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A New Method of Remote Control Checking for Substation Monitoring System Retrofit

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Abstract. In the process of monitoring system retrofit of 500kV Ouhai substation without power cut, because there is no design of remote control outlet plate on the measuring and control device, the remote control checking work cannot be completed by traditional method. After further study of the new and old monitoring system structure and the Siemens 8FW protocol, this paper presents a new method of remote control checking, and applies it in the field successfully, which improved the reliability and efficiency of the remote control checking work significantly. The retrofit scheme in this paper provides certain reference for the same type substation monitoring system retrofit in future.

1. Introduction

The substation monitoring system of 500kV Ouhai substation has operated at least a decade. As the device is off production, it can't be solved in time when these issues occur, such as hard disk failure, power failure, system halted, remote communication loss and etc. This might bring security risks to centralized monitoring.

Thus, in order to improve the operation level monitoring system, the substation have to retrofit station control layer equipment of the monitoring system. The retrofit focuses on monitoring devices of substation control level, excluding the measurement and control device(MACD) 6MB524 of bay level. There is a tricky problem that remote control checking of circuit breaker and disconnector can't be figured out by traditional method, due to the lack of remote control outlet plate on the MACD. It increases the difficulty and risk under non-power cut retrofit. This paper formulates a retrofit scheme of accomplishing remote control checking safely without electrical blackout, depending on the comparison and analysis of original system structure and method. And it makes positive effect.

2. Introduce of monitoring system retrofit in Ouhai substation

Original monitoring system of bay level in Ouhai substation uses the SIEMENS LSA system (MACD 6MB524, central control unit 6MB5515, and communication front-end DPU). The monitor system adopts BSJ2000 of NARI technology, and the RTU (Remote Terminal Unit) uses the SIEMENS communication front-end DPU also [1]. Two central control units and front-ends in every relaying protection room are alternate to each other. The whole system is a combination of domestic and imported devices which is shown in Figure 1.

This retrofit only involves the station control equipment, such as monitor host, engineering work station, operator station, RTU, switches, DPU and etc. [2] Primary equipments are still of operation during the retrofit, which means uninterrupted power supply. During the period of retrofit, we have to

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check the remote communication data, remote measurement data and remote control data, and make sure that uploading above data to the dispatching department of Huadong and Zhejiang continuously.

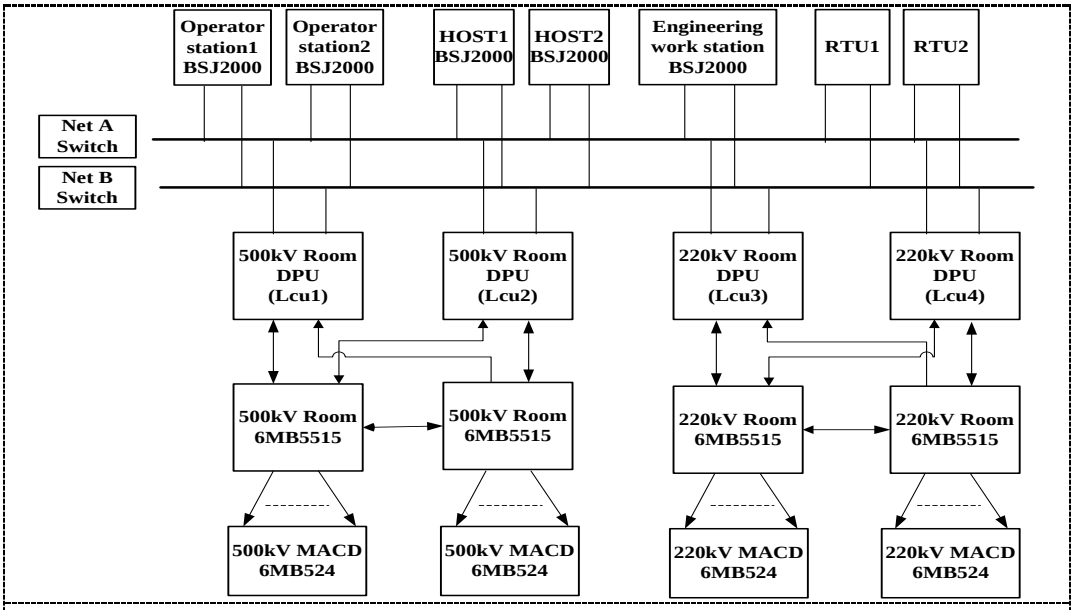

Figure 1. Figure of the overall system structural diagram before the system retrofit.

In this retrofit, the monitor system selects NS3000 system of NARI technology, and the RTU is changed into NSC332 equipment of NARI technology, and decommissioning four communication front-end DPU, and reserving MACD 6MB524 of bay level and central control unit 6MB5515. The eventual structure is shown in Figure 2, and the black dotted box part is the content of the retrofit.

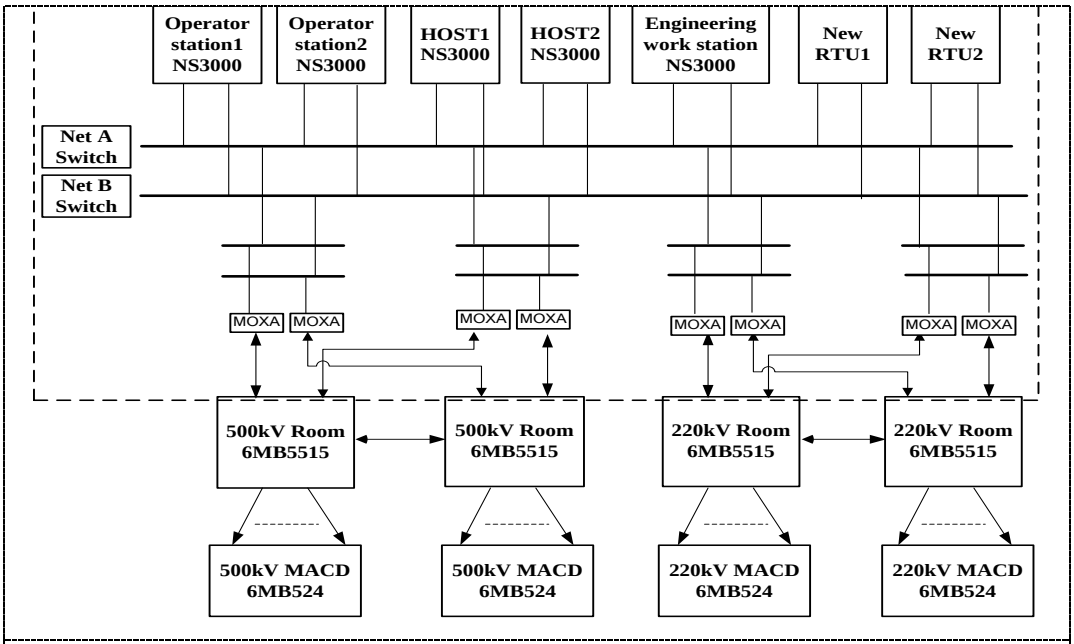

Figure 2. Figure of the eventual system structural diagram after the system retrofit.

3. Comparison and choice of remote control checking scheme in the monitoring system retrofit

To ensure the uninterrupted data exchange with dispatching department during the retrofit, the retrofit has to be step-by-step, with respect to the importance of 500kV substation and the special status in

Huadong grid. In the time of debugging equipment, keeping the old monitoring system running in initial operation mode first, then building the new system, and making it operating in parallel. After the debugging of new system completed, decommissioning the old system thoroughly.

The remote-control process of old system and new system can be simplified, shown in Figure 3, and remote control orders of both system transmit to central control unit 6MB5515 by SIEMENS 8-FW protocol [3].

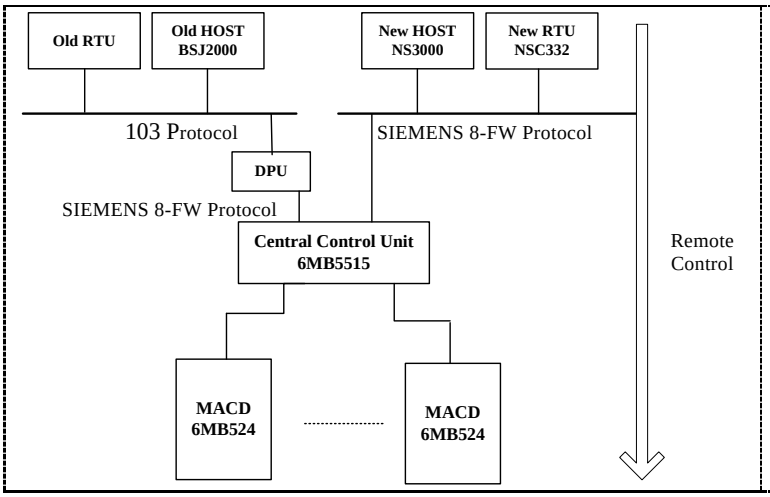

Figure 3. This is a figure of the remote-control process of old system and new system. Remote control orders of both system transmit to central control unit 6MB5515 by SIEMENS 8-FW protocol.

SIEMENS 8-FW protocol is divided into uplink packet and downlink packet. Uplink packet contains remote measurement, remote communication, SOE and pulse watthour message. Downlink packet consists of GPS, remote control and regulation message. GPS message is transmitted in schedule, and remote control and regulation message sends while primary equipments are operated [4].

The remote-control order (upshift and downshift) in downlink packet is shown in Figure 4.

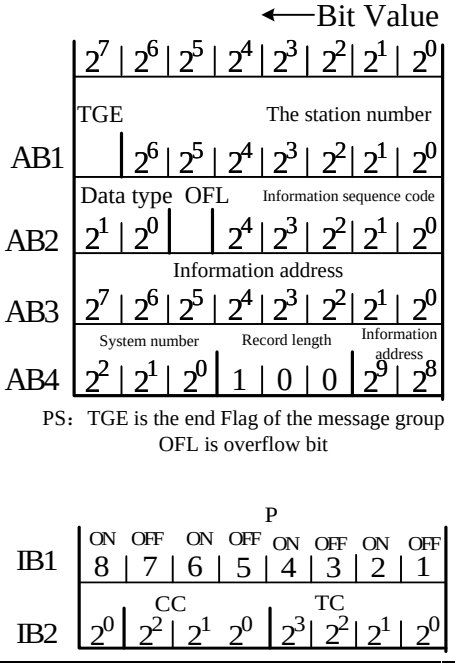

Figure 4. This is a figure of the remote-control order in downlink packet. AB1~AB4 is address byte, and IB1~IB2 is message byte. The uplink packet and downlink packet in 8-FW protocol don't interact mutually, and downlink packet can execute remote control order directly.

The devices subordinated to central control unit 6MB5515 doesn't have to checking remote control, as connection and configuration files between central control unit and each MACD haven't been changed. Although this substation is supervised by three level dispatching departments,

dispatching department of Zhejiang has the right of control. Hence, we can just be checking the correctness of remote control from both dispatching department of Zhejiang and monitor system to central control unit. There are three schemes to checking remote control.

Scheme one: Taking remote control outlet wires which used for trip and closing out of terminal array of every MACD cabinet without electrical blackout, that is to say, breaking the secondary circuit of remote control outlet. The advantage of this scheme is that splitting point is evident. However, it's at high risk for breaking and recovering wires of plenty of cabinets, and it's time consuming and laborious.

Scheme two: Disassembling connector plug AB (5-8) from backplane of MACD 6MB524 of all MACD cabinets, namely, breaking the outlet circuit of remote control plugboard of MACD. This scheme not only has an obvious splitting point, but also is easy to operate [5]. However, there are too many cabinets still is a problem. And it's also a bit time consuming and laborious.

Scheme three: Disconnecting serial port lines from both DPUs and MOXA servers to TXD of RS232 of central control unit 6MB5515. It cuts the transmission path of remote control off. This scheme merely has to break and recover TXD of RS232 of four central control units in two relaying protection room, which avoids the trouble of numerous MACD cabinets and busy workload.

Analysing the difficulty of retrofit and the risk assessment of safety measures, we decide to choose scheme three in the end.

4. Keypoint of the scheme of remote control checking

According to scheme three, disconnecting serial port lines from both DPUs and MOXA servers to TXD of RS232 of central control unit 6MB5515 for checking remote control, which cuts the transmission path of remote control off without electrical blackout.

4.1. Making communication interface device of serial port

Remove the downlink data line TX, and reserve the uplink data line RX and ground GND. The modified RS232 serial connection is shown in Figure 5.

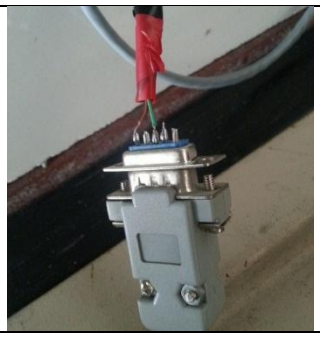

Figure 5. This is a figure of modified RS232 serial connection. Remove the downlink data line TX, and reserve the uplink data line RX and ground GND.

4.2. Installing software for supervising message

Installing SIEMENS diagnostics in bay level. Using the one-to-two connector for inserting retrofitted serial port respectively. The specific connection is shown in Figure 6.

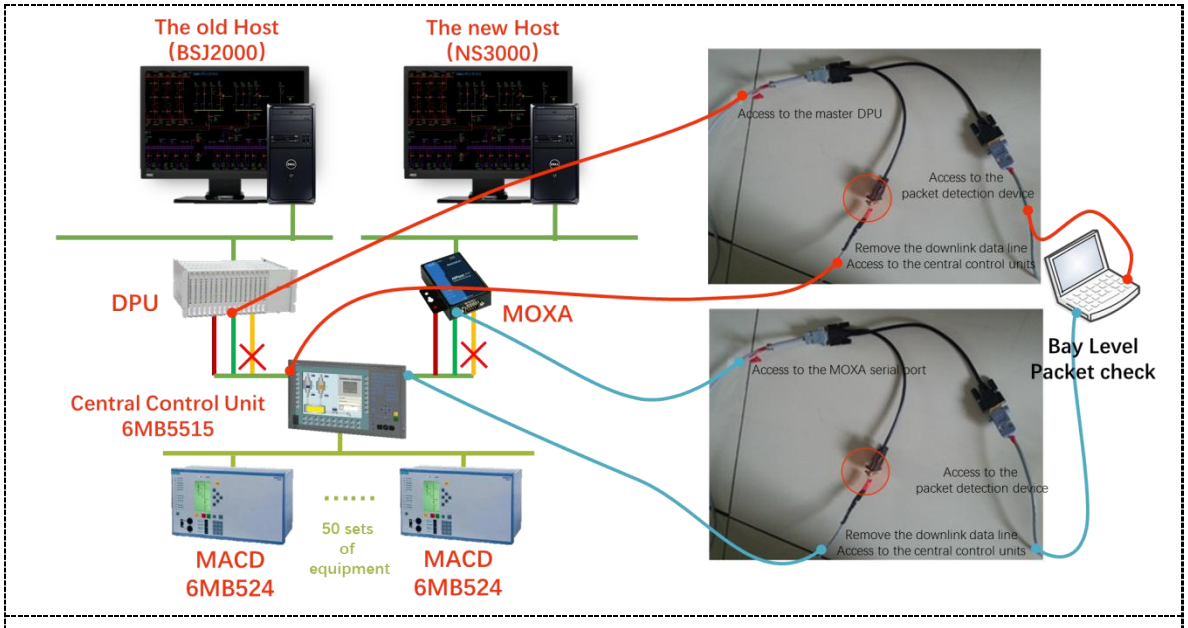

Figure 6. This is a figure of the actual specific connection mode.

SIEMENS diagnostics has the function of filtering message automatically, so it can display downlink message only, besides, it's able to distinguish remote control message of old and new monitor system evidently, which is convenient for checking.

4.3. Scheme test

We select a 35kV reactive power equipment which is cold standby and operable for remote control experiment, and disassembling its original serial port line. The remote communication and remote measurement of the bay are uplinked to old and new monitor system directly.

When remote control message received, the circuit breaker switches correctly in the remote-control experiment. And the circuit breaker doesn't switch when disconnecting the TXD line of remote control.

Comparing and analysing the remote-control messages of old and new monitor system by SIEMENS diagnostics. We can find all messages are 68 06 06 68 01 40 0C 00 02 00 4F 16. And the message is the same when remote control the 35kV reactive power equipment after disconnecting the TXD line. This experiment illustrates disconnecting the TXD line to central control unit can assure breaker and disconnector do not switch, and making no difference to downlink remote control messages.

4.4. Work flow

We must checking the remote control for monitor system and dispatching department of Zhejiang to ensure the correctness of retrofitting the remote control, as the configuration of monitor system and RTU has been reconfigured. The specific work flow is shown in Figure 7.

4.5. Effect of retrofit scheme

Finally, we succeed to apply the new method to the remote control of retrofit project of supervising system in Ouhai substation, and control the time of checking remote-control less than 5 days. It will take 10 days to achieve the same results, if adopting scheme one or scheme two. Therefore, scheme three could shorten the time of checking remote control significantly, and it's impossible to switch breaker and disconnector while safety measures are done after disconnecting the TXD line.

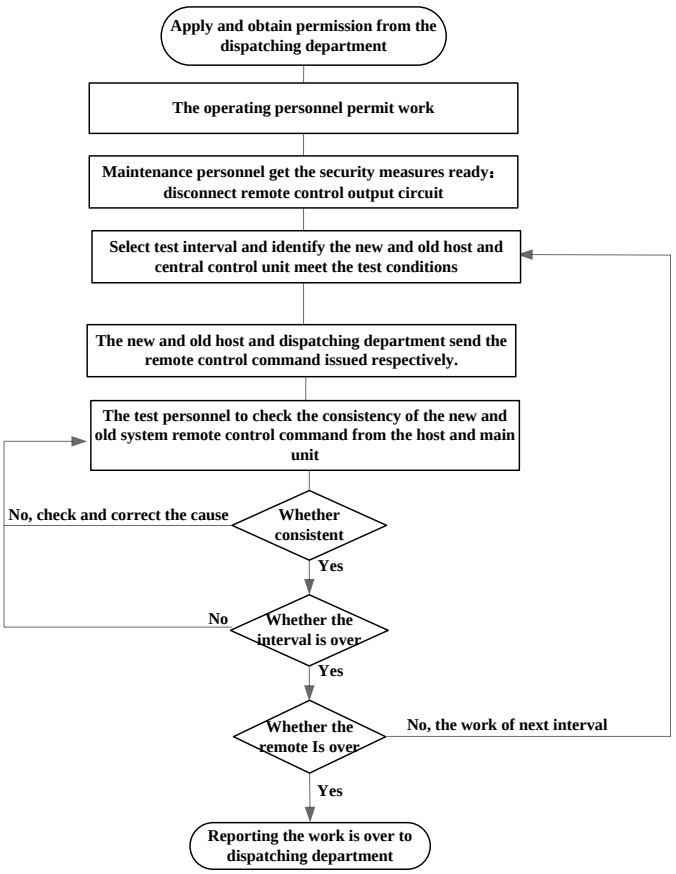

Figure 7. This is a figure of Flowchart of checking remote control by dispatching department.

5. Conclusion

With the automatic technology of substation developing, numerous substations begin the substation comprehensive automation transformation for promoting stability of substation operation. However, the process of retrofit demands electrical blackout, which reduces the reliability of power supply. The non-power cut remote control checking method used in 500kV Ouhai substation retrofit is also applicable to similar remote control checking project in which substation is lack of remote control outlet plate on the MACD, and this method will bring a certain reference value to the similar substation automation retrofit.

6. References

[1] Chuck Newton. Developments in Substation Integration and Automation. Transmission World. 2002
[2] Newton C. Communications infrastructure and substation automation communications planning issues. Power Engineering. 2011
[3] Sousa,O,Vale, Z.A,Ramos, C,Neves. An intelligent distributed architecture for power distribution automation. International Conference on Electric Utility Deregulation and Restructuring and Power Technologies. 2010
[4] Keiichi Kaneda, Setsuo Tamura. IEC61850 based Substation Automation System. Power System Technology and IEEE Power India Conference. 2008
[5] Shephard B, Janssen MC, Schubert M. Standardised communications in substations. Developments in Power System Protection, 2001, Seventh International Conference on (IEE). 2001