Control Strategy of Flexible HVDC Transmission System Based on MMC

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Abstract: Compared with the power supply system at both ends, the multi-stage power supply is more stable, but the corresponding internal line structure is also more cumbersome. A hybrid mode control scheme is set up in order to deal with the deficiency of current DC voltage, which introduces skew characteristics, delays the power impact force in the process, effectively reduces the power change of multiple stations when the system starts, and finally establishes the simulation design in the PSCAD/EMTDC.

1. Introduction

Based on the basic situation of the MMC-MTDC system, this paper analyzes the control scheme based on the multi-segment DC system.Through the study of the two control schemes, a hybrid control scheme is proposed, which not only combines the advantages of the first two systems, but also promotes the perfect treatment.

2. MMC-MTDC System Profile

Multi-stage transmission systems, which are generally divided into series or parallel connection lines, are mainly designed to be connected in parallel and connected to form a complete system structure, namely: three-phase MMC topology, as shown in figure 1, there are six bridge arms in the MMC, each of which contains a circuit induction device, bridge arm resistance and N cascade submodules[1].

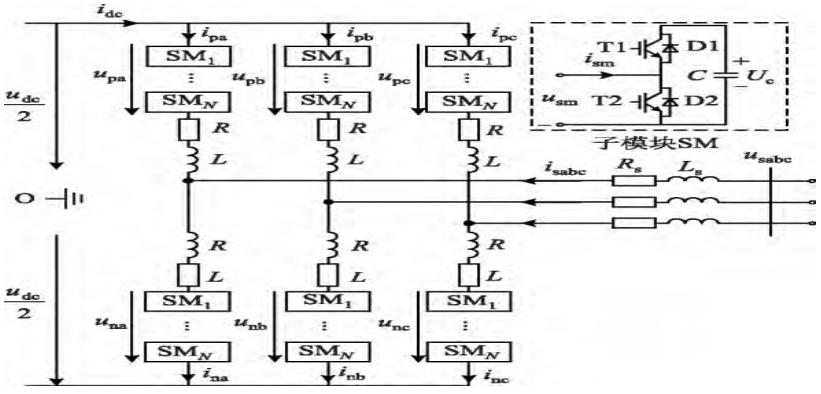

Figure 1 MMC basic topology

3. MMC Model Selection

MMC circuit adopts modular design, by controlling the number of conduction modules of the upper and lower arms, and the multi-level approximate sinusoidal inverter output waveform, it can also adjust the number of cascaded modules through this bridge arm to achieve the purpose of increasing the number and standby design situation, and then ensure the design quality of the

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module and shorten the time limit.

The high-level construction of flexible HVDC project puts forward more strict requirements for the simulation modeling technology of large power electronic equipment.At the same time MMC in practical engineering, the number of modules in series of each bridge arm can reach hundreds, so the detailed modeling and simulation of hundreds of nodes and the use of complex modulation strategy can fully understand the engineering situation and grasp the information. However, for the higher-order circuit model, the current processor computing speed can not meet the actual demand, so from the main circuit modeling work, the MMC model is established to improve the efficiency of electromagnetic transient multilevel inverter simulation.in view of this, the research mainly analyzes MMC traditional detailed model and effective model, and the effective model is based on the model segmentation MMC simulation model.

3.1. Mmc Model Simulation Requirements

MMC HVDC analysis and AC/DC network, A lot of new requirements are put forward for MMC electromagnetic transient simulation. MMC simulation model needs to accurately reflect the MMC transient characteristics, such as: communication fault, dc fault and reconciliation/latching transient behavior etc. In small and medium capacity, MMC HVDC transient process, Even the entire MMC and outlet - HVDC system is in operation, Because of the external grid, Maybe it's just a trend change, But with the improvement of MMC HVDC capacity and voltage level and the development of MMC HVDC project, MMC- the transient characteristics of HVDC itself can not be ignored. Parallel connection to the DC prop, For example, Multiple - MMC and HVDC lines, If it's not properly controlled, A line break can cause cascading failures on some routes, The wave of mass transfer around the communication line can lead to overload and shutdown, has a great influence on the stability of the circuit grid. Therefore, The complex ac/dc hybrid networks include MMC - DC simulation studies, Equivalent to MMC simulation model should not be a simple static trend model, But it accurately reflects MMC transient behavior, in order to truly simulate the interaction between the MMC HVDC and the external grid. Second, MMC simulation model requires high simulation efficiency. This is because of the integrity of complex AC/DC hybrid networks, Simulation is a very big project, does not allow MMC to occupy too much simulation resources of the simulation model. If it's too detailed, MMC the simulation of the model takes a lot of time, The simulation efficiency of the whole AC/DC hybrid network is greatly reduced. the analysis and research work on the simulation system is also poor. Therefore, Efficient MMC simulation model is an inevitable requirement of AC/DC hybrid network simulation analysis.

4. MMC-MTDC System Level Control Strategy

4.1. Dc Voltage Margin Control Strategy

This mode of control can also be effective in the absence of communication replacement work.How it works is shown in the following figure, P.x ,refRepresents various converter stations, where x are different values in the data ,Δ.UdcFor DC voltage margin[2].

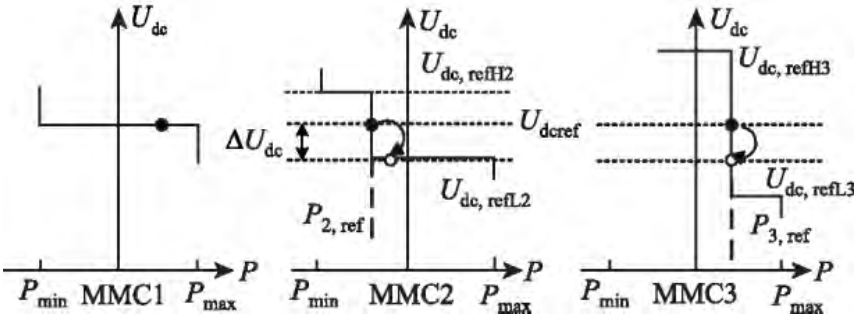

Figure 2 Basic principles of DC voltage margin control

Above MMC1 represents one of the most important converter stations, using fixed voltage

controls to ensure stable operation of the system.The latter two use direct voltage margin manipulations, in general, other converter stations to use without problems are required to be marked in the small ball (solid) position. when the converter station MMC1 is not working because of the problem, the dc system enters the power lower than the external transmission power, and the power generated by the power grid will be different, which will cause the voltage drop to occur. when it falls to the control range of the second part, the second part will adjust to the stable voltage through its own, and the third part will maintain the fixed power control because of the large voltage margin selection. The system will again remain in the position of the small ball (hollow) indicated therein[3].

A voltage margin controller in this paper is obtained by changing the external loop power controller, and the PI controller will be set up to ensure that it does not exceed the limit.

isd=max (i)sdlmin (i)sd2isdh))

The disadvantages of DC voltage control are:

When the main device does not work, there is only one auxiliary bit working alone, which makes the speed slow.

Voltage margin is difficult to choose from, if the selection of small will appear in the fluctuations of the wrong changes, but if the selection of large in the normal work into the size of confusion.

A short voltage shock occurs when the control mode changes.

4.2. Dc Voltage Droop Control Method

The following figure 3, figure 4 shows the characteristics of the P-U control in the DC voltage droop control method and the controller parts. If the disturbance fluctuation causes the power to change, the MMC1、MMC2 will find another smooth working position through the change of the power along the line tilted alone.

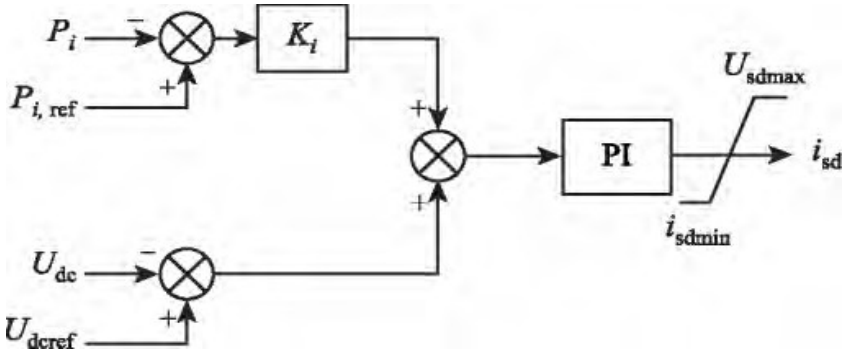

Figure 3 DC voltage sag control characteristics

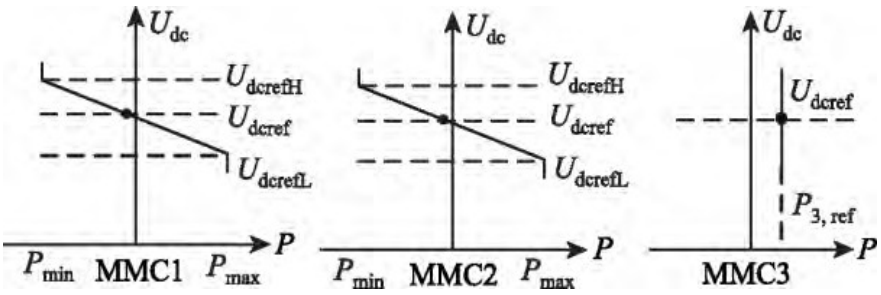

Figure 4 DC voltage droop controller

Suppose there are x droop operation characteristics used, then the remaining y-x power operation using fixed values, according to the data shown in the figure tilt, they will appear as follows:

UudcrefU -dc+kipi,refp -i)＝ 0

When the power of the DC system is unstable, the value of the distribution of abnormal power at each converter station using droop control depends on the size of the U-P characteristic tilt line K. KiΔPiAn inverse ratio, K.iIf the reactor becomes larger, the power of the instability i the converter station becomes smaller; the reverse is the same. The steady power of the system is replaced

between the assumed x stations when the K amount is the same in the total converter station droop operation machine. x of the droop control sites will work together to maintain stability, so it is more stable than ever. DC voltage droop control can avoid transient overvoltage in progress, but there will be some loopholes:

If the droop-controlled DC voltage is unstable, the system power will change.

When the converter station does not work, all the relevant droop control methods in DC system will have some problems.

3 can not effectively track the data issued by the system, there will be data deviation.

5. DC Voltage Hybrid Control Strategy

to reduce the problems of these two methods, this paper formulates a different dc voltage hybrid control method through the two schemes proposed above. in order to understand the hybrid control method more clearly, the paper makes a simple analysis, and this way is mainly a control method formed by mixing form between single and multi-segment converter stations, and the droop control is used at the appropriate stage to P the lines in it U this paragraph is changed into a tilted design idea.The specific design situation is shown in Figure 5 below.

When the small black ball in the figure can work normally, the main converter station 1 is controlled by a fixed value voltage; the secondary converter station 2 uses the mixed mode mentioned in the text; and the converter station 3 uses another control method through the matching between 2 and 3 in the figure.In the event of fluctuations, the converter station 2 and 3 will work together for unstable regulation, and finally when the work returns to stability, it will return to the position of the small ball (hollow). The power command value of auxiliary station 2 is no longer fixed, but the following numerical method:

Pi,ref =Prefi +(U)dcrefU -dcD)

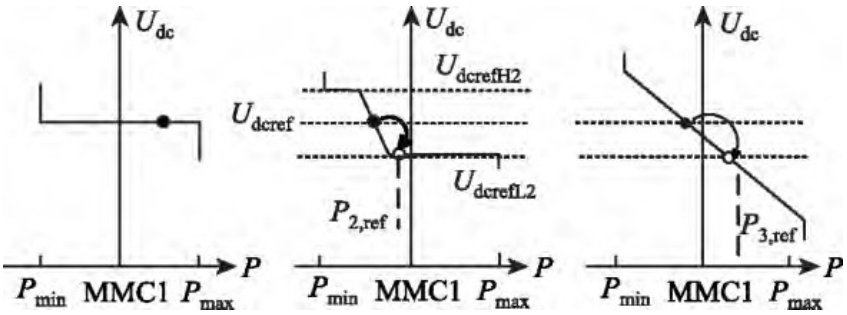

Figure 5 Basic principle of DC voltage hybrid control

6. Concluding Remarks

This paper expounds the principle of MMC general workflow, and through the analysis of its current situation and the understanding of the two MTDC control methods often used, the shortcomings of different levels are obtained from the workflow, and after this analysis, a new hybrid mode method is proposed. By using this method, the system can quickly find new work docking points and put into work quickly, thus effectively reducing the instability in the work and avoiding the impact on the overall control. At the same time, through the implementation of this method, Effectively avoids the fluctuation situation many converter station power work together brings the change.

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