The Status and Problems of Wind Turbine Generator Systems in Hokkaido

<The Research in the Operations and Maintenances>

Summary

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1. Overview

Wind power is considered a key renewable energy source, and the Japanese government presented that the current goal is to have 3,000MW of generating capacity installed by fiscal 2010.

In Japan, as of the end of March 2004, there were 735 wind turbine generator systems (WTGS), generating a total capacity of 677MW. Technological advances and increases in the scale of wind power generation facilities have reduced costs and contributed to the recognition of the viability of wind power generation. Large-scale facilities continue to be established, predominantly in Hokkaido and Tohoku, Japan. However, there are concerns that the instability of the output of wind power could adversely affect the electric grid (by disrupting frequencies, etc.) and research has therefore commenced towards stabilizing wind power output and preventing any negative impact on the existing power supply.

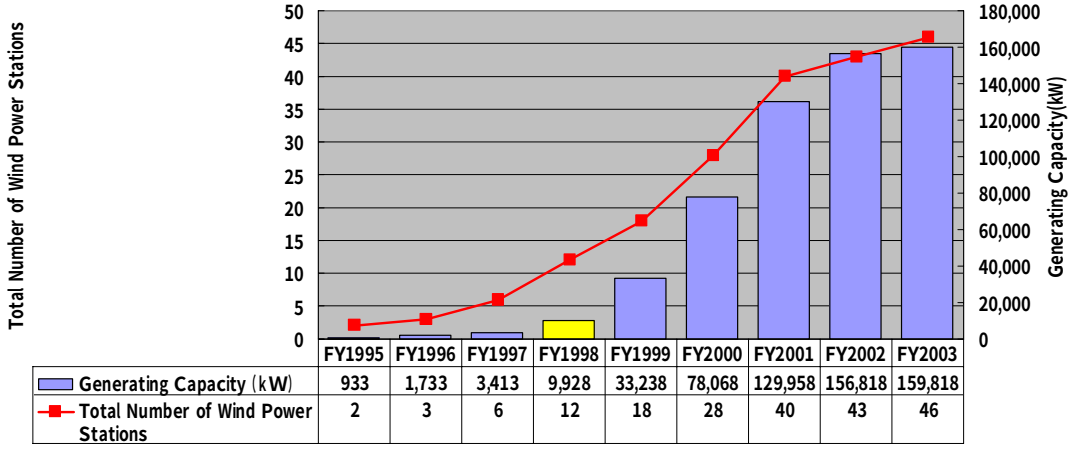
This report represents the result of the research on local governments and private companies which generated utility-scale wind power stations in Hokkaido. The objective of this report is to recognize the status of operations and maintenance of facilities, and discuss the problems of WTGS. In fiscal 2000, new energies account for only approximately 1% of the primary energy supply, but the goal is to increase the figure to around 3% in fiscal 2010. To

achieve this end, it is necessary to recognize the status of the WTGS in Hokkaido and resolve the problems.

2. WTGS in Hokkaido

As of the end of March 2004, there are 192 WTGS (46 wind power stations) with a total generating capacity of 159,818 kW in Hokkaido. Installed capacity had increased rapidly since 1998 when surplus electricity purchase under long-term contracts with Hokkaido Electric Power Co., Inc, materialized, and consequently, as shown in Figure 1 and Figure 2. 92% of WTGS were made in foreign countries. The capacity of these wind power stations installed in Hokkaido represents 24% of the Japanese total capacity. 89% of this capacity was distributed along the coast of the Sea of Japan and 56% of the total capacity was concentrated in the Rumoi district as shown in Figure 3. As of the end of March 2004, the first offshore wind power plant in Japan was installed near Setana town, the Hiyama district, Hokkaido, and started functioning.

Figure 1　Wind Power Stations in Hokkaido



	FY1995	FY1996	FY1997	FY1998	FY1999	FY2000	FY2001	FY2002	FY2003
Generating Capacity (kW)	933	1,733	3,413	9,928	33,238	78,068	129,958	156,818	159,818
Total Number of Wind Power Stations	2	3	6	12	18	28	40	43	46

Figure 2 Wind Power Stations in Hokkaido (Detail)

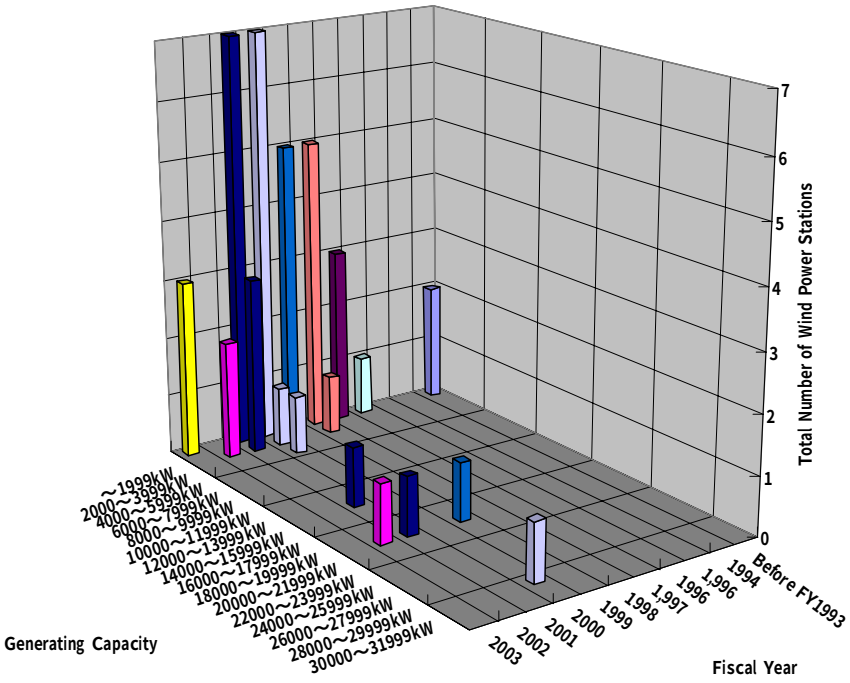


Figure 3 Location of the Wind Power Stations

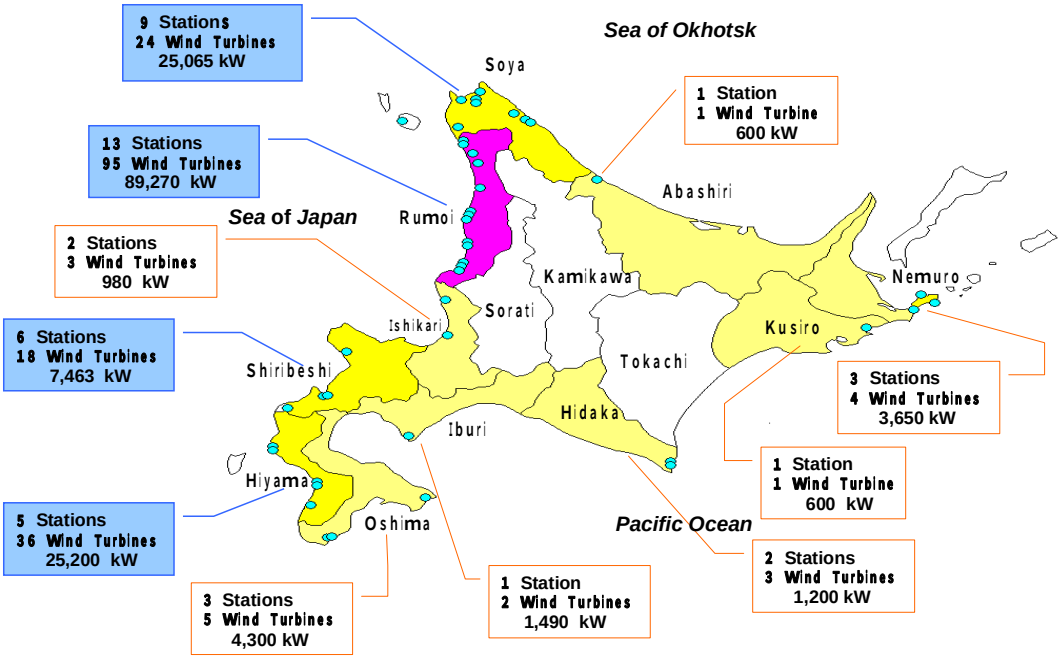
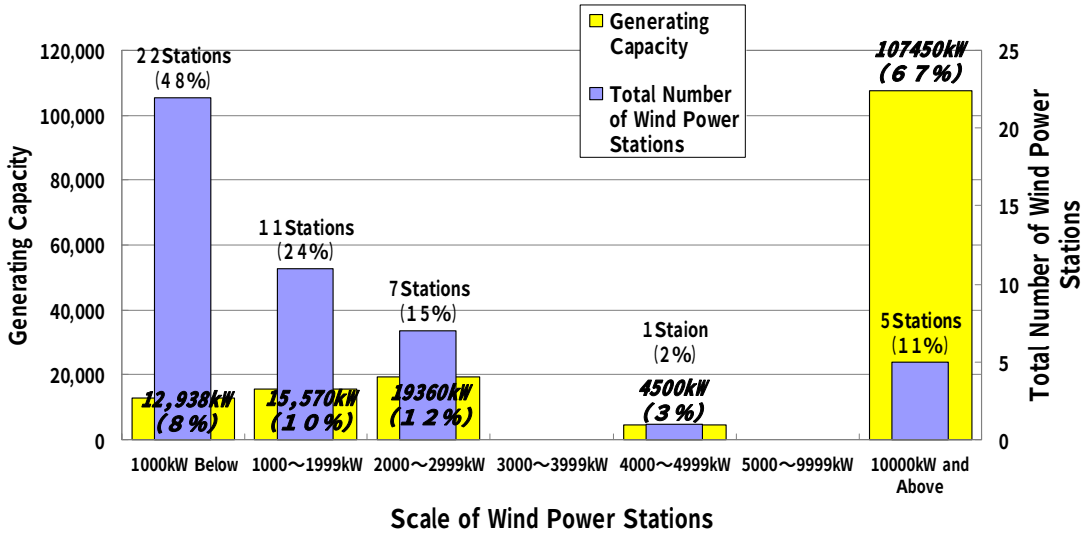


Figure 4 Distribution on the Scale of Wind Power Stations



3. Monthly Operating Results and Capacity Factors in Fiscal 2003

The annual average capacity factor of WTGS was 21.5% in fiscal 2003. The highest factor, 25.7%, was registered in the Soya district, the second highest factor, 25.5%, was registered in the Shiribeshi district as shown in Table 1.

The monthly average capacity factor in Hokkaido was 37% in December 2003. And the highest factor, 41.6%, was registered in the Rumoi district in December 2003 as shown in Table 1 and Figure 5.

Figure 6 shows the comparison between the achieved capacity factors and planned capacity factors. In 12 wind power stations, the annual capacity factor was 5% less than that planned, because the wind power was weaker than the prospected in the terms of the anemometric and meteorological data, many unanticipated faults aroused at the WTGS, and the expected wind turbine power performances were not achieved in fact.

Table 1　Monthly Average Capacity Factor in Fiscal 2003

FY2003	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAL	FEB	MAR	Annual Average Capacity Factor
Soya District	**32.5**	26.7	22.4	15.1	17.5	18.8	21.4	26.1	**34.7**	26.7	30.8	**36.5**	25.7
Rumoi District	19.4	13.2	9.5	5.7	12.8	13.0	28.3	31.3	**41.6**	19.5	**30.4**	**35.3**	21.6
Shiribeshi District	17.4	24.3	27.3	**37.0**	23.0	16.4	22.4	25.1	**32.6**	23.0	19.1	**37.9**	25.5
Hiyama Dustrict	11.3	8.7	11.0	13.5	8.5	8.7	14.3	17.5	27.4	19.4	27.8	26.2	16.2
Others	15.5	14.1	13.0	15.3	13.2	15.1	29.0	24.4	23.0	18.7	23.2	21.2	18.8
Monthly Average Capacity Factor	20.1	15.2	12.7	10.2	13.4	13.6	25.0	27.8	**37.0**	20.8	29.4	**33.5**	21.5

Ranking 1st　Ranking 2nd　Ranking 3rd

The capacity factor is the ratio of total annual energy production divided by the total that would be produced if the plant operated at its rated power output 100% of the time (i.e.,8,760 hours).

Figure 5　Monthly Average Capacity Factor

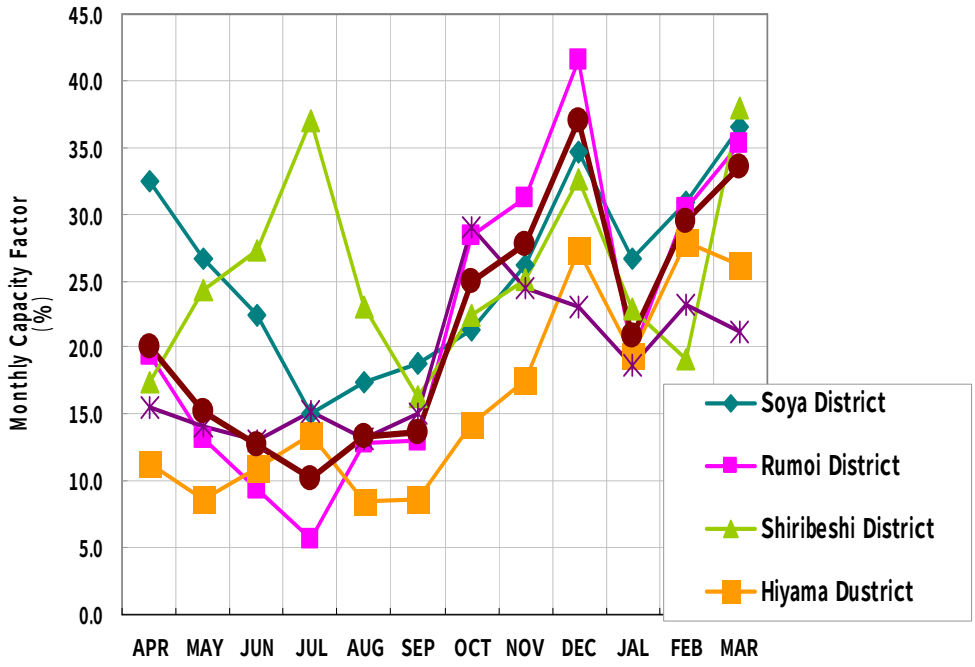
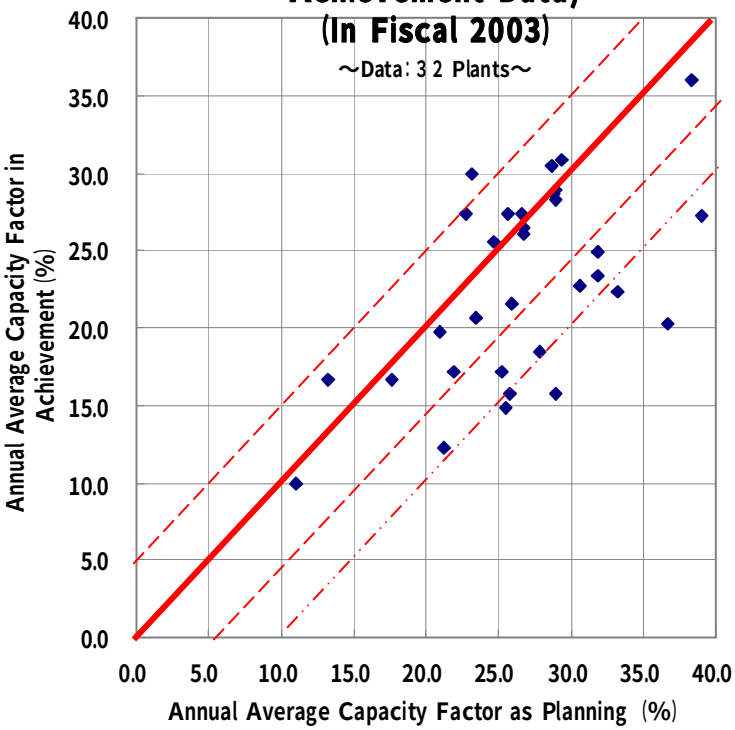


Figure 6 Comparison of Annual Average Capacity Factor (Planning and Achievement Data) (In Fiscal 2003)



4. Operations of 110 Wind Turbine Generator Systems

According to the obtained data from 110 WTGS (out of 192 WTGS) in Hokkaido, the operating time was 8,354 hours (95%) a year. However, the generating time was only 6,154 hours (70%), the ingenerating or idling time was 2,200 hours (25%), the periodic maintenance time was 80 hours (1%), and the unheralded malfunction time was 350 hours as shown in Figure 7.

As of fiscal 2002 and 2003, the unheralded 240 malfunctions occurred in 270 WTGS. The most accounted malfunctions were the ones of the control systems, 67 (28%), and the second were the ones of the driving equipments (transmission, pitch and yaw control systems), 63 (26%) as shown in Figure 8. Otherwise, the malfunctions resulting into changing the parts were 156 (65%). The maintenance completed within 3 days, was 79 (51%) with necessary changing parts as shown in Figure 9. The reason for the long maintenance duration (1 more month) was that the wind power plant engineers had to obtain the necessary parts from foreign countries.

Figure 7 Average Operating Time of 110 Wind Turbines

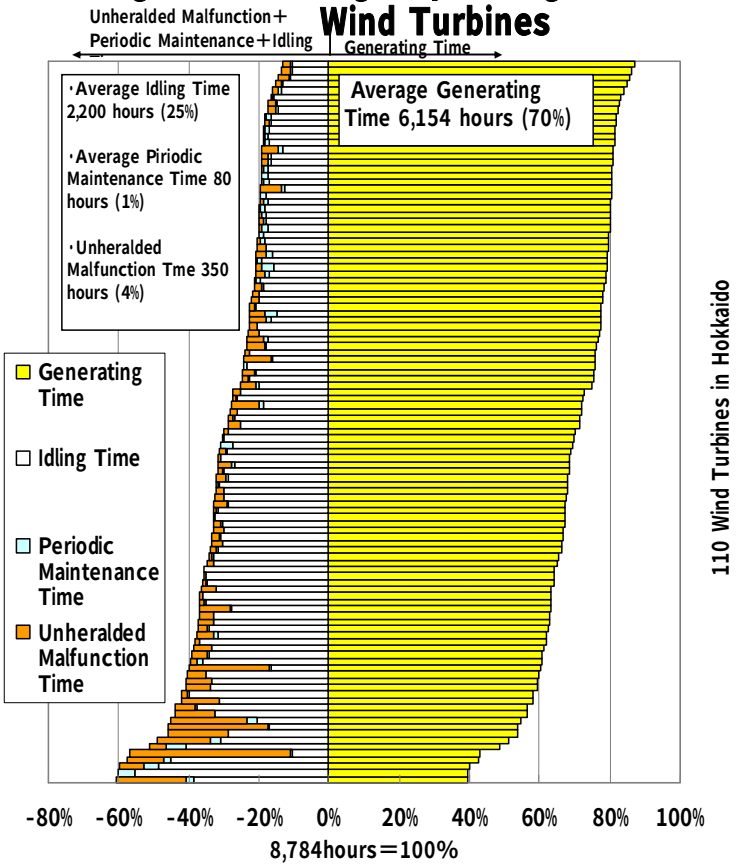


Figure 8 Unheralded Malfunctions (Fiscal 2002 and 2003) Total 240 Items

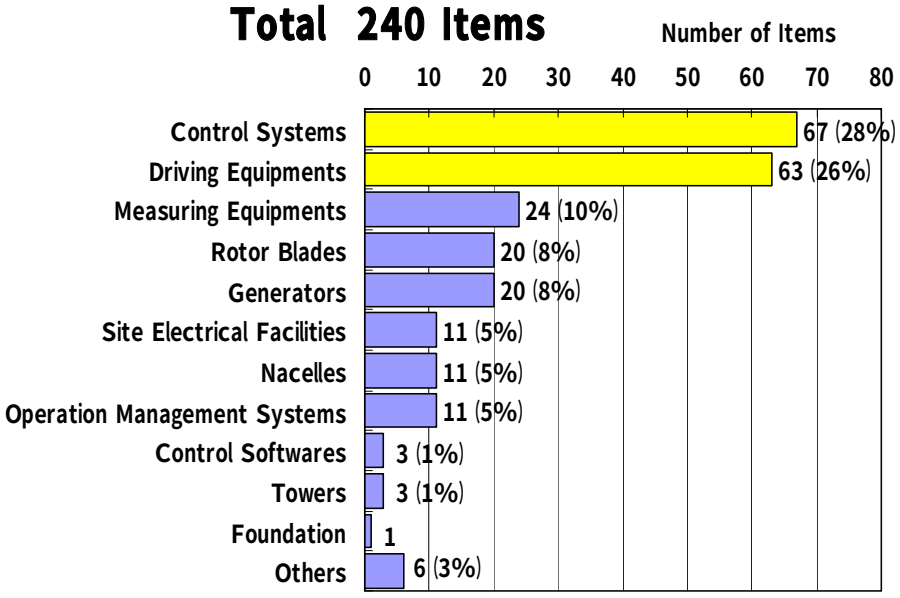


Figure 9 Malfunctions Resulting into Changing Parts (Total 156 Items (Fiscal 2002 and 2003))

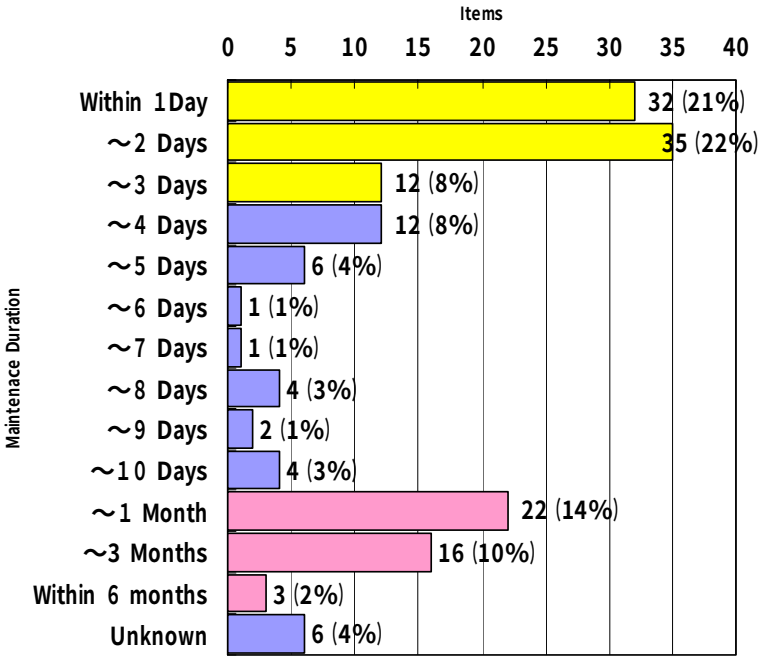
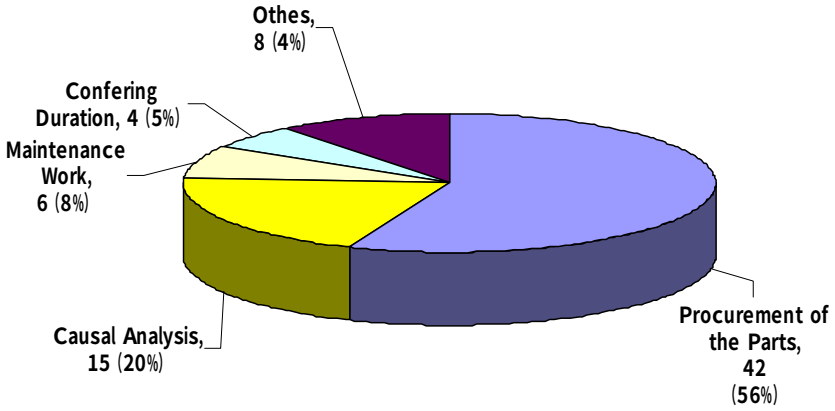


Figure 10 The Reason for the Long Maintenance Duration



5. Problems and Recommendations

5-1 The Importance of Accurate Wind Resource Assessment

The importance of accurate wind resource assessment was also recognized as the result of our research. The meteorological data of the wind conditions are collected, the more accurate data are measured on the test site, and the forecast of annual energy production in the planning WTGS may be implemented.

In order to obtain the highest capacity factor, some operating data of the other WTGS may be exploited when the new WTGS is planned.

5-2 The Contraction of the Periodic Maintenance Duration

The collecting occupation of the technical maintenance data by the WTGS engineers may be necessary to contract the periodic maintenance duration. As there are problems with obtaining the necessary parts from the foreign countries, it should be considered to produce them in Hokkaido and may be established “The Parts Center of WTGS in Hokkaido”.

5-3 The Necessity of “The WTGS Hokkaido Specification“

“The WTGS Hokkaido Specification “may be dictated in order to the avoidance of WTGS faults and the contract of the periodic maintenance duration. “The WTGS Hokkaido Specification “will be used to application for complex wind conditions and adjustment to severe natural conditions such as typhoons, lightnings and icing.