TALOYOAK, NUNAVUT - EA HYBRID POWER SYSTEM EQUIPMENT OPERATIONS & MAINTENANCE GUIDE

1. OVERVIEW AND PURPOSE

a) This describes major components as provided by Energy Alternatives; and

b) Suggestions for additions or revisions are welcome and sought after. Please make comments available to Energy Alternatives by any means convenient; and

c) This document is a guide only and is not intended as a replacement for manufacturers operating and maintenance instructions. It serves as a condensed overview of the components and systems installed by Energy Alternatives; and

d) In particular, generator O&M, generator starting and transfer logic, the ASCO transfer switches and all system components and logic installed and configured by BI Pure Water are specifically excluded from this document as they are beyond the scope of Energy Alternatives services at this time.

2. TABLE OF CONTENTS

3. HYBRID POWER SYSTEM (HPS) COMPONENTS

a) Batteries; this battery bank has a capacity 3500 amp/hours at 48vdc . These batteries are of a sealed type requiring no fluid checking. Each battery has a serial number and each battery if checked should read 2 volts DC. Batteries are EXTREMELY DANGEROUS. DO NOT REMOVE COVERS;

b) Inverters; there are 4 Xantrex XW inverters capable of producing 24Kw sending 240vac to required loads. An inverter 'system control panel' or SCP, programs the group and will display inverter status;

c) System Control Panel, SCP, is a white Xantrex system Control Panel. This is the primary interface for warnings, messages and control of the inverters and other automated components; and

d) Six Xantrex MPPT 60 Solar Controller are installed to regulate the flow of electricity from the six solar panel arrays; and

e) One wind turbine controller that regulates the flow of electricity from the Whisper 500 Wind turbine, including diverting excess loads; and

f) The Generators are also a source of electricity for the HPS via the ASCO transfer switches, but these components and operational logic are SPECIFICALLY EXCLUDED from this document as their operation and maintenance is the responsibility of BI Pure Water.

4. NORMAL OPERATIONS, AUTOMATIC

a) the hybrid power system operates automatically, providing electricity to users and charging the batteries as needed. It is normal to hear the generators automatically start and run to charge the batteries. An optional quiet time can be specified to prevent the generators from running at night or at other specific times;

b) it is important to regularly monitor and maintain components to ensure the greatest lifespan of the system. Monitoring and maintenance tasks are detailed later in this manual;

c) components of the HPS are labelled. A working knowledge of where various devices are located within the structure is useful. In particular it may be important to note locations of the System Control Panel (SCP);

d) in the event of failures or emergency situations, it is important to have as much information as possible to help EA technicians quickly resolve any issues.

5. SYSTEM CONTROL PANEL (SCP)

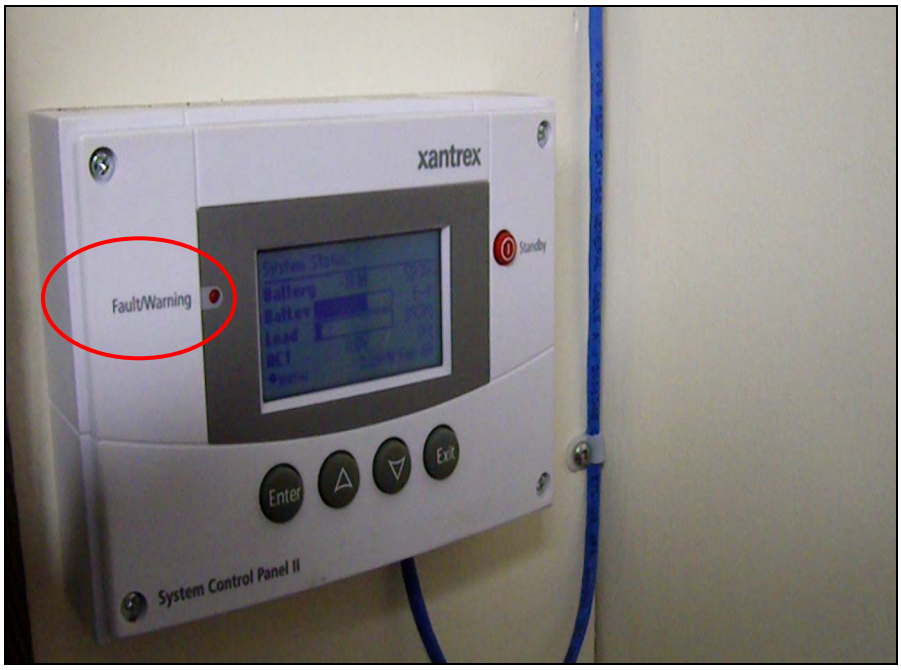

Figure 1. White Xantrex System Control Panel (SCP).

(Fault/Warning Indicator highlighted)

General description:

a) small white control panel box in the inverter/battery room, readout displays Voltage of Battery generally between 48 and 52v;

b) warnings and faults:

   i. if the red warning light is flashing an alert condition exists, action is required;

   ii. determine the source/cause of the warning. There will be a screen message, write it down carefully and accurately - EA technicians will need the EXACT message to provide assistance;

   iii. press the <ENTER> button to continue; and

   iv. the readout may give instructions on how to clear the fault; remedy the warning or contact EA for help. EA technicians will need to know the EXACT wording of the warning message.

d) A red light on solidly means there is a fault condition and action is required;

   i. there will be a message and fault number on the SCP screen. Write down the fault number carefully and accurately. EA technicians will need the EXACT information should assistance be required; and

ii. contact EA for further troubleshooting instructions.

e) There are two common fault conditions;

i. if the SCP is in fault mode and there is NO POWER, it is possible the batteries are low;

ii. there may also be a problem with the generators;

iii. check the display panels on the Inverters and note down the LED display readout. they will likely read "F##", carefully write down these fault numbers and contact EA for further troubleshooting assistance;and

iv. contact EA for further assistance;

f) Using the SCP to reset the generators to full automatic control;

i. on the SCP, press <exit> until you reach the main SCP readout menu;
ii. use the (v) (down arrow button) to scroll to "AGS01";
iii. press <Enter>;
iv. use the (v) (down arrow button) to select "Generator Mode";
v. press <enter>;
vi. use the (v) (down arrow button) to select "Manual OFF";
vii. press <enter>;
viii. use the arrow buttons to select "Generator Mode" AGAIN;
ix. press <enter>;
x. use the arrow buttons to select "Automatic";
xi. press <Enter>;
xii. press <exit> until you reach the main SCP readout menu;

Note that performing this reset operation will set all of the automated timers back to 0, thus it may be up to 24 hours before the generators try to start again. The generators may start sooner based on low battery voltage conditions.

5.1. INVERTER STATUS WEEKLY

a) Check the SCP to confirm that the Fault/Warning LED is not lit or flashing;

b. visually check inverters to determine nothing visual is amiss; and

c. refer to SCP (above) for other inverter operating parameters.

7. SOLAR CONTROLLERS

Figure 2. Xantrex MPPT 60-150 Solar Charge Controller

a) when in charge control mode the LCD shows the output power, voltage and current;

b) when a fault condition exists the LCD shows "fault active";

c) when battery equalization is taking place the LCD shows "equalization pending" during change-over and will display time to completion remaining for the remainder of the process; and

d) refer to the Xantrex MPPT 60 manual for detailed operations and troubleshooting menus.

8. WIND TURBINE CONTROLLER

Figure 3. Wind Charge Controller Display

a) Normally the LCD shows the battery charging status, windspweed, charging voltage, battery charge current and turbine power;

b) when the battery is charging, the green LED will be lit;

c) If the diversion load is being used, the red led will be blinking (automatic) or steady (manual diversion);

d) The display can provide much more detailed information for technicians and troubleshooting, please refer to the Whisper 500 manual for further details;

e) Monthly and annual maintenace inspections of the turbine equipment are recommended. Please refer to the Whisper 500 Operators Manual for further details and instructions.

9. BATTERY SAFETY

a) although all valve-regulated batteries have the electrolyte immobilized within the cell, the electrical hazard associated with batteries still exists; and

b) work performed on these batteries should be done with the tools and the protective equipment listed below.

i. safety glasses or face shield;
ii. acid-resistant gloves;
iii. protective aprons and safety shoes;
iv. proper lifting devices; and
v. properly insulated tools.

c) the following safety procedures should be followed during installation:

CAUTION
Always wear safety glasses or face shield when working on or near batteries.

i. batteries are sealed and contain no free electrolyte; Under normal operating conditions they do not present any acid danger. However, if the battery jar or cover is damaged, acid could be present;

ii. Sulfuric acid is harmful to the skin and eyes. Flush affected area with water immediately and consult a physician if splashed in the eyes;

iii. prohibit smoking and open flames, and avoid arcing in the immediate vicinity of the battery;

iv. do not wear metallic objects, such as jewelry while working on batteries;

v. keep the top of the battery dry and clear of tools and other foreign objects;

vi. provide adequate ventilation;

vii. follow recommended charging voltages;

viii. ***never*** remove or tamper with the pressure relief valves. Warranty void if vent valve is removed;

ix. inspect all flooring and lifting equipment for functional adequacy. Specifically review floorloading; and

x. adequately secure battery modules to the floor.

9.1 UNIGY BATTERIES GENERAL

a) Float Voltages:

i. These batteries are designed for 20-year life when floated at 2.25 ± .01 volts per cell (VPC) at 77°F (25°C)or less;

ii. The charger must be able to sustain the system voltage within ± .5% volts of the desired level at all times. The desired float voltage varies with the temperature according to the table below; and Operating Temperatures

Temperature Per Cell Float

°F	°C	Voltage ± .01
50°	10°	2.25
59°	15°	2.25
68°	20°	2.25
77°	25°	2.25
86°	30°	2.25
95°	35°	2.23

b. Equalizing:

i. upon installation of the battery, an optional boost charge of 2.30 VPC ± .01 volts for a maximum of 24 hours can be applied. **(Note: Verify that the higher battery voltage will not adversely affect the other connected equipment.) If this is done, be sure to reset the charging equipment back to the proper float voltage;**

ii. the average battery operating temperature should not exceed 95°F (35°C) and never exceed 105°F (40.5°C) for more than an eight-hour period; and

iii. operating at temperatures greater than 77°F (25°C) will reduce the operating life of the battery.

c. Record Keeping

i. Record keeping is an important part of stationary battery maintenance and warranty coverage;

ii. this information will help in establishing a life history of the battery and inform the user if and when corrective action needs to be taken (Refer to Appendix A, Battery Maintenance Report);

iii. while it is acceptable to operate at temperatures less than 77°F (25°C), it will require longer charging time to become fully recharged. Also, the capacity will be less at operating temperatures below 77°F (25°C); and

iv. record battery detail as follows;

a) battery terminal voltage;

b) charger voltage;

c) individual cell float voltages;

d) individual cell ohmic readings. Place the meter leads on the positive and negative posts which are furthest from each other on the same cell;

e) ambient temperatures;

f) terminal connections should be checked to verify that the installer did torque all connections properly to 125 inch/lbs; and

g) resistance readings between cell connections should be consistent and very low. Any reading that differs by more than **20%** from the rest of the bank values require a re-torque of the connection to 14.12 ±0.5 Nm (125 ± 5 inchpounds). If resistance readings still remain high, clean contact surfaces, re-torque and measure again.

9.2 UNIGY BATTERY MAINTENANCE

a) Annual inspection:

i. conduct a visual inspection of the battery;

ii. record the battery terminal voltage;

iii. record the charger voltage; record the individual cell voltages. Cell should be within ± .05 volts of float voltage;

iv. record individual cell ohmic readings;

v. record the ambient temperatures; and

vi. record all interunit and terminal connection resistances.

b) rectifier ripple voltage acceptable charging ripple (peak to peak) shall be less than 0.5% of the manufacturer's recommended string float voltage and have a duration shorter than 8 milliseconds;

c) Battery cleaning:

i. battery terminals, cases and covers should be cleaned with clear water or a mixture of baking soda and water.

Never use solvents to clean the battery.

APPENDIX A. BATTERY MAINTENANCE REPORT

Date _____

Technician Name _____

Battery Location and/or Number _____

No. of Cells _____ Type _____ Date Mfg. _____ Date Installed _____

Charger Output _____ Ambient Air Temperature _____ ºC

Total Battery Voltage _____ Panel Meter Volts _____ Installer _____

Cell No.	Serial No.	Volts	Cell Ohmic Value	Connector Ohmic Value	Cell No.	Serial No.	Volts	Cell Ohmic Value	Connector Ohmic Value
1					**25**				
2					**26**				
3					**27**				
4					**28**				
5					**29**				
6					**30**				
7					**31**				
8					**32**				
9					**33**				
10					**34**				
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