

# Protection coordination

Analyzing and proposing protection schemes and settings

## At a glance

Siemens Power Technologies International (Siemens PTI) analyzes protection systems using state-of-the-art methods to optimize operations and eliminate vulnerabilities. With the aid of system calculations based on national and international standards, and system and protection simulations, we devise protection systems that are:

- safe
- compliant with regulations,
- selective,
- technically and economically suited for the customer's requirements.

## The challenge

An electrical power system is intended to operate in a safe manner at all times. However, no matter how well designed, faults will always occur in a power system. Faults are very special events in the life cycle of a public or industrial system as they can greatly affect or restrict operations. They may also lead to severe damage to installations and equipment, or may cause personal injuries, which could be fatal. Therefore, the availability of an adequate protection system is an indispensable and integral part of power system design.

## Our solution

Our team comprises highly skilled experts in all aspects of system and machine protection, from converter design and equipment protection to coordination of low, medium, high and extra-high-voltage protection. We can advise and offer a comprehensive service for power system protection.

## Application examples

### Disturbance analysis

When faults occur, they must be cleared as quickly as possible to obtain a high level of system availability with minimum failure probability. There are a number of methods available for analyzing the causes and the behavior of the network and the protection system, including:

- analysis of fault records and fault annunciations from protection relays, substation control and protection systems, and SCADA systems
- dynamic system and protection equipment simulation
- vulnerability analysis, development of countermeasures
- verification of the optimized system

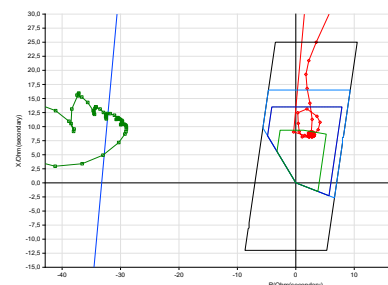


Figure 1: Fault analysis – Zone 1 trip of distance protection on remote end due to wrong earth-fault compensation factor settings

## Measuring transformer dimensioning

The choice of suitable current and voltage transformers as connection links between the primary and protection systems depends on the steady-state and transient phenomena and the technical requirements of the connected equipment.

Siemens PTI offers the following services:

- classification according to national and international standards
- dimensioning of instrument transformers to suit all common protection equipment
- dimensioning of instrument transformers when the specifications of the primary system and protection equipment change

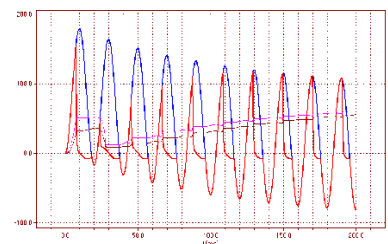


Figure 2: CTDim dynamic simulation

Siemens PTI also offers a software tool which supports engineers in the selection, dimensioning and simulation of current and voltage transformers. For more details, please visit [siemens.com/ctdim](http://siemens.com/ctdim).

### Protection coordination

Selective system protection must take into account the system structure, the system elements, different switching conditions as well as supplier and customer requirements. Siemens PTI offers the following services:

- design of protection systems
- selection of suitable relays and fuses
- settings calculation tailored for each vendor-specific relay type
- coordination of all protection equipment

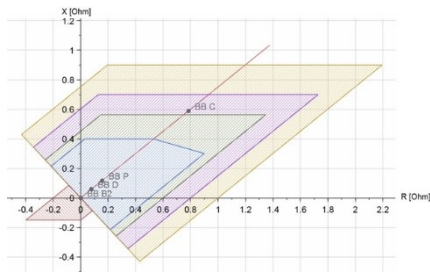


Figure 3: Impedance diagram including the line impedance

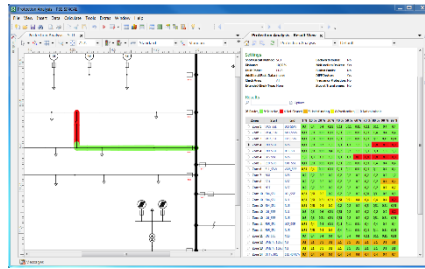


Figure 4: Concept verification with PSA

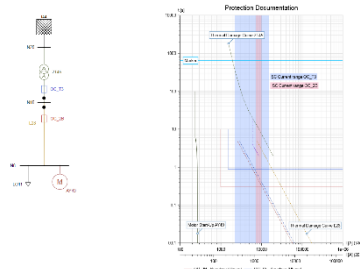


Figure 5: Documentation of a protection path including path in network and I-t diagram with result data

As the first step in the protection analysis, Siemens PTI consultants will work with the customer to collect all relevant data such as equipment parameters, contingencies typically applied by the utility when calculating protection settings, and information about any special operating conditions that need to be considered.

After data collection, instrument transformers are checked and/or newly dimensioned and selected, enabling proper operation of corresponding relays. In parallel, an analysis of the protection system philosophy is carried out, considering the customer's requirements, practices, industry standards and state-of-the-art technology.

Based on all these aspects, the protection scheme is devised, which provides the customer a technically and economically optimal solution. Selective protection coordination and relay-consistent setting calculations are then carried out using software-aided, short-circuit and/or system stability calculations.

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