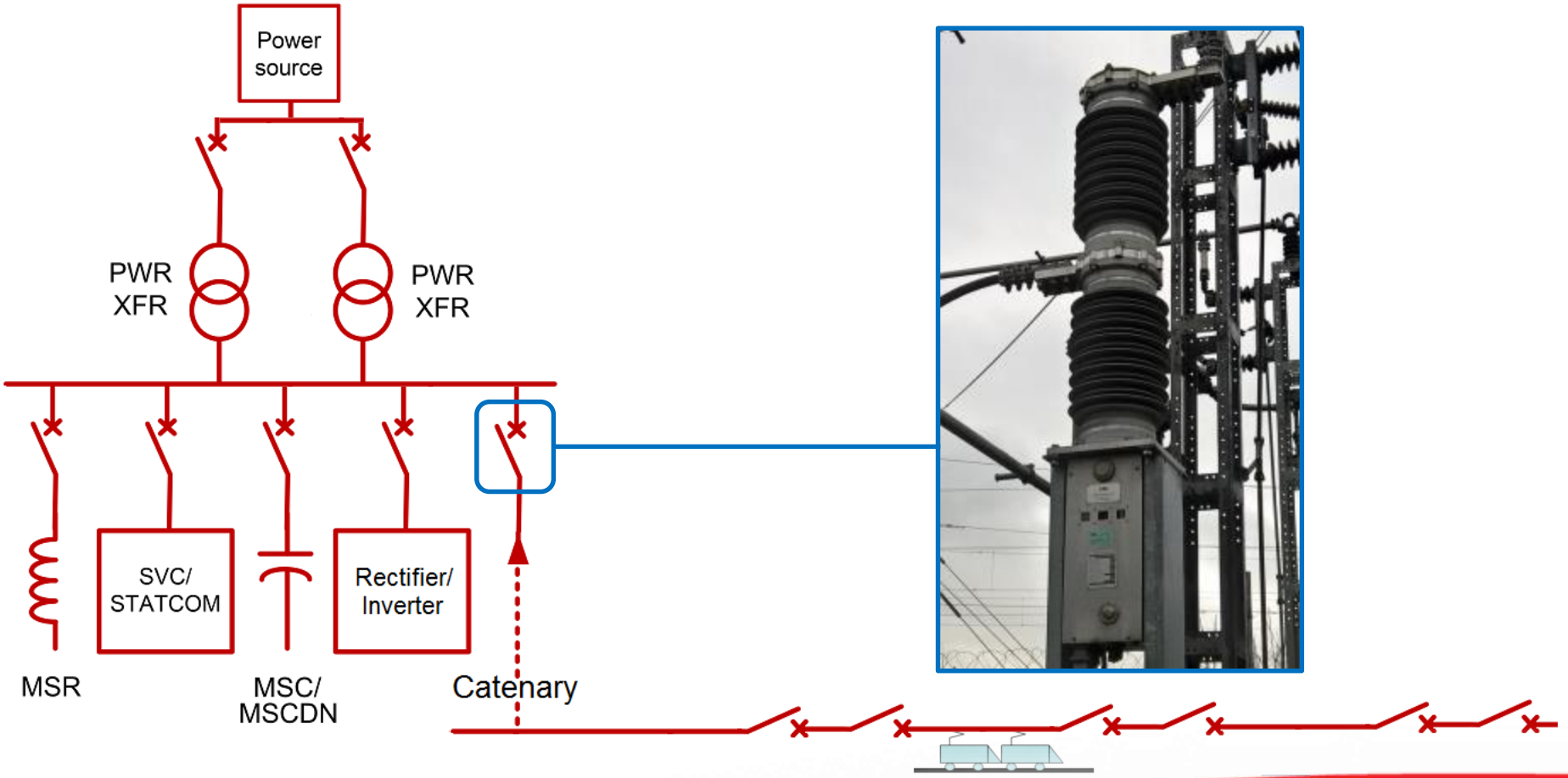
www.smart-transportation.org

Example 1 - Catenary protection

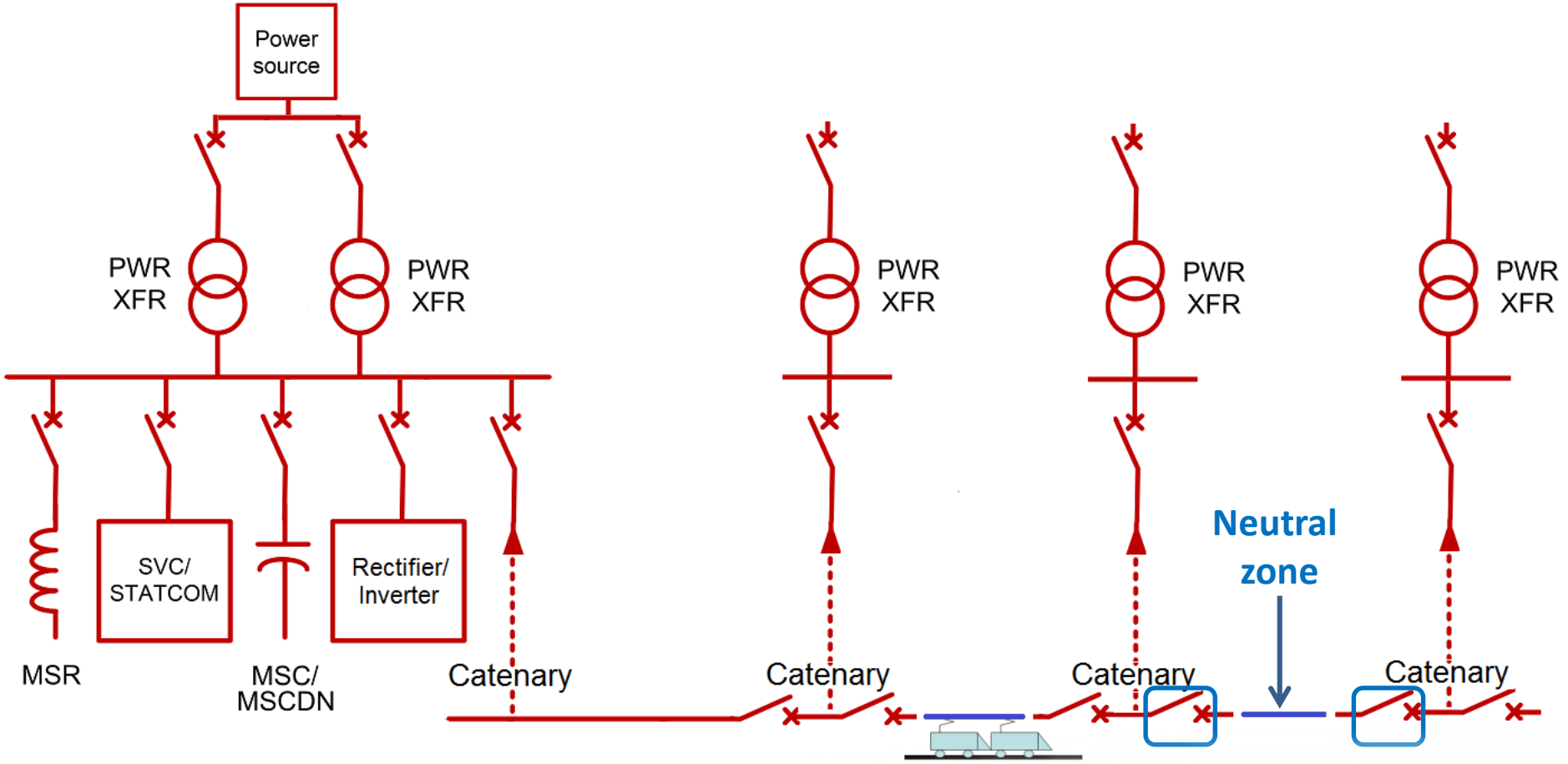
The overhead lines (catenary) in AC traction systems are energized and protected using circuit breakers (MV switchgear).



Example 2 – MV Transformers

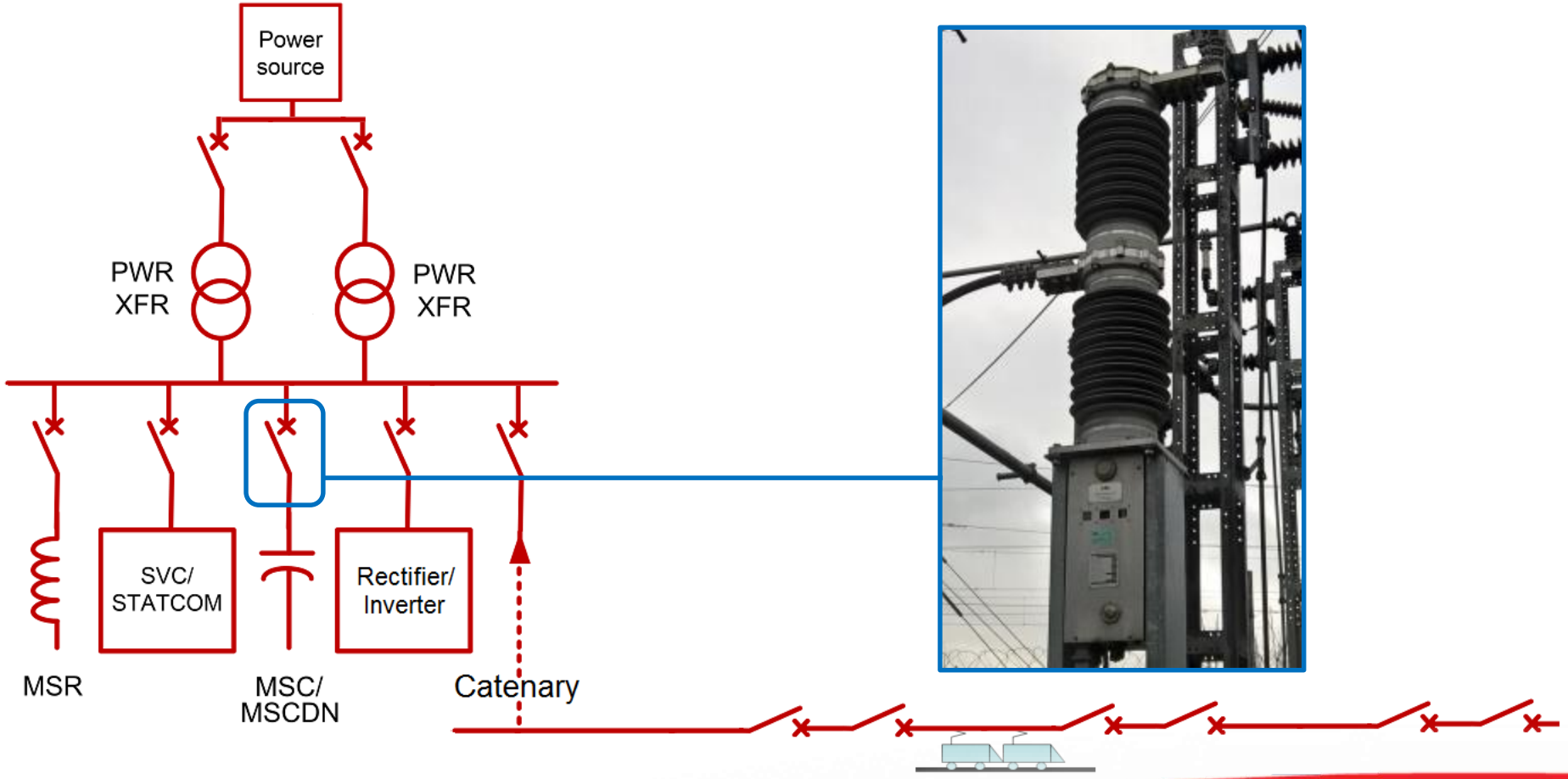
Example 3 – Neutral zone

AC traction systems are made of multiple sections, each powered by a substation. Sections are isolated by "neutral zones".

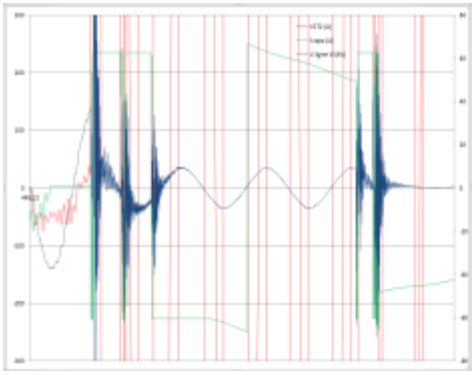


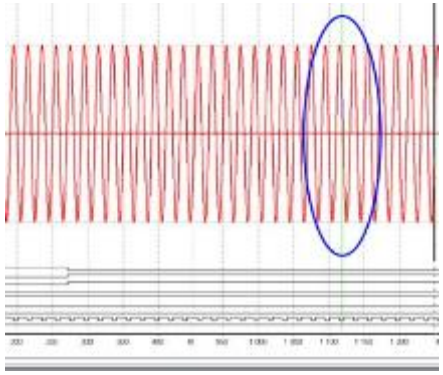
Example 4 – Capacitors and Filters

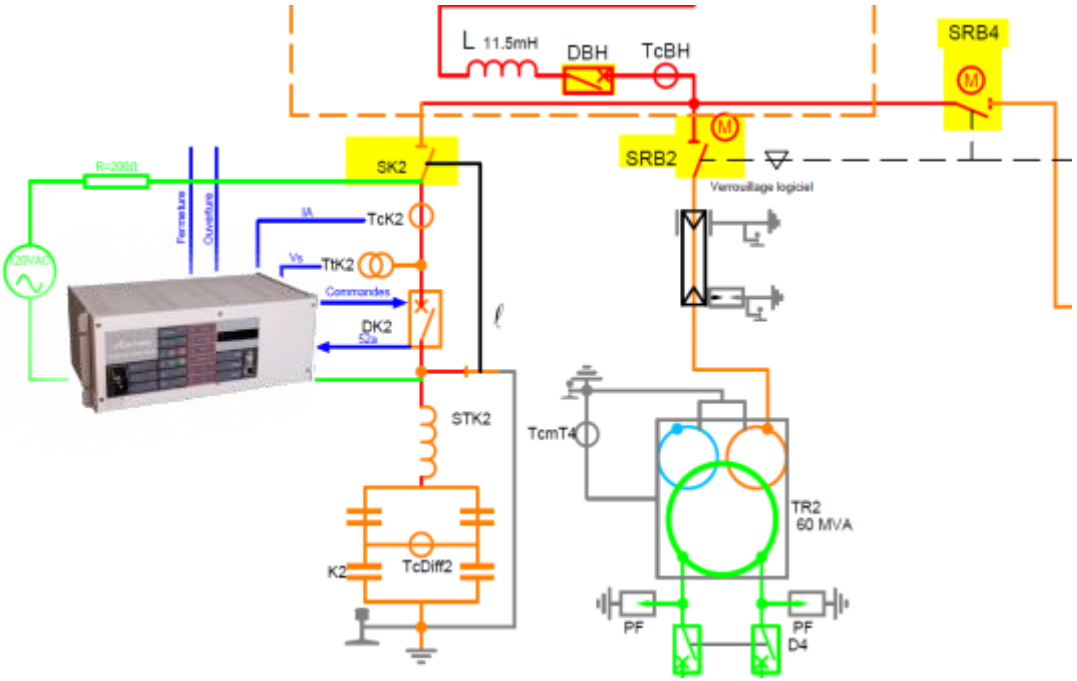
Reactive power compensation and power factor correction call for capacitors / filters in standalone or in hybrid-Statcom / SVC applications



Example 4 – Capacitors and Filters







- Asset Preservation
- CB Wear / I2t Reduction
- Data & Status Collection
- Predictive Maintenance

vizimax ENERGY 3.0

MEASURE – Solutions for digital substations

MEASURE

CONTROL

SWITCH

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MEASURE – xMU / SAMU & PMU – Benefits

- **Asset protection**
  - Extend the service life of existing PTs, CTs and CVTs
  - International standards compliance: interoperability
- **Reduce installation & maintenance costs**
  - Many copper cables replaced with few optical cables
  - Solves cable duct congestion
  - Simplifies system commissioning & troubleshooting
- **Improved system performance**
  - Improve substation safety by eliminating open current circuit condition
  - Improve accuracy by eliminating CT saturation
  - Improve the flexibility of the protection system
  - Top measurement & time precision accuracy

Enhanced measurements:
Flexible & scalable systems

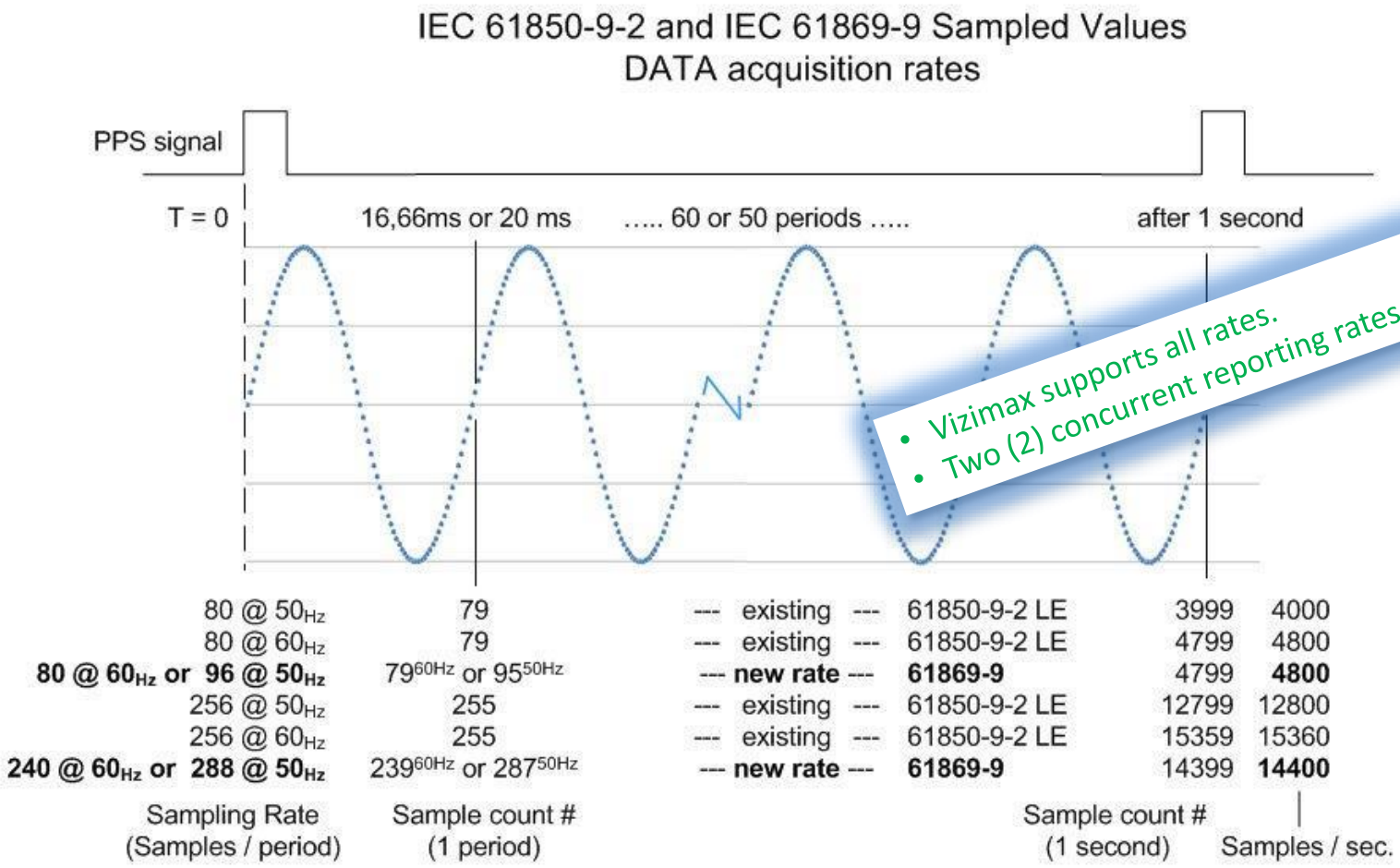
MEASURE – xMU – SAMU & PMU

- **IEEE C37.118.1a-2014 Certified (2005 and 2011)**
- Exceeds requirements for M & P measurement class accuracy.

- From 1 and up to **200 frames per second (50Hz) – up to 240fps at 60Hz**.
- Time sync via IRIG-B, IEEE PTP 1588, NTP combined with PPS signal or via internal 100ns precision GPS receiver.
- Web based configurator and viewer.
- **Optional 10x Built-in DIs**, ModBus TCP & Serial, **GOOSE Messaging**.
- **Dual** C37.118 output streams with independent parameter sets.
- Dual Ethernet ports (copper/fiber) and **hardware PRP support**.
- **IEC 61850-9-2LE / IEC 61869-9** enabled - Two concurrent reporting rates.

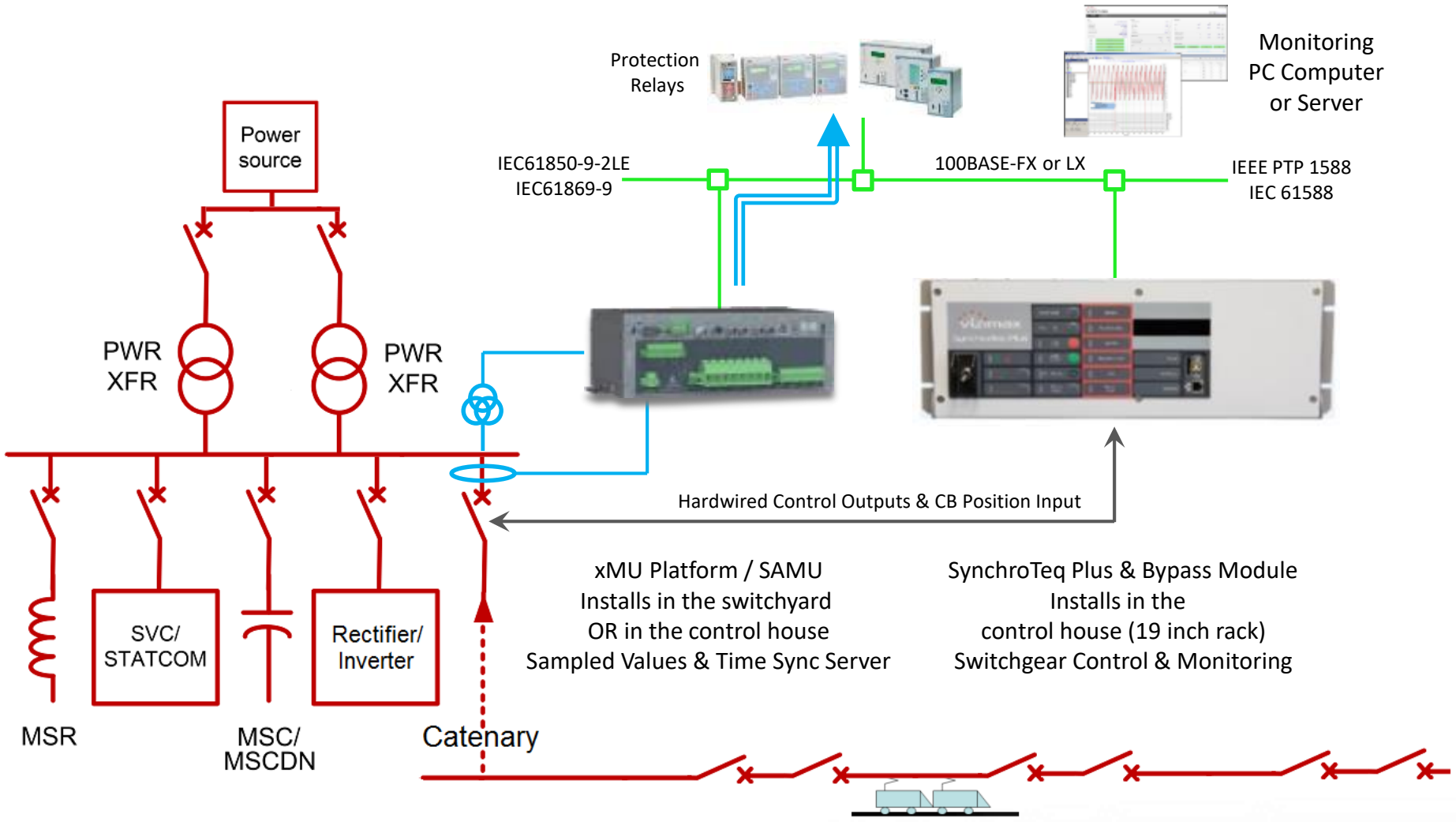
World's fastest IEEE PMU 240 f/sec

MEASURE – xMU – SAMU & PMU

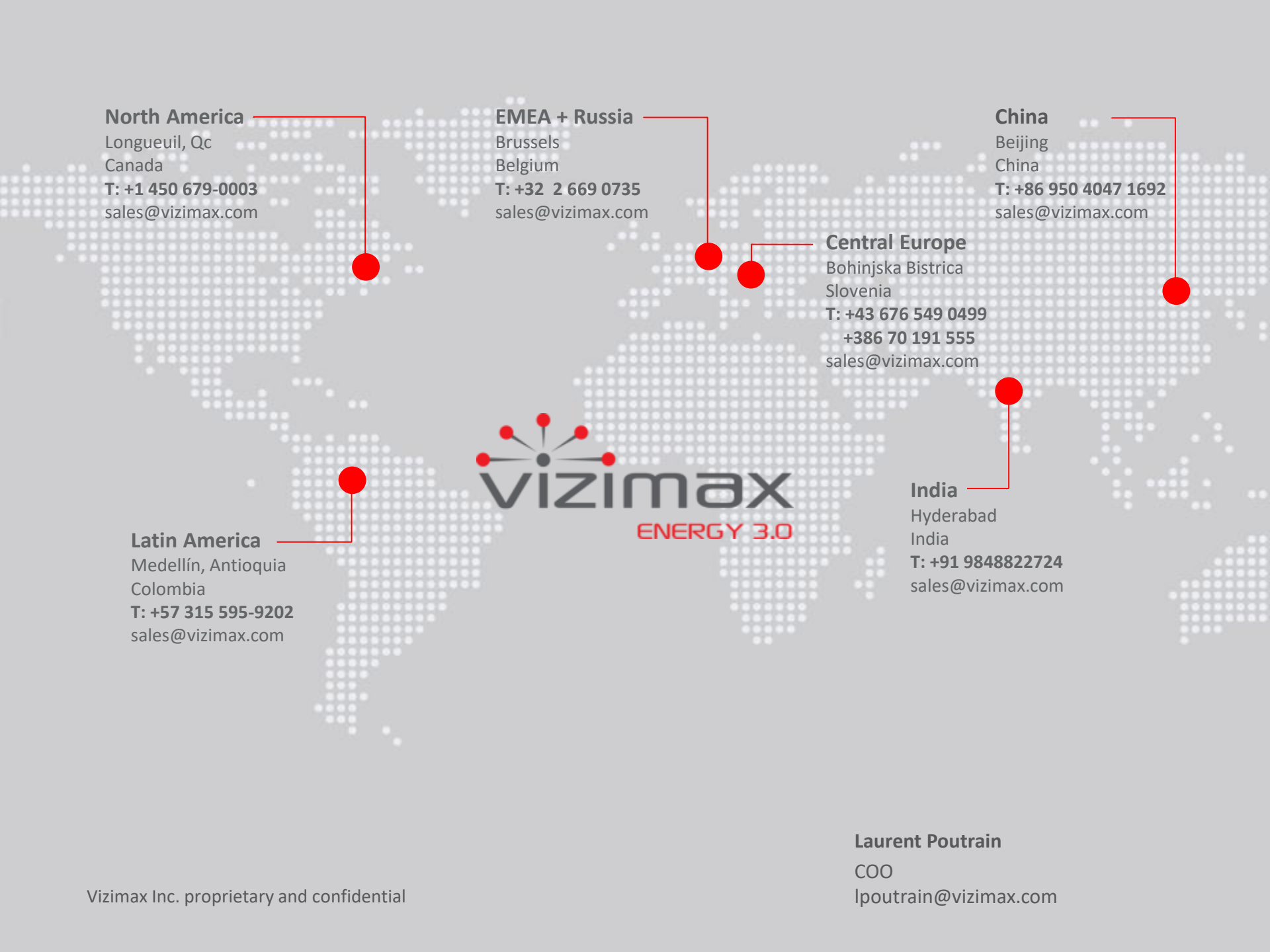


vizimax ENERGY 3.0

MEASURE – SV for Digital Protection Relays



vizimax ENERGY 3.0



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