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DESIGN AND ANALYSIS OF THE POWER ELECTRONIC TRANSFORMER FOR POWER QUALITY IMPROVEMENT

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Abstract : Transformers are essential components of power systems that provide a number of functions including voltage transformation, electrical isolation, noise decoupling, and power quality enhancement. However, at low frequencies (60/50 Hz), it is a significant and expensive component. In this work, the concept of electronic transformers is broadened and examined for its application in power systems. The electronic transformer and the conventional transformer have the same input/output characteristics, but the PET is smaller in size.

Index Terms-PET, SVPWM (space vector pulse width modulation), matrix converter, and voltage regulator.

I. INTRODUCTION

Transformers are often used in electrical power systems for voltage transformation, isolation, and noise decoupling. In general, the transformer's size is governed by the saturation flux density of the core material, which is inversely proportional to frequency. The increased frequency allows for higher use of the transformer core. Transformers are among the largest and most expensive components in an electrical system because to the massive iron cores and heavy copper windings used in their production. The power electronics transformer (PET) uses high frequency, as opposed to low frequency in standard transformers, to improve power quality. The PET offers an innovative approach to transformer design by incorporating power electronics devices in both the main and secondary windings. This leads to greater voltage regulation.

II. LITERATURE SURVEY

[1] **B.T Kalyan.** This study introduces a unique notion of series or parallel converter connections for addressing low efficiency and reliability in advanced power quality tests. The described system is made up of a number of strong software algorithms as well as a hardware data gathering device based on a digital signal processor.

[2] **P. Ram Prasad.** This paper describes how this effort resulted in the characterization of power quality in terms of short-duration fluctuations such as voltage sags, voltage swells, and voltage interruptions using data from 480 power quality monitors in various locations. Increasing efficiency while lowering power quality and voltage stress factor.

III. PROBLEM STATEMENT

Assessment of power quality is necessary for the precise operation of sensitive equipment, particularly for nuclear sites. It also ensures that wasteful energy losses in a power system are kept to a minimum, resulting in higher profitability. With technological advancements, the number of industrial/commercial facilities is increasing in various regions.

IV. NEW APPROACH

Power quality is defined as the combination of voltage profile, frequency profile, harmonics containment, and power supply reliability. Power Quality is defined as the extent to which the power supply approaches the ideal situation of a steady, uninterrupted, zero distortion, and disturbance-free supply.

V. OBJECTIVES

Developed a high frequency transformer and control system.

- Design isolation stage or circuit for transformer.
- Implementing a power electronic transformer.

VI. METHODOLOGY

Due to a lack of an energy storage system, the PET design with a high frequency AC link fails to safeguard essential loads from sudden power outages. Figure 2 depicts the basic block diagram of a PET with DC link capacitor, which has three phases. The first stage is an AC/DC converter that bends the input current, corrects the input power factor, and controls the voltage on the principal DC bus. The second stage is an isolation stage, which ensures galvanic isolation. In this stage, the DC power is transformed to a high frequency square wave voltage using a DC/AC converter connected to the primary side of the HF/MF transformer. The secondary side voltage of HF/MF transformer is rectified to DC by another.

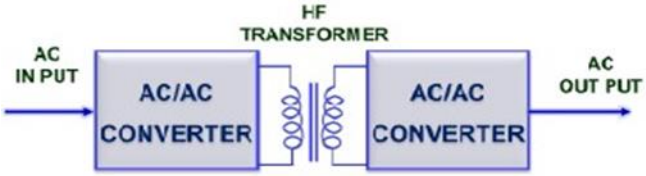

Fig. 1. Block diagram of PET with high frequency AC link

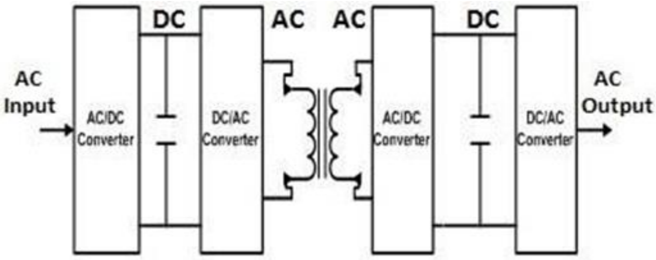

Fig. 2. Block diagram of PET with DC link

VII. PROPOSED DESIGN FOR PET

The suggested PET is divided into three sections: the input stage, the isolation stage, and the output stage, with no DC storage capacitor. The input stage consists of a pulse width modulation (PWM) converter, a class C chopper that serves as a boost regulator, and a low pass tuned filter. The isolation stage consists of a PWM inverter, a high frequency transformer with high insulation capacity, and a tuned high pass filter. The suggested design's output stage makes use of a matrix converter. Figure 3 depicts the block diagram of the proposed PET. The matrix converter addresses power quality issues such as sag rectification and reactive power compensation. The three stages of PET can be controlled independently of each other. The close loop control is necessary for overall operation.

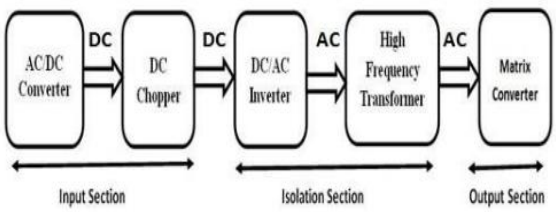

Fig.3. Proposed design for PET

VIII. RESULT AND DISCUSSION

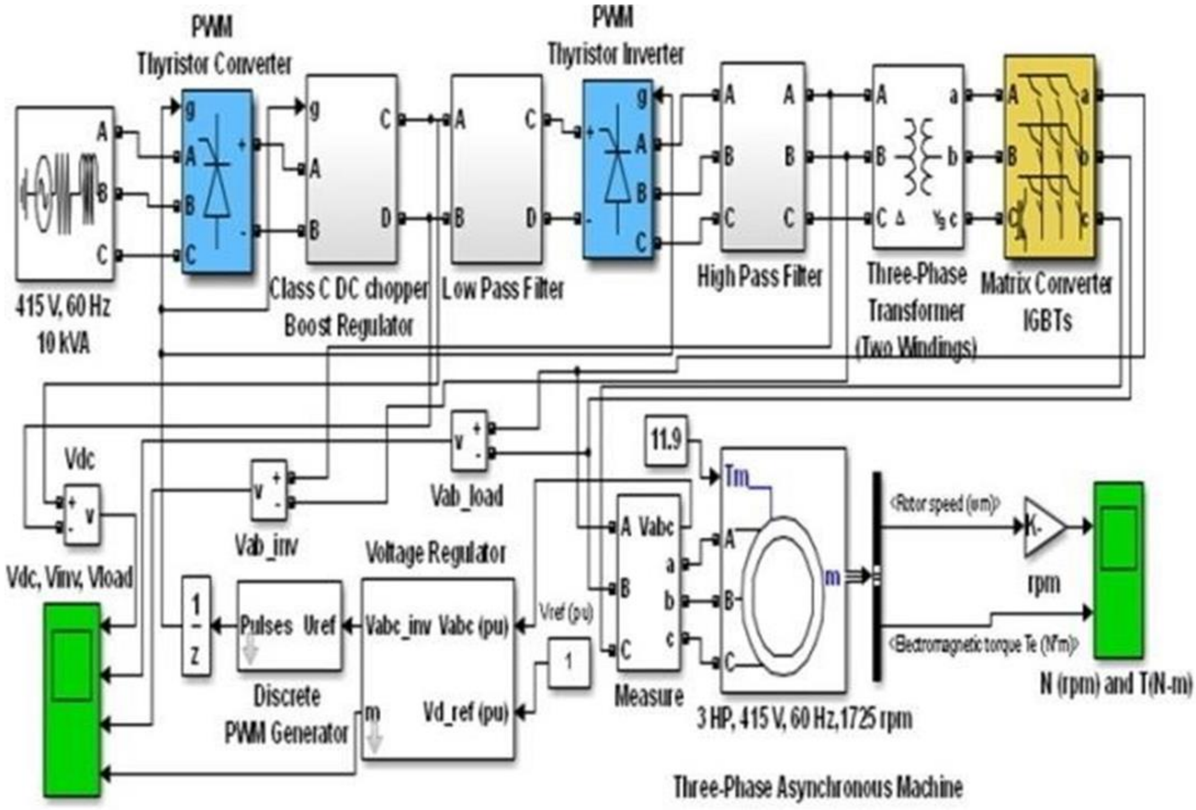

Fig. 4. proposed model of PET

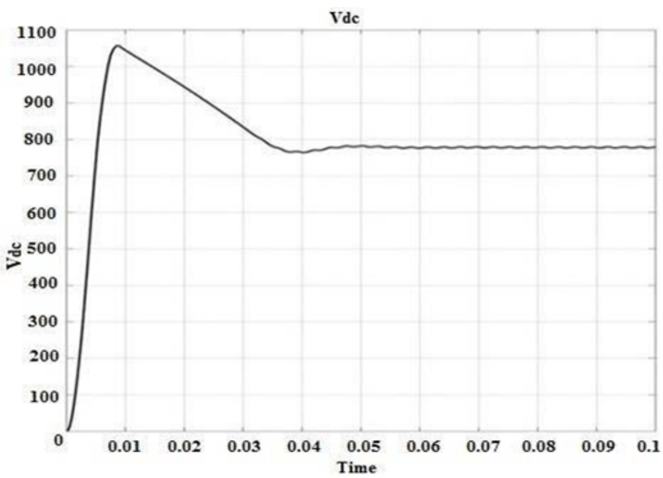

Fig.5. Output voltage of the converter

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CONCLUSION

The possibility of a distorted supply voltage has been examined. This shown that the performance of the p-q theory-based active power line conditioner diminishes in the presence of non-ideal source voltage conditions. The usage of a self-tuning filter (STF) is recommended to increase APLC's harmonic suppression efficiency. The simulation results demonstrate that the proposed technique can improve the performance of APLCs under non-ideal supply voltage situations. This work describes a control approach for compensating unbalanced and harmonic currents. The shunt active power filter has been simulated and explored in two scenarios: balanced and unbalanced non-linear loads. The results indicate that the shunt active power filter adjusted for the harmonic and unbalanced components of the load current. Total harmonic distortion.

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