

USES Units as Multi-Purpose Equipment

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Recent tests at the Northrop Grumman Corporation demonstrated that the USES® Unit improves power quality and circuit efficiency by balancing the amps and volts in 3-phase systems. To conduct the tests, engineers connected a 150 HP chiller motor in parallel with a USES Unit. The tests showed that USES corrected the phase imbalances dynamically and responsively. The phase balancing (PB) corrections were always proportional to the degree of phase imbalance. By connecting the phases magnetically with a specially wound wrap-around magnetic choke, USES corrected power factor (PF), reduced harmonics, absorbed surges and sags, attenuated transients, improved the motor efficiency and released system capacity.

In these tests, the USES system corrected power factor (PF) by 20 KVARs. How did it do this? USES corrects PF by PB when the 3 wrap-around chokes delta-connect the 3 phase lines. In these tests, a small (27 A) resultant current flowed to each main phase line. These small capacitive reactant currents cancel the inductive reactive currents the motor produces. If the motor is off, these currents circulate harmlessly until canceled. This corrective current also reduces the starting surge of motors, which reduces ratchet demand charges and cooking of motor windings. The location and sizing of the USES Units are not critical and these units have many other advantages over capacitors.

The USES system reduced harmonic distortion by 30%, because the field coils induce to the armature more radially symmetrical rotating magnetic fields than the egg-shaped fields induced in the imbalanced system. The inertia of the motor interacts with the balanced magnetic fields to produce less electrical distortion (harmonics) than it otherwise would. Energy not trapped in harmonics is available for the motor to use. Consider the significance of this effect when it occurs on every motor in the system.

USES compensated for sags and surges because the wrap-around chokes connect the USES capacitors with all three phases. The chokes are inductive and respond rapidly to compensate any variation detected, thus holding up voltage and suppressing current surge. In 1994, USES allowed the freezer plant at Coldwater Seafood in Cambridge, MD to ride through a 20% voltage sag without electrical damage or loss of product.

USES released system capacity because of the 10% kW demand reduction and the 30% harmonics reduction. The USES protection is close to the loads where PO problems arise and the effects translate throughout the entire system. Increased PF reduces the amperage to do a given amount of work, thereby releasing additional KVA for use. Other tests have shown that, even with a VFD, a PB unit up line produces significant benefits for the motor.

A transformer behaves like motor at zero rotation and PB reduces associated eddy currents. Calculations predicted an increase in efficiency of an additional 5% for the transformer feeding the branch circuit in this test.

At the IUSA Cable Plant in Pasteje, Mexico and at Coldwater Seafood, USES Units have attracted and absorbed 1000V transients without damage to plant equipment. MOVs in the

USES system attenuate larger transients; the MOVs which have indicator lamps to display the MOV condition, so the end-user knows if the MOV need replacement. The USES system then attenuates smaller transients through the chokes. Transient attenuation occurs when the higher amplitude of the transient phase is balanced with the other two phases, thus reducing the transient gradient. The wrap-around magnetic chokes are self-healing suppressors that operate indefinitely without thermal cycling. A unit at the service entrance would absorb external transients on the phase lines and on the neutral. A unit on each panel would isolate it from the rest of the system for maximum protection.

Devices that use the PB principle will bring greater PO, reliability and efficiency to AC systems. USES. Installation of USES for particular phase arrangements and voltages is similar to PF correction capacitors, but the sizing, location and switching are less critical. PB dramatically reduces maintenance requirements and keeps equipment on line.

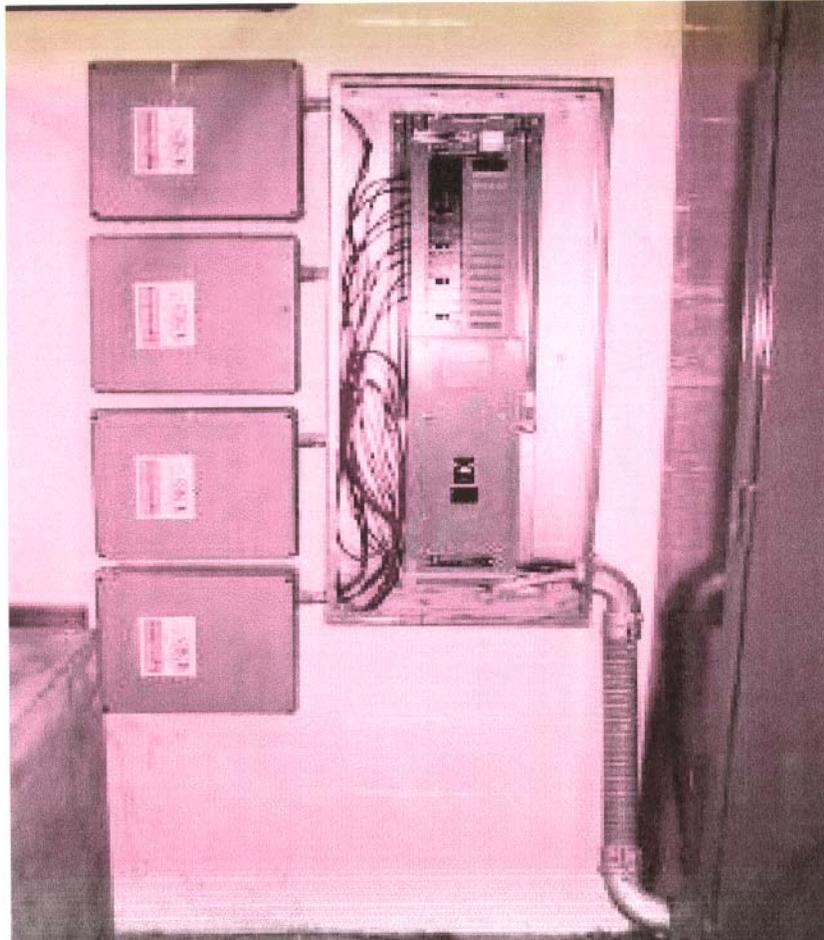


Figure 1. Bank of 4 USES Units connected to the H-10 Motor Control Center for 500 HP Compressor H-10 at Icelandic USA, Inc. Individual units are wired to individual 30 amp breakers and the connection passes through a 150 amp master breaker to the incoming power lugs in the MCC via the cable at lower right.