A New Versatile Control Scheme for UPQC for Power Quality Improvement

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Abstract - This paper deals with unified power quality conditioner system (UPQCs), which is the combination of shunt active power filter and series active power filter .the series active power filter are used to mitigate or overcome supply side disturbances and shunt active power filter are used to mitigate or overcome the load side disturbances. The main task of the utility system is to provide the power to load with proper sinusoidal wave of the voltage and current, with fixed frequency and magnitude with less total harmonics distortion (THD) as possible according to IEEE 519-1992 stranded. The proposed system double feeder transmission network are used and methodology are based on synchronous reference frame (d-q) theory and PWM based sinusoidal pulse width modulation(SPWM) carrier phase disposition(PD) technique.in this technique the switching signal is generated by comparing fundamental reference signal with a carrier signal of required switching frequency. The simulation result are carried out in MATLAB environment.

Keywords - *UPQC, THD, Transmission Network, Facts Device, Power Quality, PWM, SPWM.*

I. INTRODUCTION

The power quality has different meaning to different people but according to IEEE stranded power quality is defined as "the concept of powering and grounding sensitive electronics equipment in a manner suitable for the equipment". The power quality based on time such as long duration variation, short duration variations and other disturbances [1].

The terminology and the guidelines for power quality has been described in detail at **IEEE-519 and IEC-555.**According to these guidelines, the voltage sag ore swell is allowed by 10% , the total harmonics distortion is allowed by 5 % and the voltage unbalance is allowed by 10 %[3].

In proposed system use the custom power device, there are two types first one is network configuring type and compensating type this device is used for active filtering such as load unbalancing, power factor correction and voltage regulation. In proposed system use the compensating type unified power quality conditioner system [4]. Each of custom power devoice has its benefits and limitation. The UPQC is expected to be one of the most powerful solution's to large capacity loads sensitive to supply voltage and load current disturbances / imbalance. The most effective type of these devices is considered to be the unified power quality conditioner (UPQC) .there are numerous reasons why the UPQC is preferred over the others. UPQC is much more flexible than any single inverter based device [6.] It can simultaneously correct for the unbalance and distortion in the source voltage and load current whereas all other devices either correct current or voltage distortion . Therefore the purpose of two device is served by unified power quality conditioner only.

The various function performed by UPQC such as reactive power compensation, voltage regulation, compensation for voltage sag and voltage swell, unbalance compensation for current and voltage (for-3-phase system) and neutral current compensation (for3-phase 4 wire system) [8].

The series PWM converter of the UPQC behaves as a controlled voltage source, that is, it behaves as a series active power filter, where the shunt PWM converter behaves as a controlled current source, as a shunt active power filter. No power supply is connected at the DC link. It contain only a relatively small DC capacitor as a small energy storage element [12].

II. UNIFIED POWER QUALITY CONDITIONER

The basic configuration of UPQC as shown in fig.1. The UPQC has two distinct parts.

1) Power circuit formed by series and shunt PWM converter.
2) UPQC controller.

The power circuit formed by using shunt active power filter and series active power filter, connected back-to-back on the dc side sharing a common DC capacitor. The seriescomponent is used to mitigation of the supply side disturbances such as voltage unbalance, voltage sag / swell, flicker and harmonics. It insert a voltage so as to maintain the load voltage at a desired level with balanced and distortion free. The shunt component is used to overcome or mitigation of the current quality problems caused by the consumers such as poor power factor, load harmonics current, load unbalance etc. it injects current in the ac system such that the source current becomes balanced sinusoidal and in phase with the source voltage [7].

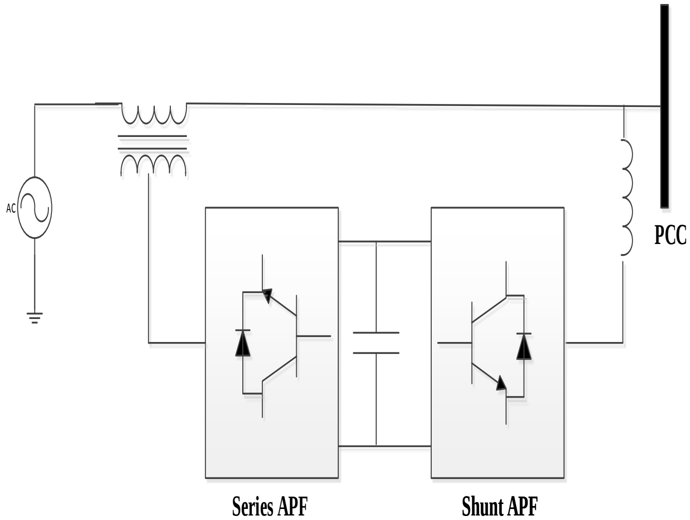

Fig.1: Basic Configuration of UPQC

III. CONTROLLER OF UPQC

In proposed system use multi-level converter to increase the converter operation voltage, because to avoid the series connection of switching elements. However, the multi-level converter is complex to form the output voltage and require an no. of back connection diode or flying capacitor or cascade converter. The controller strategies of UPQC as shown in fig.2.

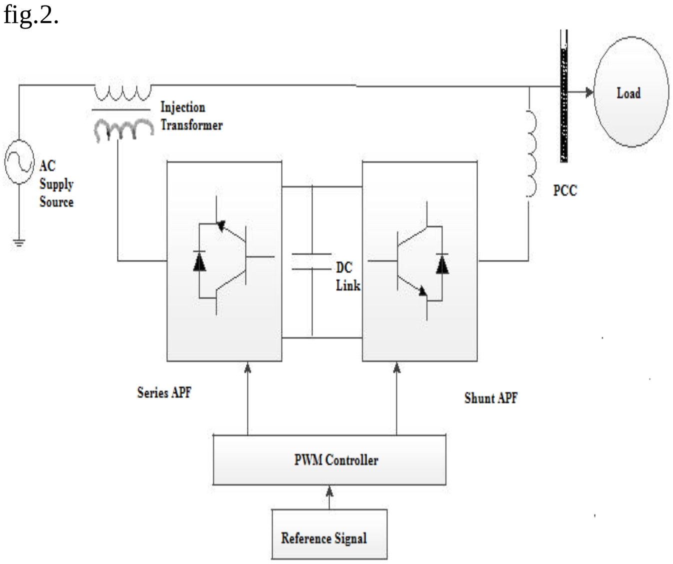

Fig.2: UPQC with controller arrangement

The above figure show controller arrgement of multi-level converter UPQC consist of two VSC's are connected with a commutation reactor and high pass output filter to prevent the flow of switching harmonics in to the supply. The voltage source converter is controlled by pulse width modulation (PWM) technique.

The control scheme algorithm is based on sinusoidal pulse width modulation (SPWM) technique. In this technique fundamental reference signal are compare with carrier signal to generate the gate pulses for multi-level inverter. Fig.3. show the control scheme algorithm for sinusoidal pulse width modulation (SPWM0 technique. Fig.4. show the waveform of SPWM control scheme with Phase Disposition (PD) carrier waves. The phase disposition, where all carrier are in phase.

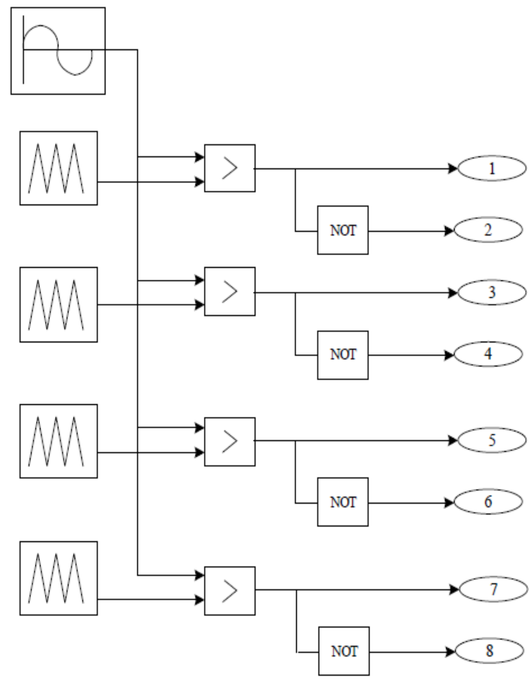

Fig.3: Control scheme algorithm for SPWM

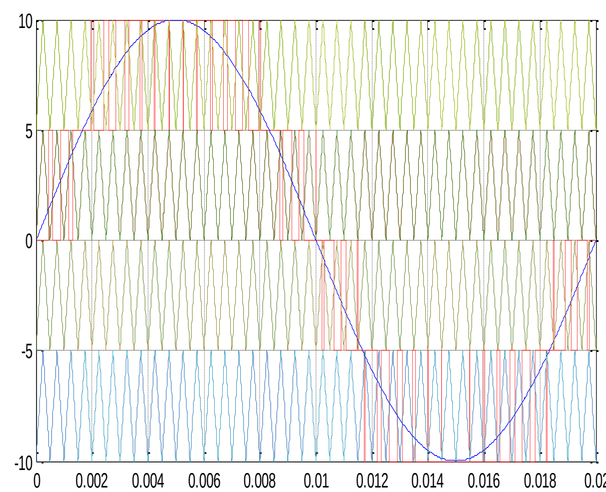

Fig.4: SPWM PD Control Scheme

IV. MODELLING FOR TRANMISSION NETWORK WITH UPQC

The modeling of UPQC in mat lab environment for electrical network as shown in fig.5. In which a double feeder of power transmission is considered and simulated. The simulation result is presented on the basis of that network for the performance of UPQC. The fault is created manually for some period and various results during such condition are carried out.

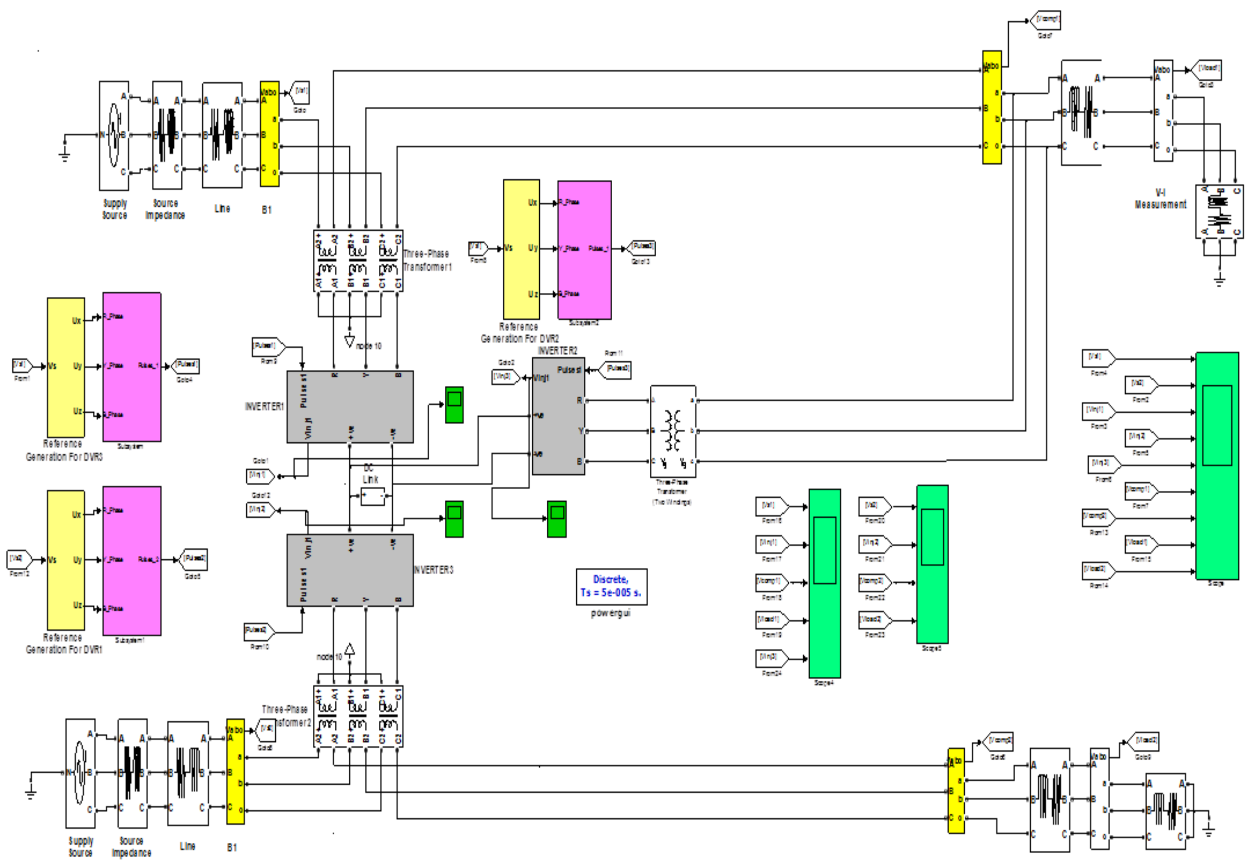

Fig.5: Mat lab simulation model for double feeder of UPQC in transmission network

V. SIMULATION RESULTS

For the verification of the performance of UPQC the system was simulated using Simulink power system block set in mat lab Simulink.

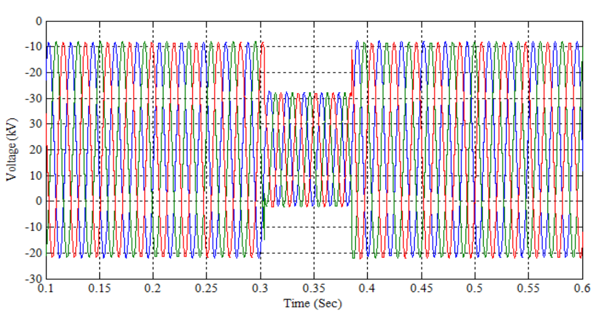

Fig.6: Uncompensated voltage waveform

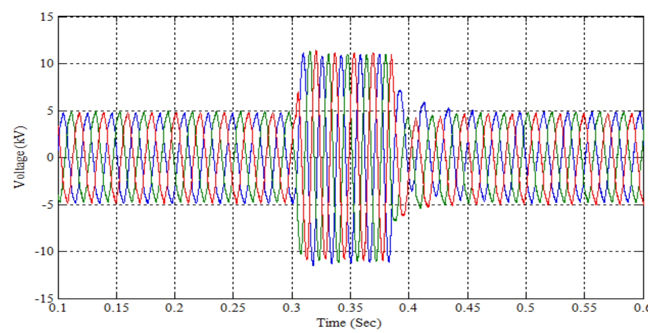

Fig.7: Feeder one injection

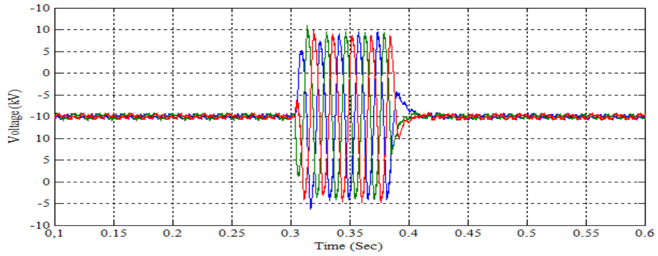

Fig.8: Common injection

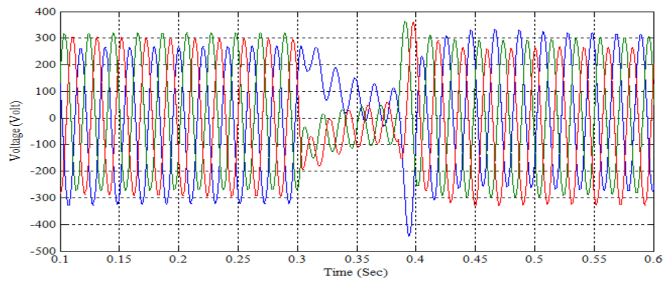

Fig.9: Feeder two injection

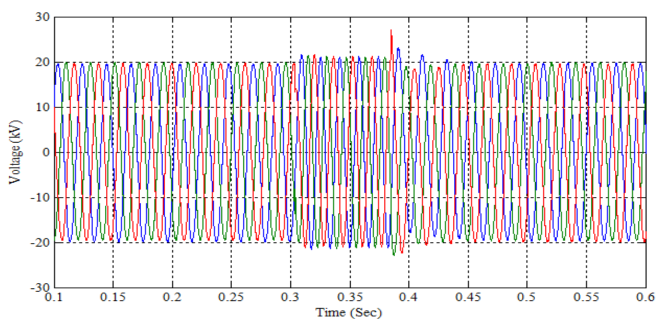

Fig.10: Feeder one compensation

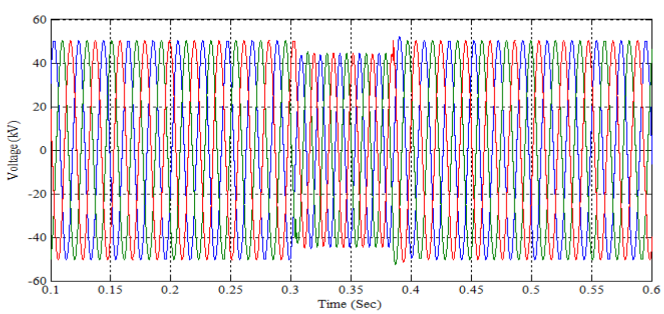

Fig.11: Feeder two compensation

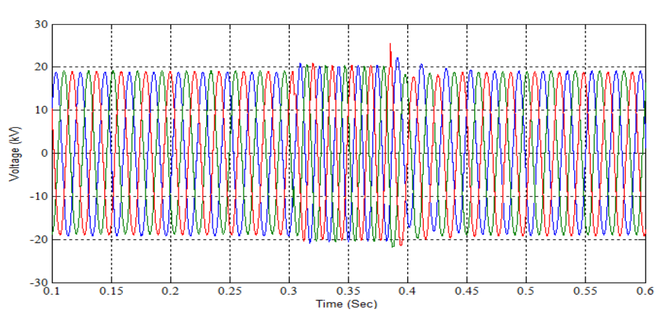

Fig.12: Load compensation for feeder one

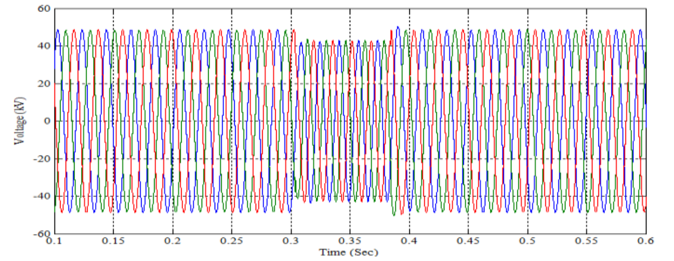

Fig.13: Load compensation for feeder two

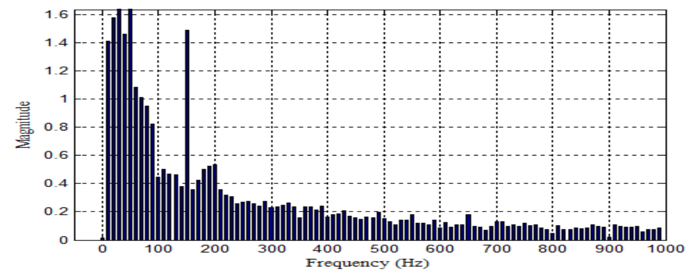

Fig.14: THD V. Compensation for feeder one

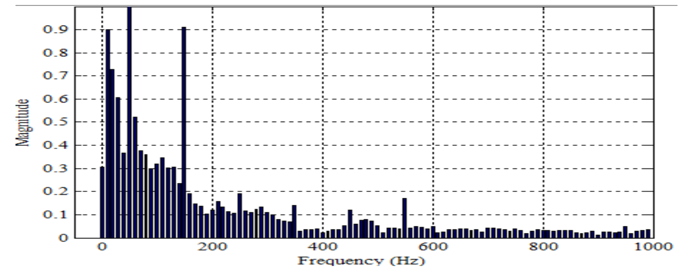

Fig.15: THD V. Compensation for feeder two

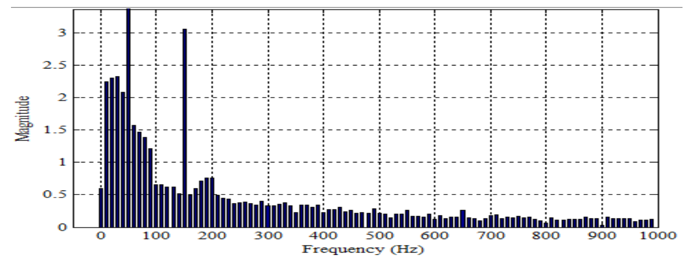

Fig.16: THD V. injection for feeder one

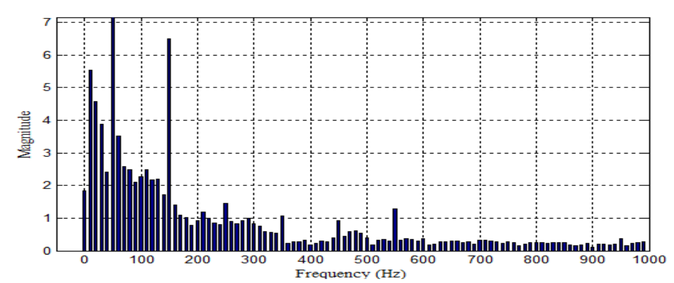

Fig.17: THD V. common injection

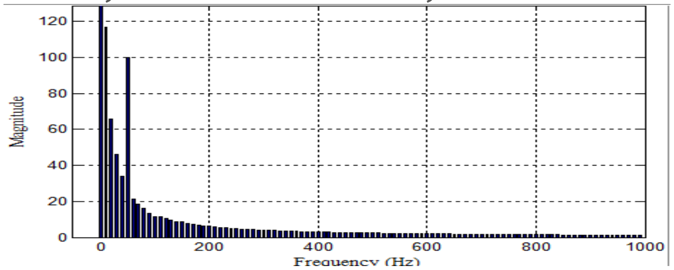

Fig.18: THD V. injection for feeder two

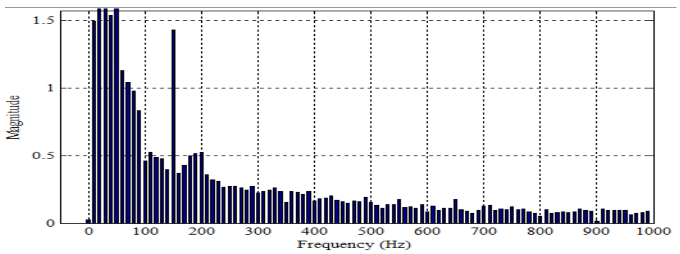

Fig.19: THD V. load one

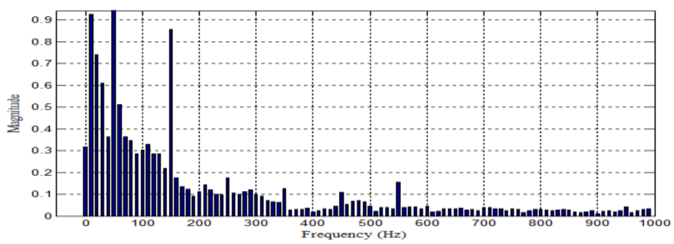

Fig.20: THD V. load two

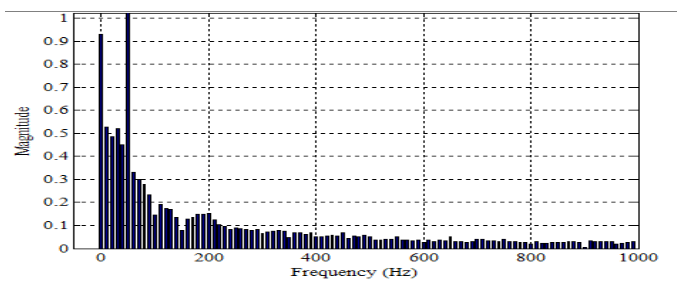

Fig.21: THD across voltage source

VI.CONCLISION

In order to protect critical load from more voltage harmonics and current harmonics in distribution and transmission network, the UPQC i.e., series connected voltage-source converter know as dynamic voltage restorer and shunt connected voltage-source converter know as Dstatcom is suitable and satisfactory. Due to its reliability it was adopted as the optimal solution for the compensation of voltage and current. The MATLAB/SIMULINK were used to carry extensive simulation studies on unified power quality conditioner and for the controlling purpose the Pulse Width Modulation controller is used and RL is used as a load therefore, UPQC is consider to be an efficient solution. The UPQC is capable of reducing the of level THD in the case of network which are connected to the harmonics generating loads. The simulation is carried out by SPWM technique. From this paper and simulation result it is clear that the performance in the voltage profile or waveform get improved using UPQC.

VII. REFERENCES

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