



## **ENERGY COST SAVING ASPECTS OF USES® TECHNOLOGY**

Aspects that make USES save hard dollars:

### **Through power factor correction.**

By returning a lead from both phase L2 and phase L3 through the rap-around choke of phase L1, two small voltage vectors are created that together will be 120 degrees out of phase with phase L1. This is identified as the 'USES wave'. As such the 'USES wave' will nullify the negative part of the reactive energy, that is returned to the grid and provides this part to the motors.

Same concept as applied to both phases L2 and L3.

### **Through efficiency improvement of induction motors.**

The voltages provided by Power Supply Companies to residential, commercial and industrial sites worldwide are never exactly balanced. This is a good reason for this phenomenon. Thus, in general,  $V_1$  is not equal to  $V_2$ , is not equal to  $V_3$ .

This unbalance of voltages is further amplified by the relative large single phase loads such as for lighting, heating etc., drawing unequal currents from the transformers resulting in further increasing the unbalance between the three voltages,  $V_1$ ,  $V_2$ ,  $V_3$ .

The method of symmetrical components provides a tool to calculate the effect of any unbalanced voltages and the corresponding currents by their three symmetrical components,  $V_{a1}$ ,  $V_{a2}$ ,  $V_{a3}$ .

The method of symmetrical components provides a tool to calculate the effect of any unbalanced voltages and the corresponding currents by their three symmetrical components  $V_{a1}$ ,  $V_{a2}$ ,  $V_{a3}$ , their three symmetrical components  $V_{b1}$ ,  $V_{b2}$ ,  $V_{b3}$ , and their in-phase zero sequence components  $V_{a0}$ ,  $V_{b0}$  and  $V_{c0}$ .

Since the stator windings of induction motors are usually delta wound or ungrounded star wound, the zero sequence components do not exist.

The positive sequence components of the three phase impressed voltage, create in the induction motor the rotating field, required to rotate the rotor. The negative sequence components create a rotating flux in the motor air gap that rotates at double frequency in opposite direction to the positive sequence flux.

This counter flux creates considerable losses in the induction motor that the world at large has lived with and paid for.

USES, balances the three motor voltages by means of 300 degrees phase shifts, thus considerably reducing the losses in induction motors, caused by the negative sequence fluxed.

Both aspects of this ingenious device, developed by USES MFG, lead to great cost reductions in electricity bills.

To estimate the hard dollar savings it is necessary to determine:

- As guide for this aspect, it is recommended to apply NEMA Standard, MG 1, Electric Motors and Generators, in particular, the derating requirements given in section IV part 14 'Application data', that specifies a derating factor as a function of percentage voltage unbalance.

A required derating is determined by the overheating caused by unbalanced voltages and is equal to additional losses experienced by the motor.

As an example: a 3% Voltage unbalance, requires a 10% derating caused by 10% extra motor losses.

- Averaging the annual Kw demand on the electricity bills and multiplying this figure by 0.85 can calculate the average Plant demand.
- The annual hours of utilization can now be calculated by dividing the total annual Kwh by the average Plant demand.
- The hard dollar savings obtained by penalty avoidance can be calculated, from the reactive power requirements, to correct the power factor to the amount, required by the Power Supply Company and based on an average reactive power component provided by the USES devices.

1. The expected Kw savings
2. The average Demand
3. The hours of utilization.
4. The average annual power factor

- A. All savings are determined by the inductive load that are addressed by the USES product
- B. The amount of unbalanced voltage
- C. The amount of surges and spikes (IE) "Dirty Power". That is filtered and made into usable power
- D. I<sup>2</sup>R losses due to bad power factor
- E. Amperage reduction due to the operation of the patented magnetic control chokes (IE) the amount of amperage that is magnetically induced into the circuit.

The basic concepts on how the magnetic chokes work (IE) Patent # 5105,327. The choke is wrapped around a ferrite core.

The wrapping must follow the right hand rule and wrap through each coil. This is where the magnetic field will induce current into the wire, running through the coil. By having the Power Company using 60 cycles this coil has the means to induce the current. The current is then run through the capacitor and injected into the next phase at 180 out and the happening to each phase. This happens in each cycle. The chokes attribute 70 percent of savings:

Filtering 15-20 %

Power factor 1-3%

Harmonic reduction 4-5%

In addition to the hard dollar savings, USES also provides soft dollar savings, such as extension of motor life, spike reduction, etc.