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DC isolators for photovoltaic systems

A good practice guide

Steve Pester

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Executive summary

The photovoltaic (PV) market is now expanding rapidly worldwide and this trend is expected to continue. In the UK there was a sudden (but necessary) reduction in state subsidies for solar installations in 2012. However, following that, a more stable Feed-in Tariff (FiT) mechanism was implemented which resulted in the UK becoming one of the best PV markets in Europe.

This rapid expansion of the market is accompanied by the need to be vigilant in the maintenance of standards of safety in the installations – misunderstandings concerning some of the details of the technology can prove to be dangerous.

This guide is intended for installers, distributors, inspectors and anyone who has an interest in the correct specification of DC isolators – a critical component for the safe design and installation of PV systems.

The Wiring Regulations (BS 7671[1]) make the fitting of these devices mandatory within the UK but a lack of understanding has led to a few incidents of fire in UK installations. These incidents, whilst not common, have the potential to damage the reputation of the solar power industry, or worse, to cause loss of life.

It is hoped that, by following the guidance laid out in this publication, those responsible for designing and installing PV systems will be in a better position to make good product selections and to install them correctly.

For readers with little background knowledge, a primer on direct current (DC) and alternating current (AC) electricity and typical PV systems is included as an introduction to the requirements and desirable characteristics of isolators on PV systems.

After explaining some basic terminology, what isolators are and why they are used, a list of issues seen in the field, along with some pictorial examples, are presented in order to explain why it is essential to understand how to correctly specify these devices.

A short summary of the main types of product on the market is then followed by a clear explanation of the key points to take into account when specifying DC isolators.

A list of the relevant standards and certifications for both manufacturers and installers is also included for easy reference.

The purpose of this guide

The reason for writing this guide is not theoretical. A small but significant number of incidents on PV systems in the field, apparently caused by malfunctioning DC isolators, has prompted a close look at the likely causes, and identified the need to provide guidance for designers, installers, distributors and inspectors.

This guide therefore:

- describes the purpose, functions and features of isolators on PV systems
- describes some of the available products
- highlights some of the real issues occurring in the field (with a rogues' gallery of examples)
- reviews the relevant standards and guidance that are currently available
- summarises the key recommendations.

Whilst this guide is essentially technical in nature, it is intended to be accessible and relatively easy to read for the target audience.

More formal guidance and a detailed interpretation of the regulations may be found in the Institution of Engineering and Technology (IET) guidance note on isolation and switching[2], which interprets the requirements of the 17th edition of the Wiring Regulations (BS 7671)[1], and in the standards listed in this guide.

1 Introduction

This guide is intended for installers, distributors, inspectors and anyone who has an interest in the correct specification of DC isolators – a critical component for the safe design and installation of photovoltaic (PV) systems.

The scope covers standard isolators for small/medium size PV systems, generally building-mounted.

Since the introduction of the Feed-in Tariff (FiT) in the UK in April 2010, PV power systems have become commonplace. In the vast majority of cases, these are safe, reliable systems, with no moving parts and the system owners can look forward to 20 to 30 years of electricity production from sunshine. The technology and installation techniques are quite mature since Germany has been leading the way for over 20 years.

One effect of the introduction of FiTs has been a rapid increase in the number of installers and distributors. This trend has been echoed worldwide and a similar expansion in numbers has occurred in the manufacturing sector, notably in China and the Far East. However, more recently many governments (with only a few exceptions) have made large cuts to their incentive schemes, leading to increased competition amongst installers and manufacturers, creating pressure to drive down the cost of PV systems.

This pressure has manifested itself in various ways, including the search for cheaper component parts, and in some cases, this 'value engineering' has resulted in some shortcuts being taken and a resulting effect on quality and safety.

For reasons of maintenance or fault-finding, isolators are required on both the direct current (DC) and alternating current (AC) sides of the system (PV systems are inherently DC and they use an inverter to convert the current to AC so that it can be used with standard mains electricity systems).

BRE was recently sent an example of a DC isolator which had malfunctioned and filled up a room with smoke in a few seconds. The electrical arcing inside the unit burnt through the side of the enclosure before it could be disconnected. The cause – most probably an incorrectly specified isolator. Fortunately, in this case, a solar engineer was on hand to deal with the dangerous situation, but it is unnecessary to describe in detail the potential consequences for life, property and the reputation of the solar industry from such incidents. This was not an isolated incident; BRE has been made aware of several others involving isolators used for switching DC currents in PV systems.

In the UK we are fortunate to have the Microgeneration Certification Scheme (MCS)[3], which certifies both installers and products. The MCS requires installers to use appropriately rated DC components for all DC functions, but the MCS product scheme does not currently certify isolators. Moreover, it is difficult for MCS assessors, when inspecting installations, to ascertain the suitability of the DC isolators used since they are often not marked with a make and model number.

To make matters worse, there is anecdotal evidence that some suppliers have been re-designating some types of AC isolator as DC-rated in order to be able to supply a low cost item. Little wonder that some installers have been using incorrectly specified devices.

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Photovoltaic (PV) power systems are now commonplace. In most cases these systems are safe and reliable, but incorrectly specified or installed isolators can cause fires, damage the reputation of the solar power industry, or worse, cause loss of life.

This guide provides the key points to take into account when specifying DC isolators, including standards and certifications required.

The guide:

- describes the purpose, functions and features of isolators on PV systems
- describes some of the available products
- highlights some of the real issues occurring in the field (with a rogues' gallery of examples)
- reviews the relevant standards and guidance that are currently available
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