

IRIS POWER HYDRO

Machine Condition Monitoring System for Hydro Generators

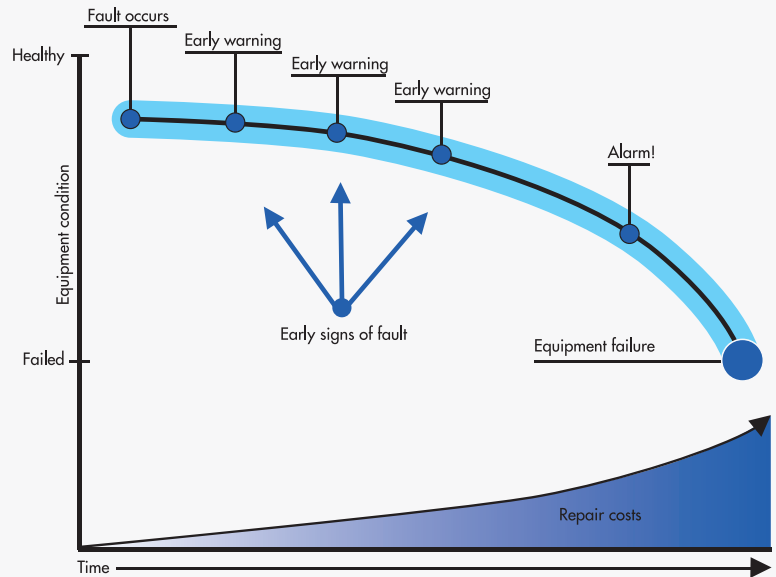


PREDICTIVE MAINTENANCE

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

Modern monitoring systems include vibration monitoring, monitoring of electrical parameters and process parameters (temperatures, pressures, flow etc.).

System must include continuous measurement, trending and database creation of all measured data. Substantial and well structured database ensures organized and cost effective maintenance planning. Repair works based on the exploitation state can significantly reduce the maintenance cost, up to 50 %. Modern monitoring systems are based on network communication and data transfer with other systems installed in power plants using standard industrial protocols (modbus, profibus).



BENEFITS OF CONDITION MONITORING

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

CoDiS MACHINE CONDITION MONITORING SYSTEM

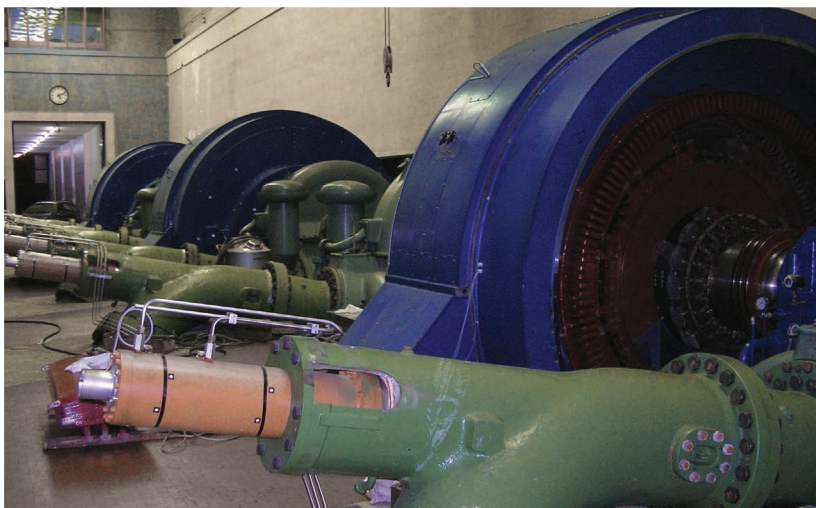
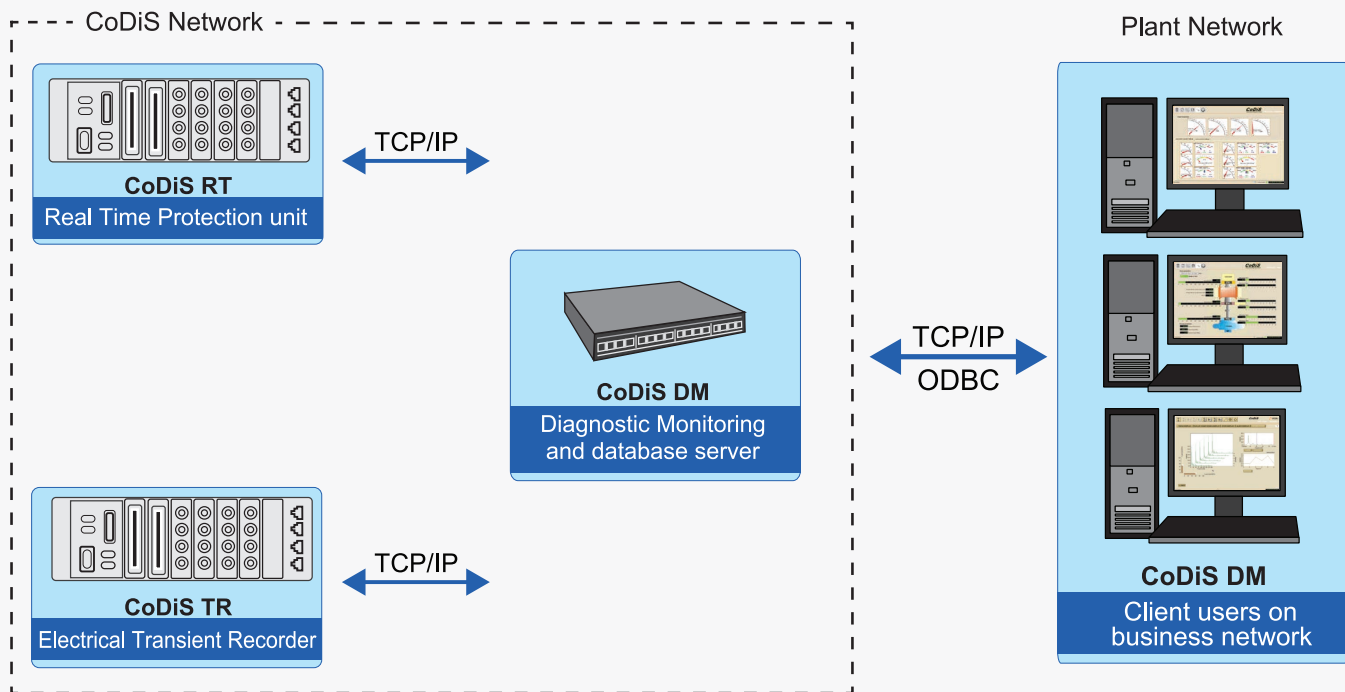
The system used for early warning and predictive maintenance of rotating machines in power plants and processing industry. **CoDiS** architecture includes Real Time protection and alarming system (**CoDiS RT**), electrical Transient Recorder and power quality monitoring (**CoDiS TR**), Rotor wireless Monitoring (**CoDiS RM**) and integrative software module for diagnostic monitoring (**CoDiS DM**). Each of the modules can be installed as an individual system or in combination with others making an integrated CoDiS platform with single database.

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.



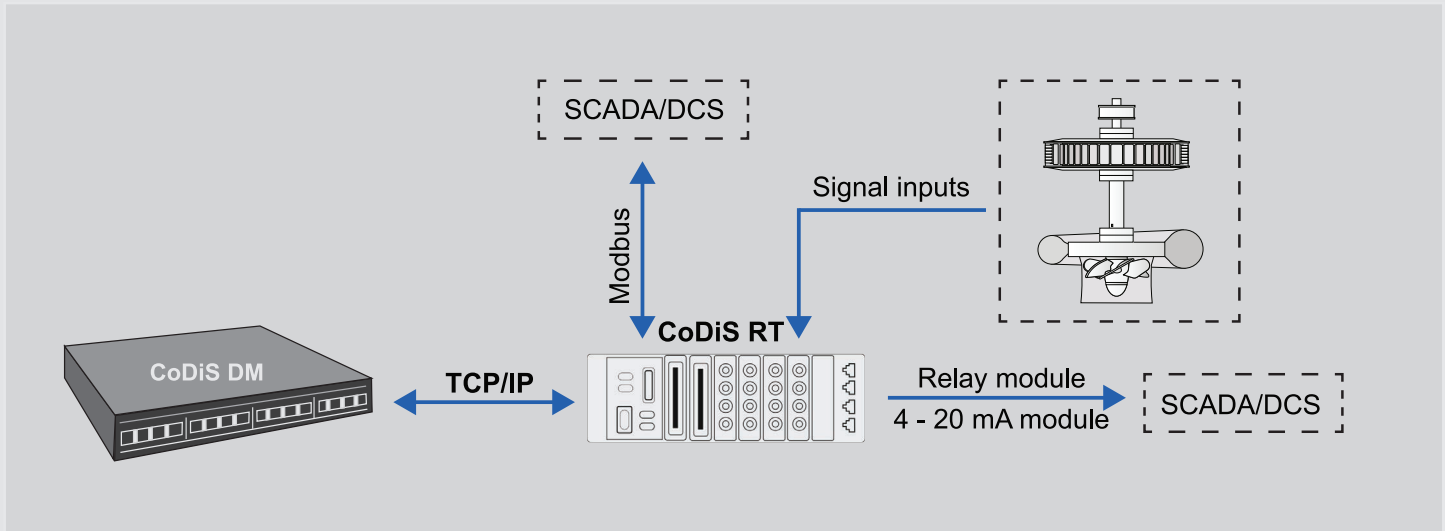
- CoDiS monitoring is based on rugged National Instruments Compact RIO technology as processing and data acquisition hardware running on RT operating system.
- Controllers are used for safety purposes and high priority tasks such as machine shutdown, communication with SCADA and Control systems.
- Server PC running on Windows OS are used for off line analysis, database storage and data distribution to remote users.
- Remote users have client software installed or connect to remote PC web access to client software on remote PC on the network.

CoDiS SYSTEM LAYOUT



CODIS MODULES

„CoDiS RT” – real time protection and alarming

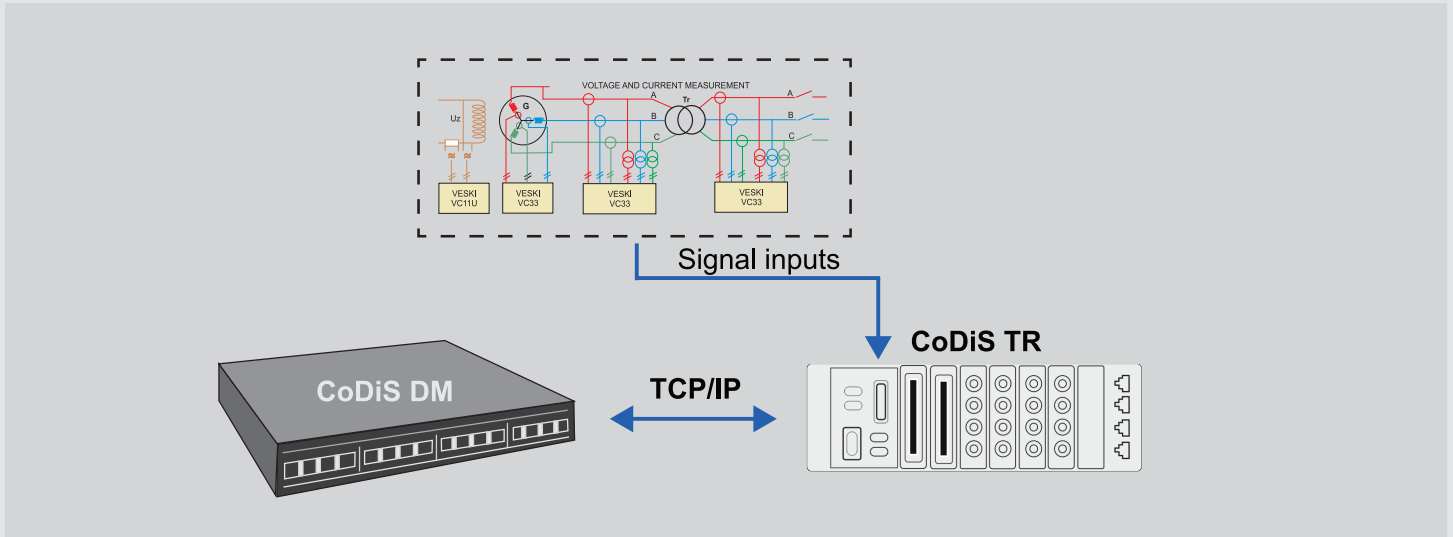


CoDiS RT tasks:

1. Performs real time analysis on all measured signals
2. Analyzes different operating conditions (i.e Stop, Run Up, Normal operation, User defined condition)
3. Triggers relay and alarm notifications
4. Sends condition vectors (calculated values) to the Server
5. Sends signal waveforms to the Server
6. Communicates with SCADA or DCS
7. Receives the orders from the server (user created event recording, configuration and setup etc.)
8. Time synchronization



„CoDiS TR” , „Electrical Transient Recorder” continuously acquires all the significant signals for behavior monitoring of the target object when transient in the electrical signals (generator currents) occurs.



CoDiS TR tasks:

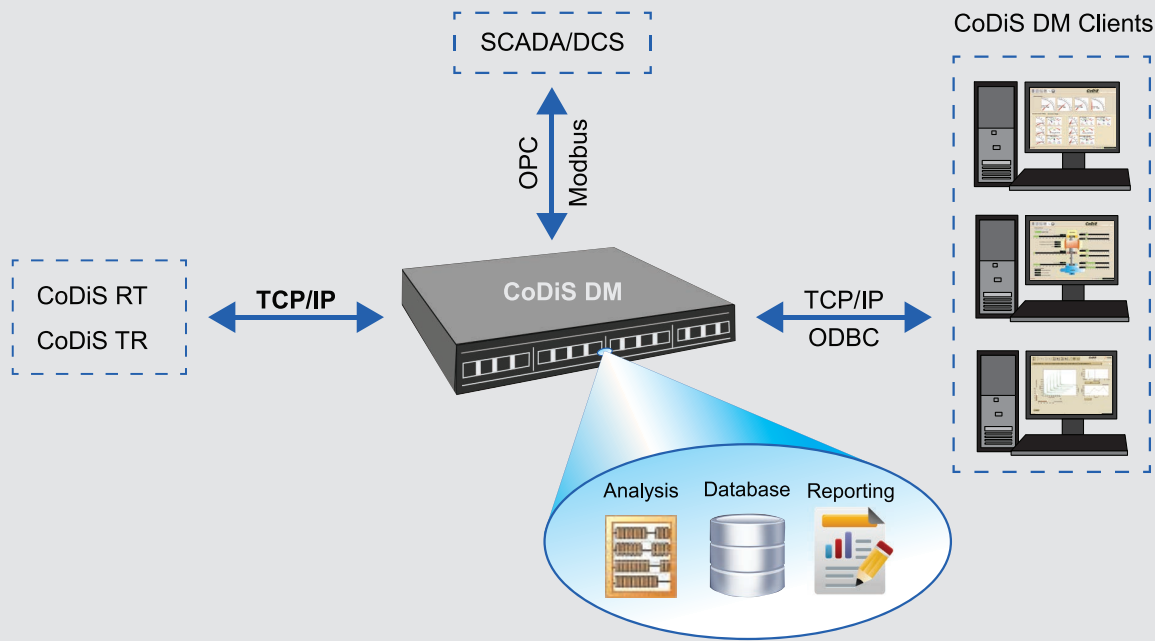
1. Performs real time analysis of trigger conditions
2. Triggers event recording and notification
3. Sends signal waveforms to Server for Power Quality analysis
4. Receives the orders from the server (user created event recording, configuration and setup etc.)
5. Time synchronization

Post process analysis tools are included as part of CoDiS DM diagnostic software package (Spectrum, Power analysis, Vibration response due to electrical faults).

STANDARD DATA ANALYSIS TOOLS:

- Electrical Transient recording with vibration signals in addition
- Power quality
- Generator load angle
- Torsion magnetic field stiffness

„CoDiS DM” is diagnostic platform and is used to create history database of all measured values and created events.



CoDiS DM tasks:

1. Receives the Condition Vectors from CoDiS modules and performs history data storage and event recording in MySQL database
2. Evaluates the operating conditions and stores the data accordingly
3. Receives Alarm notification from CoDiS modules
4. Communicates with SCADA or DCS via OPC
5. Performs the time synchronization of CoDiS modules

The system creates a database of each measured signal continuously while in operation constantly obtaining data from all CoDiS unit. Diagnostic monitoring module CoDiS DM is used for predictive maintenance, to detect permanent changes in machine performance and to track the condition changes in early phase.

Diagnostic monitoring provides continuous on-line data analysis, database recording and is responsible for data distribution to client users. Each event is archived and user has capability to track all the changes and apply diagnostic tools to extract the essential information and highlight the problem.

STANDARD DATA ANALYSIS TOOLS:

- Bode plot, Nyquist plot,
- 2D and 3D orbit analysis,
- 2D and 3D shaft centerline

- Run Out Compensation,
- Air Gap polar plot and stator geometry
- Magnetic field pole profile
- FFT spectrum, CPB spectrum
- Waterfall spectrum

EXPERT DATA ANALYSIS TOOLS:

- Bearing and structure stiffness identification
- Critical speed identification

- Statistical analysis of machine operation
- Torsion vibrations identification

CoDiS SOFTWARE

HOME SCREEN

- Display of main operational parameters for each unit:
 - Vibrations
 - Process quantities
 - Air gap minimum
 - Magnetic field
- Alarm indication
- Navigation buttons

This display can be completely tailored to customer needs.

REAL TIME DISPLAY

Tab control separated by groups:

- 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 minute real time trends for quick overview (suitable for operators).

ANALYSIS TOOLS

TREND DATABASE DISPLAY (LONG TERM) HISTORY, TRENDS:

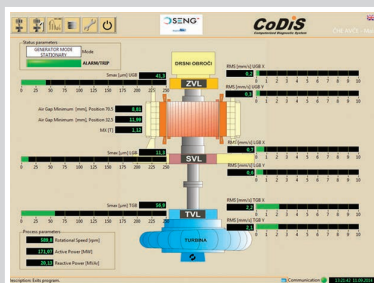
- Daily data storage organization (selectable from one day to multiple days/months)
- Operating condition filter display
- Data export to ASCII

RUN UP/COAST DOWN DATABASE DISPLAY:

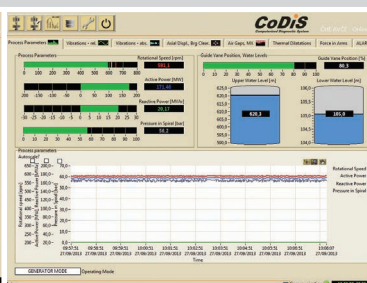
- Each day has list of transient events
- Data recorded with highest resolution (0.5s, 1s, 2s selectable)
- Post processing analysis available:
 - Shaft centerline 2D and 3D, Nyquist and Bode, 2D and 3D orbits, RunOut compensation, shaft run out in 3D

EVENT ANALYSIS (ALARM OR USER CREATED)

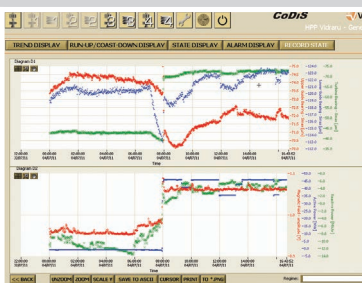
- Waveform raw data display (up to 60 sec with pre-trigger)
- Spectrum analysis (CPB, Waterfall)
- Order analysis (Orbit display)
- Air Gap analysis (Stator geometry, Rotor geometry, eccentricity)
- Magnetic field (Pole profile, pole winding short circuit detection)



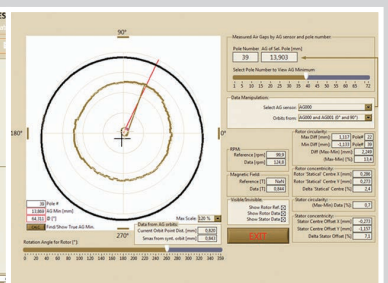
Home screen



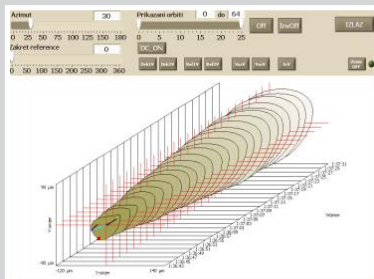
Real time data



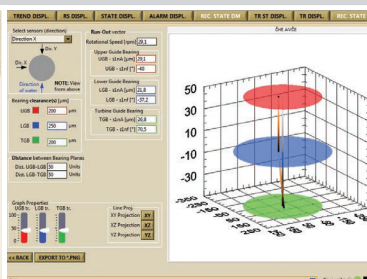
History trends



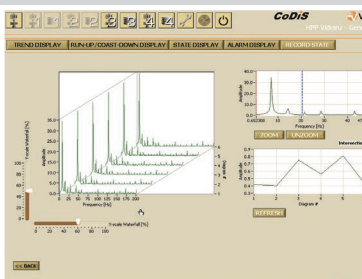
Air Gap polar display



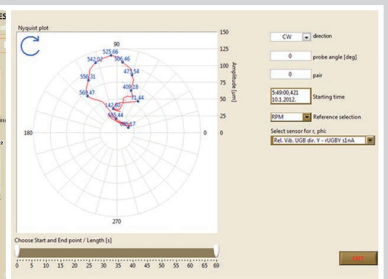
Cascade orbits



3D Shaft Run Out

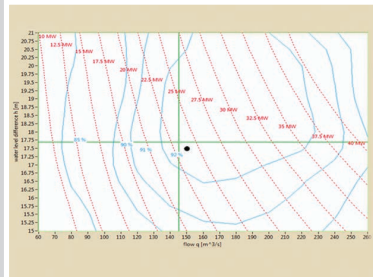


Waterfall spectrum

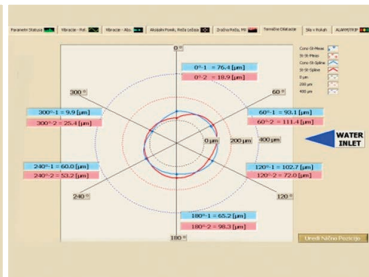


Nyquist plot

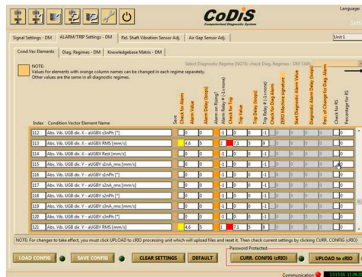
CoDiS MONITORING CAPABILITIES



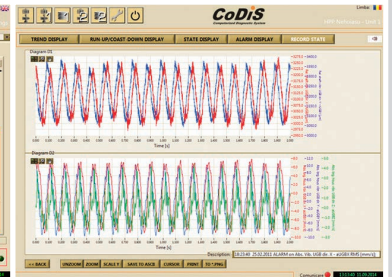
Turbine Efficiency monitoring



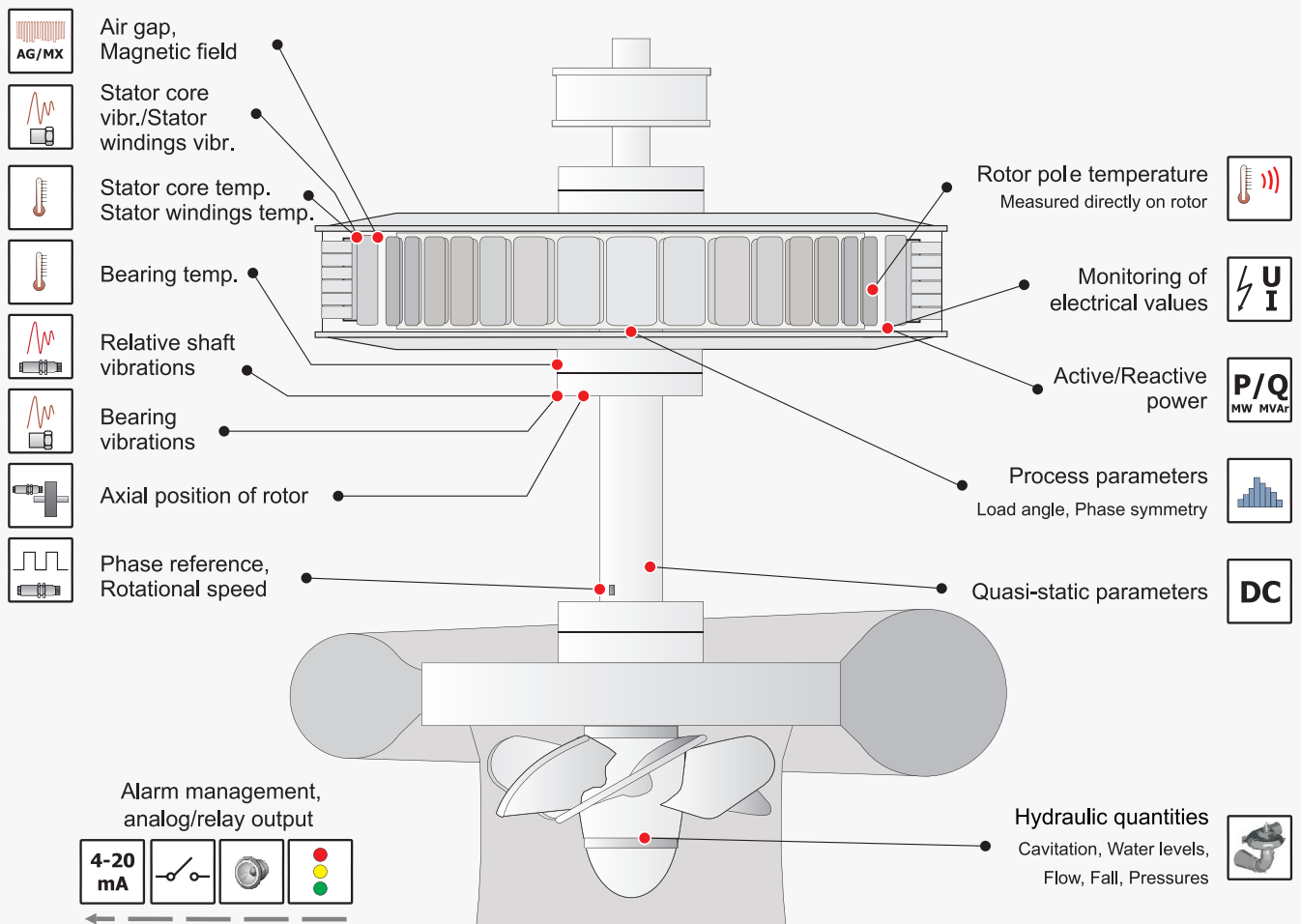
Stator frame geometry



Setup and administration module

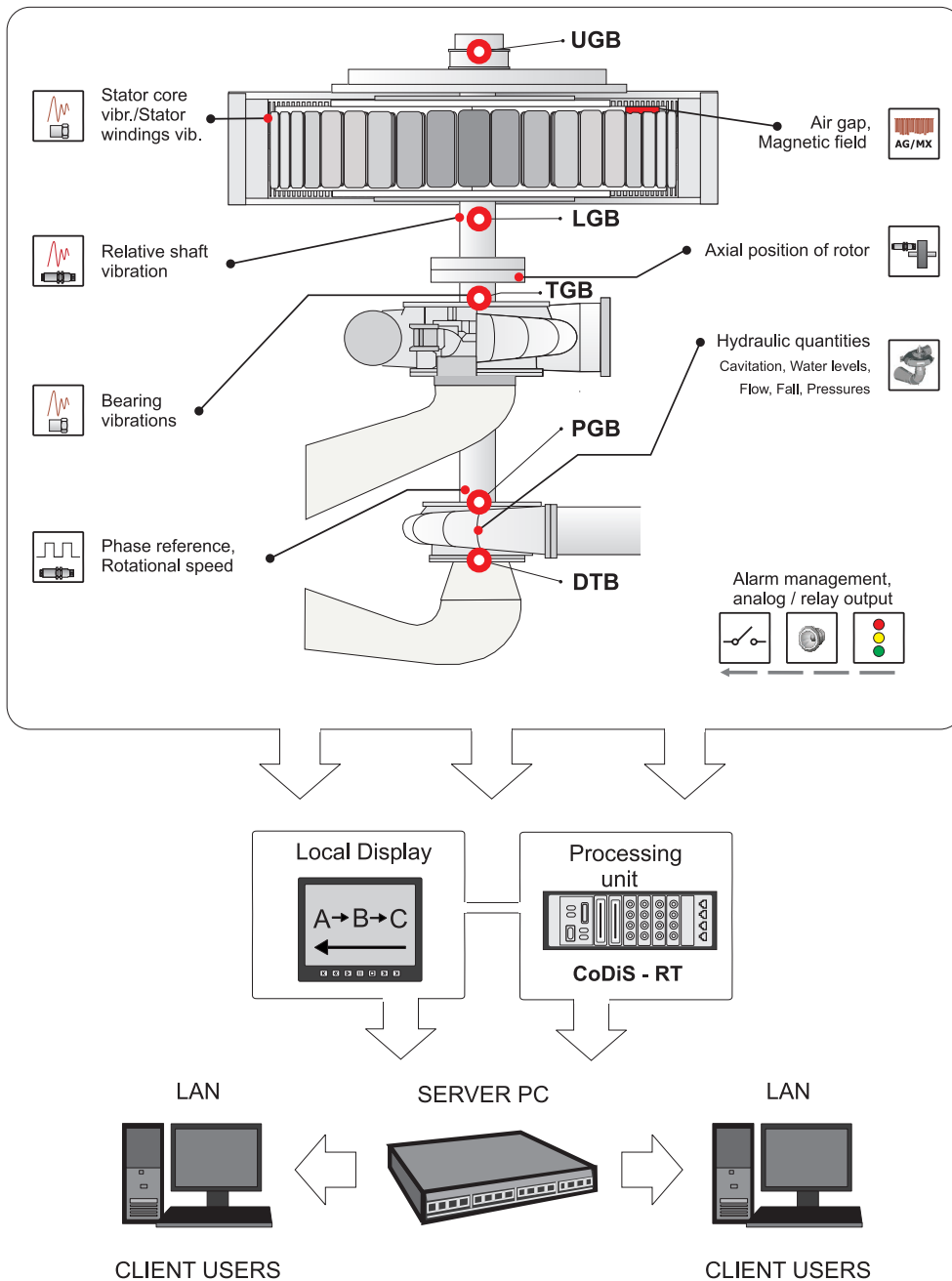


Raw data analysis



REFERENCE: PSPS WIVENHOE

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



Vibrations

- Relative shaft vibrations
- Absolute bearing vibrations
- Stator vibrations
- Discharge valve

Axial displacement

Air gap

Magnetic field

Partial Discharge

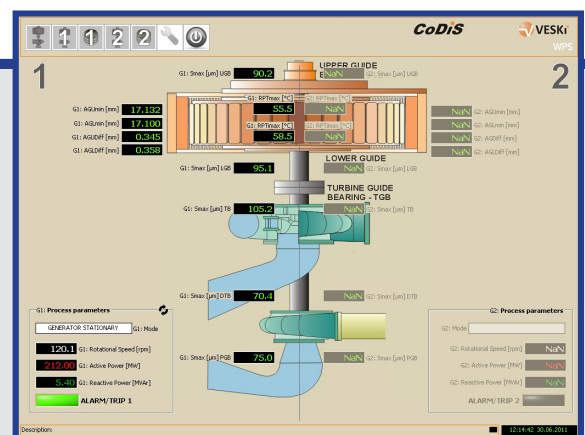
Temperatures

Process quantities

- Active power
- Reactive power
- Pressures
- Water head

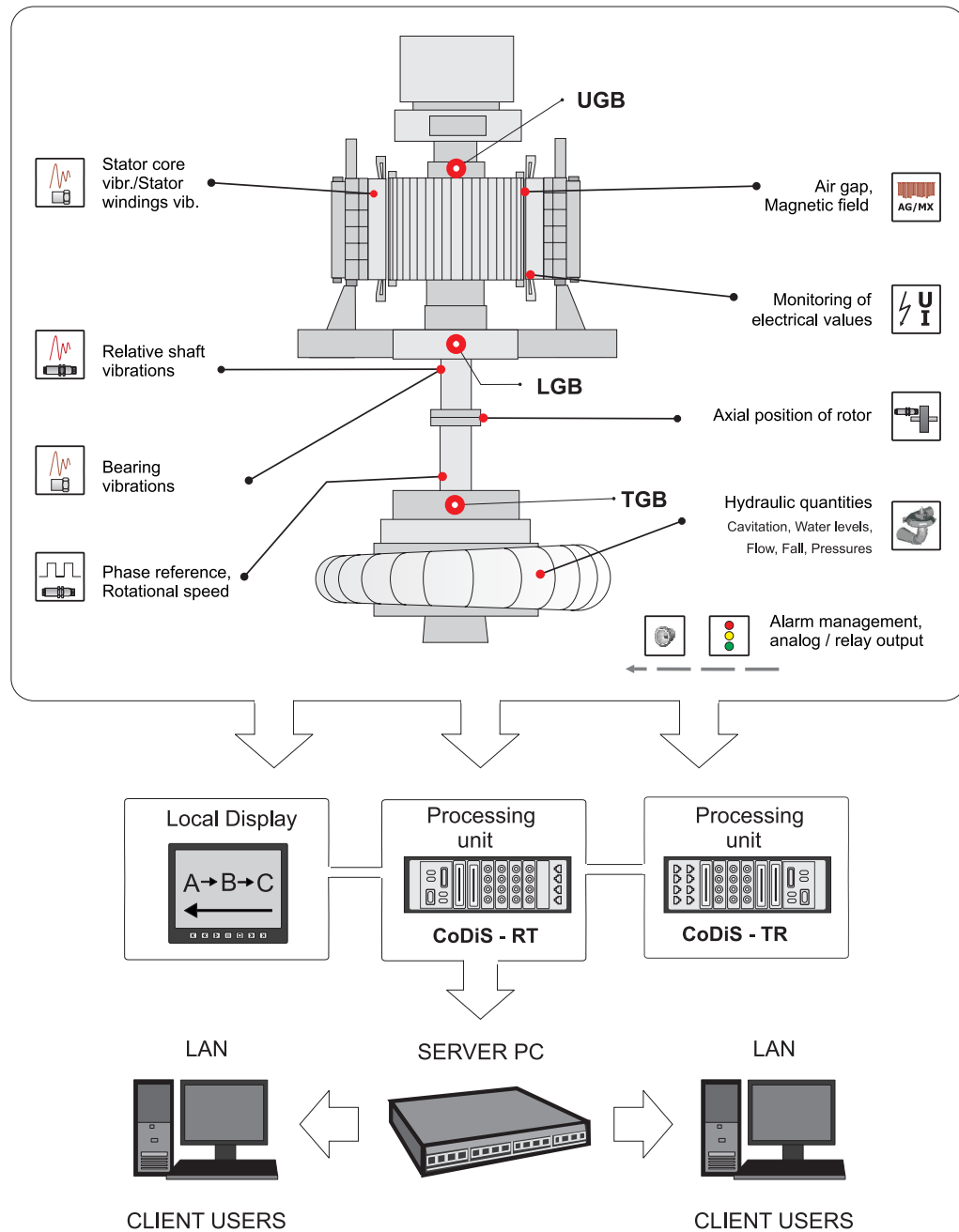
Rotor pole temperatures

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



REFERENCE: 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

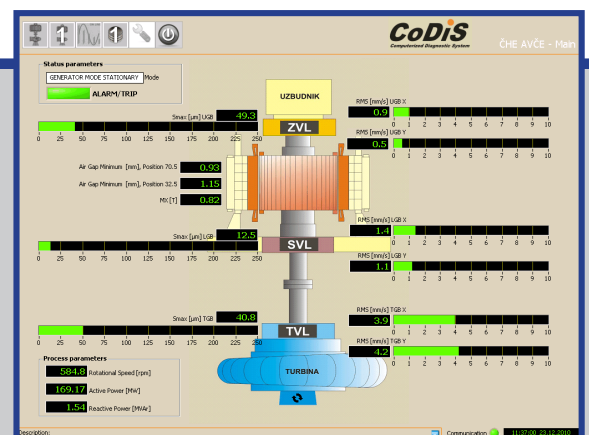
Electrical quantities

- Transient recording
- Power quality monitoring

Temperatures

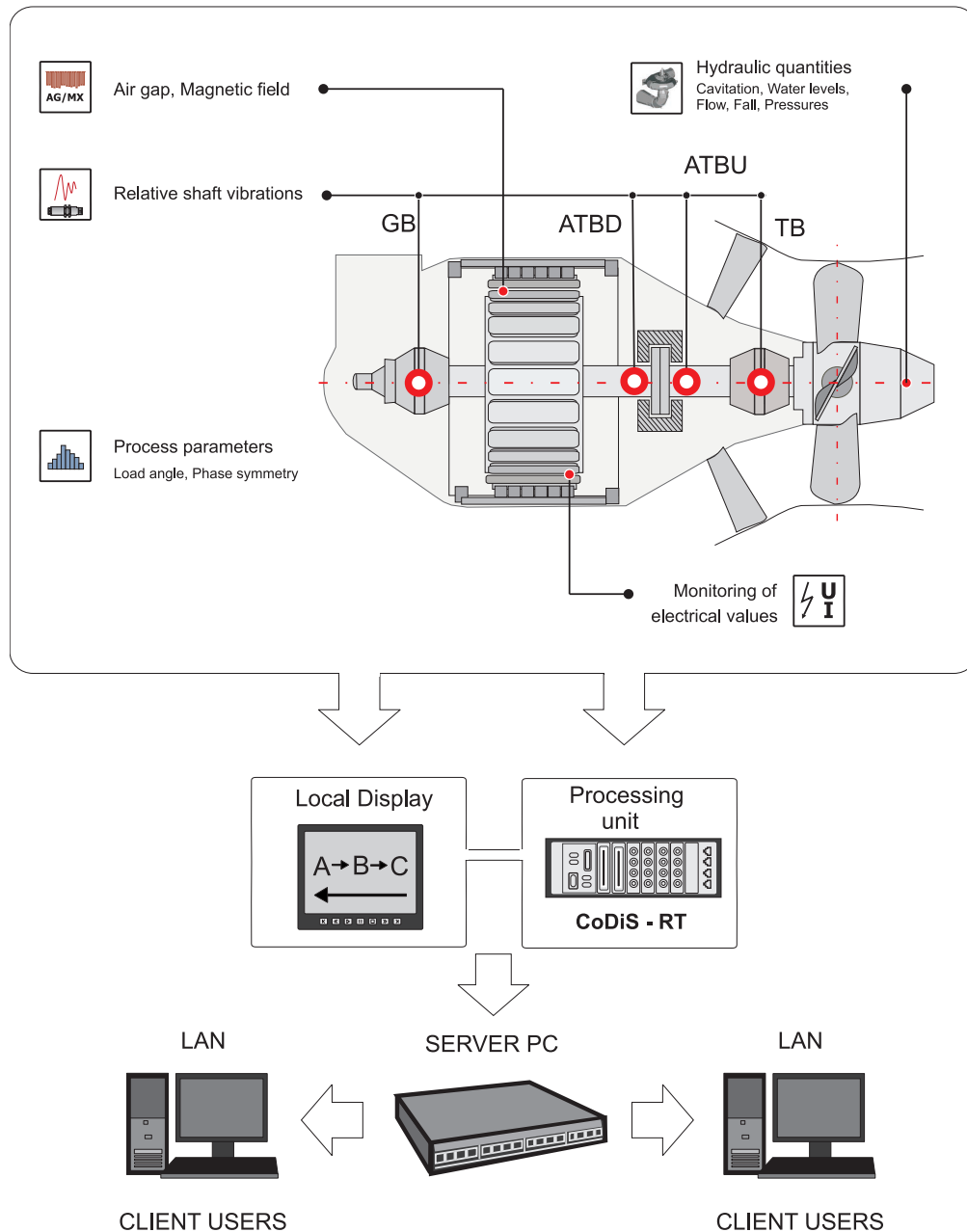
Process quantities

- Active power
- Reactive power
- Pressures
- Water head



REFERENCE: HPP DUBRAVA,

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



Vibrations

- Relative shaft vibrations

Axial displacement

Air gap

Magnetic field

Electrical quantities

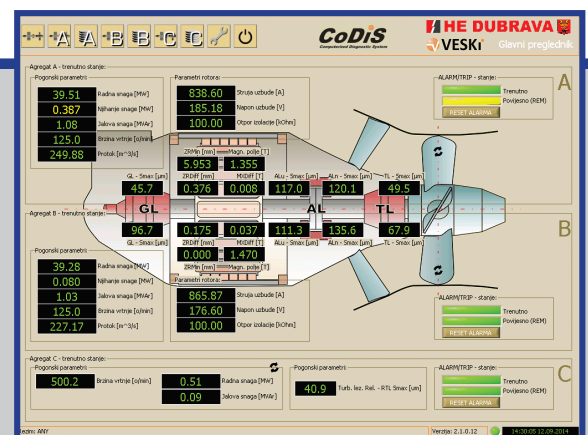
- Power quality monitoring

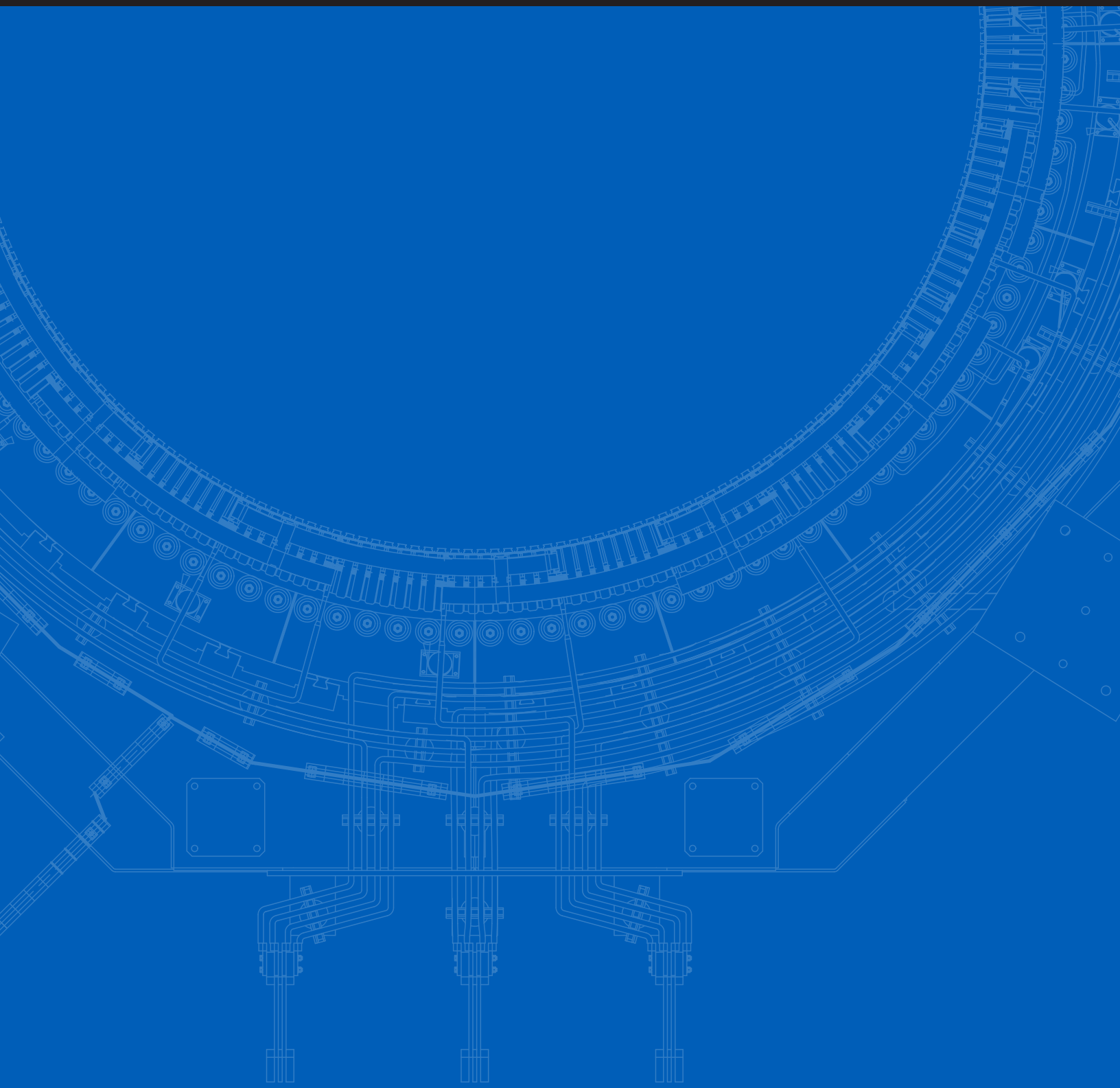
Rotor monitoring

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

Process quantities

- Active power
- Reactive power
- Pressures
- Water head





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