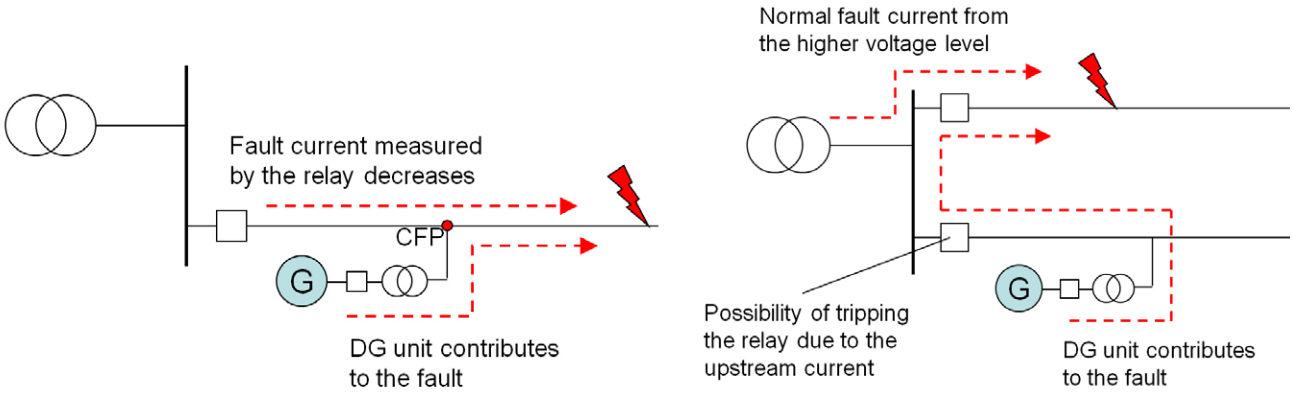
DG Protection Planning Methods

The increasing amount of distributed generation (DG) in distribution networks can result in problems with present network protection methods. These impacts may lead to safety hazards or, on the other hand, unnecessary service interruptions. As the network planning process is essential for ensuring the safety of the installation, practical tools are needed at the moment. Methods have been developed during the project.

Typical problems faced during DG integration relate to the basic requirements; sensitive and selective operation of protection. Presence of DG will affect the fault currents flowing in the network. In the worst case fault currents measured by the relay are reduced so that fault detection is disturbed. On the other hand, DG unit or even the whole DG feeder may become disconnected during a fault elsewhere in the network. This will result in service interruption.

Typically network planning is made by using network information systems (NIS) or similar systems. These tools are usually based on database structures and simplified network calculations. They are strongly integrated to other systems such as distribution management, documentation and customer information systems.

Possibility of studying the DG impacts with same planning tools is widely anticipated among network operators.



Typical protection related problems include decreasing feeder fault currents due to the contribution of DG (left) and false trippings caused by upstream currents during faults on other feeders (right).

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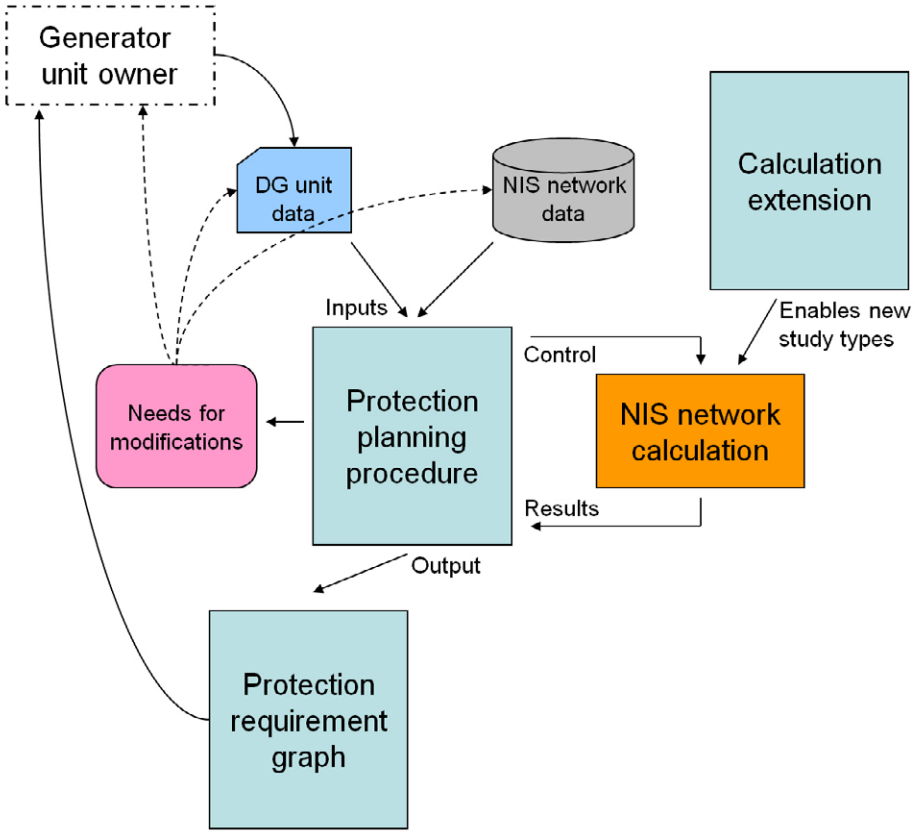
As the normal NIS fault calculation is based on steady-state approach and rms values, the dynamic behavior of DG unit is difficult to model. However, as the present calculation has proved to be reliable and to offer suitable information for planning purposes, it has been assumed that basic calculation should not be modified.

Instead, the fault calculation is repeated in time steps between which the generator values are modified. This enables more accurate studies on relay operation times. Wrong operation sequences can be found with suitable analysis.

The core of the developed method is the protection planning procedure, which performs the necessary studies automatically in correct sequence. Process goes through network faults point by point and saves results for further analysis. This calculation is iterated with time steps as described previously. Time step approach enables also studying different generator types. As a result, the impact of new DG unit on system protection can be studied. Wrong operations on certain fault locations are reported and modifications can be made according to the results.



Functionality applies normal network calculation of network information system together with suitable extensions. Time step approach is used as an extension to normal fault calculation.

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