GRIDSCALE X ADVANCED PROTECTION ASSESSMENT

Breaker Duty Module

Automated evaluation of current margins

SIEMENS

At a glance

The Breaker Duty module can be used to easily evaluate circuit breaker interrupting current margins. Support is provided for both IEC and IEEE/ANSI rated circuit breakers. All the circuit breaker data along with reclosing scheme information is stored in the Advanced Protection Assessment database. Detailed reports listing the breaker margins are provided.

The challenge

Breaker Duty automates the evaluation of breaker interrupting duty following approved procedures of either the IEC or ANSI standards. It streamlines the evaluation of new and existing breakers. Utility network circuit breakers isolate short-circuited equipment from the remainder of the network in a quick and effective manner. Utilities need to use software to evaluate the effectiveness of their breakers and ensure they are capable of interrupting the power at the proper time.

Our solution

Choice of IEEE/ANSI or IEC type calculations

The starting point for evaluating the breaker interrupting rating is a fault calculation. This fault calculation is performed on a phasor-based model of the network – as in Advanced Protection Assessment SC – and it produces what is known as the “symmetrical first cycle current”. Both the IEEE/ANSI and the IEC standards use very similar methods to compute the network model and determine the initial fault current. There are some differences in the way generators, motors, and transformers are handled, and Advanced Protection Assessment accounts for these differences when the network model is built. There are significant differences between the standards when it comes to determining the actual interrupting current – the current that the breaker will need to interrupt.

The IEEE/ANSI method is governed by the standard C37.010-1999. It uses a special system X/R ratio at the fault point as defined by the standard, along with the relay operating time and the breaker opening time, to determine the so-called “XR multiplicative factor”. This factor is then multiplied by the initial symmetrical current to arrive at the actual interrupting current. This current is then compared with the breaker’s interrupting capacity (after any derating for reclosing duties), to determine the available breaker margin. Advanced Protection Assessment can also handle IEEE/ANSI breakers that are rated according to the Total current standard (C37.5-1979).

The IEC method is governed by the standard IEC 909. It does not use the XR multiplicative factors. The X/R ratio at the fault point is determined from the Thevenin impedance at the fault point, (with a suitable correction). Then, the decaying dc current is computed based on the breaker’s opening time and the relay operation time. The dc component at breaker opening is added to the initial current to get the actual interrupting current. This current is compared with the breaker’s interrupting capacity.
IEC type breakers are not derated for reclosing duties other than normal.

In Advanced Protection Assessment, the user can easily choose to use IEC or ANSI/IEEE type calculations on the Session Setup form.

Library of breaker models and reclosing schemes

The user first creates a library or catalog of circuit breaker models and reclosing schemes that are in use in his company. Once the model is created, it can be used at any number of locations in the system.

A breaker model is defined by its manufacturer and model name. In addition, the model stores the rated interrupting time of the breaker, its interrupting capacity, the rated kV and maximum kV, the K factor (if any), the period of manufacture (pre or post 1960), the interrupting medium – air, oil, gas, etc. and whether the breaker is rated according to the “Total” or “Symmetrical” standard (IEEE/ANSI only).

Reclosing schemes are defined in terms of the number of openings and the time-intervals between the openings. Circuit breaker interrupting capacities have to be applied to oil and air-magnetic IEEE/ANSI breakers only. IEC type breakers are not derated.

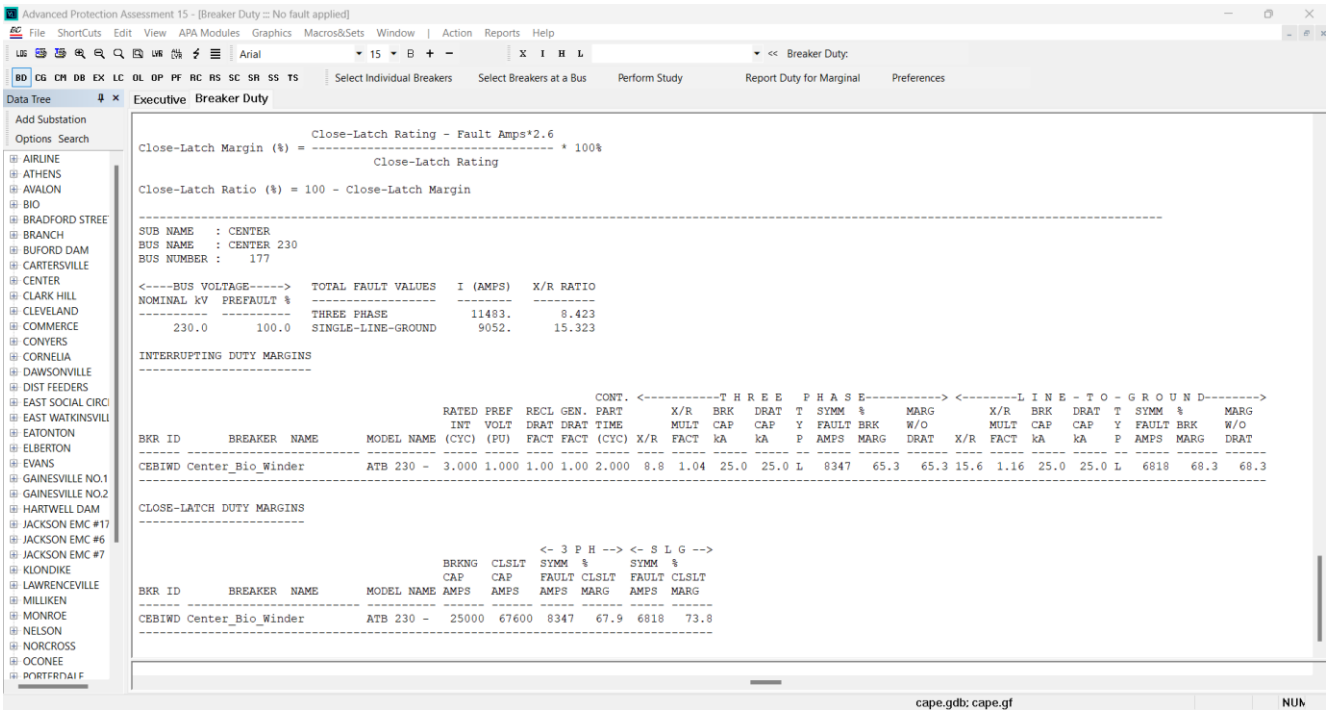

Figure 1: Choose to use IEC or ANSI/IEEE standard calculations when you use the Session Setup form.

Model any breaker configuration

Breakers in the breaker catalog can be used at any location in the system. When placing a breaker in the system, the user chooses the breaker model, the reclosing scheme if any, and the network equipment for which the breaker is responsible. Advanced Protection Assessment allows the user to model virtually any type of breaker configuration. Shown here is a breaker being used as the line breaker in a breaker-and-a-half configuration. The user chooses the branch being protected on either side of the breaker. Additionally, the user specifies relay operating times and operating voltages (if different from what is initialized by Advanced Protection Assessment SC).

Virtually any type of breaker configuration can be chosen for analysis.

Many ways of selecting breakers for study

The user can select breakers to study in a number of ways:

- Select individually, from easy-to-navigate forms.
- Select all breakers at a particular bus.
- Select all breakers in a bus set. The bus set can be all buses at a certain voltage level or all buses in a substation, or all buses in the network.
- From the one-line diagram, the user can right-click on a bus and choose to study all breakers that are connected to that bus.

Options for controlling the study and the reports

A number of options are available to the user for controlling the study and limiting the output. Some of these are:

- Specifying the allowed breaker margins for three-phase and single-line-ground faults.
- Evaluating single-contingencies. Choosing this option will force the breaker margin to be computed by outaging connected branches one at a time. Normally, the worst-case margin occurs for the case when all equipment is in service. But it may be that outaging a connected branch produces the highest current that the breaker will have to interrupt.
- Using a breaker operating voltage that is different from what it is first initialized to. In the absence of a load-flow calculation, prefault bus voltages in Advanced Protection Assessment are initialized to 1.0 pu. However, if the user knows that the bus to which a particular breaker is connected is operated at a voltage different from 1 pu, he can specify that voltage on the breaker form in the system. Choosing this option will force the breaker margin to be computed with the specified voltage, instead of the voltage to which the bus is initialized.

Reports

Typically, Breaker Duty reports print the available margins of all the breakers that were selected for the study. This report can be filtered so that only those circuit breakers that violate either the single-line-ground margin or the three-phase margin are printed. Additionally, the close-latch margins can be computed and reported. Reports detailing the breaker system data and the breaker catalog data for the selected breakers can also be produced.

Typical reports include interrupting duty margins and close-latch margins for all selected breakers or only for those with violations.

Features

- Choice of IEEE/ANSI or IEC type breaker evaluation
- Library of circuit breaker models and reclosing schemes
- Ability to model virtually all breaker configurations
- Graphical and batch selection of breakers for studies
- Many options to specifically tailor the study and reports
- Clear and detailed reports

Published by
Siemens AG
Smart Infrastructure
Grid Software

Siemens Technopark
Humboldtstr. 64
90459 Nuremberg, Germany

For the U.S. published by
Siemens Industry Inc.

3617 Parkway Lane
Peachtree Corners, GA 30092
United States

For more information, please contact: Gridscale-X-APA-Contact.si@siemens.com

Article No. SIDG-T10015-00-7600 – Advanced Protection Assessment – Breaker Duty Module