

GIS database for Electric Power Network Planning

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Abstract In this paper, the method of designing GIS database for electric power network planning was studied and applied in “T” area.

We divided the power system by using object oriented method in accordance with the needs of the structure of GIS spatial data, designed the spatial database and the attribute database by rational combination of hierarchical, relational and network data structure, and realized the linkage of spatial and attribute database by linking method of spatial and attribute data.

Key words power network, GIS, distribution network, transmission network

Introduction

The great leader Comrade **Kim Il Sung** said as follows.

“We must develop science and technology quickly in many fields in step with world trends in modern science and in keeping with the present requirements of socialist construction in our country.”(“**KIM IL SUNG WORKS**” Vol. 41 P. 34)

Electric power network planning is an important part of general plan for land development and use. Until now, many researches for power network, especially the design and the management of a distribution network were introduced [1—10]. Now with development of GIS technique, the design of GIS database and its application is an important problem.

Here, the problem for designing of GIS database in electric power network was researched.

1. Division for Database-Oriented Object

Division for database-oriented object is one of the important contents to design the structure of database with division of data.

In database for the power network location planning, the main object of GIS database-oriented is power system. For this end, it must progress division of database-oriented object by using object division method by object oriented technique. The object oriented technique distinguishes the detail object and the notional conception reflecting in actual space, express mutual relation between objects by using conception of information. The electric power network is divided into the power transmission system and the power distribution system, the transmission system is divided into electric power station and power transmission line, the power distribution is divided into power transformer substation, load and power distribution line.

So according to division principle of GIS spatial object, it divides the electric power system into group of electric power station, transformer substation, load, facility and line, sets up the design

structure of each group, and then analyzes relation between them.

The object of electric power location planning consists of the center of transmission and distribution such as electric power stations and power transformer substations, a power transmission lines, linking the transformer substations and the load objects and other facilities.

There are some loads, some distribution lines and some transformer substations in one sub-power distribution network. The power distribution networks with different structures each other include attributes and states that are different each other, that is, the numbers of different load points, the numbers of sub-lines and the numbers of transformer substations.

2. Data Model of GIS Database for Electric Power Network Location Planning

As previous consideration, the power transmission network and the power distribution network are similar each other in the data model.

On the other hand, the power transmission network is comparatively simpler than the power distribution network. So in this paper, a data model of power distribution network was considered for example.

The power distribution network is directly linked with consumers, its information consists of the attributive information linking the power distribution network facilities and the consumers and the spatial information related to geographical position.

These information are related each other and form a hierarchy characteristics. For example, primary information, historical information and load information and etc are the series of information about one object of power distribution network.

In power distribution network, the combination of information is information space to be composed with attribute of each layer.

Through concretization of the power distribution network space, it can express the power distribution network information by the plan form and make the plan layer space of power distribution network.

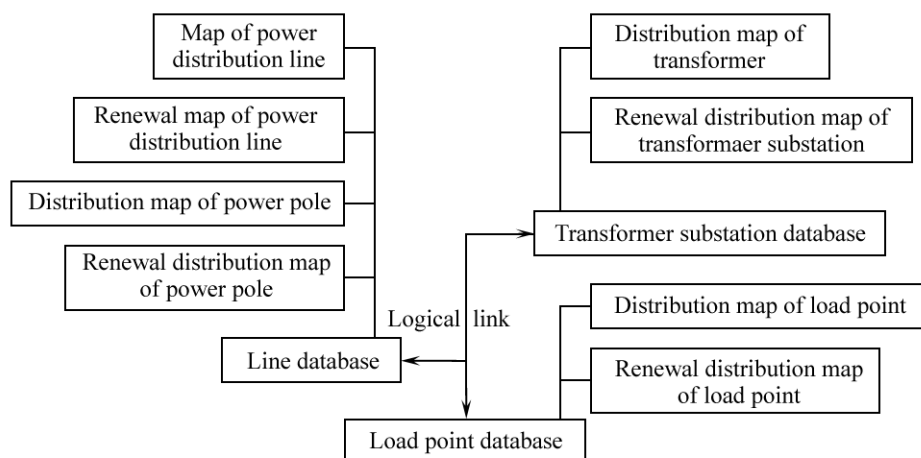


Fig. 1. Data model of power distribution network plan database

As you can see in Fig. 1, each element form one spatial data layer makes various spatial overlays on the plan co-ordinate system and can be linked with given attributive data each other by using the topological relation and the spatial data of GIS.

Spatial data of power distribution network apply a vector model and attributive data apply a relation model (Fig. 2).

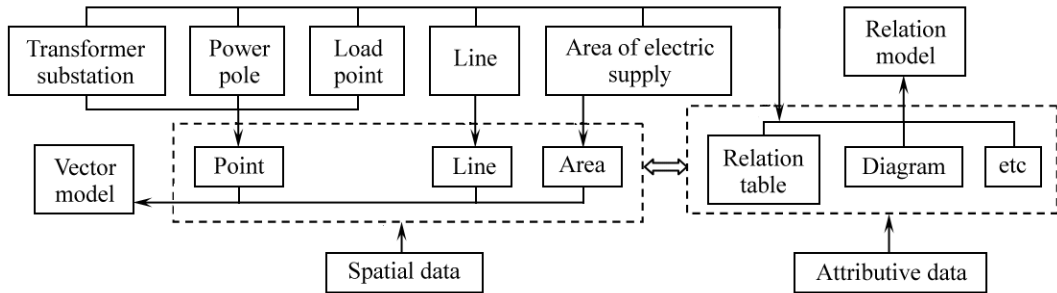


Fig. 2. GIS data model for power distribution network planning

3. Structure of GIS Database for Power Distribution Network Planning

The design of GIS database includes two sides, spatial database and attributive database. In design of spatial database, the important one is division of spatial elements.

Actually, a sheet of map consists of result that given spatial elements were overlaid in database. So in the design of spatial database, the spatial information layer is determined by the spatial elements consisting of electric power network.

- ① Background layer: administrative area, road, river, building, traffic facility and etc.
- ② Power station distribution layer: power stations in given area
- ③ Power transmission line distribution layer: power transmission lines passing through given area
- ④ Power transmission tower distribution layer: power transmission towers of various grade in given area
- ⑤ Power distribution substation layer: power distribution substations in given area
- ⑥ Power distribution line layer: power distribution lines in given area
- ⑦ Power pole distribution layer: various power poles in give area
- ⑧ Main facility distribution layer: distribution layers of disconnect, transformer and substation of making and breaking
- ⑨ Load distribution layer: power consumers, institution consuming power
- ⑩ Layer of note and symbol: name, expression and map symbol etc of given object

The design of theme attributive database and spatial database are closely related.

Generally, one figure only corresponds to oppose to one theme attributive database. In theme attributive database, data is expressed by form of 2-dimension relation table.

In GIS database for power network location planning, theme attributive data are recorded in different tables according to type of spatial objects.

Here express data type of theme attributive database is expressed through the structure and the contents of attributive table of power distribution line (table 1).

Table 1. Attributive of the power distribution line

No.	Field name	Data type	Length/B	Content
1	LNCD	CHAR	10	Line code
2	LNNM	CHAR	20	Line name
3	LNLNG	CHAR	8	Line length
4	LNKD	CHAR	16	Line kind
5	CHCD	CHAR	10	Power transformer Substation code
6	CHNM	CHAR	20	Power transformer Substation name
7	VTRG	CHAR	3	Voltage grade
8	PLNMB	NUMBER	4	Numbers of power pole
9	SPLNB	CHAR	10	Number of beginning power pole
10	EPLNB	CHAR	10	Number of ending power pole
11	LNARG	CHAR	8	Line arrangement
12	STDT	DATE	8	Laying date

As you can see in table 1, it can link the power distribution line and the attributive table of the power transformer substation with 'power transformer substation code' and analyze the relationship by recording the topological relation between the line and the power pole by number of power pole beginning and ending.

There are two methods, the method combining the spatial data and attributive data and the method separating them in the design of GIS database. Which method can be used depends on type and content of attributive data of spatial objects.

In this paper, from characteristics of theme attributive data of spatial objects composing the electric power network, it uses the method that spatial data and theme attributive data are separated and saved.

By the way, data process in GIS must be progressed with spatial data and theme attributive data comprehensively. So the linkage of spatial data and theme attributive data are very important problem.

Generally, the linkage of spatial data and theme attributive data are made by 4 methods, that is, method that attributive data is a part of spatial data, method that attributive data link to spatial data only one direction, method using classical DBMS (Data Base Management System) application program and method that figure data and attributive data is linked with pair direction. In the method of pair direction opposition between figure data and attributive data, the figure data is managed by using the database offered by GIS software and attributive data is managed by using the private database management system, it determines the linkage relation between figure and attribute and realizes the unique manufacture of them.

Such linkage method doesn't depend on organizing method of data and saving position, and it keeps independence of data. If we use this method, it can realize either from figure to attribute or from attribute to figure. So the data linkage in database for electric power network planning use the pair direction opposition method between figure data and attributive data.

The examples of theme attributive database of load points in “ㄱ” area are same as table 2.

Table 2. Theme attributive database of load points in “ㄱ” area

No.	Node_code	Load name	Front point	Back point	Voltage /V	Lind kind	Distance /m	Pole number	Circuit numbers
1	D010000	Substation	C0101	D010001, D010029, D010062	3300	A-35	0.8	D10	3
2	D010003	A	D010001	0	3300	A-35	0.8	4	1
3	D010006	B	D010005	D010007	3300	A-35	0.8	7	1
4	D010008	C	D010007	0	3300	A-35	0.8	9	1
5	D010012	D	D010910	0	3300	A-35	0.8	13	1
6	D010014	E	D010013	D010015, D010016	3300	A-35	0.8	15	1
7	D010015	F	D010014	D010506	3300	A-35	0.8	0	1

As shown in table 2, in electric power network planning of “ㄱ” area, the spatial and attributive data are linked through field “Node code”.

Conclusion

The database for electric power network location planning is composed with fundamental database, standard database, and outcome database and standardization term dictionary for planning.

The database researched in this paper corresponds to the database of electric power network system in the planning fundamental database. Based on the planning fundamental database, it can design and construct historical database and real time renew database.

References

- [1] 김일성종합대학학보(자연과학), 47, 7, 100, 주체90(2001).
- [2] Zhou Quan et al.; Proceeding of the 2nd ICMEP-ACEID, 10, 423, 2003.
- [3] 陈拥军; 电力建设, 26, 10, 48, 2005.
- [4] 杨琴 等; 电力建设, 26, 9, 68, 2005.
- [5] 周正贵; 武汉水利电力大学(宜昌)学报, 22, 1, 50, 3, 2003.
- [6] 贺星棋 等; 电力系统及其自动化学报, 17, 6, 87, 2005.
- [7] 范忠 等; 江苏电机工程, 24, 2, 37, 3, 2005.
- [8] 石敏 等; 山西大学学报(自然科学版), 25, 4, 315, 2002.
- [9] 尚海燕 等; 电力学报, 13, 4, 274, 1998.
- [10] 汤红卫 等; 中国农业大学学报, 6, 2, 68, 2001.