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Technological Development of Hydroelectric Generating Unit of Hydropower Plants in Condition Monitoring System

Authors:

Irfan Jamil, Rehan Jamil, Rizwan Jamil , Zhao Jinquan, jiang Qirong, Wei Ying Dong

Corresponding Speaker: Irfan Jamil
Hohai University, Nanjing China
Visiting Research Scholar, Tsinghua University, Beijing
Past: Electrical Engineer@ Sinohydro Group of Cooperation, China
中国水利水电第十一工程局有限公司

Outline of Paper

1. Abstract
2. Introduction
3. Composition of Condition Monitoring System
4. Configuration of Condition Monitoring System
5. Functions of Condition Monitoring System
6. Typical Applications of Condition Monitoring System
7. Conclusion
8. Acknowledgment

1. Abstract

- Condition monitoring system of hydroelectric generating units is essentially needed to protect the system against sudden failure and fault problems which took place rapidly during the operation.
- Many hydroelectric generating units are located in remote areas where making regular inspection is difficult and fault development is frequently occurred.
- Therefore resolve this issue, technical solution is to have a monitoring system technology that continuously monitors and supervise the machine condition.
- And while a short description is also appended of Baishan Hydropower Plant.

2. Introduction

Sound

- Technical Communication
- Machine - Hydroelectric Generating unit
- System- Condition Monitoring

Aim & Scope

- Demand of Hydroelectric Industry
- Unit work safe & reliable with Monitoring system
- Prevent the operation against sudden accident

Problem Statement

Research on issues and technical levels

2. Introduction

- Hydroelectric power industry has an increasingly vital role in global energy production market.
- By using the computer technology, condition monitoring system of hydroelectric generating unit can continuously acquire and monitor on line the parameters of conditions like vibration, swing, pressure fluctuation and air gap etc.

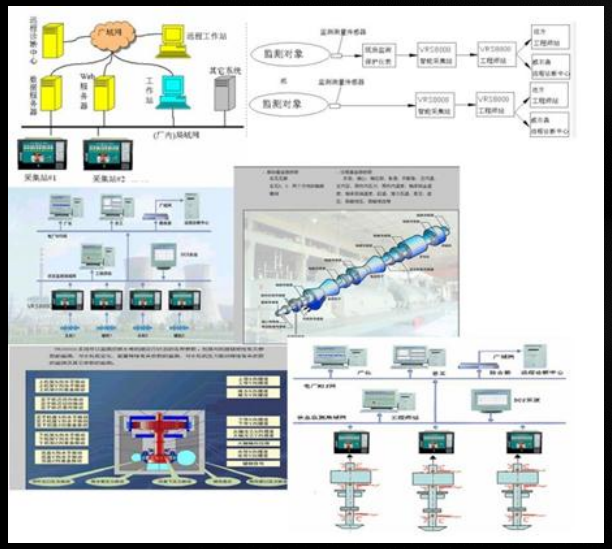
Significance:

To prevent sudden accident and ensure safe operation of the unit

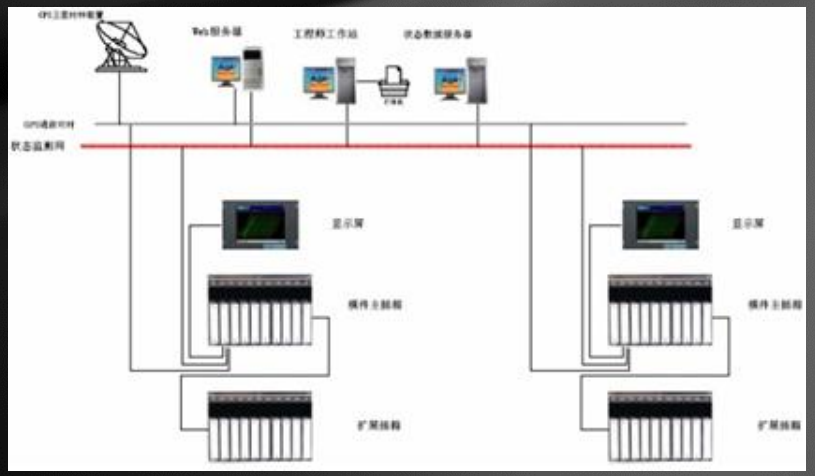
2.1 Course Development of condition monitoring

Simple instrument

Standalone monitoring



WAN remote analysis and diagnosis



LAN monitoring and analysis

3. Composition of Condition Monitoring System

The composition of condition monitoring system are four parts included such as

A. Structure and Monitoring Layer

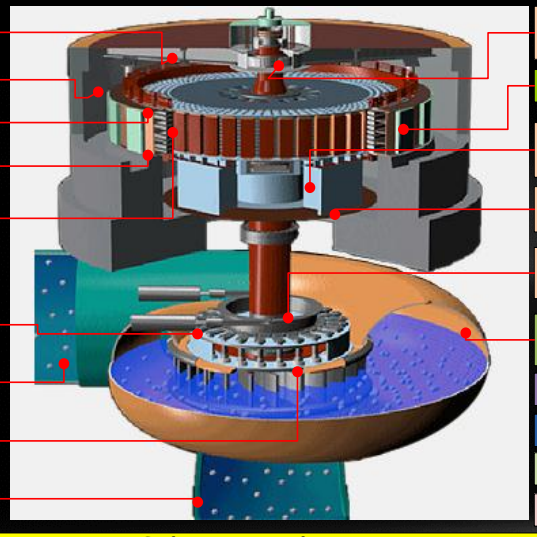
B. Selection of Condition Monitoring Parameters

C. Monitoring of Vibration, Swing and Pressure fluctuation

D. Monitoring of Turbine Cavitation and Cavitation Erosion

Screen of In-Situ Condition Monitoring & Sever Cabinet of Plant Station Layer product by NARI Group of Corporation

The monitoring scope of Francis Type Hydroelectric Generating Unit (as show in fig beside) has various monitoring levels.

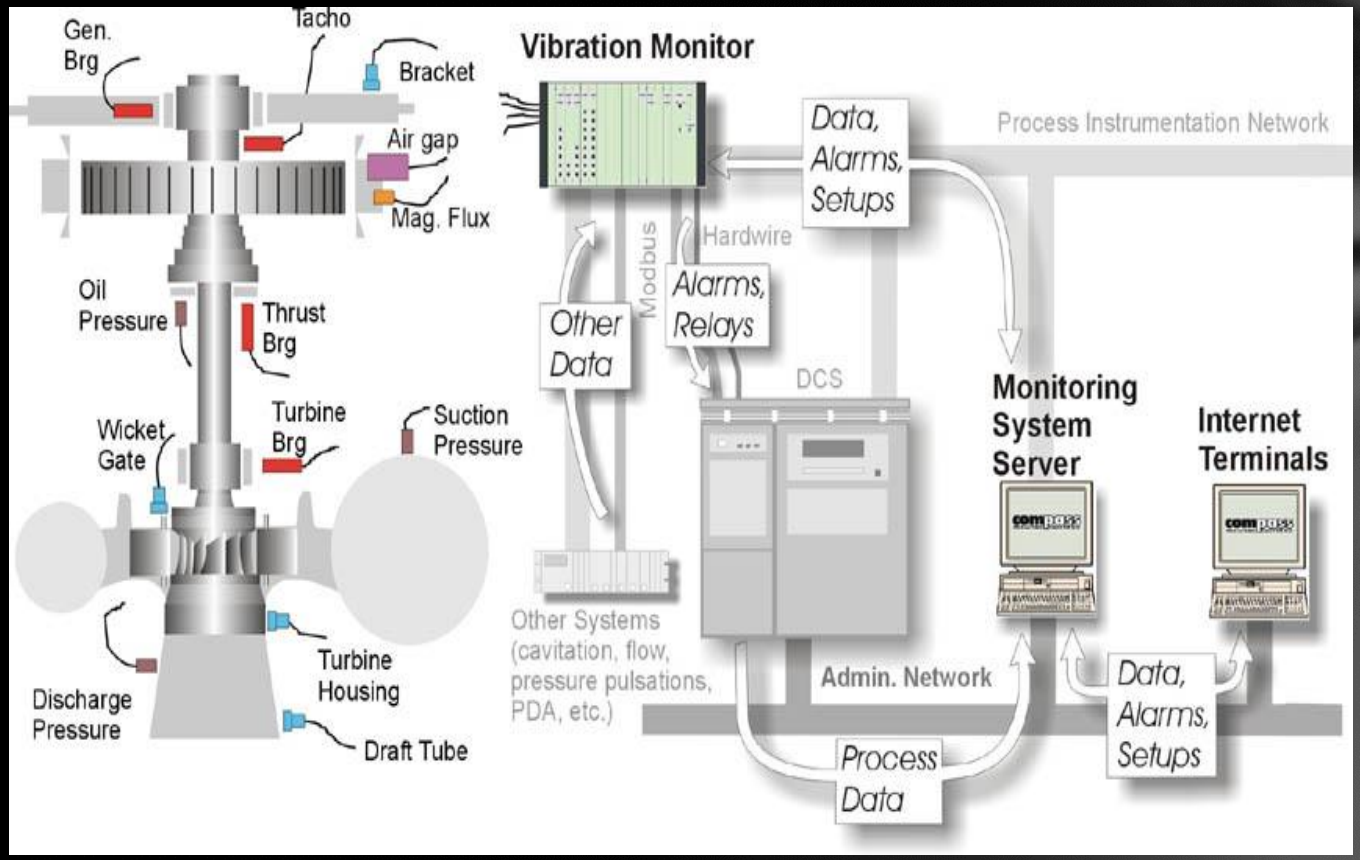


Work Condition Measuring Points：Guide vane opening ,Flow, Excitation current, Excitation voltage, Active power, Reactivve power, Environment temperature, Environment humidity.

The model of Francis type hydroelectric generating unit (as shown below) is exhibited by Exchange Center of UNIDO-ICSHP, Changsha in 2013 3rd international training program of small and medium hydropower station technology for developing countries

4. Configuration of Condition Monitoring System

The integral elements of main configuration of condition monitoring system are sensors, In-situ condition monitoring layer and Plant station layer.



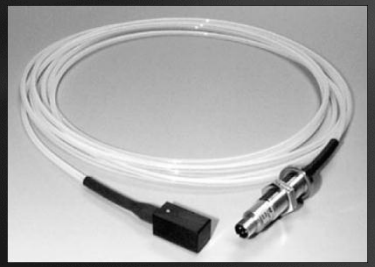
Configuration of monitoring system for a hydroelectric application

The wide ranges of sensors are involved in the configuration.

1) Sensor-eddy current displacement sensor
2) Sensor – velocity type vibration sensor
3) Sensor – piezoelectric acceleration sensor
4) Sensor – pressure fluctuation sensor
5) Sensor – air gap and magnetic flux sensor
6) Sensor – partial discharge sensor
7) Sensor – stator winding end vibration sensor
8) Sensor – cavitation & cavitation erosion monitoring sensor
9) Sensor – ultrasonic flow meter







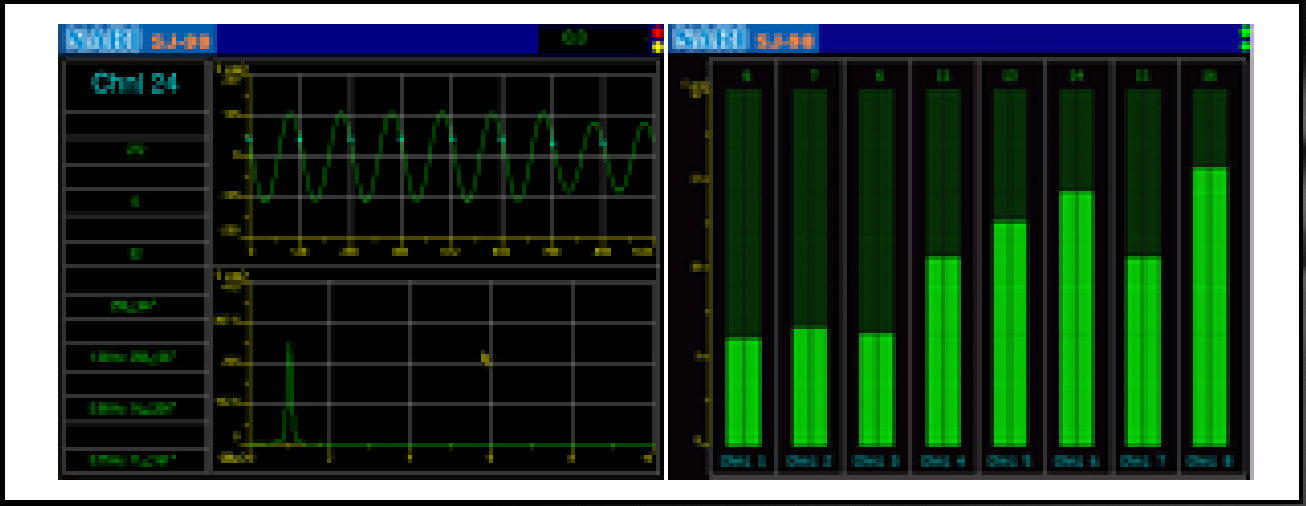


5. Functions of Condition Monitoring System

A. In-situ monitoring function

B. In-situ condition display and analysis

This software (SSJ-9000 system) is built by NARI Group of cooperation, China to maintain the monitoring function of hydroelectric generating unit.



Time-Frequency Comparison Chart & Bar Chat (software built by NARI)

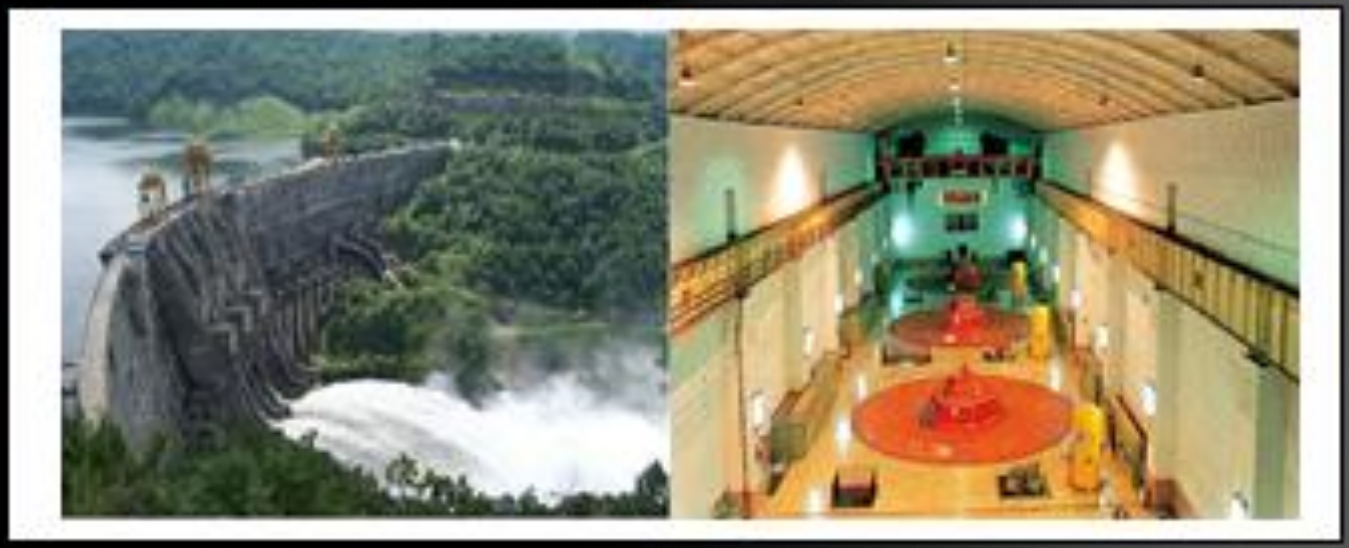
C. Energy characteristic & Generator Air Gap state analysis

D. Generator magnetic intensity, partial discharge and operating parameter state analysis

E. Alarm and early warning & Unit condition analysis in transient process

6. Typical Applications of Condition Monitoring System

- Today development of condition monitoring system of Baishan hydropower plant to monitors intelligent fault diagnostics techniques on machines increase productivity and ultimately profits .
- According to the project profile, it has been installed total capacity of Baishan Hydropower Plant is 2,000,000KWH and the design annual energy output is 2,958,000,000KWH. 5 sets of Francis type hydroelectric generating unit with unit capacity of 300,000KW were installed in phase I and phase II of Baishan Hydropower Plant, 2 sets of reversible unit with unit capacity of 150,000KW were installed in phase III.
- The monitoring parameters are involved to acquire 64-way sensor channel data for each unit, including the monitoring points..



7. Conclusion

One of the crucial factors for achieving in reducing maintenance, prevention and unnecessary downtime in the hydroelectric industry is condition monitoring system of the hydroelectric power generating units. This paper presents the applied communication in technical levels of Condition Monitoring System of Hydroelectric Generating Unit which helps in effective maintenance and operation decision depends on reliable, timely and relevant machine condition information.

8. Acknowledgment

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Presenter: Irfan Jamil Biography

Irfan Jamil was born in Punjab province, City Multan, Pakistan on Feb 25, 1987. He received his bachelor degree in Electrical Engineering and its Automation from Harbin Engineering University, Harbin, China in 2011. He received his Master degree in Power System & Automation from Hohai University, Nanjing, China in 2013. He did his master research as a Visiting Research Scholar in Tsinghua University, Beijing from 2012-2013 under the Grant No. is 2012AA050215, National High-Tech R&D Program (863 Program) of P.R China. He has been published 16 research papers and 9 e-books in referred international journals including IEEE conference during the period of master degree program from 2011-2013. He is registered member in Chinese Society for Electrical Engineers (CSEE), National Society of Professional Engineers (NSPE), International Association of Engineers (IAENG), Universal Association of Computer and Electronics Engineers (UACEE), Institute of Healthcare Engineering and Estate Management (IHEEM) and American Society of Mechanical Engineers (ASME). He is editorial board of committee in International Journal of Innovation and Applied Studies (ISSR) and in World Academy of Science, Engineering and Technology (WASET). He is senior editorial board member in smart science (TAETI ACADEMIC PUBLISHER). He is also president of Kambohwell Publisher Enterprises. His research interest involves in Power electronics and Power system Automation.

Thank you for your attention
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