

# Protection coordination

Protection schemes and settings for transmission grids

## At a glance

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

- selective,
- system compliant, and
- 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 damages to installations and equipment, or may cause personal injuries, which could be fatal. Therefore, the arrangement of an adequate protection system is an indispensable and integral part of power system design.

## Our solution

Our team is comprised of 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

From a disturbance to an optimized system

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
- weak point analysis, development of countermeasures
- verification of the optimized system

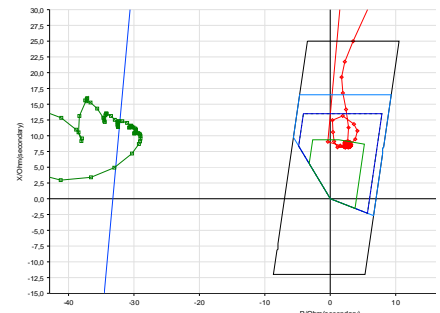


Figure 1: Fault analysis – Zone 1 trip of distance protection on remote end due to wrong earth-fault compensation factor settings

From the primary system to the protection equipment

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.

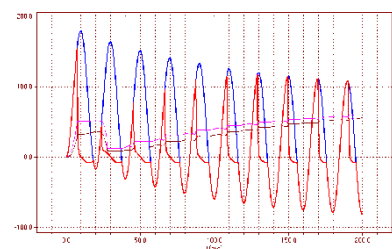


Figure 2: CTDim dynamic simulation

Our software program, can study and dimension instrument transformers. For more details specific to software features and functionality, please visit [siemens.com/ctdim](http://siemens.com/ctdim).

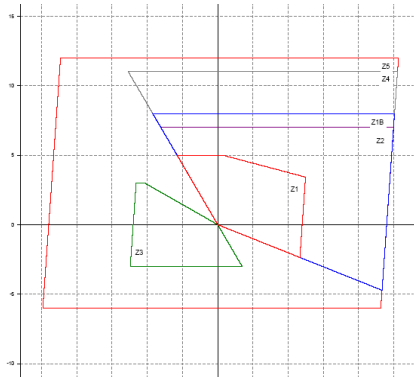


Figure 3: Example of distance zone protection settings

From the protection equipment to a coordination system protection 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
- relay consistent setting calculation
- coordination of all protection equipment

The analysis is based on a comprehensive data collection in close cooperation with the customer during which the system structure, its elements and operational conditions are collected.

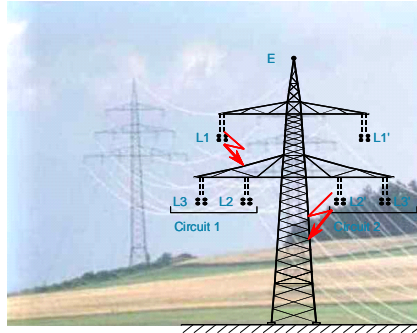


Figure 4: Short-circuit considerations on overhead line

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 concepts is carried out, considering the customer's requirements, habits and state-of-the-art technology.



Figure 4: Evaluation of protection system performance with SIGUARD PSA

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

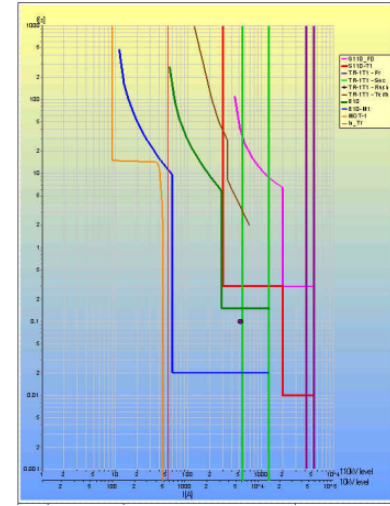
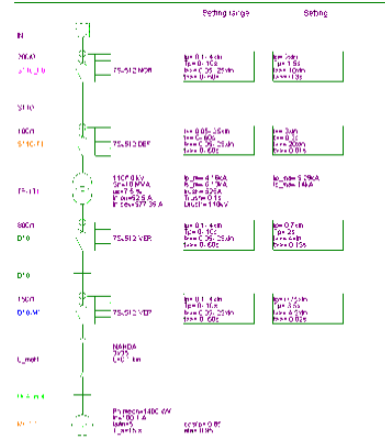


Figure 5: SIGRADE grading path and grading diagram

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Energy Management Division  
Freyeslebenstrasse 1  
91058 Erlangen, Germany

For more information, please contact:  
[power-technologies.energy@siemens.com](mailto:power-technologies.energy@siemens.com)

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