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동북아 연계선로 구성 및 지역별 예비력 증가 효과

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Northeast Asia Interconnection and Regional Reserve Increase Effects

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Abstract - This paper presents the effects and the regional power distribution of an increase or a decrease of a power reserve by load flow calculations under seasonal load patterns of each country for the future power shortages faced by the metropolitan areas or by the southeastern area of the South Korea in North-East Asia. In these connections, the types of a power transmission for interconnection consist of the 765kV HVAC and the HVDC. In this paper, the various cases of the power system interconnections in Far-East Asia are presented, and the resulting interconnected power systems are simulated by means of a power flow analysis performed with the PSS/E 28 version tool. The power flow map is drawn from data simulated and the comparative study is done. In this future, a power flow analysis will be considered to reflect the effects of seasonal power exchanges. And the plan of assumed scenarios will be considered with maximum or minimum power exchanges during summer or winter in North-East Asia countries.

Index Terms-Northeast Asia, Interconnection, Seasonal Power Pattern, Power Flow Map, Power Reserve, HVDC, HVAC 765kV, PSS/E.

1. Introduction

Economic and technical considerations are usually the underlying factors for interconnecting electric power systems. Among some of the benefits that may be realized are plant capacity savings, interchange due to diversity, emergency power interchange, spinning reserve savings. However, the planning of interconnection is a demanding task and needs to meet a wide range of technical aspects. The interconnection of the power systems among North-East Asian countries (Russia, China, Mongolia, Japan, and Korea) has been proposed on numerous occasions, but little progress has been made due to the complicated political issues and economical problems involved. Now, the necessity for this power system interconnection is increasingly being felt due to the benefit of each country. Because of these reasons, Korea peninsula takes the role connect a bridge between different areas of Northeast Asia, such as Russia, Mongolia, China, and Japan [1-5].

The problem of utilizing 2,000MW power output after the successful construction for the Sinpo nuclear power plant in future has studied, and a 765 kV HVAC interconnection between South Korea and North Korea has been discussed with several papers [6-12]. In South Korea, the potential increase in power demand is higher than that of any other country. The metropolitan area situated in the central parts consumed nearly 43% of the total electricity generated, and the southeast area consumed about 33%.

In this paper, we present various scenarios and the accompanying power flow analyses considering on seasonal load patterns, in order to provide the interconnection of the electric power grids. A distribution map of the projected power flow will be drawn by the results of simulations performed using the PSS/E tool.

2. Power system status and seasonal load

2.1 Power system and seasonal load patterns in South Korea

Figures 1 and 2 represent the load curve for day and the load curve for month in South Korea and in North Korea. The pattern of a curve in North Korea has a flat and small variation.

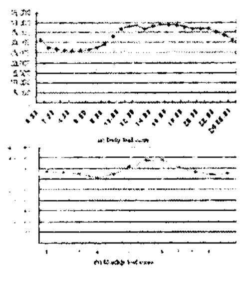

Fig. 1. S. K. load curves

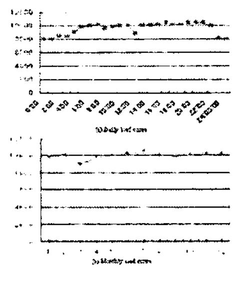

Fig. 2. N. K. load curves

3. Power flow considering seasonal load pattern

3.1 No interconnection among other countries

Figure 3 shows a South Korea's load flow map in the case of isolated operation (2005 data provided by KEPCO).

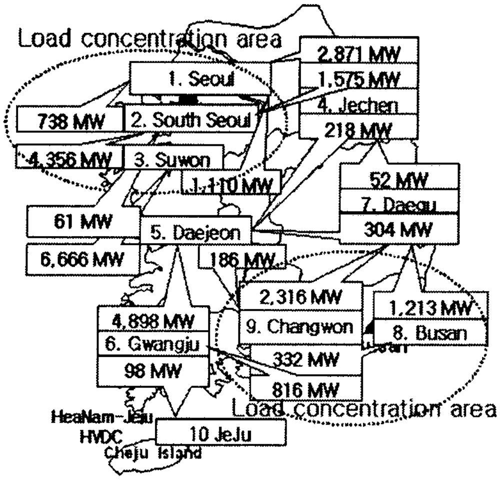

Fig. 3. Load flow map in South Korea

3.2 Interconnections for Far East Russia (or North East China)-North Korea-South Korea-Japan considering seasonal load patterns

Figure 4 shows that the load flow for summer is calculated to provide a load increase of 2,000MW in S.K. In these cases, the load flow is primarily in the southward direction. The two regions have a change of load flow direction as right side in figure 3.

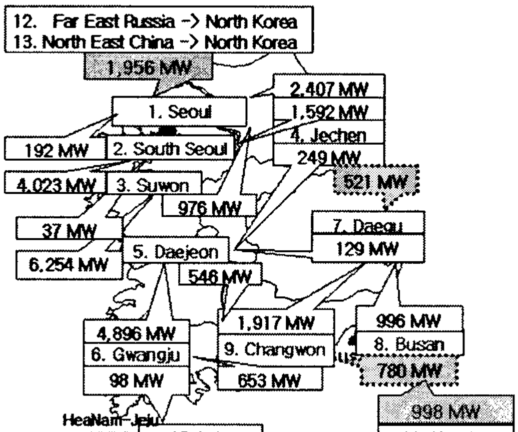

Fig. 4. Load flow map for summer in Far East Russia (or North East China)-North Korea-South Korea-Japan

Figure 5 shows that the load flow for winter is calculated to provide a load decrease of 10,000MW in comparison with summer peak in S.K. In these cases, also, the load flow is primarily in the southward direction. The two regions have a change of load flow direction as right side in figure 4.

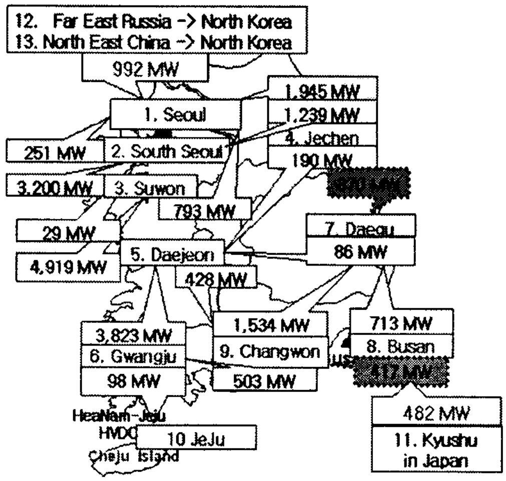

Fig. 5. Load flow map for winter in Far East Russia (or North East China)-North Korea-South Korea-Japan

3.3 Assumed seasonal power exchange quantities for power flow calculation

Table I represents the assumed peak load data for summer and winter in South Korea, 2005. To simulation the PSS/E package, the load was decreased with 2,000MW in summer season and decreased with 1,000MW in winter season. Table II has the assumed peak data for summer and winter in North Korea, 2005. All the load and supply patterns were assumed with constant quantity. Table III is the assumed peak data for summer and winter at Kyushu in Japan, 2001. Table VI has the assumed export power for summer and winter in Far East Russia. Table V represents the assumed export power for summer and winter in North East China.

Table I

Assumed peak data for summer and winter in South Korea, 2005

Seasons	Generation [MW]	Load [MW]	Receive Power[MW]
Summer peak	51857.8	51,090.4	2,000+1,000
Winter peak	41,857.8	41,090.4	1,000+500

Table II

Assumed peak data for summer and winter in North Korea, 2005

Seasons	Generation[MW]	Load [MW]	Transmission P[MW]
Summer peak	9,000	9,000	-
Winter peak	9,000	9,000	-

Table III

Assumed peak data for summer and winter at Kyushu in Japan, 2001

Seasons	Generation [MW]	Load [MW]	Transmission Power (Japan → Korea)
Summer peak	17,743	16,743	1,000
Winter peak	13,461	12,961	500

Table IV

Assumed export power for summer and winter in Far East Russia

Seasons	Generation [MW]	Load [MW]	Transmission Power (Russia → Korea)
Summer peak	2,000	0	2,000
Winter peak	1,000	0	1,000

Table V
Assumed export power for summer and winter in North East China

Seasons	Generation [MW]	Load [MW]	Transmission Power (China → Korea)
Summer peak	2,000	0	2,000
Winter peak	1,000	0	1,000

4. Conclusions

The purpose of this paper was to execute a power flow analysis considering seasonal load patterns for the increase of a reserve power for the future power shortages faced by the metropolitan areas or by the southeastern area of the South Korea in North-East Asia. Several cases were considered as follows:

(i) Analysing the effects and the regional power distribution of an increase or a decrease of a power reserve by load flow calculations under seasonal load patterns of each country for the future power shortages faced by the metropolitan areas or by the southeastern area of the South Korea in North-East Asia.
(ii) Securing South Koreas power reserve by a power interchange considering seasonal effects in North East Asia countries.
(iii) Exchanging and Leveling power among North East Asia countries.
(iv) Drawing possible scenarios and power flow maps for relieving the power shortages faced by the metropolitan areas and southeastern area in Korean Peninsula.
(v) Considering seasonal load patterns and studying power flow for the interconnection with 2,000MW in Far-East Russia or in Northeast China, and 1,000MW in Japan to utilizing remote power sources.

Acknowledgment

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