THREE PHASE PF HVSYSTEM FOR ESP IN A GLASS FACTORY

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Introduction

This paper describes our experiences in replacing a mid frequency HVR set by a 3 phase HVR set in a Glass Factory in Luxemburg. This paper also describes the features and advantages of a 3 phase HVR set, over single phase and which could also provide a techno-economical solution over other solution types, for certain applications. The collection efficiency of the Electrostatic Precipitator depends upon many process parameters such as input dust loading, Temperature, Dust resistivity, etc. However,the electrical parameters / performance plays a significant role in enhancing this efficiency.

Implementation of PF Three Phase Systems

At one of the glass factory at Luxemburg, Europe, it was decided jointly by GEA Bischoff – Germany and ADOR to check the performance of an existing ESP, which was operating satisfactorily with a medium frequency system by replacing with a 3 Phase system, to evaluate techno-economical solution possibilities.

Fig 1: Three phase TR at Luxemburg

This ESP was a 2 Field ESP, with both the Fields, powered by a mid Frequency unit, 70kV, 700mA. The 2nd Field was replaced by a 3 Phase Power Frequency (PF) unit, whereas the 1st Field continues to be mid frequency. The rating of the 3 Phase unit selected was 90KV(P), 2200mA. It was purposefully decided to opt for a higher rated unit, as this was an experimentation, being done to establish performance levels as well as relevant correlation, while keeping the same emission performance, if not better.

The earlier unit was operating at 38kV, 700mA. This unit was replaced and at the same time routine maintenance was carried out. On commencement, the unit output voltage obtained was 50kV at 700mA. This increased corona power has also resulted in reduced visual emission levels, as compared to earlier. The actual measurements are in planned in September.

Table 1 – Results

	mA	KV (Average)	KV (Peak)
Readings before changing to three phase system	700	38	--
Readings after changing to three phase system	700	50	53

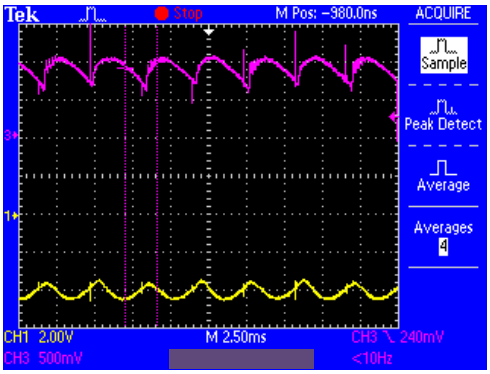
These readings indicated a higher KV (average) at the same current at this site. This enables a higher corona power. The difference in peak and mean values shall practically be the same for a mid frequency and a 3 Phase system.

This monitoring including emission shall be carried out for a period of time and on completion of this study, the next phase plan is

to suitably replace the inlet Field with a similar PF 3 Phase system and monitor overall results and effectiveness.

The output voltage and current waveforms taken during commissioning are as under.

Steady State Current and Voltage

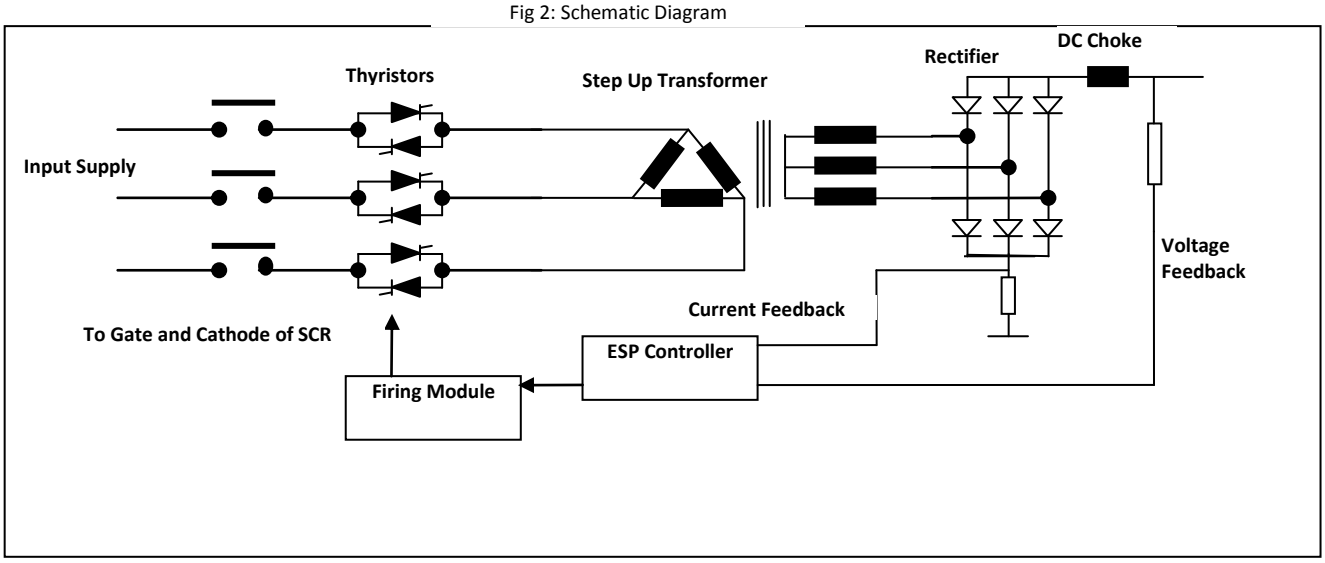


Current during flashover

Features of a Three Phase Controls

In a 3 Phase Power Frequency (PF) High Voltage Transformer Rectifier set, the input to the control panel is three Phases and output of the control panel is phase controlled three Phases. This is fed to the three Phase HV step up transformer. The output of the transformer is rectified and the negative is taken out through a DC Choke and positive terminal is earthed through a shunt resistance. The typical schematic drawing is as follow.

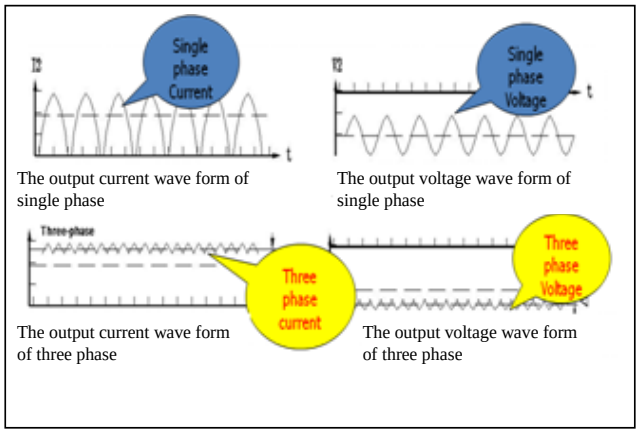
Fig 2: Schematic Diagram



Inherent Benefits of a Three Phase system over a 1 Phase system

The Output Voltage and Current waveforms are as under;

Fig 3: Output voltage and current waveforms



Higher output average voltage

The ripple of a conventional single-phase power supply output voltage is above 25%, where as the ripple of a three-phase output voltage is below 5%. Thus in a 3 phase system, the DC average voltage is very close to the peak value and results ina higher current density as compared to a single phase system, which helps to enhance the collection efficiency. The ripple Frequencies varies as per the switching frequencies. The ratio of the Peak to Average of a PF 3 Phase system is a lot similar to a mid or Higher Frequency units.

Higher Transfer Efficiency

The transfer efficiency ratio of single-phase HVDC system is about 70%; while the transfer efficiency of a three-phase HVDC system is as high as 95%. Thus there is enhancement in transfer efficiency by 25%.

Input supply is balanced

In a three Phase system, the input currents are equal and balanced. This reduces the Total Demand Distortion at the input side. This also impacts the cable and switchgear sizing. The Total Demand Distortion of a higher frequency system is lower than a PF system.

The response time to spark is faster

The response time of a PF three Phase system to spark is only $^{1}/_{3}^{rd}$ as that for a single Phase system. This limits the flashover energy dissipated in the ESP Field. This enhances the life of the electrodes.Similarly a HF unit offers a faster response, due to the higher switching frequencies.

Conclusions

A PF 3 Phase system offers a lot of advantages of a 3 Phase Higher frequency switched units, but in a more cost effective manner.
As seen at this Glass factory, the performance levels exceeded / matched the existing performance. This then supplements, the cost effectiveness of this solution.
ADOR has also supplied a number of three phase PF systems for other applications in Paper Plant, etc.