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ASPEN Breaker Rating Module

We are creating a new Breaker Rating Module to streamline the otherwise tedious work of checking the rating of circuit breakers against the short circuit currents they need to interrupt. The output of the Module is a text report showing the fault current as a percentage of the rating. The report calls attention to those breakers that are operating at or near their short circuit ratings and therefore warrant closer scrutiny by the protection engineers.

Before using the Breaker Rating Module, you must first enter the breaker information in *OneLiner*™ V1999 (which will be released at the same time as the module.) We designed the data structure in such a way that each circuit breaker is associated with the bus where it resides — and not with a line or a transformer, so that each breaker can be linked with up to two lines or transformers. The reason behind this design is illustrated in the breaker-and-a-half example in Figure 1. Breaker A in this configuration has to be checked against a close-in fault on Line 1; thus it is linked with only one line. Breaker B has to be checked against the maximum of two faults: a close-in fault on Line 1 and a close-in fault on Line 2; thus it is linked with two lines. You can also link the breaker with a generator. In the case of a generator breaker, the breaker rating is checked against the generator current, instead of the total fault current.

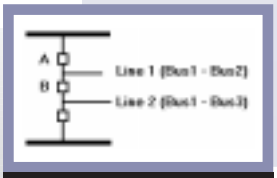

Fig. 1: A typical breaker-and-a-half configuration at Bus1.

Fig. 2: The info dialog box of Breaker A, which protects a single line (selected in the combo box near the bottom of the dialog box.) This breaker is rated on a total-current basis.

Figures 2 and 3 show the breaker data of Fig. 1. You can see from these dialog boxes the different data requirements for the older breakers that are rated on a total-current basis, and the newer breakers that are rated on a symmetrical-current basis. Figure 3 also demonstrates how you can enter the reclosing information.

The Breaker Rating Model can accept either a binary data file or a text data file as input. The dialog box of Figure 4 appears when you execute the Check Breaker Rating command within the Breaker Rating Module.

For each breaker, the module simulates the following faults and computes the fault current and the ANSI X/R ratio:

- A bus fault, both 3-phase and single-line-to-ground, at the breaker bus. For generator breakers, this is only fault simulation.
- A bus fault, both 3-phase and single-line-to-ground, at the same bus, with the first protected branch taken out of service. This effectively simulates a close-in fault on the first protected branch with the far end open circuited.
- The same faults as the last item, but with the second protected branch outaged. This step is skipped if the breaker has only one protected branch.

Fig. 3: The info dialog box of Breaker B, which protects two lines. This breaker is rated on a symmetrical-current basis and is designed to reclose on a fault.

The procedure for rating breakers is complicated and headache inducing, but here are the details. First, a multiplying factor, which can be looked up from a set of digitized charts, is applied to each of the fault currents. The multiplying factor depends on the X/R ratio of the fault, the interrupting time and the contact parting time of the breaker, as well as the method of rating (total current or symmetrical current). If the breaker recloses, then the rating is reduced by a derating factor.

For an older breaker, the program has to compute its short-circuit current rating based on the breaker's MVA rating and the operating voltage. For newer breakers with nominal voltage less than 121 kV, the short-circuit current rating

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ASPEN
34 North San Mateo Dr., San Mateo, CA 94401
Phone: (650)347-3997 FAX: (650)347-0233
schan@aspeninc.com www.aspeninc.com

also has to be adjusted based on the maximum design voltage and the voltage-range factor of the circuit breaker.

The module then compares the adjusted short-circuit current rating to the adjusted short circuit current. The module identifies the most severe case and flags it if it exceeds the user-defined margin, which is typically around 70 to 80 percent.

Fig. 4: Options for breaker rating checking.

In the final step, for older breakers, the module multiplies the adjusted fault current by 1.6 and compares the result to the momentary current rating. Again, the module identifies the most severe case and flags it if it exceeds the user-defined margin.

The results are written to a text file. The program gives you the option of outputting all the cases checked or just the ones that are potentially troublesome. You can view this file within the module or send it to a printer.

The Breaker Rating Module will be released before the end of 1999. The license fee for the module is $5,000, regardless of the number of copies of *OneLiner* your company has licensed.

Recent and Upcoming Releases

- *ASPEN DistriView*™ V1999, July 1999.
- *ASPEN Relay Database*™ V1999, Access, Oracle and SQL-Server versions, July 1999.
- *ASPEN OneLiner* V1999, Dec. 1999.
- *ASPEN Power Flow*™ V1999, Dec. 1999.
- *ASPEN Breaker Rating Module*™, Dec. 1999.

Employee Profile

Thanh Nguyen joined ASPEN in August, after completing his Ph.D. work on the subject of utility reliability assessment at the University of Wisconsin. Thanh led a team of graduate students working on software projects while pursuing his Ph.D. degree. The software they helped develop included Cooper Power System's V-NET and V-HARM.

Thanh is originally from Vietnam. Prior to coming to the U.S., he received his B.S. and Master of Engineering degrees from the Moscow Power Engineering Institute in Russia, and a Master of Engineering degree in Energy Planning and Policy from the Asian Institute of Technology in Thailand. Thanh is fluent in English, Vietnamese and Russian.

At ASPEN, Thanh will help maintain and develop various software products. Currently, he is working on the Breaker Rating Module. We are very pleased to have Thanh as part of our software team.

Upcoming Events

- OneLiner Users Group Meeting, Spokane, WA, Oct. 25, 1999.
- DistriView Users Group Meeting and Training Class, San Francisco, Feb. 3-4, 2000.
- OneLiner Training Class in Philadelphia, Feb. 9-11, 2000.
- OneLiner Training Class in Amsterdam, The Netherlands, October 5-6, 2000.

New Users

ASPEN DistriView™

- ABB, Ltd., Taipei, Taiwan
- City of Redding, CA
- Luz y Fuerza del Centro, Mexico City, Mexico
- Municipal Electric Authority of GA
- Tenaga Nasional Berhad, Petaling Jaya, Malaysia
- Haight & McLaughlin, Inc., Juneau, AK
- Merced Irrigation District, CA
- Southern Peru Copper Corp., Lima, Peru
- Sentry Technical Services, Millarville, AB, Canada
- Tackett Electric Co., Richmond, VA

ASPEN Line Constants Program™

- Universidad de la Rioja, Logrono, Spain
- Western Power, Perth, Australia

ASPEN OneLiner™

- PDVSA Petroleo y Gas, S.A., Caracas, Venezuela
- City of Tallahassee, FL
- Beckett and LaRue, Inc., Evergreen, CO
- Emirates Trading Agency, Dubai, U.A.E.
- EPRO, Llc., Augusta, ME
- NorControl, Madrid, Spain

ASPEN Power Flow™

- City of Anaheim, California
- NorControl Madrid, Spain

ASPEN Relay Database™

- ARCO Alaska, Inc., Deadhorse, AK
- City of Riverside, CA
- NorControl, Madrid, Spain

ASPEN Leaflet Editor: Sherman Chan. Readers are encouraged to submit articles to Editor, *ASPEN Leaflet*, 34 North San Mateo Dr., San Mateo, CA 94401.