VIBROSYSTM

ZOOM NOTCH

# COMPLETE MONITORING SOLUTIONS & DIAGNOSTICS SERVICES

## for the **Hydro Industry**

HYDRO

# Table of Contents

# Generator Diagnostics Asset Management Tool

By offering to its customers the first web based diagnostic platform ZOOMWatch, a revolutionary online machine management platform that meets a growing need in the industry.

Once again VibroSystM is the pioneer in machine diagnostic and management solutions.

ZOOM WATCH™

- Mobile friendly, web-based diagnostic platform
- 24/7 on-demand support at your fingertips
- Analysis results displayed in easy to understand graphs

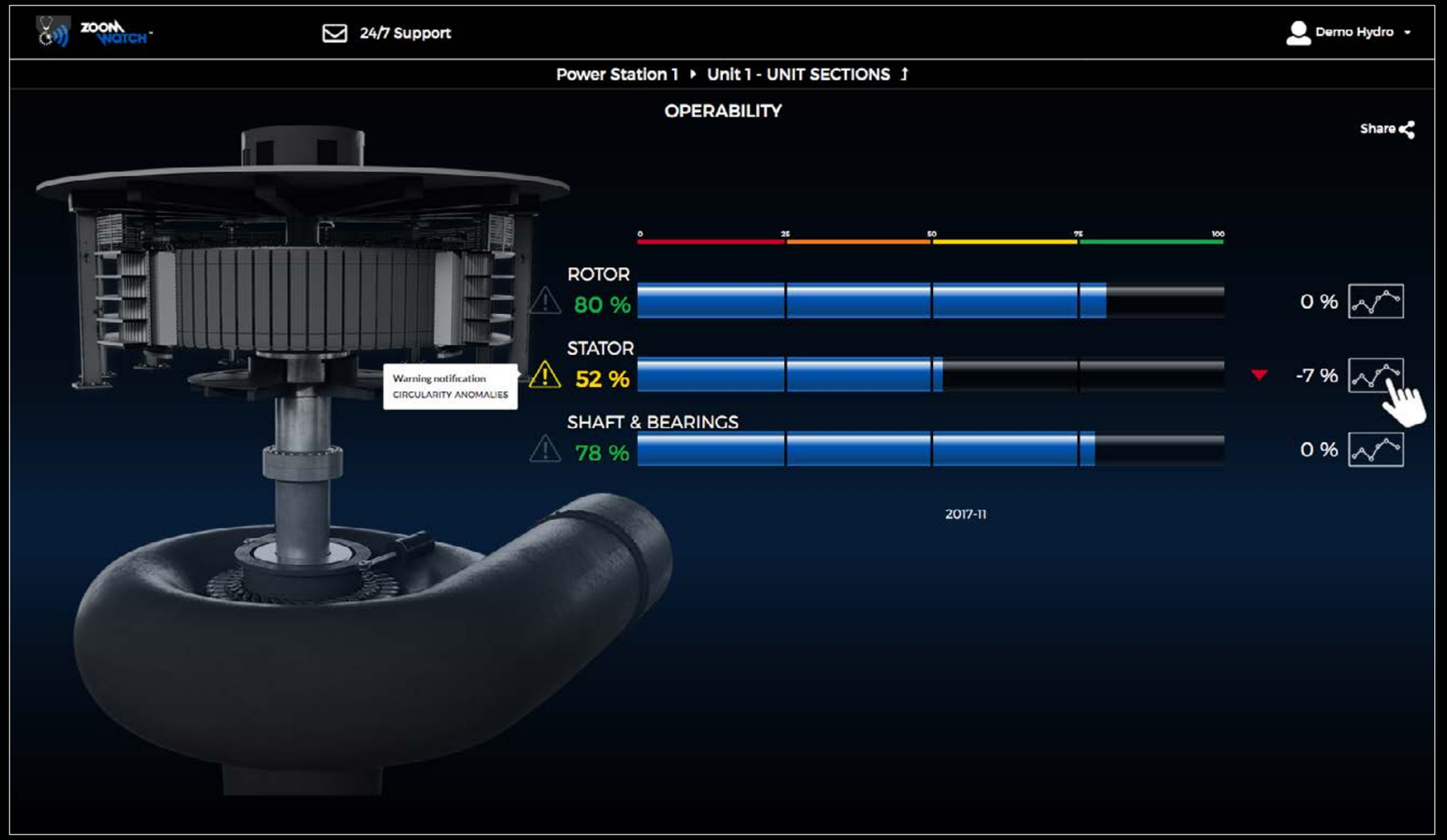
TRY IT NOW


## Cyber Security Map (CSM)

Watch the video

# Operability levels

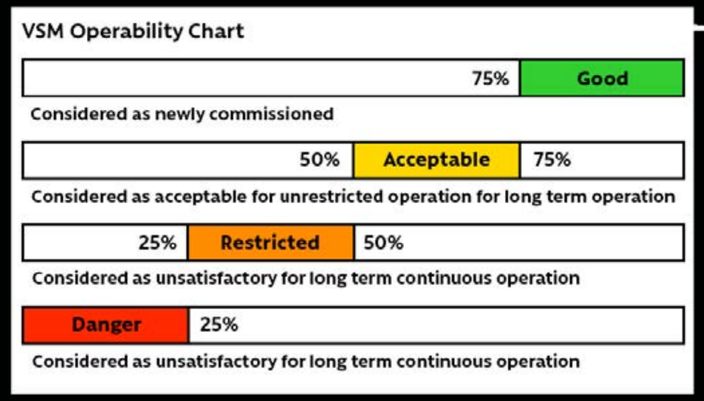
Operability assessment of the various sections of the Unit accompanied by intervention recommendations

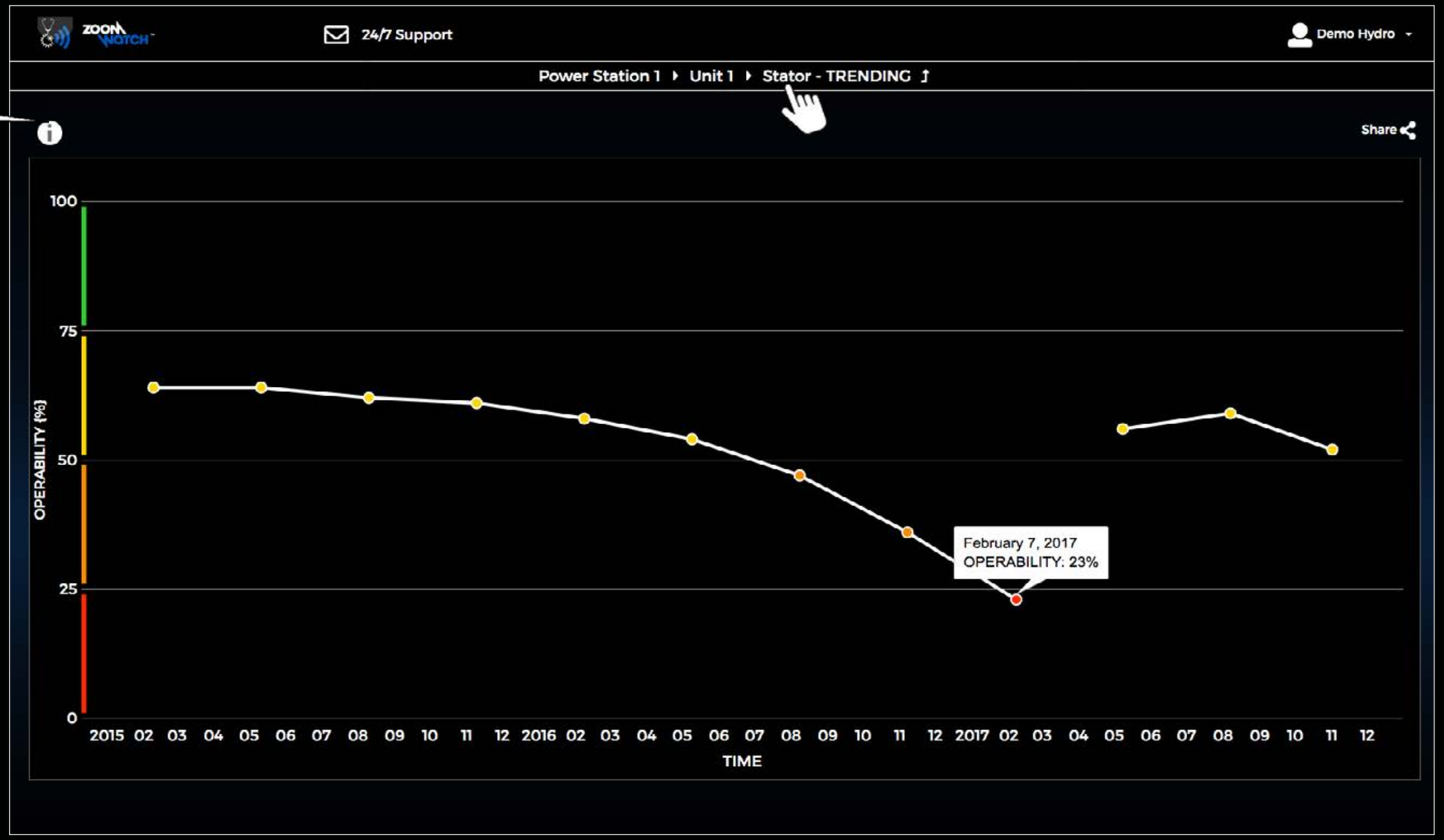



These values represent the overall operability of any given section of the Unit, based on the severity levels of each phenomenon monitored associated to the section of the Unit.

Each value gives a good indication of the overall health of a section of the Unit and more importantly, an early detection tool to identify any deteriorating condition of the Unit.

## Operability level based on current and previous results providing a trending of results over time




**Simplified results** displayed on an intuitive interface:

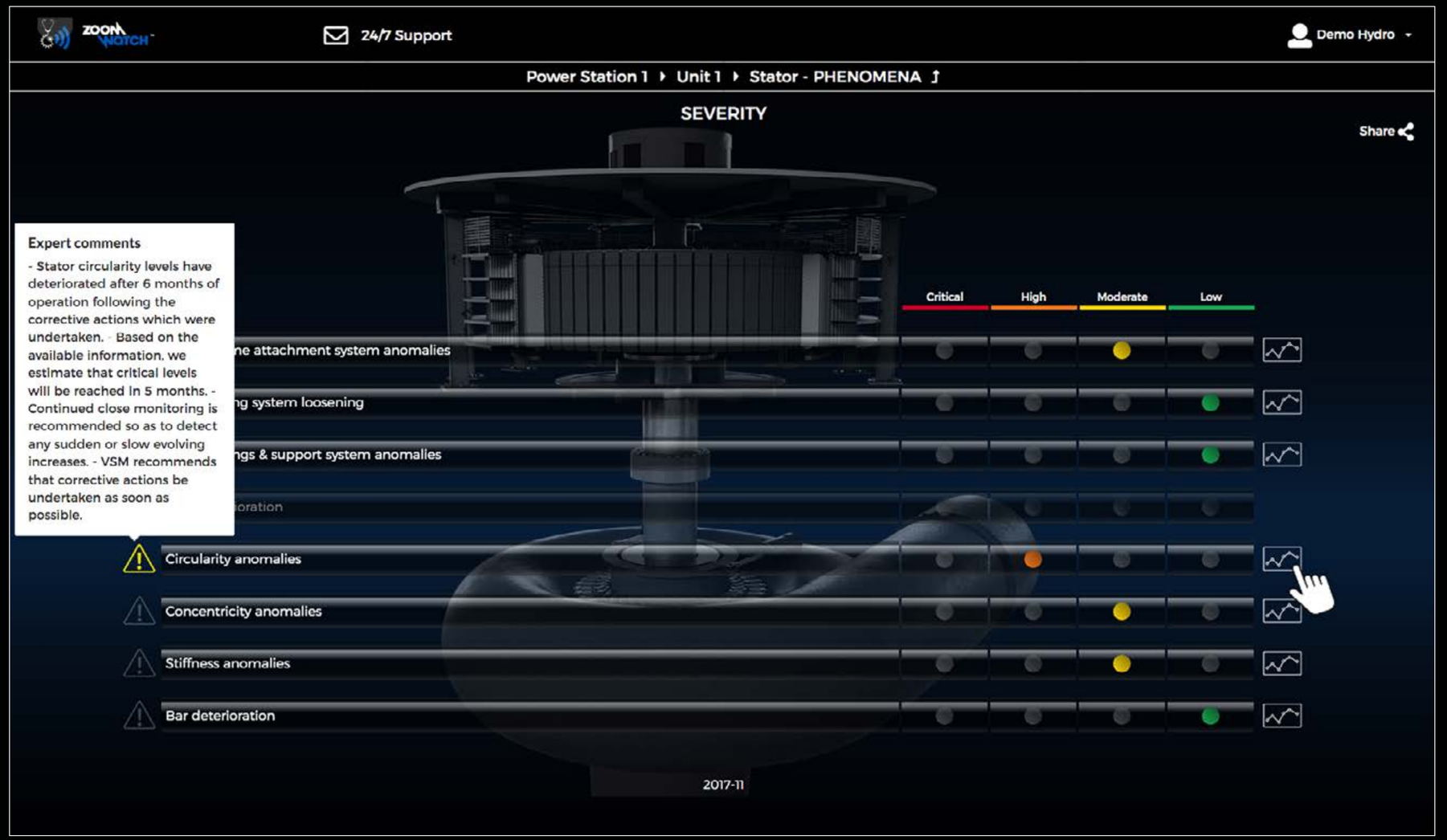
- Can be used by plant managers, both engineers and non-engineers
- Eliminates the need to have experts available

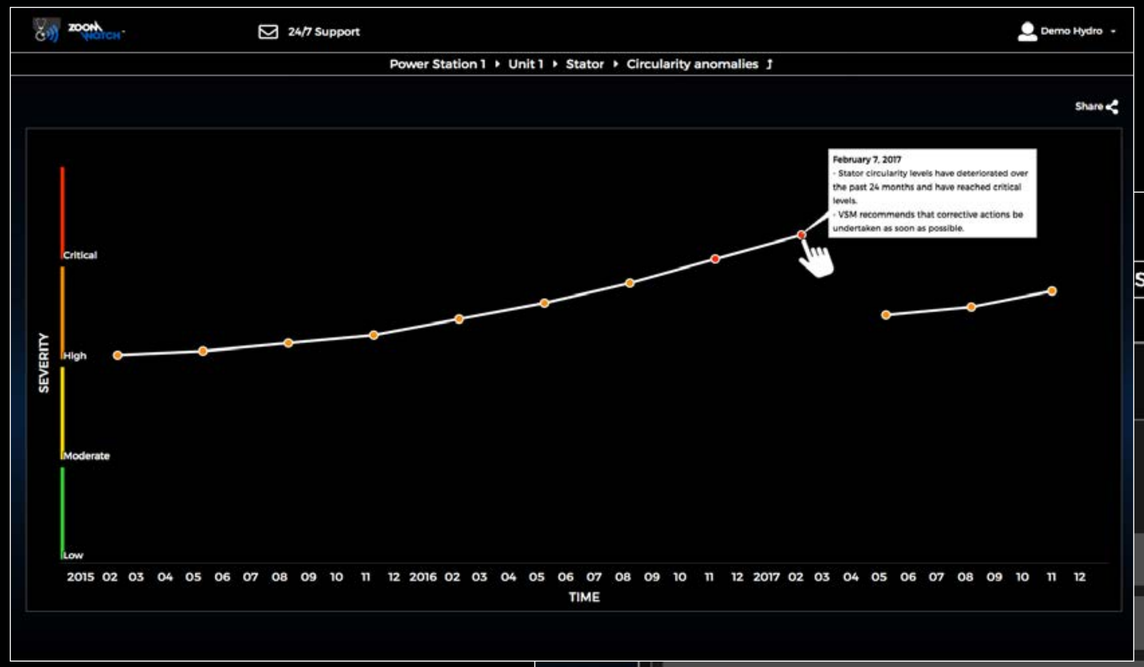
# Severity levels

Represent the severity of any given phenomenon monitored on the Unit. Theses results are made **much easier to understand** by providing results per phenomenon, and displaying these results based on existing tolerances and standards, in an easy to understand graphical environment making it much easier to evaluate and react.

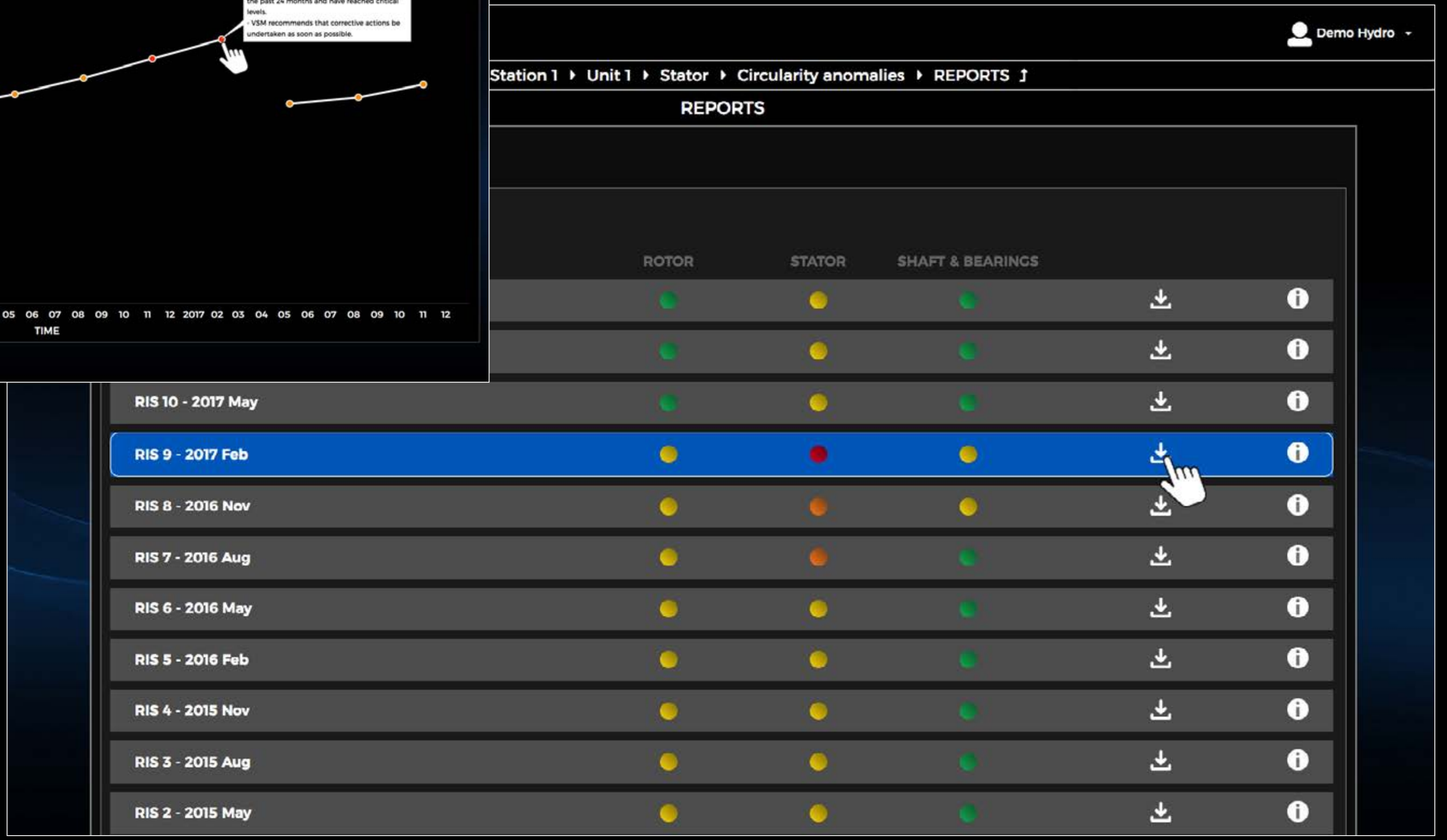
*Severity results for all phenomenon monitored on the unit section will be used to assess the operability level of the Unit section.*

## Actual severity of each phenomenon on the asset




24/7 Support
Demo Hydro
Power Station 1 ▸ Unit 1 ▸ Stator ▸ Circularity anomalies
Share
February 7, 2017
- Stator circularity levels have deteriorated over the past 24 months and have reached critical levels.
- VSM recommends that corrective actions be undertaken as soon as possible.
Critical
High
Moderate
Low
SEVERITY
2015 02 03 04 05 06 07 08 09 10 11 12 2016 02 03 04 05 06 07 08 09 10 11 12 2017 02 03 04 05 06 07 08 09 10 11 12
TIME

1


Demo Hydro
Station 1 ▸ Unit 1 ▸ Stator ▸ Circularity anomalies ▸ REPORTS
REPORTS
ROTOR
STATOR
SHAFT & BEARINGS
RIS 10 - 2017 May
RIS 9 - 2017 Feb
RIS 8 - 2016 Nov
RIS 7 - 2016 Aug
RIS 6 - 2016 May
RIS 5 - 2016 Feb
RIS 4 - 2015 Nov
RIS 3 - 2015 Aug
RIS 2 - 2015 May

2

# RIS report

## Results Interpretation Service

The specialists in our Tests & Diagnostics division provide clients with detailed reports on the general condition of their machines. They analyze and correlate all the information our systems collect and provide comprehensive training sessions on how to understand their machine behavior.

## Analysis & Diagnostic reports

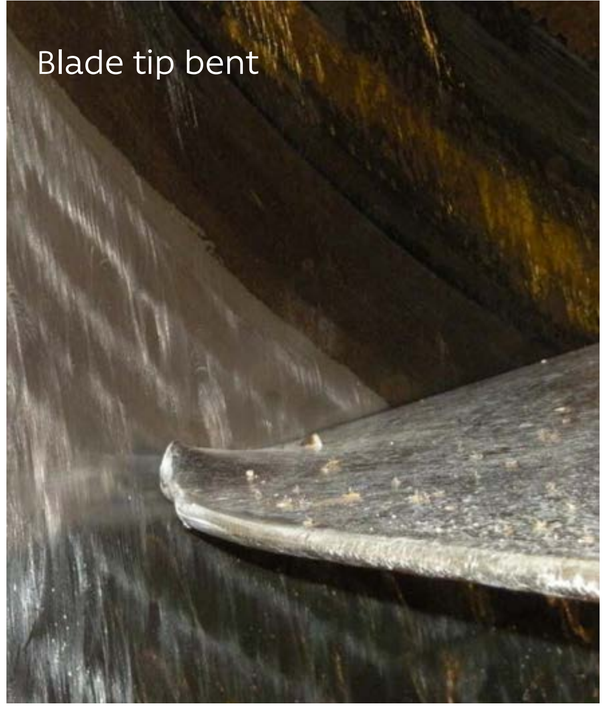
In combination with our powerful ZOOM software, VibroSystM's results interpretation service puts decades of experience at work, allowing our clients to extract the most out of their monitoring systems. The service helps users identify patterns and anomalies that are both meaningful and informative. Our RIS is among the many tools we put directly into the hands of our customers around the world empowering them to make informed business decisions that will have a direct impact on the bottom line of plant management.

# Phenomena requirements

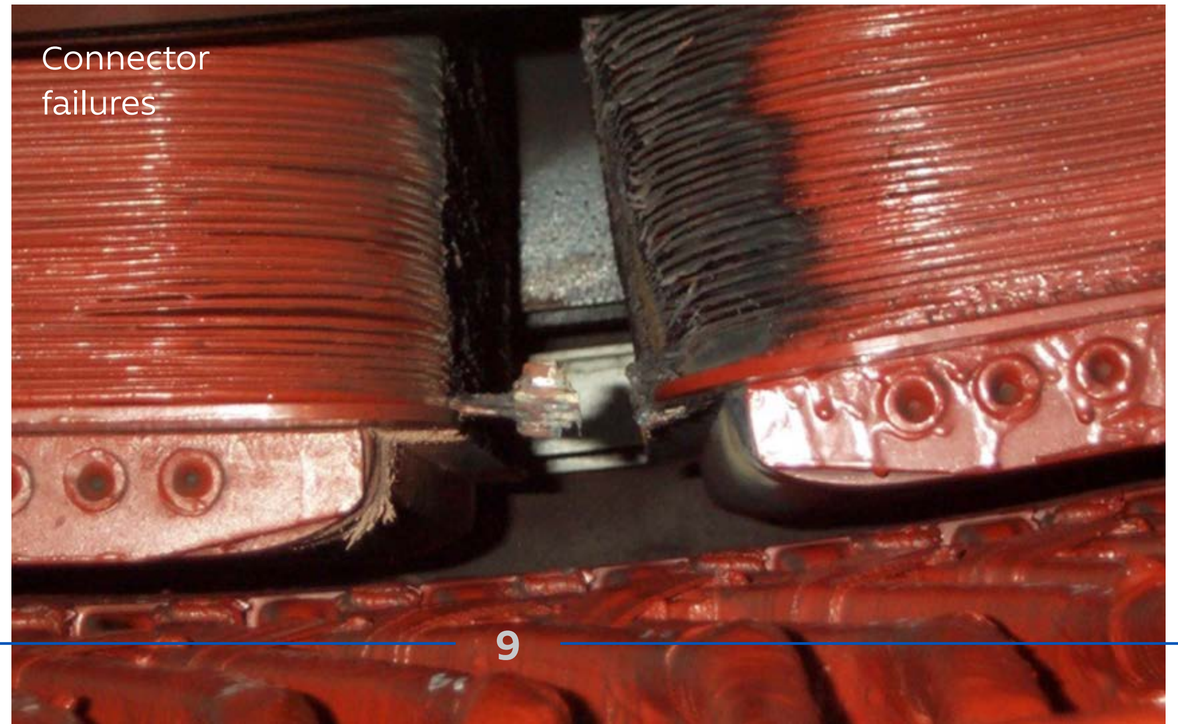
| SEVERITY | SENSORS REQUIRED | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | AIR GAP | MAGNETIC FLUX | VIBRATION & DISPLACEMENT | | | | | TEMPERATURE | | |
| ROTOR | VM | MFP | FOA | PCS | PES | SBV | VSM797S | FOT | TWR | TWS |
| Rim expansion anomalies | x | o | | x | o | | | | | |
| Circularity anomalies | x | o | | x | o | | | | | |
| Pole radial position anomalies | x | o | | x | o | | | | | |
| Concentricity anomalies | x | o | | x | o | | | | | |
| Pole overheating | x | o | | | | | | | x | |
| Stiffness anomalies | x | o | | x | o | | | | | |
| Pole shorted turns | x | x | | | | | | | | |
| STATOR | | | | | | | | | | |
| Stator core & frame attachment system anomalies | | o | | | o | | x | | | o |
| Stator bar wedging system loosening | | | o | | | x | | | | o |
| End windings & support system anomalies | | o | x | | | | | o | | |
| Stator core deterioration | | | | | | | x | | | x |
| Circularity anomalies | x | o | | x | o | | | | | |
| Concentricity anomalies | x | o | | x | o | | | | | |
| Stiffness anomalies | x | o | | x | o | | | | | |
| Stator bar deterioration | | | x | | | x | | | | x |
| SHAFT & BEARINGS | | | | | | | | | | |
| Shaft & bearing anomalies | x | | | x | | | o | | | |
| Thrust bearing anomalies | x | | | | x | | | | | |

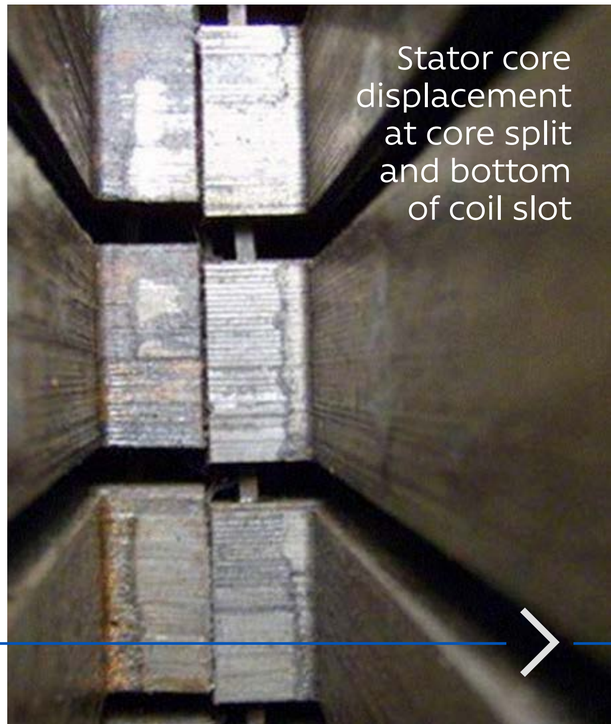
x mandatory o optional


Damage
caused by pole
inter-connection
overheating


Blade tip bent


Throat ring
liner damage
and runner
blades


Connector
failures


Stator core
displacement
at core split
and bottom
of coil slot

# Sensors

## Precision & Reliability

In order to give our customers a precise prognosis on the condition of their machine, data accuracy is essential. VibroSystM sensors were all designed to withstand the harsh and robust variety of environments they are to be installed in, without compromising the accuracy needed to correctly monitor and protect your machine.


- Magnetic flux

### MFP™-100

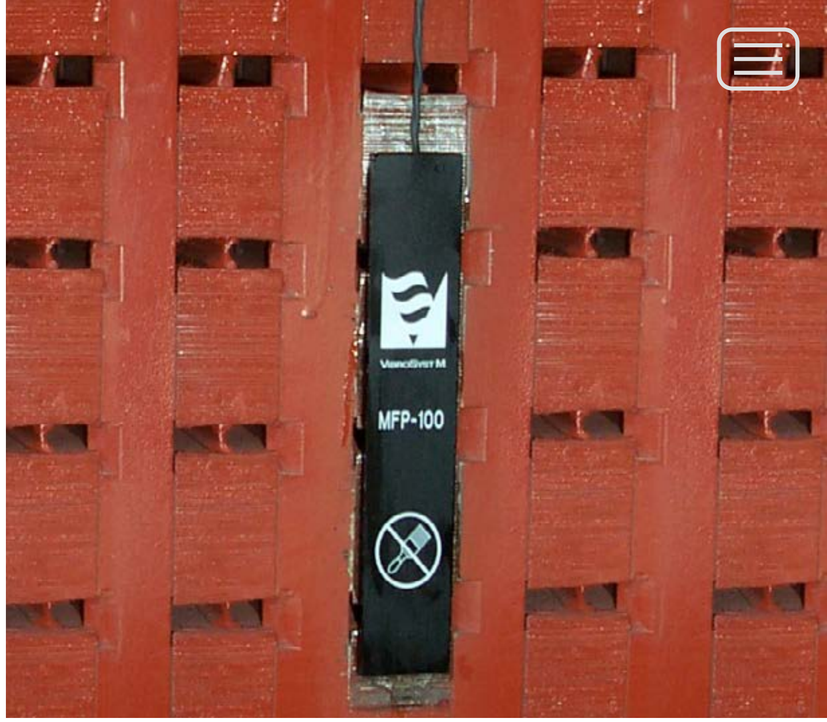
The MFM magnetic flux measuring system monitors magnetic field density and detects imbalances that contribute to machine vibration, overheating and excessive stress on the rotor and stator. The sensor can be installed without removing the rotor or the poles.



- Stator bar absolute vibration
- End winding absolute vibration
- Phase leads absolute vibration
- Iso-phase bus absolute vibration

### FOA™-100/200

The FOA fiber optic accelerometer was designed to measure vibration amplitudes of high voltage components that are exposed to electrodynamic and mechanical stress, such as stator end-windings. Its robust design, made of non-metallic and electrically non-conducting materials, makes it suitable for hostile environments. No field calibration is required.




- Shaft displacement
- Shaft relative vibration

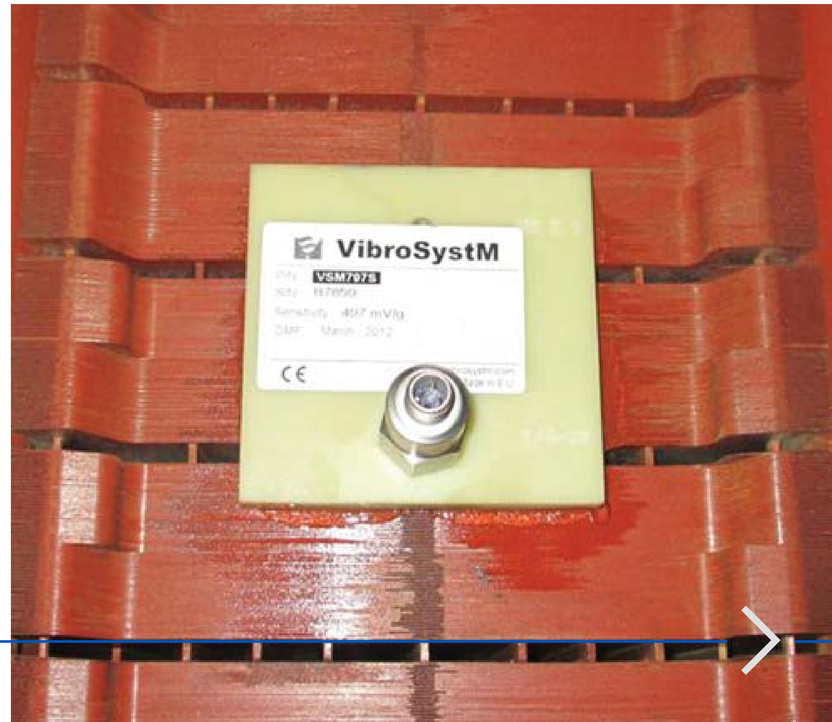
## PCS™-302

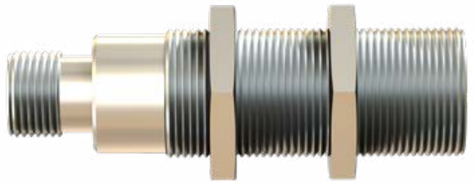
The PCS capacitive proximity probe was designed for non-contact measurements of relative vibration, displacement and radial positioning. Its exclusive capacitive measuring technology makes it unaffected by conductive or semi-conductive target material types, therefore requiring no field calibration.


- Stator frame absolute vibration
- Stator core absolute vibration
- Pressure plates absolute vibration
- Bearing absolute vibration
- Turbine head cover absolute vibration
- Nose absolute vibration

## VSM797S™

The VSM797S is a piezoelectric accelerometer designed to measure absolute vibration in harsh industrial environments. This sensor was developed to ensure accurate results throughout the entire operating temperature range.





Stator frame relative displacement

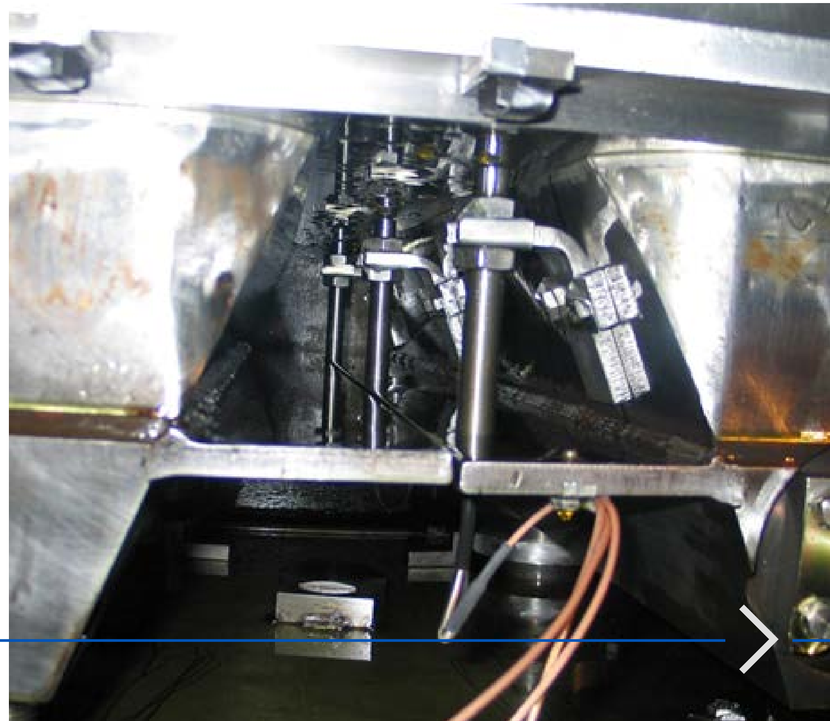
## PES™-110

The PES-110 eddy current proximity sensor is designed for non-contact measurements of relative vibration, displacement, and axial positioning. The sensor is equipped with built-in conditioning circuitry allowing it to be directly connected to processing instrumentation.

Thrust bearing relative displacement

## PES™-300 Serie

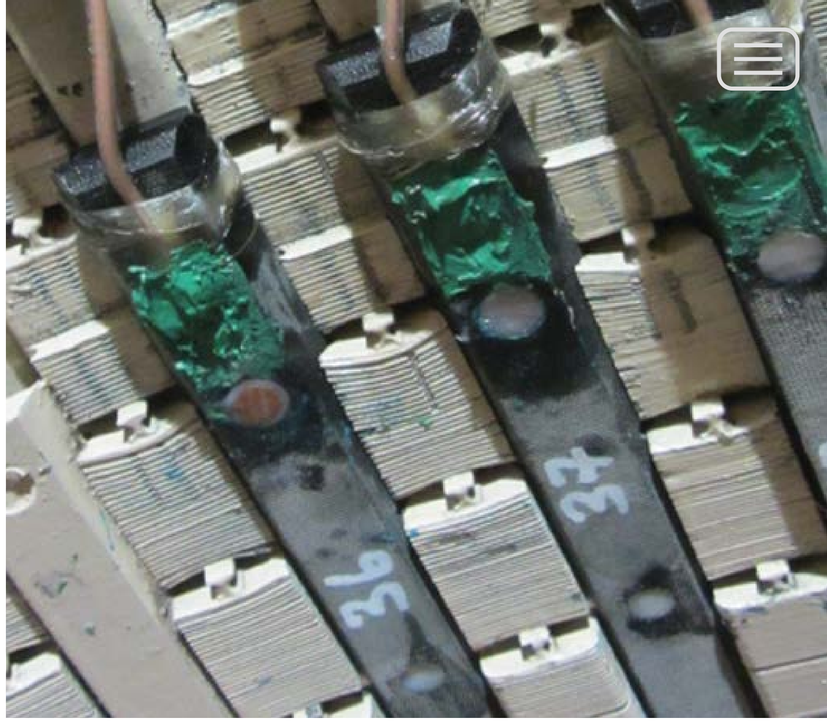
The PES eddy current proximity probe is designed for non-contact measurements of relative vibration, displacement and axial positioning. The probe is equipped with built-in conditioning circuitry and protected to be fully operational in oil. Since it requires no field probe drivers, it can be directly connected to processing instrumentation.



Stator bar relative vibration

## SBV™-202

The SBV stator bar vibration capacitive sensor was designed for non-contact in-slot measurements of stator winding vibration. Built to be immune to strong magnetic fields, this sensor provides reliable and accurate information on bar vibration and displacement.




Stator bar relative vibration

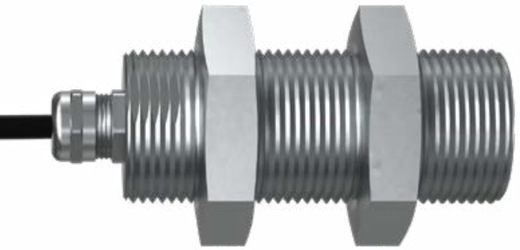
## DCS™-400

The DCS capacitive sensor is designed for non-contact in-slot measurements of stator winding vibration (i.e. bar relative to core). The sensor is embedded in a stator slot facing the bar and replacing a wedge or a part of it.

- Stator core temperature
- Stator bars temperature
- Pressure plates temperature (end core)

## TWS™

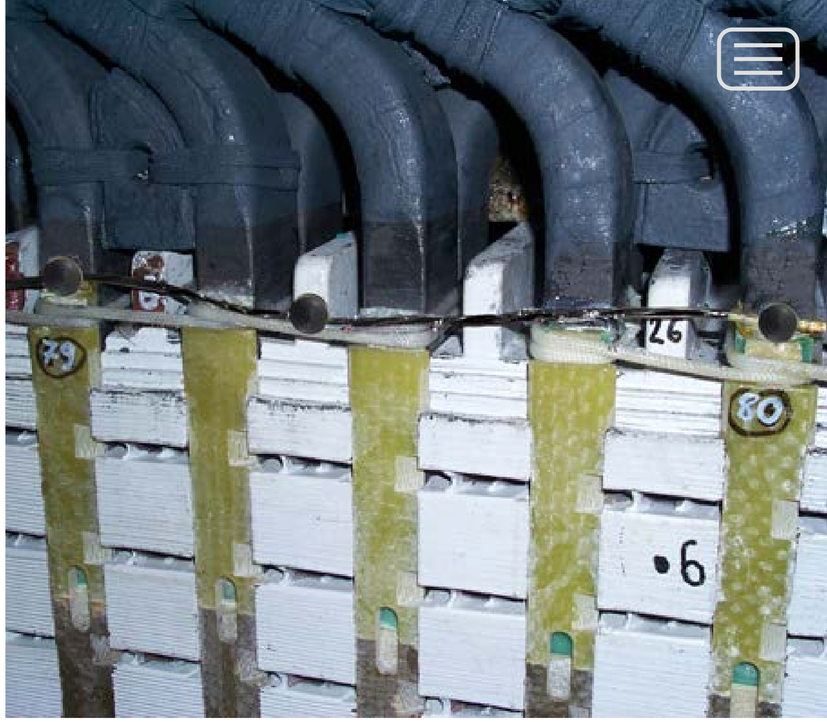
The TWS ThermaWatch stator sensor is a real-time multipoint temperature sensor for the stator core and windings. It provides valuable information about the thermal behavior of a stator core, especially the hot spots or shorted laminations.



- Turbine clearance

## SPES™

The SPES proximity sensor is designed to measure the relative distance of an underwater metallic target surface. It is usually used to measure blade tip clearance in Kaplan turbines as well as runner band clearance in Francis turbines. The sensor can sustain high levels of underwater pressure and is equipped with built-in conditioning circuitry allowing it to be directly connected to processing instrumentation.



# Improved Design


## VM™ Air Gap

U.S. Patent No. 11125795

The VM™ AIRFLOW sensors are non-contact capacitive sensors that measure the distance between the rotor and the stator. These sensors are designed with apertures, thus limiting obstruction of the ventilation holes on the stator. They are specifically designed to continuously provide reliable information about the machine air gap

End-winding temperature

Phase leads temperature

Iso-phase bus temperature

## FOT™-200

The FOT fiber optic temperature sensor was developed to monitor temperature of high voltage components, such as generator end-windings, isophase bus bars, exciter brushes and knife switches. Its robust design, made of non-metallic and electrically non conductive materials, makes it suitable for hostile environments. No field calibration is required

Rotor poles

## TWR™-200

The TWR ThermaWatch rotor sensor is a fast-response, non-contact sensor that measures rotor pole and rotor pole joint temperature. Although small in size, this high speed temperature sensor allows for a comprehensive analysis of the rotor's condition

# Acquisition Units

## Protection, Monitoring & Analysis Unit

Combine all your quality control data acquisition units in one single space, and simultaneously monitor all the critical parameters on your machine.


### ZPU™-5000 Protection, Monitoring & Analysis Unit

The ZPU-5000 is a multi-channel acquisition instrument designed for monitoring and protecting large rotating machines. Available in a network (with a ZOOM server), the ZPU-5000 can simultaneously monitor multiple parameters and communicate with the ZOOM software.

# ZOOM® Monitoring Cabinet

## 19" Rackmount Freestanding Cabinet (42 U)

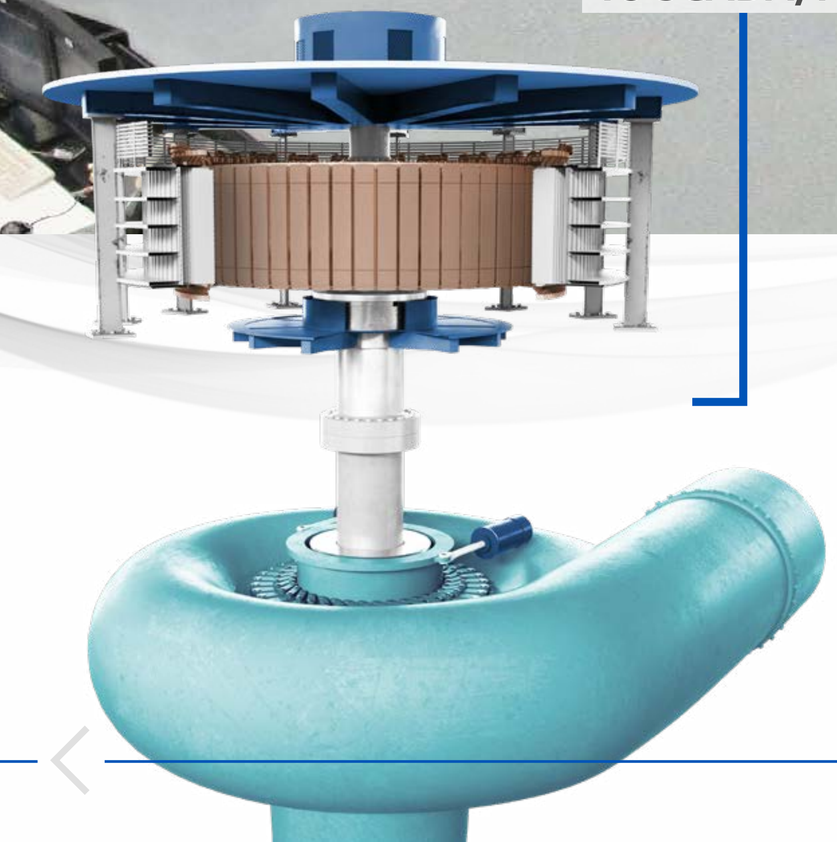
Our ZOOM cabinet comes pre-wired, fully tested and complemented with as-built drawings for a fast and effective on-site installation. Its robust design keeps VibroSystM's monitoring hardware protected, extending its longevity.

# ZOOM® Software

## Zero Outage Online Monitoring

VibroSystM's ZOOM software provides its users with a clear, real-time picture on the condition of their machine in any operating mode. The ZOOM software suite is the only one on the market that can be tailored to a user's specific needs. It is composed of various acquisition services, which gives its users the possibility of choosing the parameters to be monitored on their machines.

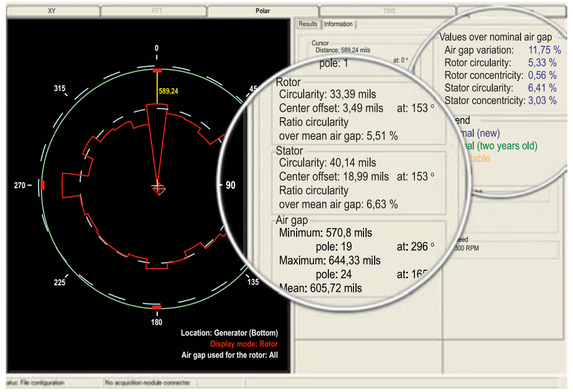
To SCADA/PLC



# Bi-directional communication Services

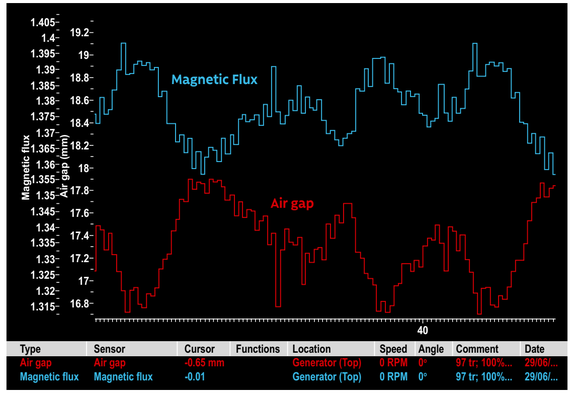
ZOOM Software can be complemented by Modbus® and OPC® bi-directional communication services that collect and send data to and from the **plant's control system**.

# ZOOM® Software



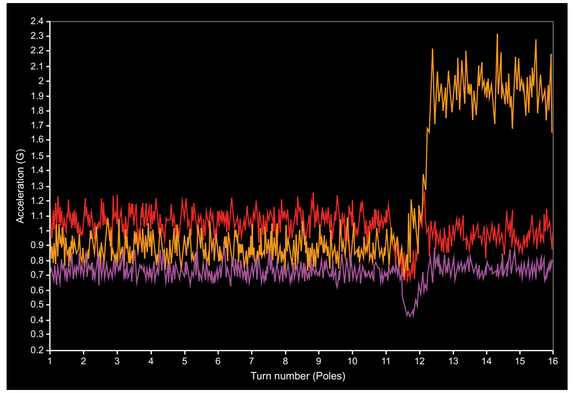

**VM + ZPU + ZOOM**

**Generator Shapes & Clearance,** Rotor shape and position inside stator shape. Quickly identify critical air gap locations and associate its values to industry standards



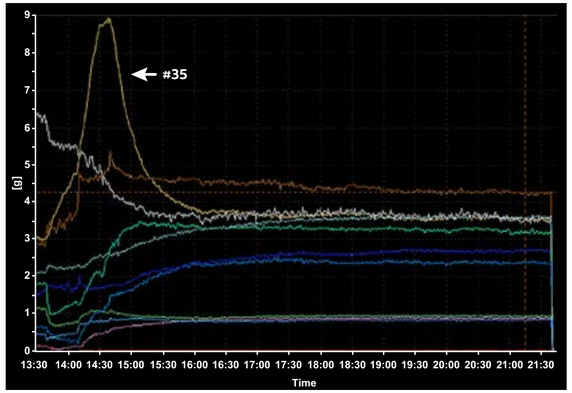

**MFM + VM + ZPU + ZOOM**

Magnetic flux intensity is inversely proportional to air gap. Therefore, a small air gap produces higher magnetic flux results and vice-versa



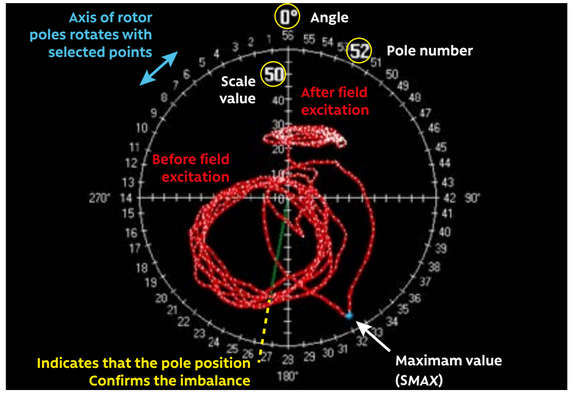

**FOA + ZPU + ZOOM**

**End-Winding Vibration during Load Increase,** End-winding vibration behavior during load increase on a hydroelectric generator




**FOA + ZPU + ZOOM**

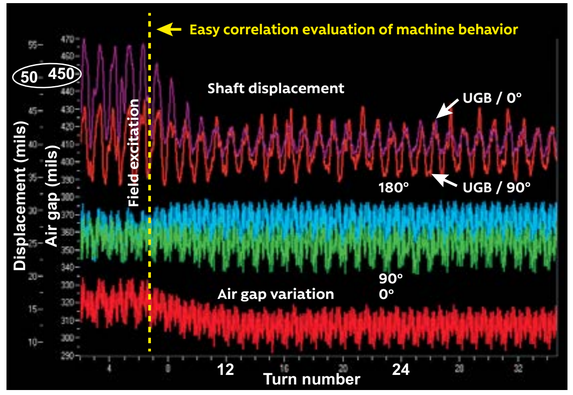
12-hour trend of end-winding vibration (radial) with a peak of ~9 g (~310 µm, pk-pk, at 120 Hz) for end-winding #35 during temperature increase




**PCS + ZPU + ZOOM**

**Shaft Orbit & Displacement**

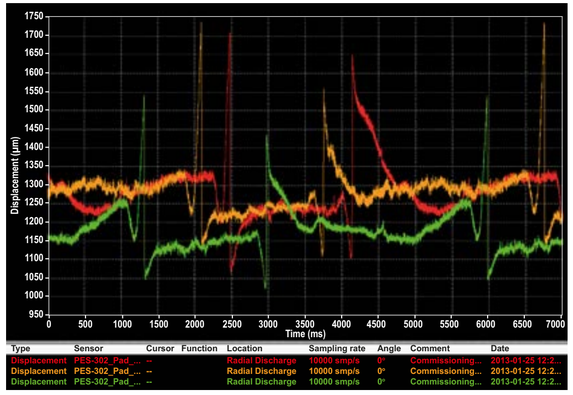
Shaft orbit relative to rotor pole position. Indicates that the pole position confirms the imbalance




**PCS + VM + ZPU + ZOOM**

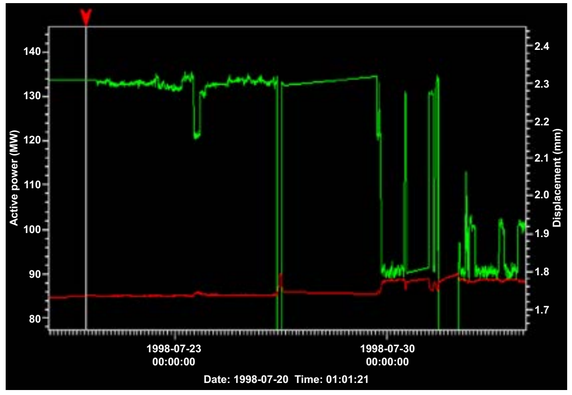
**Machine Behavior Over Multiple Rotations**

Shaft displacement and air gap variation vs. turn/pole number. Extend measurements over many turns to see parameter dynamic behavior, especially during transient operating modes




**PES + ZPU + ZOOM**

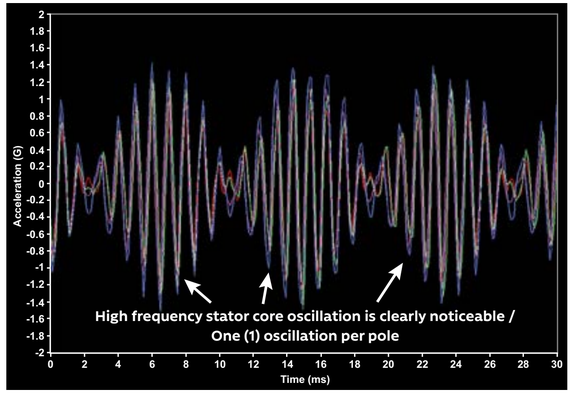
Example of oil film thickness results



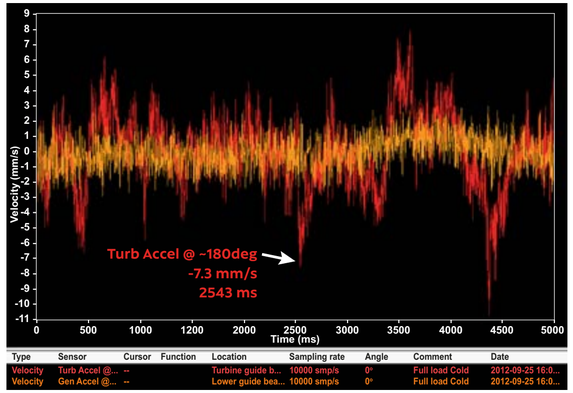

**SBV + ZPU + ZOOM**

**Trend Graph Correlating Bar Position and Active Power (MW),** This graph shows that the bar is magnetically pulled inward into the slot as the load is increased

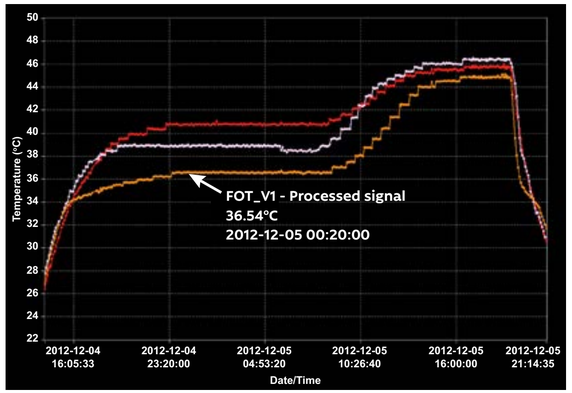
# ZOOM® Software



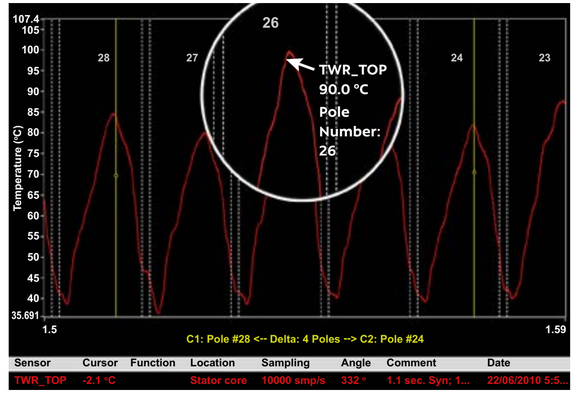

**VSM797S + ZPU + ZOOM**
High frequency stator core oscillation is clearly noticeable. The results at 0 Mvars are somewhat lower than at 16 Mvars



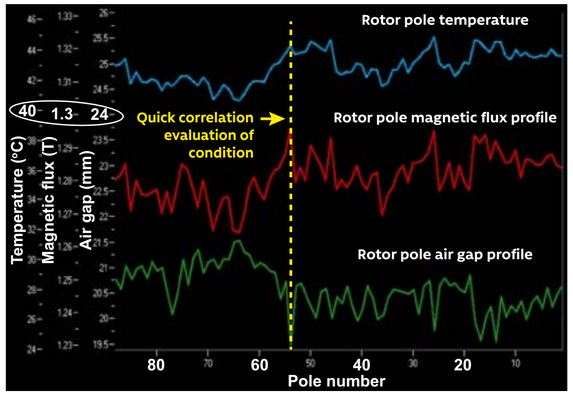

**VSM797S + ZPU + ZOOM**
Example of absolute guide bearing vibration at full load - cold



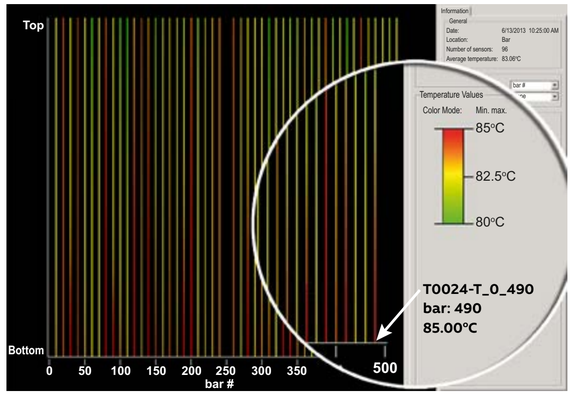

**FOT + ZPU + ZOOM**
Example of coil temperature in trending format during a short period of time



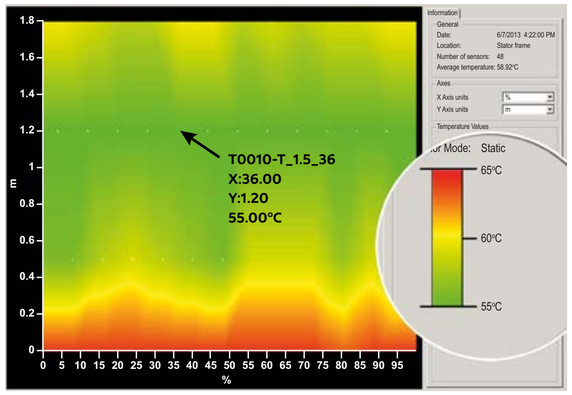

**TWR + ZPU + ZOOM**
Online rotor pole and interpole temperature measurements



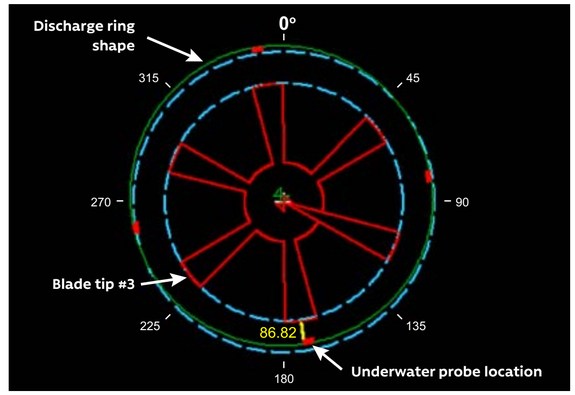

**TWR + MFM + VM + ZPU + ZOOM**
Machine Condition Over One Rotation
Pole temperature, magnetic flux and air gap vs. pole number. Compare results with our exclusive pole-reference method for easy correlation and accurate diagnosis




**TWS + ZPU + ZOOM**
Bar graph
Graph showing temperature measurements of multiple stator bars




**TWS + ZPU + ZOOM**
Stator thermal mapping
Provides valuable information about the thermal behavior of a stator core, especially hot spots or shorted laminations




**SPES + ZPU + ZOOM**
Turbine blade tip clearance
Turbine position inside discharge ring. View of blade gap and discharge ring shape

# FOLLOW US

www.vibrosystm.com