"ULTRA CAPACITORS" A REFORM TOWARDS POWER SYSTEM ENGINEERING: A BASIC IDEA

Aniket Bhattacharya
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES, DEHRADUN, INDIA
Email: rbtaniket@gmail.com

Abstract
This paper consists of the basic idea regarding the maintenance of balance between the inductive and capacitive loads in the power systems with the help of the usage of "Ultra capacitors" as a backup power source for household as well as commercial purposes at the place of conventional batteries. This idea will reduce the issue of establishing capacitor banks at the substations and the distribution lines. It is basically a fulfillment of a requirement with a good and efficient technology.

Keywords-*distribution; capacitive; backup; efficient; VARs; ultra capacitors.*

I. INTRODUCTION

Power System engineering, one of the oldest and the most important part and application of electrical engineering. It is almost impossible to imagine life and development without the base of power systems. The power systems externally appears to be a very simple system involving three basic stages of generation , transmission and distribution but on giving a deep study on the whole we come to know that power systems is one of the most challenging and complex system to deal with. Here in this article we are going to discuss one of the innumerous challenges faced in power systems and also certain basic ideas are suggested here in order to minimize such challenges to a certain extent.

II. POWER DISTRIBUTION

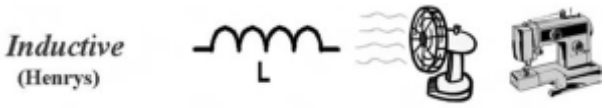
The power generated from the power plants is carried at high voltages through the transmission lines and then stepped down at the substations an then they are again carried further at a lower voltage and distributed to various commercial and household establishments satisfying their needs and demands. Here our main focus will remain towards the distribution part of the whole system considering substations as the part of the same. It is necessary to know the fact that under power distribution a balance between the inductive and capacitive loads is required. This balance is required in order to maintain the power factor and prevent certain types of loses taking place in the whole system.

III. TYPES OF LOADS

There are three types of loads under electrical power systems:

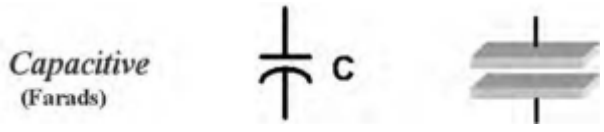
Resistive Loads: It refers to the loads that offer an obstruction to the flow of the electrons resulting in dissipation of energy in the form of heat and light. Example bulb, heater etc.

Inductive Loads: This load consists of coiling and requires some amount of magnetic field to operate and perform certain task. Example fan, weaving machine etc.



Under these loads the current lags the applied voltage.

Capacitive Loads: These loads contain capacitors with dielectrics in them and are not generally used by household or commercial consumers.



Under these loads the current leads the applied voltage. [1]

IV. CAPACITOR BANK

Similar to inductors, the power associated with capacitors is also called reactive power, but has the opposite polarity. Thus, inductors have positive VARs and capacitors have negative VARs. Note, the negative VARs of inductors can be cancelled by the positive VARs of capacitors, to leading a net zero reactive power requirement. Hence capacitors cancel out inductors in electrical circuits and improve system efficiency by preventing it from the loss. As a general rule, capacitive loads are not items that people purchase at the store in massive quantities like they do resistive and inductive loads. For that reason, power companies must install capacitors on a regular basis at the substations or at the distribution lines in order to maintain a reactive power balance with the inductive demand.

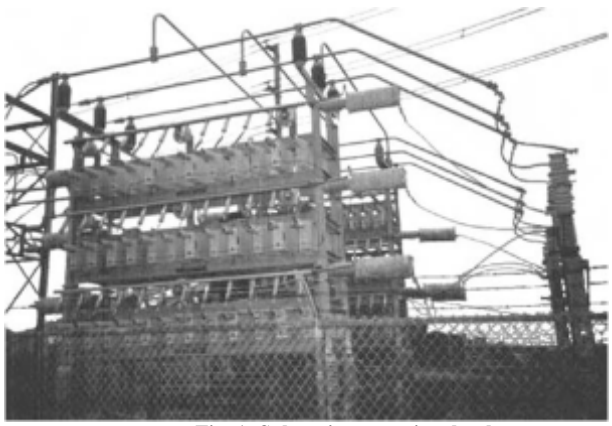


Fig. 1: Substation capacitor bank

Fig. 2: Distribution capacitor bank

V. THE BASIC IDEA

The extra effort taken by the substation designers and distribution lines for the establishment of these large capacitive banks requires a greater amount of space, time and money. In order to remove this issue from the whole power system structure, the idea of household capacitor is generated. The idea suggests that the battery used for commercial and household purposes for energy storage during the time of power cut as backup power can be replaced by capacitor banks that are more efficient in charging and also serve the purpose of lagging load and create a balance between the inductive and capacitive load as discussed above for an efficient power system working. Such capacitors that are used as a replacement for the conventional battery structures are known as Ultra capacitors. They share the same property and principle as that of a normal capacitor but have a bit complex structure and construction as compared to the normal one.

VI. CONSTRUCTION AND WORKING OF ULTRA CAPACITORS

[2] Researchers at MIT are developing a new device that has the potential to hold as much energy as a conventional battery but could be recharged in seconds rather than hours, would last almost indefinitely, and won't mind the cold. The device could prove the first economically viable alternative to today's battery. The battery continues to improve, but its basic concept hasn't changed much since it was developed by Alessandro Volta in the 19th century. Conventional batteries store energy by using chemical reactions to trap ions that move from one electrode to the other. Batteries have a huge storage capacity, but—because of the chemistry involved—electricity can go in and out only so fast, and some is lost as heat. In contrast, capacitors store energy in an electric field. The absence of chemical reactions has advantages. Capacitors can deliver energy quickly, and they can be charged up in minutes or even seconds. They can withstand

temperature changes, shocks, and vibrations. And they can be recharged hundreds of thousands of times before they wear out. They're thus much easier on the environment than today's batteries, which must be tossed out after a few hundred charges. But their capacity for storing energy is limited. The best version is the ultra capacitor. It contains an electrolyte, a fluid containing positive and negative ions; and its electrodes are coated with activated carbon, which is extremely porous and so provides a large surface area for storing the ions. Nevertheless, today's commercial ultra capacitors store around 25 times less energy than a similarly sized lithium-ion battery can. As a result, they need to be much larger than batteries to hold the same charge.

Fig. 3: Ultra Capacitors

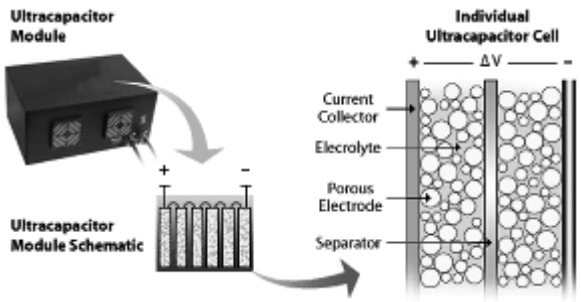


Fig. 4: Construction of Ultra Capacitors

CONCLUSION

The introduction of the ultra capacitors as an alternative for the conventional batteries can provide a better and efficient charging procedure, backup supply and besides this it can also manage the balance between the leading and lagging loads under the power systems which resultantly can improve the power factor and reduce the field losses to a certain extent.

As said earlier the paper contains only the basic idea regarding the future of power systems in India as well as various other developed and developing countries in the world. The complete construction and references of this paper was done by keeping a single motive and objective in mind that is the betterment in technology as well as introduction of a cost effective technique. Our young engineers and scientists are always welcome for their ideas and contributions under this field of operation so that the world can proceed towards a simple and energy efficient living.

ACKNOWLEDGMENT

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REFERENCES

[1] Steven W. Blume, Electric Power system basics,. IEEE, pp4,5.

[2] Nancy Stauffer, ultra on ultra capacitors, MIT, USA.

[3] Photo credits from Wiki Commons.