Application of Intelligent Communication Power Operating System in Nuclear Power Plant

Zhen-Xu FU and Chao SHU
Centre of Information Technology, CGN Power Co., Ltd., Shenzhen City, China

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Abstract. Communication power is often referred to as the heart of communication equipment, and the communication equipment also affects the stable operation of the power transmission and transformation, and even about nuclear safety in nuclear power plant. This paper introduces an intelligent communication power supply operation system, modularization of power systems. It has the characteristics of high reliability and convenient maintenance, comprehensive monitoring function; it can provide a more intelligent and reliable communication power supply system for nuclear power plants.

Introduction

Intelligent communication source operating system by AC power distribution and monitoring system (which is composed of the main monitoring and monitoring system), charging module ("N + 1" redundant configuration) and the battery, DC load, step-down unit, on-line monitoring, battery inspection, DC screen cabinet and other components. The intelligent communication power supply operation system adopts the configuration integrated monitoring system, which is controlled independently by several decentralized sub monitoring systems, and centralized management is carried out by main monitoring. Each sub monitoring unit has an independent microcomputer processor to implement its own control functions.

System Structure

AC Power Distribution

Each group charging module adopts two AC incoming line power sources, which are taken from different plant power buses, and the incoming switches are all closed at the closing position, which are selected by interlocking AC contactors, so as to prevent non synchronous switching on when two alternating current power supplies is supplied at the same time. As shown in Figure 1. The main monitoring system monitors the voltage of dual AC power supply and the state of AC contactor. When the power supply of a power source is out of phase, the voltage is unbalanced, the voltage is too high or the voltage is too low, the system automatically switches the power incoming switch to another power supply and gives out the acousto-optic alarm signal.

When the AC configuration for dual way automatic priority in the main monitoring system, once the communication way will switch to a normal communication way, regardless of whether the two channels is normal; the configuration for a road two road work or work, even if the road is not active switch fault.
Rectifier Module

The charging module is the core component of the DC operating power supply, and the intelligent high frequency switch module is used. The charging module in 220 V AC power input, after the first treatment and two lightning electromagnetic interference (EMI) filter circuit, and then through rectification and passive power factor correction circuit converts the high voltage DC power, the three-phase full bridge pulse width modulation (PWM) inverter circuit high voltage direct current power into high frequency alternating current through the high frequency after the isolation transformer step-down rectifier, DC controllable output stability. The charging module is equipped with a standard RS485 interface to dock with the host computer.

The rectifier module equipped with phase absences, input voltage, input voltage, output over-current, output short-circuit, output overvoltage, under voltage alarm output, and communication module, abnormal temperature, input devices such as lightning protection function, with remote control, remote communication, remote control, telemetry function of "four remote". The rectifier module uses the latest full bridge phase shift soft switching PWM technology to improve the efficiency of the module, reduce the electromagnetic interference and reduce the volume weight.

In addition, the intelligent high frequency switching rectifier module realizes the modules with electric heating and plugging, better circuit board dust-proof and moisture-proof treatment, optimized heat distribution processing, and self-balancing current between the charging modules.

DC Power Distribution

In order to improve the reliability of DC power distribution, two DC distribution buses are derived from the "DC bus wiring group".

Each DC distribution bus is made up of two segments in series. The first section is the distribution bus for the important load, and the second segment is the distribution bus of the secondary load through the low voltage load shedding relay. Operation of low voltage load reducing relay.

The threshold value is 48 V (can be set). When the AC is lost, the battery pack can ensure the power supply of the important equipment for a long time.

Battery Pack

Because of the stable voltage and large capacity, the battery pack can provide short time impulse current for circuit breaker closing, and it can also serve as backup power for accident safety load. The system selects the valve controlled lead-acid battery. In the process of electric power production, it plays the role of voltage stabilizing and accident reserve, and bears the impact load. Each battery is equipped with a set of battery patrol apparatus, which can inspect the voltage and other parameters of the single cell and have the alarm function.
Monitoring System

The monitoring and control system is the control center and the management center of the communication power system. As shown in Figure 2. The monitoring system automatically monitors every function unit and battery group in the DC power supply system, and obtains the running state parameters of each unit and processes them in real time. On this basis, each function unit of the system and the battery group are controlled to realize the full automatic and accurate management of the power supply system.

![Figure 2. System intelligent monitoring function.](image)

The communication power monitoring system is composed of a main monitoring and multiple sub monitoring system. The three level control systems are used in this monitoring system.

Management structure: the first level is the highest level, for the computer monitoring system are connected through the communication interface and the monitoring system; second level monitoring; third at the bottom of the monitoring system, composed of a battery charging module unit inspection unit, monitoring unit etc.. The main monitoring is connected by the communication interface (RS232/RS485/ network) with the battery monitoring unit, the AC distribution unit, the DC sampling unit and the charging module unit. These basic units are responsible for monitoring the working state and operating parameters of each module and executing the control commands of the main monitoring.

The hardware of the main monitoring system is composed of the main board, the display board, the core board, the switch output board and the DC sampling plate. The main monitoring system use touch screen, embedded installation; can control more than 32 charging module, management of 2 groups of battery discharge, battery temperature compensation, insulation monitoring, feeder monitoring; PC equipped with RS232 or RS485 interface, and network interface and multiple protocols, achieve the "four remote" function.

The operation interface of the main monitoring system uses window display and touch operation, which consists of two main parts: main window area and menu area. The main window area can display the specific content of the system state information, fault information, system setting parameters, system control parameters and so on. The menu area is composed of 4 functional buttons, which are view, operation, setting and help. Through the view button, we can find information about current and historical alarm information, feeder switch status, real-time data and curves, historical discharge curves, dynamic and static discharge records and so on. Enter the system after the operation button is entered by the operation button.
The operation interface can control the battery charging and float operation, dynamic discharge and AC switching operation switch and charging module of machine. By setting the button input system after setting up a password to enter the system setup, including time setting, password modification, communication parameters, DC configuration, module configuration, battery configuration, IO configuration, operation parameter setting, system configuration and program upgrade operation and file backup load operation. Through the help button, you can see the software version information and other help information.

The sub monitoring is the main control box, multiple insulation leakage current sampling box, the battery voltage sampling box, AC distribution unit box, DC sampling box, passive into the box, into the box, open the active passive box, single intelligent leakage current sampling box, temperature acquisition box, temperature sensor probe and a balance resistor box unit composition.

**Insulation Monitoring**

Insulation monitoring is composed of main monitoring system insulation unit and sub monitoring insulation unit. It is used to monitor the insulation status of DC bus and output branch to the earth during normal operation, it can accurately estimate the insulation reduction of bus and a branch, and improve the reliability of the system. The insulation inspection unit consists of insulation inspection, insulation main control box, multi-channel current sampling box, intelligent leakage current sampling box, balance resistance box, current Holder sensor and so on.

**Battery Monitoring**

Battery monitoring is composed of main monitoring battery inspection unit and sub monitor battery inspection unit. It is used to automatically monitor battery voltage, battery pack end voltage, charging and discharging current and temperature automatically, and automatically calculate battery internal resistance. Battery inspection unit has protective functions such as discharge module overheating protection, short circuit protection, input reverse connection, under voltage, external event triggering, and stop discharge protection and so on. On the other hand, it also has functions of charging monitoring, discharge management, discharge protection and so on. The unit can automatically store alarm information, dynamic discharge and static discharge data, and provide battery internal resistance detection and data storage with monitoring and instantaneous discharge devices. The battery inspection unit consists of main controller of battery inspector, battery voltage sampling box, battery temperature sampling box, temperature sensor probe, dynamic discharge load, and constant current discharge load and so on.

**Summary**

The intelligent power communication power supply system, based on the conventional power supply, introduces the technology principle of flexible, safe, stable and reliable power supply in the power grid, which meets the high reliability, high stability and high availability of the modern power communication power supply. This paper combined with the practical application of intelligent communication source operating system in nuclear power plant, introduces the characteristics of hardware and intelligent communication power supply operating power system, each power system uses the advanced configuration, "N + 1" redundant charging module, powerful monitoring system, advanced software design and high reliable insulation battery monitoring and inspection instrument, safe and stable operation of the nuclear power plant has played a strong role in security.

**References**
