Research on Safety Evaluation and Early Warning Decision System of Hydropower Equipment Based on Power Big Data Technology

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Abstract. Hydropower equipment has the characteristics of high frequency and high load in operation, and safety problems may occur under long-term operation. Once such problems occur, it will cause safety problems at the work site and affect the quality of hydropower energy supply, so it needs to be taken seriously. In order to ensure the safety of hydropower equipment, it is necessary to establish a safety assessment method. Under this condition, traditional manual evaluation methods are affected by artificial instability and error, and there are many defects. Combined with modern big data technology, a better one can be obtained. The evaluation system can give artificial early warning decision assistance according to the evaluation results of the system. In order to understand the application of big data technology in this paper, relevant analysis work will be carried out.

Introduction

Traditional equipment state is a vague concept, which must be quantified in order to introduce information system, that is, "state quantization". Most on-line monitoring systems are not suitable for evaluating the amount of data collected. It must undergo deep mechanism design and algorithm mining in order to effectively evaluate the quantity.Here, it is necessary to design a feature set for each device, which includes not only the data collected directly, but also the computation that must be obtained through calculation. The system should be able to make use of the technical data, operation history data, off-line inspection data (including live detection), off-line pre-test data, historical defect data and on-line detection data of the main equipment of hydropower plants, and to evaluate the health status of the equipment in combination with the data and conclusions of condition monitoring and analysis, fault warning and so on. Estimation should be able to give clear health assessment conclusions, trend prediction conclusions and risk assessment conclusions.

Equipments health evaluation uses algorithm engine to process and calculate real-time collected data, excavate all kinds of feature signals of equipment, set threshold value for feature signals of parts, and judge the health status of parts. The system supports the equipment health assessment rules designed by users. On the system platform, users can configure any data on the data platform and design reasonable evaluation rules by themselves. The equipment evaluation level is divided into four states: normal, attention, abnormal and serious.

Through the mining and analysis of on-line and off-line monitoring quantities of power generation equipment, valuable characteristic data are extracted, which are called "indicators" for fault diagnosis and trend warning of equipment health.

The system can build a four-tier equipment health assessment model, which is composed of "equipment-equipment components-component state variables-judgment basis". According to the collection and accumulation of equipment component state variables characteristic data - > calculating component state variables - > evaluating component health status - > evaluating equipment health status, health assessment can be carried out. The system should be able to support the automatic generation of equipment units and the overall evaluation conclusion function of the system through component evaluation results. The system adopts an open design, with multiple

controls built into the platform. Users can configure any data on the data platform by themselves and design reasonable evaluation rules. The system can evaluate the health status of equipment according to the rules designed by users.

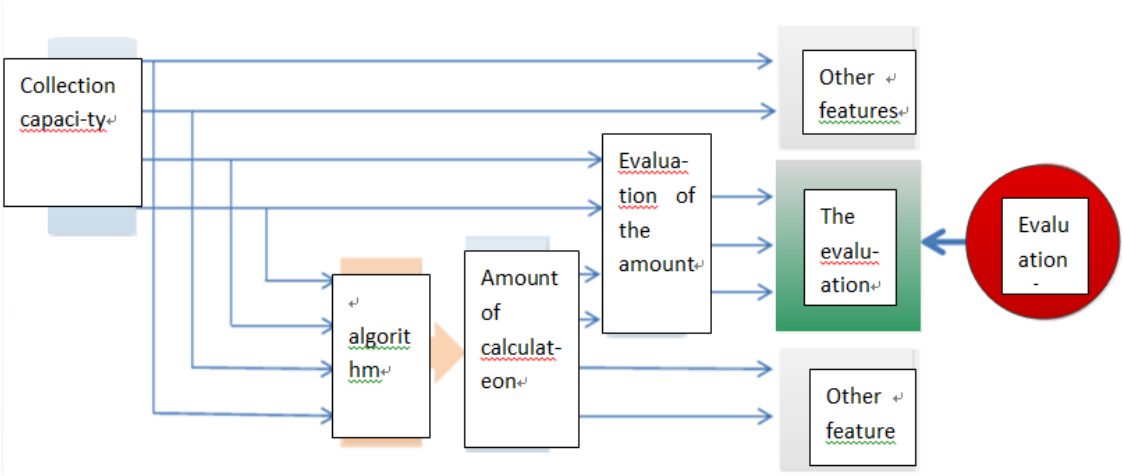

Figure 1 evaluation system

Establishment of Health Assessment Index System

The generalized "equipment state" includes two forms of "measurement state" and "component state":

Measuring state: classified by measuring device

Such as: oscillating state; pressure fluctuation state; air gap state; temperature state; chromatographic state and other professional measurement equipment or system provided by the state.

Component Status: Classified by Equipment Components

Generator state: rotor state, stator state, guide bearing state, thrust bearing state, etc.

The state of the system is inferred by the state of the components contained in the system according to the determined logic.

The grade of the overall evaluation is to take the parts to evaluate the most serious state.

The state of components corresponds to the equipment one by one, which is more useful for field application. The original data of components come from various measuring systems. Health assessment indicators can be divided into three categories: equipment status indicators, power grid demand indicators and hydraulic resources indicators. The equipment status indicators mainly refer to the operation of equipment, and are statistical indicators based on unit condition monitoring data.

Health Assessment Model

According to the historical data of condition monitoring and fault record data, the characteristic signal model of the key parts of the unit is established.

Select the characteristic parameters in the process of equipment operation, track their changing rules, and compare them with the standard model of healthy operation. According to the set alarm threshold, evaluate and judge the operation status of the unit.

By judging whether the characteristic signal of the equipment exceeds the health limit, the health diagnosis of the unit operation status is realized, and the qualitative evaluation results of the health status are given.

Table 1 index name

The serial number	The index name	The serial number	The index name
1	Generator shaft index	21	Looseness index of upper guide support
2	Uniform load index of upper and lower guide tiles	22	Lower leading pendulum index
3	Spindle bending index	23	Lower guide tile temperature index (technical water supply)
4	Upguide dynamic turning index	24	Horizontal vibration index of lower frame
5	Water guide dynamic turning index	25	Index of gap unevenness of lower guide tile
6	Major axis movement index	26	Looseness index of lower guide support
7	The most stingy gap indicator	27	Mirror plate is not vertical indicator
8	Rotor centrifugal force index	28	Vertical vibration index of thrust frame
9	Index of elastic deformation of rotor	29	Thrust bearing tile temperature index (technical water supply)
10	Rotor irroundness index	30	Looseness index of thrust support
11	Stator core temperature index	31	Index of water conductance pendulum
12	Stator bar temperature index	32	Horizontal vibration index of roof
13	Insulation damage index of stator lamination	33	Vertical vibration index of roof
14	Center deviation index of fixed rotor	34	Water guide tile temperature index (technical water supply)
15	Copper loss deviation index of stator wire rod	35	Index of gap unevenness of water guide tile
16	Air cooler efficiency index (technical water supply)	36	Water guide support looseness index
17	Upper leading pendulum index	37	Centrifugal force index of runner
18	Horizontal vibration index of upper frame	38	Unevenness index of turbine opening
19	Upper guide tile temperature index (technical water supply)	39	Draft tube pressure pulsation index
20	Index of gap unevenness of upper guide tile		……

Equipment Operation Decision

Operational Guidance

According to the operation status of the equipment, the system can provide optimum operation suggestions such as load interval, priority of starting and stopping, load distribution, oil filter of governor, filter cleaning, etc. The functions are as follows:

- The system can forecast the development trend of equipment failure, and provide suggestions for equipment operation according to the conclusion of trend prediction.
- When the equipment is abnormal, the system can automatically calculate the parameters such as the optimal operating conditions of the equipment, and give suggestions.
- When the equipment is abnormal, the system can give the key inspection suggestions to guide the safe and reliable operation of the equipment, and list the key inspection parts in the form of tables.
- The system can identify the working conditions and provide guidance for the optimal operation of units.

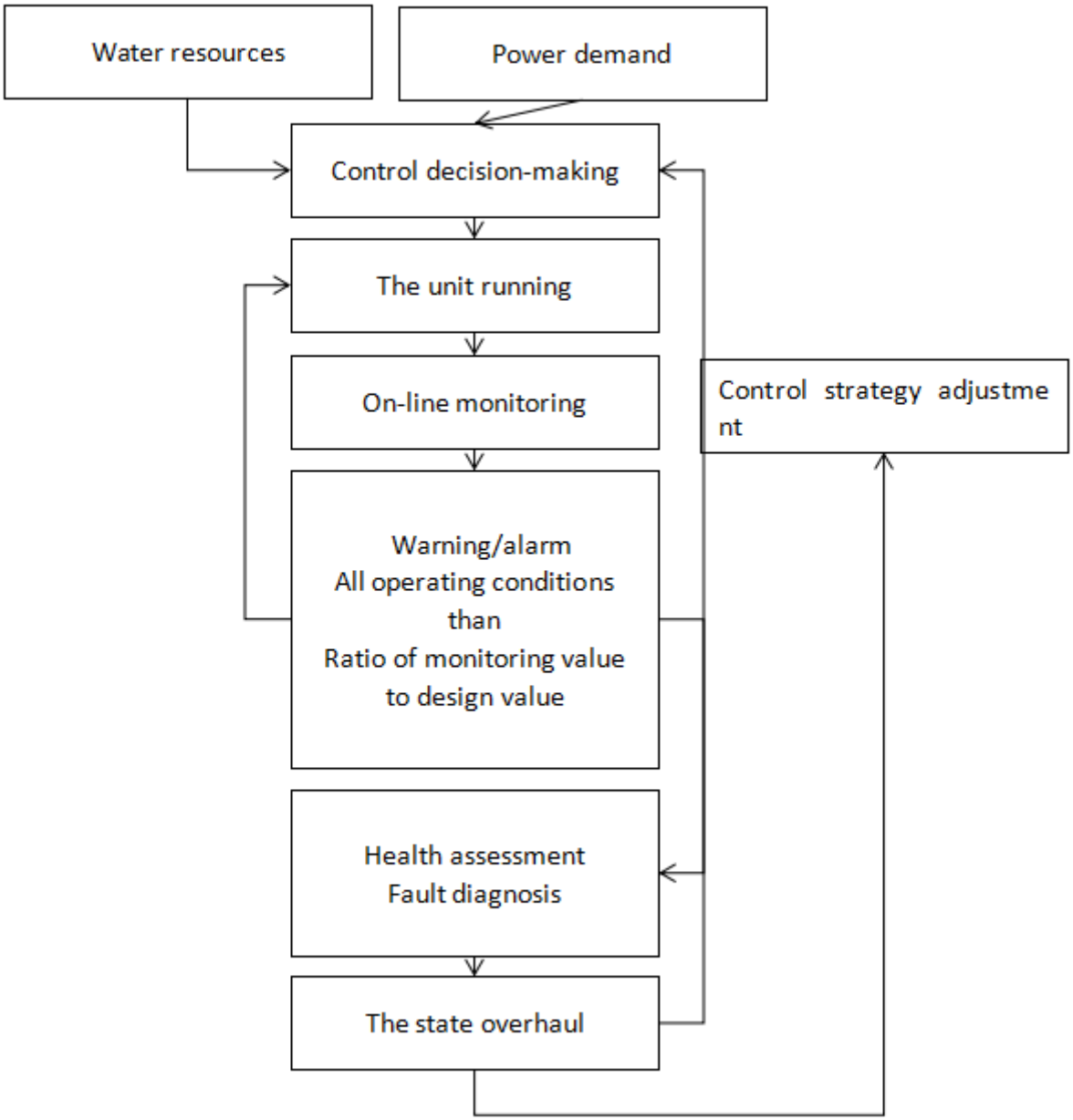

Figure2.Evaluation process

Through collecting operation data of power plant, including real-time data of all professional systems, breaking down barriers of professional systems, further processing data, and forming corresponding indicators according to the demand of power plant operation and maintenance. It is used for optimal dispatch of unit operation.

Equipment Maintenance Decision

The system adopts decision-making and support technology for condition-based maintenance of power plant equipment based on machine self-learning, based on condition monitoring and fault diagnosis technology of power plant equipment, combined with data indicators of off-line preventive test of equipment and manual patrol record data, and adopts multiple means such as trend diagnosis, performance evaluation and pattern recognition.Comprehensive evaluation of the health status of power plant equipment operation, and then assess the necessity of its maintenance, to provide decision-making and support for the implementation of optimal and optimal maintenance.

In application, the overhaul strategy, time and content of the next overhaul time should be

comprehensively evaluated, and the overhaul plan should be formed. At the same time, all kinds of data generated in the overhaul provide the basis for the next evaluation and form the closed-loop management of production data.

The condition-based maintenance is to advance or postpone the maintenance cycle according to the technical status and operation requirements of the equipment, increase or delete the maintenance items, and truly realize the purpose of maintenance, with the greatest economic and technological benefits.

The system functions include:

- According to the conclusion of equipment health assessment, suggestions for equipment inspection and construction are given.
- With abnormal operation parameters, the system can determine the fault type and location, analyze the deterioration grade of the main equipment, and give the decision-making conclusion: maintenance priority, maintenance grade and maintenance time.
- Automatic generation of maintenance work planning, process, process, etc.
- Periodic equipment condition evaluation: Through the condition monitoring, fault diagnosis and defect data of equipment history, equipment evaluation and conclusion report are carried out regularly.
- The system automatically issues maintenance decision-making recommendations, and finally generates maintenance work arrangements through system consolidation and manual intervention.

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