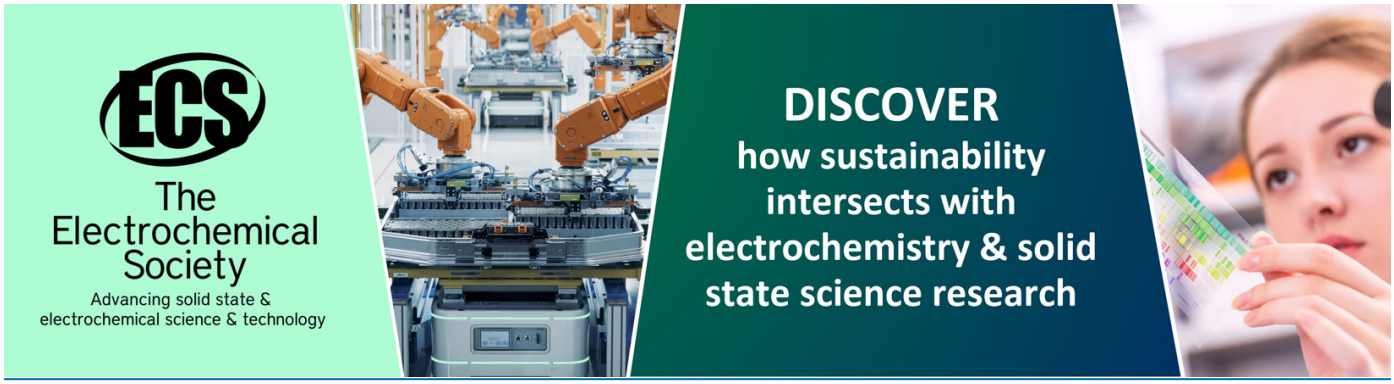
Ultra-High Voltage DC Convertor Station Equipment Condition Data Access Technology Based on multi-Source Heterogeneous Fusion



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Ultra-High Voltage DC Convertor Station Equipment Condition Data Access Technology Based on multi-Source Heterogeneous Fusion

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Abstract. With the large-scale construction of special high-voltage project, as well as power supply reliability, security, economic and other increasingly demanding, state monitoring equipment involved in more and more monitoring projects and more and more monitoring data, because these data exist in multiple isolated systems in the Ultra-High Voltage（UHV）AC-DC substation, there is no data sharing mechanism, so a holistic analysis, application and sharing approach for the data set will need a deep consideration. In this paper, the equipment condition monitoring system frame of the UHV converter station and the scheme of the equipment state data access of UHV converter station based on the multi-source and heterogeneous data fusion are presented. Then, data exchange technology of UHV equipment state early warning center was introduced, and a data access and conversion device in the Zhongzhou converter station was deployed to solve the timeliness and functionality difficult of the existing system to meet the requirements of UHV operation and maintenance support.

1. Introduction

AC-DC transformer equipment is very important in UHV power transmission project, and its reliability and operation directly determine the stability and security of the whole system. In order to ensure the safety of the large power grid, according to the relevant documents and the requirements of State Grid Corporation of China (SGCC), the UHV AC-DC substation belongs to first-class substation, directly managed by SGCC Inspection Department. China Electric Power Research Institute（CEPRI）established SGCC UHV equipment status warning center in order for professional equipment management and the whole process of technical supervision, including monitoring and early warning, state detection and diagnosis, analysis and evaluation for UHV AC-DC equipment. At present, SGCC has built the transmission and distribution equipment monitoring system with the provincial company and SGCC headquarters two deployments, but because the data for the state monitoring system were huge, the master station of the provincial company bore the traffic pressure of power supply companies of the whole province and SGCC headquarters, the information channel restricted the SGCC UHV equipment status warning center to obtain equipment monitoring information timely. What's more, the existing condition monitoring system could not satisfy the demand of service support of the UHV equipment condition warning center, as in [1].

For the characteristics of the UHV DC converter station equipment state information, such as wide sources, Information heterogeneity, Huge quantity and various attributes, the paper put forward a

UHV DC converter station equipment monitoring system framework which met the timeliness requirements and a UHV DC converter station equipment condition data access scheme based on multi-source heterogeneous data fusion; It introduced the data exchange technology between the station and SGCC UHV equipment status warning center, and proposed multi-source cross platform data access interfaces and data access methods. The data access and conversion device has been deployed in the Zhongzhou converter station pilot to implement related data cross platform interactive sharing, such as charge detection, on-line monitoring and robot inspection. And it solved the problems which the existing system could not meet the requirements of UHV operation support in terms of timeliness and function.

2. UHV DC converter station equipment monitoring system framework

The project established a unified UHV equipment condition monitoring system which included the two level deployment, namely UHV converter station and SGCC headquarters, and three level application, namely SGCC headquarters, provincial company and provincial maintenance company; Also, the project established a standard open information technology framework. And it established two data sources, including the UHVDC converter station and the SGCC UHV equipment status warning center. The UHV equipment state warning center could obtain data directly from the UHV station, and did not need to go through the Production Management System (PMS) on the side of the net or SGCC headquarters. The UHV converter equipment condition monitoring system frame is shown in Figure1. The data access and conversion device is deployed in the internal of convertor station. The device accesses to online monitoring data through the Condition Access Controller (CAC), and it should follow Q/GDW 740-2011 Transformer Equipment On-line Monitoring I2 Interface Specification when communicating with the CAC, as in [2]. What's more, all data within access station, such as valve hall infrared temperature measurement data, fault data and meteorological data, should follow UHVDC Converter Station Equipment Condition Data Access Specification; After the data is collected, the device uses the Web Service interface service to push the data to the UHV equipment state warning center through the internal information network, as in [3] and [4]. The PMS on the side of the net provides data, such as Equipment, test, defects and adverse conditions, for UHV equipment status warning center by setting the database read-only access, as in [5].

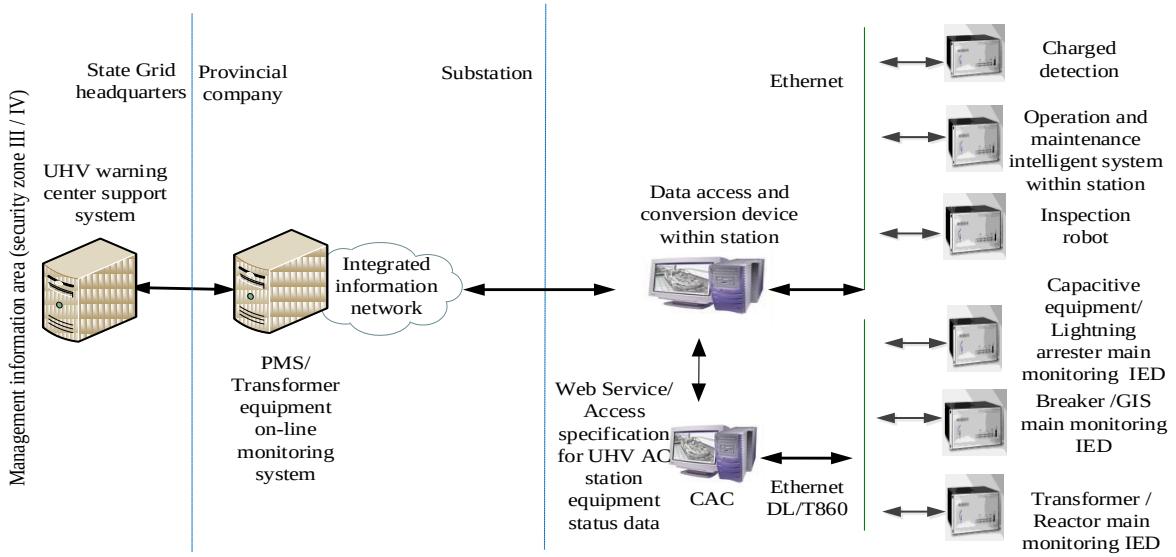

Figure 1. Equip condition monitoring system framework of UHV DC converter station.

3. UHV DC converter station transformer state data access scheme

3.1. The data access framework

The UHV DC converter station equipment condition data access framework is shown in Figure 2:

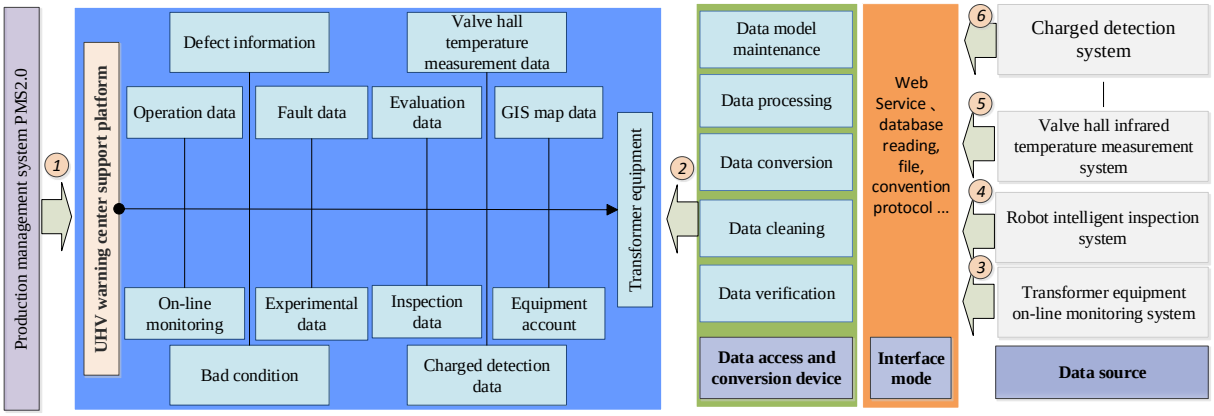

Figure 2. Framework of equipment condition data access for UHV DC converter station.

PMS2.0 syncs basic data, substation account, primary device account within station, defect information, fault information, adverse condition information, hidden information and test data to the UHV warning center support system;

Data access and conversion device within station syncs online monitoring data, robot inspection data, the valve hall infrared temperature measurement data and live test data to the UHV warning center support system;

Online monitoring system syncs data to the data access and conversion device within station, such as basic data and monitoring device account, dissolved gases in oil, top-oil temperature, top-oil temperature and SF6 gas water, as in [6];

Robot intelligent inspection system syncs inspection data to the data access and conversion device within station;

The valve hall infrared temperature measurement system syncs data, for example, infrared temperature measurement data, to data access and conversion device within station;

Live test system syncs data, such as oil chromatogram, partial discharge, infrared and ultraviolet to data access and conversion device within station.

3.2. Methods of obtaining data in the station

The main data sources of the UHV converter station mainly included online monitoring system, electric testing system and the inspection robot system. The specific data sources and data types are shown in Table 1. In UHV DC converter station equipment condition data access and conversion device, access station used three ways to get data, namely the database direct reading, file import and Enterprise Service Bus (ESB) , as in [7].

Table 1. Data types within station

Data source	Data type
On-line monitoring	transformer equipment condition monitoring parameter， hydraulic oil temperature, oil chromatogram, partial discharge, grounding current, casing capacitor dielectric loss, OLTC condition, vibration spectrum, etc.; GIS equipment condition monitoring parameters, mainly including partial discharge, gas density and water content, gas leakage, gas composition, circuit breaker operating mechanism and the schedule, etc.
Charged detection	infrared temperature measurement, lightning arrester charged testing, ultrasonic/UHF partial discharge testing, SF6 micro water and decomposition product testing, etc.

Inspection robot	visible light image and infrared heat maps, infrared measuring temperature, ultraviolet spectrum, etc.

4. The function design of UHV DC converter station equipment condition data access and conversion device

The UHV DC converter station equipment condition data access and conversion device was an integrated hardware device integrating the function of related software. The input of the device was the data associated with device status, such as on-line monitoring, live testing, robot inspection and valve hall temperature measurement within the UHV station. Through a series of data processing, data become believable and could be displayed, while meeting the requirements of data storage and data analysis, as in [8].

The specific functions of the device included data extracting, data transformation, data loading, data output, etc. For internal information network in the business system data (such as online monitoring data, the inspection data, charged detection data, etc.), the system directly got data pushed by business system. For business system and data (such as weather information, lightning monitoring data, etc.) deployed in the external information network, it carried out data transmission under the aegis of the isolating device, as in [9] and [10]. Functional process framework is shown in Figure 3:

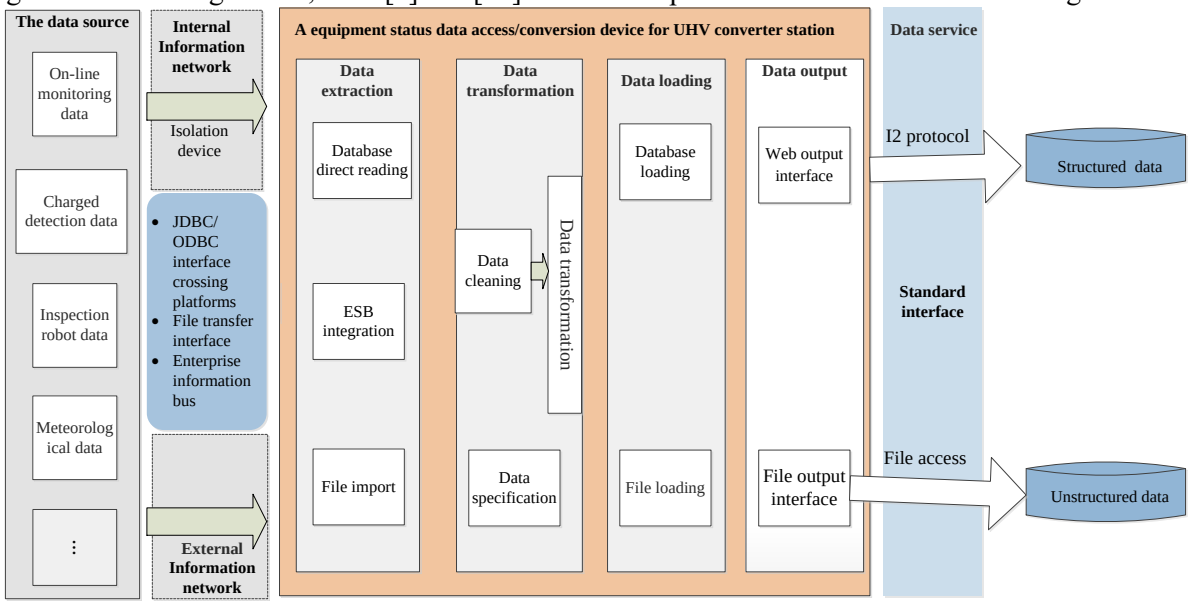

Figure 3. Functional flow diagram of data access and conversion device.

5. Conclusion

Because UHV equipment status information was scattered, and the existing system was difficult to meet the requirements of UHV operation support system in terms of timeliness and function, this paper carried out technical research on UHV transformer equipment state monitoring system architecture and equipment status management, control and early warning.

This paper established UHV transformer equipment warning center support platform based on multi-source heterogeneous data. Finally, this paper implemented the functions of equipment condition data access and processing, information interaction and control in the information island within UHV station, and achieved the functions of UHV substation equipment state centralized monitoring, condition evaluation and analysis and diagnosis, and forecasting and early warning to ensure the safe and stable operation of UHV.

The paper carried out in-depth research and beneficial exploration on the UHV equipment condition monitoring system architecture and UHV DC converter station equipment condition data access and conversion technology.

- The paper put forward a UHV DC converter station equipment monitoring system framework which met the timeliness requirements, and a UHV DC converter station equipment condition data access scheme based on multi-source heterogeneous data fusion.
- The paper carried out the data exchange technology research between the UHV DC converter station and the SGCC UHV equipment status warning center; proposed multi-source cross platform data access interfaces and data access methods; designed the UHV DC converter station equipment condition data access and conversion device function frame. And the device has been deployed in the Zhongzhou converter station pilot to implement related data cross platform interactive sharing. And it solved the problems which the existing system could not meet the requirements of UHV operation support in terms of timeliness and function.

Acknowledgement
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