±800kV DC Power Transmission Converter Valve Structure Research

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Abstract. Converter valve was the core equipment of HVDC power transmission project, followed by the three-phase AC voltage was connected to the DC side to get the desired DC voltage and realize the power of control, its value accounted for about converter station complete sets of equipment for a total of 22 ~ 25%. Take Hami-Zhengzhou ±800kV DC power transmission for example, air insulation, water cooling, and suspension type double valve structure. Double valve was the 2 single valve series connection, each single valve, including 4 valve module, each double valve was a total of 8 valve module, the structure of a valve tower. This paper introduced high-voltage 800kV HVDC project converter valve main body structure, and structure of converter valve tower, valve module, valve assembly was analyzed.

1. Introduction

UHV ±800kV DC Power Transmission meet the need of long-distance and large capacity transmission, it can improve the transmission efficiency and reduce the transmission cost. HVDC converter valve is a 6 inches thyristor tube device of high voltage and large capacity controllable semiconductor switch based on is UHV DC transmission system to achieve AC and DC conversion core equipment, is the tight coupling of multi physics field of complex electrical system, the investment accounted for one-fifth of the entire investment in the converter station. Value of converter valve accounted for about converter station complete sets of equipment for a total of 22 ~ 25%. UHV ±800kV DC power transmission project includes 2 complete unipolar, divided into polar and polar. Each complete single pole is composed of a series of 12 pulse converter, which is composed of 2 equal voltage equal to the high end and low end [1-4].

2. Valve tower

The overall layout of the valve tower not only considers the needs of beautiful and electrical design, but also carefully considered many related factors, such as distance, air, air, internal interference, stray inductance, distributed capacitance, water pressure, weight distribution, installation, maintenance and test simple, etc.. At the same time, in order to achieve high reliability and long-term safe operation, careful consideration of the structural material selection and design of parts, reduce the risk of fire in the case of the flow valve.

Take Hami-Zhengzhou ±800kV DC power transmission for example, air insulation, water cooling, and suspension type double valve structure. Double valve is the 2 single valve series connection, each single valve, including 4 valve module, each double valve is a total of 8 valve module, the structure of a valve tower.

Shield cover is installed at the top and bottom of the valve tower. The edges and corners of the shield cover is designed according to the circular arc, the surface is smooth and without burr. It can effectively improve the distribution of the electric field distribution of the valve under high voltage operation.

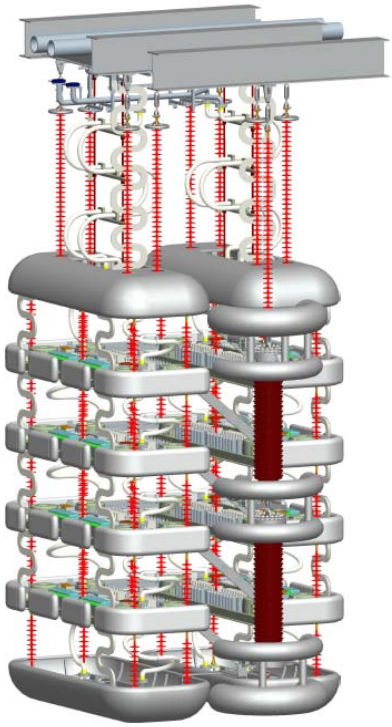

Fig.1 Double valve tower

3. Valve module

Valve module is an independent functional unit, the electric can be used as a complete single valve, and the series of multiple valve modules can meet the requirements of different voltage levels of DC transmission system. Valve tower in the same column next to the valve module adjacent to the isolation of the composite insulator, different columns of the adjacent valve module through the bus connection.

Valve module is composed of two valve components, each valve components by a number of thyristor level (maximum of 9) and the saturated reactor in series. Each of the thyristor stages including thyristor, damping capacity, damping resistance, DC resistance, resistance and TTM. The valve module frame is the main body of the valve module parts, and the various devices of the valve module are fixed on it.

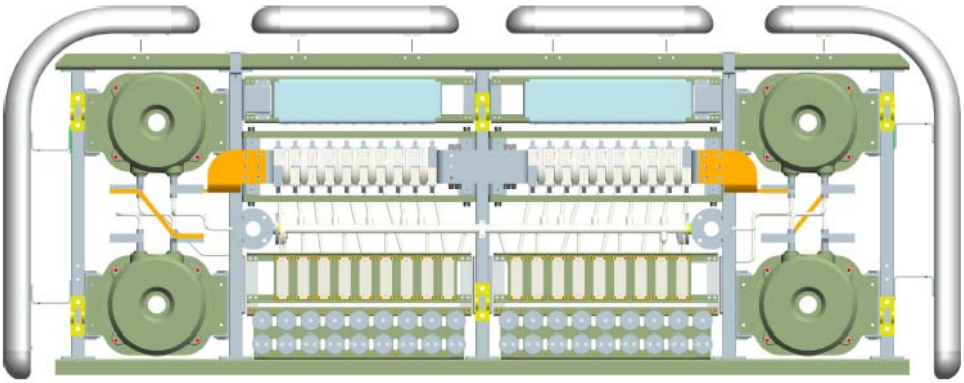

Fig.2 Valve module top view

The valve module frame is composed of 2 non halogen insulated tanks and 5 aluminum alloy beams. The insulating material is made of epoxy glass cloth composite insulation material, which is made of high strength, high insulation, aging resistance and flame retardant (meet the requirements of UL94-V0 or UL94-HB). Aluminum alloy beam using special section design, with high mechanical strength.

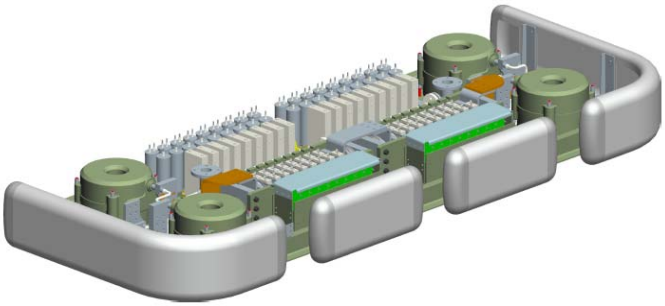

Fig.3 Valve module side view

4. Valve assembly

Valve assembly includes the Clamped Assembly TCA (Thyristor), door pole unit components, saturated reactor components, damping resistance components, damping capacitor components, DC voltage resistance, resistance, cooling pipe, and ancillary supporting structure and electrical connection structure. Damping resistance components, damping capacitor components and gate cell assemblies around TCA layout. Thyristor, damping resistance, DC voltage resistance and resistance to water cooling method.

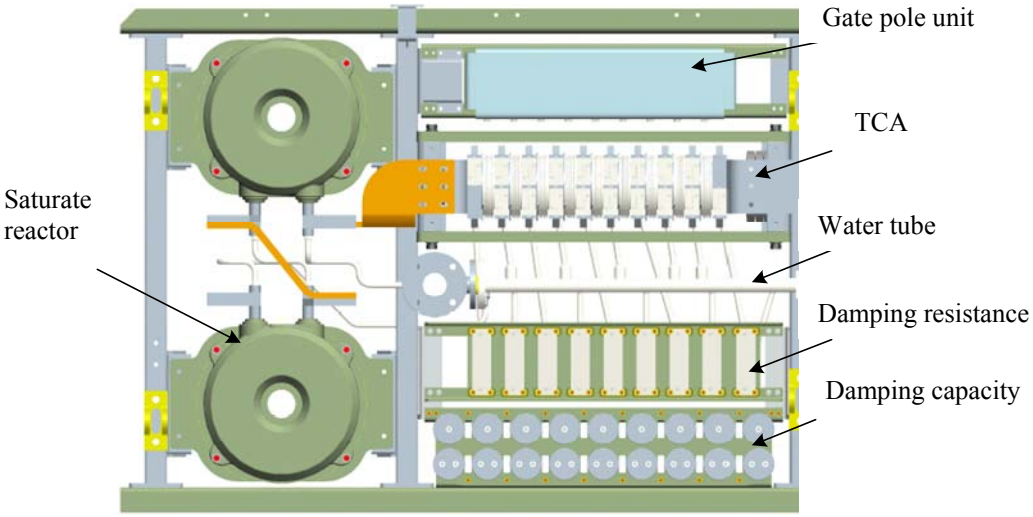

Fig.4 Valve assembly structure

Valve assembly includes the Clamped Assembly TCA (Thyristor), door pole unit components, saturated reactor components, damping resistance components, damping capacitor components, DC voltage resistance, resistance, cooling pipe, and ancillary supporting structure and electrical connection structure. Damping resistance components, damping capacitor components and gate cell assemblies around TCA layout. Thyristor, damping resistance, DC voltage resistance and resistance to water cooling method.

The DC voltage resistance is installed on the thyristor radiator to make full use of the cooling capacity of the heat sink. TCA internal conductive bus bar for the copper material, has good conductivity, can meet all the requirements of current conditions and has certain margin.

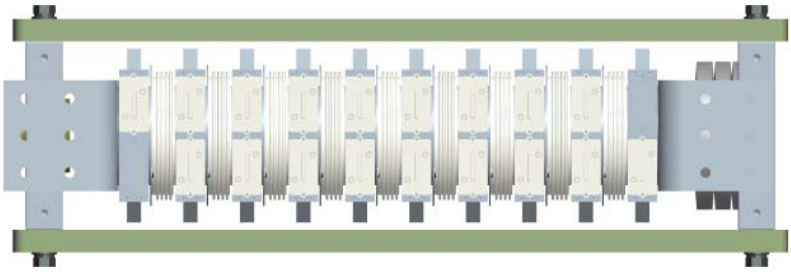

Fig.5 Thyristor pressure loaded structure

In order to inhibit thyristor opening when the current amplitude and current rate of rise and reduce the converter valve under transient impact crystal brake tube voltage withstand stress, while reducing the converter valve turn-on and turn off of valve components of voltage distribution is not uniform, each thyristor tube assembly series a full and reactor components.

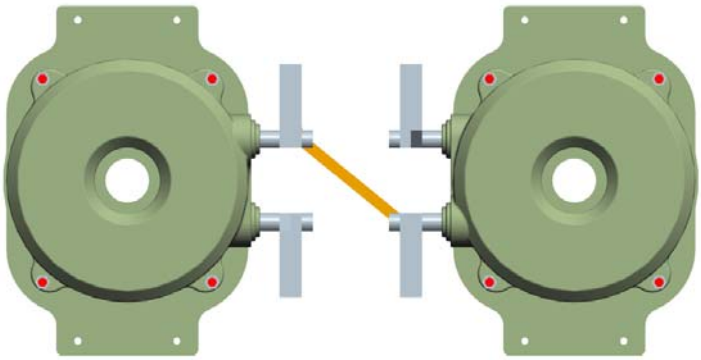

Fig.6 Saturated reactor module structure

The core loss of the saturated reactor is taken away by cooling water flowing through the hollow winding, and it can be ensured that the core of any working condition can be fully cooled, and the core temperature of the saturated reactor is not more than 100 at various operating conditions.

5. Summary

Converter valve is the core equipment of HVDC transmission project. Take Hami-Zhengzhou ±800kV DC power transmission for example, air insulation, water cooling, and suspension type double valve structure. Double valve is the 2 single valve series connection, each single valve, including 4 valve module, each double valve is a total of 8 valve module, the structure of a valve tower. Structure of converter valve tower, valve module, valve assembly was analyzed.

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