



**MC-monitoring SA**

Measuring - Consulting - Monitoring

# Integrated fiber optics acceleration sensors for hazardous environments

A partnership between CSEM SA and MC-monitoring SA

**CSEM SA**

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**Think** ahead, **Move** forward

# Content

Company Presentation

Main Markets

Testing environment

Product life span

Questions?

# Key partner for demanding customers providing reliable, cost effective and innovative monitoring solutions



# Core Competences

Projects

CMS - Condition Monitoring Software

Data Aquisition Module (vibration, airgap & PD)

Sensors and conditioners



Fiberoptic Acceleration Sensors

- Sensors
- Cables
- Integrated electronics



Air Gap Transmitters

- Sensors
- Impedance adapter modules
- Conditioners



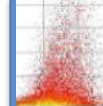
Accelerometers & Velocimeters

- Linearized velocity sensors
- Piezo-electric sensors
- Charge amplifiers



Special proximity probes

- Runner clearance probes
- Submersible proximity probes



Partial Discharge Sensors

- Sensors

### Monitoring of hydrogenerators



Zarnowiec, Poland

### Monitoring of Gearless Mine Drives (GMD)



Lafarge, France

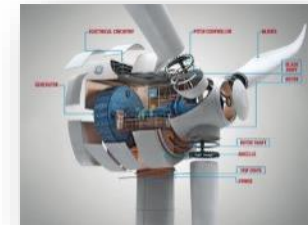
## Main markets

### Monitoring of turbogenerators



Alstom Power Thermal Services

### Monitoring of gearless windmills



### Monitoring of industrial machines



Tabreed

# Monitoring solution for turbo generators

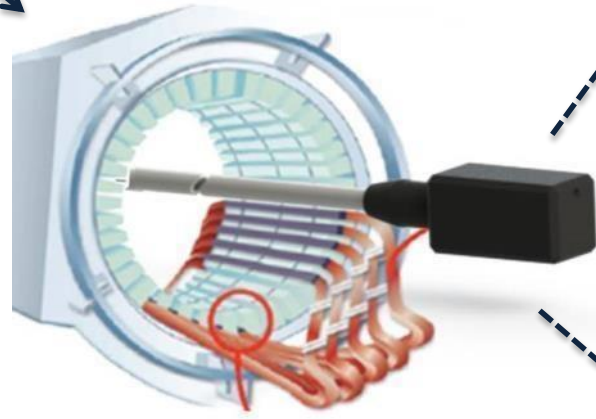
FAS – Fiberoptic Acceleration Sensor



PVS – Piezoelectric Acceleration Sensors



PDC-xx-1000 –  
Partial Discharge Sensors



Vibration Analysis Software



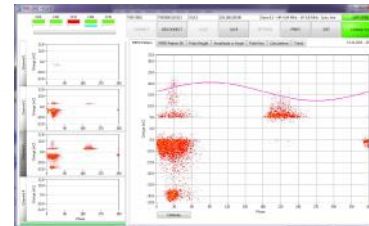
PMS-200-EW Data Acquisition



VPM-100 – Process Module



PD Analysis Software



TMS-5x41 – PD Monitoring



# Monitoring solution for turbo generators

FAS – Fiberoptic Acceleration Sensor



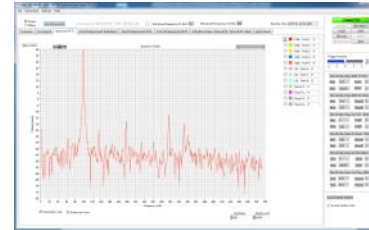
PVS – Piezoelectric Acceleration Sensors



PDC-xx-1000 –  
Partial Discharge Sensors



Vibration Analysis Software



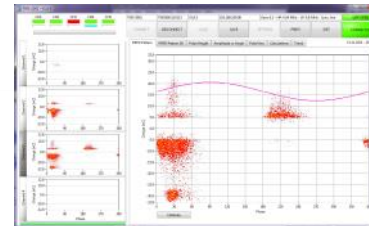
PMS-200-EW Data Acquisition



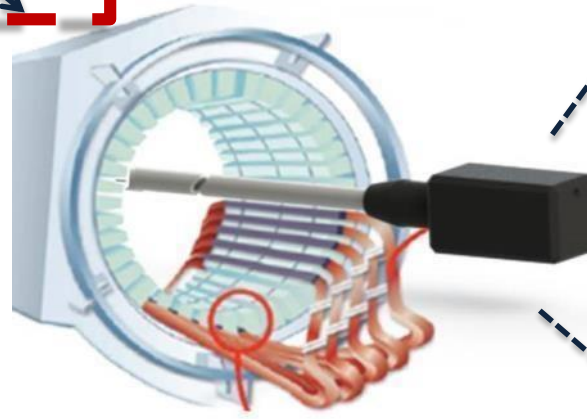
VPM-100 – Process Module



PD Analysis Software



TMS-5x41 – PD Monitoring



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EW-monitoring

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# Necessity to monitor endwinding vibrations

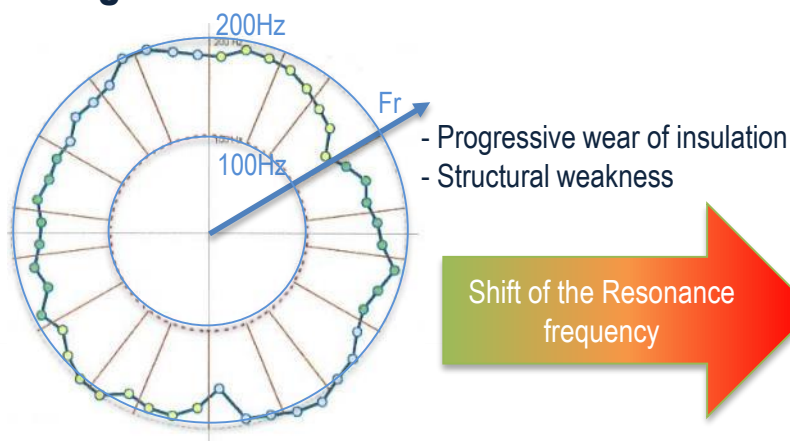
## Cause

- Endwinding vibration is due to strong **electromagnetic forces** at **twice** the synchronous frequency
- Deterioration is accelerated when the self **resonance frequency** of the stator bar is similar to the **double synch. frequency**

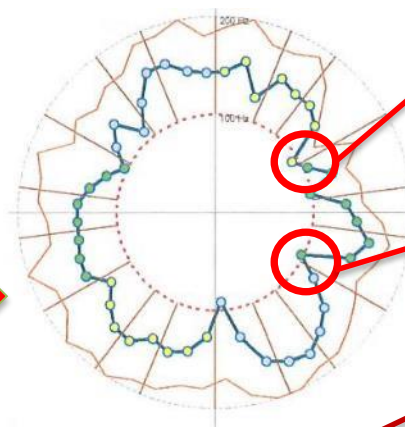
## Effects/Observations

- Weakening of the structure
- Weakening of the insulation (cracks)
- Failure of the cooling system
- Cracking of the conductor
- Potentially short-circuit

### Original status:



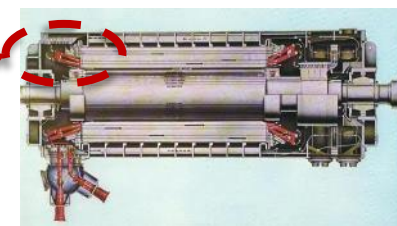
### Endwinding deterioration:



Friction dust



Dominant self Resonance frequency at 2X – Heavy vibration



Endwinding

# Fiberoptic Acceleration Sensor: FAS-Sensor

## Fiberoptic Acceleration Sensor “FAS”

- Vibration measurements in hazardous and explosive environments
- Immune against electrical and magnetic fields
- Highly isolated: more than 65kV demonstrated



**ADVANTAGE : No electrical coupling between sensor head and cubicle = NO DANGER TO LIFE**



## Design

- Sensor head: Sensitive element placed on the end-winding
- Fiberoptic cable with PTFE protection tube: transmission of optical signal
- Conditioner: Signal conditioning with dual output (acceleration/displacement)

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# Product requirements

## Requirements

Description	Unit	Range	Tolerances	Status
Minimum frequency range	[Hz]	10 to 400	-3 dB	By design
Linearity	[g]	0.1 to 40	+/- 10%	By design
Resonant frequency	[Hz]	> 600		By design
Sensitivity	[mV/g]	100	+/- 10%	By design
Temperature range	[°C]	-20 to +90°C	+/- 10%	By design
Product life span	[years]	10	>10 years	To be defined ?

## Monitored parameter

Monitored parameter	Measuring unit	Accepted deviation
Sensitivity	[mV/g]	+/- 10%
Electrical current consumption	[mA]	+/- 10%

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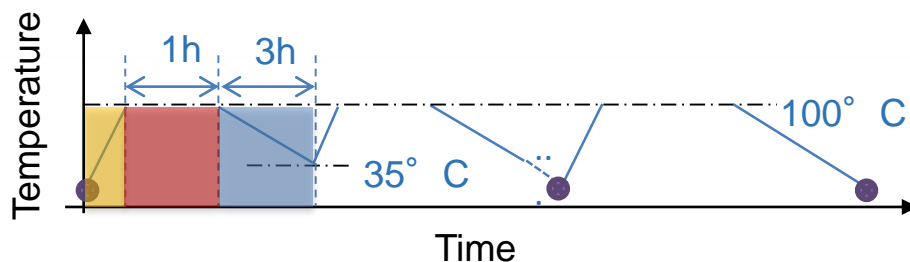
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# Steady-state temperature robustness

- Continuous testing
  - Goal: demonstrate the reliability to the specified temperature over an extended time period
  - Excitation: Sensor at rest
  - Minimum exposition temperature: 100°C
  
- Cycling testing
  - Goal: Determine the resistance of the sensor to temperature extremes
  - Excitation: Sensor at rest
  - Temperature variation: 35-100°C
  - Exposition time equivalency during operation: 7'300 cycles
    - 2 temperature cycles per day during 10 years



(●): Measurements

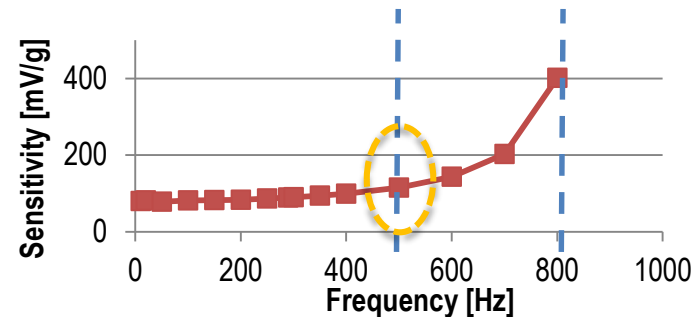
Step 1 : Heating / 15min

Step 2 : High temperature

Step 3 : Cooling

# Constant acceleration test

- Ambient temperature
  - Goal: Determine types of structural and mechanical weaknesses
  - Excitation: Sine function, 10g pk-pk,  
F= resonance frequency/1.5,
  - Exposition temperature: Ambient temperature
  - Exposition time : 10 min



- Combined temperature and acceleration test
  - Excitation: Sine function, 10g pk-pk,  
F= resonance frequency/1.5
  - Temperature variation: 35-100°C

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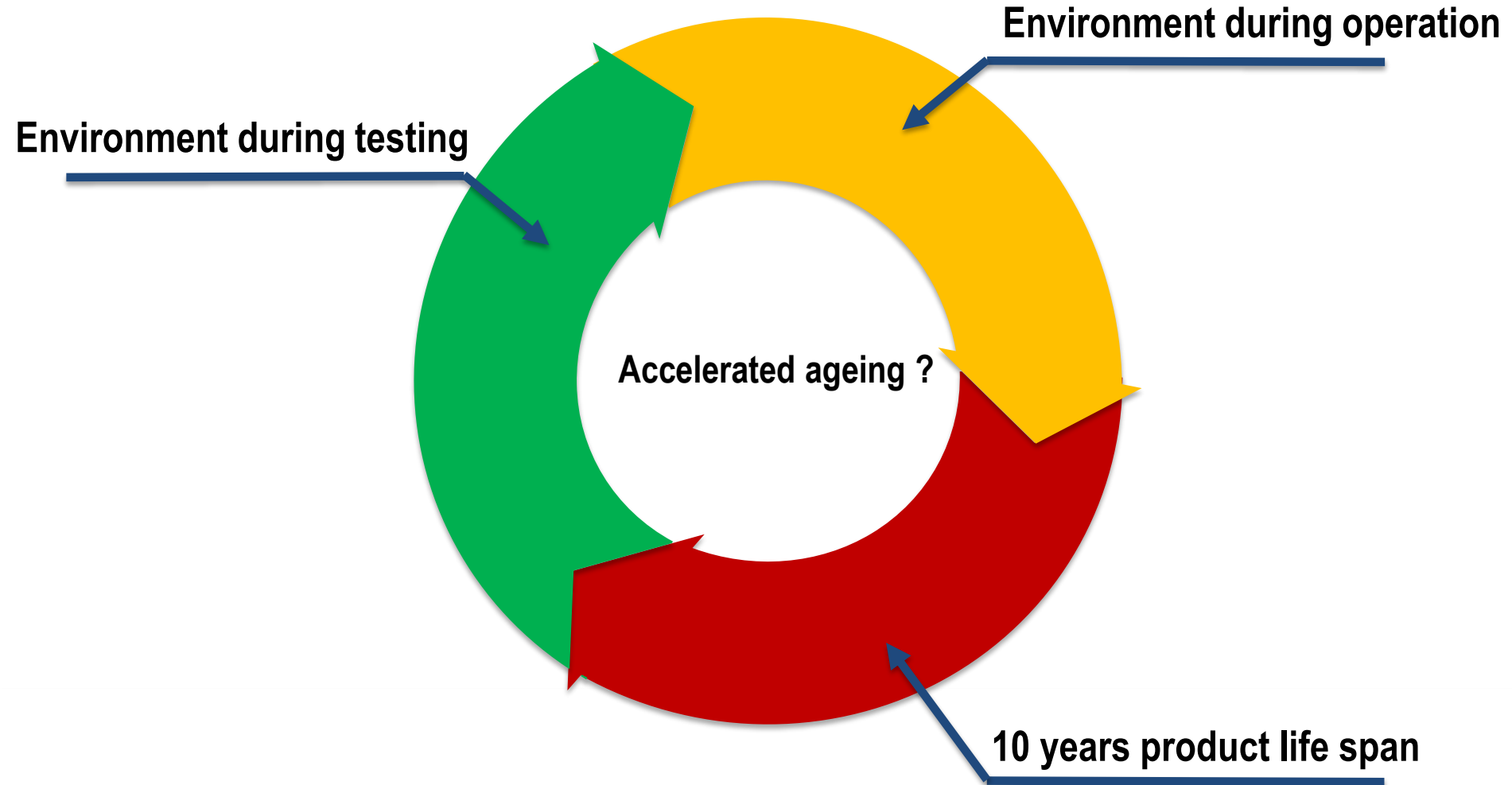
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[www.mc-monitoring.com](http://www.mc-monitoring.com)

Many thanks for your attention

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