



[Courtesy: Dr Sung]



Renewable sources of electricity and the 17th Edition of the IEE Wiring Regulations (BS 7671:2008) A brief overview

by Geoff Cronshaw

THE SCOPE of the 17th Edition is wider and contains many new requirements, including additional requirements to ensure the safe connection of low-voltage generating sets including small scale embedded generators and solar photovoltaic (PV) power supply systems. In this article we look at the new Regulations in Section 551 and Section 712.

Chapter 55 – Other Equipment. Regulation 551 – Low Voltage Generation Sets

This set of Regulations now includes additional requirements contained in Regulation 551.2 to ensure the safe connection of low-voltage generating

sets including small scale embedded generators.

A new Regulation, 551.4.2, regarding the use of RCDs, has been added. Regulation 551.4.2 states:

The generating set shall be connected so that any provision within the installation for protection by RCDs in accordance with Chapter 41 remains effective for every intended combination of sources of supply.

Notes have been added including one to Regulation 551.1 stating that the procedure for connecting generating sets up to 16 A in parallel with the

public supply is given in *The Electricity Safety, Quality and Continuity (Amendment) Regulations 2006*. For sets above 16 A the requirements of the distributor must be ascertained. The 17th Edition recognises that there are two connection options:

- (i) Connection into a separate dedicated circuit
- (ii) Connection into an existing final circuit

Connection into a dedicated circuit is preferred. Regulation 551.7.2 sets out the requirements for the two options. The Regulation requires that a

[Courtesy: Dr Sung]



Fig 1: A wind generator. The pole mounted unit on the roof of the first house is a weather station which can measure wind speed and rate of solar radiation (insolation) and the dark PV tiles are integrated with the red roof tiles.

generating set used as an additional source of supply in parallel with another source shall either be installed on the supply side of all protective devices for the final circuits of the installation (connection into a separate dedicated circuit) or if connected on the load side of all protective devices for the final circuits must fulfil a number of additional requirements.

These additional requirements are:

- (i) the current carrying capacity of the final circuit conductors shall be greater than or equal to the rated current of the protective device plus the rated output of the generating set, and
- (ii) A generating set shall not be connected to a final circuit by a plug and socket, and
- (iii) A residual current device providing additional protection of the final circuit in accordance with

Regulation 415.1 shall disconnect all live conductors including the neutral conductor; and

- (iv) The line and neutral conductors of the final circuit and of the generating set shall not be connected to earth, and
- (v) Unless the device providing automatic disconnection of the final circuit in accordance with Regulation 411.3.2 disconnects the line and neutral conductors, it shall be verified that the combination of the disconnection time of the protective device for the final circuit and the time taken for the output voltage of the generating set to reduce to 50 V or less is not greater than the disconnection time required by Regulation 411.3.2 for a final circuit.

PV Installation

Section 712 of BS 7671:2008 is concerned with the safe installation of solar photovoltaic (PV) power supply systems. A PV system is a collection of interconnected PV cells that turn sunlight directly into electrical energy.

The risks

Modules produce electricity when exposed to daylight. This needs to be taken into account during design, installation, use and maintenance. Also, the electrical installation which incorporates a PV system has a second source of energy which needs to be



Wiring Matters is produced by IET Services Limited, a subsidiary of The Institution of Engineering and Technology (IET), for the IET. Michael Faraday House, Six Hills Way, Stevenage, Herts, SG1 2AY, United Kingdom Tel: +44 (0)1438 313311 Fax: +44 (0)1438 313465

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IEE Wiring Matters is a quarterly publication from the Institution of Engineering and Technology (IET). The IET is not as a body responsible for the opinions expressed.

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Co-operating Organisations The Institution of Engineering & Technology acknowledges the contribution made by the following organisations in the preparation of this publication: British Electrotechnical & Allied Manufacturers Association Ltd – P D Galbraith, M H Mullins | Department for Communities and Local Government – I Drummond | Electrical Contractors Association – D Locke, S Burchell | City & Guilds of London Institute – H R Lovegrove | Electrical Contractors Association of Scotland SELECT – D Millar, N McGuinness | Health & Safety Executive – K Morton | Electrical Safety Council | ERA Technology Limited – M Coates | British Cables Association – C Reed | Scottish Building Standards Agency | Department for Business, Enterprise and Regulatory Reform | CORGI – P Collins | GAMBICA – M. Hadley, A. Sedhev | Lighting Association – L Barling

ISSN 1749-978-X

[Courtesy: Dr Sung]



Fig 2: Dark PV tiles are integrated with the red roof tiles.

[Courtesy: Dr Sung]



Fig 3: Inverter unit installation

isolated before starting work. A further risk involves working at height on a roof for example together with the manual handling associated with a PV installation. Finally, PV installations require expertise in dc wiring and fault protection for d.c. side of the installation.

Scope

Section 712 of BS 7671:2008 applies to the electrical installations of PV power supply systems including systems with a.c. modules. Section 712 does not apply to PV power supply systems which are intended for stand-alone operation.

The Electricity Safety, Quality and Continuity (Amendment) Regulations 2006

Solar photovoltaic (PV) power supply systems are required to meet the Electricity Safety, Quality and Continuity (Amendment) Regulations 2006 (ESQCR) as they are embedded generators. These are mandatory requirements.

However, where the output does not exceed 16 A per line they are small-scale embedded generators (SSEG) and are exempted from certain of the requirements provided that:

- (i) the equipment should be type tested and approved by a recognised body,
- (ii) the consumer's installation should comply with the requirements of BS 7671,
- (iii) the equipment must disconnect itself from the distributor's network in the event of a network fault, and
- (iv) the distributor must be advised of the installation before or at the time of commissioning.

See *Engineering Recommendations G83/1, for PV systems up to 16A (5kw) and G59/1*, published by the Energy Networks Association (ENA)* for larger systems and generators, etc.
* Further information can be obtained at the ENA's website: www.ena-eng.org/

Protection for safety General requirements

Regulation 712.410.3 requires that PV equipment on the dc side must be considered to be energised, even when the system is disconnected from the a.c. side. This is because modules produce electricity when exposed to daylight. Regulation 712.410.3.6 states that the protective measures of non conducting location and earth free local equipotential bonding are not permitted on the d.c. side.

Protective measures

Regulation 712.41 recognises three methods of protection. Regulation



Fig 4: A large building with an integrated PV system

712.411 gives requirements for the protective measure, automatic disconnection of supply. Where this method of protection is used on the a.c. side, the PV supply cable shall be connected to the supply side of the protective device for automatic disconnection of circuits supplying current-using equipment. Regulation 712.412 gives requirements for the protective measure, double or reinforced insulation and states that protection by Class II or equivalent insulation shall preferably be adopted on the d.c. side.

Regulation 712.414 gives requirements for the protective measure, extra-low voltage provided by SELV or PELV. Where this method of protection is used Uoc STC replaces Uo and must not exceed 120 v dc.

Protection against overcurrent and electromagnetic interference

Regulation 712.433 gives a relaxation, and allows overload protection on the d.c. side to be omitted when the current carrying capacity of the cable is equal to or greater than 1.25 times I_{sc} STC (short-circuit current under standard test conditions) at any location.

Regulation 712.434 requires that the PV supply cable on the a.c. side shall be protected against fault current by an overcurrent protective device installed at the connection to the a.c. mains.

Regulation 712.444 deals with Protection against electromagnetic interference (EMI) in buildings. The Regulation recognises that in order to minimize voltages induced by lightning, the area

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Fig 5: Roof mounted PV installation



WARNING - DUAL SUPPLY

**ISOLATE BOTH MAINS AND ON-SITE GENERATION
BEFORE CARRYING OUT WORK**

ISOLATE THE MAINS AT _____

ISOLATE THE GENERATOR AT _____

Fig 6: Dual supply warning notice

of all wiring loops shall be as small as possible.

Selection and erection of equipment **Compliance with standards**

Regulation 712.511 requires that PV modules shall comply with the requirements of the relevant equipment standard, e.g. BS EN 61215 for crystalline PV modules.

Operational conditions and external influences

Electrical equipment on the d.c. side must be suitable for direct voltage and direct current as required by Regulation 712.512. Equipment approved to normal a.c. standards may not be suitable, especially switchgear. It is therefore essential that PV systems are installed by competent

persons to an approved design. The designer must clarify the standards and performance requirements with the equipment manufacturers as part of the design process. It must also be remembered that as PV systems are often installed on a roof or other location external to the building they will be subject to external influences such as heavy rain, high winds, etc. and therefore need to be designed and installed to withstand such conditions. Also, it must also be remembered that planning and building regulations approval may be required.

Accessibility

Regulation 712.513 requires that the selection and erection of equipment shall facilitate safe repair and maintenance.

Wiring systems

Regulation 712.522 requires that PV string cables, PV array cables and PV d.c. main cables shall be selected and erected so as to minimize the risk of earth faults and short-circuits. Cables should be selected that are suitable for their environment and conditions of use and the expected equipment temperatures. The Regulations require that wiring systems must be able to withstand the expected external influences such as wind, ice formation, temperature and solar radiation.

Isolation, switching and control

Regulation 712.537.2.1.1 recognises the need for maintenance and requires that a means of isolating the a.c. and d.c. sides of the PV converter needs to be provided.

Regulation 712.537.2.2 has requirements for the selection and erection of isolation and switching devices. The Regulation states that the selection and erection of devices for isolation and switching to be installed between the PV installation and the public supply, the public supply shall be considered the source and the PV installation shall be considered the load.

Earthing arrangements and protective conductors

Regulation 712.54 requires that where protective bonding conductors are installed, they shall be parallel to and in as close contact as possible with d.c. cables and a.c. cables and accessories.

Labelling

Labels are required at the:

- supply terminals (fused cut-out)
- meter position
- consumer unit, and at all the points of isolation to indicate the presence of the SSEG within the premises

The Health and Safety (Safety Signs and Signals) Regulations 1996 stipulate that the labels should display the prescribed triangular shape and size using black on yellow colouring. A typical label both for size and content is shown in Fig 6.

Conclusion

There are a wide range of microgeneration technologies including: Solar photovoltaic (PV), wind turbines, Small scale hydro and Micro CHP (Combined heat and power). Microgeneration systems such as solar PV installations should always be carried out by a trained and experienced installer. For example, the roof must be strong enough to take their weight, especially if the panel is placed on top of existing tiles. It is also important to note that there are mandatory requirements concerning the parallel connection of generators with the supply network.

For further information refer to *BS 7671:2008, Engineering Recommendations G83/1 and G59/1*



published by the Energy Networks Association and the Department for Business, Enterprise & Regulatory Reform (BERR).

Further information

For further information on

Building Regulations contact:

England and Wales - the Department of Communities and Local Government - www.communities.gov.uk

Scotland - The Scottish Building Standards Agency - www.sbsa.gov.uk ■



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