SOLAR INSTALLATION SERVICE OPPORTUNITIES

Fit and forget for solar panels is a bad policy. Panels deteriorate slowly as part of a natural process, but fixable problems also occur, and when not taken care of, compromise performance. Excessive leakage through loss of insulation resistance may require a panel replacement, or at least careful inspection and cleaning. Bypass diode failure will severely affect the solar panel energy performance. Once identified, the fix is easy. Regular inspection on a yearly basis presents an excellent business opportunity for accredited contractors.

Once installed, most solar PV installations are forgotten. Their owners obviously check electricity bills and unexplainable upward changes in consumption are flags for complaints, but very often these fall between the cracks because of the number of parties involved - original installer, electricity retailer, metering company, network provider - to whom gripes can be sheeted home. Solar panels lose efficiency over time, and can also develop cell faults and degradation of insulation resistance with respect to earth. Inverters, by virtue of mainly being shielded from the weather don't degrade, but can still develop time-related faults, a common one being failure of direct current (DC) link capacitors.

Solar panels require a regular check-up for open circuit voltage and insulation resistance to earth. The practical side of things makes these tests awkward to perform. Open circuit voltage indicates whether there are individual cells not operating, or whether bypass diodes have given up the ghost. Insulation resistance to earth is important because of the fact virtually 100% of rooftop installations have transformerless inverters, so that as a result, leakage to earth injects a DC component into the grid - a big no-no!

How leakage to earth occurs

The primary factor in loss of insulation is ion mobility through potential induced degradation (PID) of solar cells. The effects vary and depend on the grounding system. For example, negative terminal leakage is associated with PID; positive leakage, less so.

The mechanisms of degradation vary but in general, current through the front glass can provide a build-up of trapped charge in the active layer of cells.

The accumulation of charge, comprising of limited mobility ions, can lead to a slow degradation of the active layer of cells. As a practical example, in the case of negatively biased active layers, positive ions (e.g. Na^+) can migrate towards the active layer.

Testing leakage current, and keeping a track of data gathered over time, will provide a good indication of any degradation as this leads to serious impairment of cell efficiency. There are encapsulating materials that assure virtually no leakage to ground including some thermos-plastics.

A convenient insulation test in bright sunlight

High humidity levels, such as encountered in Queensland, can encourage electrolytic corrosion, and can increase observed leakage current. A practical way of testing panels for PID is through the use of insulation resistance with respect to earth for both the P (positive) and N (negative) terminals of the PV panels. In principle, this is an awkward test requiring not only isolation of the panels, but passive test conditions, as well meaning that ideally the tests should be carried out at night, or with panels covered. Figure 1a shows the principle of the test set up for the average insulation tester.

The measured quantities are compromised in terms of accuracy, primarily because the panels in question still have some activity level. In figure 1b, the Hioki methodology is shown using the purpose-developed IR4053 insulation tester. It is only necessary to open the isolation switch between panels and the inverter. Unlike the test as shown in fig 1a, requiring shorting of the P and N lines connecting to the inverter, with the attendant risk of arcing, this is avoided in the test as shown in Figure 1b where the test voltage supplied by the Hioki IR4053 will allow the drawing of a leakage current to earth independent of current available between the P and N terminals as a result of normal conditions, i.e. insolation under full daylight conditions.

Another critically important feature of solar panel installations is the bypass diode. Without testing the function of this component, panels can be badly compromised. Bypass diodes are not exactly passive elements, that is to say, they are exercised by dove poo, leaves, dirt, etc. causing them to have cycles where they draw no current flowed by current drawing. The result is a gradual deterioration to the point of becoming simply a resistor. When that occurs, the section of panel protected by the diode is now compromised with panel voltage dropping. In figure 2, the simplified equivalent circuit of a single solar cell is shown, comprising of a current generator, whose current value relates close to linearly to the insolation level.

On open circuit, the current generator forward biases the diode developing a voltage of about 0.6 volts. In a string of

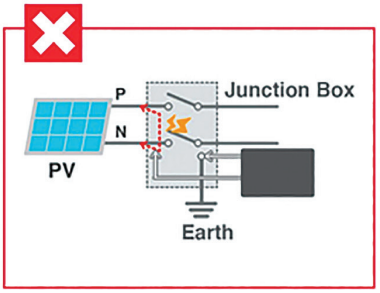

Figure 1a: the principle of the test set up for the average insulation tester.

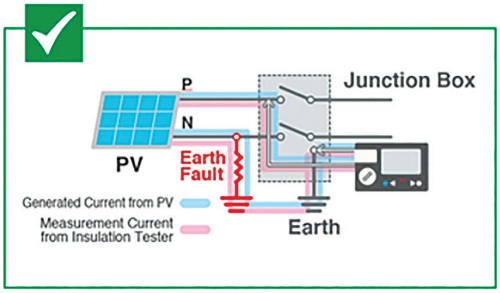

Figure 1b: the Hioki methodology is shown using the purpose-developed IR4053 insulation tester.