European Association for the Development of Renewable Energies, Environment and Power Quality (EA4EPQ)	*International Conference on Renewable Energies and Power Quality* (ICREPQ'10) Granada (Spain), 23rd to 25th March, 2010

The role of the dc-bus in voltage sags experienced by three-phase adjustable-speed drives

Mañana, M.; Muñiz, L.M.; Ortiz, A.; Aranda, R.; Arroyo, A.; Delgado, F.

Department of Electrical Engineering
E.T.S.I.I.T. University of Cantabria
Avda. Los Castros s/n
39005 Santander, Cantabria
Spain
Phone: +34942201378 Fax: +34942201385 Email: mananam@unican.es

Abstract. This research work is devoted to the critical evaluation of the role of the dc-bus in the behavior of three-phase adjustable-speed drives with voltage sags. In particular, the dc-link voltage variation under voltage sag and its dependence on bus capacity, dc-link resistance and inductance and source impedance.

The analysis can be used to introduce additional capacitance in the dc-link in order to increase the ride-through capability of the ASD.

Both an electromagnetic transient model and a set-up facility have been introduced. This test platform can be used in order to study the sensitivity of ASD to different disturbances.

Keywords. power quality, sags, PWM drives, ASD

1. Introduction

A voltage sag or dip can be defined as a reduction of the voltage related to the nominal value with a duration that can go from one cycle to some few seconds. The effects of voltage sags on adjustable-speed drives (ASD) has been studied from different points of view [1–4].

2. Electric Circuit Model

The simplified equivalent electric circuit model of the ASD is shown in fig. 1.

The basic model of Fig. 1 has been implemented using PSCAD [5]. This model can be considered a basic approach for analyzing the behavior of the residual voltage at dc-bus as a function of L_{dc}, C, R_g, L_g and the voltage sag depth and duration.

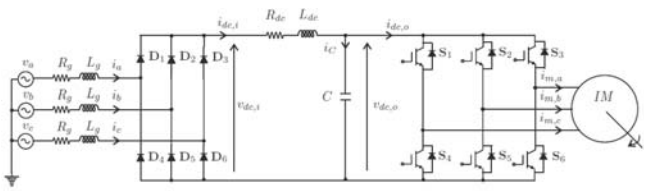

Figure 1. Equivalent circuit model of the ASD power stage.

3. Results

The basic equivalent circuit of fig. 1 has been simulated using PSCAD/EMTDC [5] for a 1.5 kW equivalent machine. This software has a powerful multiple run module that can be used to study the sensitivity of electrical parameters.

The full paper shows the impact of voltage dips over the dc-bus as a function of the ratio between the short-circuit power and the nominal power of the ASD considering a dc-link capacity C of 300 μF.

4. Conclusions

The survival of the ASD to voltage sags depends on the trip-point settings of the drive protections and the way the control is implemented. Undervoltage protection with a trip point set close to the nominal voltage will cause high sensitivity to sags. An increase in the capacity at dc-bus will increase their immunity to voltage sags.

References

[1] M. Bollen, "Characterisation of voltage sags experienced by three-phase adjustable-speed drives," *Power Delivery, IEEE Transactions on*, vol. 12, no. 4, pp. 1666–1671, Oct 1997.

[2] M. H. J. Bollen, *Voltage Sags and Interruptions*. John Wiley & Sons, 2000.

[3] J. Cano, G. Orcajo, C. Rojas, M. Melero, and M. Cabanas, "Technical and economical assessment of the effect of voltage sags on adjustable speed drives," in *International Conference on Renewable Energies and Power Quality (ICREPQ)*, Barcelona, 2004.

[4] J. Collins, E.R. and A. Mansoor, "Effects of voltage sags on ac motor drives," in *Textile, Fiber, and Film Industry Technical Conference, 1997., IEEE 1997 Annual*, May 1997.

[5] *PSCAD Electromagnetic Transient. User's Guide. V4.2.*