RESEARCH ON AUTOMATIC BACKUP POWER BASED ON DUT

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ABSTRACT

Combined the characteristics of the regional power grid, the paper analyzed the failure process of DTU (Distribution Terminal Unit) with 10kV different connection mode. By the data acquisition, logic and fault location of DTU, it can achieve load control and status monitor to ensure reasonable load. For the DTU can resume its normal operation mode after the fault cleared, it is advantage to realize the automation of low voltage distribution network and rapid self-healing.

INTRODUCTION

With the application of modern computer and communication technology, the operation of medium voltage distribution network automation (Distribution Automation) can improve the power quality and power management efficiency. International power companies in some developed countries have a large area of distribution automation applications, in China, electricity supply in many cities the company's distribution automation system has reached a high level. With the continuous social and economic level of development, user's increasingly high demand on the quality of power supply, the implementation of distribution automation is an inevitable choice for the electricity sector.

As the weak power grid in most area and the wiring of the substations is complex, most of them are still using a single power supply. To ensure the reliability of power supply, standby power of the automatic cut and isolate faults quickly and accurately is very important.

Currently, telecommunication and automation technology, constantly updated to promote the rapid development of smart grid and advanced communication technology can quickly and accurately in real data acquisition and transmission.

Traditional SCADA or remote system remote terminal (RTU) is just a completion of "From the data, give orders," the task of on-site installation. But distribution automation terminals (referred to as distribution terminals) can not only implement the "four remote "(telemetry, remote communicate, remote control, remote adjustment) tasks, but also to detect faults and achieve some local control functions, such as to control the re-closing of the disconnect switches or the backup power source and so on.

In this paper, combined the characteristics of the regional power grid, it analyzed the failure process of DTU (Distribution Terminal Unit) with 10kV different connection mode. By the data acquisition, logic and fault location of DTU, it can achieve load control and status monitor to ensure reasonable load. For the DTU can resume its normal operation mode after the fault cleared, it is advantage to realize the automation of low voltage distribution network and rapid self-healing.

CONNECTION MODE OF THE REGIONAL AREA

Since the wiring of the substation is simple, it has been widely used. The common substation wiring is generally divided into single bus and sub-single-bus. Show in Figure 1.

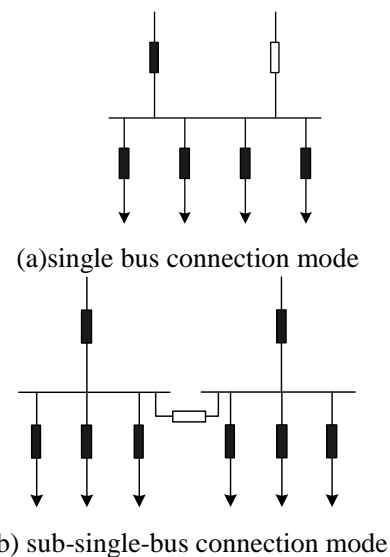(a)single bus connection mode

(b) sub-single-bus connection mode
Fig.1 the wiring of the substation

Figure 1(a) is single bus, it has two sources but one bus, when one source fails, and the other will put into operation. This kind of connection mode is highly reliable, but the supply range is very small, it is inefficient and costly.

Figure 1(b) is sub-single-bus. In fact, it has two buses, but there is a switch to connection them. So they can be the backup source to each other. Usually the section switch is open, when one source has fault, the source line switch should be off and close the section switch. But it usually over load easily and decrease its reliability. For its flexibility, it is widely used in the medium voltage distribution network.

PRINCIPLE OF DUT

DTU is the wireless terminal equipment to change the serial data into IP data or change the IP data into the series data. Its main function is to transfer the data of the remote devices to the 后台. By establishing the wireless communication link, DTU can acquire the data, self-diagnose, record time, communicate and so on.

DTU communicate by the way of serial communication converter bus network, each DTU installed serial communication converter box, which provide RS232, 485 interface to connect DTU. It leads to the RS232 serial port or optical channel connection, then it can pass the information to the fiber self-healing ring network.
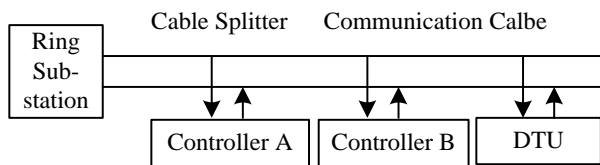
Fig.2 Communication diagram

In normal circumstances, the substation terminal unit DTU is responsible for the data acquisition and control. By the real-time analysis of sampling current and voltage, it can determine the type of the fault (whether it is the transient faults or the permanent faults) and report the fault information.

Switching, utilities and end users to monitor the distribution are generally known as the Station Control Terminal DTU. DTU composition and traditional remote RTU similar, but functionally very different from conventional RTU, the main increase in fault detection can be edited with the local logic control (PLC) function. PLC does not depend on the main station for the bus or line fault on the automatic isolation. In some station, to avoid the additional installation of protective devices, simplified secondary circuit configuration, DTU should have protection in the bus or circuit breaker with short circuit failure, can quickly detect the fault element and give the order to the corresponding circuit breaker to trip. DUT based on PLC help the station detect the fault accurately, isolate it and connect the backup power. It is one of the advantages of the smart grid that the ability of the station to heal itself.

CONTROL OF THE BACKUP SOURCE BASED ON DTU

Figure 3, the power supply S1 and S2 is the backup source to each other. When there is a fault at k1 in the substation, DTU obtain the information and automatically detect the DL1 has lost the voltage for a while, it recognizes as a fault on the power line, so DL1 will be jumped and closed the section switch FD.
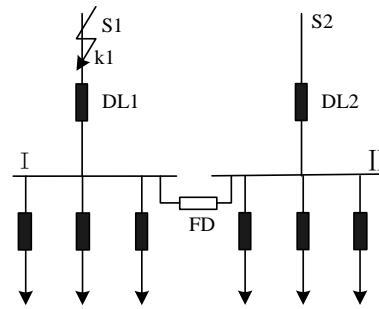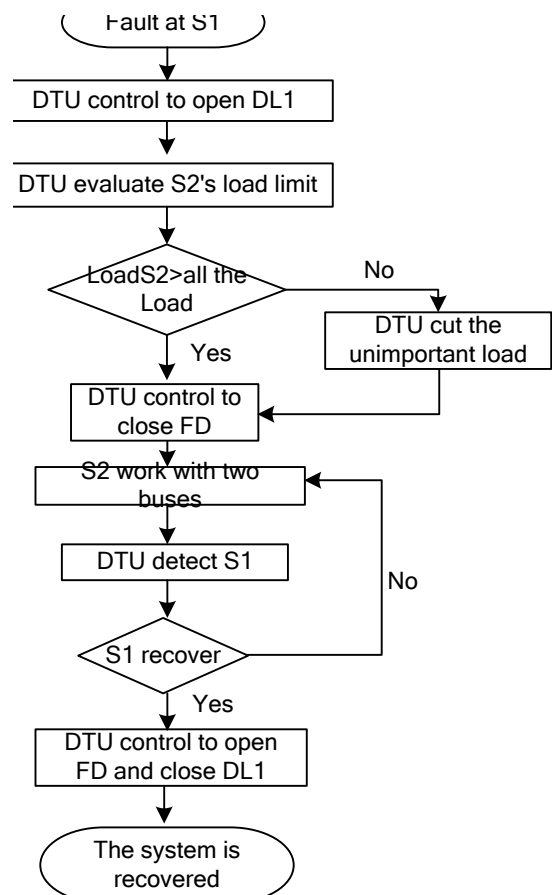
Fig.3 The fault at k1

Fig.4 Control of the Backup Source based on DTU

Power line S1 and S2 all have load limit, when the system is working normal, according to the requirements of the plan, the power line can work with all the load. As DTU detects the voltage of S1 low, S2 is put into use as the backup source, at that time, S2 may be overload and it will damage the power line S2. So before closing the section switch FD, DTU should evaluate the load ability of the power so that DTU can cut part of unimportant load to ensure the VIP users to work continuously.

The program to control load of DTU:
①Evaluate the load ability of the source line;
②Select the VIP users;
③Calculate the rate of the overload of the source line;

④Choose the optimum case to cut the load

As the fault is cleared, in the traditional substation, the section line is operated by workers on site, but DTU can decrease this kind of labor cost and the risk of working. It recovers by detecting the voltage and operates the switch by itself.

The program to detect the status and recover by itself:

①Detect the PT of power line, whether the voltage is recovered normally;

②Open the section switch, and close the power line switch;

③According to the load-cutting record, DTU close the load line switch, and transfer the operation to the station.
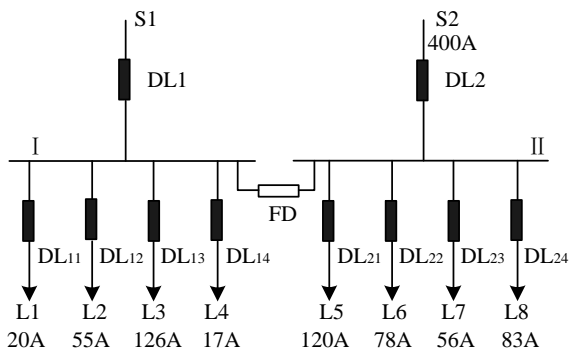
EXAMPLE

Fig 5 sub-single-bus connection mode

This kind of connection mode has two source lines. In normal, DL1 and DL2 closed, section switch opened. That means the power line S1 worked with bus Ⅰ, but the power line S1 worked with bus Ⅱ. S1 and S2 are the backup source to each other.

When there is a fault at S1, DTU control to open the DL1 and isolate the fault. The loads on bus Ⅰ are all out of work, and the other loads are working normally.

Detecting the load limit of S2, it can carry 400A, but now the total load is 555A, the rate of the load is 138.75%. So, the section switch is locked shortly and part of load should be cut. For L1 and L2 are VIP users and we must ensure most of the users can work continuously, L6 (78A) and L5 (120A) should be cut. At that time, the rate of the load is 98.5%, and now DTU can control to close FD.

Table.1 the load of the line

Line	Load（A）	Remarks
L1	20	VIP
L2	55	
L3	126	
L4	17	
L5	120	VIP
L6	78	
L7	56	
L8	83	
The total load	555	

After the operation of the section switch, DTU still detect the power line S1's PT. When the fault is cleared, PT shows the voltage and show the power line can work now. After getting the order, DTU open FD and close DL1, the substation finally recovered.

CONCLUSION

DTU can acquire and transfer the data, and it can also protect the relay, especially in the application of the backup source. Evaluate the ability to carry the load of the source line, it can ensure the line work normally; it will raise the reliability and ensure the users can work continuously.

After the backup source worked, DTU still acquire the data of the line so that when the fault is cleared, DTU can control the system to recover itself.

DTU is efficient to isolate the fault in 10kV substation, ensure the users to work continuously, It is economic and reliable, and is advantage to raise the ability to heal itself. It is important to promote the development of the smart grid.