

ARE 110-48V (2.5kW) Wind Generator
Battery Charging Model

Owners Manual

Electrical

Installation, Operation, & Maintenance

Version 5.0



Manufactured in the USA by:



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1. SAFETY WARNING!

- **Electrical shock hazard:** The wind generator can produce high voltages – sometimes more than 200 volts. These voltage levels can cause serious injury or death. No wires or electrical connections should be touched or handled without ensuring that the wind generator has come to a complete stop, the brake is applied and the power to the Voltage Clamp™ is off and the batteries are disconnected. After these steps are taken, approximately five (5) minutes is required for system voltage to decay to safe levels.
- The **ARE110** is a powerful machine and can cause injury if not assembled and erected properly (according to the instructions and using appropriate equipment).
- Do not approach the machine while the blades are spinning – they can cause serious injury!

Please Note:

***ABUNDANT RENEWABLE ENERGY** has made every effort to ensure that the information presented in this manual is accurate but assumes no responsibility for any errors or omissions. Users of this information and **ARE** products assume full responsibility and risk.*

2. Introduction

This manual provides the information needed to assemble, operate, and maintain the **ARE110-LV** (2.5 kW) wind generator with a direct grid connection. Please read it thoroughly and keep for future reference.

The **ARE110-LV** Voltage clamp is designed to ensure maximum energy capture from low and high wind speeds and protects the turbine, batteries and other electronics attached to the system from damage due to high voltage.



Figure 1. ARE110 wind generator

3. Voltage Clamp Specifications

Input Power	0 to 9700 Watts
Input Voltage	3-phase, variable voltage (0 - 100 VAC)
Input Frequency	0 to 50 Hz
Diversion Load	2 Ohm Air Heater w/ temperature sensor
Diversion Load Power Dissipation	7200 Watts
Diversion Load Frequency	1500 Hz PWM Square Wave
Output Voltage	0 to 150 VDC
Output Power	0 to 2500 Watts
Cooling	Fan Cooled/vented Enclosure

Table 1. **ARE110** specifications

4. Equipment Supplied

Qty.	Item Description
1	ARE Voltage Clamp™ (battery charging controller)
1	OUTBACK POWER SYSTEMS Wind Tracker 80
1	ARE resistor load
6	GloCoil screw in type heating elements.

Table 2. *Equipment Supplied with **ARE110** wind generators*

To Be Purchased from Other Suppliers:

- Appropriately sized wiring, as described in Section 9 (“Wire Size Recommendations”) and in Section 7 (“Electrical Schematic”)
- Adequately sized (200 AH Min) Battery bank. A larger capacity battery bank is strongly recommended.
- Batteries bank voltage must be 48V nominal.

5. Required Installation Tools

Screwdrivers – Phillips (#2) & flat-head (3/16” max width blade 6” over all length)
Wire Strippers

6. Electronics Installation

It is important to install the **ARE** Voltage Clamp™, resistor load, and battery bank (provided by user) prior to installing the wind turbine. This will provide a control system for the turbine and allow the brake to be used during turbine installation.



ARE Voltage Clamp™

Wind Tracker 80

ARE resistor load

Figure 5. Electrical Components Supplied by ARE

Installation Instructions

It is suggested that a piece of 3/4" plywood be mounted to the wall where your wind turbine electronic equipment will be installed. This will provide a secure substrate to which to mount equipment. It also provides for adequate flexibility in mounting the equipment without needing to rely on stud spacing or special wall anchors.

A. Resistor Load

The resistor load enclosure must be mounted so that the terminal block in is the lower right hand corner. Air must be permitted to flow freely through the box. Do not locate this device near flammable substances or loose cloth. Ensure a minimum of 18" clearance above the resistor load enclosure and 12" on all other sides of the resistor load enclosure.

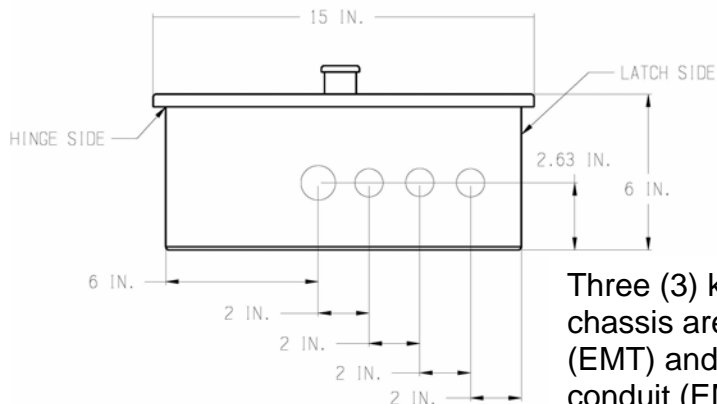
Installation of Resistor Elements (Glocoils): Remove the cover from the resistor load enclosure, and unpack the Glocoil heating elements from their protective packaging. The resistor elements are packaged separately to protect them during shipping. Remove the Glocoil elements from their packaging and screw them securely into the sockets inside the diversion load enclosure.

INSTALL ALL 6 GLOCOIL RESISTORS! The turbine will not operate without the resistors.

B. Voltage Clamp™

The **ARE Voltage Clamp™** should be mounted on a vertical surface in a dry location. It should be mounted in suitable location to provide easy access to the red "**STOP**" button and so that the enclosure door may be opened fully.

BOTTOM VIEW OF VOLTAGE CLAMP



Three (3) knockouts in the Voltage Clamp chassis are sized for 3/4-inch rigid conduit (EMT) and one (1) is sized for 1-inch rigid conduit (EMT). **DO NOT** enlarge any of these holes, as this will void the **ARE** warranty.

Figure 6. Knockout locations on bottom of Voltage Clamp™

The Voltage Clamp™ is a Fan Cooled/vented Enclosure. Do not block the inlet/outlet Filters. Ensure a minimum of 6" clearance on all the sides of the enclosure.

See the Wiring Diagram for proper connection and wire sizes. Ensure all wiring is in accordance with local codes and laws. Wire the Wind Tracker 80 PV- and PV+ terminal to the “- OUT” and “+ OUT” slots of the Voltage Clamp’s din-rail mounted terminal block (pictured below in Figure 7). Wire smaller wires (14 to 16 AWG) directly to the battery pack to the “+in” and “-in” terminal blocks

POLARITY IS IMPORTANT! Wiring the either the input or the output with reverse polarity will damage the equipment and result in an expensive repair bill.

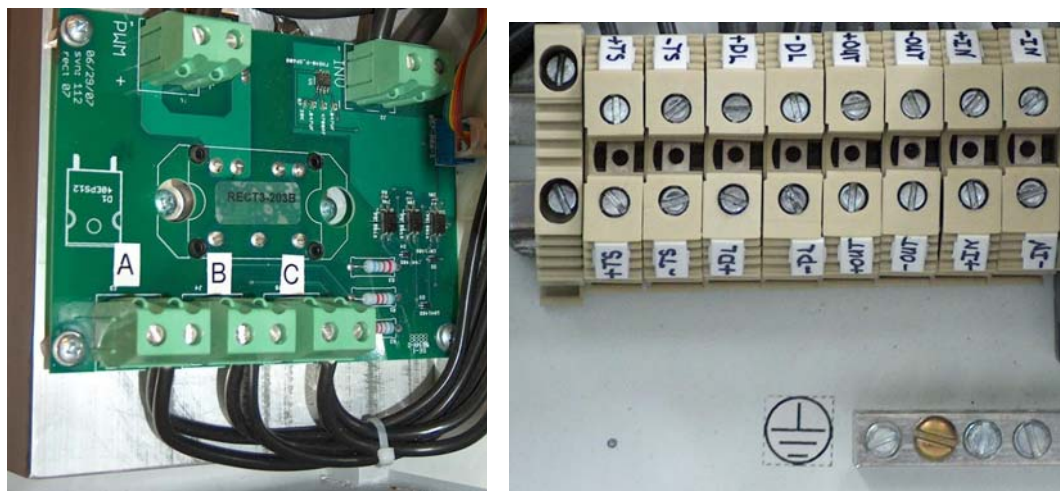


Figure 7. Board Mounted Terminal Blocks & Main din rail terminal blocks mounted inside Voltage Clamp™

After all electrical equipment has been installed and all connections made, press the “**STOP**” button to ensure that the brake is engaged. This will ensure that the equipment will not be energized while the wind turbine is being installed.

C. Wind Tracker 80 Charge Controller

Refer to the Wind Tracker 80 users manual for schematics and instructions about how to properly install and connect the Wind Tracker 80. The Voltage clamp can be connected to the Wind Tracker 80 exactly as instructed for a PV array or solar panel.

Outback Power Systems has supplied **ARE** with a **customized** charge controller. The Wind Tracker 80 has all the features of the new FM80 charge controller plus a special wind mode. Your **ARE** Voltage Clamp and Outback Wind Tracker 80 have been carefully designed to work together to produce the maximum power possible from your wind turbine. The Wind Tracker 80 will not work with other turbines, nor will the Voltage Clamp work with other charge controllers. In the event of errors, malfunctions, technical questions, or any warranty issues with the Wind Tracker 80 or the Voltage Clamp please contact **ARE** at (503) 538-8298. **Outback will not be able to help you with any questions.**

To work effectively with the **ARE 110**, the Wind Tracker 80 must be in Wind Mode. From the status screen press the left hand button. Move cursor to the **ADVANCED** menu press **GO**. If asked to enter a password, the password for all outback products is 141. Scroll down to the **MPPT MODE** menu press the **MODE** button until the **WIND** is selected. Please refer to the Wind Tracker 80 manual for more detailed explanation about navigating through all the menus on the Wind Tracker 80.

Refer to the Wind Tracker 80 owner's manual for complete documentation of the Wind Tracker 80's other features, and instructions for electrically connecting the the battery pack and the Voltage Clamp.

D. Electrical Schematic

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 ABUNDANT RENEWABLE ENERGY, LLC.
 ANY REPRODUCTION OR TRANSMISSION
 OF THIS DRAWING IS STRICTLY FORBIDDEN WITHOUT
 WRITTEN PERMISSION.

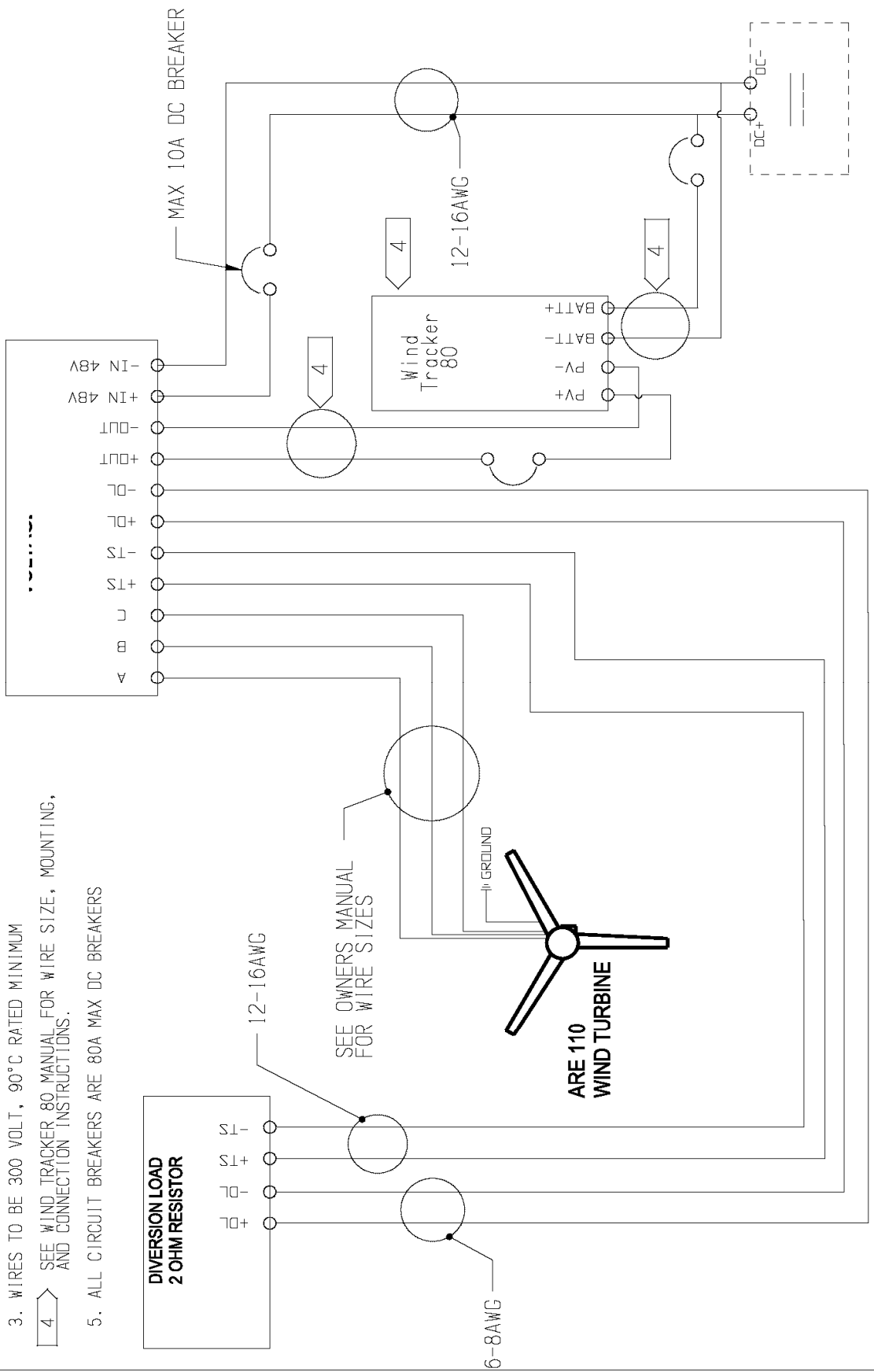
ELECTRICAL WIRING DIAGRAM, ARELLO DL CONTROL

REV B

NOTES: UNLESS OTHERWISE SPECIFIED

1. SEE MANUAL FOR CLEARANCE AROUND ALL ENCLOSURES
2. EQUIPMENT SUPPLIED BY A.R.E.: RESISTOR ENCLOSURES, VOLTAGE CLAMP, WIND TURBINE, AND FM80 CHARGE CONTROLLER. ALL OTHER EQUIPMENT PROVIDED BY CUSTOMER.
3. WIRES TO BE 300 VOLT, 90°C RATED MINIMUM

4. SEE WIND TRACKER 80 MANUAL FOR WIRE SIZE, MOUNTING, AND CONNECTION INSTRUCTIONS.
5. ALL CIRCUIT BREAKERS ARE 80A MAX DC BREAKERS



7. Wire Size Requirements

The following table lists the required wire gauge, based on the **one-way** wire run distance from the tower top to the building entrance (where it connects to system electronics). These requirements result in a voltage loss to less than 2% at rated power. Ensure that the wire insulation is rated for outdoor use and for at least 300 volts. Please contact the factory if you have wire runs longer than those listed in the table below.

It is important to use the proper wire size for the number of feet of wire run. The turbine controls rely on a specific wire size for a given distance. Do not use a larger or smaller wire than specified in the table.

One-Way Distance between turbine and Voltage Clamp

8 AWG	6 AWG	4 AWG	2 AWG	1 AWG	1/0 AWG	2/0 AWG
140-220 feet	220-350 feet	350-550 feet	550-870 feet	870-1100 feet	1100-1390 feet	1390-1770 feet

Table 3. Wire size requirements

NOTE: The Voltage Clamp's terminal block does not accept wire sizes larger than 6 AWG. If a larger wire size is used, the wire size must be "stepped down" prior to insertion into this terminal block.

WARNING: Using larger or smaller wire than specified will **void your warranty** and may cause damage to your turbine, or prevent it from stopping in high wind situations. This can be very dangerous.

8. Generator Start-up, Shut-down, & Reset

CAUTION: ALLOWING THE WIND GENERATOR TO ROTATE UNLOADED CAN RESULT IN VERY HIGH VOLTAGES WHICH CAN CAUSE INJURY OR DEATH AND CAN DESTROY EQUIPMENT.

A. Prior to Generator Start-up (Verify the Following):

- All electronic equipment installed per Section 7 of this manual.
- All electronic equipment wires double-checked for proper location.
- Circuit breakers to electronic equipment placed in the **OFF** position.
- **STOP** button on the Voltage Clamp™ is in the depressed position.
- Wind turbine installed per ARE-110 LV Mechanical Owners Manual.
- Wind turbine and tower erected and properly secured per tower instructions.

B. Generator Start-up Procedure:

1. Rotate the **STOP** button clockwise (CW) 1/6th of a turn and release. This will start a 5 minute wait period. The **YELLOW** and **GREEN** lights will flash. **NOTE: If STOP button is depressed, the RED, YELLOW, and GREEN lights will flash.**
2. After the 5 minute wait the flashing **YELLOW** light will turn off. The **GREEN** light will continue flashing. Once sufficient wind is available, the turbine blades will start to spin, activating the Voltage Clamp's "TEST MODE".
3. When the generator's rectified voltage reaches approximately 20 V_{DC}, the Voltage Clamp™ will perform a test to verify proper installation and functioning of the resistors (load and brake). Upon successful test results, the **GREEN** light will be steadily illuminated.
4. Whenever the voltage gets to close to preset limits, the **YELLOW** light will turn on and off intermittently as the controller diverts power to the diversion load. The preset limits are designed to protect your battery pack by limiting the maximum battery voltage.
5. The system will operate automatically, and monitoring is not required.

C. Voltage Clamp™ Operation in Decreasing Wind Speeds

- If the generator's rectified voltage drops below 20 V_{DC} for more than one hour, the Voltage Clamp™ returns to the **START UP MODE**.

D. Generator Shut-down & Reset Procedures

To shut down the wind energy system, press the red mushroom emergency **STOP** pushbutton. To reset the system, depress the **STOP** button, then rotate the **STOP** button clockwise (CW) 1/6th turn and release.

9. Voltage Clamp Operation & Faults

Mode	Lights			Mode / Fault Description	Solution / Comments
	Green	Yellow	Red		
Normal Operation	Flash	Flash	Off	START UP MODE: The system is initializing and going through system checks.	Brake will release within five minutes.
	Flash	Off	Off	TEST: The system is waiting for the turbine to start. When the wind speed reaches 12 to 15 MPH, the turbine should start turning and then the system will perform some safety tests then enter RUN MODE .	
	Steady On	Off	Off	RUN MODE: The system is producing energy, which is being used by domestic loads or being sent to the utility grid.	
	Steady On	Steady On	Off	RESISTOR LOADING: The system voltage is approaching the upper limits of the acceptable range. The load resistors are absorbing excess energy.	Depending on the wind speed the yellow light may be steady on, or may flash on and off as the resistor loads are turned on and off as required.
	Flash	Flash	Flash	STOP: The STOP push button has been pressed. The turbine brake is applied to the system.	
Faults Auto-Reset	Off	Off	Flash	OVER-VOLTAGE FAULT (130 V_{DC}): The rectified system voltage has exceeded 130 V _{DC} , and the brake has been applied.	After a 5 minute delay, the system will automatically reset.
	Off	Flash	Flash	OVER-TEMPERATURE FAULT: One of the bi-metallic temperature switches has tripped and the turbine's brake has been applied. Temperature switches inside the Voltage Clamp are set at 60°C (140°F). Temperature switches inside the Diversion Loads are set at 90°C (195°F).	The system will not reset until the temperature decreases to below the set-point of all bi-metallic switches, and a 5 minute cool-down period has expired.
Fault Manual Reset	Off	Off	Steady On	GENERAL SYSTEM FAILURE: The system has encountered an internal error. Check the brake and load resistors and try again.	Manually reset the system. If problem persists please contact ARE for Support.*
	Off	Flash	Steady On	LOAD RESISTOR TEST FAILED: The test performed by the Voltage Clamp to verify proper connection and functioning of the diversion load resistors has failed.	Check all electrical connections and ensure that diversion load connections are correct in Voltage Clamp enclosure. Manually reset the system.*
Fault Manual Reset	Steady On	Off	Steady On	BRAKE RESISTOR TEST FAILED: The test performed by the Voltage Clamp to verify proper connection and functioning of the brake resistors has failed.	Check all electrical connections and ensure that brake connections are correct in Voltage Clamp enclosure. Manually reset the system.*

	Off	Steady On	Steady On	CALIBRATION: The system has entered a special calibration mode. Please power cycle – <i>power off the Voltage Clamp’s circuit breaker for 10 seconds and restore power</i> – to clear this message.	ARE may instruct you in how to place your voltage clamp into a special calibration mode to obtain advanced technical information from the voltage clamp.
	Steady On	Steady On	Steady On	TIMEOUT: This is an internal error. Please power cycle – <i>power off the Voltage Clamp’s circuit breaker for 10 seconds and restore power</i> – to clear this message.	If this problem persists, please contact ARE for support.

Table 12.1. Voltage Clamp Operation & Faults

- * **TO MANUALLY RESET THE SYSTEM:**
Depress the STOP button, then rotate the STOP button clockwise (CW) 1/6th turn and release.

10. Inspection & Maintenance

Frequency	Category	Task	Comments
Every 12 months	Controller	Inspect wires for tightness, corrosion, or insulation damage.	Wires that connect to the voltage clamp terminal blocks from the turbine side should be tightened or replaced as necessary. Damage on the factory side of the terminal block indicates that the controller should be returned for repair, please contact ARE
	Diversion Load	Inspect wires for tightness, corrosion, or insulation damage.	Replace damaged wires, tighten loose connections.

Table 5. Inspection & Maintenance Schedule

11. Troubleshooting

Symptoms	Possible Causes	Solutions
Turbine fails to turn (or turns very slowly) in significantly windy conditions	Shorted wires or alternator windings	Remove short
	Shorted diodes	Replace faulty diode(s)
	Controller operating improperly	Call ARE .
Low output	Insufficient wind	Improve tower location/height
Turbine vibrates excessively	3 phase power improperly connected	Check all 3 phase connections from the yaw head to controller. Inspect slip rings.
	Blades out of balance	Check blades for water intrusion
Turbine running at high speed no output	Cables disconnected	Fix cables
	Slip Rings Failed	Replace Slip Rings

Table 6. Troubleshooting Guide

Five-Year Warranty for ABUNDANT RENEWABLE ENERGY Wind Generators

WARRANTY AGREEMENT

In order to validate this Warranty Agreement, the Customer must detach, complete, and return the ARE Mail-in Warranty Form (page 2 of this Agreement) within one (1) month of installation or seven (7) months of receipt of warranted ARE products, whichever occurs first.

Abundant Renewable Energy (ARE) warrants that the wind turbines it manufactures will be in good working order, in accordance with ARE standard specifications, upon delivery to its customers and for a period of 66 months from the date of delivery or 60 months from the date of installation, whichever occurs first. During the warranty period ARE will, at its sole discretion, repair, replace, or refund the purchase price of defective components and assemblies. Repair parts or replacement product may be new, remanufactured, or refurbished, at the sole discretion of ARE. ARE is not responsible for any costs associated with the installation, removal, reinstallation, or transportation to ARE (or to an ARE dealer) of defective ARE products. Return freight to the customer will be provided by ARE. Product or components returned to ARE, which are not defective or which sustained damage not covered under this warranty, will be tested and/or repaired at ARE's standard labor rates. Only warranty claims submitted to ARE in writing within 15 days of problem origin will be honored.

GOVERNING LAW AND DISPUTE RESOLUTION

This Agreement will be interpreted and enforced according to Oregon state laws or U.S. federal laws, whichever has jurisdiction. Oregon law, without reference to conflicts of laws principles, shall control the interpretation and enforcement of this Agreement.

In the event that any dispute, controversy, or claim between the Parties arising out of or relating to this Agreement cannot be settled by negotiation or mediation, the parties agree to have the dispute, controversy, or claim settled by Arbitration Service of Portland, Inc. Any arbitration is to be conducted in Portland, Oregon. The Parties agree that any determination by the arbitrator(s) shall be final and binding and that judgment upon the award may be entered in any court having competent jurisdiction. The arbitrators shall have no authority to award punitive damages.

EXCLUSIONS

This warranty does ***not*** cover the following:

- Towers, equipment, materials, or supplies not manufactured or supplied by ARE (*Towers manufactured or sold by ARE are covered by their own separate warranty.*)
- ARE equipment which has been improperly installed or modified without approval from ARE
- Damage or loss from winds in excess of 45 m/s (100 mph)
- Lightning damage or other "acts of God". (*The ARE lightning protection package provides its own individual warranty related to lightning damage to wind generators and related controls*)
- Incidental or consequential damages
- Damage to product incurred during shipping

PRODUCT CHANGES

ARE reserves the right to make design changes, improvements, or additions to its products without obligation to install such changes or improvements in existing products.