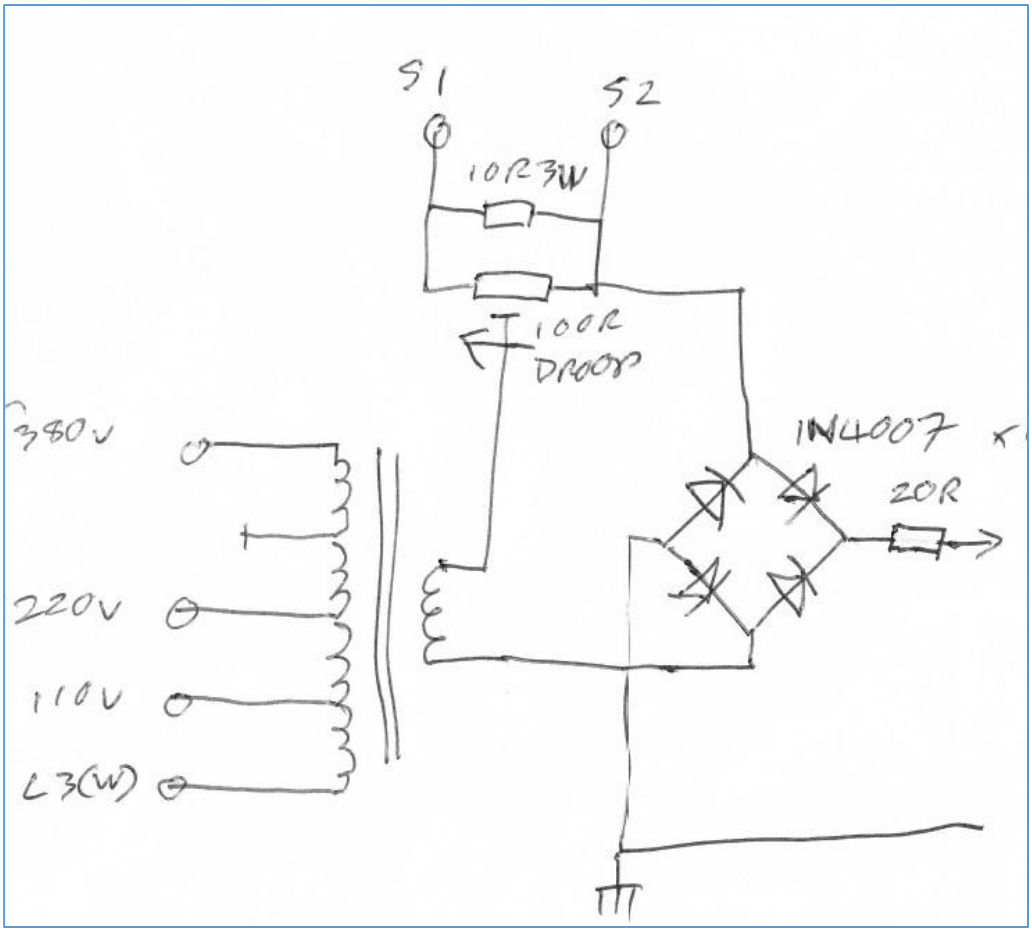
Droop CTs in small alternators – effects on Island Stability.

Over the last couple of GC0079 meetings we have been speculating on the effect of the droop CTs fitted in small alternators, their effect, and critically their effect on island stability.

In discussions with Greg Middleton, he and I have come to the following view.

Firstly here is a sketch of how the CT is connected:



The alternator output is on the LHS, and the droop CT is connected across S1-S2 at the top. The DC signal out the RHS feeds the automatic voltage regulator PI controller that drives the machine excitation. A separate PF controller typically feeds into the PI controller as well.

The machine output here is the line voltage between two phases, and the CT is fitted in the third phase. Therefore the voltage phasor and current phasor are in quadrature. This is to be expected since the purpose of the droop CT is to be to help manage the VAr output. Greg believes, as do I just from a position of logic rather than knowledge, that the polarity of the CT is such that an increase in reactive current will produce a voltage that adds to the voltage from the alternator output; ie the CT acts to reduce VAr output by increasing the signal fed into the AVR.

This certainly seems to make sense for parallel operation and fixed PF, where the arrangement would act to minimize VAr production. However I do wonder if for island operation there is a case for the polarity of the CT to be reversed so that the voltage of the island is supported when the PF of the load falls. Both cases are analogous to the control schemes of tapchangers on DNO networks, with the first case being very similar to negative reactance compounding which minimizes circulating current between parallel transformers, and the second case being analogous to line drop compensation.

Reverting to our belief that the CT is connected to reduce VAr output, this would seem to give rise to two considerations for us – assuming that the load in any potential island is conventional and is inductive rather than capacitive.

If the droop is set to any value other than zero, then when a machine islands, any reactive power that the load demands is going to reduce excitation and drive what will probably lower volts even more, and help destabilize the island.

If the droop is set to zero, then the CT has no effect.

However, this does suggest that all small alternators have a AVR that is fast acting, which in the absence of a droop setting will actually act to stabilize the island – at least for a couple of seconds before a slower acting PF control changes the excitation to hunt its set PF.

It is hard to imagine that we will ever be able to establish the characteristics of the installed population in relation to the settings of the droop CTs.

In summary this implies that we have to consider how the above knowledge and assumptions affects our interpretation of Adam's modelling.

The most prudent position would be to assume that

- droop CTs are set with zero droop;
- alternators all have fast acting AVRs.

We can discuss this on 21/12.

MK
13/12/15