An Exploratory Review of Full Bridge DC-DC Converter and Its Performance

Mangesh Choudhari[1], Varsha Mehar[2]

[1,2]Department of Electrical Engineering, RKDF University, Bhopal, India

Abstract* - Performance and scalability of the DC-DC converter have, current applications within low voltage. The DC-DC converter is an electronic circuit and it is needed to change dc electrical energy efficiently from one voltage level to another voltage level. This paper has done a survey on different types of DC-DC converter. The push pull converter gives a high efficiency. Higher output power can be achieved either by step-down or step-up. DC-DC Converter is also known as Voltage regulator that custom switches, inductor and capacitor for power transformation and switched mode operation. A dc - dc converters are widely used in dc motor drive applications and in regulated switch - mode dc power supplies. An unregulated dc voltage is given as input to the converter. This unregulated dc voltage is resolved using line voltage.

***Keywords* - DCDC converter, Switching loss, Conduction loss, Zero-Voltage Switching.**

I. INTRODUCTION

Push-Pull converter is a converter circuit that makes use of push type and pull type device which are usually BJT, FET, MOSFET, IGBT and SCR.Push-Pull is a word related with two switches where both switches are attached to the positive or negative leg of the dc power supply. The push pull converter involves a supporting circuit consisting of an induc- tor, two switches and four diodes is used for accomplishing high efficiency. A high efficiency push pull dcdc converter with low circulating current and zero-voltage switching (ZVS) characteristic throughout a full range of loads is projected. [1]. Small disturbances are in the form of load changes while large perturbations are in the form of faults, such as tripping transmission line dropping in generators and change in loads in the electrical systems. The electrical power system stability depends on both the initial operating state of the electrical system and the severity of the disturbances. For each operating condition, the behavior and severity of the contingencies of the operating electrical system will be different. The severity of contingencies depends on the location, type and duration of faults. Usually, the power system is altered so that the post disturbance steady state operation differs from that prior to the disturbances [2]. Thus, suppose the electrical power system initially operates in a bulk steady state operation condition, when the moment disturbance occurs, there will be change in the topology of the electrical power network. Therefore, when the electrical power system stabilizes, the new steady state operating condition will be different from the previous one. The degree of severity for the disturbances and the probability of occurrence in the electrical networks is varying [3]. In order to never lose the synchronism, the electrical power system should be designed and operate to withstand various types of contingences. When different contingences cause changes in system conditions or load demand due to various reasons, this will cause a progressive and uncontrollable drop in system frequency and voltage profile. Due to electrical system insta- bility, the dynamic changes and stability of electrical systems depend strongly on the size of the disturbances that may occur [4].

II. FREQUENCY STABILITY

The frequency stability is the ability of the power system to maintain steady state frequency, following a severe system upset, resulting in a significant imbalance between generation and load. Frequency stability depends on the ability to restore the equilibrium between system generation and load demand with minimum loss of loads. Various reasons can lead to loss system frequency stability, like loss of generation which may result from sudden imbalance between system generation and load demand [1] [5]. Therefore, frequency instability is due to electrical power deficiency [5]. Large deviation of both system frequency and voltage, in addition to power flow and other system parameters generally lead to sever system upsets. The interconnected power systems can be commonly associated with splitting systems into islands with different capacity of generation and certain loads. The response of these islands can be observed by focusing on system frequency instead of relying on the relative motion of machine. Frequency stability is a very important issue in isolated island grids when these small systems are exposed to various severities of disturbances, such as loss of generation or loads [2]. Generally, the lack of frequency instability is associated with several problems, such as poor coordination of operation control, protection devices, weakness of equipment response and deficiency in generation reverse [1][3][4]. Since the electrical power system is highly nonlinear, the classification has become essential for electrical power system stability problems. In order to understand the instability problems and develop solutions regarding the phys- ical nature of the instability, the size of disturbance and time frame are necessary to be deliberately estimated [6]. Therefore, according to IEEE / CIGRE Task Force [1], frequency stability as shown in figure 1 can be classified into shortterm and long term phenomena: For shortterm phenomena, frequency instability is creation of islands with inadequate generation and insufficient frequency load shedding, leading to system

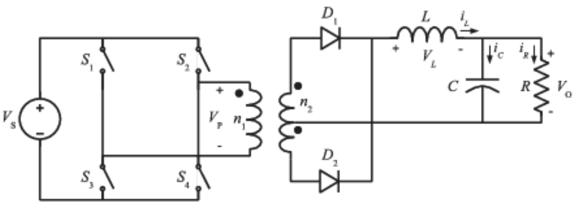

Fig. 1. Full Bridge DC−DC Converter

frequency decay and blackout for the island in few seconds. For longterm phenomena, such as steam turbine over speed control, boiler / reactor protection and control, the response for time will range from ten second to several minutes. The lack of system frequency stability resulting from unbalance between production and consumption may have a significant impact on voltage magnitude, especially for island cases or overloaded situations which lead to decrease in voltage magnitude. Similar situation will lead to decrease in voltage magnitude. There are other important aspects that affect on system frequency dynamic behavior, such as structure of power system. There is important relation between electrical network structures and risks within networks [7]. The structures of electrical power system involved with generation and transmission are transformers limit and capacity, load demand and nature of the loads that have direct impact on frequency stability in power systems. The structure of power system and grid performance has implications for managing and mitigating failures inside electrical networks [8].

III. IMPORTANCE OF FREQUENCY STABILITY

There are several factors that need to be considered to keep the system frequency in power system in narrow band:

- The performance of the generators in traditional power stations is highly dependent on the performance of all auxiliary electric motors drives. These auxiliaries deliver air and fuel to the boiler, oil bearings and cooling services for the entire systems. If low speed occurs due to low frequency, it will significantly affect these auxiliaries. The output for the power stations will reduce, and this phenomenon will lead to several cascading shutdowns of the power stations.
- The frequencies below 47 Hz will lead to damage of steam turbines, while hydro power plants and thermal units are more robust. Frequencies down to 45 Hz, may face the worst, which is disconnection
- Power transformers are sensitive to system frequency variations and might be overloaded if the frequency deviates from the normal value.
- To ensure that AC electric motors operates at a practically constant speed, a fixed speed is necessary. In several consumer applications, an AC motor is used to drive the equipment at an approximately fixed rate.
- The main frequency may be employed in electronic applications as a basis for timing various processes.

IV. LITERATURE SURVEY

A. Integral stability controlling Techniques

There are various types of load frequency controller, the PI controller is most widely used to speed-governing system for LFC scheme. An advantage of the PI control technique is to reduce the steady-state error to zero by feeding the errors in the past forward to the plant. The most of proposed techniques were based on the classical proportional and integral (PI) or proportional, integral and derivative (PID) controllers [3]. Its use is not only for their simplicities, but also due to its

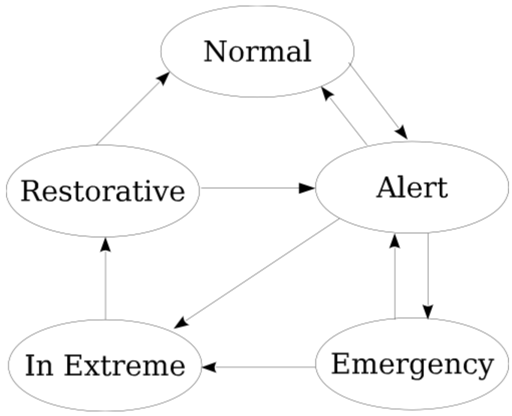

Fig. 2. Operating States for Electrical Power Systems

success in a large number of industrial applications. For PID controller design, overshoot/undershoot and settling time are used as objective function for multi-objective optimization in LFC problem. One of the developments in the field of modern control theory is in the direction of its application in optimal control allows the power engineers to cope withthe problems arising out of due to the complex structure of power systems [9].

B. Fuzzy Logic Technique

The development of design techniques for power stability control of a system in the last few years is very significant in terms of fuzzy logic. AGC regulator designs are based on adaptive control schemes [6].

The AGC regulator design techniques using modern control system theory enable the power engineers to design the optimal control system with respect to given performance criteria.

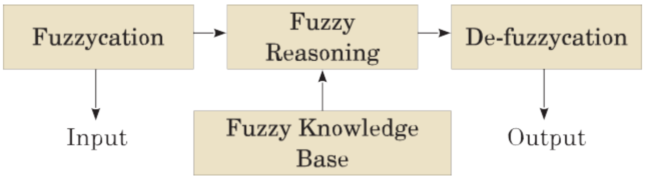

Fig. 3. Fuzzy Logic

Most of the researchers have taken the dynamic system equations for the development of adaptive controller, to cope up the change in process parameters and non-modelled process dynamics [10].

V. CONCLUSION

This paper discusses about the power system stability con-trol techniques which gives an overview of issues in voltage and frequency control system design concepts were followed by discussion about different methods for load frequency control like classical models and modern control concepts. In modern concepts different optimal voltage and frequency control schemes and intelligent voltage and frequency control schemes are discussed. Intelligent control techniques with different optimization algorithms may give better results for Load Frequency Control.

REFERENCES

[1] L. Jiang, W. Yao, Q. H. Wu, J. Y. Wen, and S. J. Cheng, “Delay- dependent stability for load frequency control with constant and time-varying delays,” IEEE Transactions on Power Systems, vol. 27, no. 2, pp. 932–941, May 2012.

[2] R. Diwakar, K. Banerjee, and T. K. Mukherjee, “Coordination of economic load dispatch and load frequency control for interconnected power system,” Journal of The Institution of Engineers (India): Series B, vol. 96, no. 1, pp. 47–54, 2015.

[3] N. K. Bahgaat, M. I. El-Sayed, M. A. Moustafa Hassan, and F. Bendary, Load Frequency Control Based on Evolutionary Techniques in Electrical Power Systems. Cham: Springer International Publishing, 2016, pp. 851–873.

[4] M. Anderson and Z. Zuang, “Power system stability for a distributed grid system involving wind and hydro power gen- eration,” in Power System Control and Embedded Systems (ICPCES), 2012 2nd International Conference on, Dec 2012, pp. 1–6.

[5] A. K. Marten and D. Westermann, “Load frequency control in an interconnected power system with an embedded hvdc grid,” in 2012 IEEE Power and Energy Society General Meeting, July 2012, pp. 1–7.

[6] A. H. Mazinan and A. H. Hosseini, “Application of intelligence- based predictive scheme toload-frequency control in a two-area interconnected power system,” Applied Intelligence, vol. 35, no. 3, pp. 457–468, 2011.

[7] Y. Wang, R. Zhou, and C. Wen, “New robust adaptive load- frequency control with system parametric uncertainties,” IEE Proceedings - Generation, Transmission and Distribution, vol. 141, no. 3, pp. 184–190, May 1994.

[8] X. Yu and K. Tomsovic, “Application of linear matrix inequal- ities for load frequency control with communication delays,” IEEE Transactions on Power Systems, vol. 19, no. 3, pp. 1508– 1515, Aug 2004.

[9] D. Rerkpreedapong, A. Hasanovic, and A. Feliachi, “Robust load frequency control using genetic algorithms and linear matrix inequalities,” IEEE Transactions on Power Systems, vol. 18, no. 2, pp. 855–861, May 2003.

[10] V. Jeyalakshmi and P. Subburaj, “Pso-scaled fuzzy logic to load frequency control in hydrothermal power system,” Soft Computing, vol. 20, no. 7, pp. 2577–2594, 2016.