

Local Perspectives on Power Grid Interconnection in Northeast Asia:

**Background and Perspectives
from Liaoning Province, China**

Ge Weichun

Liaoning Electric Power Co.,Ltd.

Abstract

- The cost and benefits for the security of the regional power grid.
- The barriers of the regional power grid interconnection in technology and management.
- The benefits of the regional power grid interconnection.
- The current and anticipated supply and demand situation in Liaoning power grid.
- The current electricity transmission and distribution system situation in Liaoning power grid.

The Cost and Benefits for the Security of the Regional Power Grid

- The thermoelectric generators and hydroelectric generators that include the generator made in China and introduced are transformed at the automation, which raises the security of the power plant, generating capacity of the generator and work effectiveness, and satisfy the demand of automatic generation control in the power system. The enormous benefits are obtained.
- The transformer stations are transformed at the automation to satisfy the monitoring and control for the various kinds of facilities and finish the remote control in dispatching center. Finally, the unattended substation is completed.

The Cost and Benefits for the Security of the Regional Power Grid

- The dispatching center makes use the various kinds advanced application soft to analyze the power grid for the security and stability. A great deal of advanced relay protection sets are applied to raise the security. The communication system based on ATM will be built recently. The accident of the power grid happened never.
- The facilities of the electricity transmission and distribution system at the operating state are monitored online to ensure the security of these facilities. Specially, the various kinds of advanced technologies are used for the monitoring and determination the accident of transformer, switch and line.

The Barriers of the Regional Power Grid Interconnection in Technology and Management

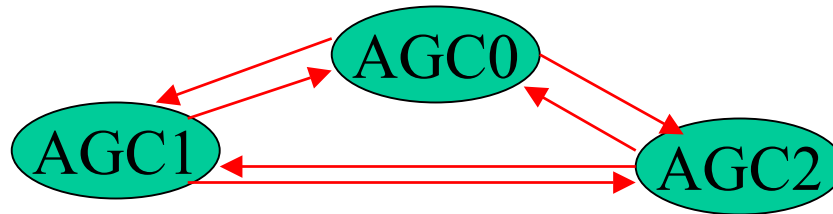
- The Barriers and resolving methods of the regional power grid interconnection in technology include:
 - The stability control technology.
 - » Transient stability must be controlled by the controllable series compensators for tie lines if both regional power grids are weak link, for example one tie line or two tie lines.
 - » Voltage must be controlled by static var compensators for the connecting substation.

The Barriers of the Regional Power Grid Interconnection in Technology and Management

- The power flow (active power and reactive power) control technology.
 - The active power must be controlled, otherwise the frequency control is very difficult.
- The frequency control technology
 - Automatic generation control is needed to control frequency, if the active power in the tie line is not controllable, the higher dispatching center is needed to control the frequency in the power grid, the dispatching center of the regional power grid is needed to control the power flow of the tie lines. When the tie line trips or repairs, the dispatching center of the regional power grid can control the frequency itself.

The Barriers of the Regional Power Grid Interconnection in Technology and management

- Automatic generation control technology



- AGC0 must have enough generating capacity to control the frequency
- AGC1 and AGC2 must have enough generating capacity to control the power flow of the tie lines and frequency when the tie lines trip

The Barriers of the Regional Power Grid Interconnection in Technology and Management

- The Barriers of the regional grid interconnection in management include:
 - The higher grade dispatching center is demanded to manage the operation for the tie lines and the generators of enough capacity to control the frequency.
 - The information management: operating information, electric quantity and other parameters.

The Benefits of the Regional Power Grid Interconnection

- Accident reserve.
 - When some regional power grid happens the accident, for example, the generator of larger capacity faults, other grid can supply the support of generation through tie lines.
- Complementary of the electric price.
 - Frequently, the electric price is different both regional power grid so that one regional power grid at higher electric price may buy electricity from other one. The price is very important!

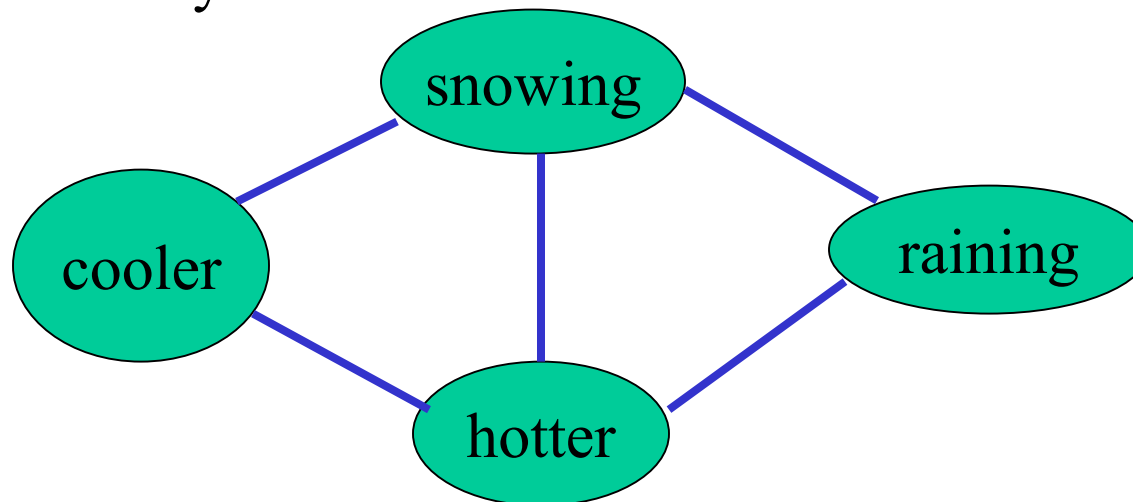


The Benefits of the Regional Power Grid Interconnection

- To raise stability.
 - For regional power grid interconnection, stability is raised each one, but the stability of the tie lines must be controlled well.
- Both peak and valley load complementary.
 - The time which the peak and valley load both regional power grid appears is different so that error between peak and valley load in each one regional power grid can be decreased.
 - The error between peak and valley load is one very important index and exerts a tremendous influence for economic benefits.

The Benefits of the Regional Power Grid Interconnection

- Meteorology complementary.
 - Some regional power grid is raining or snowing and other is not, load change is great.
 - Larger space is included after regional power grid interconnection, benefits is also huge at meteorology complementary.

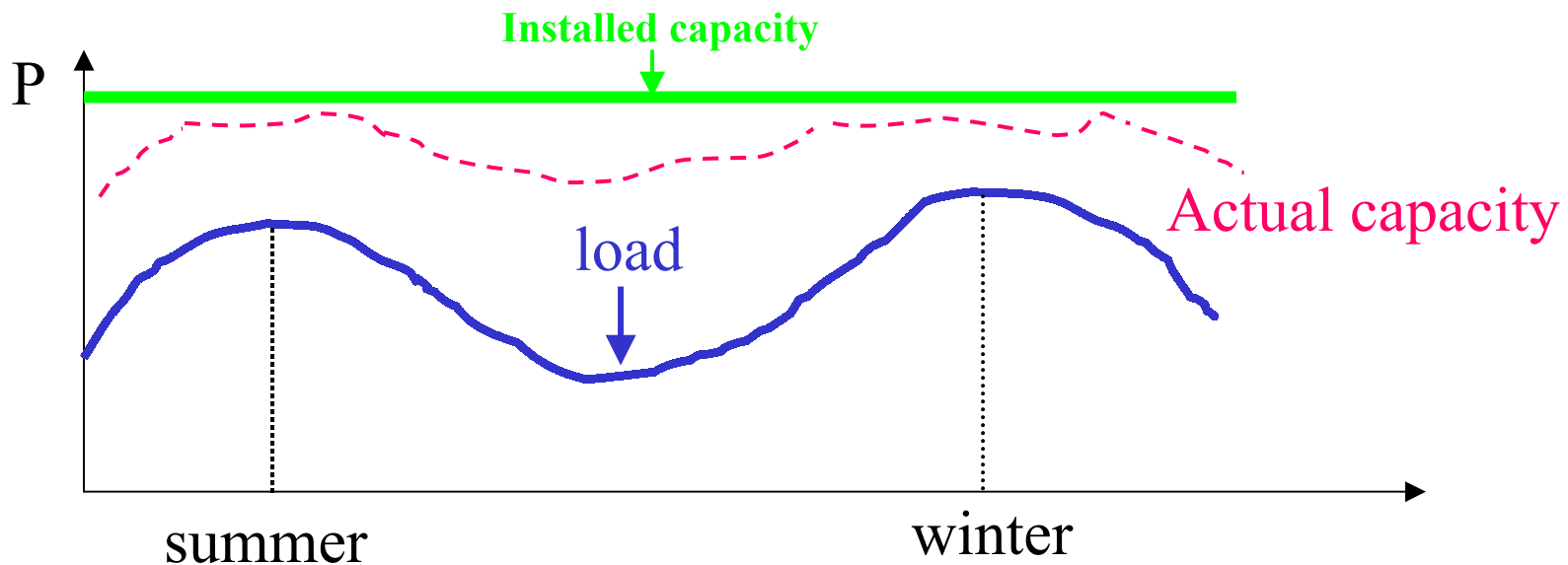


The Current and Anticipated Supply and Demand Situation in Liaoning Power Grid

- In the current supply is much larger than demand.
- The power supply is mainly thermoelectricity, the most capacity is 800MW, other includes 350MW, 300MW and 200MW, hydroelectric power plants have only three, most capacity is 75MW.
- The power supply builds is one very important work in Liaoning Power Grid, which must satisfy the development of the demand.

The Current and Anticipated Supply and Demand Situation in Liaoning Power Grid

- The demand increases rapidly last year, and it can increase still in this year, when the higher temperature appears in the summer and when the lower temperature appears in the winter the most load appears, but power supply is enough to satisfy demand, load is larger winter than summer.



The Current Electricity Transmission and Distribution System Situation in Liaoning Power Grid

- The supply capacity is much larger than the demand.
- The frequency is controlled easily for the above reason, the power flow of tie lines is also controlled and the controllable capacity of the generators for AGC (Automatic Generation Control) is enough to control the frequency (the qualified rate is about 99.99% for positive and negative 0.1 at the rated frequency). The great deal of sets of the low frequency load shedding and low voltage load shedding are installed for the security when the large capacity or main lines trip.

The Current Electricity Transmission and Distribution System Situation in Liaoning Power Grid

- The Voltage of 220kV and 500kV is satisfied with demand at the operation (the qualified rate is about 99.5% positive and negative 5% at rated voltage) for the enough reactive to control the voltage. The voltage is mainly controlled by the reactors that are installed at 500kV lines, and reactive output of the generators for 220kV and 500kV network, but The voltage is controlled by the shunt capacitor compensators transformer tap for 66kV and 10.5kV network.
- Equipment was made mainly in China, Some generator of larger capacity was made in Russia and Japan, which 800MW and some 300MW was made in Russia and 350MW was made in Japan. Old equipment has been transformed recently. Power grid is being stable and safe operation.

The Current Electricity Transmission and Distribution System Situation in Liaoning Power Grid

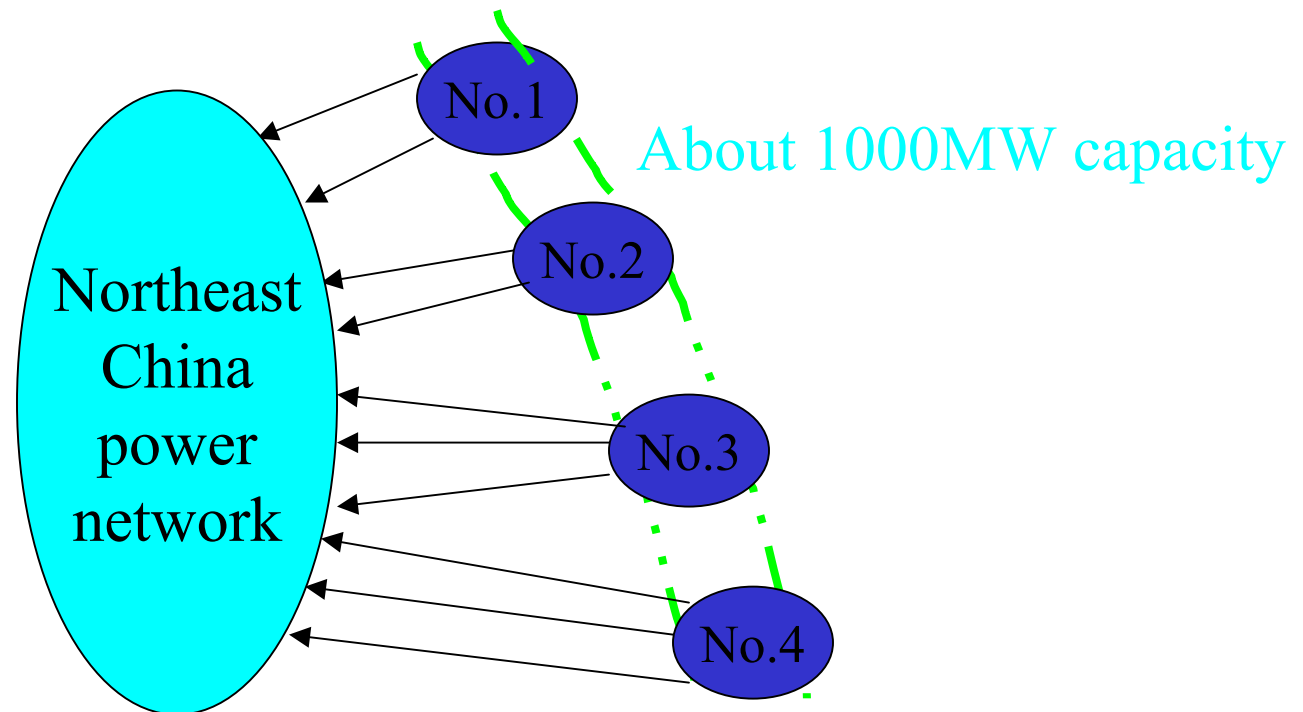
- The dispatching system includes the dispatching center of Liaoning Province and local dispatching centers. There are thirteen local dispatching centers. The dispatching center of Liaoning Province applies the CC-2000 dispatching automatic system to finish data collection, monitoring and control.
- Software on line for security, stability, economic and market has been studied and applied in dispatching center of Liaoning Province, which includes: state estimation, power flow calculation, static security analysis, safe constrained dispatching, load forecasting, generation schedule, voltage stability analysis, transient stability analysis, dispatcher simulating system, optimal power flow and automatic generation control.

The Current Electricity Transmission and Distribution System Situation in Liaoning Power Grid

- Technology supporting system for electric power market has been built.
- Communication system will be transformed to ATM.
- Electric transmission system is 220kV and 500kV network, and main network structure is 220kV. There is one loop network of 500kV, next will be built late. Electric distribution system is 66kV and 10.5kV network.

The Current Electricity Transmission and Distribution System Situation in Liaoning Power Grid

- It is possible that Liaoning power grid is connected with north Korea and Northeast power grid is connected with Russia.



Conclusion

- The cost is much larger and benefits are also much larger in the regional power grid.
- The barriers of the regional power grid interconnection in technology and management can be overcome.
- The benefits of the regional power grid interconnection are very huge.
- The current and anticipated supply and demand situation in Liaoning power grid can not tense.
- The current electricity transmission and distribution system situation in Liaoning power grid has the condition to complete interconnection with other regional power grid.

Thank You!

- Tel:(o)02423115589 (h)02423113247
13904011720
- e-mail:gwc@mail.lnepc.com
- Add:No.18 Ningbo Road, Shenyang,
P.R.China
- Postcode:110006
 - Welcome to Shenyang!