

## Simpow Dips

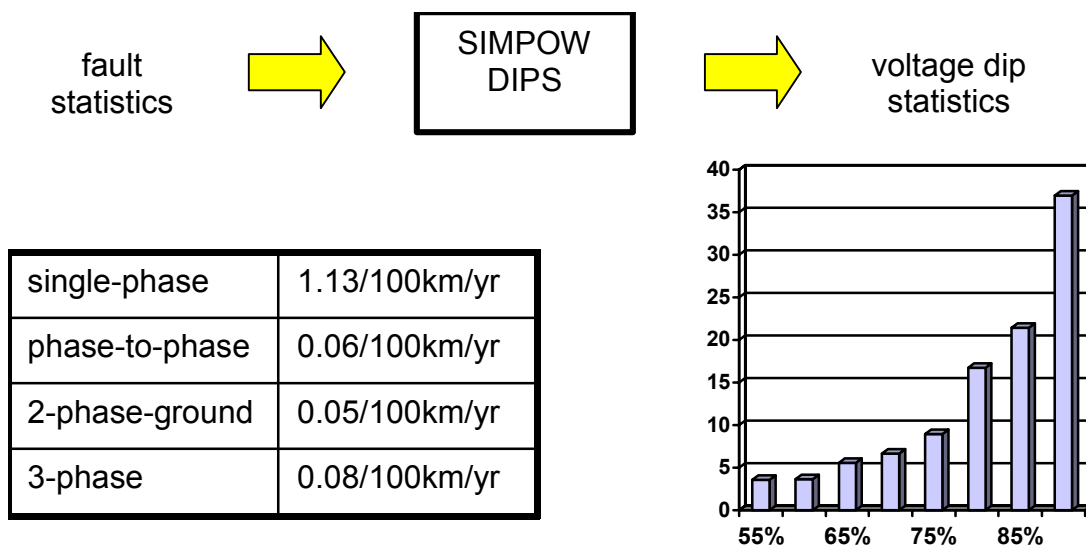
STRI can now offer a new module for voltage dip analysis, Simpov Dips. From the input data, consisting of the standard network description used in Simpov together with the fault frequency for the components, the module calculates the expected number of dips for all locations in the network. For further information, see also the following pages.

Yours sincerely,

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## Simpow Dips – New module in Simpow for estimation of dip frequency from fault statistics



Calculates the expected number of voltage dips with different magnitudes and angles due to faults in the network. The information required by the customer (number of dips) is calculated from information available to the network operator (number of short-circuits and earth-faults).

Can be used, e.g.:

- To estimate how many dips and production stoppages a certain customer will experience per year.
- To set demands on the dip immunity for industrial installations and for generator units (e.g. distributed generation or wind-power installations).
- To compare different solutions to improve power quality: e.g. improvement of end-user equipment or in the network.
- To compare different network configurations and seasonal changes: e.g. generator and maintenance scheduling.
- To set limits to the fault frequency during the design of new transmission lines.

The new module in Simpow is available from November, 2005.

For further information, please contact STR I ([simpow@stri.se](mailto:simpow@stri.se)), and see next page.

## Introduction

The Simpov Dips software is a module in Simpov for voltage dip analysis. The input data consists of the standard network description used in Simpov together with the fault frequency for the components.

The program calculates the expected number of dips for all locations in the network. The program output is a standard data output (cumulative number of dips per location) and a detailed list of data that can be used to present the results in any user-specific way. Included in the calculation are dips due to single-phase, phase-to-phase, two-phase-to-ground and three-phase faults.

## Calculation theory

The calculations are based on the so-called "method of fault positions" [1][2]. With this method a large number of fault positions are defined in the network. Each fault position represents faults in a small part of the network and is associated with a certain expected number of faults per year. The four different fault types are applied at the fault positions one at the time and the during-fault voltages ("residual voltages") at the customer locations in the network are calculated by using the well-established method of symmetrical components.

Simpov Dips calculated during-fault voltages in a three-phase system. For three of the four fault types the three voltages are different for the three phases. A classification method has been developed that results in a characteristic voltage that is independent of the monitor connection (phase-to-ground or phase-to-phase) or the winding-connection of the transformers between the fault and the customer location. Simpov Dips uses the complete classification method and characterizes the dip by its type, characteristic (residual) voltage, PN-factor and zero sequence voltage. The classification method is described in detail in [2][3][4].

## Output data

SIMPOW DIPS results in two different output files. Both are ASCII files that can be read directly into Excel and other plotting and analysis programs. The standard output file contains the cumulative distribution of the characteristic residual voltage for each node. This function shows how many times a year each node is expected to have a characteristic voltage equal to or less than a given value (the so-called "cumulative voltage-dip frequency").

The second file contains the detailed calculation results with voltage dip characteristics (dip type, characteristic voltage, PN-factor, zero-sequence voltage) for all nodes in the network due to the different fault types at each fault position. This file can be used to present the results in any user-specified way and for further analysis of the calculation results.

## Interface with Simpov

The input to the Simpov Dips module is found in three files, two of which are obtained directly from Simpov whereas the third one is created by the user. The otes-file contains the network model and the load flow results. It is generated by Simpov when a loadflow calculation is performed for the network. The dynpow-file contains sequence and generator data. It is created according to the standard Simpov procedure as described in the Simpov user manual. The fault frequency data file contains the fault frequency data for the nodes and lines in the network. It is created by the user as a text file in ASCII format in the same way as the other Simpov files.

## References

- [1] *IEEE Recommended Practice for the Design of Reliable Industrial and Commercial Power Systems* (IEEE Gold Book), Chapter 9, Voltage sag analysis - L.E. Conrad, M.H.J. Bollen and others, IEEE Std.493-1997.
- [2] *Understanding Power Quality - Voltage Sags and Interruptions* – M.H.J. Bollen, IEEE Press, New York, 2000.
- [3] *Characterization of voltage sags experienced by three-phase adjustable-speed drives* - M.H.J. Bollen, IEEE Transactions on Power Delivery, Vol.12, No.4, Oct. 1997, pp.1666-1671
- [4] *Different methods for classification of three-phase unbalanced voltage dips due to faults* - M.H.J. Bollen, L.D. Zhang, Electric power systems research, Vol.66, No.1, July 2003, pp.59-69.