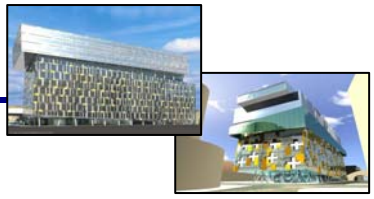
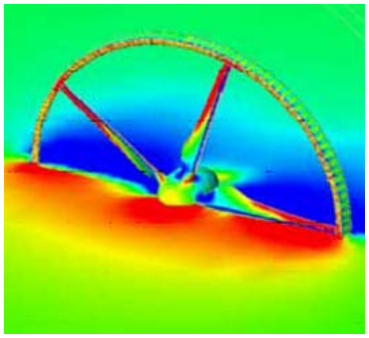


APPENDIX F:
Wind Energy Data

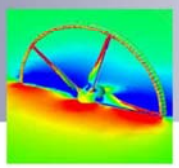
Renewable Devices

Technical Information Pack



SWIFT

Rooftop Wind Energy System™



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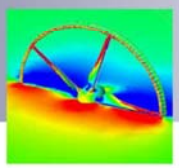


1. SWIFT Rooftop Wind Energy System™

1.1 Introduction

This document is intended to provide guidance to engineers, architects and specifiers, when considering the installation of a SWIFT Rooftop Wind Energy System™. It is not intended as an Installation Manual and does not contain information suitable for the maintenance, installation or decommissioning of the SWIFT Rooftop Wind Energy System™.

The system must ONLY be installed by trained and approved installers.

The information contained in this document is subject to periodic review and it is the specifiers' responsibility to ensure that the most recent version is utilised.

1.2 Product Description

As part of its mission to provide accessible renewable technologies, Renewable Devices Swift Turbines Ltd (RDSTL) has produced the world's first feasibly rooftop-mountable wind turbine, capable of providing a cost effective renewable energy source for domestic, community and industrial use. The SWIFT Rooftop Wind Energy System™ is grid connected for "beyond the meter" generation.

The emphasis of the design process has focused on safety, reliability and ease of operation, alongside high performance of this innovative system. The turbine uses unique patented technologies, which allow:

- Wide ranging application
- Vibration-isolated rooftop mounting
- Quiet operation through acoustic suppression aerodynamics
- Safe, efficient & autonomous operation
- Visually appealing design
- Environmentally sustainable "harm neutral" design; allowing the SWIFT™ to become carbon and energy positive within four years.
- Sophisticated electronic control system

The SWIFT™ turbine is mounted on a bespoke aluminium mast with a minimum blade-roof clearance of 0.5 metres. It is usually optimally mounted at the highest point of a roof in a position that benefits from maximum prevailing wind.

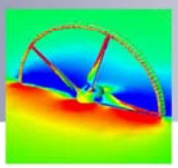
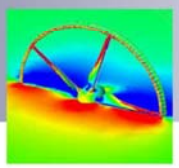


Figure 1 - Installed SWIFT Rooftop Wind Energy System™

To ensure minimal transmission of oscillations from turbine to building, the mounting brackets incorporate damping systems, designed to isolate at a wide range of frequencies. The patented ring diffuser around the rotor blades is designed to minimise turbine noise by preventing the creation of violent vortices at the blade tip. In addition the five-bladed design allows for a slower speed of rotation further reducing noise, making the SWIFT Rooftop Wind Energy System™ the quietest wind system currently available.

The SWIFT™ turbine has a unique over-power regulation mechanism to control rotation speed and maintain system integrity/safety in high winds. This consists of an innovative twin-vane progressive mechanical furling mechanism, coupled with a sophisticated electronic control system. This allows the optimum amount of power to be extracted from the turbine under varying wind and loading conditions, representing a step change in the accurate and safe control of small wind turbines.

In environmental terms, each unit of electricity generated from a SWIFT Rooftop Wind Energy System™ displaces one unit generated from fossil fuels, with the added benefit that the electricity is consumed on-site, thus negating losses from transmission. This can amount to a displacement of up to 1.4 tonnes of CO_2 per year – a significant environmental contribution.



2. Planning Policy

2.1 Policy and legislative context

The Scottish Executive's policy for renewable energy is described in PAN 45 and is set out in "NPPG6, Renewable Energy Developments". UK policy encourages the uptake of widespread micro generation including rooftop wind turbines such as the SWIFT Rooftop Wind Energy System™ on domestic, educational and industrial premises. Indeed the Energy Minister Malcolm Wicks expressed his support during a speech at a Green Conference in his constituency in October 2005: "Imagine one day, every school with its own micro wind turbine and/or state of the art solar paneling. Imagine a clear display panel on such a school detailing how much carbon dioxide has been saved. Imagine how the science teacher, or those teaching citizenship responsibilities, could use such technology in their teaching…"

2.2 Technology Overview

The need for increased use of renewable energy is well established. Opportunities to generate 'bulk' electricity from renewable resources are currently being exploited throughout Europe, including the development of wind, hydro and other technologies.

It is recognised however, that in order to both meet objectives for CO_2 reductions and decrease our dependency on fossil fuels, domestic and commercial application of renewable technologies must be increased. Small-scale wind turbines have the potential to contribute towards this, providing electricity or hot water heating in both domestic and commercial applications. The associated CO_2 savings per turbine contribute to the UK's CO_2 emissions reduction targets and longer term cost savings per household or business can be significant. In addition wide deployment of turbines will lead to significant CO_2 savings in the longer term and will increase levels of 'embedded' generation.

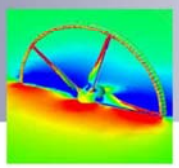
2.3 Visual impact

Rooftop-mounted small wind turbines will be installed in a position to take advantage of higher wind speeds on the top of building structures (with the exception of 'building integrated' designs) and will be comparable in height to a large television aerial or chimney stack. The SWIFT™ has been designed to comply with planning requirements and to complement the aesthetics of a building. As with satellite dishes, rooftop wind turbines are now becoming more widely accepted with increasing familiarity.

Applications should be assessed on a case-by-case basis, taking account of the existing building/structures, relative scale, nature of the setting and benefits of renewable energy generation. Computer generated photo montages of buildings with superimposed in-situ turbines can be used to assist the planning process. The colour and finish of the SWIFT Rooftop Wind Energy System™ is designed to minimise visual impact and reflection of light.

Due to the fact that SWIFT™ turbines will be located on or near existing commercial/domestic buildings, they will not add a significant new visual element to the local landscape. Unlike large wind farm installations, a full landscape and visual impact assessment is not required.

Free standing SWIFTs™ mounted on masts (as opposed to being building mounted) should also be assessed on a case-by-case basis, in accordance with guidance contained in the main planning annex on wind energy and any additional structural/engineering issues.



2.4 Noise

The need to control noise emissions from a small-scale wind turbine is critical in domestic settings. In commercial/light industrial settings, where there are no residential properties in the immediate vicinity, the control of noise is important, but less critical. Detailed discussion of noise from wind turbines is contained in the main wind energy appendix to "PAN 45 (revised 2002): Renewable Energy Technologies", and wider discussion of planning and noise can be found in PAN 56.

In the absence of specific guidance on noise for small-scale wind turbines, they should meet the criteria identified by the DTI/ETSU report: 'The Assessment and Rating of noise from wind farms.'[1]. As a general rule, noise emitted from the turbine should not exceed 5dB(a) above background noise, with a fixed limit of 43dB(A) recommended for night time. Both day and night time noise limits can be increased to 45dB(A) where the owner of the property benefits directly from the operation of the turbine. The SWIFT Rooftop Wind Energy System™ always emits less than 35dB(A,) across all wind speeds and therefore meets all legislative criteria.

The SWIFT™ has been designed to comply with these regulations and there is no evidence to suggest that SWIFT Rooftop Wind Energy Systems™ have any detrimental effect on wildlife.

2.5 Reflectivity and Reflection

To minimise the occurrence of 'flash' the SWIFT's™ rotor is comprised of moulded carbon fibre, with a matt black surface. Matt is specifically chosen to avoid highlights or bright reflections from rotor surfaces during rotation, in either natural or artificial light. The black colour allows for minimal reflectivity (the ratio of the total amount of white light diffusely reflected by the surface to the amount falling on the surface) as it is extremely absorptive over a wide range of wavelengths.

In addition, the small diameter and likely location of the turbine ensures that reflection and reflectivity are not considered to be issues for the SWIFT Rooftop Wind Energy System™.

2.6 Electromagnetic Interference

Aircraft, Military Low Flying, Aerodromes and technical sites:

Unlike large wind turbines and wind farms, small SWIFT™ rooftop wind turbines are extremely unlikely to cause any detrimental effects on aviation and associated radar/navigation systems. They have been successfully installed near major airports without any negative effects on aviation.

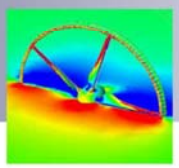
Television / radio reception:

The SWIFT Rooftop Wind Energy System™ meets all of the mandatory UK and EU Electro-Magnetic Compatibility (EMC) standards and does not affect television or radio reception.

Effect on mobile phone and telecommunications links:

The SWIFT Rooftop Wind Energy System™ meets all of the requisite UK and EU Electro-Magnetic Compatibility (EMC) standards and does not effect mobile phone reception or fixed radio/microwave communications links.

[1] ETSU (1996) 'The Assessment and Rating of noise from wind farms.' DTI Noise Working Group, Energy Technology Support Unit.



Emission of electromagnetic radiation:

The SWIFT Rooftop Wind Energy System™ has been fully EMC tested for electro-magnetic compatibility and exceeds all of the relevant UK and European standards (BS EN 61000-6-3: 2001 EMC Emissions and BS EN 61000-6-1: 2001 EMC Immunity, both of which are relevant for residential, commercial and light industry).

2.7 Bird Strike

The transparency of the SWIFT's™ five rotating blades is much less than that of a window and this combined with the solid diffuser ensures that the turbine remains a clearly defined unit at all times. The small diameter of the SWIFT™ rotor (~2m) makes it comparable as an obstacle to a rooftop television aerial, satellite dish or chimney stack. It is extremely unlikely therefore, that the location of a rooftop turbine will cause a significant increase in bird strike, beyond the rates already caused by existing buildings, windows and other such obstacles. During a twelve month in situ testing program on a single storey structure, not a single bird collision was recorded, neither have any been reported from turbines installed throughout the UK to date.

All accredited installers are advised to enquire as to the location of localised nesting areas and carry out subsequent installations with the minimum of disturbance, in line with regulations of the Wildlife and Countryside Act 1981 (WCA) and Countryside and Rights of Way Act 2000 (CROW Act - specifically in England and Wales).

The sixteen species of bats in the United Kingdom are virtually all classified as rare, vulnerable or endangered and as such both bats and their roosts are also protected by the afore mentioned WCA 1981 and CROW Act 2000; the regulations of which SWIFT™ installations strictly adhere to.

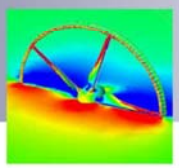
The RSPB views climate change as the most serious long-term threat to wildlife, both globally and in the UK. They subsequently support the deployment of wind turbines, both large and small, provided they are positioned sensitively with care and consideration shown for the local flora, fauna and wildlife.

2.8 Safety

Structural safety:
The SWIFT™ has been designed and independently tested to ensure compliance with all mandatory product standards of the IEC 61400 and in particular, BS EN 61400-2: 1995 "Wind turbine generator systems - safety requirements".

The SWIFT Rooftop Wind Energy System™ is designed to withstand extremely high winds and will typically shut down or 'furl out' in high wind speeds to protect the turbine from damage. The SWIFT™ is designed (and has been independently verified) to meet and exceed all of the structural and safety constraints required by BS EN 61400-2 and all other UK safety standards for machines of this type. Electrical connections and/or an associated hot water system should be installed in accordance with appropriate building standards.

Electro-magnetic compatibility:
The SWIFT™ complies with BS EN 61000-6-3: 2001and BS EN 61000-6-1: 2001 for domestic, commercial & industrial premises (power quality) effects including flicker and harmonic distortion.



Electrical safety:
The SWIFT Rooftop Wind Energy System™ meets all of the electrical safety criteria set out in EN 50178 and the 16th Edition of the UK Wiring Regulations.

Grid monitoring:
The SWIFT Rooftop Wind Energy System™ meets all of the grid-monitoring criteria set out in VDE 126, including Anti-Islanding Protection.

G83 compliance
The SWIFT Rooftop Wind Energy System™ has been independently verified to ensure that it meets the G83 standard for the grid-connection of small-scale generators.

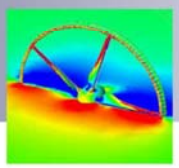
CE Marking
The SWIFT™ Rooftop Wind Energy System™ meets all appropriate European Directive legislation and is certified as CE compliant.

2.9 Versatility

The SWIFT Rooftop Wind Energy System™ can be installed safely and simply into almost any building design. Single or multiple installations are both equally possible, as are installations on both residential and commercial properties.



Figure 2 – SWIFT™ installations



3. Installation summary

For information only, below are the steps required to achieve a safe and effective installation of the SWIFT Rooftop Wind Energy System™:

The system must ONLY be installed by trained and approved installers.

- Transportation and receipt of SWIFT Rooftop Wind Energy System™.
- Preparation of walls and installation of mounting brackets.
- Installation of turbine mounting mast.
- Installation of electronic control system and grid-tie inverter.
- Installation of SWIFT™ turbine.
- Electrical connection of system.
- Testing.
- Commissioning.
- Completion of test certificates and commissioning documentation.

The SWIFT™ turbine is typically wall-mounted at the gable end of a building using the bespoke brackets supplied (figure 3). For information, the bracket spacing is as shown in figure 4, below.

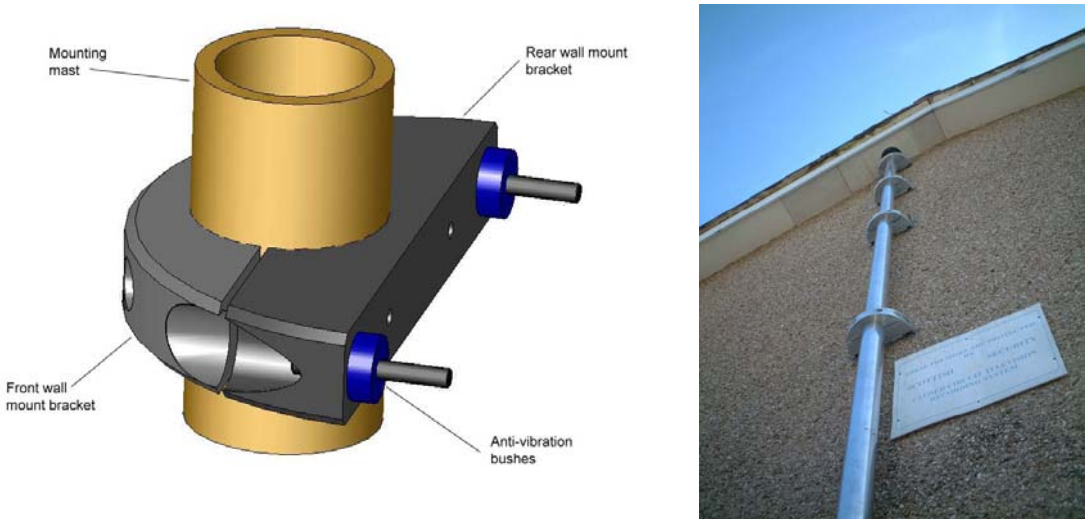
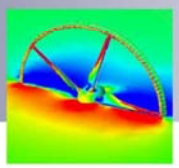


Figure 3 - Correctly assembled & installed mast mounting brackets

The pitch of the holes required to mount there brackets to the wall or any reinforcing structure is 254.0mm.



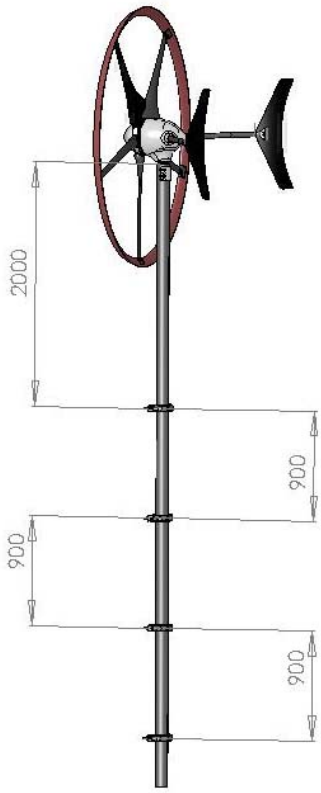
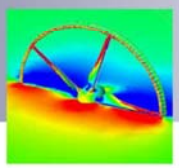


Figure 4 - SWIFT™ wind turbine assembly showing bracket spacings

In some circumstances it may be necessary to mount the SWIFT™ wind turbine mounting mast onto the exterior, and through the overhanging eaves of a building. In this instance, sealing roof glands will be required. The mounting mast is located by sliding it up through these rubber glands.

Figure 5 - Typical installation of rubber roof gland seal.



3.1 Flat Roof Installation

The SWIFT Rooftop Wind Energy System™ can also be installed on a flat roof. In this type of installation, the mounting mast described above is replaced with a bespoke mounting stand. The installation of this stand is site-specific and may require additional engineering work to be carried out in order to assess/ensure the structural suitability of the building.

The most common type of flat roof installation uses a bespoke stand, as shown in Figure 6.

Figure 6 - A typical flat roof installation configuration

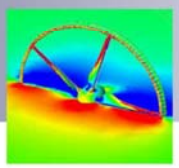
The height of the flat roof mounting mast will vary as some sites may have a parapet. The flat roof mounting mast will be between 1.5m and 3.5m in height (from the base plate to the turbine hub height) and will typically be 2.0m.

For reference, the approximate mass of the SWIFT™ turbine components are as follows:

Mass of SWIFT™ turbine:	50 kg
Mass of mounting mast:	40 kg

3.2 Loadings

In all installation configurations, the wall mounting anchors or the flat roof stand will transmit the aerodynamic thrust from the rotor to the mounting structure. The amount of mechanical stress imposed on the anchors will depend on the height of the mounting mast – each installation is different. As a guide, when designing the mounting structure, the stress at the anchor points should be considered to be induced by an axial thrust (acting horizontally at the rotor hub height) of 7kN, plus the loads due to the mass of the turbine and mounting masts.



4. Electrical & electronic controller connections

The SWIFT Rooftop Wind Energy System™ will be supplied with two electronic components: an electronic control system and a grid-tie inverter.

The electronic control system provides sophisticated electronic control of the turbine and includes a manual brake to allow for safe access near the installation etc. The grid-tie inverter is used to synchronise the power output to that of the consumers' electricity supply.

Figure 7 - Installed SWIFT™ Electronic Control System

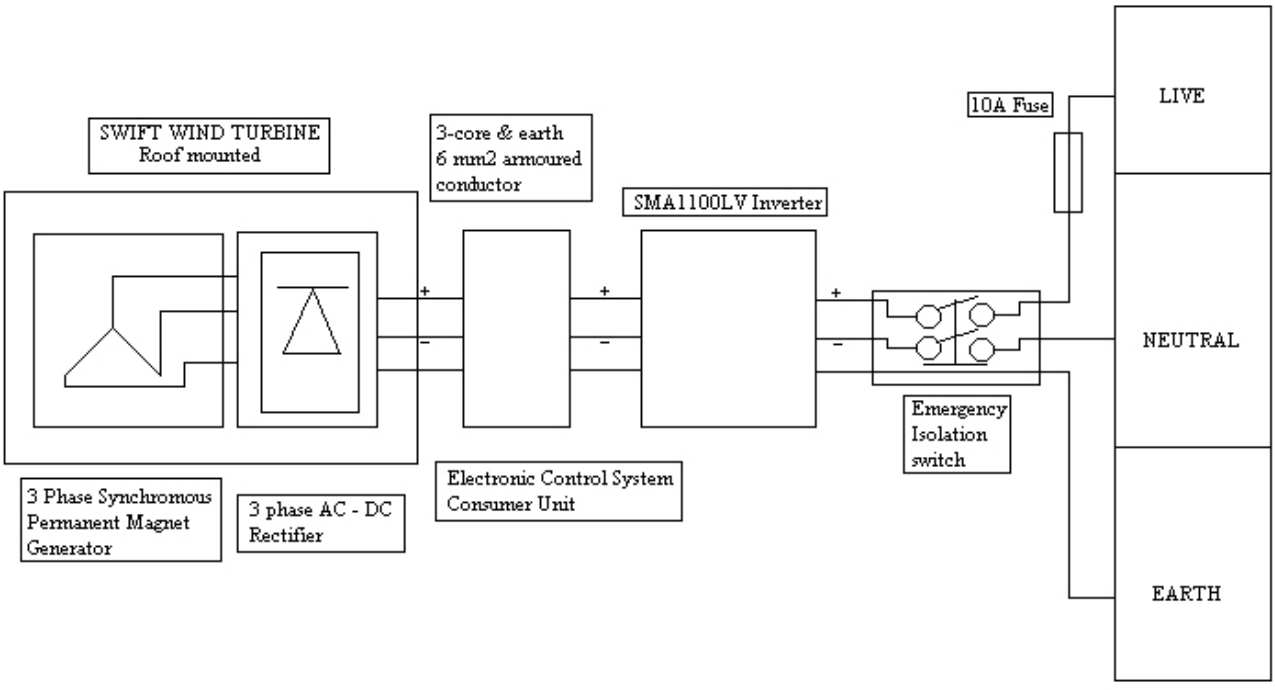
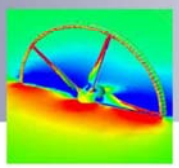


Figure 8 - Electrical Schematic of a typical installation



5. Performance

The power curve for the SWIFT Rooftop Wind Energy System™ is shown in figure 9, below.

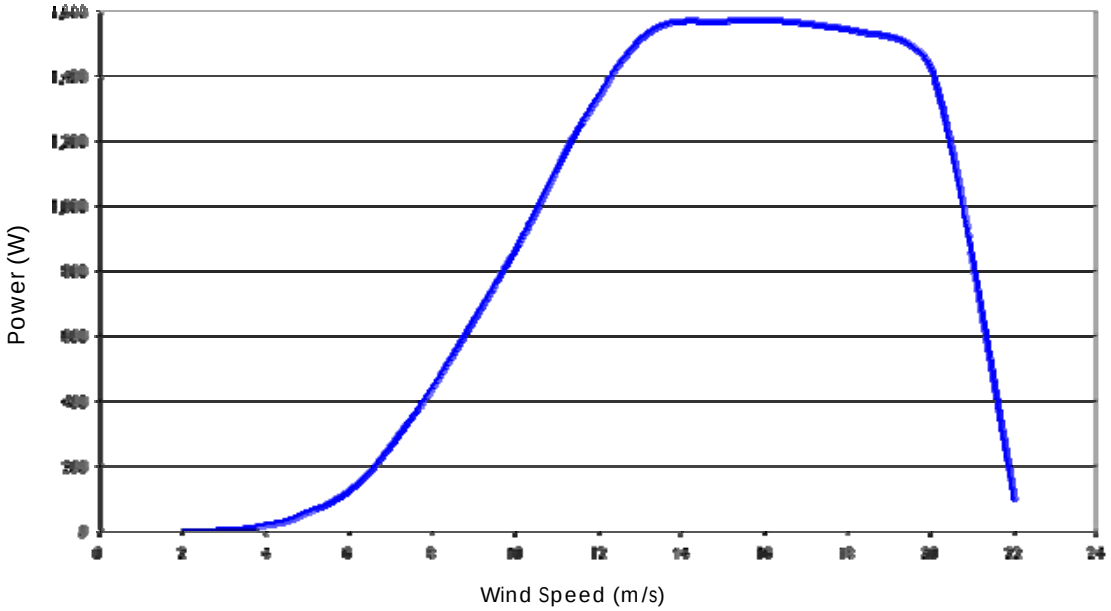


Figure 9 - SWIFT™ power curve

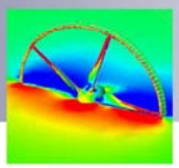
6. Compliance

The SWIFT Rooftop Wind Energy System™ has been independently tested and certified to comply with the following standards and directives:

EN 61400-2: 1996
This standard relates to the safety of wind turbine generator systems and is applied as the SWIFT Rooftop Wind Energy System™ has a swept rotor area of less than 40m² and generates at a voltage below 1,000 V, a.c. or 1,500 V, d.c. Mechanical components are designed and specified to meet this standard. Apart from EMC, described below, the specific electrical standard applied to satisfy EN 61400-2 is EN 60950.

EN 61400-24: 1996
Lightening protection of wind turbines.

EN 60950: 2000
The SWIFT™ turbine operates at safety extra low voltage (SELV), below the threshold voltage at which the low-voltage directive is normally applicable. However, EN 60950 is applied as a standard for safety aspects other than the risk of electric shock. These include flammability of component parts, temperature rise of user-accessible components, labelling and accompanying documents.



BS 5760-0:1986
Although BS 7671 deals with electrical installations, component parts of the SWIFT Rooftop Wind Energy System™ are designed to facilitate its installation in accordance with this standard.

BS EN 61000-3-2 and BS EN 61000-3-3
Electro-magnetic compatibility limits for harmonic distortion & voltage fluctuation.

EN 50081-1
Electro-magnetic compatibility - domestic, commercial and light industrial premises.

EN 50081-2
Electro-magnetic compatibility - industrial premises.

EN 61000
Mains frequency (power quality) effects including flicker and harmonic distortion.

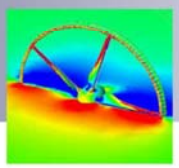
VDE 126
For the safety of Grid Monitoring (Including Anti-Islanding Protection).

IEE 16th Edition Wiring Regulations BS7671
For the safety of domestic electrical installations.

Electricity Association, Engineering Recommendation G59
Electricity Association (since 1 October 2003 superseded by Energy Networks Association). Grid connection of embedded generators at <5MW and <20kV.

Electricity Association, Engineering Recommendation G83/1
Electricity Association (since 1 October 2003 superseded by Energy Networks Association). Grid connection of embedded generators up to 16A per phase (supersedes G77).

BS 5080-1: 1993
The structural fixings used to attach the SWIFT™ system to a concrete substrate are tested in compliance with BS 5080-1: 1993.



7. Technical Specification

Rated power output: 1.5kW *

Approx. annual power supplied: 2000-3000kWh **

1.4 Tonnes of CO_2 reduction/annum ***

Planning Compliant Design

Acoustic emission < 35dB(A)

Moulded carbon-fibre rotor (fail safe)

EMI suppression technology

Embedded electrical connection

Direct Water Heating

Compact design

5-blade HAWT wind turbine

Rotor diameter 2.12m (6.5 feet)

Product Life: 20 years

Mounting mast (BS1387, ISO65)

EMC directive compliant

LVD directive complaint

CE marked

Low maintenance

Single or multiple installation

Safety systems comply with International Standard IEC 1400-1 & BS EN 61400-2

Electricity Association Requirement G59, G77and G83 compliant

BS 7671 :16th Edition of the IEE Wiring Regulations

BS 5760-7: Reliability of Systems, Equipment and Components

The SWIFT Rooftop Wind Energy System™ is mounted on a bespoke mast with a minimum blade-roof clearance of approximately 0.5 metres. It has a novel over-power regulation mechanism, which is totally passive and maintains its tip speed ratio across its entire operating envelope. The turbine has a novel twin-vane progressive furling mechanism which maintains the systems integrity and safety in high winds. It will operate automatically around the clock.

* Rated wind speed: 12.5m/s
** Dependant on siting of turbine
*** Substituting end-user electricity with a single 1.5kW rooftop turbine at 30% utilization by CEDRL RETScreen® International).

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