GE
Measurement & Control

HydroX™ RulePak

Diagnostic Monitoring for Hydro Turbine Generators

Overview

The HydroX™ RulePak is one of the most comprehensive solutions available for monitoring and diagnosing hydro turbine generator faults, merging the expertise of IRIS Power, New York Power Authority (NYPA), and GE Energy. The solution utilizes partial discharge analysis, air gap analysis, vibration analysis, process analysis, and diagnostic interactions.

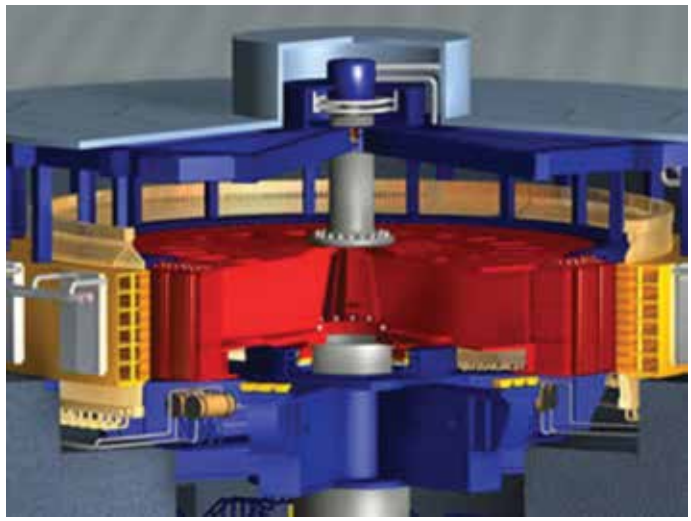
Like all RulePaks, its purpose is to package knowledge of experts to diagnose anomalies and events relating to certain types of assets, in this case medium- to large-sized hydro turbine generators. The fact that this RulePak diagnoses over 50 anomalies and events is an indication of how extensive this solution is. By combining the expertise of multiple knowledge sources, the cooperative offering is far greater than what each could offer individually.

When a condition is diagnosed, the operator or plant maintenance personnel can be notified regarding: 1) What is wrong; 2) What needs to be done; 3) How long before action must be taken; and 4) What will happen if no corrective action is taken.

How the System Works

Machine properties and models are utilized in the HydroX™ RulePak to transform complex data into anomaly identification. Examples of these include deviation from predicted stator temperature based on load and cooling system performance, air gap during generator synchronization, and partial discharge polarity predominance. Trending and alarming of these calculated parameters in System1* provide the user with an understanding on the generator state and the conditions being diagnosed.

The HydroX™ RulePak utilizes a unique belief engine to assign a confidence weighting to all processed data. The resulting beliefs are combined according to knowledge algorithms for each fault to generate a fault belief that represents the certainty a fault is occurring. This hierarchical design, allows the HydroX™ Rulepak to realize a high degree of diagnostic interaction between multiple data acquisition systems, in order to corroborate fault diagnoses and provide a comprehensive approach to condition-based monitoring.



The modular design of the HydroX™ Rulepak encompasses faults diagnostics dealing with Partial Discharge Analysis, Air Gap fault Problems, Mechanical Vibration Problems and Process Problems. This robust modular design allows the HydroX™ Rulepak to provide a high degree of data interaction while remaining adaptable for assets with varying levels of instrumentation.

Benefits

- Protect assets
- Reduce cost of operations
- Transition from preventive maintenance to condition-based maintenance
- Extend machine life
- Reduce forced outages
- Avoid catastrophic failures

Malfunctions and Corresponding Measurements

Mechanical Vibration	Shaft centerline out of Position due to magnetic or hydraulic pull or bearing misalignment
	Unit Unbalance due to unknown reasons
	Possible loose shaft coupling
	Rub
	Vortex whirl (rough load zone or Rheingans influence)
	Bearing wear or loose bearing
	Increased amplitude at non-fault specific frequencies
	Thrust bearing position problem due to thrust bearing wear/damage or misaligned/loose thrust collar
	Unit unbalance due to magnetic or hydraulic unbalance
	Mechanical unbalance
	High overall vibration
	Misalignment and possible misalignment
	Head cover vibration problems
	Wicket gate shear pin failure
	Wicket gate problem
	Runner damage
	Stator core instability
	Bearing preload
	Increased amplitude due to thrust bearing wear/damage or unexpected frequencies
Process Parameters	Stator and/or rotor winding overheating due to unit overload, cooling system problem, air gap distortion, ventilation system problems
	Bearing overheating problem
	Bearing cooling water supply problem
	Bearing clogged strainer
	Oil leakage
	Bearing cooler fouling problem
	Oil debris problem
	Bearing overheating problem due to unknown reason
	Water leakage into the oil
	Low oil pressure
	Shortened coast-down time
Air Gap	Core or rotor rim distortion
	Rotor or stator eccentricity
	Rotor misalignment
	Rotor rim mechanical distortion
	Core frame assembly stunted growth
	Field winding turn shorts
Partial Discharge	Thermal deterioration
	Load cycling
	Loose coil/bars
	Electrical slot discharge
	Improper impregnation
	Contamination at connections
	Stress interface

Key Features of HydroX™ RulePak

- Continuous online expertise from many disciplines
- Customizable graphical interface, enabling quick anomaly identification
- Consolidated display from multiple sources/systems
- Machine-state or time-specific limits and trends
- Expert system-based approach combines inputs from available sensors and monitors

Product Application

- Vertical propeller (Fixed, Kaplan or Francis) with 2 or 3 guide bearings
- Speeds < 600 RPM
- Power > 20 MW
- Not for pump storage applications

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