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Current and voltage transformer dimensioning

CTDim

At a glance

CTDim is a software program for current and voltage transformer (CT, VT) dimensioning. Both protection and measuring cores can be considered.

The benefits of working with CTDim include:

- dynamic check and optimization of CT requirements
- simulation of CT transient behavior
- automated report generation and project oriented documentation
- CT dimensioning and settings calculation for high impedance differential protection

The challenge

The development of the digital protection technology and the introduction of gas insulated switchgear (GIS) have lead to a paradigm change in CT and VT dimensioning. As a result, the accuracy limiting factor of the CT plays an important role, rather than the nominal burden of the CT. Unfortunately, sometimes specifications regarding CTs have not been changed and are now in contradiction with the limited space reserved for CTs in GIS substations. Therefore, the optimization of CTs regarding both technical requirements of modern digital relays and economic aspects is becoming more and more important.

Our solution

CTDim makes CT and VT dimensioning more efficient. It saves engineering and production costs by optimizing the CT data.
CTDim is comprised of the following features:

- easy dimensioning of CT electrical data
- database of specific CT requirements for protection devices (Siemens and other manufacturers)
- input of CT data according to the following standards: IEC 61869 P, PR, PX, PXR, TPX, TPY, TPZ and ANSI class C
- conversion between standards
- automatically customized documentation (the user can modify the report with additional comments)
- transient simulation of CT behavior during short circuit
- export functions, e.g. transfer of the simulated curve in COMTRADE file format
- dimensioning of measuring CT
- dimensioning of VTs (accuracy burden check)

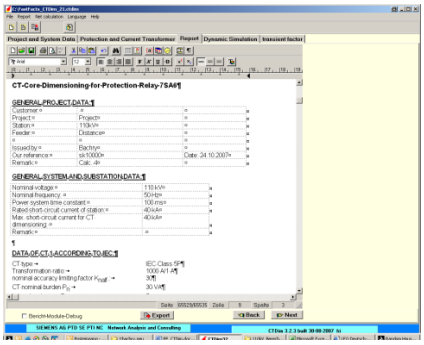

Figure 1: CT dimensioning report

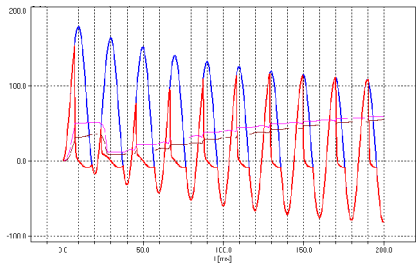

Figure 2: Transient simulation of CT behavior

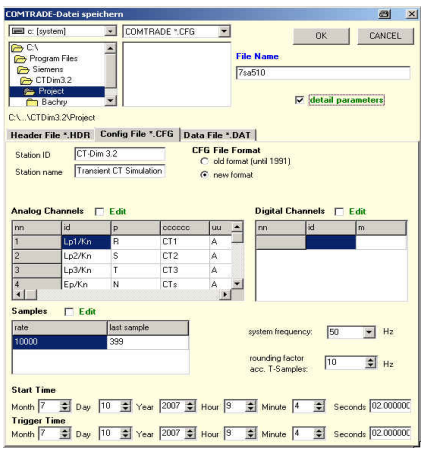

Figure 3: COMTRADE export (Microsoft® Windows®)

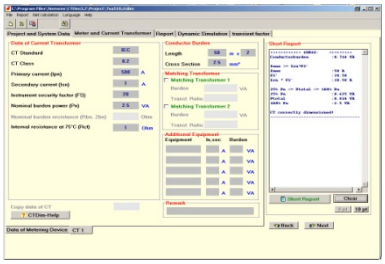

Figure 4: Data input for measuring CT

Application examples

In new substations, the process of CT dimensioning takes place at the beginning of the project planning for the switchgear. Since the CTs act as an interface between primary and secondary system, a lot of clarification work has to be done at this stage of the project planning. The function of CT, which is specified according to the secondary equipment it will be connected to, has a straightforward influence on its size and in consequence on the sizing of the whole switchgear.

Therefore, it is very important that at that time, the protection philosophy and the characteristic data of the equipment are known. In practice, however, it is often impossible to collect all of the necessary data at this early stage. On the other hand, the primary equipment design should be fixed in order to start production of the switchgear. Moreover, not only specified secondary functions, but customers' habits also play an important role in the selection and sizing of current transformers.

Thus, the CT dimensioning process is a multi-level optimization task, involving knowledge not only about the primary and secondary equipment, but also about the surrounding network in which the switchgear will be put into operation. Direct cooperation between the primary/secondary engineering and the manufacturer of the CTs is often indispensable. In this relation, a lot of knowledge and personal experience is necessary to manage this process.

CTDim can help to handle this process, since many scenarios can be quickly calculated and the data influencing the CT size can be optimized. The user can carry out the simulation of CT transient behavior using the transient simulation module of CTDim. Thereby not only CT parameters, but also fault current values, primary system time constant and fault inception angles can be defined.

As a short example, the figure below shows the transient simulation of a CT class 5PR used for bus bar protection (Siemens 7SS52). The performance of 3000 A / 1 A CT, 5PR30, 5 VA, RCT <10 Ω is simulated for 40 kA short circuit current with 100 ms primary time constant and fault inception angle of 0°.

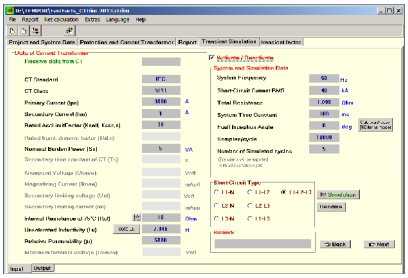

Figure 5: Transient simulation window

The resulting primary current (blue curve) and secondary current (red curve) are shown.

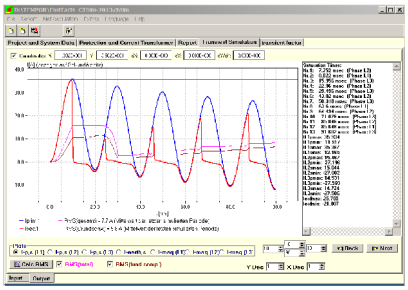

Figure 6: Transient simulation of a 3000 A / 1 A, 5PR30, 5 VA CT with R_{CT}<10 W

In Figure 6, the time to saturation of this CT is approximately 10 ms, which is much more than the required time by 7SS52 relay (3 ms).

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