

## Smart Design of Supply in Industries in Order to Reduce the Ratings of Distribution Equipment and to Improve the Quality of Power

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**Abstract:** We use high KVA rated transformers in industries to supply high transient state current, however the steady state current is low which lead to high primary coil losses in the transformer. As a substitute we therefore present the application of super capacitors in industries to avoid voltage dip and the usage of high VA rated transformers for the sake of high transient state current hence saving the primary coil losses and reducing the size of the supporting equipment. The super-capacitor also contributes to the improvement of power factor, regulated voltage supply during steady-state and reduces harmonics in the supply. This paper has the detailed explanation of the application of super-capacitor as an additional source and has a diagram of the proposed super-capacitor circuit.

**Keywords:** power factor, super capacitor, transformers, transient current, voltage dip.

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### I. INTRODUCTION

While designing distribution in an industry the equipment is planned and designed to bear high currents though they conduct such high current for a very short amount of time. Voltage dips can result in loss of synchronism in synchronous motors and shutting down of production lines leading to production loss and expensive restart procedures. Voltage dips and their impact on other industrial loads constitute the most prevalent power quality problem in the industrial power sector. Though computer-controlled processes, variable speed drives (VSD) are used the voltage dips have not been eliminated completely. The synchronous motors, as mentioned above, are very much vulnerable to voltage dips while the induction motors are the main cause for voltage dips. The super capacitors can be used to reduce the load on the main supply due to its property of supplying high amount of instantaneous current and hence rectifying the voltage dip in the motors running when a motor is started suddenly. These super capacitors are connected in series - parallel connection in order to form a super capacitor bank which can provide both the sufficient voltage and current to the high VA induction motors. This circuit mainly finds its application in all major industries and especially in the industries which constitute rolling mills as there are a lot of transient variations in the amplitudes of current and voltage due to constantly varying loads.

### II. RESPONSE OF INDUCTION MOTORS TO VOLTAGE DIPS

The starting current for an induction motor is several times the running current and the starting power factor is much lower than the power factor at rated speed. Both of these features tend to cause the supply voltage to dip during start-up and can cause problems for adjacent equipment. The rated torque is usually slightly smaller than the starting torque so that loads can be started when rated load is applied. In industries, when a number of motors are started at a time, while other motors are running, a high amount of current is drawn from the supply for a short time interval resulting in a voltage dip. As the supply voltage to the induction motors decreases, the motor speed decreases. Depending on the impact and the span of the voltage dip, the motor speed may recover to its normal value as the amplitude of the voltage recovers. If the voltage dip magnitude and duration exceed certain limits the motor may stop suddenly resulting in stalling of running operations. The rated torque is usually slightly smaller than the starting torque so that loads can be started when rated load is applied.

### III. REDUCING THE TRANSFORMER AND SUBSTATION V-I RATINGS

The starting current of an induction motor is many times the steady state current but it lasts for a very short period. Therefore the industries are using high VA rated transformers to supply the starting current to the induction motors which leads to a high amount of power stagnation which can otherwise be used in a much better manner. If we place a super capacitor bank in parallel to the main supply, it will provide the high starting

current and also supplies the sudden current demands of the induction motor due to addition of high amount of load or faults that occur for a short period of time while running. So if we install a super capacitor bank for supplying the transient state current for all the induction motors in an industry the rating of the transformers used to supply the current to the induction motor can be reduced drastically as the motors draw only the steady state current from the main supply consequently reducing the rating of the sub-station which is used to supply the power to the industry. There would be high primary coil losses in thousands of transformers used across the globe just for the sake of supplying transient state current and If this method is widely implemented we can use the power generated by various means in a much better manner.

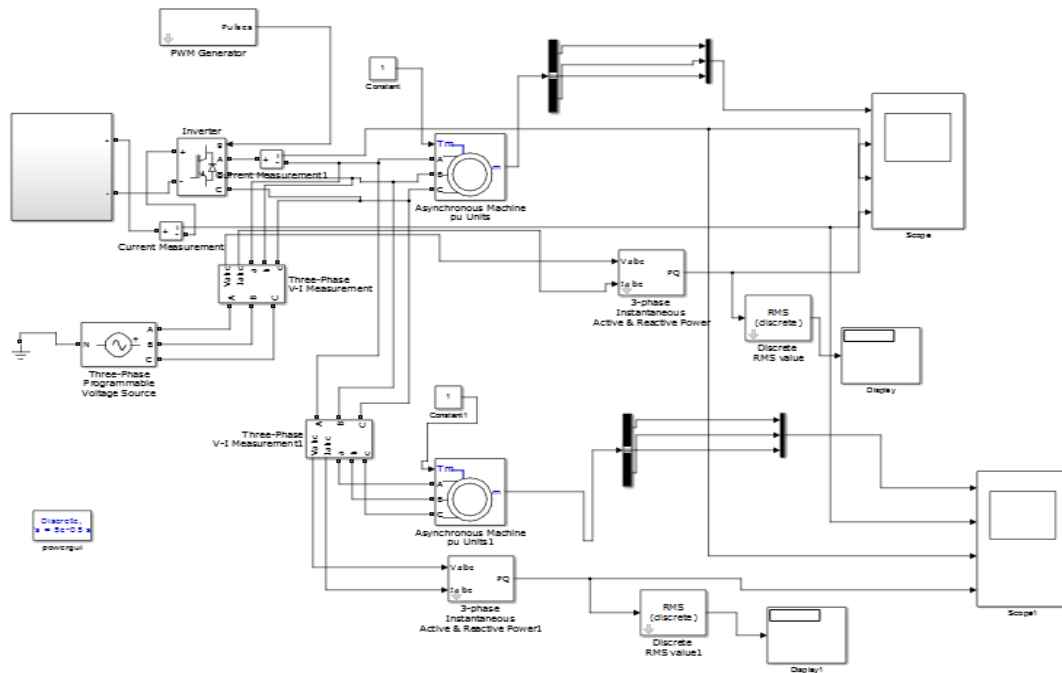
**IV. HOW SUPER CAPACITORS MAKE A DIFFERENCE**

The super-capacitor has found a unique application due to its property of supplying high amount of current in a very short period of time. Though the power capacitors are rated for very high values of power which can supply high amounts of current and can work at very high voltages they cannot supply high amount of current in a short period of time hence it cannot reduce the load on the main power supply.

The main point of focus however remains to be the reduction of the size of the equipment that is being used in the industry and to eliminate voltage dips and therefore the supply to the load must be designed to reduce the burden on the main supply. The super-capacitor bank supplies the needed high starting current for a short interval of time hence the main supply can be designed to supply the low running current that is required for a long period of time. The conventional capacitors are not capable to substitute the super capacitors due to their low current density of supply contrary to the capability of the super-capacitors which have high current density and as a result they cannot be replaced.

**V. CIRCUIT AND TABLES**

Function	Super capacitor
Charge time	1–10 seconds
Cycle life	1 million or 30,000h
Cell voltage	2.3 to 2.75V
Specific energy (Wh/kg)	5 (typical)
Specific power (W/kg)	Up to 10,000
Service life	10 to 15 years
Charge temperature	-40 to 65°C (-40 to 149°F)
Discharge temperature	-40 to 65°C (-40 to 149°F)



## **VI. CONCLUSION**

We therefore conclude that the use of super capacitor circuits in industries will remove the voltage dips and will avoid the need for high VA transformers which also reduces primary coil losses and improves the power factor of the supply.

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