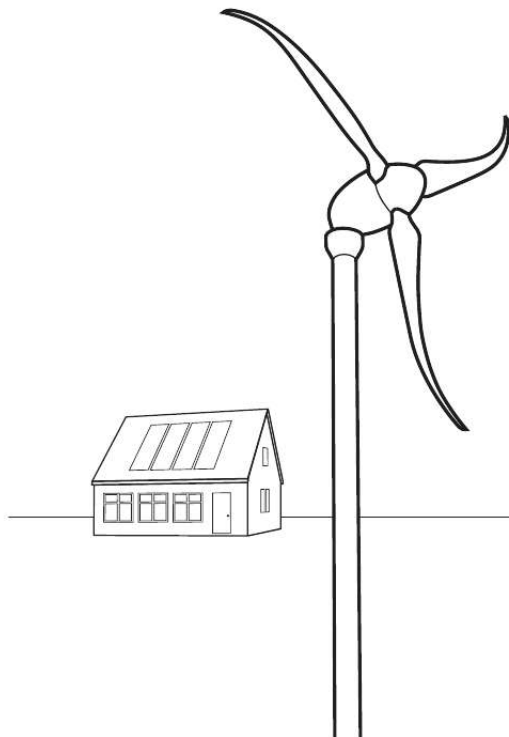




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You can read the recommendations in the user guide, the technical guide or the installation guide for SOUTHWEST WINDPOWER SKYSTREAM 3.7. You'll find the answers to all your questions on the SOUTHWEST WINDPOWER SKYSTREAM 3.7 in the user manual (information, specifications, safety advice, size, accessories, etc.). Detailed instructions for use are in the User's Guide.

User manual SOUTHWEST WINDPOWER SKYSTREAM 3.7
User guide SOUTHWEST WINDPOWER SKYSTREAM 3.7
Operating instructions SOUTHWEST WINDPOWER SKYSTREAM 3.7
Instructions for use SOUTHWEST WINDPOWER SKYSTREAM 3.7
Instruction manual SOUTHWEST WINDPOWER SKYSTREAM 3.7



SKYSTREAM 3.7*

OWNER'S MANUAL EU EDITION

Installation
Operation
Maintenance



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Manual abstract:

The conditions of your warranty are dependent upon the proper installation of Skystream. Furthermore, this will assure you of being kept up-to-date with the latest developments from Skystream Energy Europe. These include new options, performance tips, updated software to maximize output and user notices. It is important to know that we do not sell or distribute your information to any third party. We understand your privacy is important. If you have any questions or comments, we would like to hear from you. Please call during working hours (Monday-Friday 09:00 - 15:00 CET). Our phone number is +49 (0) 221 16 53 94 50. Again, welcome to our family and thank you for investing in the future of wind energy with Skystream. Sincerely, Skystream Energy Europe Enter the serial and model number below Skystream Owner's Manual, EU Edition 3-CMLT-1357-01 Revision: B Serial Number

_____ Model Number _____ ImporTanT SafETy InSTruCTIonS rEad ThESE InSTruCTIonS In ThEIr EnTirETy bEforE InSTallIng or opEraTIng.

Professional installation: skystream energy europe strongly recommends skystream be installed by trained professionals. SAVE THESE INSTRUCTIONS. This manual contains important instructions for Skystream that must be followed during installation and maintenance. 2) Read, understand and respect all warnings. 3) Do not install Skystream around standing water.

4) Do not install Skystream on a windy day. 5) Install Skystream in accordance with National Electric Code (NEC) and local building codes. 6) Always obtain a building permit before construction. 7) A minimum of 2 adults are required to safely lift or move Skystream. Use proper equipment such as hydraulic hoists to lift Skystream.

8) Always wear appropriate protective personal equipment such as closed toe work shoes, hard hat, work gloves, and safety glasses when working on or installing Skystream. 9) If unusual noise or abnormal operation is observed from Skystream, turn off the machine and contact authorized service personnel. 10) Shut Skystream "OFF" if ice accumulates on blades to avoid possible injury resulting from ice flying off blades. 11) This wind generator complies with international safety standards and therefore the design or its installation must never be compromised. a. Do not open the inverter cover, doing so without factory authorization will void the warranty. b. Apply the proper torque to all fasteners. c. Torque field wire connections to Skystream to 2.

3-2.5 N-m. Refer to Electrical Connections section of this manual (Section 2-1-2). d. Install only on a Professional Engineer (PE) certified tower. e. Do not paint the blades. 1) 12) 13) 14) 15) Use only proper grounding techniques as established by the NEC. Properly complete the warranty registration card; failure to complete and return the card may affect your warranty. Skystream must be installed in accordance with this manual and local and national building codes.

Failure to comply with the manual and local codes will affect and possibly void your warranty. Skystream uses high voltage and is potentially dangerous. Be sure to use all safety precautions at all times. 4 Skystream 3.7® Owner's Manual, EU Edition, Rev B radio (rf) interference Skystream 3.

7 has been tested and found to comply with the limits for a class b digital device, pursuant to part 15 of the FCC rules (uS federal Communications Commission). These limits are designed to provide reasonable protection against harmful interference in a residential installation. Skystream generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. however, there is no guarantee that interference will not occur in a particular installation. If Skystream does cause harmful interference to radio or television reception, which can be determined by turning the Skystream on and off, you are encouraged to correct the interference by one or more of the following measures: · Reorient or relocate the Skyview Interface Module or Remote Display.

· Increase the separation between Skystream and Skyview Interface Module or remote display. radio (rf) interference (eU) Complies to European Standards En 61000-6-3 (2007), En 61000-6-2 (2005), En 61000-3-2 (1995), En 61000-3-3 (2000). In this manual ImporTanT: Please take note TIp: Helpful information to ease the installation professional installation highly recommended Warning: Risk of injury or death - proceed with extreme caution Skystream

3.7® Owner's Manual, EU Edition, Rev B 5 Table of ConTEnTS IMPORTANT SAFETY INSTRUCTIONS _____ RADIO INTERFERENCE _____ SKYSTREAM 3.7® WARRANTY _____ SKYSTREAM 3.7® SPECIFICATIONS _____ EUROPEAN GRID STANDARDS _____ 4 5 7 8-9 10 appEndICES appendix a: Electrical diagrams 1 Typical Grid Connection _____ 3 2 Typical Battery Charging _____ 4 appendix b: Tower grounding 1 Introduction _____ 4 2 Grounding Techniques _____ 4-9 appendix C: lightning protection 1 Introduction _____ 4 2 Lightning Protection Data _____ 2-3 2 4-9 appendix d: Compliance/Certification documents 1 UL (US & Canada) _____ 2-3 2

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7® Owner's Manual, EU Edition, Rev B skystream 3.7® limited 5-Year Warranty Wind Turbine Warranty agreement hardware Warranty Skystream Energy Europe GmbH, ("Skystream Energy") will repair or replace free of charge any part or parts of the Skystream Energy Skystream 3.7® wind generator determined by Skystream Energy to be defective in materials and/or workmanship under normal authorized use consistent with product instructions for a period of five years from the date the original purchaser ("Customer") receives the wind generator ("Start Date"). This warranty extends only to the original purchaser.

The Customer's sole and exclusive remedy and the entire liability of Skystream Energy, its suppliers and affiliates under the warranty is, at Skystream Energy's option, either (i) to replace the wind generator with new or reconditioned wind generator, (ii) to correct the reported problem, or (iii) to refund the purchase price of the wind generator. Repaired or replaced products are warranted for the remainder of the original warranty period. will be under no obligation to accept any returned wind generator that does not have a valid RA number. Customer's failure to return the wind generator within 30 days of its receipt of a RA number may result in cancellation of the RA. All parts that Skystream Energy replaces shall become Skystream Energy's property on the date Skystream Energy ships the repaired wind generator or part back to the Customer. Skystream Energy will use all reasonable efforts within five days of receipt of the defective wind generator to repair or replace such wind generator. If a warranty claim is invalid for any reason, the Customer will be charged at Skystream Energy's current rates for services performed and will be charged for all necessary repairs and expenses incurred by Skystream Energy. disclaimer restrictions Problems with the wind generator products can be due to improper use, maintenance, non-Skystream Energy additions or modifications or other problems not due to defects in Skystream Energy's workmanship or materials. No warranty will apply if the wind generator (i) has been altered or modified except by Skystream Energy, (ii) has not been installed, operated, repaired, or maintained in accordance with instructions supplied by Skystream Energy (iii), or (iv) has been exposed to winds exceeding 140 mph (63 m/s), or has been subjected to abnormal physical, thermal or electrical stress, misuse, negligence, or accident. If Skystream Energy's repair facility determines that the problem with the wind generator is not due to a defect in Skystream Energy's workmanship or materials, then the party requesting warranty service will be responsible for the costs of all necessary repairs and expenses incurred by Skystream Energy.

EXCEPT FOR THE EXPRESSED WARRANTY SET FORTH ABOVE, SOUTHWEST WINDPOWER DISCLAIMS ALL OTHER EXPRESSED AND IMPLIED WARRANTIES, INCLUDING THE IMPLIED WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY AND NON-INFRINGEMENT. NO OTHER WARRANTY, EXPRESSED OR IMPLIED, WHETHER OR NOT SIMILAR IN NATURE TO ANY OTHER WARRANTY PROVIDED HEREIN, SHALL EXIST WITH RESPECT TO THE PRODUCT SOLD UNDER THE PROVISIONS OF THESE TERMS AND CONDITIONS. SKYSTREAM ENERGY EXPRESSLY DISCLAIMS ALL LIABILITY FOR BODILY INJURIES OR DEATH THAT MAY OCCUR, DIRECTLY OR INDIRECTLY, BY USE OF THE PRODUCT BY ANY PERSON. ALL OTHER WARRANTIES ARE EXPRESSLY WAIVED BY THE CUSTOMER. limitation of liability Warranty Claims & return procedures In order to be eligible for service under this warranty the Customer MUST return the warranty registration card included with this Warranty Agreement within 60 days of purchasing the wind generator.

Additionally, the Customer must submit a service request for the wind generator covered by this warranty within the warranty period by contacting Skystream Energy in writing or via telephone and obtaining a Return Authorization ("RA") number. This RA must be obtained before returning any product under this warranty. Notification must include a description of the alleged defect, the manner in which the wind generator was used, the serial number, and the original purchase date in addition to the name, address, and telephone number of the party requesting warranty service. Within 3 business days of the date of notification, Skystream Energy will provide the Customer with a RA number and the location to which the Customer must return the defective wind generator. Any wind generator requiring warranty repair shall be transported at the expense and risk of the party requiring warranty service, including but not limited to proper packaging of the product.

The Customer must return the entire wind generator kit within 30 days after issuance of the RA number. Skystream Energy 3-CmlT-1063 UNDER NO CIRCUMSTANCES WILL SKYSTREAM ENERGY OR ITS AFFILIATES OR SUPPLIERS BE LIABLE OR RESPONSIBLE FOR EDF Référentiel Technique "Modele de Contrat de raccordement, d'accès et d'exploitation pour une installation de production de puissant 36 kVA rac cordée au Réseau Public de Distribution basse tension Conditions Générales" / Standard Form Agreement for the Connection, Access and Operation of Power Generating Stations 36 kVA Connected to the Public Low Voltage Distribution Network General Terms and Conditions", Referentiel technique NOPRES_55E, Vesion V6, 2006, France. · DIN V VDE V 0126-1-1 (VDE V 0126-1-1) "Automatic disconnection device between a generator and the public low voltage grid", February 2006 Germany. · Italian Standard CEI 11-20 "Electrical energy production systems and uninterruptible power systems connected to LV and MV networks" · ÖVE/ÖNORM prEN 50438 " Requirements for the connection of micro-co generators in parallel with public low-voltage distribution system", 01.10.2004 10 Skystream 3.7® Owner's Manual, EU Edition, Rev B Prior to installation intended Use Skystream 3.7 is a wind powered electricity generator containing an integral AC power inverter. It is designed to supplement the electrical power provided by the local electrical utility company in residential applications by connecting directly to the main AC utility panel. Skystream 3.

7 may also be utilized to provide power with battery based residential electrical systems or utility grid connected systems with battery backup. A typical Skystream installation is depicted in fig. 1 of this manual. Skystream 3.7 is designed to operate at sites with average wind speeds less than 8.5 m/s - IEC (International Electro-technical Commission) Class II wind conditions. The installation of Skystream at sites with higher average wind speeds will accelerate component wear and require more frequent inspections. Unintended Use Utilizing Skystream 3.



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7 for other than its intended purposes or with inappropriate equipment or modifying Skystream is not authorized by Skystream Energy Europe and will void the warranty and may result in serious or even fatal injury. Observe the following precautions.

· Disconnect power to Skystream prior to servicing observe "Lock-out" and "Tag-out" procedures. · Observe all Electrical Code Requirements including tower grounding requirements, electrical disconnect switches, wires size and type. Reference the appendices in this manual. · Skystream may only be installed on a tower approved by SWWP for use with Skystream. Do not install Skystream on roofs or on unauthorized towers.

· Do not use unauthorized fasteners. Use fasteners supplied with Skystream. Contact your dealer for authorized replacement fasteners. · Observe fastener torque requirements. · Do not attempt to modify Skystream in any fashion internally or externally.

· Do not install blades other than those supplied with Skystream. Use only genuine replacement blades supplied by Skystream Energy Europe. · Do not attempt to use a power source other than the wind to power Skystream for example connecting pulleys or as water powered turbine. Important: Precautions listed here cannot address all the possible misuses of Skystream therefore contact Skystream Energy Europe. if there is any doubt or question regarding the installation or use of Skystream. Skystream 3.7® Owner's Manual, EU Edition, Rev B 11 Your skystream shipment includes: Your Skystream shipment includes the following components. For your convenience a small quantity of spare fasteners is included with each Skystream. The quantities indicated below are quantities required to assemble Skystream: Turbine assembly on pallet Tip: See exploded view on page 23. installation Personnel Skystream Energy Europe recommends professional installation of Skystream.

While Skystream is not difficult to install, and many homeowners have successfully installed their own Skystream, knowledge of local zoning and building code requirements, construction techniques, as well as residential electrical systems is required for a safe installation. Skystream dealers displaying the following insignia have completed factory training on the correct and safe installation of Skystream. · Includes: turbine, nosecone, blade hub, blade plate (screwed to pallet), M42 hub mounting nut. blades (may be shipped separately) · Blade mounting hardware - M10 x 120, grade 10.9, hex head bolts (quantity 12) - M10, grade 10.9, nut (quantity 12) nosecone mounting hardware · M6 x 12 socket head screws, A2 stainless steel (quantity 3) Skystream to Tower mounting hardware · Vibration Isolators (quantity 8) · Vibration Isolator Snubbing Washers (quantity 8) · M12 x 90 hex head bolts, grade 10.9 (quantity 8) · M12 nuts, grade 10.9 (quantity 8) · M12 flat washers, A2 stainless steel (quantity 8) yaw Shield · Yaw shield halves (quantity 2) · M5 x 12 socket head screws (quantity 4) Strain relief Cover skystream Dealer · Cover with ground wire (quantity 1) · M5 x 12 socket head screws (quantity 4) miscellaneous · RF antenna (quantity 1) 12 Skystream 3.7® Owner's Manual, EU Edition, Rev B fig. 1 Typical Skystream Installation Yaw ground wire Optimal kilowatt-hour meter G N L I other loads T r a n s i t o n t o l a r g e r g a u g e w i r e i f r e q u i r e d d u e t o d i s t a n c e b e t w e e n S k y s t r e a m a n d p a n e l .

20 A N 40 A N G N (blue) N L I G N D N L I G N D L I G G S P D L I N L I (brown) G N D (yellow +green) G D i s c o n n e c t s w i t c h 2-p o l e 3 0 A , 2 4 0 V A C G G A l u m i n u m w i r e s m a y b e u s e d f o r h o m e / u t i l i t y c o n n e c t i o n i f t r a n s i t i o n i s m a d e i n j u n c t i o n b o x . 14AWG wire must be copper only. T o w e r g r o u n d s y s t e m U s e o n l y c o p p e r w i r e a t t h e g e n e r a t o r t e r m i n a l s S P L I G A R P R L I G R E D = H T R E O T H T C O S N I S T E C N I M U R G N G O R T I O N G M E N E P R O T C U R R E N T O S A T I N L E V E L P R O T E C D A T I O N E C T S F M T I S T I V E A R R E Y T H E U S T B O N S E D E V S T O R E I N C T I C E R . Q U I S T O N S U A N R E A L L O F C H A P D L E D M A S P R O I G H T . S E N U A A P R I A T E N I N G E L F O R n o t e : R e f e r t o a p p e n d i x a f o r d e t a i l e d w i r i n g d r a w i n g s S k y s t r e a m 3 .

7® Owner's Manual, EU Edition, Rev B 13 siting - finding the Best location for skystream The best location to install a wind turbine is often a compromise. Local building restrictions, the height of surrounding structures, wire length, and available open space may require Skystream be installed in a less than optimum location. In general Skystream will produce more power if installed on a taller tower. However, towers are expensive so it is important to balance performance (tower height) to installed cost in order to achieve the lowest cost of energy and the quickest payback. the General rule: For optimal performance, install Skystream 6.

5 m above any surrounding object within a 75 m radius. See figure below. Tip: your dealer can help you determine the best location for Skystream on your property. local requirements Building codes and installation regulations may vary greatly depending upon country, state, city and local townships. Be sure to obtain all the required building permits BEFORE beginning installation. Make sure you understand all inspection and installation requirements. Many locations may require installation by licensed professional to meet building code requirements or to qualify for rebate incentives. Additionally, be sure to contact the local electrical utility company. Many utility companies will require an "Interconnection Agreement" prior to installation. Some utilities may also require installation of a separate power metre for Skystream.

Tip: See our website: www.skystreamenergy.com for a sample interconnection agreement that may be used by a utility yet to establish a program. Prevailing Wind 6.5 m 75 m Optimal Skystream location. 14 Skystream 3.7® Owner's Manual, EU Edition, Rev B installation introduction The following sections of this manual assume a tower and foundation appropriate for use with a Skystream are in place and ready for Skystream to be installed. Southwest Windpower designed Skystream for easy installation by minimizing the number of electrical connections. In most cases Skystream may be connected directly to the electrical utility panel. However, local requirements may require installation of a disconnect switch and a second power meter between Skystream and the utility panel.

Wire sizing These wire sizing directions are for SINGLE Skystream turbine installations which are direct run to a main service panel. DO NOT attempt to use these wire sizing instructions for a Skystream connected to a sub-panel or for multiple Skystreams.



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Note that the largest wire size that may be connected to the Skystream yaw terminals is 10 mm² (8 AWG) . For installations requiring a larger wire size (because of distance) Southwest Windpower recommends using a disconnect switch box installed between the tower and utility panel to transition to a larger wire size. To determine the appropriate wire size measure the total distance from the turbine to the electrical utility panel including the tower height and refer to the tables on this page.

Table 1 includes maximum wire length information for wire sizes 10 mm² (8 AWG) and smaller without transitioning to a larger wire size. Select the appropriate wire size based on the total wire length and Skystream voltage configuration (230 VAC, single phase). If the required wire length is greater than can be accomplished with 10 mm² (8 AWG) wire refer to Table 2. This table includes wire size information for installations requiring a transition to 16 mm² (6 AWG) or 25 mm² (4 AWG) gauge wire. Table 2 provides for a 25 m (82 ft) length of 10 mm² (8 AWG) wire to be run from the Skystream yaw to a disconnect switch box and a length of 16 mm² (6 AWG) or 25 mm² (4 AWG) gauge wire to be run from the disconnect switch box to the utility panel.

Select the appropriate wire size combination from Table 2 based on the of wire run length and Skystream voltage configuration. Note if needed the 25 m (82 ft) length of 10 mm² (8 AWG) wire may be shortened and the larger gauge wire lengthened a corresponding amount. However, DO NOT lengthen the 10 mm² (8 AWG) wire and also lengthen the larger gauge wire as this will cause excessive resistance. Table 1 Wire Size 25 mm² (4 AWG) 16 mm² (6 AWG) 10 mm² (8 AWG) 2 230 VaC, Single phase See Table 2 See Table 2 85 m (278 ft) 53 m (174 ft) 34 m (110 ft) 6 mm² (10 AWG) 4 mm² (12 AWG) Use copper conductors only - Minimum wire temperature rating is 75° C (167° F). Distances and wire sizes are based on 2400 W power production and maximum 2% voltage rise at the turbine. Table 2 System Voltage maximum Wire length 176 m (577 ft) 10 mm² (8 aWg) 25 m (82 ft) 16 mm² (6 aWg) -----25 mm² (4 aWg) 151 m (495 ft) 230 VAC, Single Phase 230 VAC, Single Phase 120 m (394 ft) 25 m (82 ft) 95 m (312 ft) ----- Warning: for your safety, make sure power is turned off before working on any and all electrical connections. Skystream 3.7® Owner's Manual, EU Edition, Rev B 15 Grounding All electrical systems must be grounded in accordance with local and national standards. Grounding provides protection from electrical shock, voltage surges and static charge build up. The figures in appendix a provide information for grounding the tower and Skystream at the service panel by means of the ground lead coming from the yaw terminals of the turbine.

appendix b provides information for grounding the tower according to the National Electric Code (USA) and IEC 60364-5-54. Information about grounding electrodes, grounding conductors, and connections is provided. The turbine must be grounded to the tower as depicted below. note: The AC output neutral is NOT bonded to ground within Skystream. The AC neutral is bonded to ground at the AC service panel. The instructions in this section and appendix a are provided as reference, local electrical codes and standards have precedence over these instructions. Utility Panel Connections Skystream connects directly into your electrical panel. Wiring will vary with local zoning authority and utility. Refer to Appendix A for drawings for each voltage, frequency and phase configuration. Some installations will require a visible lockable disconnect switch located next to the electrical metre and/or at the base of the tower.

The disconnect switch is utilized by your local utility in the event of a power outage to ensure no voltage is placed on the utility line during repair. Again, it is extremely important to install in accordance with local and national zoning regulations. note: Only 20 Amp circuit breakers may be used to connect Skystream to AC service panel. Refer to wiring diagrams in appendix a. fig.

2 Proper grounding of the yaw connection 16 Skystream 3.7® Owner's Manual, EU Edition, Rev B electrical Connections to skystream CauTion be sure power is turned off when making electrical connections. g: yellow/green n: blue The following section provides directions for completing the main power connections to the Skystream yaw assembly. The connections are most easily accomplished with Skystream on the ground as would be the case when utilizing a tilt up tower. If the installation does not incorporate a tilt up tower, the connections may still be made on the ground by utilizing a sufficient length of cable to connect Skystream to the nearest junction point.

If, for example, an electrical disconnect box will be installed at the base of the tower, connect enough cable to Skystream to make the connections at the disconnect box leave some extra cable for connections. The wire connections can then be made on the ground, Skystream hoisted to the top of the tower and the cable "lowered" down the tower and Skystream bolted to the tower. 1 11: brown fig. 3 Wire run to the yaw connection (230V, 50Hz, single phase). Position Skystream on its side to access the wire terminals. Remove approximately 5 cm of protective sheathing from cable and strip approximately 1 cm of insulation off wire leads. Note the maximum wire size that can be connected directly to Skystream is #6 Metric Wire Size or #8 AWG. Refer to Wire Sizing Section of this manual for instructions on selecting correct size wire. Pass cable through strain relief cover so approximately 2.5 cm of cable sheath protrudes through the cover.

230 V, 50 hz, 1 phase systems: Connect the brown, blue and green/ yellow wires to the matching corresponding color coded terminals on Skystream yaw. There is no wire connection to bare yaw terminal as shown in fig 3. Tighten wire terminal screws to 2.3-2.5 N-m. Wiring Symbol definitions - 230 V, 50 hz, Single phase Systems L1 = Line 1, AC Line Voltage, Brown Wire (230V, 50 Hz, systems) N = AC Neutral, Blue Wire, (230V, 50 Hz, systems) G = Gnd. = AC Ground, Green/Yellow Wire Indicates AC Ground 1 1 1 1 ImporTanT: Install the Skylevel "spider" on the tower top prior to connecting the power wires to Skystream yaw. The wires must pass through center of "spider" as shown in accompanying photograph. Skylevel "spider" Skystream 3.7® Owner's Manual, EU Edition, Rev B 17 1 With power still on, wait approximately 5 minutes and attempt to rotate main blade shaft; blade should be noticeably easier to turn than with power off.

Turn off power and verify that Skystream has returned to its "braked" mode. If Skystream fails this test check connections and repeat test test MUST be passed before proceeding. With power turned off position the wires as depicted in accompanying figure and secure strain relief cover using four M5-0.



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8 x 12 socket head screws. Tighten strain relief clamp to secure cable.

Caution: Make sure AC power is switched "Off" before proceeding with installation. lightning Protection yaw wire **Caution: Electrical Shock Hazard** - use extreme care when making electrical measurements on live electrical systems. The Skystream 3.7 turbine is designed to withstand over voltages and surge currents (6kV, 3kA, 8/20µs) caused by INDIRECT lightning strikes or switching operations according to the Standard for Interconnecting Distributed Resources with Electric Power Systems (IEEE 1547) . For this protection to be effective, it is necessary to ensure that over voltages at the Skystream connection terminals will not be higher than the above values of the surge test.

To provide this over voltage protection against dIRECT lightning strikes; a Type 1 lightning current arrester, that reduces over voltages to a level below 6 kV but is capable of discharging very high currents, much larger than those handled by surge protective devices present inside Skystream is required. note: refer to appendix C for specific instructions on the selection of a lightning protection System. after making connections, turn on power and measure voltages at terminals. See table below: 11 - n 120 / 240 VaC, 60 hz, Split phase 120 / 208 VaC, 60 hz, 3 phase 230 VaC, 50 hz, 1 phase 120 VaC, 60 hz, 1 phase 127/220 VaC, 60 hz, 3 phase 120 VAC 120 VAC 230 VAC 120 VAC 127 VAC 11 12 240 VAC 208 VAC -----220 VAC 18 Skystream 3.7® Owner's Manual, EU Edition, Rev B installing skystream on a tower There are several types of towers that can be used with Skystream. It is essential that Skystream is installed on a properly engineered tower. One of the leading causes of wind generator failure is use on a poorly designed tower. Regardless of the tower design and height you select, there are two critical areas that must be considered when selecting the tower. These are the stub tower height and blade clearance, refer to accompanying figure. note: The orientation of the vibration isolators is very important.

Refer to figs. 4, 5 & 6. **Warning:** Working on towers is dangerous and should be left to professionals with proper safety equipment and training. **ImporTanT:** Skystream Energy Europe's Warranty is only extended to installations that are made on a properly engineered tower. Skystream Energy Europe reserves the right to deny any warranty claim in which an improperly designed tower is used. Stub tower Not to exceed 213 cm 46 cm 30 cm Critical turbine blade clearances Skystream 3.7® Owner's Manual, EU Edition, Rev B 19 Bolting skystream to the tower The following section provides directions for bolting Skystream to the tower. Before Skystream is bolted to the tower complete the electrical connections as described in the "ELECTRICAL CONNECTIONS" section of this manual. Bolting Skystream to the tower is most easily accomplished at ground level as in the case with a tilt-up tower. Alternately Skystream may be bolted to the tower on the ground, and the tower with Skystream hoisted into position as an assembly; or Skystream may be hoisted to an already erected tower.

These latter two options require specialized equipment and training and should only be attempted by trained professionals. · Install the vibration isolator halves (items 4 and 5) on the yaw as shown in fig. 6. Note the orientation of the isolator halves is very important install as shown. · Insert the vibration isolator bolts and snubbing washers into the vibration isolators from "above" as shown in fig.

6. · Using an appropriate lifting device, lift Skystream and align vibration isolator bolts with holes in the tower flange. 18 cm CG Centre of gravity note: A wide nylon lifting strap may be used to hoist Skystream into position. The strap MUST cinch or "choke" the turbine tightly prior to hoisting. Refer to the accompanying figure for positioning the strap along the centre of gravity.

20 Skystream 3.7® Owner's Manual, EU Edition, Rev B · Install nuts on bolts to secure Skystream to the tower. · Connect the turbine ground wire as depicted in fig. 2. The turbine MUST be grounded to the tower as shown. · Torque the vibration isolator bolts to 80 N-m in two steps. First torque all bolts to 55 N-m then tighten all bolts to 80 N-m. · Mount the yaw shield halves using four M5 socket head screws. Refer to fig. 6.

fig. 4 Placing vibration isolators fig. 5 Grounding turbine to tower Skystream 3.7® Owner's Manual, EU Edition, Rev B 21 installing the Blades (Hub not on turbine) Proper installation of the blades is critical for safe operation. The blade nuts and bolts are a unique grade of steel and are specially coated to prevent corrosion. DO NOT substitute different nuts and bolts. Spare nuts and bolts are provided with Skystream. Carefully follow these instructions to obtain secure bolted joints and maximum corrosion protection, particularly in corrosive marine environments. 1 Bolt tightening sequence 1 Torque the blade bolts to 68 N-m in two stages. Following the Blade Bolt Tightening Sequence shown torque each bolt to 41 N-m in two stages.

After completing first stage, following the Blade Bolt Tightening Sequence, and tighten each bolt to 68 N-m. After completing the second tightening stage RECHECK each bolt is tightened to 68 N-m. The blades are now assembled to the hub and ready for installation onto the turbine rotor shaft. Coat the inside diameter of the blade hub with a multipurpose lithium grease to prevent corrosion between the hub and shaft. Position the hub nut in the centre of the blade hub and slide the entire hub / blade assembly onto the shaft and "spin" the entire assembly to screw the hub onto the shaft.

Tighten the blade hub assembly to 270 N-m by holding the blades and using the "flats" on the rotor shaft. 1 1 1 Start the assembly by positioning a blade between the blade hub and blade plate. The blades may only be installed in one position due to the triangular boss cast into one side of the blade root. Install the bolts by passing the bolt through the BLADE PLATE and AWAY from the NACELLE as shown in fig 7. Leave the nuts loose until all blades are installed and then tighten the bolts just enough to clamp the blades between the hub and plate.

1 1 1 1 1 **ImporTanT:** · Do NOT substitute nuts, bolts or washers. Contact SWWP for replacements. · DO NOT apply lubricants to nut or bolt threads. · RECHECK bolt torque after tightening bolts. 11 10 9 12 1 2 3 4 5 8 7 6 Blade bolt tightening sequence 22 Skystream 3.7® Owner's Manual, EU Edition, Rev B Installing the nosecone and antenna 1 1 Install the nosecone with three M6-1.0 socket head bolts. Install RF Antenna on matching fitting on top of Skystream.



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Fingertight is sufficient. 2 3 1 Important: do not forget to Install rf antenna Do not forget to install the RF antenna.

Skystream is equipped with an on-board radio that may be used to monitor its performance via the Skyview Interface. Additionally, service personnel may use the radio to diagnose, troubleshoot or upgrade your Skystream without removing it from the tower. final Electrical Tests (Tilt-up Towers) At this point Skystream should be bolted to the tower and all the ancillary equipment blades, nosecone, yaw shield, and antenna attached. Prior to tilting the tower into position, the following final electrical tests should be performed: 1 4 7 8 6 8 1 With power turned off attempt to rotate the blades there should be noticeable resistance although the leverage provided by the blade will make it possible to rotate the blades. Turn on power and attempt to rotate the blades after approximately 5 minutes. There should be noticeably less resistance required to rotate the blades. Turn off the power and verify that Skystream returns to a "braked" condition. Verify Skystream is grounded to the tower by measuring the resistance between the nacelle (use an unpainted bolt head in the case of marine units) and the tower flange. The resistance must = < 1 ohm. 11 5 14 1 13 1 fig.

6 yaw and antenna assembly Do not attempt to put Skystream into service until these tests pass. If tests pass, tower may be tilted into position and placed into service. Skystream 3.7® Owner's Manual, EU Edition, Rev B 23 24 # dESCrlpTion QTY. 1 RF Antenna M12 x 1.

75 x 90mm Hex Bolt Grade 10.9 Snubbing Washer Vibration Isolation Ring (4) and Bushing (5) Strain Relief Cover Assembly Yaw Shield M5 x 12mm Socket Head Screw Skylevel Assy. M12 x 1.75 Nut grade 10.9 5" Tower Insert (optional) Blade Plate Blade Blade Hub Hex head bolt, M10, grade 10.

9 Hex nut, M10, grade 10.9 Nosecone Hub Retaining Nut grade 10.9 M6 x 1 x 12mm Bolt SHCS grade 8.8 1 8 8 8 1 2 8 1 8 1 1 3 1 24 12 1 1 3 23 2 3 4, 5 6 7 8 11 22 21 17 20 18 19 13 14 17 18 19 20 21 22 23 24 fig. 7 Blade and nosecone assembly fig. 8 Completed assembly 24 Skystream 3.7® Owner's Manual, EU Edition, Rev B oPeration anD aDJUstMents Manual operation of skystream Manual operation of Skystream is limited to starting and stopping using the circuit breakers at the electrical utility panel or electrical disconnect switch if equipped. To stop Skystream, switch the circuit breakers to "OFF" and to restart Skystream switch the circuit breakers to "ON". Note that Skystream may require approximately 5 minutes to restart after the circuit breaker is switched "ON". An "ATTENTION" label, depicted below, is provided to indicate the location of the AC power disconnect switch or circuit breakers.

Apply the label in a prominent location where it will be seen by operators or service personnel. REV. NC Maintenance after 20 years of service the blades MUST be replaced even if there is not apparent damage. The blades should be replaced as a set. Do not attempt to replace individual blades. All blade mounting hardware bolts, nuts and washers should be replaced at the same time. Do NOT attempt to reuse the blade fasteners. There are no periodic service requirements other than replacing the blades after 20 years. All bearings and rotating components were designed for a 20 year life at an IEC Wind Class II site, under the IEC 61400-2 Small Wind Safety Standard. This corresponds to a site with an average wind speed of 8.

5 m/s. Although there are no routine service or maintenance requirements, Skystream owners should be observant of any unusual sounds, vibrations or erratic behavior. If unusual behavior is noticed the best course of action is usually to shut down the turbine down and contact the dealer or service centre. One area of Skystream that may experience damage are the blades, for example from flying debris during a high wind storm. For this reason Skystream Energy Europe recommends Skystream be shut down on an annual basis and an inspection of the blades performed.

The inspection may be accomplished using binoculars or by close visual inspection. Inspect for cracks and chips particularly along the edges of the blades. Any damage is cause for replacing the blades. If in doubt contact your local service centre. Proprietary rights are included in the information disclosed herein.

This information is submitted in confidence and neither the document nor the information disclosed herein shall be reproduced or transferred to other documents for manufacturing or for any other purpose except as specifically authorized in writing by Southwest Windpower. DESCRIPTION REVISIONS DATE APPROVED -- ECO#1012 9/30/06 DWG #3-CMLB-1039 adjustments Adjustments to Skystream are limited to setting the elevation. As delivered, Skystream is configured for operation up 1000 m above sea level. There is no need to reset the elevation unless Skystream is installed above that elevation. The elevation may be reset using the optional remote display. If a remote display is unavailable to you, contact your Skystream dealer about resetting the elevation. For artwork see DOC 0325 Label: 2"W x 4"H Z-Ultimate 3000 White, Zebra part #68431 Ribbon: 3.27" x 1.476" Premium 5100 Resin Ribbon, Zebra part # 05100BK08345 unless otherwise specified CAD-generated drawing dimensions are in [inches] do not manually update tolerances are : decimals angles APPROVALS DATE X. ±1 ± 30 ' DRAWN Dan Nielsen 9/30/06 .

X ± .5 R&D .XX ± .2 MATERIAL --FINISH DO NOT SCALE DRAWING PROD EGR MFG QUAL Dimensions [inches] mm LABEL, SAFETY CAD file : 3-CMLB-1039 LABEL SAFETY Flagstaff, Arizona U.S.A. dwg. n° 3-CMLB-1039 rev. NC size A sheet 1 of 1 Skystream 3.7® Owner's Manual, EU Edition, Rev B 25 In the event you must gain access to Skystream use the opportunity to perform the following inspections: · Remove the yaw shield, and wipe off any grease that may have seeped from the yaw bearing.

- Check hatch cover bolts are tight, Bolts should be tightened to 7 N·m. · Verify the yaw bearing snap ring is still properly seated in the snap ring groove within the nacelle. (this is the snap ring located just below the yaw bearing). · Check the tightness of the (8) yaw bolts with a torque wrench. All yaw bolts should be torqued to 80 N·m.
- Reinstall the yaw shield and secure the fasteners. · Check tightness of blade bolts with torque wrench. All blade bolts should be torqued to 68 N·m. · Clean the rotor blades with a mild soap and water. Remove as much of the dead bug matter as possible from the blades.
- Look for any problems with the blades such as cracks, or damage to the edges of the rotor blade. · Inspect the face, nacelle, and the rest of the Skystream and note any potential damage or problem.



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troubleshooting Without the optional wireless "Skyview Interface kit", troubleshooting Skystream is limited to checking the Skystream connections to the utility grid. Check the connections as "close" to Skystream as possible, depending on the installation this may be at the utility panel or at a disconnect switch. The connections may also be checked at yaw terminals (see Electrical Connections Section in this manual), however, this will require removing Skystream from the tower. Using the Skyview Interface kit this voltage and additional troubleshooting information may be accessed without the need to remove the turbine. Contact your local dealer or Skystream Energy Europe Technical Service. emergency shutdown If Skystream's internal microprocessor determines a serious internal fault has occurred it will execute an Emergency Stop and E-Stop. An E-Stop will only take place if the fault is severe and requires servicing Skystream's internal components. @@@@At that speed the blades will rotate at approximately 120 rpm.

@@As the wind speed increases the blade speed will also increase. At about 9 m/s the blades achieve a rotational speed of 330 rpm. This is Skystream's rated speed. @@@@If it is not set, the turbine may experience premature shut downs. @@@@This is the same cycle that occurs when Skystream is initially powered. Additionally, should Skystream determine an internal fault exists it will execute an emergency shutdown an E-stop. An E-stop will only take place if a severe fault that requires servicing internal components has occurred. For that reason resetting an E-stop requires gaining access to the interior of Skystream. It cannot be reset from the ground. electronic stall regulation The Skystream 3.7 has the ability to adjust the rotational speed of its blades or even stop the blades if required by ambient conditions. This referred to as Stall Control and it is accomplished by adjusting the current draw from the alternator. The higher the current draw the greater the electromagnetic torque applied to the rotor and if enough torque is applied the blades will slow or even stop. In simple terms the inverter is demanding more power than the available wind can provide thus causing the blade rotational speed to decrease. As a safety feature the alternator is capable of producing approximately five times the torque required to control the turbine.

This extra available power means that even if segments of the alternator windings are damaged there is still sufficient torque to stop the turbine. While Skystream is connected to the utility grid it constantly monitors that all conditions, for example grid voltage and frequency, are within limits. If the inverter determines that all operating conditions are within limits, it opens three Normally Closed (NC) relays, RL1, 2 and 3, removing the short from the alternator windings and allowing the blades to spin freely. Skystream 3.7® Owner's Manual, EU Edition, Rev B 27 Only then will it operate the DPDT Grid Relay RL_G to allow the inverter to export power to the grid.

Refer to the Skystream Block Diagram in Appendix A. Should the inverter sense an abnormal condition, for example high current in the alternator windings by means of the current sensors on the relay board, it will close relays RL1, 2, and 3 thereby stopping the turbine. In turn, the DPDT Relay RL_G will be operated to the position where the inverter power exporting circuitry is disconnected from the grid. redundant relay switch Control As a redundant measure of safety to guarantee stopping the turbine in case of a winding fault or a lost connection to the alternator, there are seven connections to the alternator windings, but only three are necessary to control or stop the turbine. And as a final measure of safety, if the inverter is unable to control the rotational speed and Skystream exceeds approximately 400 rpm, the rectified voltage will exceed the Zener (Z) voltage on the relay board, causing the latching relay (RL4) to open. This will cause the relays RL1, 2, and 3 to close and apply all the available electromechanical torque to the rotor, stopping Skystream completely. The inverter power path will also be disconnected from the grid by means of relay RL_G. This is the final level of control and is only applied when all other methods of control have failed. As such, once set, (latched) RL4 may only be reset by gaining internal access to Skystream it cannot be reset via the Remote Display. Disposal of skystream This symbol shown on Skystream or its packaging indicates it may not be treated as household waste.

Dispose of Skystream properly by handing the entire turbine assembly over to the applicable collection point for recycling of electrical equipment. By ensuring Skystream is disposed of correctly, you will help prevent harm to the environment, which may be caused by inappropriate disposal of this product. The recycling of materials will help conserve natural resources. For more detailed information about recycling of Skystream, please contact your local waste disposal authorities, your household waste disposal service or the store where you purchased Skystream. Skystream was manufactured in compliance with the Restriction of Certain Hazardous Substances in Electrical and Electronic Equipment 2002/95/EC (RoHS) and therefore does not contain any of the materials regulated by that standard. Warning: Power to Skystream MUST BE TURNED Off prior to servicing 28 Skystream 3.7® Owner's Manual, EU Edition, Rev B frequently asked Questions 1) What happens if I lose power from my utility company? 7) When should I contact an authorized service technician? If there is a power outage the Skystream will shut down within one second. It will resume normal operation when power is restored. There are many safety requirements of a utility-tied inverter. The Skystream meets all of these requirements per UL 1741, IEEE 1547 and appropriate European Regulations. 2) does the Skystream have lightning protection? a. If there is any unusual vibration coming from Skystream. b. If you hear any noise that sounds like mechanical interference. c.

If the Skystream is connected to the utility power (i.e. all breakers and disconnects are turned on), the wind is blowing, but the Skystream is not turning very fast. 8) Can I mount Skystream to my roof? Yes, the Skystream has lightning protection. The Skystream can handle 6000 Volts as required by UL 1741, IEEE 1547 and appropriate European Regulations.

If you live in a lightning prone area Skystream Energy Europe recommends an additional lightning arrestor at the base of the tower. 3) What should I do if I'm expecting a severe storm? Roof and building mount is not recommended. Because of the size and weight of the wind generator, Skystream needs to be mounted on a PE certified tower to ensure the quietest and safest system. Roof mounting will invalidate the warranty. The Skystream is designed for very high winds, but it is always a good idea to shut Skystream down if there is going to be a severe storm to protect against any flying debris.



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4) how do I shut down Skystream? To turn off Skystream all you need to do is turn off the breaker Skystream is connected to. This will cause NO damage to the unit. 5) Can I leave Skystream unattended? Yes, the Skystream is designed to operate without any user input. If there is any fault it will shut down on its own. 6) What do I do if Skystream is facing upwind even though there is a strong wind? If the Skystream is not tracking correctly, you should check to see if the tower is level.

Skystream 3.7® Owner's Manual, EU Edition, Rev B 29 aPPendIX a: eleCtrIcal diaGraM Skystream Energy Europe GmbH A wholly-owned subsidiary of Southwest Windpower, Inc. Mannesmannstr. 6 50996 Cologne Germany Tel: +49 (0) 221 16 53 94 50 info@skystreamenergy.eu www.skystreamenergy.eu November 2010 Skystream Energy Europe All Rights Reserved Skystream 3.7® owner's manual appendix a: Electrical diagram 1) TypIcal grId ConnECTIon: 230 V, 50 Hz, 1 Phase, Junction Box at Tower Base _____ 3 2 Skystream 3.7® Owner's Manual, EU Edition, Rev B Fig. 1.

Typical Grid Connection: 230 V, 1 Phase, Junction Box at Tower 1 2 3 4 5 6 7 REV. DESCRIPTION 8 Proprietary rights are included in the information disclosed herein. This information is submitted in confidence and neither the document nor the information disclosed herein shall be reproduced or transferred to other documents for manufacturing or for any other purpose except as specifically authorized in writing by Southwest Windpower. A REVISIONS THIS DRAWING IS FOR REFERENCE A B NC ECO 1212 Admin Ch# 0056 ECO# 1180 4/13/07 DATE APPROVED tg 5/24/07 12/08/08 VARIATIONS MAY BE MADE IN ACCORDANCE WITH LOCAL EUROPEAN ELECTRICAL WIRING GUIDELINES "SKYSTREAM" WIND TURBINE CABLE EXAMPLE INDICATES #10 AWG CABLE BASED ON 45 FT FROM TOWER TO SWITCH, 187FT FROM SWITCH TO MAIN PANEL. TOTAL 232 FT.

FOR LONGER SPANS SEE WIRE CHART. SPAN BETW'N TOWER TOP TO AC MAIN PANEL (FOR CU WIRE), ASSUMING 230VAC (L-N) AT THE AC MAIN SERVICE PANEL, TURBINE OUTPUT 1.8kW USABLE AWG FOR 2% LINE NEUTRAL VOLTAGE DROP BETW'N TURBINE AND MAIN SERVICE PANEL A 934 FT. 588 FT. 371 FT.

232 FT. 146 FT. 92 FT. CONNECT NEUTRAL AND GND LUG ONLY IN AC MAIN PANEL AND NOT IN SUB-PANEL. NACELLE 4 AWG (25mm²) 6 AWG (16mm²) 8 AWG (10mm²) 10 AWG (6mm²) 12 AWG (4mm²) 14 AWG (2.5mm²) B B other loads C NACELLE CHASSIS ELECTRICALLY CONNECTED TO YAW, WHICH MUST BE ELECTRICALLY CONNECTED TO THE TOWER #10-2 UFB DIRECT BURIAL CABLE W/#10 GND FROM YAW CONNECTION TO SAFETY SWITCH (230V 1-PH, 50HZ) 230V, 1-ph, AC MAIN SERVICE PANEL 20 A 40 A 2 4 5 9 TOWER (APPROX. 35 FT. HIGH) 6 G N L1 8 SAFETY SWITCH 2-POLE, 30A, 240VAC, SQUARE D #DU221RB AT TOWER BASE #10-2 W/#10 GND THWN-2 CABLE FROM SAFETY SWITCH TO MAIN SERVICE PANEL LENGTH < 187 FT. N (blue) UTILITY KILOWATT-HOUR METER N C N G B N L1 GND N L1 GND L1 G 7 G SPD D L1 N 12 INCH MAX. 10 INCH MIN.

L1 (brown) GND (yellow +green) G D G G DEDICATED WIND POWER SYSTEM KILOWATT-HOUR METER GROUND LEVEL E TOWER GROUND SYSTEM 6" MIN. 4 2 WIND POWER SYSTEM DISCONNECT SWITCH 2-POLE 30A, 240VAC SQ-D #DU221RB 3 GROUND SYSTEM 230 VAC (L-N) TO SERVICE TRANSFORMER, UTILITY GRID * NOTES: 1. 2. EQUIPMENT SHALL BE INSTALLED IN ACCORDANCE WITH LOCAL EUROPEAN ELECTRICAL WIRING REGULATIONS. PROVIDE WARNING SIGN READING "WARNING-ELECTRIC SHOCK HAZARD-DO NOT TOUCH TERMINALS - TERMINALS ON BOTH THE LINE AND LOAD MAY BE ENERGIZED IN THE OFF POSITION". LABEL "WIND POWER SYSTEM DEDICATED kW-HR METER". LABEL SWITCH AS "WIND GENERATOR SAFETY DISCONNECT SWITCH; REMOVING AC POWER TO TURBINE ACTIVATES ITS SAFETY BRAKE". OPTION IS TO USE A JUNCTION BOX AT TOWER BASE INSTEAD OF A SWITCH. LABEL "REMOVING AC POWER TO TURBINE ACTIVATES ITS SAFETY BRAKE". BI-DIRECTIONAL METER TO BE INSTALLED BY UTILITY (WHEN REQUIRED).

USE COPPER WIRES ONLY AT TURBINE TERMINALS ALUMINUM WIRES MAY BE USED FOR HOME / UTILITY CONNECTION IF TRANSITION WERE DONE IN A JNC. BOX. 14AWG WIRE MUST BE COPPER ONLY. CAD-generated drawing do not manually update APPROVALS DRAWN CHECKED RESP ENG MFG ENG QUAL ENG E RUN FROM JNC. BOX AT TOWER BASE TO HOME 24 INCH MIN.

3. 4. 5. 6. 7.

8. 9. F TOWER FOUNDATION TOP SURFACE TO BE MIN. 6" ABOVE GROUND LVL. REFER TO SWWP FOUNDATION DWG. 1" DIA. SCHED. 40 RIGID PVC CONDUIT; SUNLIGHT RESISTANT; UL LISTED 1 2 3 B NOTE 10. SPD = SURGE PROTECTIVE DEVICE SUCH AS A LIGHTNING CURRENT ARRESTOR. AN APPROPRIATE ARRESTOR TO SATISFY THE REQUIRED LIGHTNING PROTECTION LEVEL MUST BE INSTALLED.

SEE LIGHTNING PROTECTION SECTION OF MANUAL FOR RECOMMENDATIONS Skystream NEXT ASSY USED ON Southwest Windpower Flagstaff, Arizona U.S.A. DATE - N.Agrawal 8 Mar '07 - 230 V 50Hz 1Ph W/ JCT BOX CAD file : 3-CMLT-1085 rev B+ 230V 50HZ 1PH doc. n° 3-CMLT-1085 scale none rev. B size A3 sheet 1 of 1 4 5 APPLICATION DO NOT SCALE DRAWING Skystream 3.7® Owner's Manual, EU Edition, Rev B 3 aPPendIX B: tOwer GrOundinG Skystream Energy Europe GmbH A wholly-owned subsidiary of Southwest Windpower, Inc. Mannesmannstr. 6 50996 Cologne Germany Tel: +49 (0) 221 16 53 94 50 info@skystreamenergy.

eu www.skystreamenergy.eu November 2010 Skystream Energy Europe All Rights Reserved Skystream 3.7® owner's manual 1 2 3 4 5 6 7 REV. NC 8 DESCRIPTION Proprietary rights are included in the information disclosed herein.

This information is submitted in confidence and neither the document nor the information disclosed herein shall be reproduced or transferred to other documents for manufacturing or for any other purpose except as specifically authorized in writing by Southwest Windpower. A REVISIONS appendix b: Tower grounding Original release 01/29/06 POT DATE APPROVED A Important Safety Instructions _____ 3 External bond to tower B 1) InTROduCTIon _____ 4 Internal bonding to tower bolts using listed or approved clamp B 2) groundInG TEChnIQuES _____ 4 2-1 Copper Clad Electrodes Driven Into Soil _____ 4 2-1-1 Grounding Electrode Installation _____ 5 2-1-2 Electric Resistance to Ground _____ 5 C C SOIL D 4AWG (25 mm2) or larger copper wire CONCRETE 2-1-3 Grounding Electrode Conductor: Material, Size, Bonding to Electrode & Bonding to Tower _____ 6 2-1-4 Conductor Size _____ 6 2-1-5 Bonding the Grounding Electrode Conductor to the Earth Electrode _____ 6 2-1-6 Bonding the Grounding Electrode Conductor to the Tower _____ 6 E D E 2 inch (5 cm) min. at foundation bottom 20 ft (6 m) of 0.5 in (1).



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3 cm) dia.

re-bar OR 4AWG (25 mm²) or larger bare copper conductor 2-1-6-1 Using a Tower Bolt/Nut Assembly _____ 6 2-1-6-2 Using a Grounding Lug at Tower Base _____ 7 2-1-6-3 Using Exothermic Welding _____ 7 Unless otherwise specified CAD-generated drawing dimensions are in mm. do not manually update tolerances are : distances angles APPROVALS DATE X. ± .5 ± 30 ' DRAWN N.Agrawal 26 Jan '07 .X ± .2 CHECKED P. Thomas 26 Jan '07 .XX ± .1 Skystream MATERIAL -NEXT ASSY USED ON FINISH APPLICATION DO NOT SCALE DRAWING RESP ENG MFG ENG QUAL ENG F Listed or approved clamp for connecting Copper to steel.

Clamp is generally tin plated and must prevent direct contact between Cu and steel to prevent corrosion 4 5 2-2 Electrodes Encased in the Concrete of the Tower Foundation Flagstaff, Arizona U.S.A. electrode 2-3 Bolting Grounding Lug to Tower Base _____ 8 D. Calley 26 Jan '07 CAD file : Tower_Grounding Concrete encased dwg. n° 3-CMBP-3026 scale none rev. A size A3 sheet 1 of 2 1 2 3 2 Skystream 3.7® Owner's Manual, EU Edition, Rev B ImportanT SafETy InSTruCTIONs rEad ThESE InSTruCTIONs In ThElr EnTIrETy bEforE InSTallIng. professional installation highly recommended 1) 2) 3) SAVE THESE INSTRUCTIONS. This manual contains important instructions for grounding your Skystream tower.

Read these instructions in their entirety before beginning. Do not start installation unless all required equipment and tools are on site. In this guide tiP: Helpful information to ease the installation Professional installation highly recommended Warning: Risk of injury or death - proceed with extreme caution Skystream 3.7® Owner's Manual, EU Edition, Rev B 3 one - Introduction Even though the wind turbine is grounded at the service panel it must also be grounded at the tower base. Grounding the tower at its base may prevent electrical shocks, voltage surges and static charge build up.

Proper tower grounding may also limit or minimize damage due to lightning strikes. This document provides recommendations for grounding small wind turbine systems with rated line currents of less than 200A to achieve compliance with the 2005 USA National Electrical Code (NEC) as well as IEC (International Electrotechnical Commission) standard 60364-5-54 Selection and Erection of Electrical Equipment Earthing Arrangements, Protective Conductors and Protective Bonding Conductors. The grounding information contained in this document is provided as a reference. Please refer to the aforementioned NEC and IEC standards for complete detailed information. Local building codes and electrical standards may differ from the information presented here and have precedence over this document.

(16 mm²) Min Must be secured and buried for protection 1 ft (0.3 m) 8 ft (2.4 m) Two - grounding Techniques There are several tower grounding techniques compliant with NEC and IEC standards, this document presents two of the most common approaches: · Copper clad electrodes driven into the soil · Electrodes encased in the concrete of the tower foundation fig. 1 Electrode driven into ground. tance to ground" to determine the dimensions of the rod. The electrode shall be free from non-conductive coatings such as paint or enamel. Rod and pipe electrodes shall not be less than 2.5 m in length and shall consist of the following materials: a) Electrodes of pipe or conduit (hollow electrodes) shall not be smaller than metric designator 21 (trade size 3/4) and, where of iron or steel, shall have the outer surface galvanized or otherwise metal-coated for corrosion protection. b) Electrodes of rods of iron or steel shall be at least 15.87 mm in diameter.

Stainless steel rods less than 16 mm in diameter, nonferrous rods, or their equivalent shall be listed* and shall not be less than 13 mm in diameter. 2-1 Copper Clad Electrodes driven Into the Soil The figure 1 depicts a typical tower grounded using an electrode driven into the soil. The tower may be grounded using a copper-clad electrode(s) of appropriate diameter and length. See the section entitled "Electrode resi- 4 Skystream 3.7® Owner's Manual, EU Edition, Rev B NEC section 250.52 and in accordance with the user's local electrical code authority. *Be included in a list published by an organization (or marked as such) that is acceptable to the local authority having jurisdiction in the area. For example, UL/CSA listed in USA/Canada. 2-1-1 grounding Electrode Installation The following information is excerpted from the 2005 NEC article 250.53 (G).

Refer to code for additional detailed information. The electrode shall be installed such that at least 2.44 m of length is in contact with the soil. It shall be driven into undisturbed soil within 1 ft of the tower foundation. It shall be driven to a depth of not less than 2.

44 m except that, where rock bottom is encountered, the electrode shall be driven at an oblique angle not to exceed 45 degrees from the vertical or, where rock bottom is encountered at an angle up to 45 degrees, the electrode shall be permitted to be buried in a trench that is at least 750 mm deep. The upper end of the electrode shall be flush with or below ground level unless the aboveground end and grounding electrode conductor are protected against physical damage as specified below (quoted from 2005 NEC article 250.10): a) In installations where they are not likely to be damaged. b) Where enclosed in metal, wood, or equivalent protective covering. 2-1-2 Electrode resistance to ground The resistance to earth of a single ground rod can be calculated using Dwight's equation: $R = [r/(2L)] \times [\ln(4L/R) - 1]$, where r is the soil resistivity, L is the length of the rod buried inside the earth and R = radius of the rod; ln stands for the natural logarithm.

For calculating the resistance of the rod to ground, one must know the value of soil resistivity. This may be found in the local electrical code or building inspector's office/municipal office or by an actual soil resistivity test. The resistance of a rod electrode to ground may be lowered by increasing the rod diameter, increasing the buried length of the rod or by treatment of the soil to reduce its resistivity. If the single chosen electrode does not have a resistance to ground of 10 ohm or less, it shall be augmented by additional electrodes as necessary. The overall resistance of multiple rods to ground would roughly equal the resistance of a single rod to ground divided by the number of rods. Where multiple such electrodes are installed to meet the above requirement, they shall not be less than 1.8 m apart. The multiple rods must be bonded together using the grounding electrode conductor. Skystream 3.7® Owner's Manual, EU Edition, Rev B 5 2-1-3 grounding Electrode Conductor: material, Size, bonding to Electrode and bonding to Tower Material (Ref.

2005 NEC articles 250.



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