Data Acquisition and Analysis of Distribution Automation System

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Abstract. With the continuous development of information technology, the construction of data communication system in distribution automation begins to be put on the agenda. In the process of building distribution automation data communication system, the power enterprises should stick to the main principles of suitability, efficiency, maintainability and expansion, designing a variety of communication system construction programs, and effectively improving the operation efficiency of distribution network communication system.

Introduction

In order to reduce the running cost of distribution system and improve the stability and reliability of power supply, the power enterprises begin to study how to implement the distribution automation data communication system. Power Enterprises should pay more attention to the construction of distribution automation data communication system, and effectively realize the automation, modernization and high efficiency, thus providing the users with stable and reliable power supply, gradually enlarging the user scope and improving the economic benefit of the electric power enterprise.

Communication Network system architecture of distribution automation system

1 10KV and above substation communication within the power grid has been fully covered with optical fiber, the typical "hand-held" two-point protection access structure as shown in Figure 1, OLTL and OLT2 are installed in different substation, ONU installed in the switch station, Each ONU is connected to the OLTL and OLT2 located in two substations through different optical paths, and the single optical path interruption or the failure of the individual OLT device can be protected by ONU choosing to access different OLT.

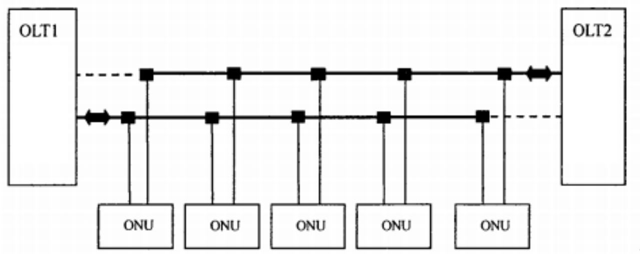

Figure 1 EPON "hand-holding" two-point access structure

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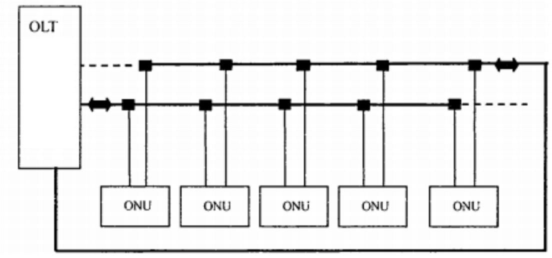

Figure 2 EPON "hand-holding" single point protection access structure

When the distribution of the grid is not satisfied with the "hand-holding" two point access to different substation, it should be at the switch station link at both ends of two different optical path, realizing "hand in hands" single point of protection access to the same substation, so a separate optical path interruption can be effectively protected. EPON "Hand-holding" single point protection access structure as shown in Figure 2.

Processing and realization of data acquisition in distribution automation system

(1) Control integration system data acquisition. The control integration system transmits the data file to the front machine through the CIM model, and the front computer parsing data file writes the real-time value to the database. (2) Data acquisition of voltage monitoring system. The interface of voltage detection system is implemented by Web technology, and data files are transmitted in the form of e language. The main data types are collected as shown in table 1.

Table 1 TAS system data model and real-time database point coding Rules

Classification	Data item	Minimum acquisition frequency	Real-time data naming rules
Real-time data	Voltage data value	5 minutes.	Termid (terminal ID) +lineno (road ID)

(3) Data acquisition system of user's electricity information collection. The user uses the Web or intermediate library in the form of information acquisition.

Table 2 demand data items and frequency of intelligent distribution area

Number	Data item	Data Minimum interval requirements
1	Real-time three-phase voltage and current	15min
2	Real-time three-phase total and phase active power	15min
3	Real-time three-phase total and phase reactive power	15min
4	Real-time power factor	15min
5	Positive and reverse total active energy indication (total, each rate)	15min
6	Positive and reverse total active energy indication (total, each rate)	Freezing of the whole point and freezing of the day
7	Power Freeze Time	The whole point, the day
8	Event logging	Immediate active escalation

Table 3 Data items and frequency of users ' demand for electricity information

Number	Data item	Data Minimum interval requirements
1	Real-time phase-splitting voltage, current, 0-wire current	15min
2	Real-time three-phase total and phase active power	15min
3	Real-time three-phase total and phase active power	15min
4	Real-time power factor	15min
5	Positive and reverse total active energy indication (total, each rate)	1h
6	Positive and reverse total active energy indication (total, each rate)	Freezing of the whole point and freezing of the day
7	Power Freeze Time	The whole point, the day
8	Event logging	Immediate active escalation

(4) Data acquisition of electric energy acquisition system. The data of electric energy is collected from the database, and the interface adopts the way of API, OPC Server and ODBC. Data acquisition of battery on-line monitoring system. The lower layer equipment of battery monitoring system provides the OPC way, and the data is interacted with the battery monitoring system in the way of OPC, and the upper layer of the battery monitoring system is used to obtain the data from the integrated information platform in the way of API. The main data types are collected as shown in table 4.

Table 4 The data model of the battery monitoring system and the coding rules of real-time database

Classification	Data item	Minimum acquisition frequency	Real-time data naming rules
Real-time data	Group End Voltage	6h	Battery number + measurement serial number
	Average voltage	6h	Battery number + measurement serial number
	Current	6h	Battery number + measurement serial number
	Capacity	6h	Battery number + measurement serial number
	Temperature 1	6h	Battery number + measurement serial number
	Temperature 2	6h	Battery number + measurement serial number
	Temperature 2	6h	Battery number + measurement serial number
	Monomer voltage L	6h	Battery number + measurement serial number
	Monomer internal Resistance 1	6h	Battery number + measurement serial number

Software realization of data acquisition pre-placement machine

(1) Front message flow. Used to overload the input-output stream. Enables it to support input and output front-end objects, including front-end information structures, field station information, channel groups, channels, ports, nodes, and the corresponding status information for the predecessor object. The interface function sends an interface as follows:

class FES-SEND_STREAM ：public sEND-sTREAM
{
public：
FES_SEND_STREAM＆operator <<(const struct FES_HOST_INFO_STRUCT const plnfo);
FES_SEND_STREAM＆operator << (const struct FES_FAC_INFO_STRUCT const plnfo);
FES_SEND_STREAM＆operator << (const struct FES_CHLGROUP _INFO_STRUCT const plnfo);
FES_SEND_STREAM＆operator << (const struct FES_CHANNEL_INFO_STRUCT const plnfo);
FES_SEND_STREAM＆operator << (const struct FES_PORT_INFO_STRUCT const plnfo);
FES_SEND_STREAM＆operator << (const struct FES_NODE_INFO_STRUCT const plnfo);
FES_SEND_STREAM＆operator <<(const struct FES_HOST_INFO_STRUCT const plnfo);
FES_SEND_STREAM＆operator << (const struct FES_FAC_INFO_STRUCT const plnfo);
FES_SEND_STREAM＆operator << (const struct FES_CHLGROUP _INFO_STRUCT const plnfo);
FES_SEND_STREAM＆operator << (const struct FES_CHANNEL_INFO_STRUCT const plnfo);
FES_SEND_STREAM＆operator << (const struct FES_PORT_INFO_STRUCT const plnfo);
FES_SEND_STREAM＆operator << (const struct FES_NODE_INFO_STRUCT const plnfo);

The receiving interface is as follows:

class FES-RECV_STREAM ：public RECV-sTREAM
{
public：
FES_RECV_STREAM＆operator <<(const struct FES_HOST_INFO_STRUCT const plnfo);
FES_RECV_STREAM＆operator << (const struct FES_FAC_INFO_STRUCT const plnfo);
FES_RECV_STREAM＆operator << (const struct FES_CHLGROUP _INFO_STRUCT const plnfo);
FES_RECV_STREAM＆operator << (const struct FES_CHANNEL_INFO_STRUCT const plnfo);
FES_RECV_STREAM＆operator << (const struct FES_PORT_INFO_STRUCT const plnfo);
FES_RECV_STREAM＆operator << (const struct FES_NODE_INFO_STRUCT const plnfo);
FES_RECV_STREAM＆operator <<(const struct FES_HOST_INFO_STRUCT const plnfo);
FES_RECV_STREAM＆operator << (const struct FES_FAC_INFO_STRUCT const plnfo);
FES_RECV_STREAM＆operator << (const struct FES_CHLGROUP _INFO_STRUCT const plnfo);
FES_RECV_STREAM＆operator << (const struct FES_CHANNEL_INFO_STRUCT const plnfo);
FES_RECV_STREAM＆operator << (const struct FES_PORT_INFO_STRUCT const plnfo);
FES_RECV_STREAM＆operator << (const struct FES_NODE_INFO_STRUCT const plnfo);

(2) Front information interface. A front-end parameter information base that provides an interface to the front-end shared memory. Provides access to the on-duty port information, sets/Gets the predecessor object status flag, sets/Gets the predecessor information status. Set up, get the front object state, information and other interfaces. The function interface is as follows:

int GetNodeActivcPon(const int＆NodeNo，int & PonNo)；

int ResetSatusModFlag(OBJ_TYPE ObjType，const int&nNo，unsigned char Flag=MOD_FLAG_UN_MOD)；

int Reset ObjModFlag(OBJ_TYPE ObjType， const int&nNo， unsigned char Flag=MOD_FLAG_UN_MOD)；

int Get ObjModFlag OBJ_TYPE ObjType，const int＆nNo，unsigned char&Flag)

int Get ObjModFlag OBJ_TYPE ObjType，const int＆nNo，unsigned char&Flag)

int GetLocalFesInfo (FES_HOST_INFO_STRUCT*pFesinfo)；

int GetLocalFesIndex x( )；

int SetLocalFesIndex(const int&Index)；

Operational evaluation of data acquisition in distribution automation system

The fuzzy analytic hierarchy process is used to evaluate the operation State of distribution automation.

(1) To establish a hierarchical structure model. Firstly, the model of power distribution automation operation evaluation system should be constructed.

(2) To construct the priority relation matrix. When the hierarchy model is established, the fuzzy complementary judgement R =(rij)n×n as the priority relation matrix. And the matrix has the following properties: rii=0.5, (i=1, 2, ..., n), rij+rji=1, (i, J, ..., N). can adopt different scaling methods, such as (0, 0.5, 1) scale method and 0.1 ~ 0.9 scale method. (0, 0.5, 1) Scale method calculation is relatively simple. For 0.1 ~ 0.9 Scaling method, if rii=0.5 The factor is as important as itself; if rij∈[0.1, 0.5), the factor rj is more important than ri; if rij∈ (0.5, 0.9), then the factor ri ratio factor rj is important.

(3) To reconstruct the fuzzy uniform matrix. After the establishment of the priority relation matrix, it needs to be transformed into a fuzzy consistent matrix, and the implementation method is as follows: firstly, the fuzzy complementary judgement R =(rij)n×n is summed up by line and recorded as

$$r_i = \sum_{k=1}^{n} r_k , i = 1,2,3...n$$

and the following mathematical transformation, rij=(ri — rj)/2n+0.5, the transformed matrix is a fuzzy uniform matrix.

(4) Build membership function. Among them, μ1, μ2, μ3 respectively represent good, medium and poor index range. The model is as follows:

$$\mu_1(x) = \begin{cases} 1 & x < \alpha 1 \\ (x-\alpha_2)/(\alpha_1-\alpha_2) & \alpha 1 \le x < \alpha 2 \\ 0 & x \ge \alpha 2 \end{cases} \qquad \mu_2(x) = \begin{cases} 0 & x < \alpha_1 \\ (x-\alpha_1)/(\alpha_2-\alpha_1) & \alpha_1 < x \le \alpha_2 \\ (x-\alpha_3)/(\alpha_2-\alpha_3) & \alpha_2 < x \le \alpha_3 \end{cases}$$

$$\mu_3(x) = \begin{cases} 1 & x \le \alpha_1 \\ (x-\alpha_2)/(\alpha_3-\alpha_1) & \alpha_2 \le x < \alpha_3 \\ 1 & x > \alpha_3 \end{cases}$$

Final Score：

$$Fk, j(x) = \frac{\mu_1(x)F_1 + \mu_2(x)F_2 + \mu_3(x)F_1}{\sum_{i=1}^{3} \mu_1(x)}$$

(5) Comprehensive evaluation. In order to show the overall operation of power distribution automation, it is necessary to evaluate the target layer in the evaluation system. Realize the overall operation of distribution automation system evaluation. That is:

$$S = \sum_{j=1}^{n} S_j W_j$$

Conclusion

In order to realize the construction of distribution network automation effectively, it is necessary to carry out the construction of distribution network data communication system. Adhere to the corresponding design principles, local conditions to choose the appropriate construction plan, so as to gradually implement the distribution automation data communication system construction, effectively improve distribution network operation efficiency, to provide more high-quality reliable power supply.

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