PROTECTION SCHEME OF HVDC GRID BASED ON MMC

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Abstract: -Due to the high penetration of renewable energies, a versatile HVDC network area unit with several connections is required. However, the protection problem is still a serious challenge. This can mainly be due to the low inductance in the DC network compared to AC interconnection. This generally leads to an unforeseen collapse of the DC voltage and a rapid increase in the fault current, which occurs within a few milliseconds harmful levels reached. Therefore, failures in the MT HVDC system must be quickly identified and eliminated before it reaches a harmful level; Typically, 4 to 6 ms (including the disconnection time of the electrical fuse) depending on the cause of the fault. For this reason, the unit area of protection techniques based mainly on transients is ideal. The subject of protection must be trustworthy and trustworthy. Protection algorithms based primarily on transients use the higher frequency elements of the signal generated by the fault to find a fault, creating the ability to find the fault while the fault current continues to rise and is well before steady-state. The normal protection algorithms developed for standard high voltage AC (HVAC) systems, such as a reserve speed and which in the event of a fault range unit can only isolate the faulty section, i.e. necessary to avoid a complete system failure over a short period of time , they are at risk of DC faults.In order to ensure high reliability and continuous operation, the fast and selective device area protection systems are indispensable. This project analyzes the transient voltages in the event of DC line faults in the HVDC network on the basis of Standard Structure Devices (MMC). MMC. The HVDC network is MATLAB of sculptural abuse and area unit for in-depth simulations conducted to verify the effectiveness of the proposed theme. Keywords - DC line protection; HVDC network with several connections; Classification of defects; Incorrect pole selection;

INTRODUCTION

Transient Fault Voltage Introduction Modular Construction Converter (MMC) is gradually being used in versatile HVDC systems and has a large capacity [1-3]. In the near future there is a good chance of determining MMC priorities in huge multi-terminal HVDC networks [4]. HVDC systems, HVDC networks with several connections offer higher transmission redundancy and adaptability [5,6]. However, the protection system restricts the case of HVDC networks to an excessive extent [7,8]. When a DC fault occurs in a multi-port HVDC network, the most effective protection alternative is to isolate the faulty branch with a DC fuse (CB) instead of sacrificing AC circuit breakers or fault tolerant converters [9]. The primary alternative ensures the traditional function of the healthy branches. However, due to the low electrical resistance of the DC network, the fault current reaches 10 times the nominal value [10,11] in a few milliseconds, which endangers the instrumentality of the converter and the CB of CC. Therefore, an area unit is indispensable for fast protection principles. Distance and overcurrent protection are widely used in AC transmission system. use the distance protection directly in the DC system, since the electrical resistance of the first harmonic of the network cannot be delimited [12]. In [12] and [13], the parameter analysis is used to restore the fault distance. used, whereby the accuracy deteriorates with increasing cable length. References [9,14] apply the topic of overcurrent to the protection of HVDC networks, but the division unit ownership and reliability suffers from gigantic fault resistance. 14], overcurrent protection is combined with directional and undervoltage protection to improve protection reliability, but this ends in the extended fault detection method. or current and voltage level spinoff range unit used as main protection while current differential protection is used as backup protection. Such protection criteria can also be used to the DC line protection in HVDC networks, with the exception of this differential protection due to its long-time delay. Supported effects on the current limiting throttle limitation, use the voltage rate of change to distinguish internal faults from external faults The reference combines the protection strategies of the rate of change of the current with the voltage level. These protection strategies meet the need for speed of protection, while sensitivity and reliability can decrease in the event of enormous reliability. In fault location strategies based on traveling waves, the area unit for DC line protection suggests that this area unit supports one or two connection measurements. Once only native data is used, the time of arrival of each of the initial and reflected waveforms of the error purpose must be determined. The detection of the reflected traveling wave is difficult because of its attenuation. within the process of propagation and confusion with alternate image waveforms, the signal transmission between 2 ports introduces a delay in communication, although the problem of fault location with two ports does not have to be forced to live the arrival time of the mirror waveform. When analyzing the fault transient voltages under the DC line condition with distributed parameters, this document introduces a topic of unitless DC line protection for MMC multi-pole HVDC networks based on the fault classification technique (within one ms) and high sensitivity even with a large one Fault resistance (eg 400 Ω) In contrast to conventional protection based on traveling waves, the fault classification threshold is also determined by a theoretical calculation instead of a simulation.

MMC:

Grid-connected photovoltaic energy conversion systems are the source of electrical energy that has grown rapidly in recent years (from 10 to 100 GW in just five years) [1]. Currently, photovoltaics accounts for 35% of wind energy and is following the same trend of becoming a major player in the energy markets in some regions, but at an accelerating pace. The main reason for this development is the cost reduction in photovoltaic modules, which paved the way for large photovoltaic or utility systems. The developments in converter topologies for photovoltaic systems have concentrated on small or medium-sized systems (roof and small photovoltaic systems) for the so-called string and multi-string inverter configurations [2], [3]. Photovoltaic systems are mainly connected with the classic two-stage voltage source inverter, also called central inverter [1]. The central inverter works with low voltage, limited by the DC-side voltage below 1000 V due to the insulation limits of the PV module. One or two voltage boosters t transformer stages: one for medium voltage in the internal collector of the photovoltaic system and one for high voltage at the substation level for transmission A typical example of a large photovoltaic system is shown in Figure A. An alternative to the single stage central inverter is the two-stage power conversion configuration, which is an additional one for higher energy efficiency DC-DC stage used for a chain-distributed MPPT. This DC-DC stage can also provide galvanic isolation to avoid a low frequency transformer. Both options, DC-DC with low-frequency transformer (LF) and DC-DC with high-frequency transformer (HF) are also shown in the illustration as alternatives. Different configurations are also possible in a photovoltaic park, especially if these are put into operation in different stages

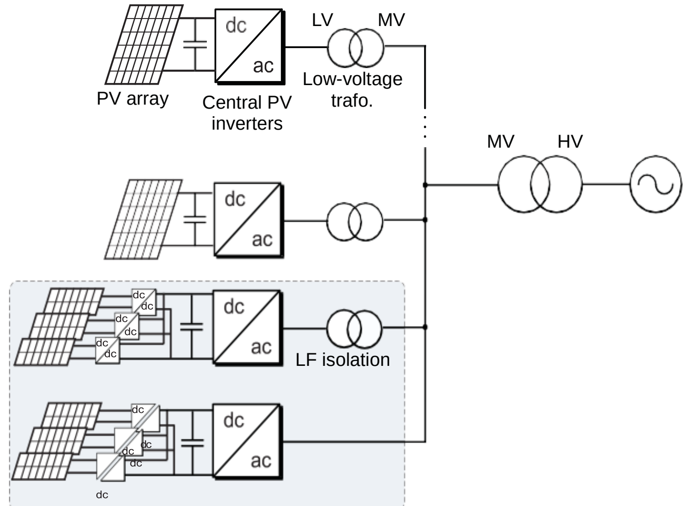

Fig. 1. Traditional grid-connected large-scale PV plant, shown with central inverters and with alternative options based on two-stage multi-string versions.

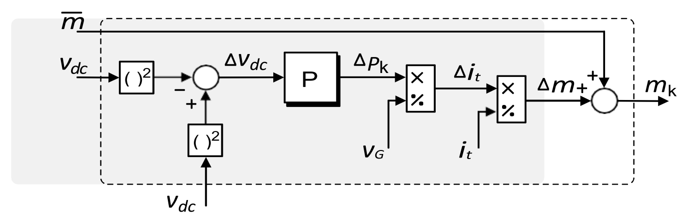

Fig.2 DC-link imbalance compensation block diagram for power cell

To overcome the low voltage limitation imposed by the DC side, multi-stage converter topologies have been proposed to arrange grid-connected photovoltaic configurations that are distributed on the DC side but connected to medium voltage AC networks [4] - [16]. In particular, the cascaded H-bridge has attracted a lot of attention due to the large number of available DC link connections that enable multiple single-line MPPT connections [11] - [16]. These AC grid-connected multilevel inverters function as central inverters, but with string or multistring capability on the DC side, with medium-voltage operation, higher grid quality, higher efficiency and smaller filters, which makes them an attractive development field for large-scale AC grid photovoltaics makes systems. Worlds where large-scale photovoltaics could be profitable are a far cry from consumer areas like desserts in Chile, Australia and Middle Eastern countries. n Consumption centers are on the other side of the seas, such as cities (mainland) and islands in Greece or Europe and North Africa, while for long airlines (more than 400 km) or submarine cables (more than 70 more km), HVDC transmission is the best Choice. In order to connect a large-scale photovoltaic system from such a remote area to a main point of consumption, the current technology would therefore first require a DC-AC photovoltaic power plant like the one in Figure 1 and then an AC-DC HVDC station

PROPOSED CONTROL METHOD

The proposed control method consists of two completely decoupled control stages, one for the MPPT DC / DC converter and one for the DC / DC converter. The first stage of regulation is responsible for performing MPPT and regulating the voltage of the input PV string. The second control stage, which is carried out by the DC-MMC or the line-side converter, has several control objectives, including - DC link total voltage control (power control), individual DC-link voltage control (to compensate for power imbalances between the cells) and line current control.

Conclusion

From the above results, we therefore concluded that when using MMC at the shipping location, the error will not affect the voltage and current waveform. The article has described the modeling process of an MT MMC HVDC system, including the structure of the system, determining the value of key parameters, the various modeling techniques available, and the many control functions required. Your essential contribution is that the essential aspects of MMC HVDC modeling were summarized and described in a compact and integrated manner. The document also highlights areas for further research, particularly the need for more detailed publications information on the general reliability of the MMC HVDC system required with connected AC systems. Finally, the MT MMC HVDC model developed in this document is used to show how MV control strategies can affect the MMC branch flows.

References:

[1] Ahmed N, Angquist L, Mahmood S. Efficient modeling of an MMC- based multi- terminal DC system employing hybrid HVDC breakers. IEEE Trans Power Del 2015;30(4):1792–801.

[2] Hu J, Xu K, Lin L, Zeng R. Analysis and enhanced control of hybrid-MMC-based HVDC systems during asymmetrical DC voltage faults. IEEE Trans Power Del 2017;33(3):1394–403.

[3] Zuniga-Garcia L, Zaragoza-Hernandez A, Nadal-Martinez JM. MMC technology and its participation in the integration of variable renewable energies and implementation of DC grids. In: IEEE int autumn meeting Ixtapa, Mexico; Nov. 2014.

[4] Rodriguez P, Rouzbehi K. Multi-terminal DC grids: challenges and prospects. J Mod Power Syst Clean Energy 2017;5(6):1–9.

[5] Tang G, He Z, Pang H. Basic topology and key devices of the five-terminal DC grid. CSEE J Power Energy Syst 2015;1(2):22–35.

[6] Li C, Hu X, Guo J. The DC grid reliability and cost evaluation with Zhoushan five- terminal HVDC case study. Power eng conf, Stoke on Trent, UK, Sep. 2015. 2015.

[7] Bucher MK, Franck CM. Contribution of fault current sources in multiterminal HVDC cable networks. IEEE Trans Power Del 2013;28(3):1796–803.

[8] Li R, Xu L, Yao L. DC fault detection and location in meshed multi-terminal HVDC systems based on DC reactor voltage change rate. IEEE Trans Power Del 2017;32(3):1516–26.

[9] Wang Y, Yuan Z, Fu J. A feasible coordination protection strategy for MMC-MTDC systems under DC faults. Int J Electr Power Energy Syst 2017;90:103–11.

[10] Zou G, Feng Q, Huang Q. A fast protection scheme for VSC based multi-terminal DC grid. Int J Electr Power Energy Syst 2018;98:307–14.

[11] Song G, Luo J, Gao S. Detection method for single-pole-grounded faulty feeder based on parameter identification in MVDC distribution grids. Int J Electr Power Energy Syst 2018;97:85–92.

[12] Yang J, Fletcher JE, O'Reilly J. Short-circuit and ground fault analyses and location in VSC-based DC network cables. IEEE Trans Ind Electron 2012;59(10):3827–37.

[13] Feng XY, Qi L, Pan JP. A novel fault location method and algorithm for DC dis- tribution protection. IEEE Trans Ind Appl 2017;53(3):1834–40.

[14] Stumpe M, Tunnerhoff P, Dave J. DC fault protection for modular multi-level converter-based HVDC multi-terminal systems with solid state circuit breakers. IET Gener Transm Distrib 2018;12(12):3013–20.

[15] Sneath J, Rajapakse AD. Fault detection and interruption in an earthed HVDC grid using ROCOV and hybrid DC breakers. IEEE Trans Power Del 2016;31(3):973–81.

[16] Wang Y, Zhang B, Fan C. Fast protection scheme for overhead transmission lines of VSC-based HVDC grid. Automat Electr Power Syst 2016;40(21):13–20.

[17] Raza A, Akhtar A, Jamil M. A protection scheme for multi-terminal VSC-HVDC transmission systems. IEEE Access 2017;6:3159–66.

[18] Wang D, Gao H, Luo S. Travelling wave pilot protection for LCC-HVDC transmission lines based on electronic transformers' differential output characteristic. Int J Electr Power Energy Syst 2017;93:283–90.