

Engineering Service: Power System Planning

Features

In developing the power supply network in accordance with the demand increase and/or the power generation plant development, the optimum development plan will be studied in consideration of following points, so as to maximize the effect of investment.

- ◆ Power supply reliability: e.g. N-1 criteria
- ◆ Transient stability
- ◆ Voltage stability
- ◆ Thermal overload
- ◆ Overvoltage analysis

The optimum power system planning can realize the reliable and efficient transmission network, which leads to following benefits.

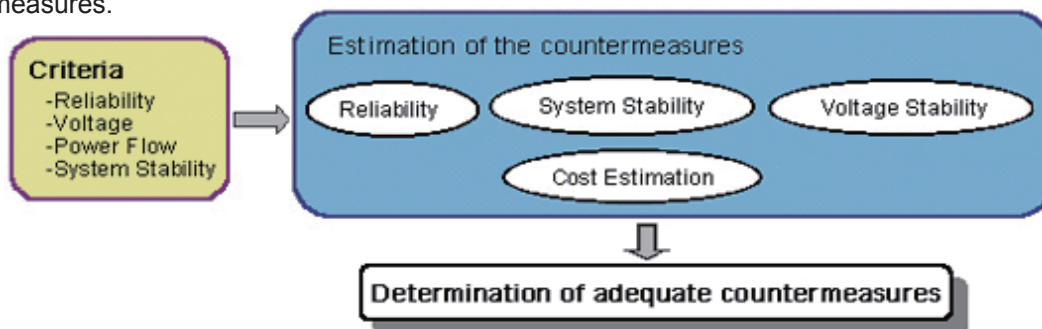
- ◆ Reduction of time and frequency of forced outage
- ◆ Transmission loss reduction
- ◆ Appropriate loading ratio of the power transmission facilities
- ◆ Reduction of power transmission/transformation facility failures

Basic Concept or Summary

Depending upon the needs of the client, Tokyo Electric Power Company (TEPCO) provides the engineering services on power system planning, to realize stable and reliable power system with high quality power supply.

As a power system expands, deterioration in the system performance is expected. For example, system problems such as increase of fault current, transient instability, thermal overloading, under frequency, voltage instability are considered. It is essential that adequate measures shall be taken in advance so as to realize the well-balanced performance for overall power network.

In the engineering service, possible problems in client's power system development plan are identified, and countermeasures for them are studied. Countermeasures include amendment of network configuration, fundamental specification of the facility, protection requirement, appropriate control devices, and so on. In addition, overvoltage analysis is implemented to identify problems of the system and propose countermeasures.



Example 1: Fault Current Level Reduction

Fault current is the current flowed from each generator into a fault point in the case of a fault in the network. Upgrading and expanding of the generation and transmission facilities cause the increase of fault current levels in the overall network.

- ◆ Problems of fault current increasing
 - Excess from transmission line's transmission capacity and circuit breaker's breaking capability
 - Interference to communication lines caused by electromagnetic induction
 - Damage to the facilities caused by the fault currents
- ◆ Countermeasures
 - Radial configuration of the transmission network
 - Upgrading the equipment

Example 2: System Interconnection Scheme

By combining independent power systems via interconnection facilities, power exchange is facilitated and more efficient network operation and more economical power system development will be expected.

- ◆ Purposes of system interconnection
 - Reduction in reserved capacity
 - Power exchange in emergency situation
 - Power exchange for economical power system operation
- ◆ Contents of studies
 - Interconnection method in consideration of individual situations
 - Change of system characteristics by interconnections
 - Construction cost estimation
- ◆ Possible concerns due to interconnection
 - Decrease in whole system stability (Wedge System)
 - Unexpected Loop Flow (Looped System, Meshed System)

Example 3: Power System Master Plan

Compile the power system master plan for required supply reliability in the designated country while considering appropriate capital investment.

- ◆ Required supply reliability level
 - The required reliability level of regional supply network shall be set depending upon the characteristics and environment of the area.
- ◆ Preparation and evaluation of the master plan for the required supply reliability
 - Prepare the master plan in accordance with reliability standards such as N-1 criteria.
 - Coordination with existing power system and/or existing power system development plan may also be evaluated
 - Propose an economically superior system development plan.

Effects or Remarks

Based upon the experiences in Japan, TEPCO can study the cases as a consultant for the client, and transfer technology through the study. Typical indices showing TEPCO's power supply reliability and efficiency are as follows.

- ◆ Forced outage frequency per customer per year: 0.14 (2013)
- ◆ Accumulated forced outage per customer per year: 15 minutes (2013)
- ◆ Transmission and distribution loss rate: 4.6% (2013)

Installation in Practice or Schedule

Domestic Power grid planning within Tokyo Electric Power Company (60GW of network capacity)

- Overseas**
- ◆ Power Network System Master Plan in Lao People's Democratic Republic (2005)
 - ◆ Development of Master Plan of Transmission System, Abu Dhabi (2008)
 - ◆ Joint Feasibility Study on 400kV Underground Cable Installation in Denmark (2007)
 - ◆ "Impact on the Transient Performance of the Network with the Introduction of High Impedance 400/230kV Transformers in the Network," Singapore (2005)
 - ◆ "Technical Services in Relation to the Pilot Project Regarding Ultra High Voltage (1000kV AC) Transmission System Design," P. R. China (2005)
 - ◆ "Power Network Data Analysis applying the TEPCO-BCU Method," USA (2004)
 - ◆ "High Density Power-Transmission Planning in Taipower Northern Area System," Taiwan (2003)

Contact: Tokyo Electric Power Company Holdings, Incorporated, International Affairs Department
<http://www.tepco.co.jp/en/corpinfo/consultant/top-e.html>
consultancy@tepco.co.jp