



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

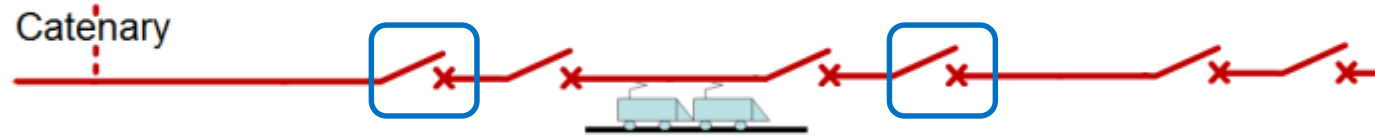
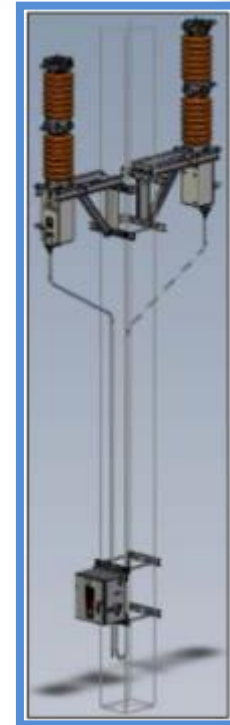
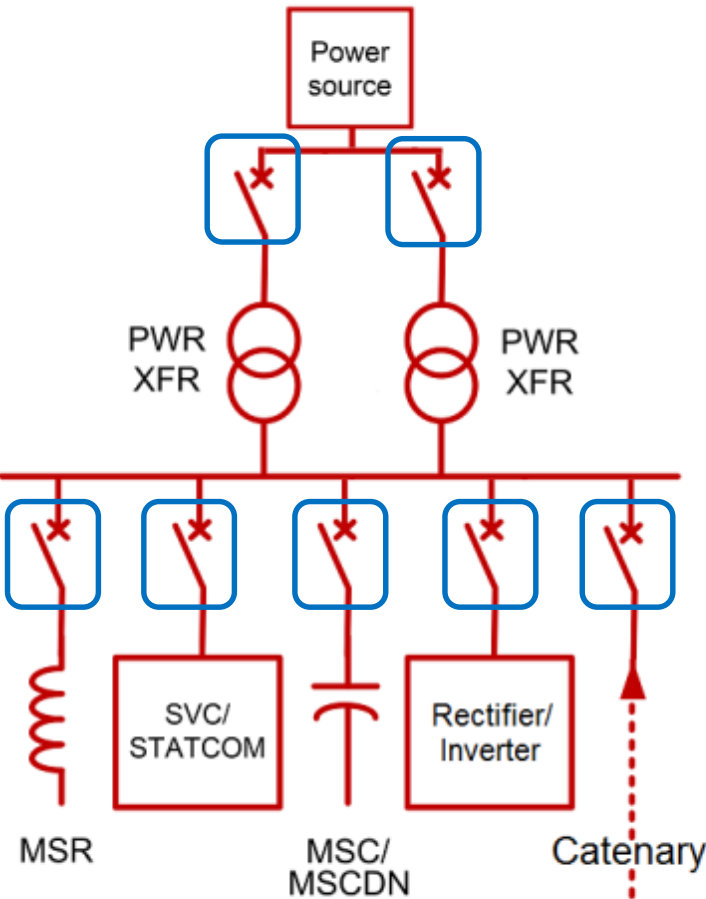


- Power transformers
- Switchgear
- Capacitors
- Shunt reactors
- VAR Compensators



Digitizing...?

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



Digitizing railway power infrastructure

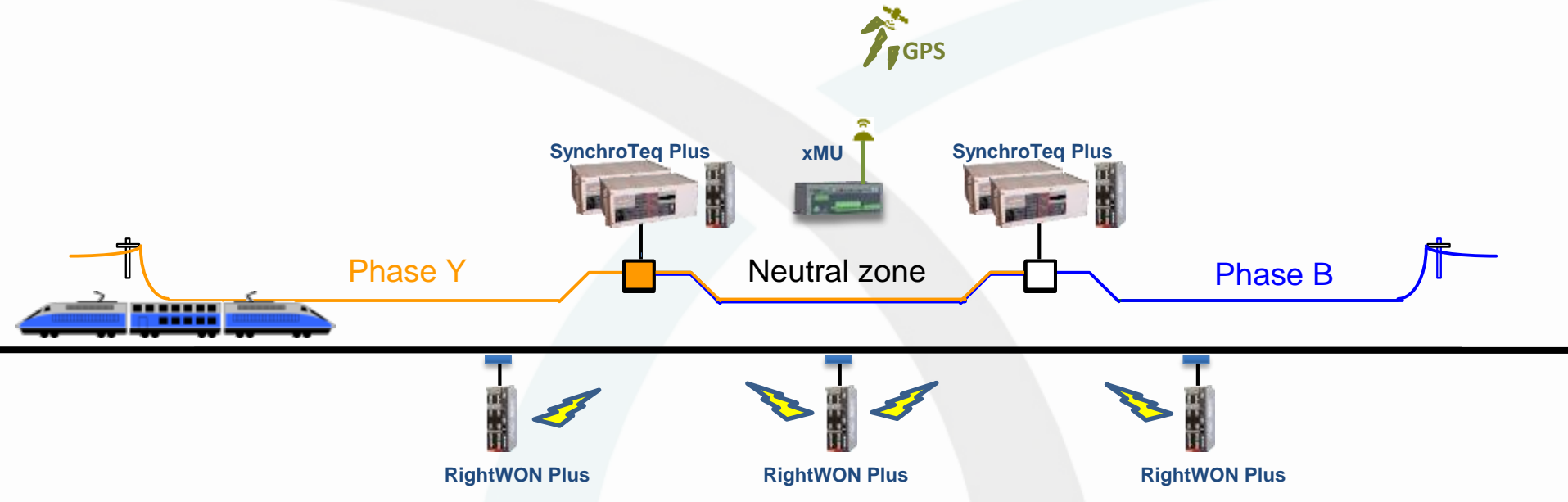
Outstanding objectives



- 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)

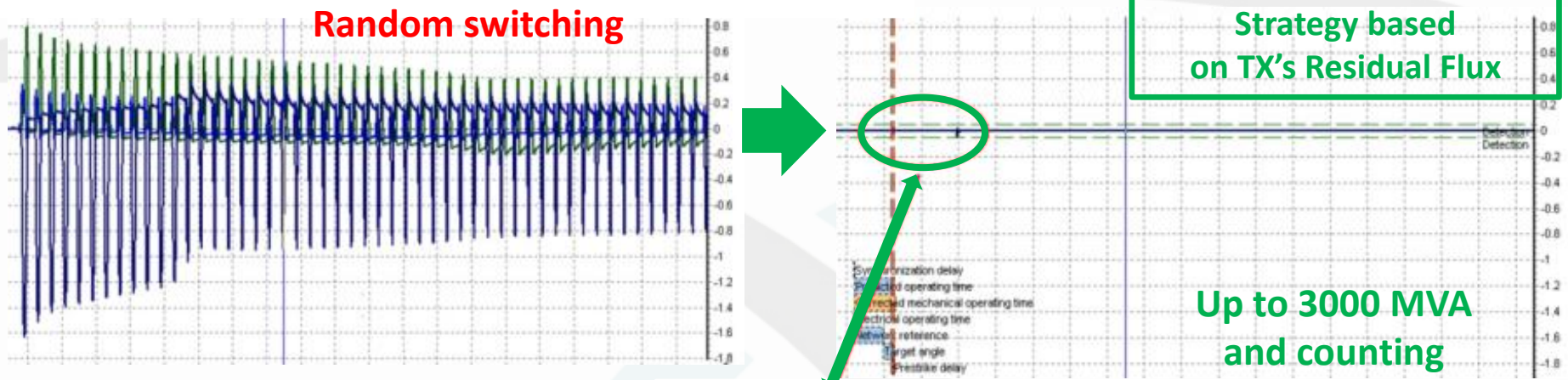
Optimising Transit Capacity - Neutral zone

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



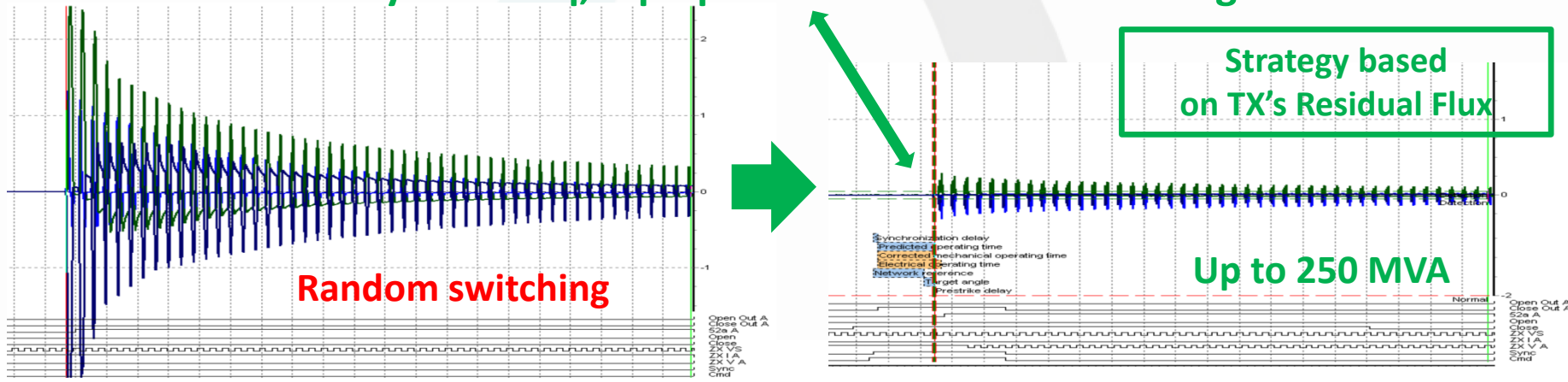
SynchroTrain®

Energizing MV & HV Transformers



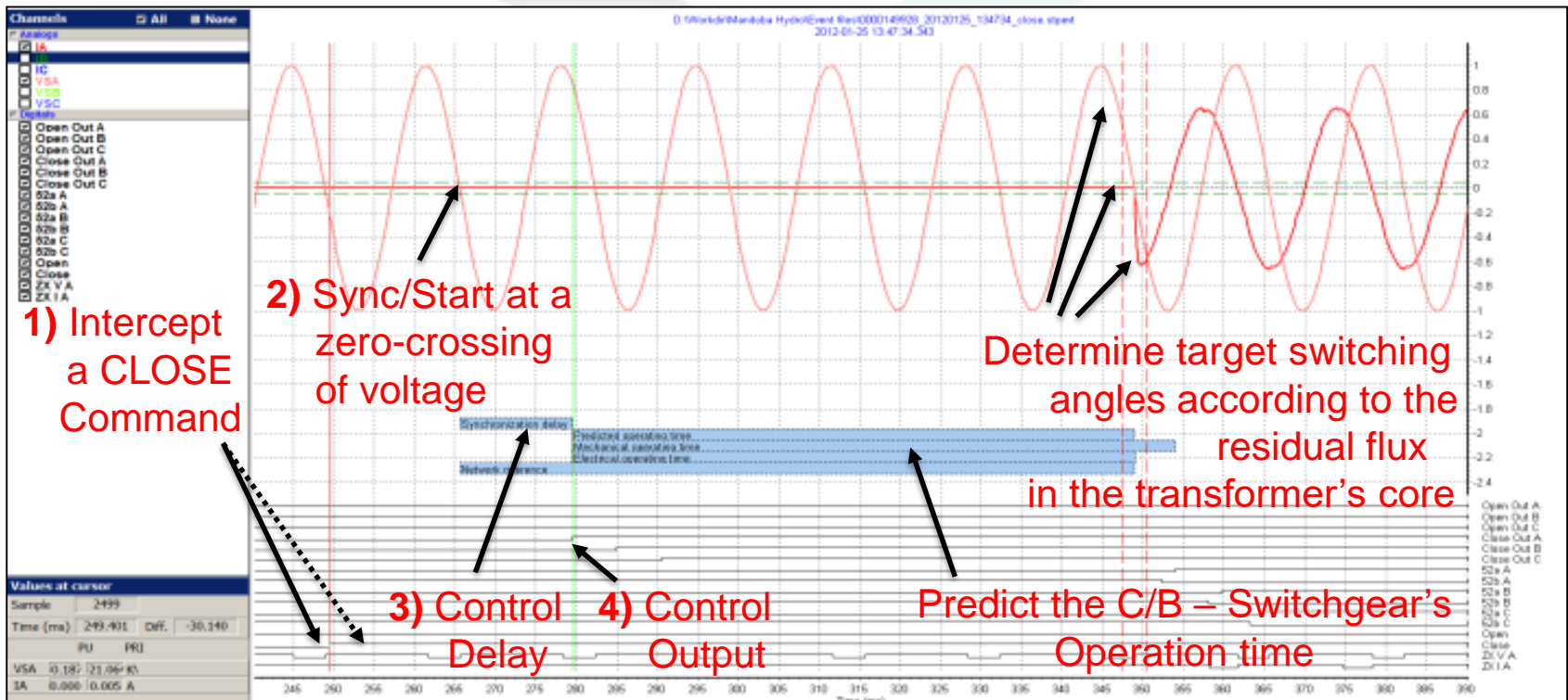
SynchroTeq, 1-p operated HV & MV CBs & Swg

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



Energizing MV & HV Transformers

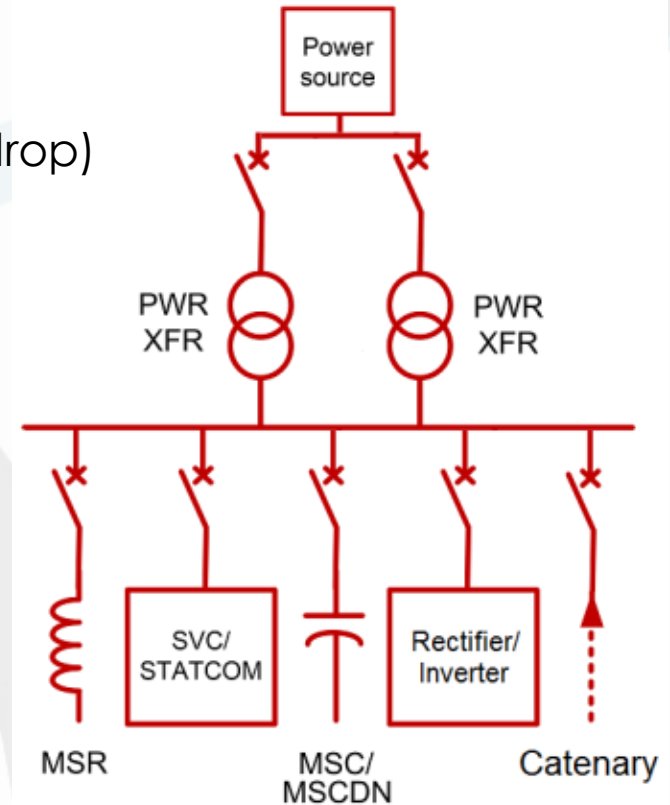
VIZIMAX SYNCHROTEQ – CONTROL AND MONITOR C/Bs



Digitized switchgear

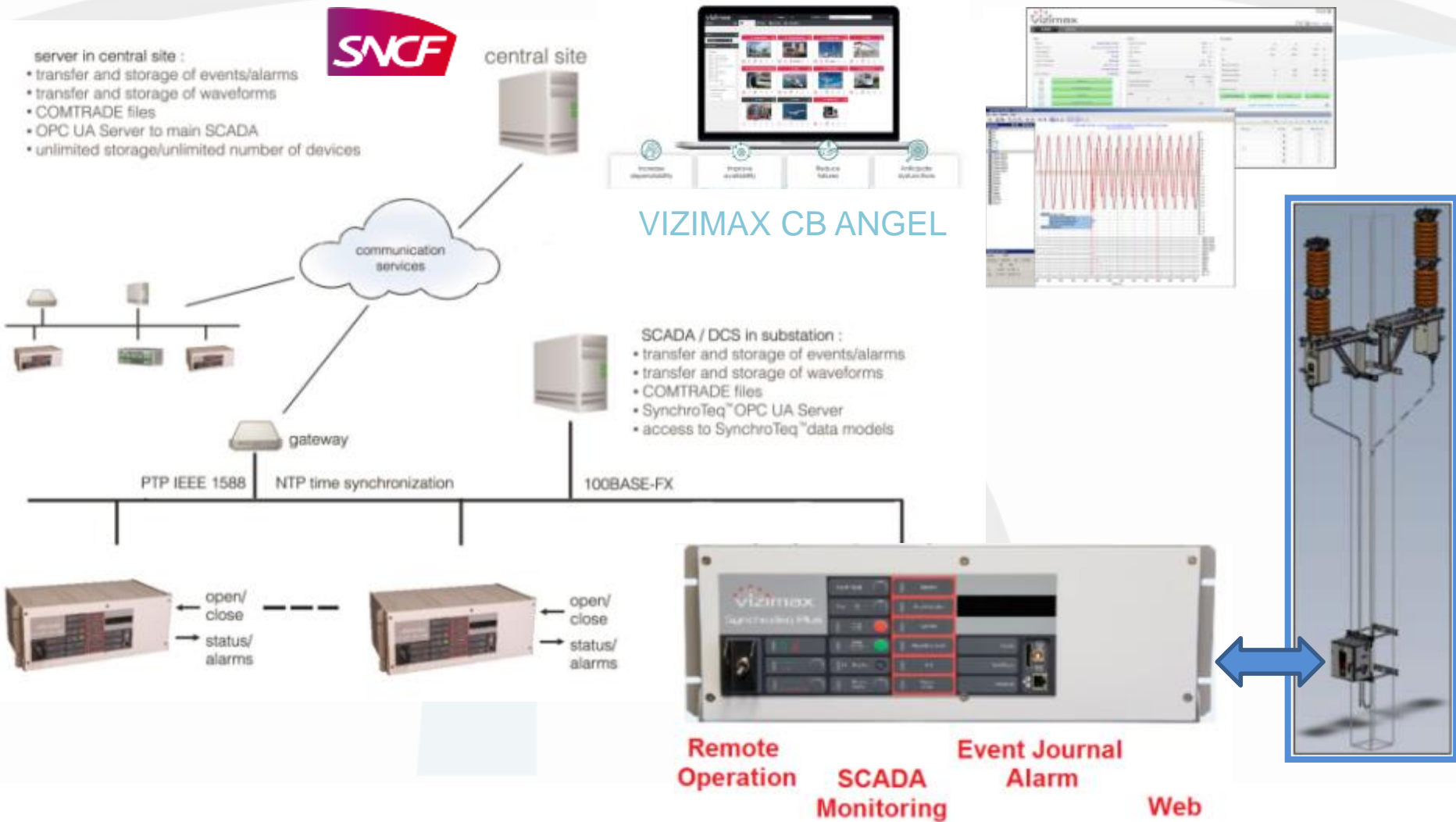
Technical & non-technical objectives – AC and DC traction

- 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

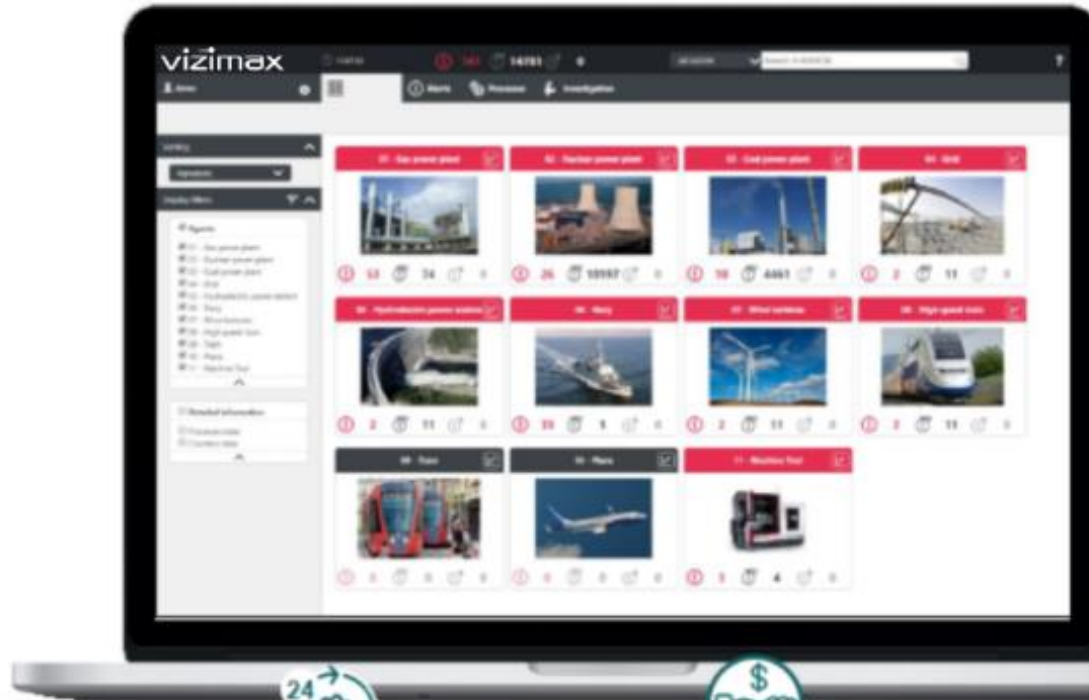


VIZIMAX CB ANGEL

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

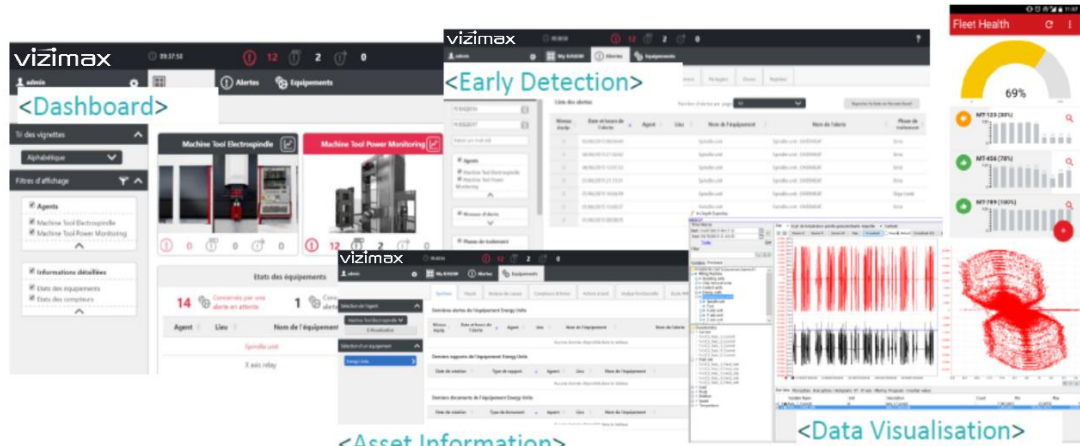
- Real-time Monitoring
- Prognostic / Anticipation
- Health Assessment
- In-depth Data Analysis

○ Database + Knowledge-based System

1+ Peta Bytes
Big Data

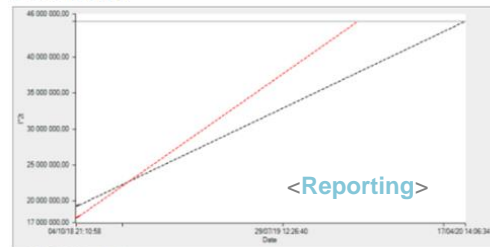


Scalability



<Asset Information>

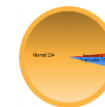
Circuit breaker electrical wear Prognostics (I²t)



<Reporting>

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

<KPIs>



1 000+

Users



Efficiency

○ Individual and Fleet-wide approach of diagnostic

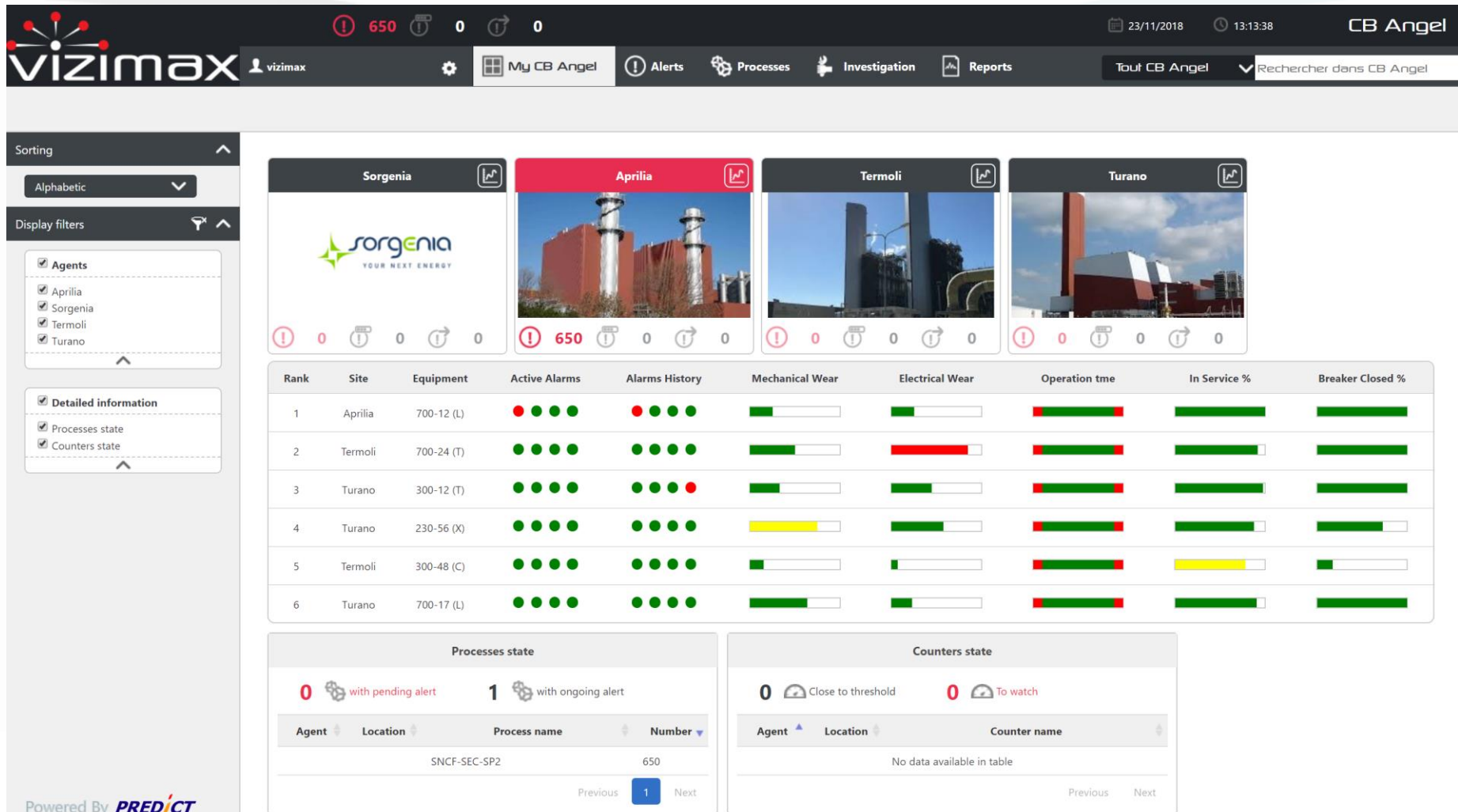
10+ year
Operating Lifetime



Reliability

CBM, AHM, Predictive Maintenance

VIZIMAX CB ANGEL – CORPORATE DASHBOARD – KPIs



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VIZIMAX CB ANGEL – MANAGE EQUIPMENT & FLEET

The screenshot displays the VIZIMAX CB ANGEL software interface. The top navigation bar includes the VIZIMAX logo, user 'vizimax', and various system icons (650 alerts, 0 counters, 0 timers). The date is 23/11/2018 and the time is 16:26:11. The main menu includes 'My CB Angel', 'Alerts', 'Processes', 'Investigation', and 'Reports'. A search bar is present with the text 'Touf CB Angel' and a search button.

On the left sidebar, there is an 'Agent selector' dropdown set to 'Aprilia' and a 'Process selector' dropdown set to 'SNCF-SEC-SP2'. Below these are buttons for 'E-Visualisation for agent' and 'Summary'.

The main content area shows 'Recent alerts for process SNCF-SEC-SP2' and 'Recent reports for process SNCF-SEC-SP2'. The alert table has columns for Process level, Date&time of alert, Agent, Location, Process name, Alert name, and Analysis status. The report table has columns for Creation date, Report type, Agent, Location, Process name, and Report title.

Process level	Date&time of alert	Agent	Location	Process name	Alert name	Analysis status
1	21/11/2018 07:15:27			SNCF-SEC-SP2	SNCF-SEC-SP2 : Controlled open	Emitted
1	21/11/2018 07:14:52			SNCF-SEC-SP2	SNCF-SEC-SP2 : Random close	Emitted
1	21/11/2018 07:10:54			SNCF-SEC-SP2	SNCF-SEC-SP2 : Controlled open	Emitted
1	21/11/2018 07:10:37			SNCF-SEC-SP2	SNCF-SEC-SP2 : Controlled close	Emitted
1	21/11/2018 07:06:05			SNCF-SEC-SP2	SNCF-SEC-SP2 : Controlled open	Emitted

Creation date	Report type	Agent	Location	Process name	Report title
2018-10-29T15:54:39.103Z	Personnalisé			SNCF-SEC-SP2	Report
2018-10-23T18:07:44.73Z	Personnalisé			SNCF-SEC-SP2	Report
2018-10-10T17:47:08.42Z	Personnalisé			SNCF-SEC-SP2	Report
2018-10-10T17:44:23.53Z	Personnalisé			SNCF-SEC-SP2	Report
2018-10-03T14:25:54.523Z	Personnalisé			SNCF-SEC-SP2	Report

Recent documents for process SNCF-SEC-SP2

Creation date	Document type	Agent	Location	Process name	Document title
No data available in table					

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VIZIMAX CB ANGEL – EQUIPMENT DASHBOARD

The screenshot displays the VIZIMAX Equipment Dashboard. The top navigation bar includes the VIZIMAX logo, a clock showing 20:25:03, and three status indicators: a red exclamation mark with '650', a grey exclamation mark with '0', and a refresh icon with '0'. Below the navigation bar are tabs for 'Alertes', 'Equipements', 'Investigation', and 'Rapports'. The left sidebar contains a 'Tri des vignettes' dropdown, a 'Filtres d'affichage' section with checkboxes for 'Agents', 'vizimax', 'Informations détaillées', 'Etats des équipements', and 'Etats des compteurs', and a search icon. The main content area features a 'vizimax' header with a red exclamation mark and '650', a photo of electrical equipment, and a status bar with a red exclamation mark and '650', and two grey exclamation marks with '0'. Below this is a section titled 'Etats des équipements' with two status indicators: '0' with a gear icon and 'Concernés par une alerte en attente', and '1' with a gear icon and 'Concernés par une alerte en cours'. A table below shows the following data:

Agent	Lieu	Nom de l'équipement	Nombre
		SNCF-SEC-SP2	650

Navigation buttons 'Précédent', '1', and 'Suivant' are located below the table. The bottom section is titled 'Etats des compteurs' and shows two status indicators: '0' with a gear icon and 'Proches du seuil défini', and '0' with a gear icon and 'À surveiller'. A table below shows the following data:

Agent	Lieu	Nom du compteur
Aucune donnée disponible dans le tableau		

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VIZIMAX CB ANGEL – MANAGE ALERTS AND EVENTS

Alert filters

10/23/2018

11/24/2018

Enter keyword

Agents

Level

Analysis status

- Emitted
- Preanalysed
- Analyzed
- Diagnosed
- Finalising
- Rejected
- Closed
- Already processed

Alerts Items per page 15

Process level	Date & time of alert	Agent	Location	Process name	Alert name	Analysis status	STP	XML
1	21/11/2018 07:15:28			SNCF-SEC-SP4	SNCF-SEC-SP4 : Controlled close	Preanalyzed	STP	XML
1	21/11/2018 07:15:27			SNCF-SEC-SP2	SNCF-SEC-SP2 : Controlled open	Emitted	STP	XML
1	21/11/2018 07:14:52			SNCF-SEC-SP2	SNCF-SEC-SP2 : Random close	Emitted	STP	XML
1	21/11/2018 07:10:54			SNCF-SEC-SP2	SNCF-SEC-SP2 : Controlled open	Emitted	STP	XML
1	21/11/2018 07:10:37			SNCF-SEC-SP2	SNCF-SEC-SP2 : Controlled close	Emitted	STP	XML
1	21/11/2018 07:10:37			SNCF-SEC-SP4	SNCF-SEC-SP4 : Controlled open	Emitted	STP	XML
1	21/11/2018 07:10:25			SNCF-SEC-SP4	SNCF-SEC-SP4 : Random close	Emitted	STP	XML
1	21/11/2018 07:06:05			SNCF-SEC-SP2	SNCF-SEC-SP2 : Controlled open	Emitted	STP	XML
1	21/11/2018 07:05:18			SNCF-SEC-SP4	SNCF-SEC-SP4 : Controlled open	Emitted	STP	XML
1	21/11/2018 07:05:17			SNCF-SEC-SP2	SNCF-SEC-SP2 : Controlled close	Emitted	STP	XML
1	21/11/2018 07:04:40			SNCF-SEC-SP4	SNCF-SEC-SP4 : Random close	Emitted	STP	XML
1	21/11/2018 07:01:24			SNCF-SEC-SP2	SNCF-SEC-SP2 : Controlled open	Emitted	STP	XML
1	21/11/2018 07:01:09			SNCF-SEC-SP4	SNCF-SEC-SP4 : Controlled open	Emitted	STP	XML
1	21/11/2018 07:01:08			SNCF-SEC-SP2	SNCF-SEC-SP2 : Controlled close	Emitted	STP	XML
1	21/11/2018 07:00:58			SNCF-SEC-SP4	SNCF-SEC-SP4 : Random close	Emitted	STP	XML

Previous **1** 2 3 4 5 ... 1773 Next

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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	Emis	STP	XML
1					CF-SEC-SP2 : random close	Emis	STP	XML
1					CF-SEC-SP4 : Controlled en	Emis	STP	XML

Waveform analysis tool showing a red sine wave. The x-axis is labeled 'Time (ms)' and ranges from 240 to 480. The y-axis is labeled 'V' and ranges from -1 to 1. A vertical dashed line is positioned at approximately 420ms. An orange arrow points from the waveform to the 'CF-SEC-SP4 : Controlled en' alert in the table above.

Statut de l'unité		LE SITE		STATUT	
Alarms		Nom	SNCF-SEC-SP4	Température interne	41.5 C
Valeurs calculées d'ouverture		Localisation	SP2	CBVol	47.5 V
Valeurs calculées de fermeture		Disjoncteur	Circuit breaker identification	Inactivité	0.0 hrs
Valeurs mesurées		Charge	Name	Freq	50.00 Hz
		Statut de l'unité	En service	Position disjoncteur	Fermer
		Local / Distant	À distance	Synchronisation	VSA
		Statut du RFC	Désactive		
		Application	(1)		

DIGITAL INPUTS			
SERVICE CONTROL	D01	D02	D03

OPÉRATIONS		Position disjoncteur			
	OUVERTURE	FERMETURE	A	B	C
Commande contrôlée	68464	15161	Fermer	Fermer	Fermer
Commande aléatoire	0	53304	Usure électrique		
Commande externe	0	0	Ouverture	1.892e+07	0.000e+00
			Fermeture	1.380e+06	0.000e+00
			Total	2.030e+07	0.000e+00

ALARMS DU PANNEAU AVANT		Lectures		
		A	B	C
CAPTEURS	VS	24.7	24.7	24.8
DISJONCTEUR	I	0.5	0.5	0.5
SYNCHRONISATION	Angle ferm.	18	18	18
LIMITES D'OPÉRATION	Angle ouv.	0	0	0

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VIZIMAX CB ANGEL – GUIDED ALERT ANALYSIS

The screenshot displays the VIZIMAX CB ANGEL interface for guided alert analysis. The top navigation bar includes the VIZIMAX logo, user profile (vizimax), and various menu items: My CB Angel, Alerts, Processes, Investigation, and Reports. The current alert is identified as '1 17/11/2018 15:14:21 SNCF-SEC-SP2 : Controlled close' with a status of 'Closed'. The interface features a 'Diagnosis' progress bar (1-4) and buttons for 'Validate', 'Reject alert', and 'Share current alert'. A 'Tools' sidebar offers options like 'Show alert into E-Visualisation' and 'Show process reports'. The main area shows a hierarchical cause analysis tree with the following structure:

- Alert: [EC3] [MAG10-21/31] Main Condenser Seawater Compartment - Line 21/31 : Fouling
- Cause 1: [EC3] EC3-Seawater & Balls Condenser Inlet - Line 21 : LESS THAN Cleaning Ability
 - Cause 1.1: [EC3] EC3-Sponge Balls injected - Line 21 : LESS THAN Quality
 - Cause 1.1.1: Internal / Structural causes
 - Cause 1.1.2: Operating time
 - Cause 1.2: [EC3] EC3-Sponge Balls injected - Line 21 : LESS THAN Quantity
 - Cause 1.2.1: [EC3] [PAH11] Collection Sieve of Condenser Cleaning System : Seizing/Breaking (Abnormal Position)
 - Cause 1.2.2: [EC3] [PAH13/15] Balls Circulation System : Loss of Performances

Additional interface elements include a 'Depth' selector (1-4), 'Display mode' (Tree/Table), 'Causes' status filters (Dismissed, Likely, Proven), and a 'Refine from' date range (2018-10-17 03:14 PM to 2018-12-17 03:14 PM).

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VIZIMAX CB ANGEL – MANAGE EQUIPMENT & FLEET

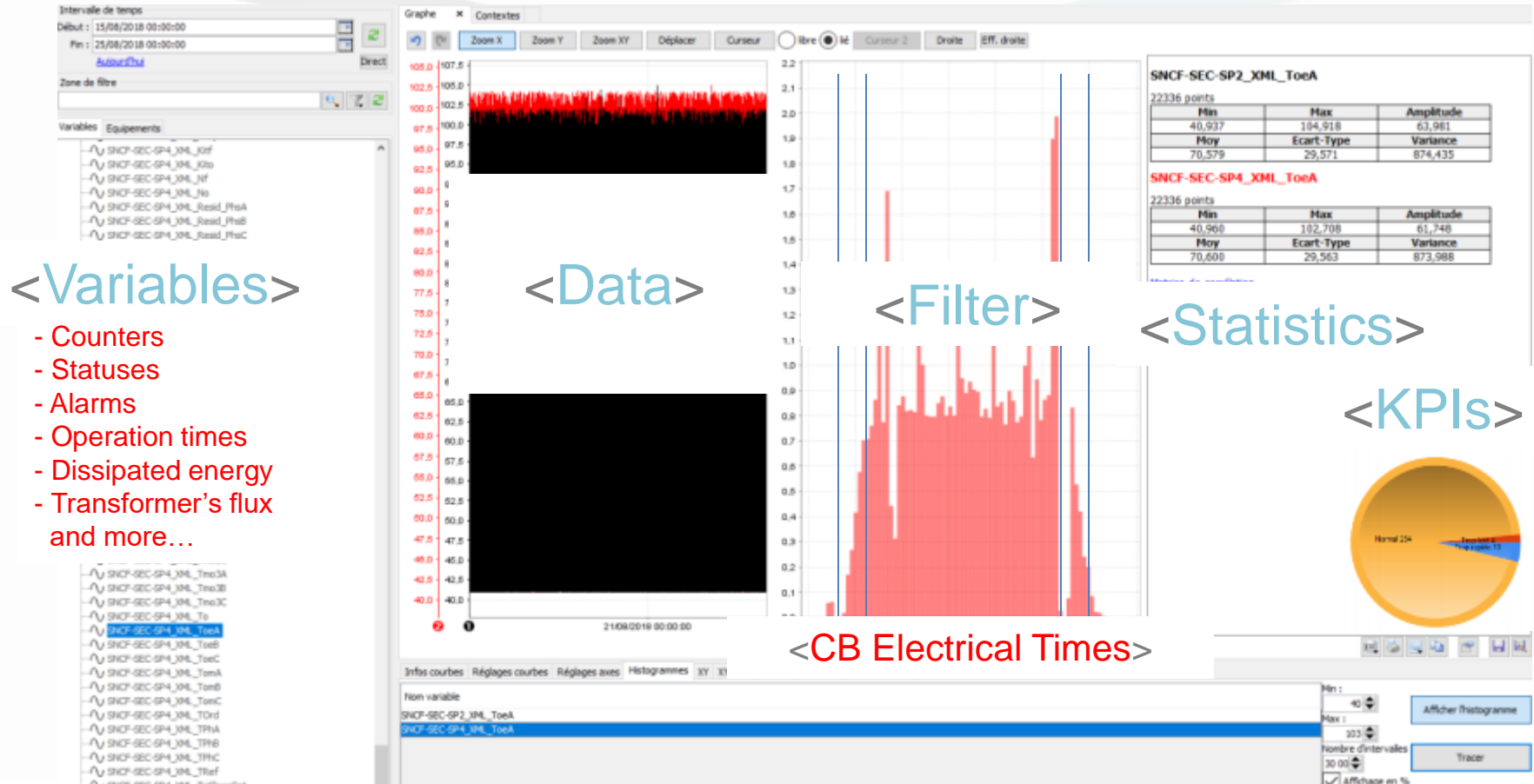
The screenshot displays the VIZIMAX CB ANGEL software interface. The top navigation bar includes the VIZIMAX logo, user profile (vizimax), and various tool icons (gear, My CB Angel, Alerts, Processes, Investigation, Reports). The date and time are shown as 23/11/2018 and 16:26:11. The main content area is titled 'Causes analysis' and shows a hierarchical fault tree diagram. The root node is 'Cause 1: [EC6] [MA] Steam Turbine (condenser only) : Loss of Performances'. This branches into 'Cause 1.1: [EC6] [MAG10] Main Condenser System (seawater part only) : Loss of Performances' and 'Cause 2: [EC6] [PA] Seawater Cooling System : Loss of Performances'. 'Cause 2' further branches into 'Cause 2.1: [EC6] [PAA/PBJ15] Seawater Supply System : Loss of Performances', 'Cause 2.2: [EC6] [PAB] Circulation System : Loss of Performances', 'Cause 2.3: [EC6] [PAC] Pumping System : Loss of Performances', and 'Cause 2.4: [EC6] [PAH] Condenser Filtration & Cleaning System : Loss of Performances'. A search bar at the top right contains the text 'Rechercher dans CB Angel'. The bottom left corner features the text 'Powered By PREDICT'.

Knowledge Base and System Engineering

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

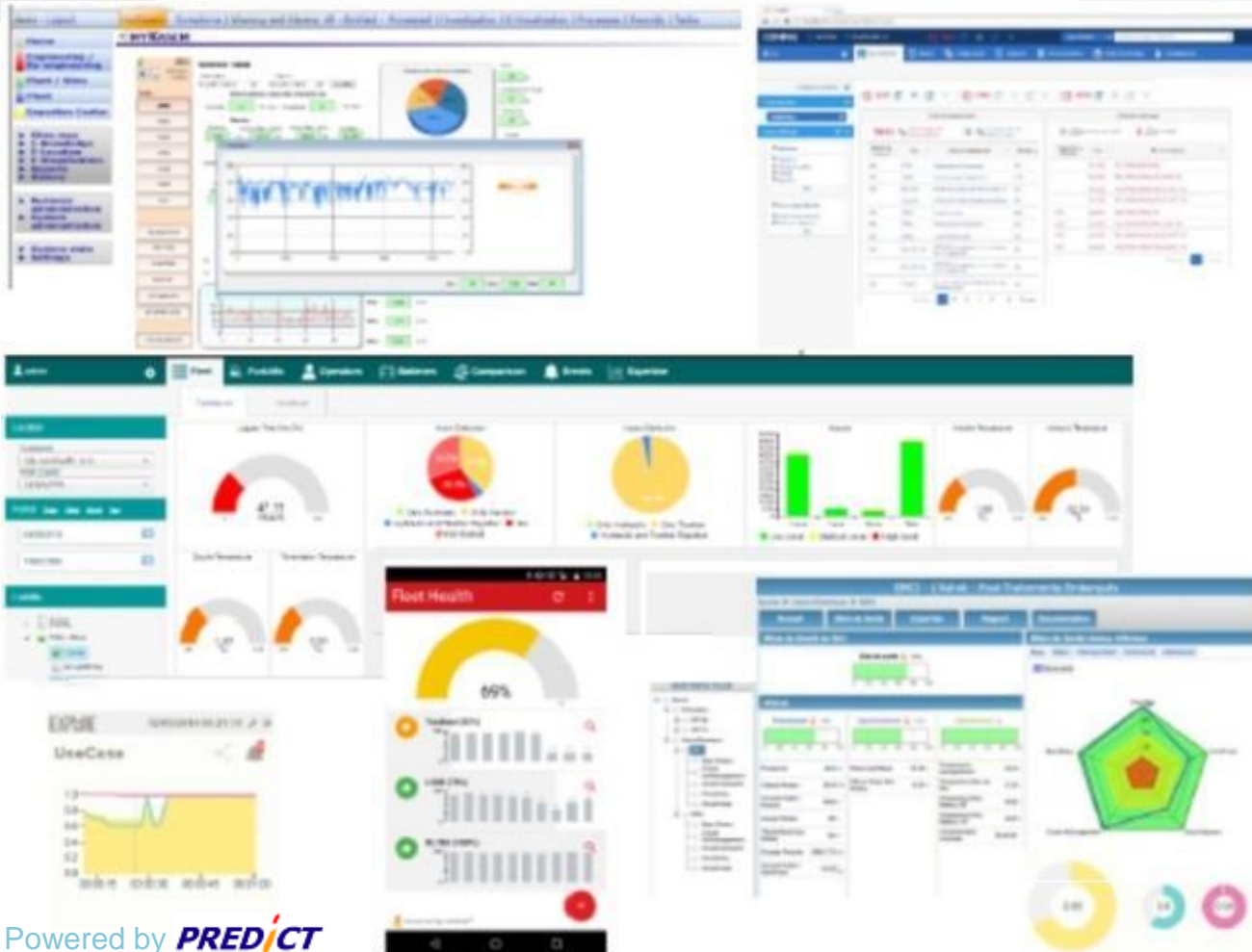
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VIZIMAX CB ANGEL – FROM RAW DATA TO KPIs



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VIZIMAX CB ANGEL – ADVANCED REPORTING

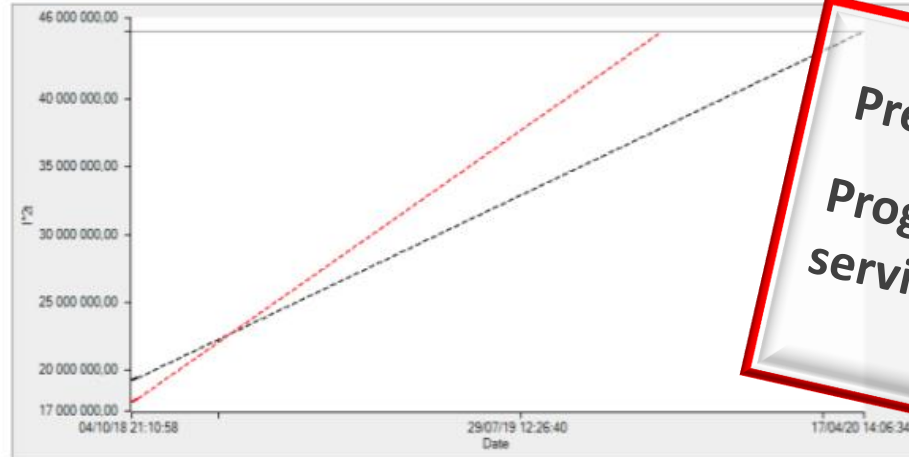


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VIZIMAX CB ANGEL – ADVANCED REPORTING



SNCF Synchrotrain
Circuit breaker electrical wear
Prognostics (I²t)



— SNCF-SEC-SP2 (actual value)
- - SNCF-SEC-SP2 (predicted value)
— SNCF-SEC-SP4 (actual value)
- - SNCF-SEC-SP4 (predicted value)

**Predictive Maintenance
Prognostics – Remaining
service life of switchgear**

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

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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)...

CBM, AHM, Predictive Maintenance

Data Science & Digital Technologies for Prognostic & Health Management

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

1+ Peta Bytes
Big Data



Scalability

Powered by **PREDICT**

10+ year
Operating Lifetime



Reliability

1 000+
Users



Efficiency

- 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...

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VIZIMAX CB ANGEL WEB PORTAL

The screenshot displays the VIZIMAX CB ANGEL web portal interface. At the top, the VIZIMAX logo is on the left, and the user 'vizimax' is logged in. The main navigation bar includes 'My CB Angel', 'Alerts', 'Processes', 'Investigation', and 'Reports'. The current date is 23/11/2018 and the time is 13:13:38. A search bar is located on the right.

On the left side, there is a sidebar with 'Sorting' (Alphabetic) and 'Display filters' (Agents, Detailed information, Processes state, Counters state).

The main content area features four site cards: Sorigenia, Aprilia (highlighted in red), Termoli, and Turano. Each card shows a status bar with icons for alerts and counters.

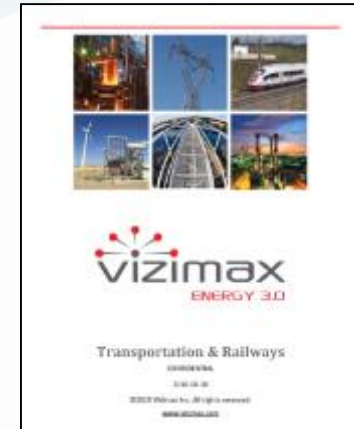
Below the cards is a table with the following data:

Rank	Site	Equipment	Active Alarms	Alarms History	Mechanical Wear	Electrical Wear	Operation tme	In Service %	Breaker Closed %
1	Aprilia	700-12 (L)	●●●●●	●●●●●	■	■	■	■	■
2	Termoli	700-24 (T)	●●●●●	●●●●●	■	■	■	■	■
3	Turano	300-12 (T)	●●●●●	●●●●●	■	■	■	■	■
4	Turano	230-56 (X)	●●●●●	●●●●●	■	■	■	■	■
5	Termoli	300-48 (C)	●●●●●	●●●●●	■	■	■	■	■
6	Turano	700-17 (L)	●●●●●	●●●●●	■	■	■	■	■

At the bottom, there are two summary panels: 'Processes state' showing 0 pending alerts and 1 ongoing alert for SNCF-SEC-SP2, and 'Counters state' showing 0 close to threshold and 0 to watch.

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Discussion - Contacts



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José PAPI

- VIZIMAX - lpoutrain@vizimax.com
- S3 Innovation - j.papi@etelatar.com



Smart Transportation Alliance

**THANK YOU
FOR YOUR
ATTENTION**

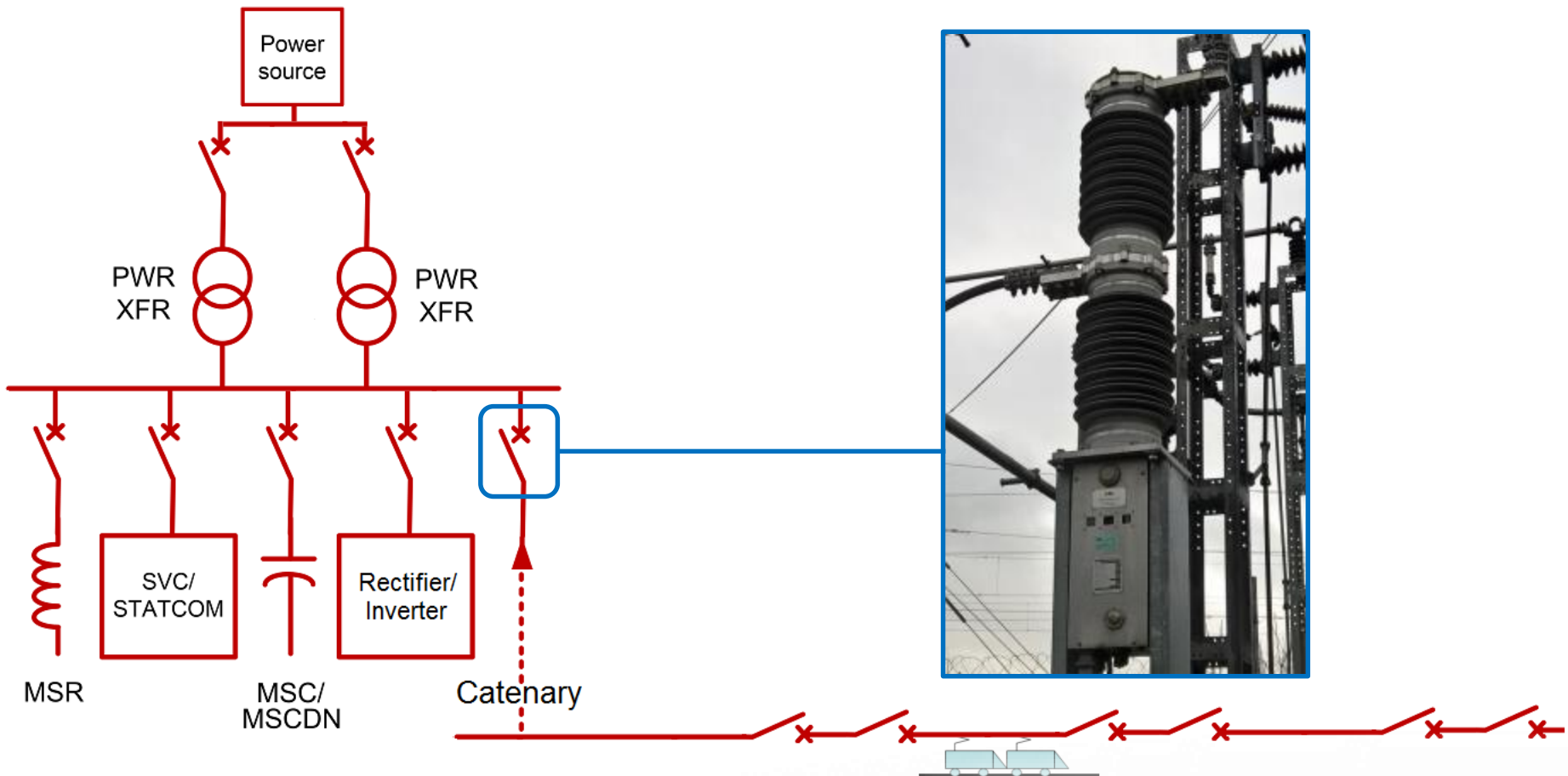
B19 Country Club
Avenue Van Bever 17-19
1180 Brussels (Belgium)
Tel: +32 2 808 60 50

Email: info@smart-transportation.org

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).



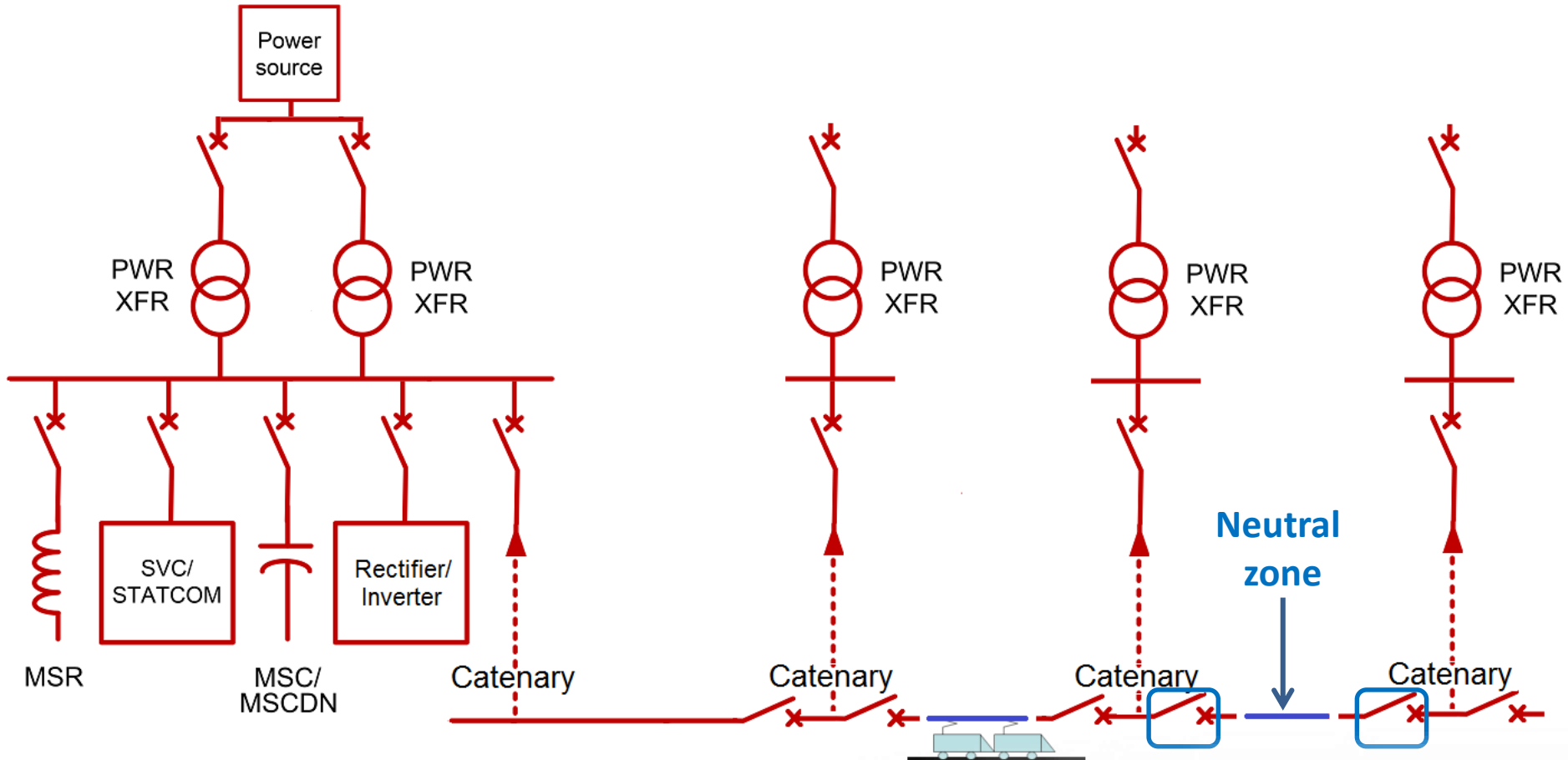
Example 2 – MV Transformers



Example 3 – Neutral zone



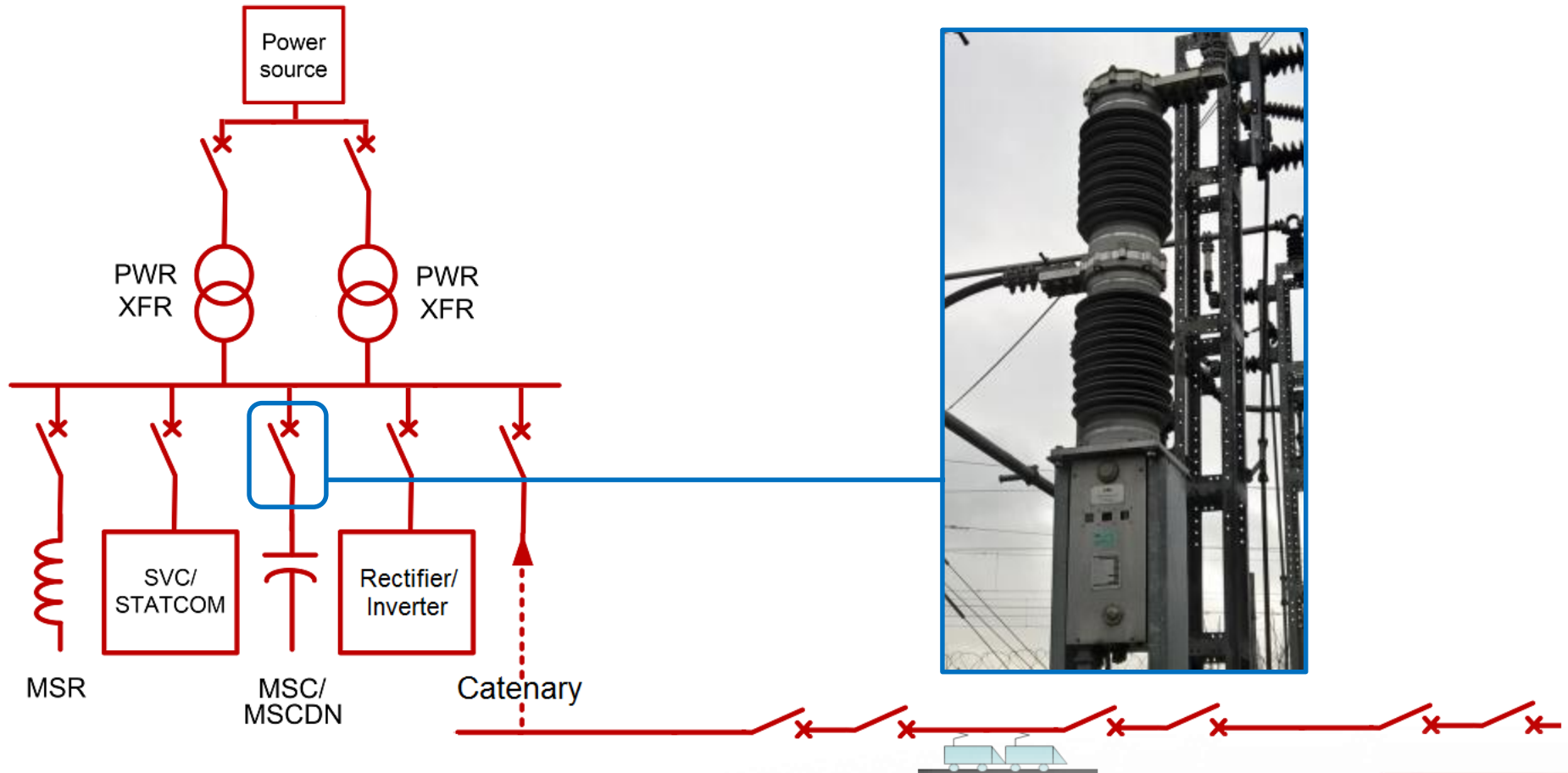
AC traction systems are made of multiple sections, each powered by a substation. Sections are isolated by “neutral zones”.



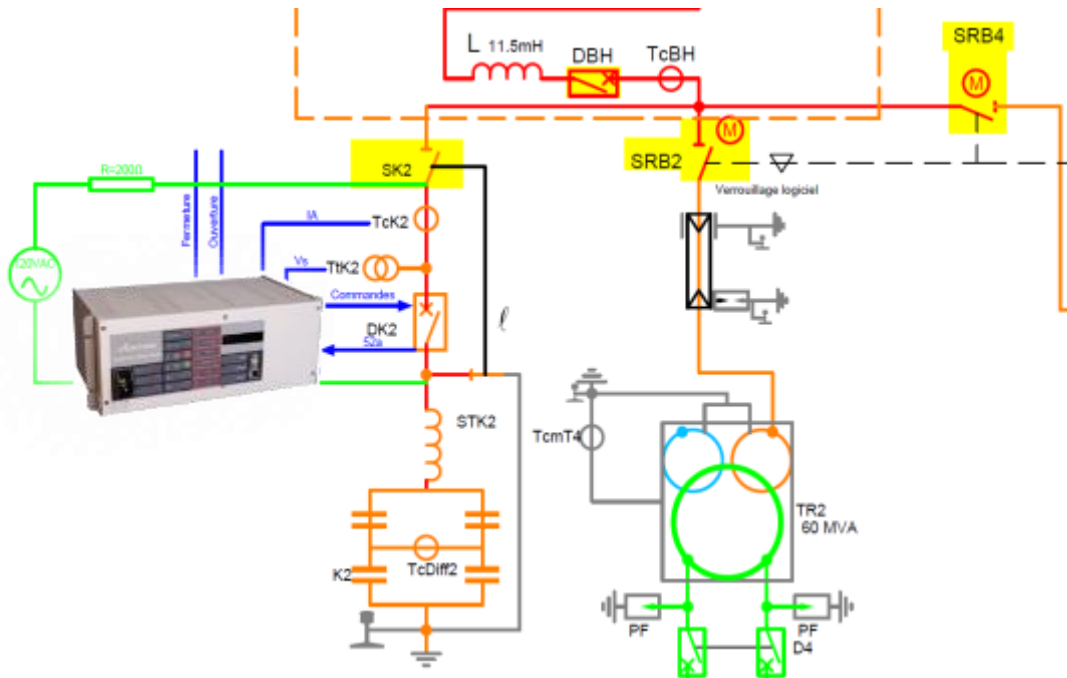
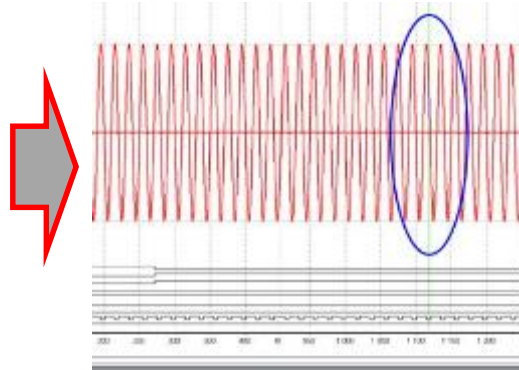
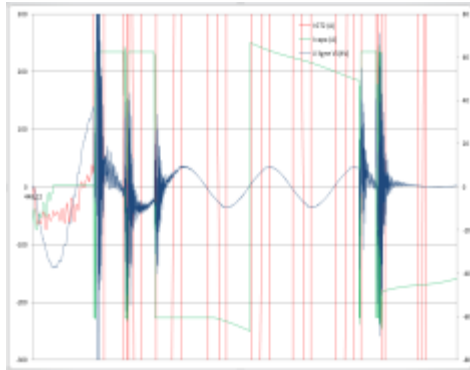
Example 4 – Capacitors and Filters



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

MEASURE – Solutions for digital substations

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

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 Certified™** PMU
C37.118.1a-2014
Synchrophasors **240 f/sec**

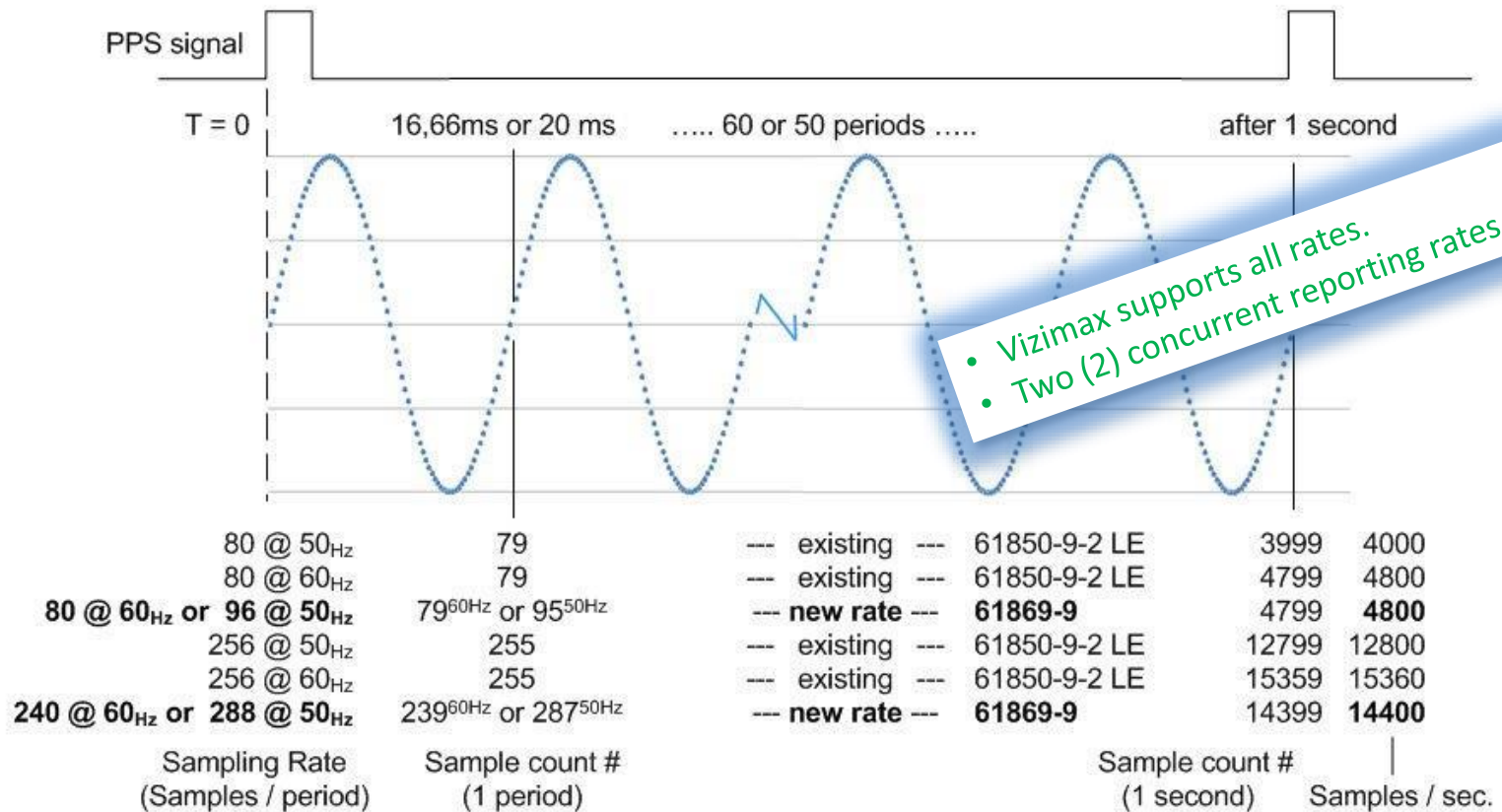


NERC
CIP

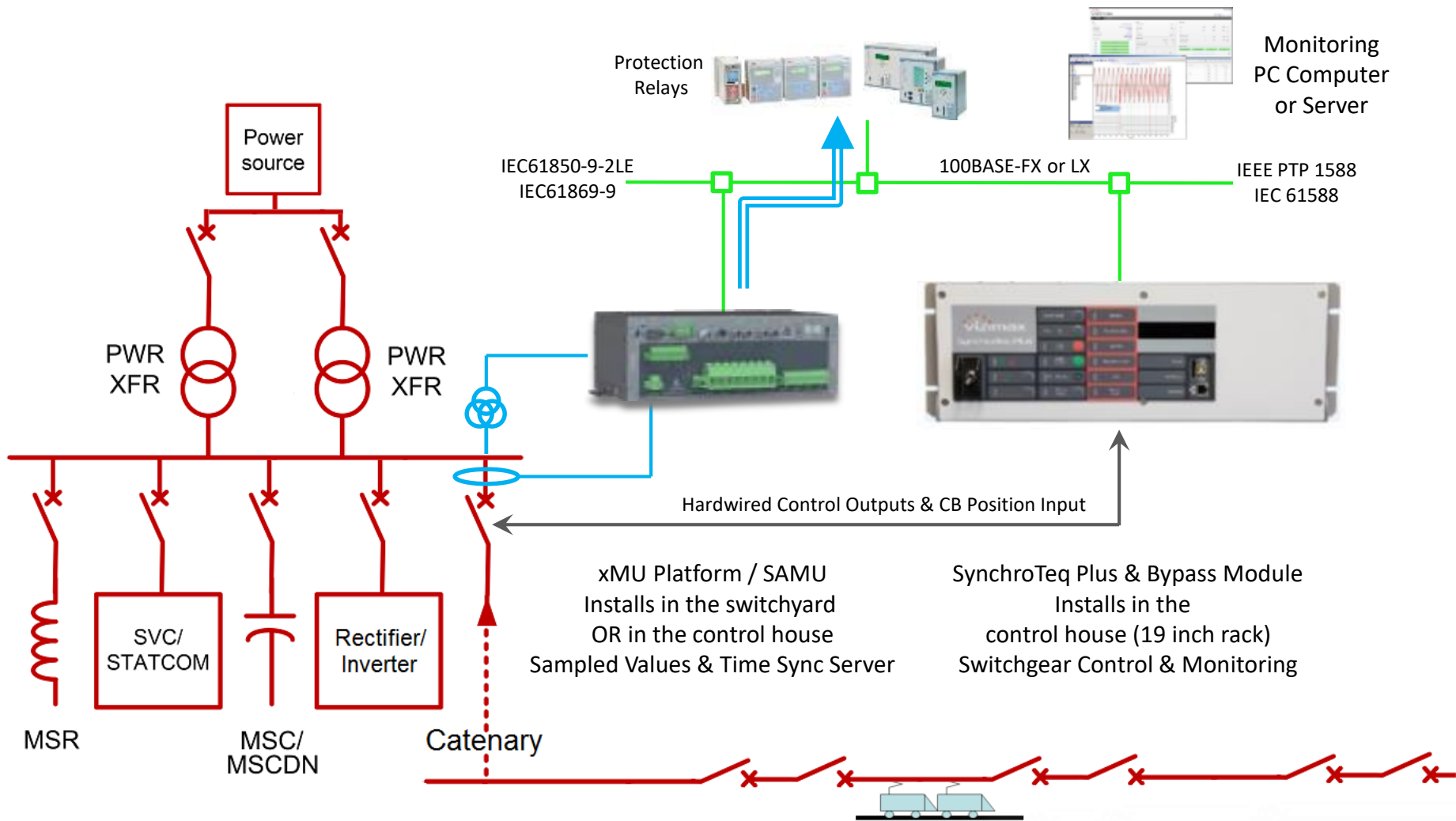


MEASURE – xMU – SAMU & PMU

IEC 61850-9-2 and IEC 61869-9 Sampled Values
DATA acquisition rates



MEASURE – SV for Digital Protection Relays



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