

## Engineering Service: Network Protection Scheme

### Features

Since power outages are inevitable due to lightning and other natural phenomena, it is crucial that the network protection system operates properly in order to isolate the network fault and keep power supply reliability with reasonable investment.

Depending upon the importance of the area for power supply reliability, following improvement in the protection system can be applied for further security and reliability.

- ◆ Duplication of the protection system, including main protection and backup protection with fail safe protections, with each of them are different operation mechanism
- ◆ Development of the special protection system which prevents cascading outage and minimizes the disturbance area. The improvement of the protection system performance can realize the reliable power supply, which leads to following benefits.
- ◆ Reduction of the time of the forced outage
- ◆ Minimize the forced outage for the very important area
- ◆ Prevent transmission facility damages due to overloads

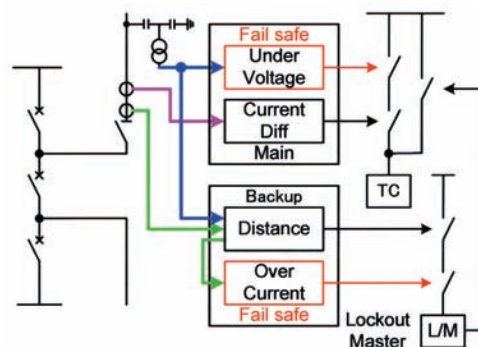
### Basic Concept or Summary

Depending upon the needs of the client, Tokyo Electric Power Company (TEPCO) provides the engineering services on power network protection scheme, for further reliability of the power supply, based upon the wealth of experience in operation practices regarding the reviewing of work, relay operation analysis and setting coordination, etc.

#### Example 1: Improvement in Protection Relay Performance

If a protection relay fails to properly operate, a cascading failure followed by a large-scale outage is likely to occur. It is essential that, the actual operation of the existing protection relay be constantly reviewed, including the validity of the relay setting. In addition to this, computational analyses and surveys on the operation of the protection relay during potential disturbances are to be conducted for the current and future system in order to prevent a malfunction.

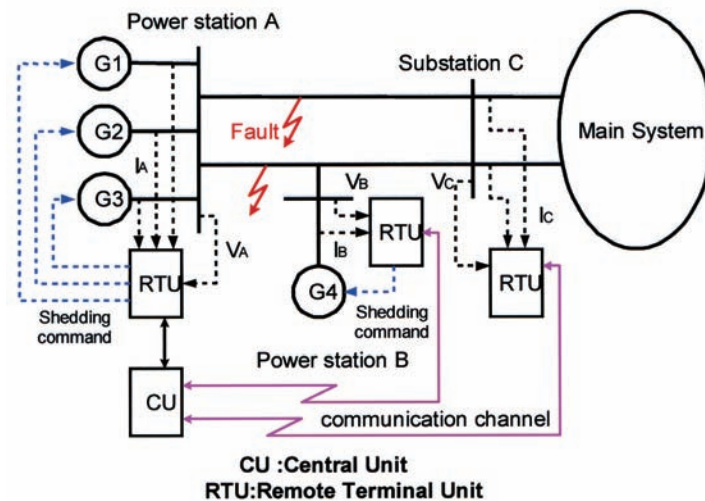
TEPCO reviews all aspects of utility's practices related to the performance of protection relays. For example, TEPCO recommends using a combination of voltage and current elements for a relay operation as shown in the figure below to enhance security against a single failure mode including either CT or VT failure.



#### Example 2: Development of Special Protection System (SPS)

Power flow, transient stability, voltage stability and system frequency in the future's bulk power system is studied with regard to severe faults in order to estimate the needs for a Special Protection System, which can prevent a disturbance area from expanding. If a cascading fault is expected, the application of SPS is considered and requirements for the SPS are found out based on offline simulations. Functional specifications are also determined so as to fulfill the requirements. TEPCO has developed and operated several types of SPSs.

In addition, TEPCO helps other utilities to develop their SPS for the overload protection, transient stability, and system islanding. The figure below shows the outline of the system configuration of the SPS for transient stability.



### Effects or Remarks

These network protection practices and schemes help secure and stable operation of the power system. 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 --- 0.12 (2008)
- ◆ Accumulated forced outage in a year per customer --- 3 minutes (2008)
- ◆ Transmission and distribution loss rate --- 4.9 % (2008)

### Installation in Practice or Schedule

**Domestic** Design, construction and operation of power grid protection systems by Tokyo Electric Power Company (TEPCO, 60GW of network capacity)

**Overseas** Project: Technical Support on the Application of Overload Protection Schemes

Client: TNB (Malaysia)

Period: May 2007 – March 2008

Outline: The effectiveness of overload protection schemes was demonstrated in the TNB network. In addition, TEPCO assisted TNB to develop Technical Guidelines for overload protection schemes. In line with the development of Technical Guidelines, the overload policies, derivation of allowable overload curves, and application rules and setting considerations of overload protection systems were discussed and included in Technical Guidelines.

Project: Preparation of Technical Guidelines and Review of TNB Protection and Control Technical Specifications

Client: TNB (Malaysia)

Period: January 2003 – August 2004

Outline: In order to standardize and optimize the design work of TNB's protection system, the Technical Guidelines for protection system, which describes basic design philosophy as well as is placed between Code of Practice and Technical Specification, was established. The Technical Guidelines referred to the Code of Practice as well as TEPCO practice and experience on protection system. The existing Protection and Control Technical Specification was comprehensively reviewed in reference to the Technical Guideline.

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<http://www.tepco.co.jp/en/corpinfo/consultant/top-e.html>

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