OPEN predictor™

INCREASES AVAILABILITY IN THE **HYDRO POWER INDUSTRY**

HYDRO POWER

- Reduce Maintenance Costs
- Improve Machine Efficiency
- Maximise Machine Availability

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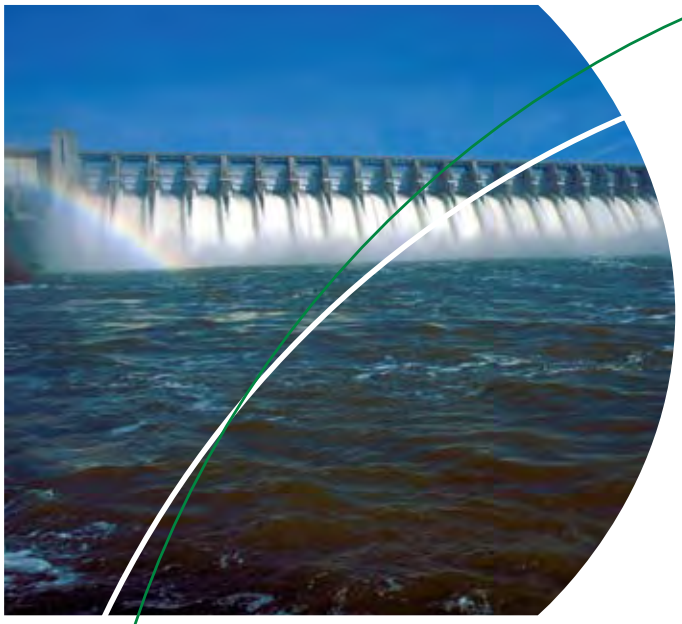


OBJECTIVES
OF A PREDICTIVE MAINTENANCE INFORMATION SYSTEM

Machinery in hydro power plants typically has a high reliability. As maintenance has a large cost impact on the total operation, it is however essential to only perform maintenance when it is really required. To guarantee the machine availability, avoid major breakdown and to schedule inspection and maintenance, the health of machines need to be monitored accurately, so the right maintenance decisions can be taken.

Short-term and long-term risks can be evaluated with the OPENpredictor™ system performing Mechanical and Functional Health Monitoring.

To warn the organisation about potential risks, individual failure modes are constantly monitored using dedicated Signature and monitoring strategies. Changes in the mechanical health and machine function are automatically reported to the relevant people.

The major function of OPENpredictor™ is to provide information to:

- Forecast machinery problems
- Optimise operation efficiency
- Schedule and cluster inspection and maintenance
- Trouble shooting

Different functions in a hydro power plant are provided by plant primary (eg. turbine, generator) and secondary (drain system, air compression, cooling etc.) machinery in order to produce power. Each machine requires dedicated monitoring techniques to assess it's health, to secure availability and efficiency of production.

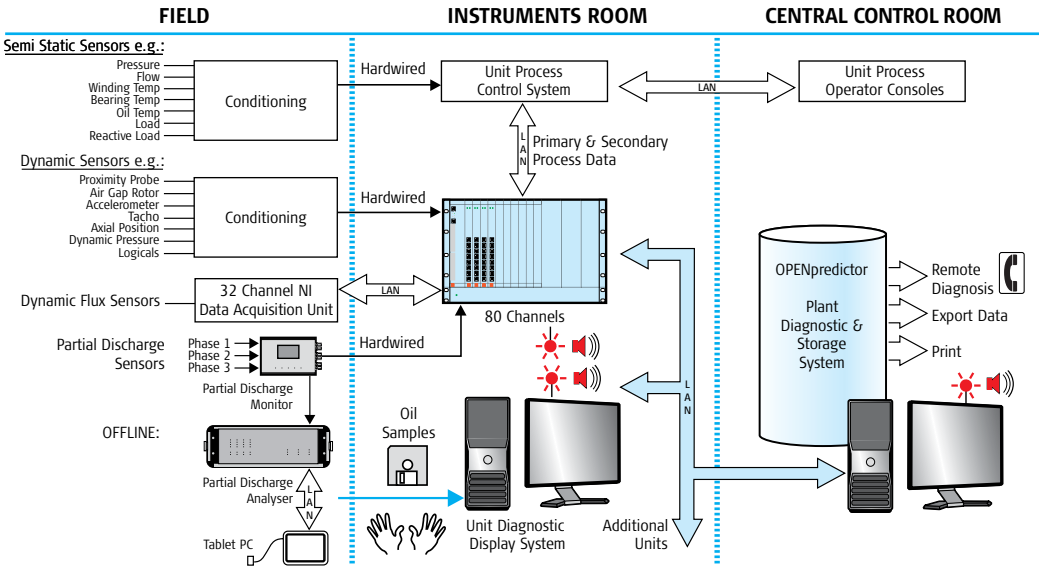
OPENpredictor™ integrates the signals and data from all sensors and subsystems, to monitor and present any required information time synchronously, so decisions can be made reliably.

Based on this information, the plant operators and maintenance department can conclude where short-term and long-term risks become too large, so corrective or preventative maintenance actions need to be organised.

OPENpredictor™ can be applied as a plant wide monitoring system. It provides one Man Machine Interface for the plant operators, rotating equipment engineers, electrical engineers and process engineers with dedicated information for each of them.

Specific characteristics:

- Economic plant-wide application
- Dedicated Signature monitoring provides automated early fault detection
- Machine operational state related monitoring provides reliable warnings and trends
- Almost any type of input sensor or output from sub systems can be integrated
- Freedom to define virtual sensors



Systems to be monitored:

- **Hydro turbine**
- **Generator**
- **Cooling system**
- **Oil pump system**
- **Air compression system**
- **Drain system**
- **Leak oil system**
- **Servo motors**

OPENpredictor™
CHARACTERISTICS AND INFORMATION SUPPLY

- Ultra fast processing allows parallel transient analysis

OPENpredictor™ provides for long term mechanical health assessment information about:

- bearing wear
- foundation looseness
- skid deformation
- misalignment
- unbalance
- coupling looseness
- shaft fatigue
- casing vibration
- gear wear
- rotor eccentricity
- winding looseness
- oil quality
- turbine noise
- shaft instability
- insulation deterioration

To assess the long term functionality of the machinery, information is provided about:

- cavitation
- efficiency reduction
- drain flow
- winding temperatures
- motor current
- synchronisation timing
- any user defined primary or secondary process parameters.

AutoDiagnosis™, AutoPrediction and AutoReporting

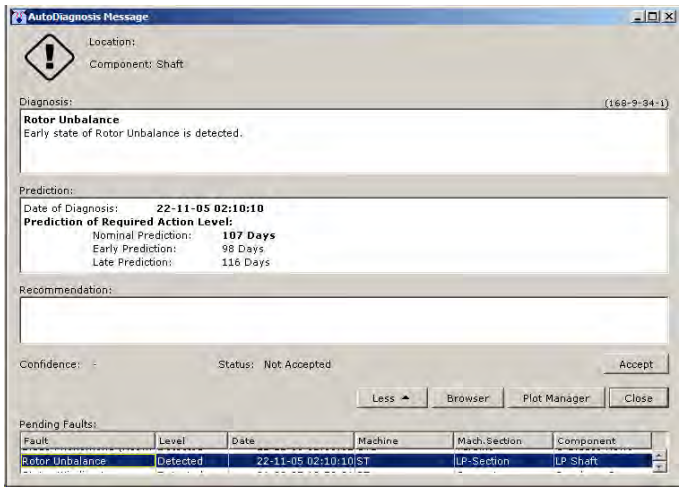
OPENpredictor™ has been developed for unmanned Machine Health Assessment. The AutoDiagnosis™ functions provide fault conclusions in clear text. The AutoPrediction provides information when faults are expected to reach a critical development stage.

The AutoReporting function provides automatic print-out of shift reports with user defined contents.

OPENpredictor™ makes distinction between short term risks for operation and long term risks for maintenance.

The user defined management reporting provides an overview of all machines and faults under development for efficient maintenance planning.

Predictive AutoDiagnosis™ message for rotor unbalance. The prediction indicates early and late prediction of lead time to inspection. The early and late prediction are calculated for a given confidence level, which can be modified by the user.



The OPENpredictor™ Condition Monitoring module offers a suite of analysis tools to verify the identified fault conclusion and providing additional information about developing faults. The forecast graph shows the symptom strength of an increasing unbalance of the turbine rotor indicated on the AD message above.

Right:
A hydroelectric generator rotor being lowered into the stator (Picture courtesy USACE)

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How to get started

The way to condition based maintenance facilitated by continuous online monitoring of critical machinery is fast and straightforward.

Once the decision is taken and we have clarified your monitoring needs, the implementation will be guided by Rovsing Dynamics' ISO 9001:2000 certified management system.

Installation of an OPENpredictor™ solution is easily conducted in connection with new build, retrofit or even on plants in service. We strive to ensure that the installation and roll-out to more machinery is as convenient for you as possible. And user training and after sales service is part of our delivery.

Interested?

If you would like know more about how a predictive maintenance information system can support your business, feel free to contact us for specific information about the different solutions or a demonstration of the OPENpredictor™.

About Rovsing Dynamics

Rovsing Dynamics is a global supplier of online solutions for the monitoring of condition, performance and reliability of critical rotating and reciprocating machinery. These are based on the proprietary OPENpredictor™ technology. The predictive maintenance information system has demonstrated its value at numerous maritime vessels, power plants, off-shore platforms etc. increasing revenue and availability significantly by predicting faults and lead time to inspection. Our customers include some of the world's leading shipping, power generation, and oil & gas companies.

We serve our customers worldwide from our head office in Copenhagen, Denmark, and sales offices in the Netherlands and the United Kingdom, and through partners and agents in Europe, Russia, North and South America, the Middle East, China, Asia and Japan.

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