Application Guidance Notes: Technical Information from Cummins Generator Technologies

AGN 120 – Light Flicker

DESCRIPTION

This guidance concerns the light flicker that may occur on lighting load connected to a Generating set with a STAMFORD alternator.

FAULT CAUSE

Flickering lights are caused by one of two faults on a Generating Set:

- Unstable excitation system on the alternator.
- The engine flywheel not being rotated with a linear circumferential speed.

FAULT DIAGNOSIS

The first and easiest check should be on the alternator's excitation system.

The alternator excitation system

The AVR's STABility control must be in the optimum position. To check this, use a low power (40W incandescent) lamp and a volt meter, connected across the alternator's output – therefore the Generating Set output, which is effectively under 'No-load' conditions:

- 'Tweak' the STAB pot clockwise and then anti-clockwise.
- At the same time, look for a change to the voltage stability and associated frequency.
- At the same time, observe the magnitude of lamp flicker.

It may take a little time to optimise the STABility control position.

Now apply 75% to 100% of rated load to the Generating Set. Again, carefully observe the lamp and voltmeter. If necessary optimise the STABility control setting, as before:

- 'Tweak' the STAB pot clockwise and then anti-clockwise.
- At the same time, look for a change to the voltage stability and associated frequency.
- At the same time, observe the magnitude of lamp flicker.

If the light flicker is still evident, then this next test will confirm if the problem really is an unstable excitation system.

Disconnect the F1[X] and F2[XX] leads from the AVR and connect to a smooth dc power supply. A 12V battery will be ideal for no load and very low levels of load. However; a better method would be to use a mains powered dc power supply module capable of providing something like 5A at 100Vdc.

Connect F1 [X] to the dc +ve, and F2 [XX] to the dc –ve.

Run the Generating Set and adjust the power packs output voltage level to make the alternator give the required output voltage. Look for an unstable output voltage by observing the incandescent bulb and voltmeter, initially with the Generating Set at No-load and then at various On load conditions. As the Generating Set's load is increased the alternator's output voltage must be maintained at the rated voltage output, by increasing the dc voltage applied across F1[X] and F2[XX].

If the alternator's output voltage is now perfectly **stable**, then the problem is associated with unstable excitation.

If the alternator's output voltage under the dc power supply excitation test is **unstable**, then the problem is associated with the engine flywheel's circumferential speed not being linear, for which the technical term is 'cyclic irregularity'.

The engine flywheel's circumferential speed

Here the fundamental problem is the engine's configuration in terms of power pulses per revolution and resulting: acceleration/deceleration/acceleration/ etc, over the 4 stroke cycle.

Under these circumstances, try increasing the engines flywheel mass:

- This can be achieved by adding weight to the flywheel. An equivalent effect is achieved by fitting a longer core alternator with a heavier rotor. Although at the relatively small diameter of the rotor poles, the increase in mass of a heavier rotor will not be as effective as the same mass added near the outer edge of the engines flywheel.

- Because of the four stroke RIC engine cycle, the actual orientation position of the rotor poles relative to the piston position, can promote cyclic irregularity if the rotor pole is doing work as the piston is nearing TDC on the compression stroke. Rotating the rotor relative to the flywheel by one set of coupling holes can help.

- Using a two bearing alternator offers the option of fitting a coupling with a large mass.

If these potential problem solving measures are not acceptable, it may be worth trying:

- A capacitor connected across the alternator's output can act as a short term electrical reservoir to help maintain the voltage over the rotational speed variations.

- When speed is low, the capacitor will try to maintain the voltage by providing some of its stored energy. When speed returns to nominal and then goes high the resulting increase in voltage will re-charge the capacitor, this work tending to suppress the voltage from rising with speed.

- It must be remembered that too much capacitance connected across the alternator's output can cause the alternator's output voltage to rise out of control of the AVR.

- A good rule of thumb is that the connected capacitance should not draw a current that exceeds 25% of the alternator's rated output current.