**Supplementary document**

TABLE S1 gives the physical meanings and values of the constant meteorological parameters used in Section II.

TABLE S1

The constant meteorological parameters

|  |  |  |
| --- | --- | --- |
| Symbol | physical meaning | Value |
| *le* | The latent heat loss due to water evaporation | 2263.8kJ/kg |
| *lf*, | The heat value released by unit mass of water during the condensation process | 334.3kJ/kg |
| *Ca* | The specific heat capacity of air | 1.006kJ/kg°C |
| *Cw* | The specific heat capacity of water | 4.18kJ/kg °C |
| *p0* | The static atmospheric pressure | 101.3kPa |
| *ε* | The mass ratio of water vapor to dry air molecular | 0.622 |

The topology of IEEE RTS-79 system is shown in Fig. S1. The area influenced by the ice disaster in each scenario has been marked by grey color. LGJQ-240 wires are used as the materials of transmission lines, and the voltage level of lines is 138 kV. TABLE S2 gives the parameters of transmission lines. The load transfer cost is set as $50 /MWh. The generation cost of units U3, U4, U7, and U8 is modified to $12 /MWh. The percentage of load participating in demand response for each node is ±5%. The reactive power regulation devices are only installed on both ends of the ice-covered lines, and the adjustment range is -5Mvar to 5Mvar. In addition, the system load profile is provided in TABLE S3.

Fig. S1. The topology of IEEE RTS-79 system

Scenario 1: L4 L9

Scenario 2: L3 L4 L8 L9

Scenario 3: L1 L2 L3 L4 L5 L6 L8 L9



TABLE S2

Parameters of the transmission line

|  |  |  |  |
| --- | --- | --- | --- |
| Wire Type | Outside Diameter (mm) | Aluminum/Steel Section (mm2) | Resistance (Ω/km) |
| LGJQ-240 | 21.88 | 243/31.7 | 0.130 |

TABLE S3

System load profile

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Period | 1 | 2 | 3 | 4 | 5 |
| Percentage of Peak Load | 0.5197 | 0.4886 | 0.4654 | 0.4576 | 0.4576 |
| Active Load  (MW) | 1481.0 | 1392.6 | 1326.3 | 1304.2 | 1304.2 |
| Reactive Load (Mvar) | 301.4 | 283.4 | 269.9 | 265.4 | 265.4 |