DC breakers (and fuses)

Notes for solar applications:

PV panels have a "maximum series fuse" rating written on their labels. Where there are 3 or more strings to the array, this may result in the need for protection of individual strings to protect against excessive reverse current to ensure that in the event of a fault, currents do not exceed this "maximum series fuse" rating.

If there are more than two PV strings in parallel (or in other cases where there is a battery in the system - not detailed here) then the maximum fault current that can arise (in reverse) in any one string is equal to the number of **other** strings connected, times the short circuit rating of each of those strings. Therefore if there are three (or more) parallel strings, the PV modules **could be** subjected to reverse currents of two (or more) times their nominal short circuit current. This reverse current rating (normally called maximum series fuse rating on the panel label) is different for different makes of panel and is typically in the range 15-20 amps for 250-300W panels.

AS/NZS 5033:2012 in NZ allows breakers for string protection and they can be either single or double pole. If you use only single pole breakers (to save costs) then with an ELV PV array you must also have a 2-pole disconnector at the PCE. If you install double pole breakers then you **do not** need a 2-pole disconnector at the PCE, you can turn off all the breakers to isolate both poles. You need to fix a sign on the breaker enclosure to say this and the breakers must be close to the PCE, otherwise a DC isolator will still be required.

Determining if you need to single or double pole, and the size of the fuse/breaker needed is complex and depends upon:

- Number on parallel strings
- Whether are not there is a battery in the system
- Maximum fuse rating of panel used
- Short circuit rating of panel
- Voltage of system, it is ELV or LV
- Whether the PV panel frames are earthed or not
- Regulations that apply in your country – these are not the same globally

It is always safer to use double-pole breakers or fuses, yes it may cost a little more and need larger enclosures but it can save in labour costs as wiring is often a little easier. If in doubt double pole protect.

We are unable to advise clients personally on the type and size of breakers required, as the human time to do so is significantly more than the margin we make selling these items.

For NZ clients fuse and breaker requirements are fully detailed in AS/NZS 5033:2012 for solar PV arrays.

Note that in Australia AS/NZS 5033:2014 applies and hence the advice above is different. The main difference is that DC breakers are **“not advised”**, this is not the case in NZ at the time of writing. If you are unsure on what version of 5033 to follow, click here. The standard version with the Gavel image after it (this means that the document is cited) is the one to follow in NZ - 5033:2012.

In NZ a standard **can be law and superseded at the same time**. This is because in NZ only the elected government can set laws and at this time they have decided not to change the law to include the latest version, but decided to cite the superseded version. It is possible that 5033:2014 will never be law in NZ and that we will jump to the next updated version. Hence follow 2012 version in NZ and the 2014 version in AUS.

We also have a system wiring guide that you can read that covers this subject specific to PowerSpout hydro turbines in much greater detail.

In general, if a short circuit or fault current **can** exceed the wire current rating, a fuse or breaker is required. If short circuit or fault current **cannot** exceed the wire current rating, then no protection is needed but an on/off DC switch may still be needed for both poles. DC breakers and DC fuses can also be used as switches in certain cases.