Power Electronic Transformer

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***Abstract* - The particular Force Electronic Transformer (PET) which is use for taking care of basic burden is introduced right now. A transformer is use to perform many functions like voltage transformation, isolation and also it is a very important component in power system. The Force Electronic based transformer is a multi-port converter which is associated on the essential side which having medium voltage level. Force electronic transformers (PETs) are proposed to supplant regular transformers and perform voltage guideline and force trade among age and utilization by electrical conversion with the help of power electronic devices. Right now, Electronic Transformer (PET) has been presented, which acknowledges voltage change, galvanic detachment, and force quality upgrades in a single device.**

***keywords* - Power Electronic Transformer, conventional transformer, voltage transformation, isolation**

I.INTRODUCTION

Dispersion transformer is the most significant hardware in power appropriation framework, which is chiefly answerable for voltage change and disengagement. Conventional appropriation transformer is entirely solid, however it is cumbersome, and sounds couldn't be disengaged between essential side and optional side. Additional equipment is required for the different protection system of the transformer. Therefore, the Power Electronic Transformer is invented which helps to maintain reliability of the system and better operation.[1] In recent years, the development of power electronics, especially after the emergency of the concept of smart grid, power electronic transformer (PET) has received increasingly more attention.[2]

Compared with the conventional transformer, power electronic transformer has many advantages such as: small in size, light weight, environmental pollution free, can act as breaker, less susceptible to load and able to improve power quality. The key part of power electronic transformer is the DC link which has a great effect on efficiency and size of the device, so how to reduce the size and weight of power electronic transformer becomes one of the most important research subjects currently.[3]The purpose of this paper is to present the key control strategies of solid state PET for electrical distribution system application, especially under voltage disturbance conditions. A few basic framework voltage unsettling influences are produced by an aggravation voltage source dependent on a three stage PWM inverter and the strong state PET model is tried and passed voltage unsettling influence ride through capacity. The outcomes check the PET force quality control capacities.

There are three primary stages as follows:

Information organize

Seclusion organize

yield arrange

II. THE BASIC PRINCIPLE OF PET

PET is mainly composed of the power electronic converter and medium/high frequency isolation transformer, as shown in figure 1, in which the power electronic converter mainly completes the conversion, control, protection of electrical energy. Medium/high recurrence disengagement transformer is for the most part liable for the change of the galvanic detachment. Because of the activity recurrence of transformer is conversely relative to its volume, the high-recurrence transformer can radically lessen the volume and weight and improve the limit and proficiency of the transformer.

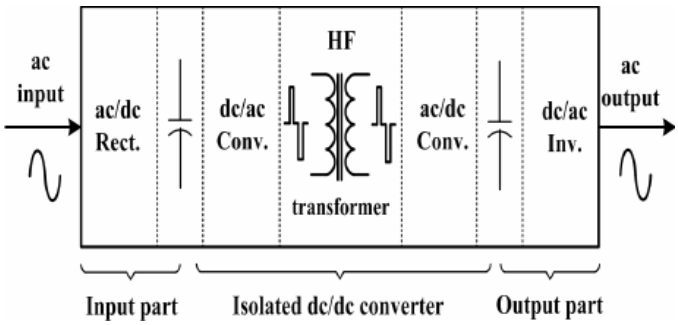

Fig (A) power flow diagrams of PET

According to whether contains dc link can PET be divided into two categories: one is direct AC/AC PET which does not contain dc link in the process of transformation, another is AC/DC/AC PET that contains dc link. Figure 2 shows the typical structure of AC/DC/AC PET [8]. This structure can realize the input power factor correction and suppress the bidirectional

harmonic flow. The use of integral modularized transformation method creates the concise structure. Furthermore, the proposed PET topology in this paper improves the structure with a muti-winding transformer.

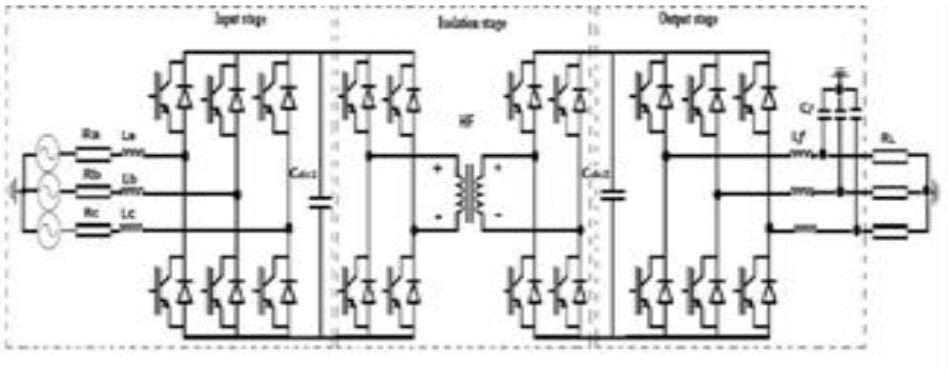

Figure.(B) AC/DC/AC topology of PET

The working rule of the PET is open. Right off the bat, input alternating current/DC converter changes over high voltage power recurrence rotating current AC to high voltage direct current (dc). Besides, the confinement DC/alternating current in inverter changes over direct current into high recurrence substituting current square wave. At that point through high recurrence seclusion transformer, the square wave is coupled to the transformer bad habit side. The seclusion ac/DC rectifier changes over rotating current square wave to low voltage direct current. At last, the yield DC/Ac inverter changes over direct current to required rotating current.

III. THE SYSTEM STRUCTURE OF PET

Figure C shows the primary circuit topology of a three-stage four-wire PET which is reasonable for the savvy appropriation organize. This is a common ac/DC/AC type tertiary structure that contains information, detachment and yield. In figure C, ea,eb,ec are three-phase grid voltage; iga,igb,igc are three-phase grid current; Lg is filter inductance for the grid side; udcH is the high voltage dc bus input voltage; udcL1,udcL2,udcL3 are the isolation low voltage dc bus output voltage; iLa,iLb,iLc are the inverter bridge arm output current; Lf is inverter output filter inductance; Cf is inverter output filter capacitor; ioa iob ioc are three-phase load current.

The contribution of PET embraces three-stage PWM full controlled rectifier which has developed innovation, can run with high force factor and is generally utilized by medium force limit PWM rectifier. The seclusion single stage full scaffold inverter converts high-voltage direct current to high recurrence square wave that is access to the essential side of the high-recurrence transformer. Transformer's vice side is made out of three single stage full extension rectifiers which convert high recurrence square wave to coordinate current. The output is made up of three two-level single stage full scaffold inverter and LC channel, and uses YN association with structure the three-stage four-wire framework. This topology is adaptable to control, straightforward and simple to acknowledge three stage free control.

Figure D shows the information control square graph. ș is the yield power network voltage vector edge of stage bolted circle, and ș=àt. À is the rakish recurrence of the force framework voltage, right now rad/s. ed eq are d and q hub parts of intensity framework voltage. igd igq are d and q pivot parts of intensity network current udcH* is the reference value of dc bus voltage udcH. igd* igq* are the reference values of igd igq. In order to achieve the unit power factor of input, the reference value of q axis current igq* is set to 0. The isolation module uses open loop control to convert input dc to high frequency square wave whose duty ratio is 50%. At that point the square wave is coupled to the bad habit side of the high-recurrence transformer and changes into dc signal through a rectifier. The high recurrence transformer essentially. The high frequency transformer mainly

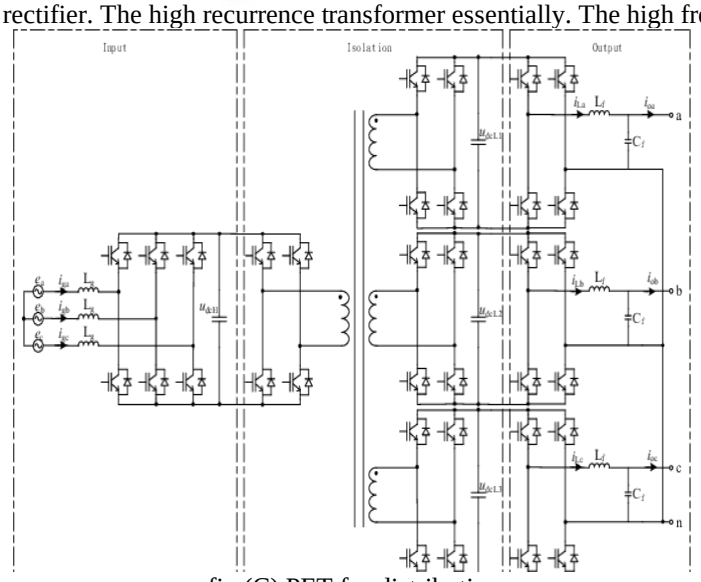

fig.(C) PET for distribution

The operating principle of the PET is accessible. Firstly, input PWM rectifier converts high voltage alternating current (ac) to direct current (dc). Besides, the front-end inverter of segregation part changes over direct current into high recurrence square wave. At that point through high recurrence confinement transformer, the square wave is coupled to the bad habit side. The back-end rectifier of disengagement part changes over alternating current square wave to low dc voltage. At last, the yield inverter changes over the dc voltage to required alternating current and voltage. Principle parameters of the framework are appeared as follows: (1) Info arrange: appraised line voltage is 600Vac, evaluated line recurrence is 50Hz, input inductance is 1.5mH, high voltage dc connect capacitors are 2160ȝF, exchanging recurrence is 4.8 kHz, semiconductor switches are SKM400GB176Ds; (2) Confinement organize: exchanging recurrence is 2 kHz; transformer essential optional proportion is 3:1:1:1, low voltage dc interface capacitors are 3000ȝF, essential semiconductor switches are SKM400GB176Ds and auxiliary switches are SKM300GB128Ds; (3) Output stage: output channel inductance is 0.4mH, yield channel capacitors are 50uF, exchanging recurrence is 10 kHz, and switches are all SKM300GB128Ds. It is found in Fig.1 that the proposed PET topology has its internal high voltage and low voltage dc interface, so the voltage unsettling influence and burden aggravation seclusion would be conceivable with the help of dc link buffer capacitors. Also, this topology can segregate the front-end and back-end through the shut of disengagement transformer in some crisis circumstances. Further efforts should be made on the key control strategies, especially in the front-end rectifier.

IV. EXPERIMENT

To approve the exhibition of the PET, a 100KW 600V/220V three-stage four-wire PET trial model is assembled dependent on the DSP TMS320F2812. Principle parameters of the framework are as per the following: (1) input: line voltage 600V, recurrence 50Hz, channel inductance 1.5mH, high voltage dc side capacitor 2160uF, switching frequency 4.8kHz; (2) isolation: working frequency 2kHz, transformer change ratio 3:1:1:1, low voltage dc side capacitor 3000uF; (3) output: filter inductance 0.4mH, channel capacitor 50uF, exchanging recurrence 10kHz; three-stage opposition heap of low voltage side 10.67ȍ.Figure 6 shows the 100 KW PET model's photographs of information and disengagement module.

Restricted by experimental conditions, the load power tested in the lab is only 15KW which means system is at light load condition. Figure 7 shows the PET's trial waveforms. Figure (a) shows three-stage input line voltage waveform estimated by Fluke434 power quality analyzer. uab is 597.1V, ubc is 595.6 V, uca is 593.5V. Figure (b) shows system operation parameters. The load power is 14.83kW and system power factor is 0.95 which shows that the input runs in high power factor. Figure (c) shows the info dc transport voltage 1050V which accomplish the worth expected, so information can understand the drifting control. Figure (d) shows the dc transport voltage trademark bend when the heap changes abruptly and the voltage vacillation is little. After 300ms system is stable and the robustness is good. The C phase voltage is almost the same which proves the topological structure has good resistance to the load imbalance. Figure (e) and (f) shows the essential side and bad habit side voltage of high recurrence seclusion transformer. The sharp pinnacle is brought about by the spillage inductance of the transformer. Figure (g) shows the low voltage dc transport voltage. The single phase full bridge rectifier converts ac square wave into 350V direct current. Figure (h) shows the yield three-stage alternating current and voltage whose waveforms are even and sinusoidal and the RMS is 221V. Compared with the reference 220V, the error is only 0.4%. Figure (I) shows that the output A phase voltage THD is only 2.5% which fits in with the national standard that the impedance load THD must be inside 3%.

V. CONCLUSION

This paper proposes a novel force electronic transformer for appropriation framework named adaptable force circulation unit. Its topology structure, working guideline and control techniques are introduced. The segregation module receives open circle control to lessen the control multifaceted nature of framework. Yield module receives three single-stage inverters to guarantee freedom. A 600V/220V PET model which is reasonable for the brilliant conveyance

VI. REFERENCE

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