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DESIGNING OF A NOVEL TOPOLOGY FOR APPLICATIONS OF HIGH-VOLTAGE DIRECT CURRENT SYSTEMS

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ABSTRACT:

For the past many years, huge research efforts were has made to improve converters mainly to make them more power resourceful than primary generation of voltage-source converters. In spite of advantages that are brought by the novel generation of converters, there are a number of aspects that can still be enhanced. Our work presents the analysis of a novel converter topology, which is part of new generation of voltage-source converters which is based on multilevel approach but in addition considers some characteristics from two-level voltage-source converter. This system is competent to produce a multilevel ac voltage and as its stacks of cells include H-bridge cells rather than half-bridge cells, they are capable to produce higher ac voltage than dc terminal voltage. This new topology does not compromise effectiveness of converter, nor on number of devices and still saves volume due to decreased number of cells for each arm.

Keywords: Voltage-source converters, H-bridge cells, Ac voltage, Half-bridge cells, Multilevel approach, Dc terminal voltage.

1. INTRODUCTION:

Increased attention was paid to a high-voltage, direct current transmission systems, particularly because most of new methods connect distant renewable sources to grid and the most efficient means to do it is to convey the generated power by means of high-voltage, direct current transmission. For offshore high-voltage, direct current transmission applications, voltage-source converters are additionally appropriate than current-source converters because of their black-start ability and capacity to function in weak ac grids [1]. On the other hand, when compared to current-source converters their power ratings are restricted and their effectiveness is to some extent lesser even if recent developments within semiconductor devices are closing gap in both cases in order that voltage-source converters are becoming reasonably viable as technological solutions in huge high-voltage, direct current transmission schemes. Our work presents the analysis of a novel converter topology, which is part of new generation of voltage-source converters which is based on multilevel approach but in addition considers some characteristics from two-level voltage-source converter. One of the characteristics of this topology lies in its capacity to maintain control of the phase current during loss of dc-bus voltage. The important advantage of this new topology lies in its decreased number of cells; as a result, it does not compromise effectiveness of converter, nor on number of devices and still saves volume due to decreased number of cells for each arm.

2. METHODOLOGY:

The modular multilevel converter replaced series-connected insulated-gate biploar transistor within each arm of two-level converter by means of stack of half-bridge cells which includes charged capacitor as well as a set of insulated-gate biploar transistors. As the voltage of each cell is minute when compared to the ac as well as dc voltages, a huge number of cells are placed within series in every stack that results in making of a voltage waveform by several steps [2]. This feature has two most important consequences such as: generated ac current is extremely close to sine wave and no longer need any filtering, consequently saving functioning of bulky as well as costly ac filters; converter does not depend on high-frequency pulse width modulation to syntheses voltage waveforms, therefore to a great extent reducing switching loss and thus improving overall effectiveness of converter. The prevention of ac filter means that cells are at present one of bulkiest modules of converter station and cell format necessitates a physically large capacitor. Half-bridge cells are in general used in preference to H-bridge cells to reduce number of devices in conduction at any instance and, thus, decrease conduction power loss. The failure of half-bridge cells to make a negative voltage results in conduction of anti-parallel diodes associated to insulated-gate biploar transistor, thus makes an unmanageable current path in collapse of dc bus voltage. Our work presents analysis of a novel converter topology, which is part of new generation of voltage-source converters which is based on multilevel approach but in addition considers some characteristics from two-level voltage-source converter. We propose a novel converter topology projected for high-voltage, direct current transmission applications, known as alternate arm converter. It is a hybrid among modular multilevel converter, due to presence of H-bridge cells, as well as two-level converter, as director switches within each arm. This converter is competent to produce a multilevel ac voltage and as its stacks of cells include H-bridge cells rather than half-bridge cells, they are capable to produce higher ac voltage than dc terminal voltage [3]. This new topology lies in its decreased number of cells; as a result, it does not compromise effectiveness of converter, nor on number of devices and still saves volume due to decreased number of cells for each arm. This permits alternate arm converter to function at the best possible point, known as sweet spot, in which ac as well as dc energy flows are equal. The director switches within alternate arm converter are accountable for alternating conduction time of each arm, leading to important reduction in number of cells within the stacks. Alternate arm converter can control current in phase reactor even in case of dc-side fault and manages ac grid [4].

3. AN OVERVIEW OF PROPOSED SYSTEM:

The alternate arm converter is a hybrid topology which merges characteristics of two-level as well as multilevel converter topologies. Each phase of converter includes two arms, each by means of a stack of H-bridge cells, a director switch, as well as small arm inductor. The stack of cells is accountable for multistep voltage generation, as within multilevel converter. The proposed topology is based on multilevel approach but in addition considers some characteristics from two-level voltage-source converter and is part of new generation of voltage-source converters. While H-bridge cells are used, voltage that is produced by stack can be moreover positive or else negative;

therefore, converter push its ac voltage high than dc terminal voltage if necessary. The director switch is includes insulated-gate biploar transistor associated in series to endure maximum voltage which might be functional across directors witch when it is in open state. These switches within alternate arm converter are accountable for alternating conduction time of each arm, leading to important reduction in number of cells within the stacks. This topology's important feature is controlling of the phase current during loss of dc-bus voltage. It does not compromise effectiveness of converter, nor on number of devices and still saves volume due to decreased number of cells for each arm. The most important role of director switch is to decide which arm is used to carry out ac current certainly; the important characteristic of this topology is to make use of basically one arm for each half cycle to build ac voltage [5]. This converter is capable to produce a multilevel ac voltage and as its stacks of cells including H-bridge cells and are capable to produce higher ac voltage than dc terminal voltage. By means of upper arm to build positive half-cycle of ac sine wave as well as lower arm for negative part, highest voltage that each of the stack of cells has to make is equivalent to half of dc bus voltage, which is roughly half rating of arm of modular multilevel converter. The aim of the proposed topology is to decrease number of cells, therefore the volume as well as losses of converter station. The short period when one arm ends its working time and hands over transmission of phase current to opposite arm is known as overlap period. While each of the contains an active stack of cells, it can completely control arm current to zero previous to opening director switch, therefore achieving soft-switching of director switch, later decreasing power losses [6]. Even though normally short, overlap period can offer extra control features, for instance controlling quantity of energy stored within the stacks.

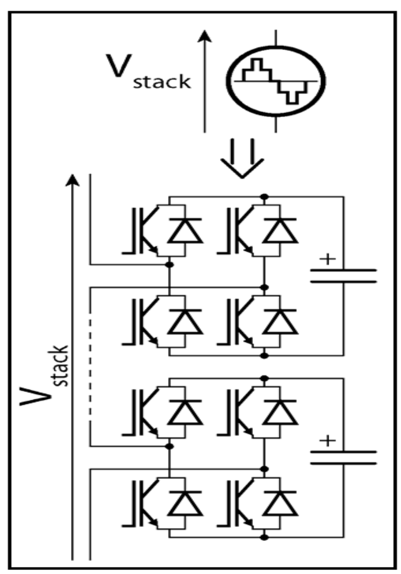

Fig1: An overview of H-bridge cells

4. CONLUSION:

We explains the principles, that are supported by simulation results, of a novel converter topology projected for high-voltage, direct current transmission applications, known as alternate arm converter. This novel converter topology is a part of new generation of voltage-source converters which is based on multilevel approach but in addition considers some characteristics from two-level voltage-source converter. It is a hybrid among modular multilevel converter, due to presence of H-bridge cells, as well as two-level converter, as director switches within each arm. One of the characteristics of this topology lies in its capacity to maintain control of the phase current during loss of dc-bus voltage. The significant benefit of this new topology lies in its decreased number of cells; as a result, it does not compromise effectiveness of converter, nor on number of devices and still saves volume due to decreased number of cells for each arm. This permits alternate arm converter to function at the best possible point, known as sweet spot, in which ac as well as dc energy flows are equal.

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