NAME :	Simon RYDER	GROUP REF. :	A2
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Collector transformers for field-scale PV generation are typically installed in or adjacent to packaged substations. The packaged substations are pre-fabricated and then installed on site as a unit, reducing installation time and costs and also reducing disturbance caused by construction works for members of the public. The packaged substations typically contain HV and LV cable terminations; HV and LV switchgear; and protection and control systems in addition to any transformer. A number of different designs are available, some of which are constructed inside standard shipping containers for ease of transport and handling.

Figure *1* shows a typical packaged substation for PV integration, constructed inside a standard 40 foot shipping container. This packaged substation includes a dry-type transformer in addition to HV and LV cable terminations; HV and LV switchgear; and protection and control systems.

Figure 1 Typical Packaged Substation for PV Integration

Whilst packaged substations provide some protection from the natural environment, the need for ventilation means that transformers installed inside are exposed to extremes of temperature and humidity and also to fine contamination. The packaged substation in Figure *1* suffered greatly from high humidity leading to condensation on the equipment installed inside.

Packaged substations are not a favourable installation environment for liquid-immersed or especially dry-type transformers. If possible, it is preferable for the transformer to be installed outdoors, adjacent to the packaged substation, rather than inside. Otherwise, as much natural ventilation as possible should be provided.

In the opinion of the author, liquid-immersed design concepts (oil or natural ester in environmentally sensitive areas) are more suitable for use as collector transformers for PV generation owing to greater inherent resistance to extremes of temperature and humidity and also to fine contamination. Liquid-immersed design concepts also lend themselves to optimisation of rated power, as liquid-immersed transformers have a slower response to changes in load.

Dry-type design concepts may be useful for some applications where the transformer can be installed in a well-controlled indoor environment, e.g. large-scale roof-top PV generation projects.