

MACHINE CONDITION MONITORING FOR HYDRO



VIBRATION EXPERT SYSTEMS
CONSULTING
SYSTEM DESIGN

The logo for CoDiS, featuring the company name in a bold, black, sans-serif font with a small white dot above the 'i'.



Benefits of condition monitoring

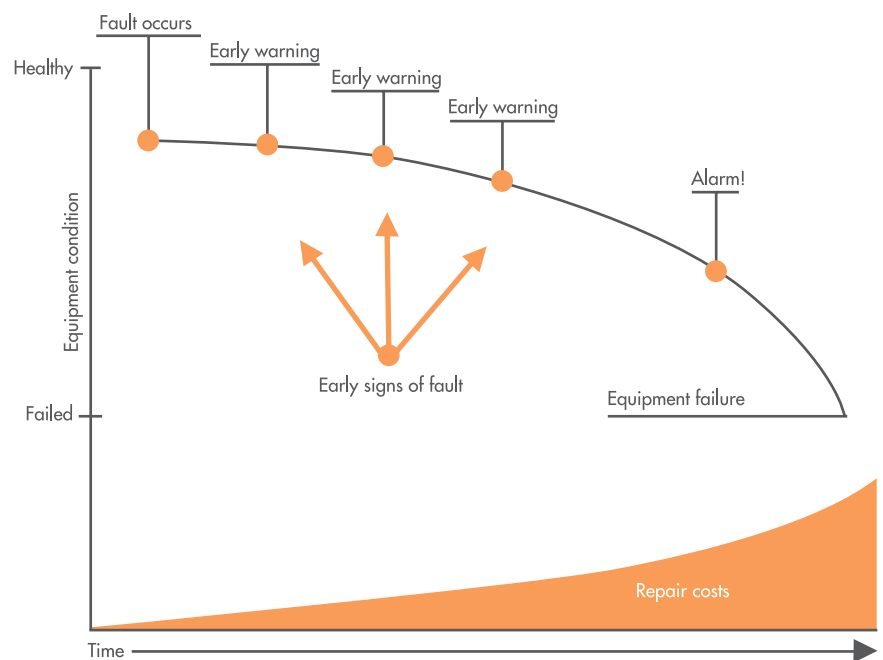
- Efficient repairs
- Better maintenance planning
- Condition change detection
- Damage prediction
- Damage prevention
- Fault diagnosis and detection

Predictive maintenance

On-line monitoring system installed in power production plants ensures continuous monitoring of exploitation and is a critical step toward predicting machine behaviour. The real benefit is the predictive capability and root cause identification, which can significantly improve repair planning and scheduling and can also prevent additional damage from occurring.

CoDiS all in one monitoring system includes vibration monitoring, air gap and flux monitoring, hydraulic quantities, seamlessly integrated with electrical parameters and process parameters (temperatures, pressures, flow etc.).

System includes continuous measurement, trending and database creation for all calculated parameters. Substantial and well structured database ensures organized and cost effective maintenance planning. CoDiS has proven to help reduce the maintenance cost, up to 50 %.



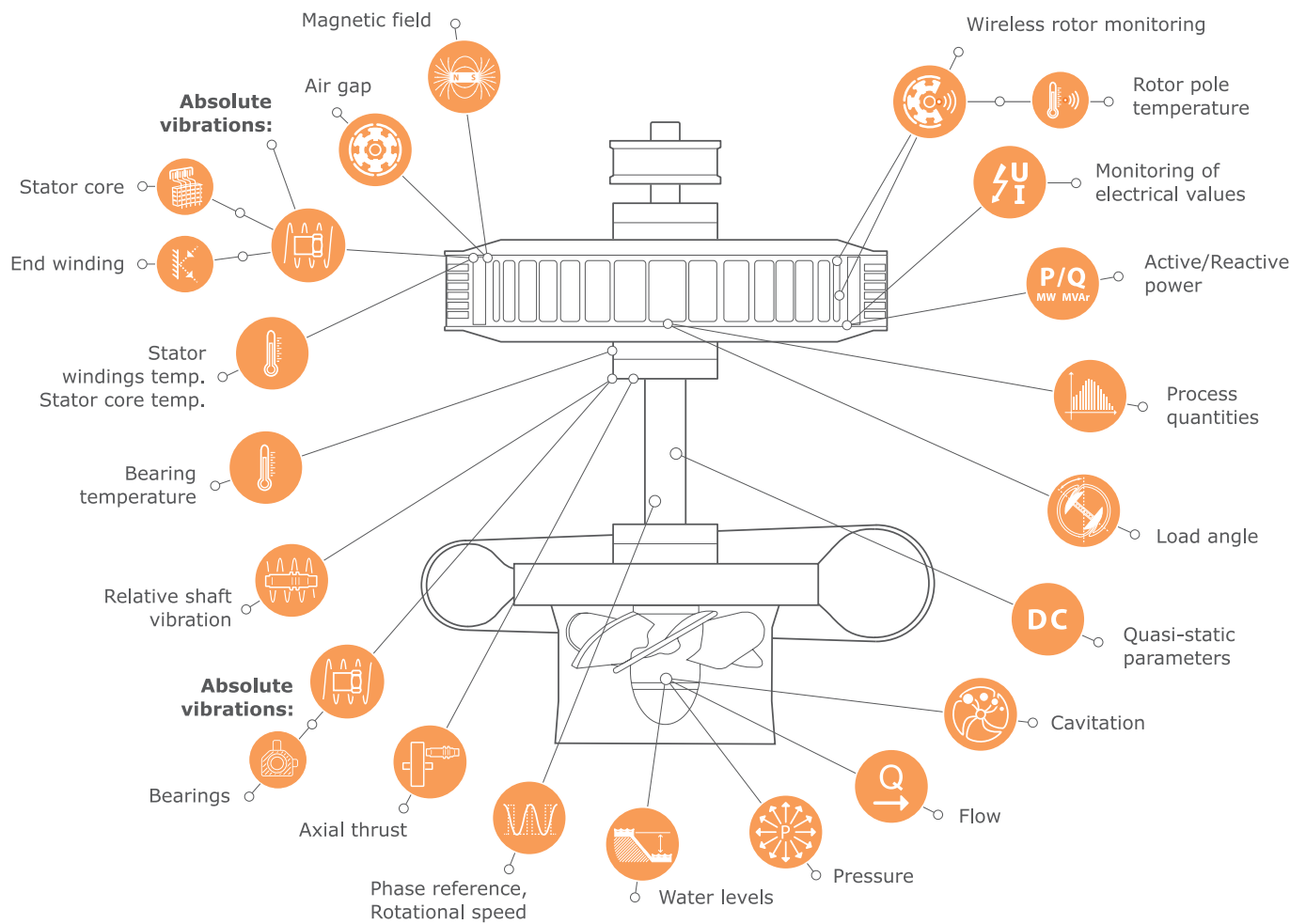
CoDiS Machine Condition Monitoring system

The system is used for early warning and predictive maintenance of rotating machines in power plants and processing industry. **CoDiS** architecture includes front end components (sensors and terminal boxes), real time protection controller (CoDiS RT hardware inside industrial cabinet) and diagnostic software (CoDiS DM running on server PC).

The key advantage is based on open software architecture which enables flexible configuration of the system, easy customization for end user and easy future upgrades.

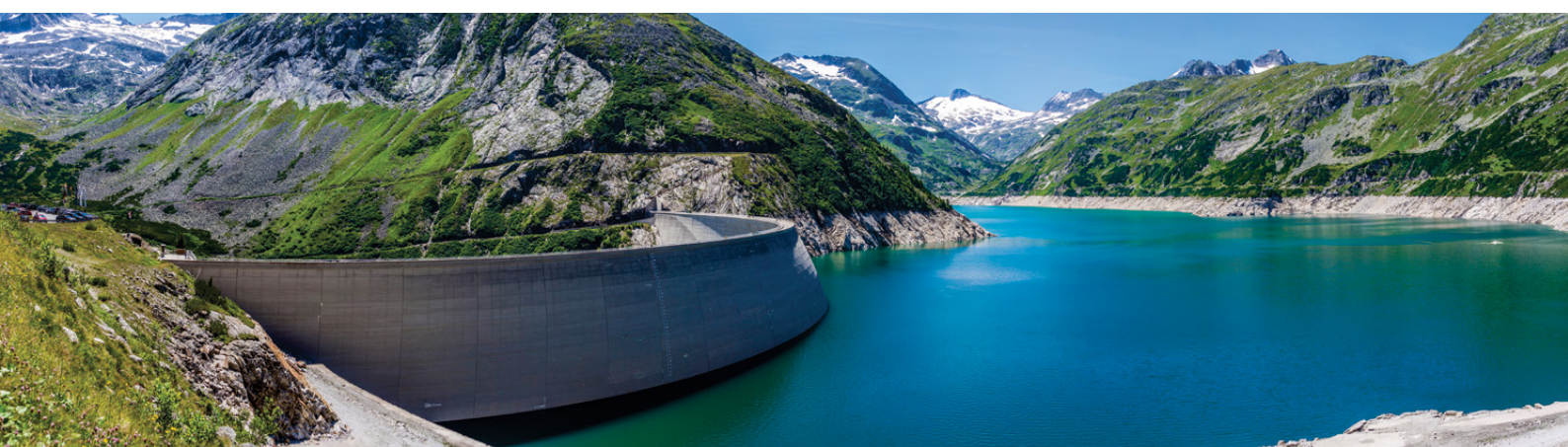
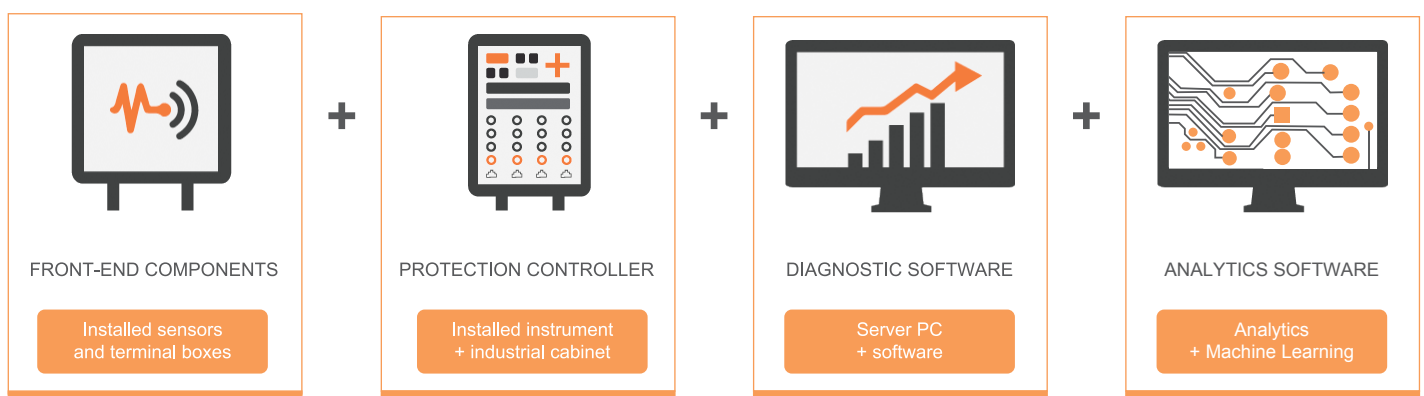
Solutions only

CoDiS All in One Hydro Generator Monitoring

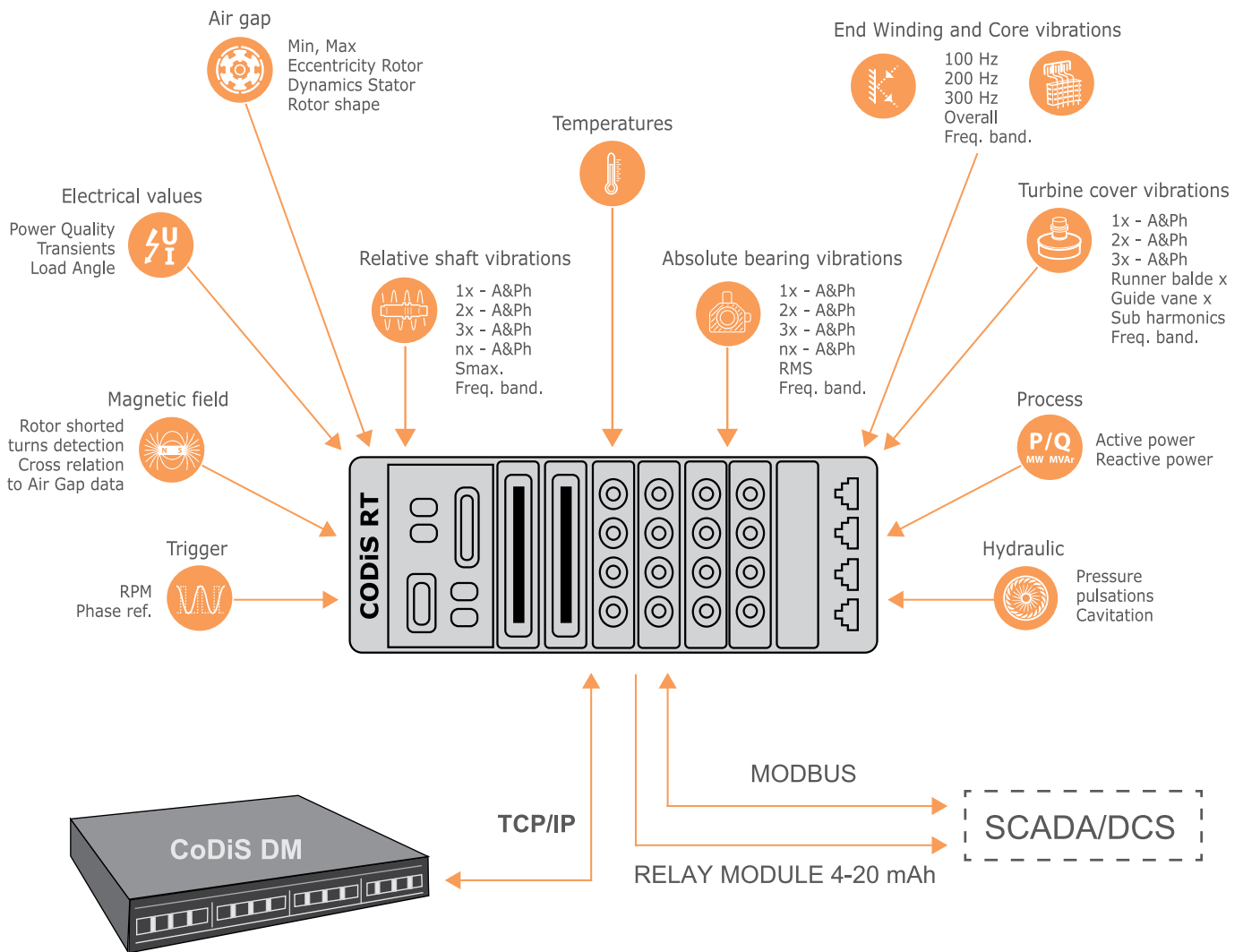


CoDiS System Architecture

„CoDiS” – Real Time data acquisition, protection and condition analysis



CoDiS Real Time Protection Unit Real Time analysis and Processing Capabilities



CoDiS RT ensures the following functionality:

1. Real time data processing and analysis
2. Recognition of different operating conditions (i.e. Stop, Run Up, Normal operation, User defined condition)
3. Relay triggering and alarm notifications
4. Condition vector (calculated values) streaming to the server
5. Raw waveform data stream to the server
6. Communication with SCADA or DCS
7. Time synchronization

CoDiS Software Feature List

PLANT or FLEET VIEW

- Machine mimic overview (suitable for operators)
 - Vibrations
 - Process quantities
 - Air gap
 - Magnetic field
 - Electrical quantities
- Alarm indication
- Alarm management

MACHINE REAL TIME DATA

- Vibrations (Relative shaft vibrations, Absolute bearing housing vibrations)
- Process quantities (Active power, Reactive power, Head, Flow, Pressures)
- Temperatures
- Air gap/Magnetic field (pole profile, eccentricity)

Each signal is trended in 10/20/30 minute real time trends for quick overview (suitable for operators).

ANALYSIS TOOLS

LONG TERM HISTORY TRENDS:

- Data recorded with highest resolution of one minute
- Daily data storage organization (selectable from one day to multiple days/months/years)
- Operating condition filter display (steady state, run up, coast down...)
- Data export to ASCII

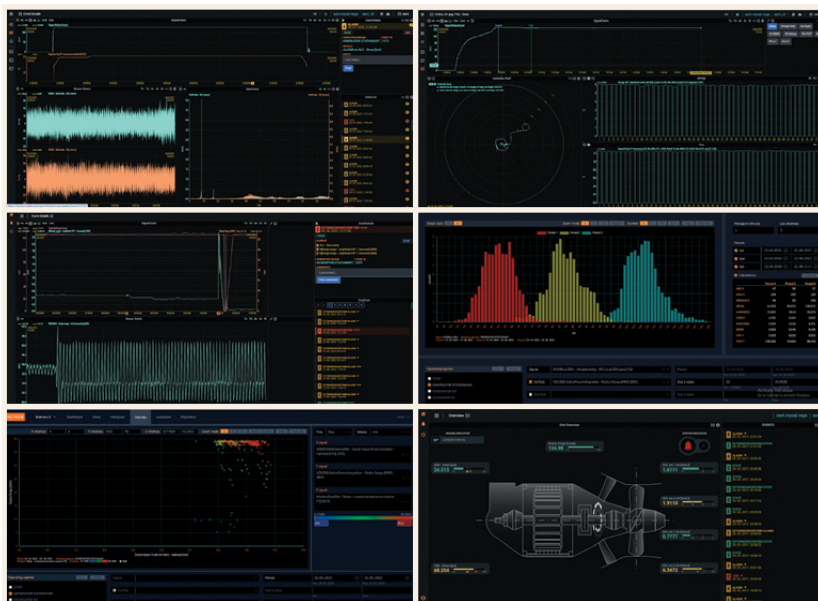
STATISTICAL ANALYTICS

- histogram
- regression curve
- machine learning prediction algorithm
- expert report library (repository)

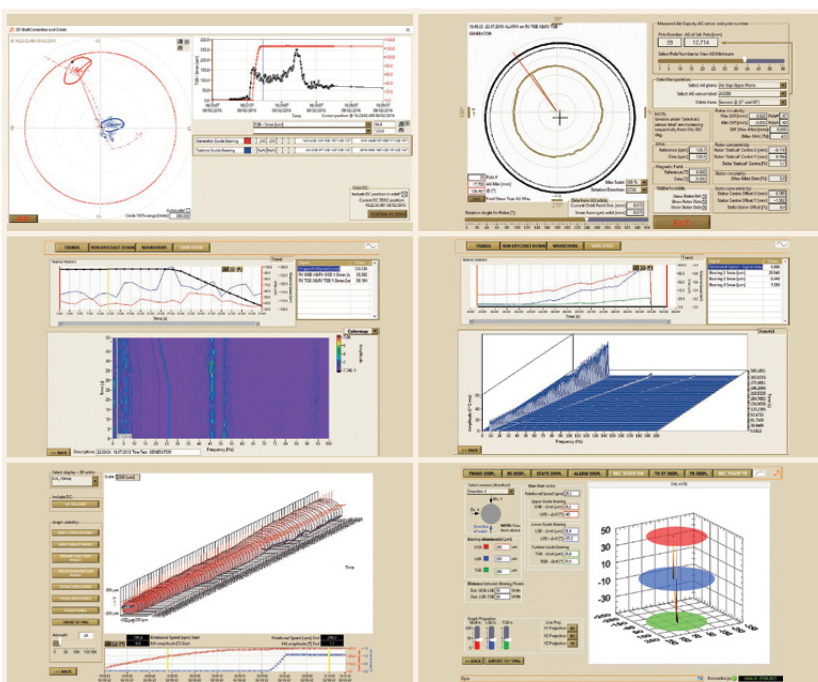
TRANSIENT CONDITION ANALYSIS:

- Trend data recorded with highest resolution (0.5s, 1s, 2s selectable)
- Post processing analysis available:
 - Shaft centerline 2D and 3D, Nyquist and Bode, 2D and 3D orbits, RunOut compensation, 3D shaft centerline

AAnT Analytics software



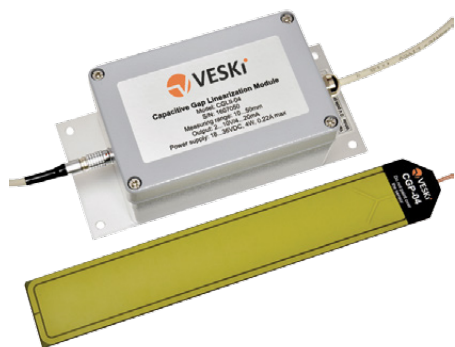
CoDiS Diagnostics software



EVENT ANALYSIS (ALARM OR USER CREATED)

- Waveform raw data display (with pre-trigger)
- Spectrum analysis (CPB, Waterfall, Intensity)
- Orbits and shaft centerline
- Air Gap analysis (Stator geometry, Rotor geometry, eccentricity, and circularity)
- Magnetic field (Pole profile, pole winding short circuit detection)

Sensors



Air gap

Air Gap Sensors features:

- Capacitive Sensor Technology
- Output directly proportional to the air gap distance (pole profile)
- Easy to install and no special calibration is needed
- Low profile
- High Temperature Stability (-15 to 125 C)
- Immune to magnetic fields, dust, oil, EMI and RFI

Capacitive Gap Sensor* models:

- **CGS020110** with measuring range 2 to 10mm
- **CGS020210** with measuring range 3 to 15mm
- **CGS020310** with measuring range 5 to 25mm
- **CGS020410** with measuring range 10 to 50mm

* Air gap sensors are also available with magnetic base, perfect for periodic measurements with CoDiS PMU.



Magnetic Field

Magnetic Field sensors features:

- Output directly proportional to field in Tesla (T)
- Easy to install and no special calibration is needed
- Low profile, used for air gaps up to 50mm
- High Temperature Stability (-15 to 125 C)
- Immune to dust, oil, EMI and RFI

MFS25 Magnetic field sensor

- Output signal from the conditioner; $\pm 5V$
- Non integrated and integrated signal available



Proximity probes

Proximity probe sensors features:

- Output directly proportional displacement
- Used for different applications;
- Shaft displacement, axial rotor displacement, stator frame displacement, phase reference

Proximity probe models:

- **Phase reference** – measuring range 1 to 4mm
- **Axial displacement** – measuring range 2-10mm
- **Shaft displacement** – measuring range 0.3 to 2.3mm



Absolute vibrations

Absolute vibration sensor features:

- Output directly proportional acceleration
- Output directly proportional velocity
- Used for different applications;
- Bearing vibrations, turbine cover and draft tube vibrations, stator core or frame vibrations

Absolute vibration sensor models:

- **Low frequency accelerometer** – measuring range 0.1 to 8000Hz, 500mV/g sensitivity
- **Low frequency velocity meter** – measuring range 1 to 7000Hz, 20mV/mm/s sensitivity

CoDiS Monitoring Systems



CoDiS MCA01

Monitoring Cabinet MCA01 features:

- Standalone monitoring cabinet 800x2000x800
- Used for 32+ ch systems
- Robust steel frame construction
- 17" Touch screen interface (or larger)
- Custom machines health on-screen dashboard
- Real-time OS with instant processing power
- Records and monitors machines health
- Front and back door construction
- Designed for the most demanding environments
- Operational at temp -40 to +70°C / -40 to +158°F



CoDiS MCA02

Monitoring Cabinet MCA02 features:

- Wall mounted monitoring cabinet 800x1000x300
- Used for <32 ch systems
- Robust steel frame construction
- 15" Touch screen interface
- Custom machines health on-screen dashboard
- Compact design
- Designed for the most demanding environments
- Operational at temp -40 to +70°C / -40 to +158 °F



CoDiS PMU

Portable monitoring unit PMU18 / PMU24 features:

- 18 or 24 channel unit configuration
- Collecting real-time machines data
- Best suited for periodic machine analysis
- Easy connectivity to PC via standard LAN interface
- Limitless channel configuration system available via synchronised PMUs
- Direct Power supply to connected sensors
- Designed for the most demanding environments

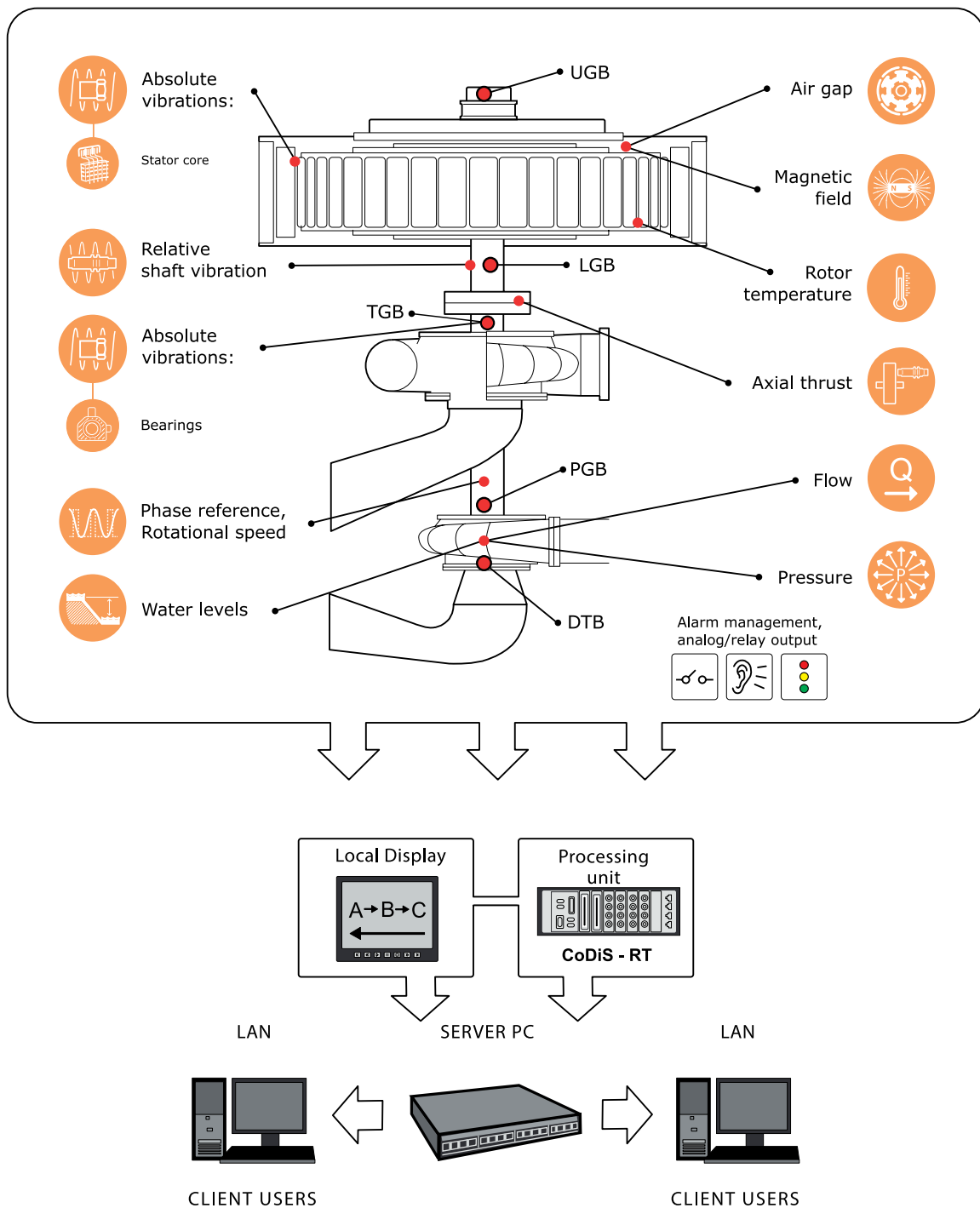


CoDiS WRM

Wireless monitoring unit WRM features:

- Online Wireless Rotor Monitoring (8 analog and 100 digital inputs)
- Real time data streaming over Wi-Fi to stationary server PC
- WRM continuously monitors: temperature of rotor pole windings, excitation current and voltage, magnetic field and air gap, rotor insulation resistance, rectifier diode failure
- Powered by rotor excitation voltage

PSPS Wivenhoe, Queensland Australia, 2x250MW | Safety and Diagnostic | SCADA communication



Vibrations

- Relative shaft vibrations
- Absolute bearing vibrations
- Stator vibrations
- Stator blades

Axial displacement

Air gap

Magnetic field

Partial Discharge

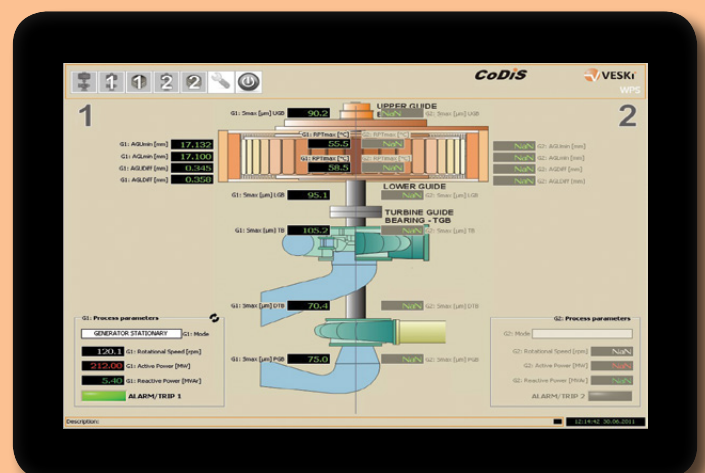
Temperatures

Process quantities

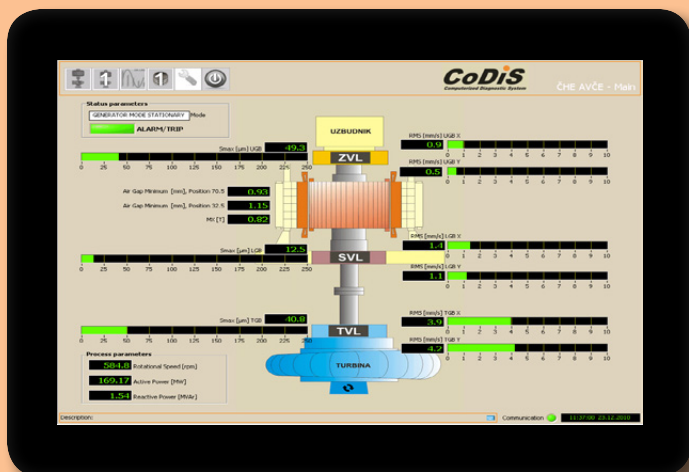
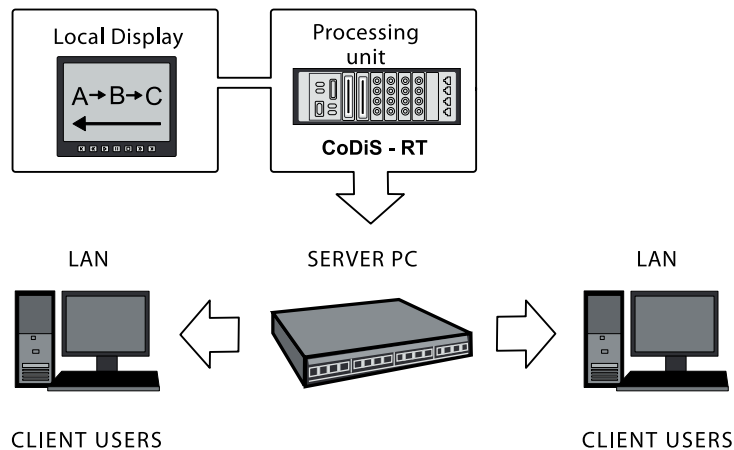
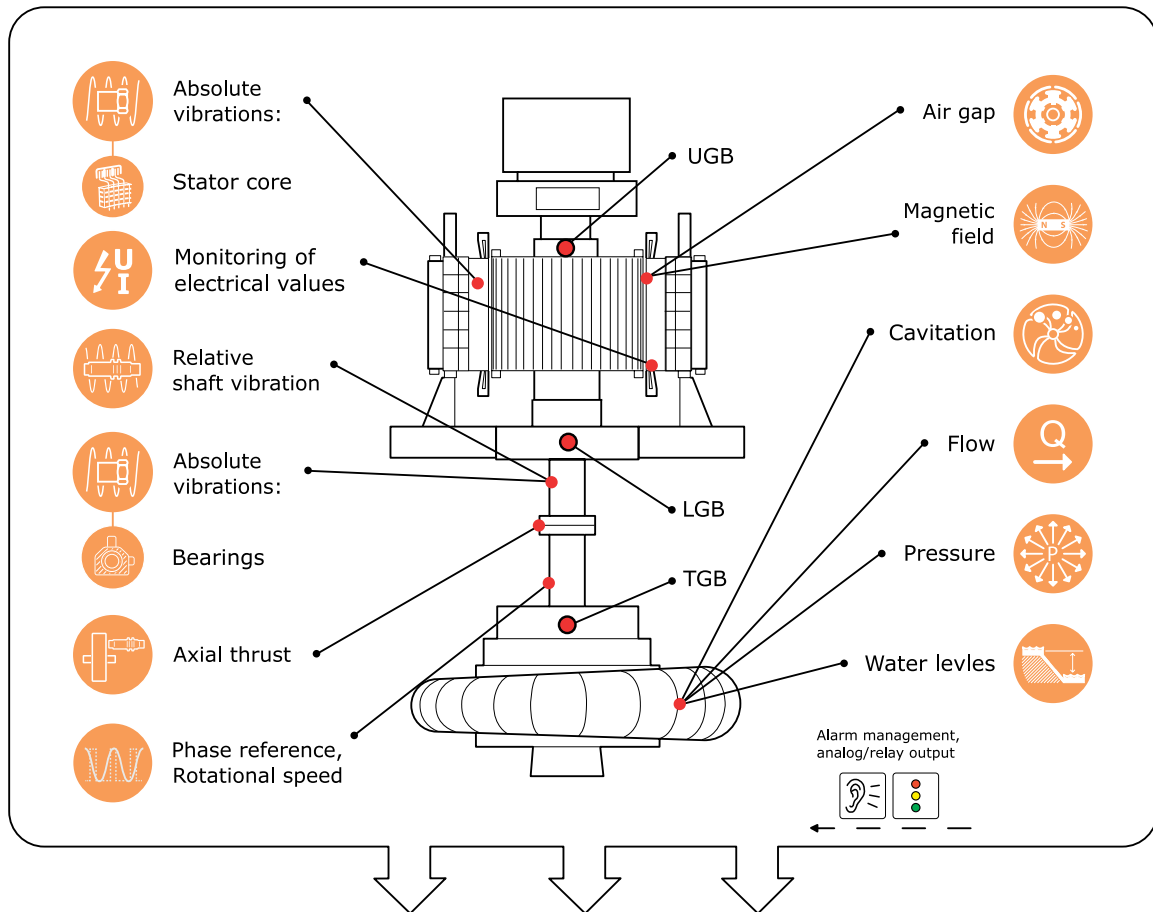
- Active power
- Reactive power
- Pressures
- Water head

Rotor pole temperatures

- temperature sensors on 50 poles
- temperature sensors on 49 pole interconnections



PSP Avce, Slovenia, 1x 185 MW | Variable speed | Safety and Diagnostic | SCADA communication



Vibrations

- Relative shaft vibrations
- Absolute bearing vibrations
- Stator vibrations
- Stator blades

Axial displacement

Bearing clearance

Air gap

Magnetic field

Partial Discharge

Cavitation

Hydraulic quantities on pipeline

Electrical quantities

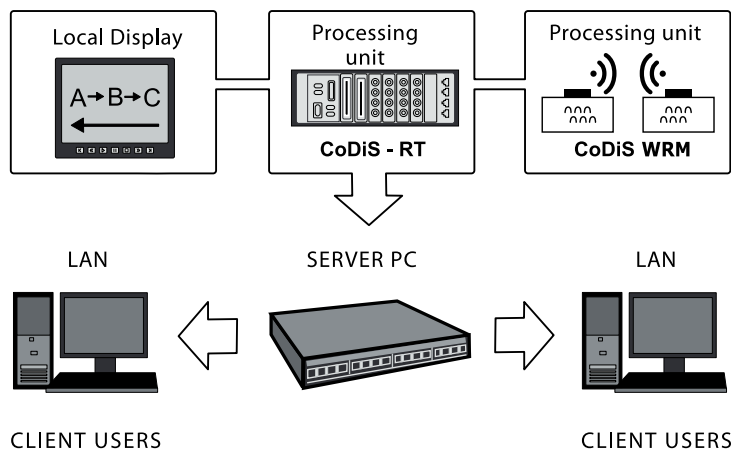
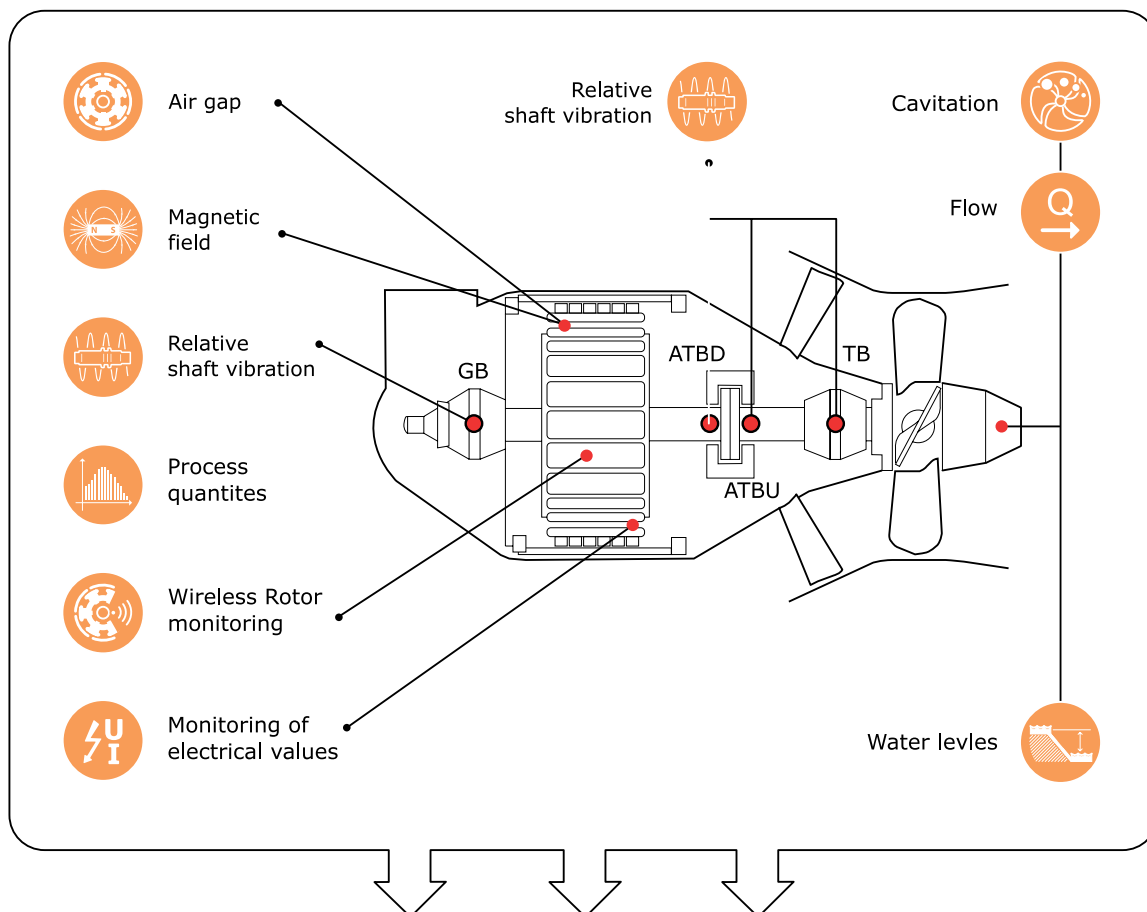
- Transient recording
- Power quality monitoring

Temperatures

Process quantities

- Active power
- Reactive power
- Pressures
- Water head

HPP Dubrava, Croatia, 2x39MW, 1x 1.2MW | Safety and Diagnostic



Vibrations

- Relative shaft vibrations

Axial displacement

Air gap

Magnetic field

Electrical quantities

- Power quality monitoring

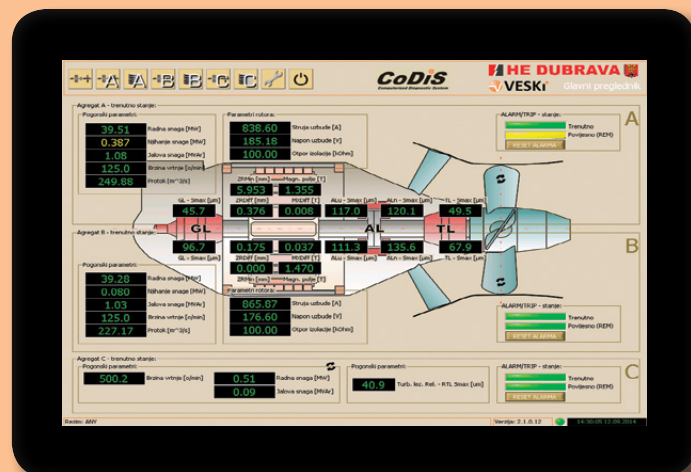
Rotor monitoring

- Rotor pole temperatures
- Excitation current and voltage
- Insulation resistance

- Air Gap on rotor pole
- Magnetic field on rotor pole

Process quantities

- Active power
- Reactive power
- Pressures
- Water head





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