



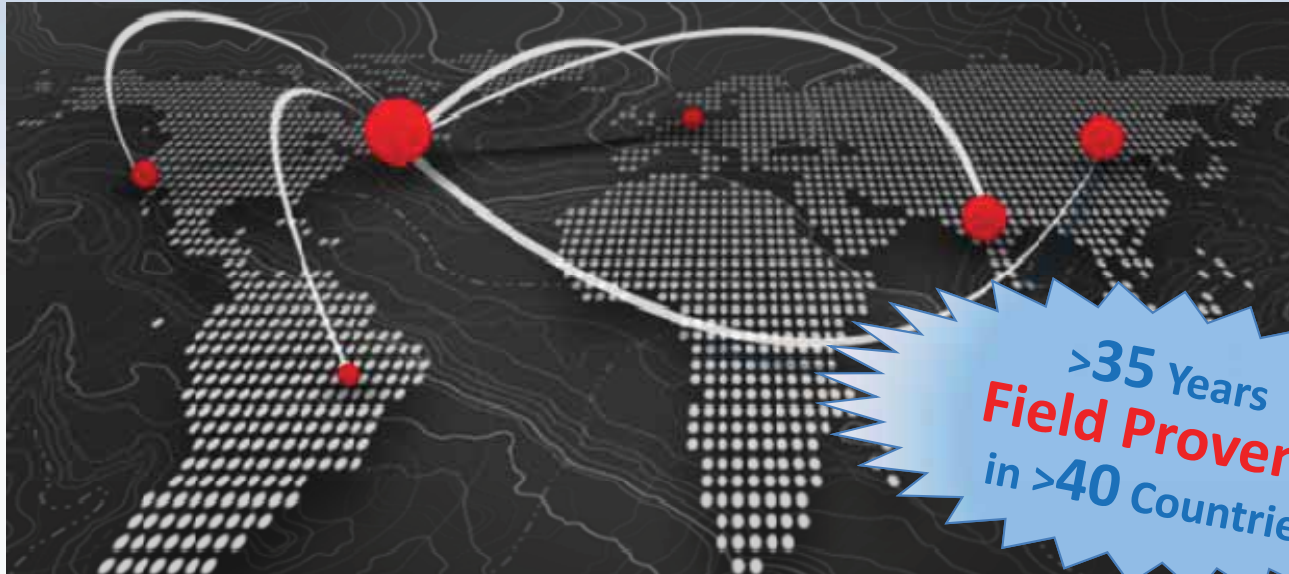
SynchroTeq  
Controlled Switching & Monitoring  
October 2014

A man in a dark suit stands in a green field, holding a smartphone. Overlaid on the scene is a network diagram consisting of white arcs and red nodes, suggesting a smart grid or data network. The background is a clear blue sky with light clouds.

**INTELLIGENT SYSTEMS  
FOR A SMARTER GRID**



# INTERNATIONAL PRESENCE



**>35 Years  
Field Proven!  
in >40 Countries**

## North America

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# INTELLIGENT SYSTEMS FOR A SMARTER GRID



## UTILITY GRADE PLATFORMS

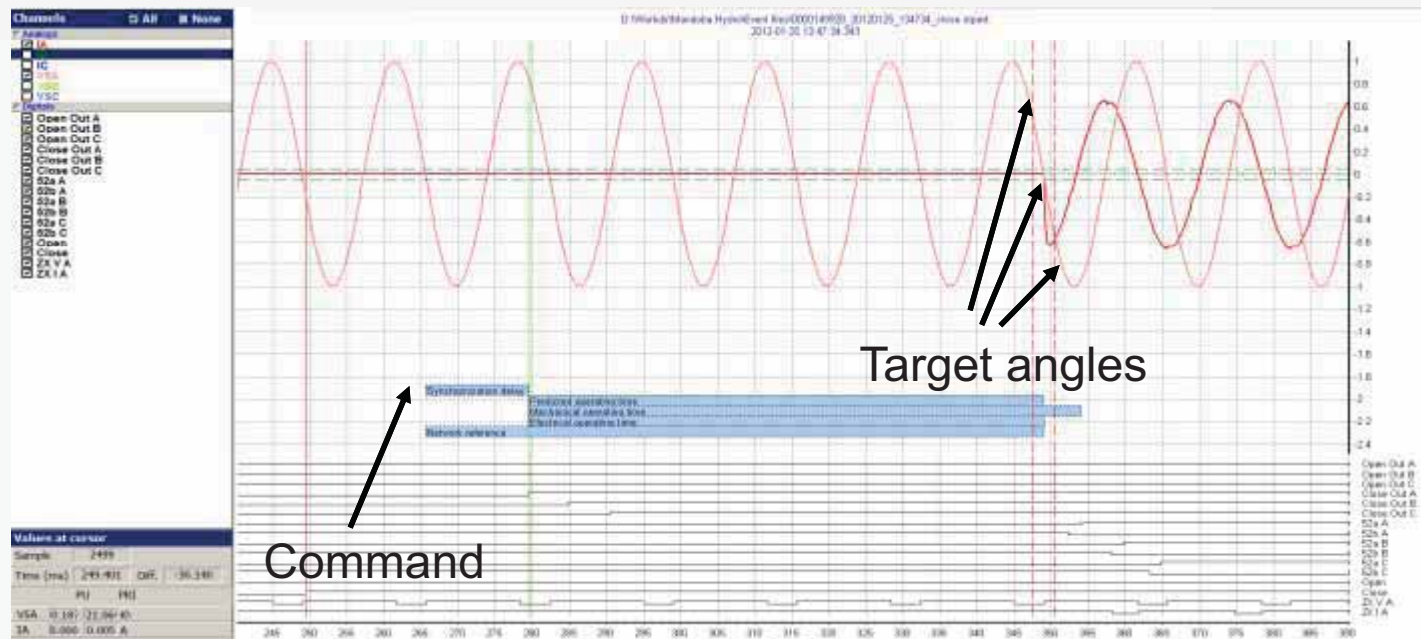
### ● **SynchroTeq Plus - SynchroTeq MV**

- Controlled Switching & Monitoring Devices for HV & MV Circuit Breakers
- FACTS: MSC, MSR, FLT in Standalone and SVC/Statcom Configurations
- Power Transformer Energization: Effective Mitigation of Inrush Currents & Voltage Disturbances via Residual Flux Management
- Easier Grid Integration of Renewable Energy Sites, Grid Code Compliance
- Mandatory in Power Generation: Hydro, PHES, Gas, Nuclear Power Plants
- Reduce Arc Flash, Increase Commercial & Industrial Power Capacity
- Also for Electrical Arc Furnaces, Railways, Oil & Gas

**INTELLIGENT SYSTEMS FOR A SMARTER GRID**

# WHAT IS CONTROLLED SWITCHING?

- ✓ Additional capability added to a standard circuit breaker
- ✓ Open/Close circuit breakers at any precise electrical instant



INTELLIGENT SYSTEMS FOR A SMARTER GRID

TODAY'S ELECTRICITY | Get Your Gear On

SMART GRID  
SOLUTIONS

IN ACTION ...





# ... AND SYNCHROTEQ MV !

## SynchroTeq™ MV



**1, 2, 3 Phase Applications**  
**Switchgears - C/Bs - Switches - Reclosers**  
**3 - 6 - 11 - 13,5 - 25 - 36 kV**



**Renewable Energy**



**Distribution,  
VVO, VVR,  
SVC-Statcom**



**Industry,  
Commercial,  
Building**



# INTELLIGENT SYSTEMS FOR A SMARTER GRID



# FACTS, SVC, STATCOM: CAPACITOR BANKS & REACTORS



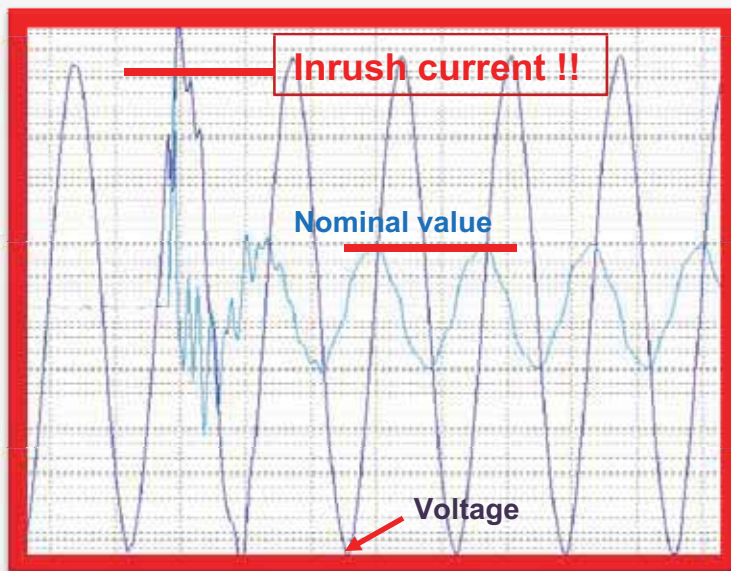
**INTELLIGENT SYSTEMS FOR A SMARTER GRID**



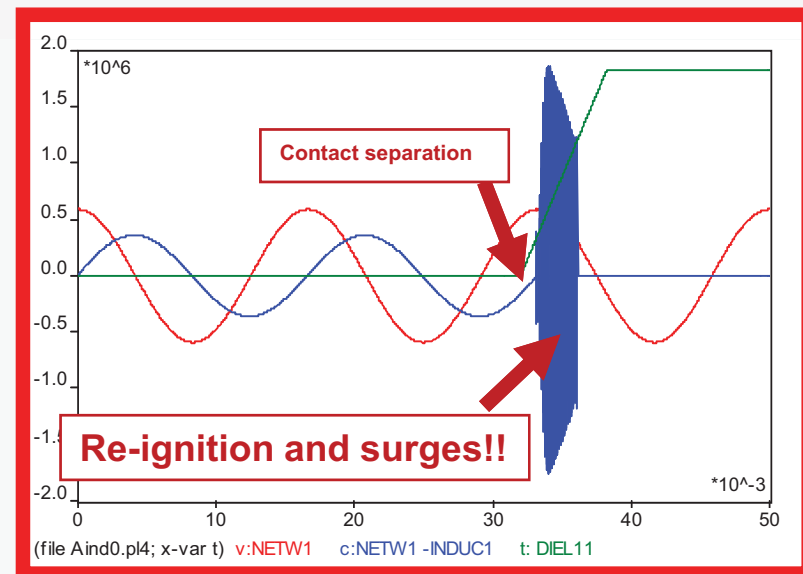
# EVOLVE FROM RANDOM SWITCHING...

## Random Switching = Restrikes and Re-Ignitions in Circuit Breakers

### ✓ Capacitor Bank Switching (Close)



### ✓ Shunt Reactor Switching (Open)

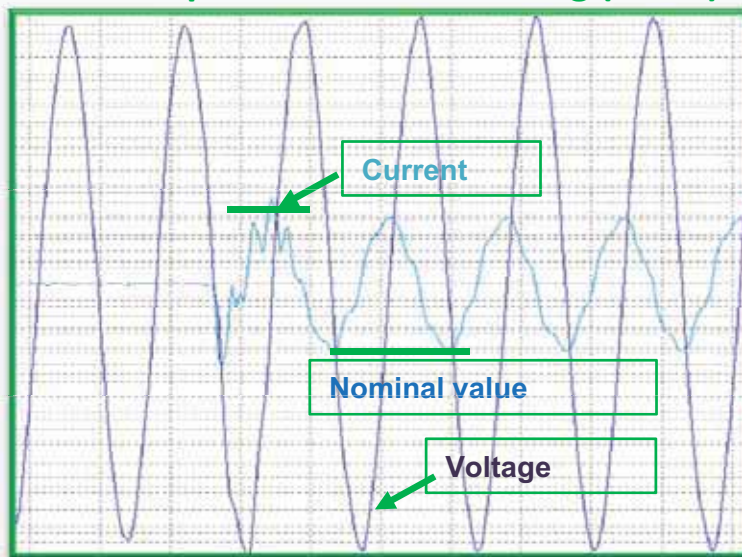


INTELLIGENT SYSTEMS FOR A SMARTER GRID

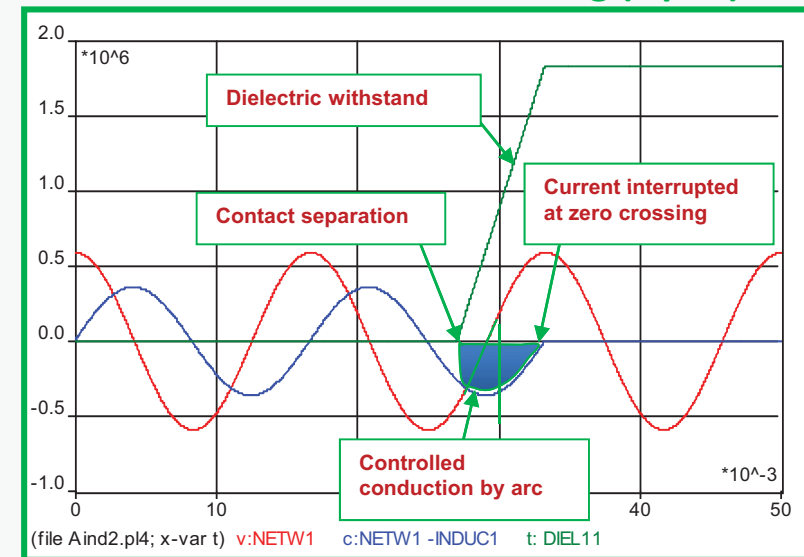
# ... TO SYNCHROTEQ !

- ✓ Good Arc Conduction, Avoid Restrikes & Reignitions
- ✓ Avoid Stresses, Voltage Dips and Transients

## ✓ Capacitor Bank Switching (Close)



## ✓ Shunt Reactor Switching (Open)

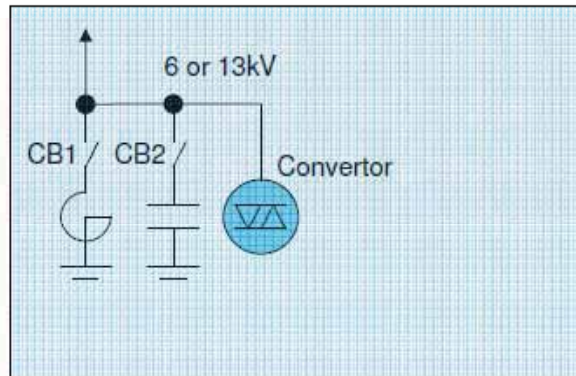
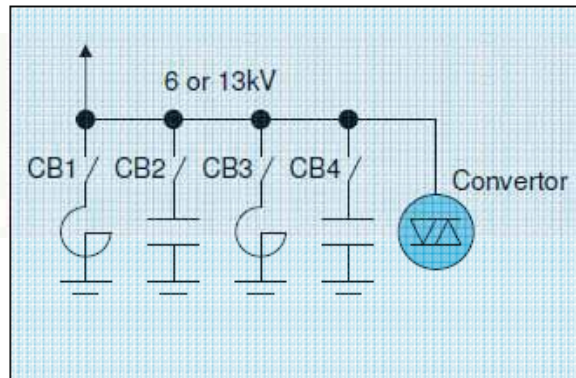


## ADVANCED FEATURES FOR FACTS, SVC, STATCOM

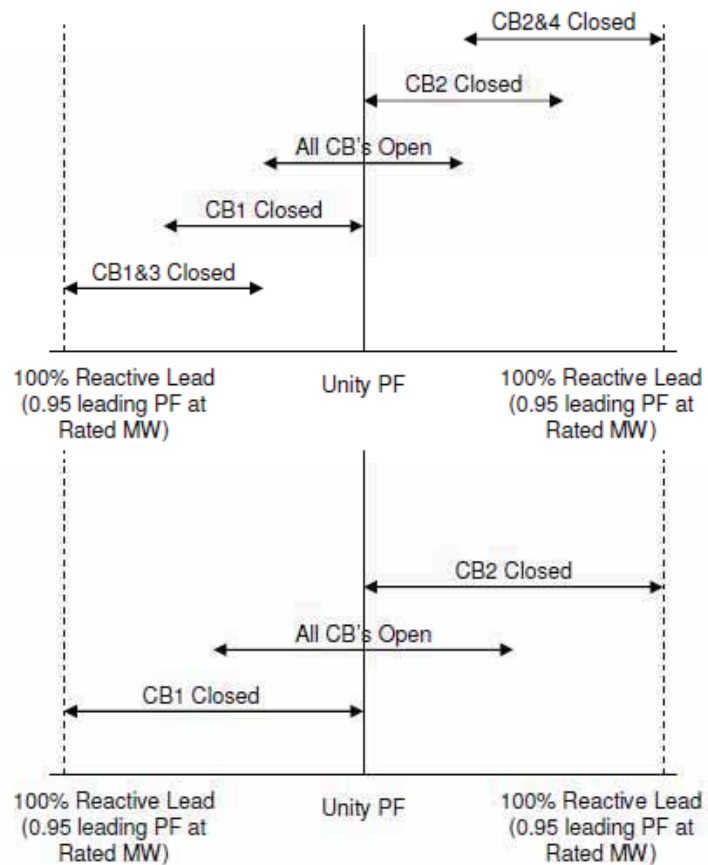
- ✓ **Fast Switching** for MSC/MSR/FLT in FACTS-SVC-STATCOM
- ✓ **Dynamic Switching Angles**
- ✓ **Secure Support** of Partially Discharged Capacitor Banks
- ✓ **Combined Loads** with Matching Switching Strategies
- ✓ **Event & Waveform Recording** + Analyzer + COMTRADE
- ✓ **IEC61850, IEC60870-5-101/104, DNP3, Modbus (Option)**

# SUITABLE FOR SVC & HYBRID-STATCOM

Double switched capacitor / reactor

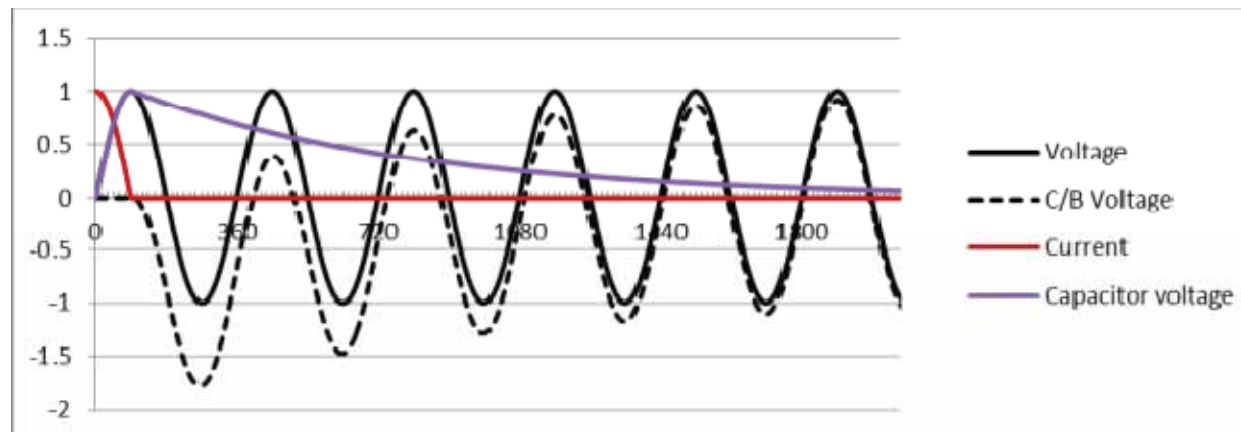


Single switched capacitor / reactor



## HOW SYNCHROTEQ IMPROVES SVC/STATCOM

- Using patented algorithms, SynchroTeq is the only product in the market capable of evaluating the capacitor trapped charge resulting from C/B opening
- The C/B is closed at a variable angle calculated according to the capacitor residual voltage thus eliminating stresses & inrush currents.
- The capacitive VAR compensation is always available, no matter the time from the previous de-energization (instantaneous restoration capable)



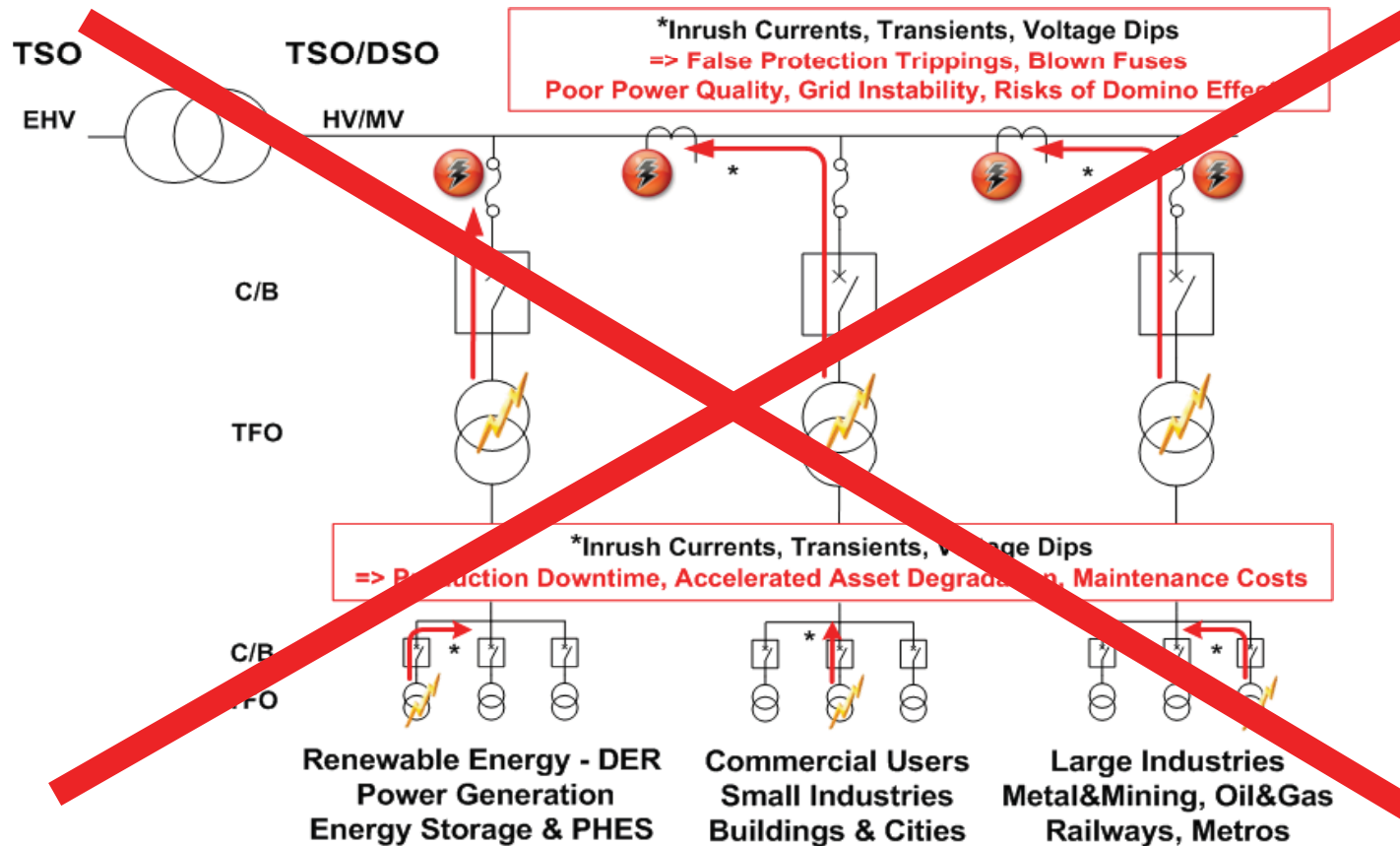


# TRANSFORMER ENERGIZATION



**INTELLIGENT SYSTEMS FOR A SMARTER GRID**

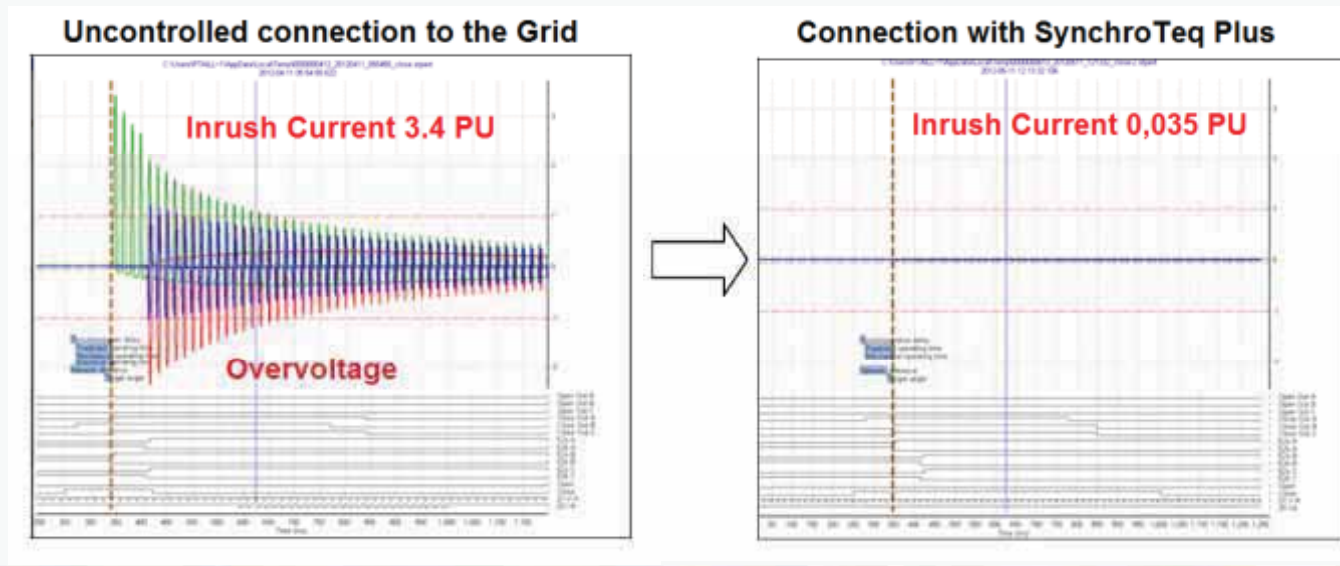
# AVOID INRUSH CURRENTS & TRANSIENTS...



## INTELLIGENT SYSTEMS FOR A SMARTER GRID

## ... WITH SYNCHROTEQ !

- ✓ Achieve Smooth Power Transformer Energizations
- ✓ Take Into Account the Residual Flux in Transformer's Core
- ✓ Avoid Inrush Currents, Voltage Disturbances, Stresses

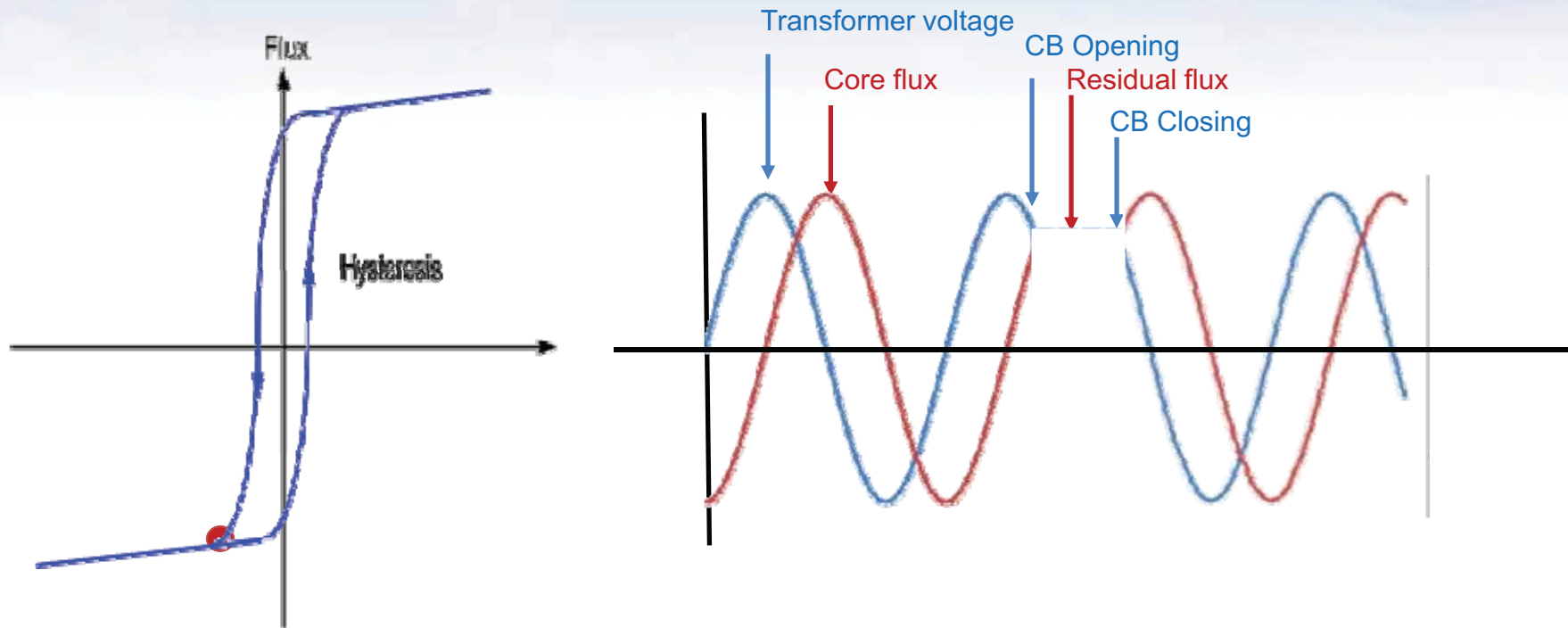


**INTELLIGENT SYSTEMS FOR A SMARTER GRID**



# POWER TRANSFORMER SWITCHING

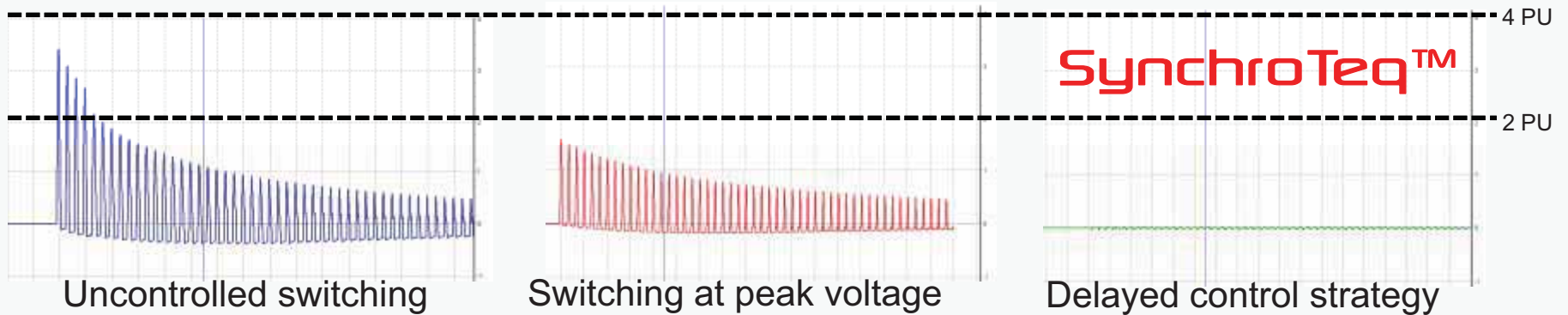
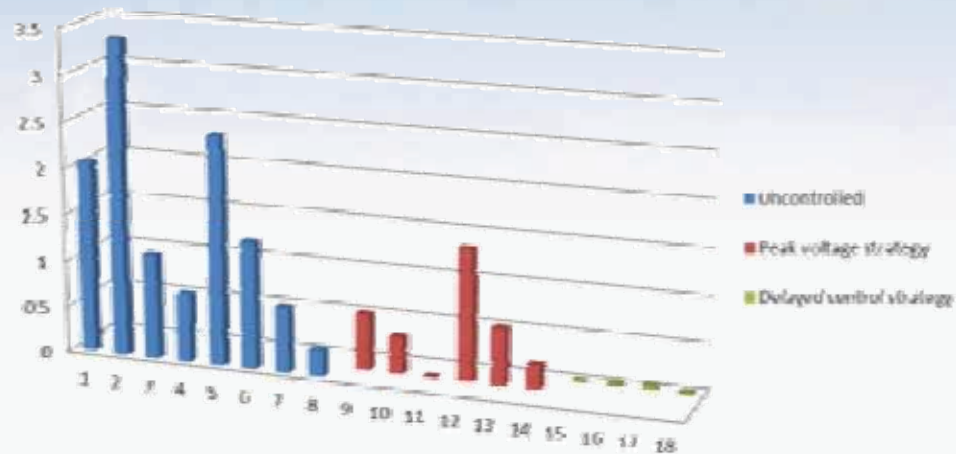
Like if there would not be any interruption!



INTELLIGENT SYSTEMS FOR A SMARTER GRID

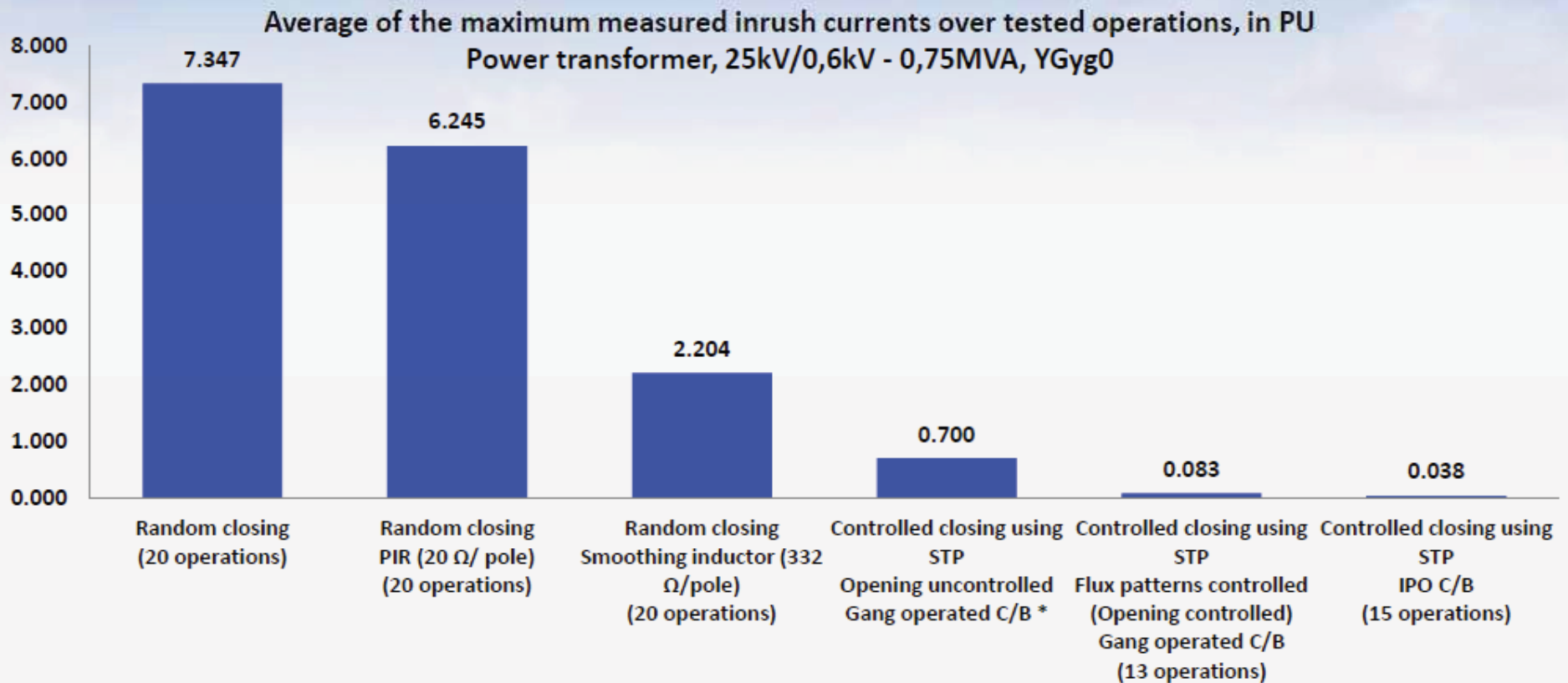
# TRANSFORMER ENERGIZING TECHNIQUES

Transformer inrush current (PU)



**INTELLIGENT SYSTEMS FOR A SMARTER GRID**

# MV TRANSFORMER & 3 POLE OPERATED C/B



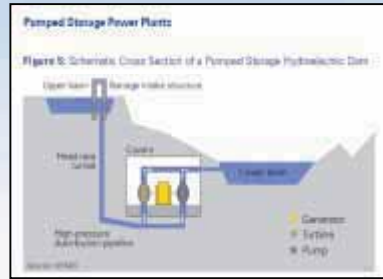
\* Simulation results, real testing scheduled by September 2014

## INTELLIGENT SYSTEMS FOR A SMARTER GRID

# SMART C/B CONTROL & TRANSFORMER ENERGIZATION



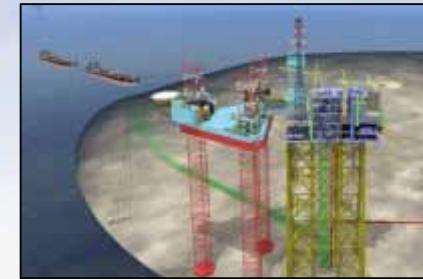
✓ Integration of Renewable Energy



✓ Hydro Generation & Storage



✓ Improved TSO & DSO Grid Stability



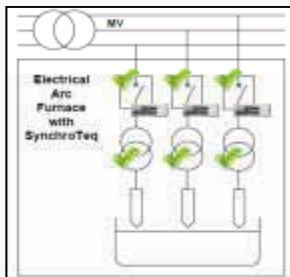
✓ On-Shore/Off-Shore sites, FPSOs

✓ Grid Code Compliance

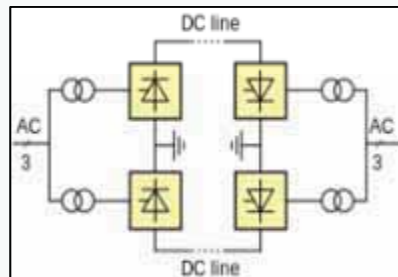
## Seamless Energization for...

✓ Improved Protection Strategies

✓ Electrical Arc Furnaces



✓ SVC & HVDC Substations



✓ Industrial & Commercial Power

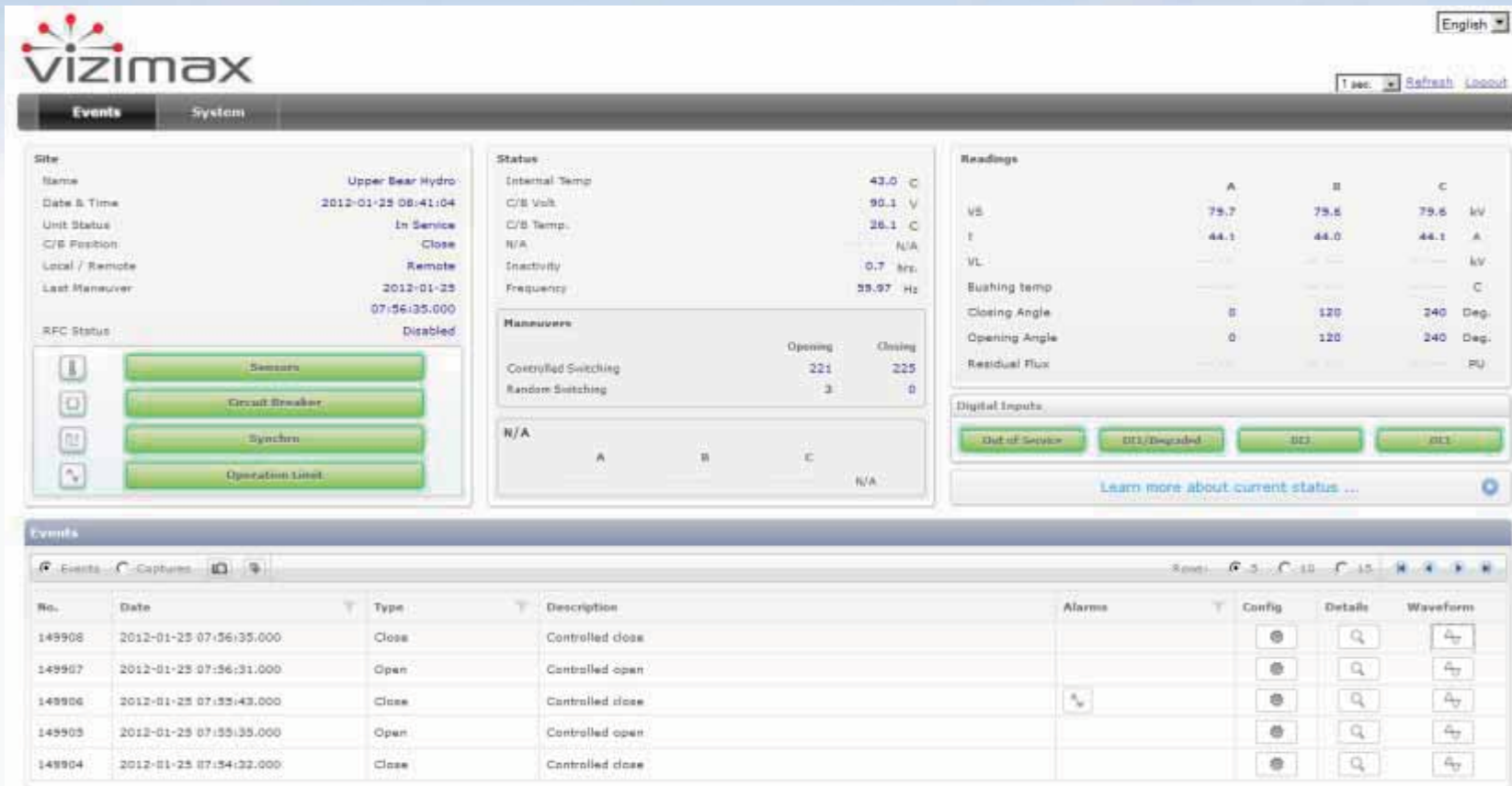


✓ Railways Substations



# INTELLIGENT SYSTEMS FOR A SMARTER GRID

# WEB-BASED SER, ALARMS & C/B MONITORING



The screenshot displays the Vizimax web-based monitoring interface for a circuit breaker. The interface is organized into several sections:

- Site Information:**
  - Name: Upper Bear Hydro
  - Date & Time: 2012-01-25 08:41:04
  - Unit Status: In Service
  - C/B Position: Close
  - Local / Remote: Remote
  - Last Maneuver: 2012-01-25 07:56:35.000
  - RPC Status: Disabled
- Status:**
  - Internal Temp: 43.0 C
  - C/B Volt: 90.1 V
  - C/B Temp: 26.1 C
  - N/A: N/A
  - Inactivity: 0.7 hrs
  - Frequency: 59.97 Hz
- Maneuvers:**

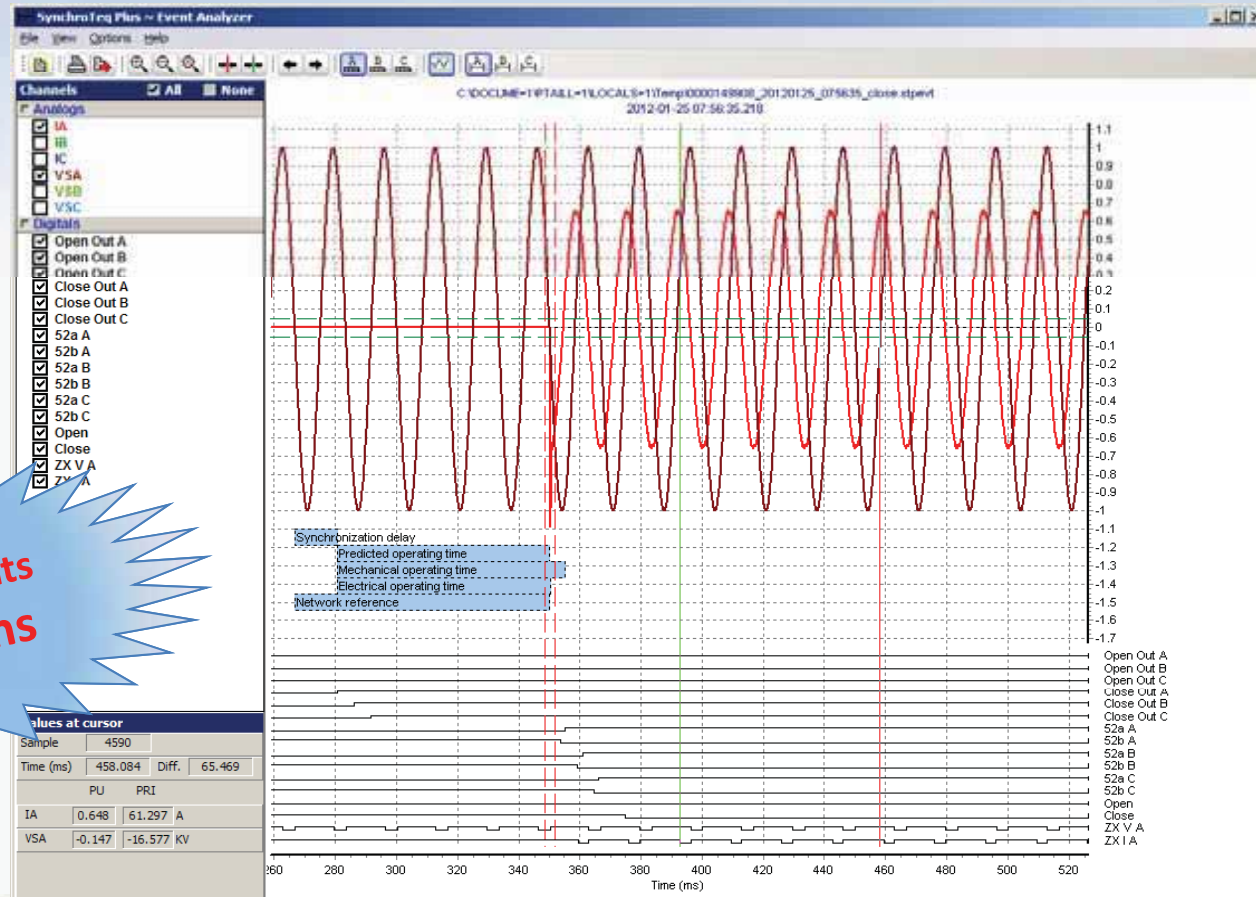
	Opening	Closing
Controlled Switching	221	225
Random Switching	3	0
- Readings:**

	A	B	C
VS	79.7	79.6	79.6
I	44.1	44.0	44.1
VL	---	---	---
Bushing temp	---	---	---
Closing Angle	0	120	240
Opening Angle	0	120	240
Residual Flux	---	---	---
- Digital Inputs:**
  - Out of Service
  - DE1/Degraded
  - DE2
  - DE3
- Events:**

No.	Date	Type	Description	Alarms	Config	Details	Waveform
149908	2012-01-25 07:56:35.000	Close	Controlled close				
149907	2012-01-25 07:56:31.000	Open	Controlled open				
149906	2012-01-25 07:55:43.000	Close	Controlled close				
149905	2012-01-25 07:55:35.000	Open	Controlled open				
149904	2012-01-25 07:54:32.000	Close	Controlled close				

INTELLIGENT SYSTEMS FOR A SMARTER GRID

# WAVEFORM RECORDER & ANALYZER



Up to 2000 Events  
& Waveforms

INTELLIGENT SYSTEMS FOR A SMARTER GRID



# SYNCHROTEQ PLUS – MODULAR PLATFORM

## SynchroTeq™ Plus



**Fits in Substation Control House  
or in Circuit Breaker Cabinets**

Advanced CSD  
Web-based Monitoring



LAN Plug-Ins



Bypass &  
Redundancy



Residual Flux  
Calculation



Automation  
Module - TRAS



**INTELLIGENT SYSTEMS FOR A SMARTER GRID**



# SYNCHROTEQ MV – COMPACT & FLEXIBLE

## SynchroTeq™ MV

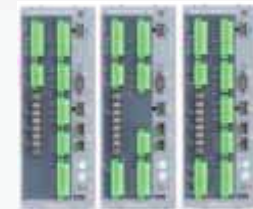


**1, 2, 3 Phase Applications**  
**Switchgears - C/Bs - Switches - Reclosers**  
**3 - 6 - 11 - 13,5 - 25 - 36 kV**

Advanced CSD  
Web-based Monitoring



3 Compact Units for  
FACTS & Transformers



Distributed Flux  
Acquisition for  
Transformers



Automation  
Module



# INTELLIGENT SYSTEMS FOR A SMARTER GRID





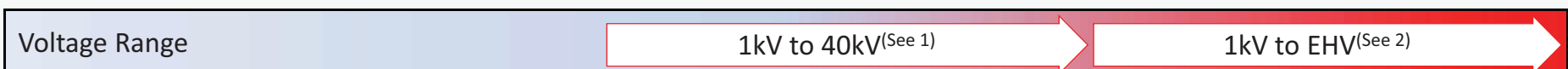
# SYNCHROTEQ FUNCTIONALITIES

	SynchroTeq	SynchroTeq			
	Plus	MVR	MVX	MVS	MVFM
Source AC voltage measurement	3	-----1-----			
Load AC current measurement	3	-----3-----			3
Load AC voltage measurement	3 (Opt.)	N/A	3	1	3
DC control voltage compensation	√	-----√-----			
Temperature compensation	4-20mA	--RTD/4-20ma--			
Pressure compensation	3x4-20mA	-----N/A-----			
Coil driver supervision	√	-----N/A-----			
Integrated bypass unit	√ (Opt.)	-----N/A-----			
Web interface	√	-----√-----			√
Event/Waveform storage capacity	2000	-----500-----			500

**INTELLIGENT SYSTEMS FOR A SMARTER GRID**

# SYNCHROTEQ SIDE BY SIDE

Applications	SynchroTeq MV			SynchroTeq Plus		
	SynchroTeq MVR	SynchroTeq MVX	SynchroTeq MVS	SynchroTeq Plus	SynchroTeq Plus + Flux	SynchroTeq Plus + TRAS
Capacitor Banks - MSC / MSCDN	✓			✓		
Shunt Reactors – MSR	✓			✓		
Power Transformers (3 Phases - Peak Voltage)	✓	✓		✓	✓	
Power Transformers (3 Phases - Residual Flux)		✓			✓	
Power Transformers in Parallel (3 Ph - Res Flux)						✓
Power Transformers (1 Phase - Residual Flux)			✓	✓		
Power Lines				✓		
SVC/Statcom - MSC / MSR / FLT		✓		✓		



(1) : SynchroTeq MV is applicable to Spring/Vacuum C/B types only - Limitations may apply

(2) : SynchroTeq Plus is applicable to all C/B motion technologies including Air Blast, Hydraulic, Pneumatic, Spring, Electro Magnetic ...

## INTELLIGENT SYSTEMS FOR A SMARTER GRID

## SYNCHROTEQ VS C/B TYPE

Applications	Circuit Breaker			
	Single Pole Operation	Three Pole Operation w/ Staggering	Three Pole Operation Simultaneous	Single Phase
Capacitor Banks - MSC / MSCDN	✓	✓		✓
Shunt Reactors – MSR	✓	✓		
Power Transformers (3 Phases - Peak Voltage)	✓	✓		
Power Transformers (3 Phases - Residual Flux)	✓		✓	
Power Transformers in Parallel (3 Ph - Res Flux)	✓			
Power Transformers (1 Phase - Residual Flux)				✓
Power Lines	✓			
SVC/Statcom - MSC	✓	✓		
SVC/Statcom - MSR / FLT	✓	✓		

# OUTSTANDING BENEFITS FOR...

## FACTS : Flexible AC Transmission Systems



MSCDN / MSC – Capacitor Banks

**SynchroTeq™ MV**  
**SynchroTeq™ Plus**



Compensated / Uncompensated Lines



MSR – Shunt Reactors / FLT - Filters



Power Transformer Energization



SVC – STATCOM – HVDC

**MV : as low as 3 - 6 - 11 - 13,5 - 25 kV**  
**HV : ranging from 63 to 1 200 kV**  
**1, 2, 3 phase Circuit Breakers**



Asset Management & Monitoring

# INTELLIGENT SYSTEMS FOR A SMARTER GRID

# OUTSTANDING BENEFITS FOR...



TSOs and DSOs

**SynchroTeq™ MV**  
**SynchroTeq™ Plus**



Energy Storage



Power Generation



Industry – Oil & Gas



Industry – Metal & Mining

**MV : as low as 3 - 6 - 11 - 13,5 - 25 kV**  
**HV : ranging from 63 to 1 200 kV**  
**1, 2, 3 phase Circuit Breakers**



Railways Infrastructure

## INTELLIGENT SYSTEMS FOR A SMARTER GRID

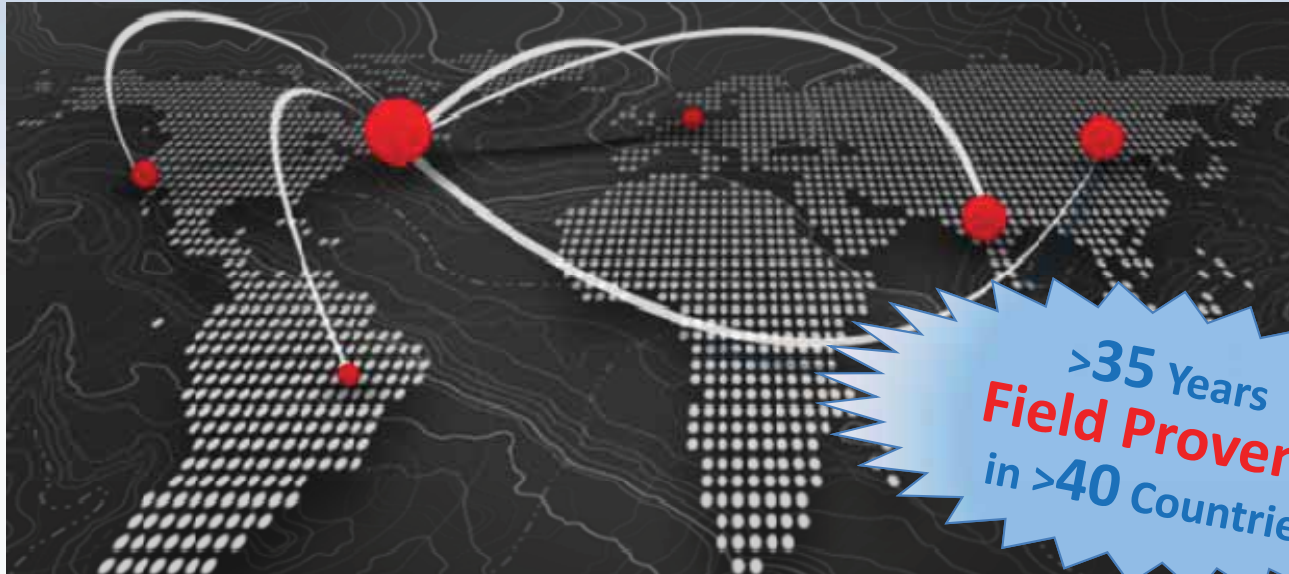


# CUSTOMERS



## INTELLIGENT SYSTEMS FOR A SMARTER GRID

# THANK YOU



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in >40 Countries**

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## INTELLIGENT SYSTEMS FOR A SMARTER GRID