NEV Power

Home energy options

Narara Ecovillage

Version 4.0 / February 2017

Document control sheet

Control	Details
Prepared for	NEV Power
Project	Narara Ecovillage Smartgrid
Report	**Home energy options**
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Current version	4.0
Date	13 December 2016
Approved by	Chris Kornek
Signed	

Version	Date	Details	Approval
Version 1.0	08/11/2016	For discussion	Chris Kornek
Version 2.0	10/11/2016	For discussion	Chris Kornek
Version 3.0	13/12/2016	For discussion	Chris Kornek
Version 4.0	13/02/2017	For discussion	Chris Kornek

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Table of Contents

1 Introduction

1.1 Project Overview

The Narara Ecovillage Cooperative (NEV) development will consist of up to 150 dwellings plus commercial, agricultural and administrative/office buildings on community titled lots in 3 stages, with the first 60 lots in stage 1. The community has a strong commitment to carbon reduction, sustainable living and resident outcomes. NEV has established NEV Power Pty Ltd, a wholly owned subsidiary, to manage the electricity network and associated retail functions. NEV Power will maximise this unique opportunity to benefit cooperative members by creating an exemplar smart grid solution to become self-sufficient in renewable energy and deliver net carbon neutrality and energy security, at reasonable cost and with no adverse impact on the utility.

The first stage will comprise lots and roads for 43 detached dwellings, 17 cluster houses and associated water and energy infrastructure. This will incorporate 526 kW of solar PV generation, 460 kWh of batteries, smart solutions for system control, power quality control, systems for bidirectional energy flow, and grid interaction controls.

Beast Solutions Pty Ltd are engaged by the NEV Power Pty Ltd to provide smart grid design and project management services.

1.2 Scope of Report

For homes in the smart grid to work effectively, there are several technologies that must be installed, and options for additional energy saving technologies. This document summarises the home energy options and provides performance specifications; which can be used as a home design guide. The technologies summarised as are follows:

Mandatory installation technologies

- PV panels.
- Hybrid ready inverters.
- Smart meters.
- Home energy management systems.

Additional energy saving technologies

- Home batteries.
- Heat pump heating / cooling systems.
- Heat pump hot water systems.

The document is intended to be a live document and will be updated as the smart grid design progresses.

2 House Energy Requirements Overview

The mandatory technologies proposed for all free-standing homes and cluster homes are:

1. 3 kW (minimum) of roof mounted photovoltaics. This is broken down into 2 kW for the first bedroom and 1 kW for each additional bedroom. The panels shall be primarily angled to face north east to north west. Following this, mountings angled further to the east and west will be acceptable. South facing installations will be considered on request.
2. A hybrid (battery ready) inverter.
3. A smart meter.
4. A home energy management system capable of turning equipment on / off and optimising generated power, stored power and exported power.

A simplified schematic showing the interconnectivity of these items with the overall smart grid is provided in appendix A.

3 Photovoltaic Panels

As part of developments sustainability mandate, each home will be required to install a 3.0 kW photovoltaic array as a minimum. In the Narara climate, a 3.0 kW photovoltaic array will generate 4,270 kWh / annum. The generated power will feed into the home distribution board, with excess power being sold to the grid or stored in a home battery. Ideally all homes in will be self-sufficient, and therefore the 3.0 kW is a minimum. The system will need to be coupled with a hybrid (battery ready) inverter. The inverter size should be 4.0 kW minimum to allow sufficient battery storage connectivity.

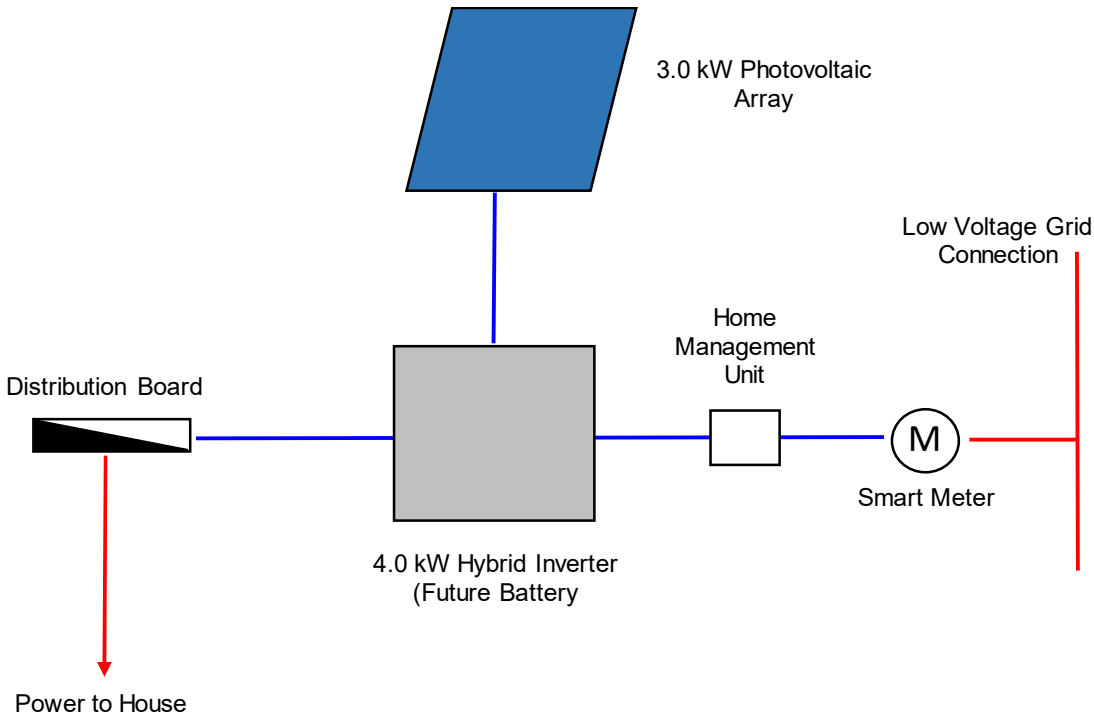


Figure 3.1 – Photovoltaic Schematic

There are several suppliers of photovoltaic panels and a sample performance specification is attached as an appendix to this document. Recommended manufactures of photovoltaic panels include:

- Trina Solar.
- LG Solar.
- Kyocera Solar.
- Mitsubishi Solar.
- Opal Solar.

4 Hybrid Ready Inverters

Hybrid inverters can simultaneously manage inputs from both solar panels and a battery bank, charging batteries with either solar panels or the electricity grid. The inverters generally have an in-built management and control system that can optimise generation, storage and use. The controls can also interface with a home energy management system or site wide smart grid control system.

There are several suppliers of hybrid ready inverters and a sample performance specification is attached as an appendix to this document. Note that the inverters should have a remote reactive power control. Recommended manufactures of hybrid ready inverters include:

- SMA.
- Fronius.
- Solax (does not have a standard remote reactive power control)
- Selectronic.
- ABB.

Figure 4.1 – Typical Hybrid Inverters (Fronius)

5 Smart Meters

A smart meter is an electricity meter that measures and records electrical data at set intervals. They are typically set-up to record data on 15min or 30min intervals and record power use, voltage, current and power quality. The output data can interface with a home energy management system or site wide smart grid control system. This interval data allows better understanding of a home's energy use profile and allows a home energy management system to optimise equipment use. Additionally, the electronic recording of energy data allows for simpler billing especially in cases where power is being imported and exported from the home. It is becoming increasingly more common for home energy management systems to provide smart meter functionality.

There are several suppliers of smart meters, recommended manufactures include:

- Ceta.
- ABB.
- Landis and Gyr.
- GE Energy.
- Schneider.

Figure 5.1 – Typical Smart Meter (Ceta)

6 Home Energy Management Systems (HEMS)

Home energy management systems are multi-function controllers that optimise equipment use within the home. It is becoming increasingly more common for home energy management systems to provide smart meter functionality as well. Home energy management systems can interface with solar inverters, smart meters and wide smart grid control system. A typical home in Narara Ecovillage will include the following home energy management system:

- Central controller with access via an internet connection. This can be a 3G, 4G or landline connection. The internet connection is critical as it allows control data to be sent / received between the home and the smart grid control system.
- Demand management control interface with the following home equipment.
    - Hybrid solar inverter.
    - Smart meter.
    - Hot water system.
    - Heating / cooling (air conditioning) system.
    - Electric vehicle charger (if installed).
- In addition to the above interfaces the home energy management system can also interface with the following home control systems to allow remote access:
    - Lighting control system.
    - Security system.
    - Smart appliances (refrigerators etc).
    - Plugged devices with an infrared interface.

The home energy management system shall operate in a way to minimise import and export of energy from the house *nano* grid. Excess power generated from home PV systems shall be allocated to local loads such as hot water and batteries before export from the building unless requested by the demand management controller and smart grid. There are several suppliers of home energy management systems and a sample performance specification is attached as an appendix to this document. Recommended manufactures of home energy management systems include:

- CarbonTRACK.
- Samsung.
- Panasonic.
- Schneider.

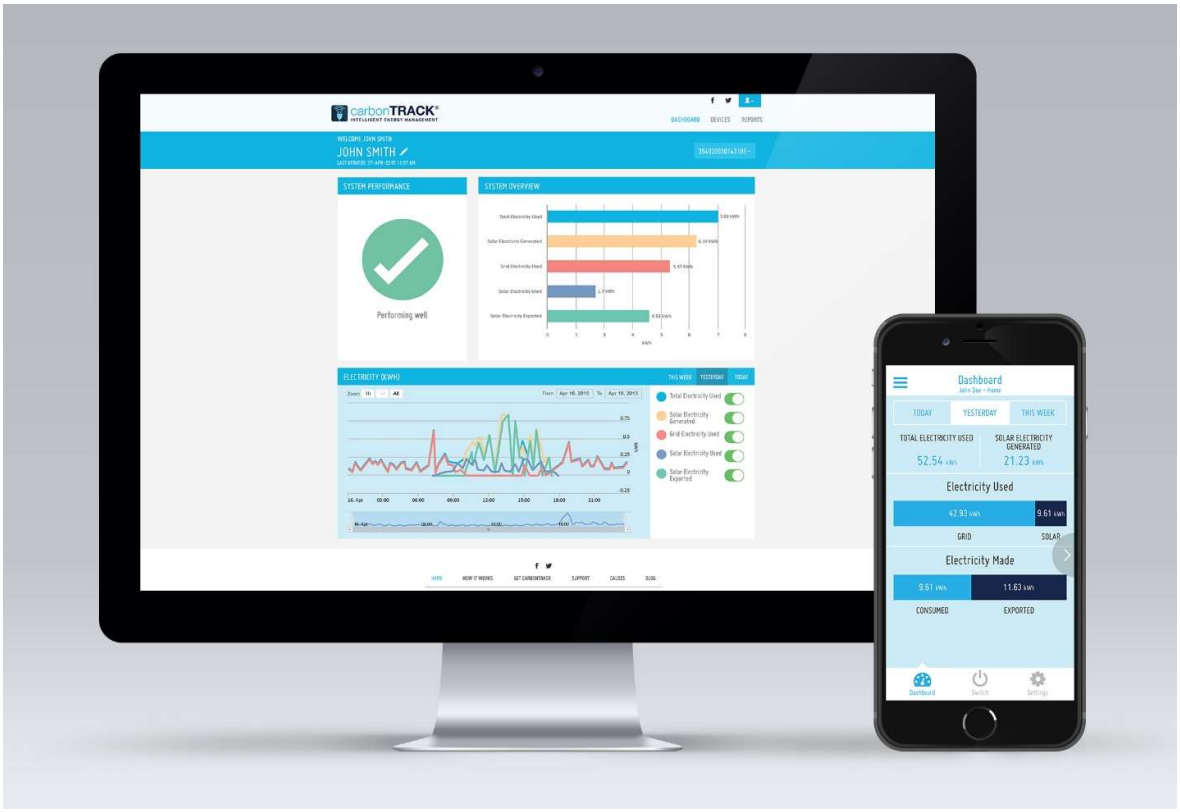


Figure 6.1 – Typical Home Energy Management System (CarbonTRACK)

7 Home Battery Systems

The Narara Ecovillage site will have centralised batteries at the main administration building (B1) and farm square. These centralised batteries will be used to store energy to support central services (water pumping, street lights, etc) when there is no available solar. Batteries can be either A.C. coupled or D.C. coupled, sketches for these options are attached as an appendix to this document. Networked battery and PV systems are also possible, sketches for a network option are also attached as an appendix to this document

Individual homes are encouraged to install batteries to balance the loads within the home environment. While current prices remain high, it is anticipated that battery prices will reduce significantly over the next 2 years as additional products are released. There are several suppliers of battery systems including:

- Lithium Ion.
  - Tesla.
  - LG.
  - Panasonic.
- Zinc Bromide.
  - Redflow.
- Salt Water.
  - Aquion.
- Lead Acid
  - Century Yuasa
  - Panasonic.
  - APC.

Figure 7.1 – Typical Lithium Ion Battery (LG)

A sample performance specification for a lithium Ion battery is attached as an appendix to this document.

8 Heat Recovery Air Source Heat Pump

Air source heat pumps have the ability to use the air as a heat source or a heat sink. With these systems, a reversible refrigeration process is used to generate heated water or chilled water, with the added benefit that the heat rejected through the cooling process can also be used to generate heated water. Electricity is used to drive the heat pump; and these systems have very high energy efficiency ratios even at low ambient conditions (-10 ^{O}C to 0 ^{O}C).

Space heating and cooling is delivered via concealed fan coil units and domestic hot water is stored in an insulated vessel via a heat exchanger with an electric heating element for emergency back-up. There are several suppliers of these systems and a sample performance specification is attached as an appendix to this document.

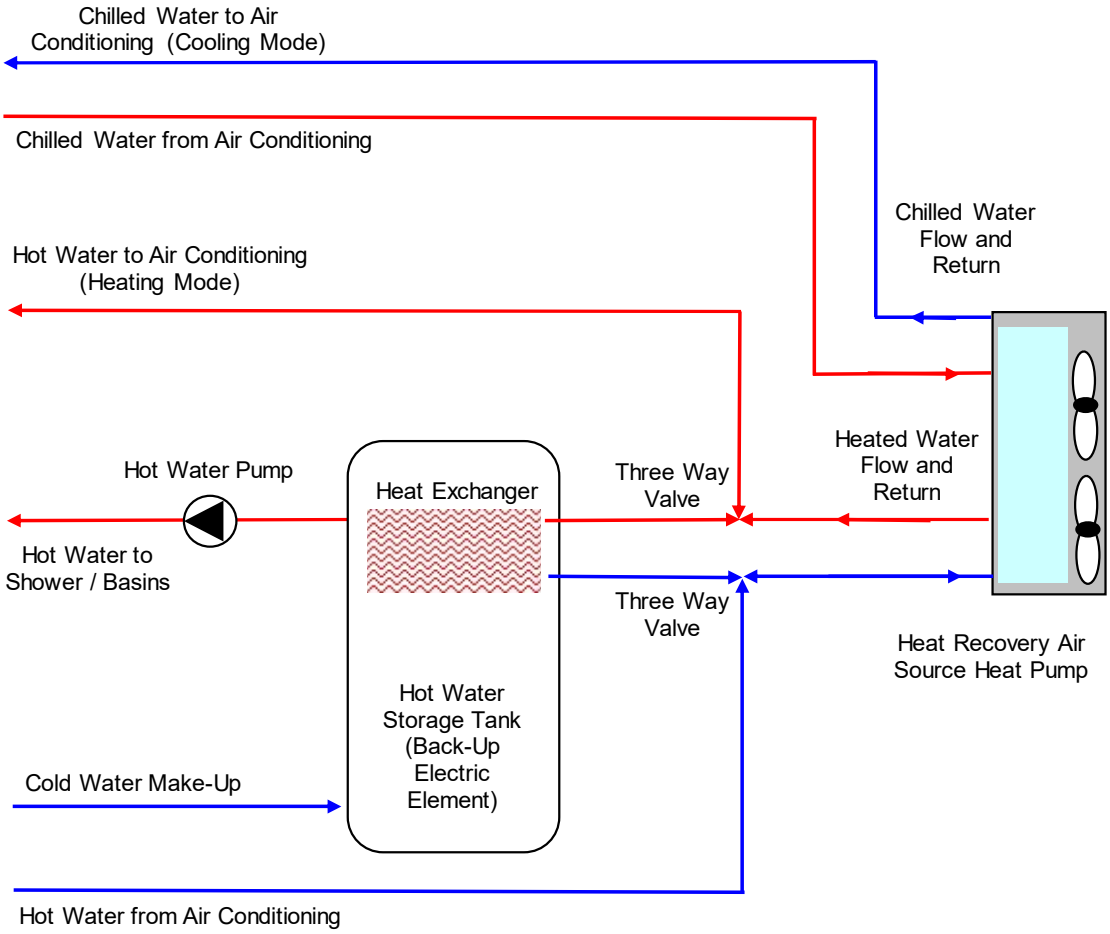


Figure 8.1 – Heat Recovery Air Source Heat Pump Schematic

9 Air Source Heat Pump Heating / Cooling

Air source heat pumps have the ability to use the air as a heat source or a heat sink. For space heating and cooling a reversible refrigeration process is used to generate heated refrigerant or chilled refrigerant. Electricity is used to drive the process; and these systems have high energy efficiency ratios. Space heating and cooling is delivered via concealed refrigerant based fan coil units. However, there is no heat recovery with these systems and therefore they do not generate hot water. There are several suppliers of these systems and a sample performance specification is attached as an appendix to this document.

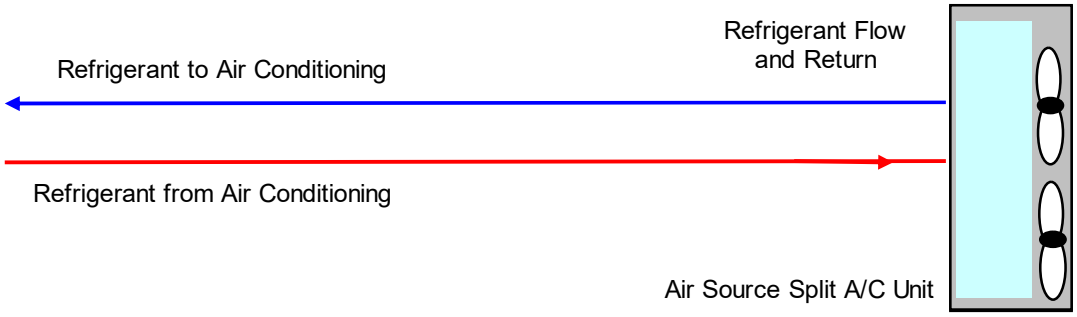


Figure 9.1 –Air Source Heat Pump Schematic

10 Air Source Heat Pump Hot Water

For domestic hot water a refrigeration process is used to generate heated refrigerant. The heated refrigerant is then pumped through a heat exchanger to store domestic hot water. Electricity is used to drive the process; and these systems have high energy efficiency ratios, even at low ambient conditions (-10 ^{O}C to 0 ^{O}C). Domestic hot water is stored in an insulated vessel with an electric heating element for emergency back-up. There are several suppliers of these systems and a sample performance specification is attached as an appendix to this document.

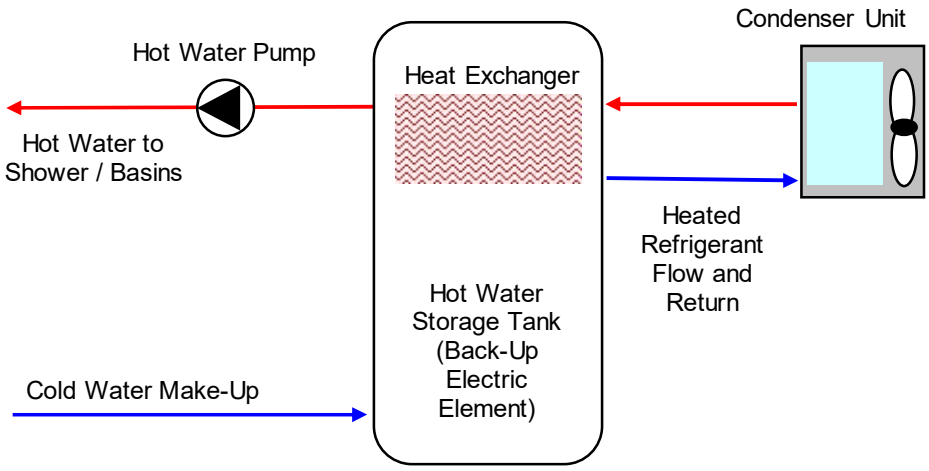
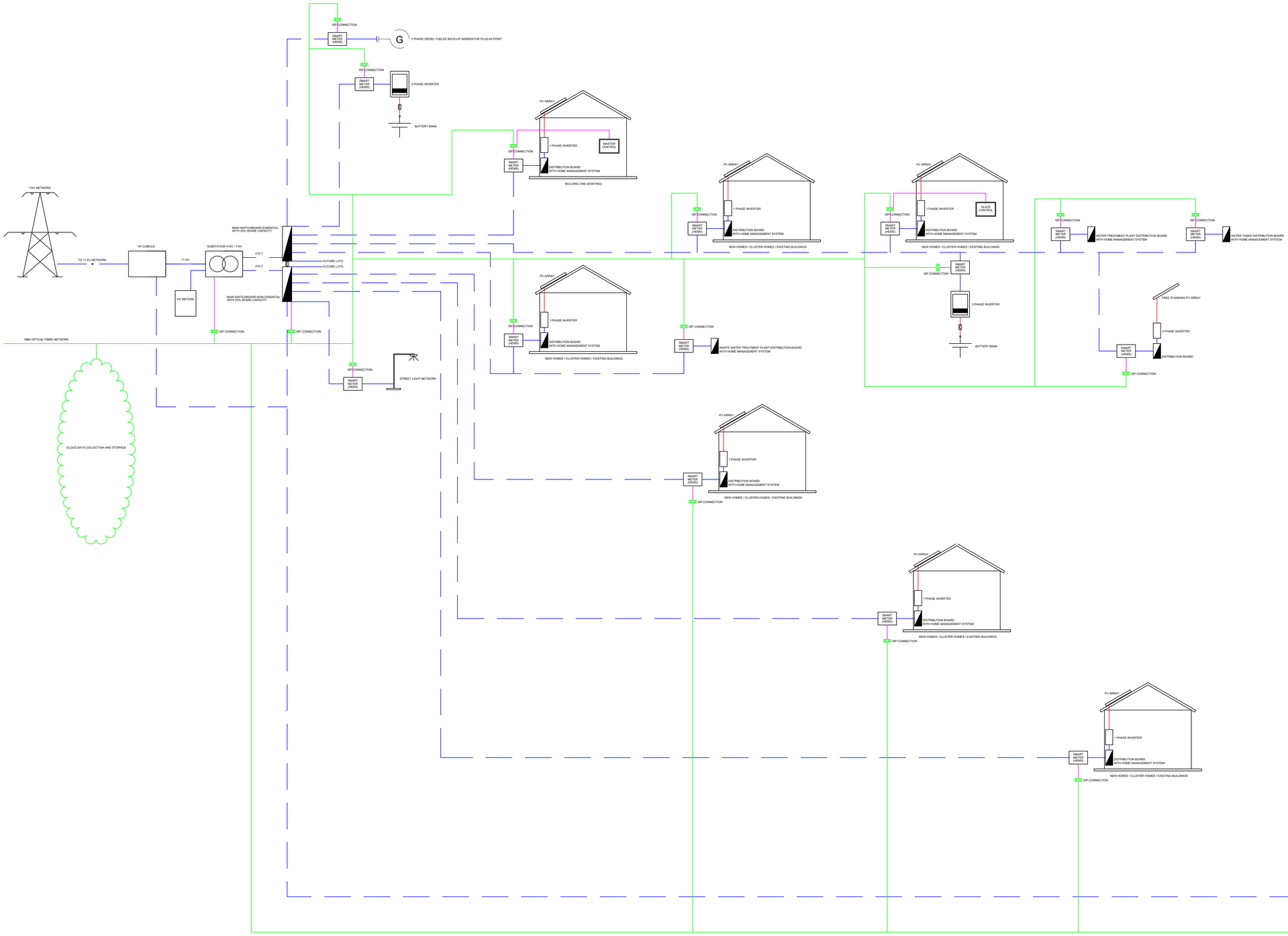


Figure 10.1 – Hot Water Air Source Heat Pump Schematic

11 Appendix A – Simplified Smart Grid Single Line Diagram



Revision notes:

Rev:	Date:	Notes:
1	23/12/2016	TENDER DESIGN
2	05/01/2017	TENDER DESIGN

Drawn by: CHRIS KORNEK

Client: NARARA ECOVILLAGE POWER PTY LTD

Project: NARARA ECOVILLAGE MICRO-GRID

Drawing Title: 01008-E100 CONTROL SCHEMATIC

Date: 05/01/2017

Scale @ A1: NTS

Revision: 2

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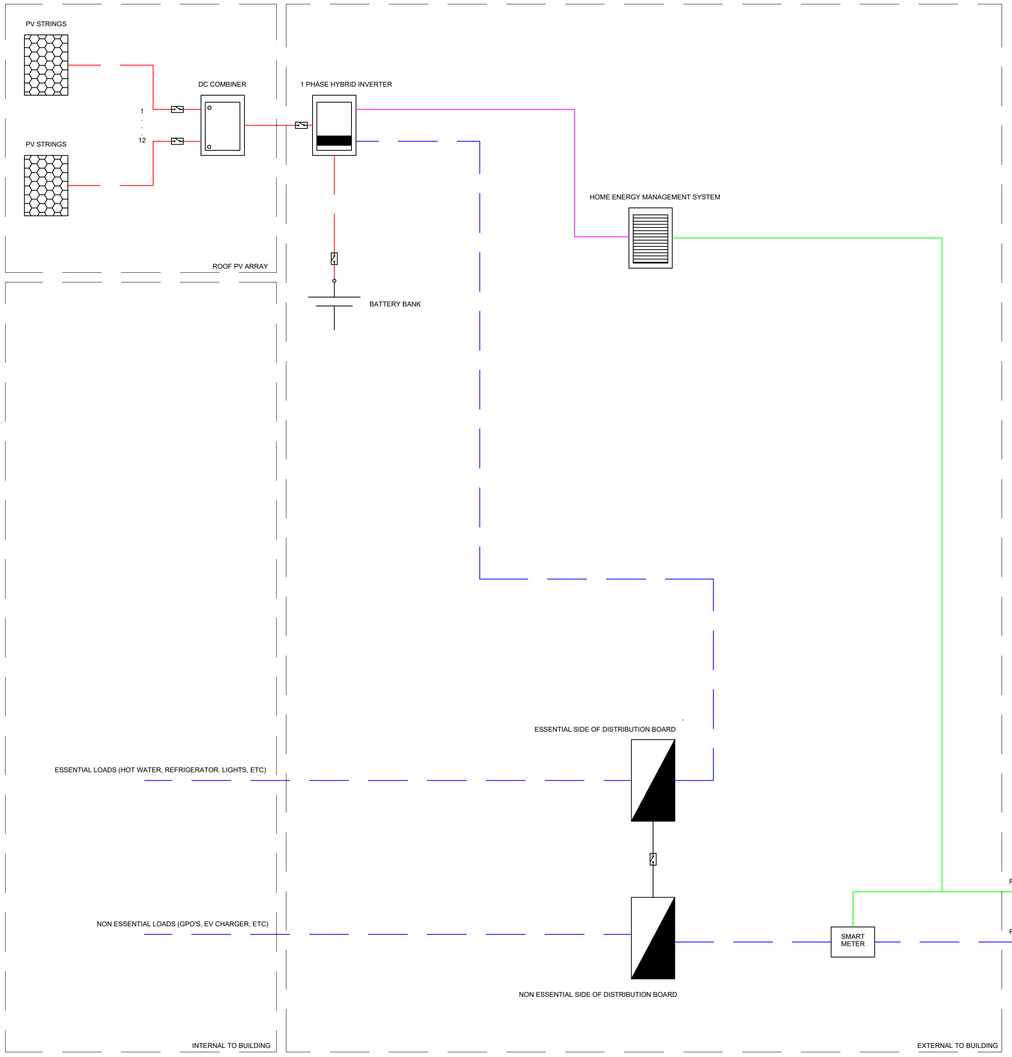
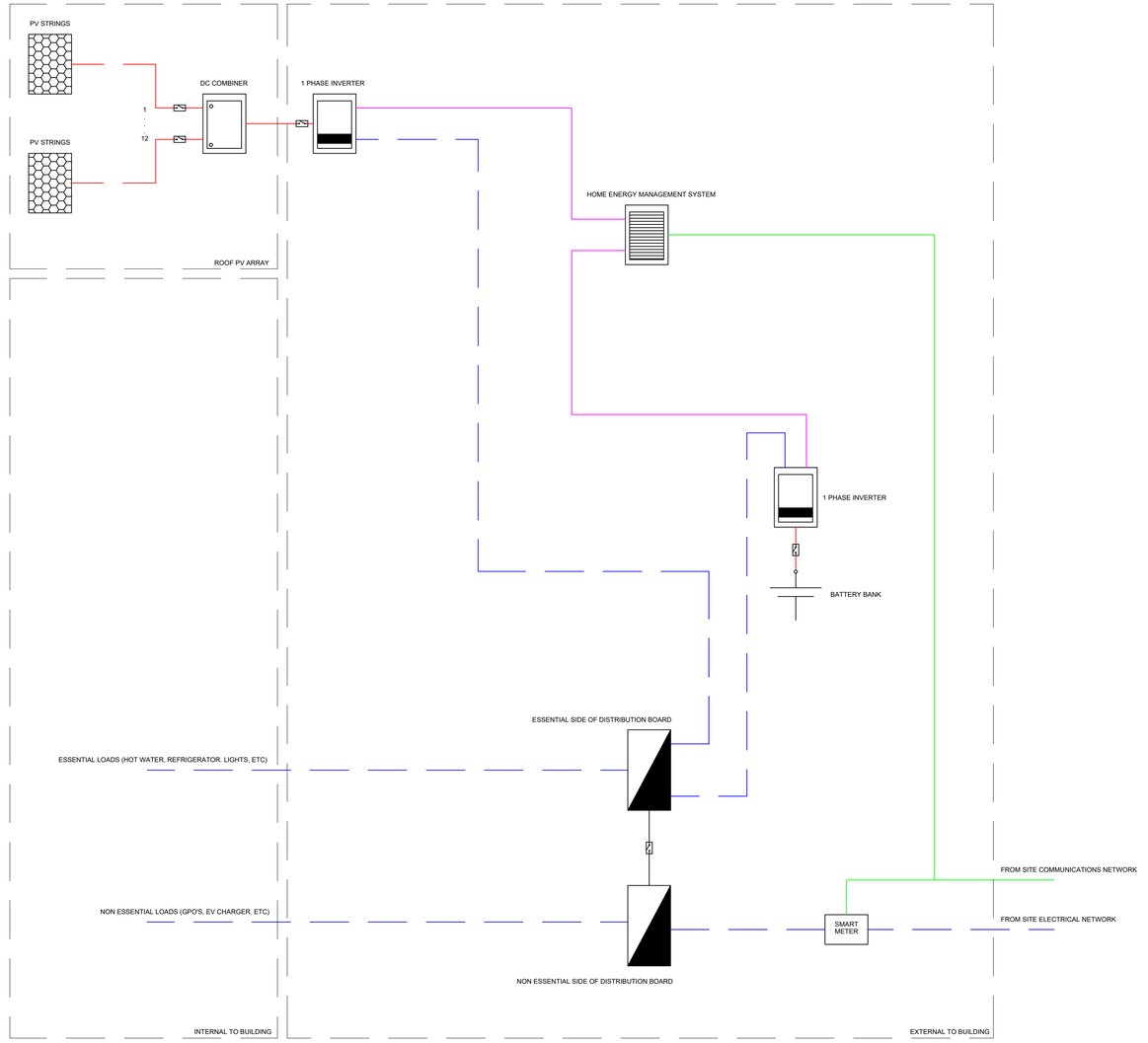
12 Appendix B – Home and Network Battery Drawings

SYMBOL KEY

- DC CABLE
- AC CABLE
- ETHERNET CABLE
- RS485 CABLE
- ISOLATOR
- BATTERY BANK



SIMPLIFIED HOME SYSTEM WITH D.C. COUPLED BATTERY



SIMPLIFIED HOME SYSTEM WITH A.C. COUPLED BATTERY

Revision notes:

Rev:	Date:	Notes:
1	14/11/2016	PRELIMINARY DESIGN

Drawn by: CHRIS KORNEK

Client: NARARA ECOVILLAGE POWER PTY LTD

Project: NARARA ECOVILLAGE MICRO-GRID

Drawing Title: SIMPLIFIED HOME SYSTEMS SINGLE LINE DIAGRAM

Date: 14/11/2016

Scale @ A1: 1:100

Revision: 1

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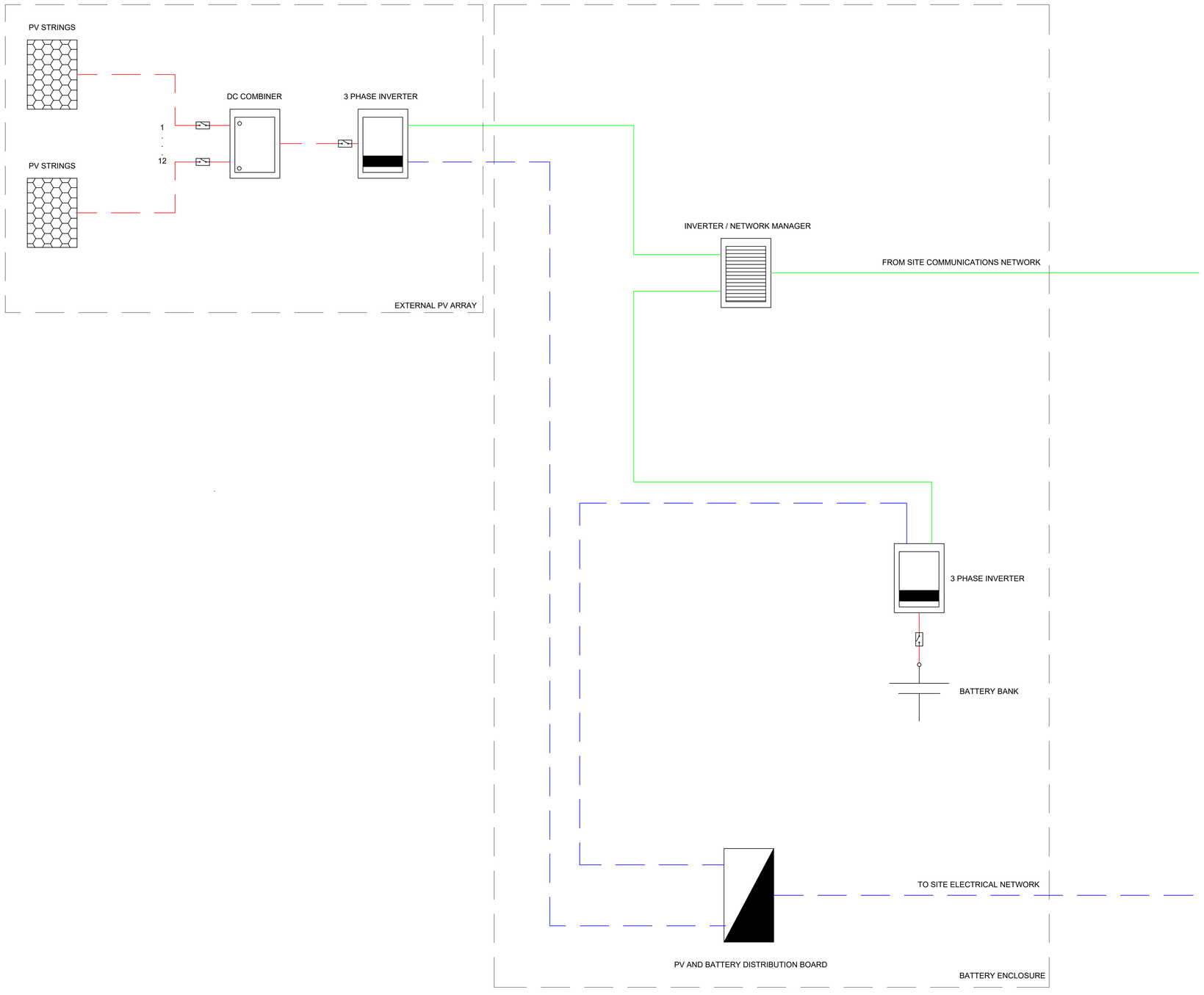

SYMBOL KEY

- DC CABLE
- AC CABLE
- ETHERNET CABLE
- RS485 CABLE
- ISOLATOR
- BATTERY BANK

NETWORK PHOTOVOLTAICS AND BATTERY

Revision notes:

Rev:	Date:	Notes:
1	14/11/2016	PRELIMINARY DESIGN

Drawn by: CHRIS KORNEK

Client: NARARA ECOVILLAGE POWER PTY LTD

Project: NARARA ECOVILLAGE MICRO-GRID

Drawing Title: NETWORK PV AND BATTERY SINGLE LINE DIAGRAM

Date: 14/11/2016

Scale @ A1: 1:100

Revision: 1

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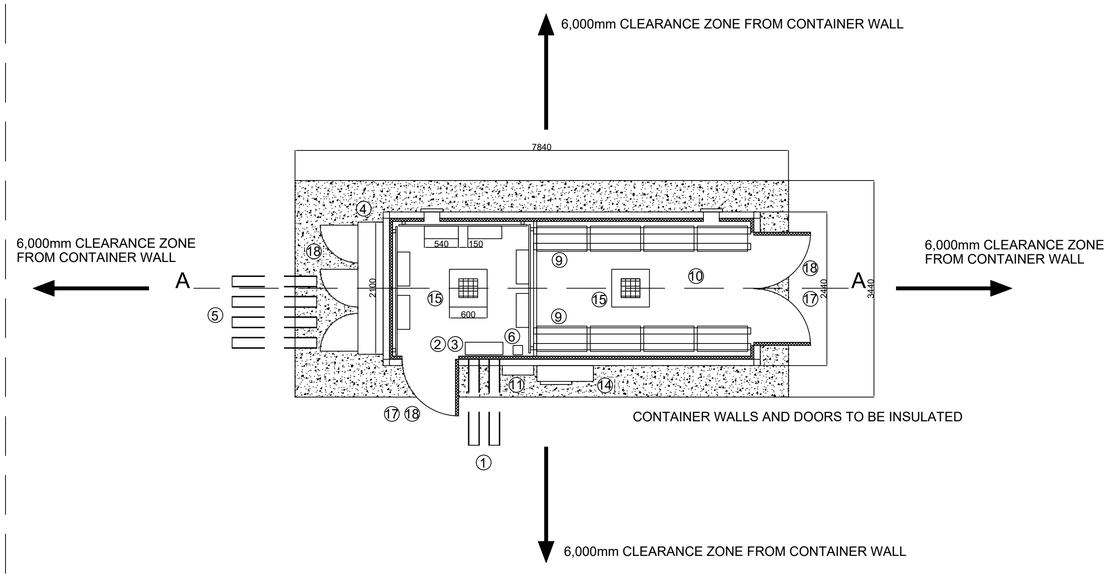
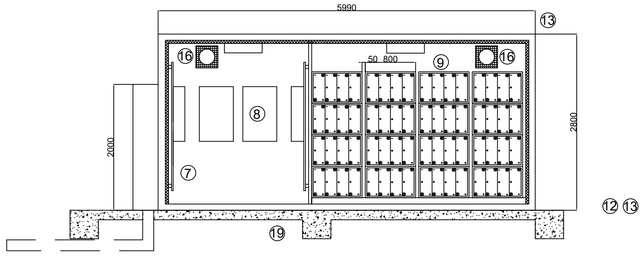
PLAN VIEW



SIDE VIEW (SECTION A - A)



SCALE BAR

NOTES

I. DRAWINGS ARE DIAGRAMMATIC ONLY AND ARE NOT TO BE USED FOR CONSTRUCTION.

II. EQUIPMENT NOISE LEVELS TO BE ASSESSED BY ACOUSTIC ENGINEER FOR COMPLIANCE WITH ALLOWABLE ZONE NOISE LEVELS.

III. ALL CABLE PENETRATIONS TO BE SEALED WITH MASTIC.

1) 2 X 150mm COMMUNICATIONS CONDUITS TO CARRY 6 CORE SINGLE MODE OPTICAL FIBRE AND 12 PAIR COPPER CABLE.

2) 12 RU COMMUNICATIONS CABINET WITH INCOMING FIBRE AND COPPER CONNECTIONS, MEDIA CONVERTER, UPS AND PATCH PANEL. COMMUNICATIONS CONNECTIONS ARE REQUIRED FOR BATTERY AND INVERTER CONTROL SYSTEM, FIRE INDICATOR PANEL AND AIR CONDITIONING PLANT. ALL INTERNAL COMMUNICATIONS CABLE TO BE INSTALLED IN SURFACE MOUNTED CONDUIT.

3) BATTERY AND INVERTER CONTROL PANEL.

4) IP 66 BATTERY MAIN SWITCH BOARD.

5) 4 X 150mm ELECTRICAL CONDUITS CONNECTING TO PV ARRAY AND SITE LOW VOLTAGE NETWORK.

6) EARTH BAR CONNECTED TO EARTH MATT WITH MINIMUM 1 OHM RESISTANCE. BOND ROOF TO EARTH BAR.

7) ALL INTERNAL ELECTRICAL CABLE TO BE INSTALLED IN SURFACE MOUNTED CONDUIT. ALL ELECTRICAL WORK TO MEET AS 3000.

8) 20 kW INVERTERS.

9) 128 V, 115 kWh BATTERY BANK.

10) ALL INTERNAL LIGHTING AND SWITCHBOARD LIGHTING TO MEET AS 3000, AS 2293 AND AS 1680.

11) FIRE INDICATOR PANEL CONNECTED TO FIRE BRIGADE VIA COPPER COMMUNICATIONS CABLE AND RADIO FREQUENCY TRANSMITTER. SMOKE / HEAT DETECTORS AND ALARMS TO MEET AS 1670. PORTABLE FIRE EXTINGUISHERS TO MEET AS 2444.

12) CONDENSATE PUMPS FOR AIR CONDITIONING UNITS TO DRAIN TO LANDSCAPING.

13) ROOF AND CONCRETE HARD STAND TO DRAIN TO LANDSCAPING.

14) REVERSE CYCLE AIR SOURCE HEAT PUMP, WITH PROPRIETARY CONTROL SYSTEM. CONTROL SYSTEM TO FULLY INTERFACE WITH BATTERY AND INVERTER CONTROL SYSTEM.

15) CEILING MOUNTED FAN COIL UNITS.

16) WALL MOUNTED VENTILATION FANS, WITH PROPRIETARY CONTROL SYSTEM. CONTROL SYSTEM TO FULLY INTERFACE WITH BATTERY AND INVERTER CONTROL SYSTEM. VENTILATION SYSTEM TO MEET AS 1668.

17) LOW LEVEL OPENINGS FOR MAKE-UP AIR VIA 600 X 450 DOOR GRILLES TO MEET AS 1668.

18) ALL CONTAINER DOORS AND SWITCHBOARD DOORS TO BE KEYED TO MASTER KEY SET.

19) CONCRETE HARD STAND TO BE DESIGNED BY STRUCTURAL / CIVIL ENGINEER BASED ON SITE GEOTECHNICAL TESTING.

Revision notes:

Rev:	Date:	Notes:
1	14/11/2016	PRELIMINARY DESIGN

Drawn by: CHRIS KORNEK

Client: NARARA ECOVILLAGE POWER PTY LTD

Project: NARARA ECOVILLAGE MICRO-GRID

Drawing Title: 230 kWh BATTERY BANK CONTAINER LAYOUT

Date: 14/11/2016

Scale @ A3: 1:100

Revision: 1

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13 Appendix C – Equipment Performance Specifications

Narara Ecovillage

Revision 1 – 08 November 2016

BEAST SOLUTIONS

Photovoltaic Panel – Specification Sheet

Standards

- National Construction Code (Building Code of Australia)
- AS/NZS 3000 Electrical Wiring Rules

Requirement

Provide from a manufacturer with certified rating data a factory assembled tier one, mono-crystalline or poly-crystalline photovoltaic panel complete with junction box, name plate, grounding connection, fixing points and drainage holes.

Warranty

Provide 10-year factory product warranty and 25-year factory performance warranty.

Efficiency

Minimum efficiency = 15.0 % (at 1,000 W/m^2 irradiance and 25 ^{O}C cell temperature).

Construction

Glass:	3.2mm thick, high transmission, AR coated tempered glass.
Frame:	Silver anodized aluminium alloy.
Junction Box:	IP 67 rated.
Cables:	4.00 mm^2 cross section area, 1,000 mm length.
Connector:	MC4 compatible.
Seals:	Water proof silicon.

Performance Parameters

Wind load:	2,400 Pa.
Hail:	35mm hail stones at 97 km/h.
Temperature:	-40 ^{O}C to 85 ^{O}C (ambient).
Voltage:	1,000 V DC (maximum).
Current:	15 A (maximum series circuit breaker rating).

Narara Ecovillage

Revision 1 – 08 November 2016

BEAST SOLUTIONS

Inverter – Specification Sheet

Standards

- National Construction Code (Building Code of Australia)
- AS/NZS 3000 Electrical Wiring Rules
- AS 4777 Grid Connection of Energy Systems via Inverters

Requirement

Provide from a manufacturer with certified rating data a factory assembled transformer less DC / AC inverter complete with battery connections, protective devices, junction boxes, name plate, grounding connection, fixing points, communications connections and interactive display.

Warranty

Provide 5-year factory warranty.

Efficiency

Minimum efficiency = 95.0 %.

Construction

Protection: IP 65 rated.

Housing: Weather proof / sun resistant polymer.

Seals: Water proof silicon.

Protective Devices:

The unit shall be factory fitted with the following protective devices:

- Input side disconnection points.
- Ground fault monitoring.
- Grid monitoring.
- DC reverse polarity protection.
- AC short-circuit current capability.
- All-pole sensitive residual current monitoring unit.

Performance Parameters

Input voltage: 125 V (minimum) – 750 V (maximum).

Input current: 15 A (maximum).

AC frequency: 50 Hz ± 5 Hz.

Output voltage: 220 V (minimum) – 240 V (maximum).

Output current: 16 A (maximum), single phase.

Temperature: - 25 ^{O}C to 60 ^{O}C.

DC connections: spring cage terminal.

AC connections: spring cage terminal.

Display: Graphic LED or LCD.

Communications: Ethernet RJ45 connection or wireless.

Control

The unit shall be supplied with a complete DC / AC control system cable of power management and full management of the photovoltaic array, battery storage system and single phase AC connection to the electrical distribution network.

Narara Ecovillage

Revision 1 – 08 November 2016

BEAST SOLUTIONS

Demand Management System – Specification Sheet

Standards

- National Construction Code (Building Code of Australia)
- AS/NZS 3000 Electrical Wiring Rules

Requirement

Provide from a manufacturer with certified rating data a factory assembled demand management system complete with protective devices, voltage sensors, current sensors, relays and communications connections.

Warranty

Provide 2-year factory warranty.

Construction

Protection: IP 65 rated.

Housing: Weather proof / sun resistant polymer.

Seals: Water proof silicon.

Performance Parameters

Single phase and three phase power configuration control.

Voltage sensor: 85 – 264 V line to neutral or line to line AC voltage sensing.

Current sensor: 60 A.

Relay: 12 VCD control port voltage.

200 mA maximum relay current draw.

Voltage: 100 V (minimum) – 240 V (maximum).

Temperature: - 20 ^{O}C to 55 ^{O}C.

Communications: Ethernet RJ45 connection, wireless or 3G.

Compatibility: Z-Wave, Zigbee or GSM.

Control

The unit shall be supplied with a complete programmable control system cable of power management and full management of the photovoltaic array, battery, inverter and AC connection to the electrical distribution network. The unit shall also be capable of controlling any device that operates on one of the matching compatibility protocols.

Narara Ecovillage

Revision 1 – 08 November 2016

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Battery – Specification Sheet

Standards

- National Construction Code (Building Code of Australia)
- AS/NZS 3000 Electrical Wiring Rules
- AS 3100 Approval and Testing of Electrical Equipment
- AS 4777 Grid Connection of Energy Systems via Inverters

Requirement

Provide from a manufacturer with certified rating data a factory assembled Lithium Ion (Lithium Manganese Oxide) battery complete with junction box, name plate, grounding connection, fixing points and control system.

Warranty

Provide 5-year factory product warranty and 10-year factory performance warranty.

Efficiency

Minimum efficiency = 80.0 %

Construction

Protection: IP 65 rated.

Housing: Weather proof / sun resistant polymer.

Seals: Water proof silicon.

Protective Devices:

The unit shall be factory fitted with the following protective devices:

- Input side disconnection points.
- Ground fault monitoring.
- DC reverse polarity protection.
- All-pole sensitive residual current monitoring unit.

Performance Parameters

Input voltage: 125 V (minimum) – 750 V (maximum).

Input current: 15 A (maximum).

Output voltage: 125 V (minimum) – 750 V (maximum).

Output current: 15 A (maximum).

Temperature: - 10 ^{O}C to 40 ^{O}C.

DC connections: spring cage terminal.

Display: Graphic LED or LCD.

Communications: Ethernet RJ45 connection or wireless.

Control

The unit shall be supplied with a complete DC control system cable of power management.

Narara Ecovillage

Revision 1 – 08 November 2016

BEAST SOLUTIONS

Reverse Cycle Air Source Heat Pump / Energy Recovery – Specification Sheet

Standards

- National Construction Code (Building Code of Australia)
- AS/NZS 3000 Electrical Wiring Rules
- AS 1677 Refrigerating Systems –Safety Requirements for Fixed Applications
- AS/NZS 3823 Performance of electrical appliances - Air conditioners and heat pumps

Requirement

Provide air cooled, reverse cycle split type multi-unit heat pump system, consisting of a singular condensing unit connected to multiple fan coil units, each having the capability of individual set point control, centred on one refrigerant circuit.

Warranty

Provide 5-year factory warranty.

Efficiency

Energy efficiency ratio cooling = 2.8 (at 35 ^{O}C and 50% RH ambient conditions).

Energy efficiency ratio heating = 3.2 (at 5 ^{O}C and 80% RH ambient conditions).

Energy efficiency ratio energy recovery = 6.7 (at 35 ^{O}C and 50% RH ambient conditions).

Ambient Conditions

Indoor and outdoor (condensing) units shall be capable of operating within a wide range of ambient temperatures. Select condensing units to provide cooling within an ambient range of -5°C DB to 43°C DB, and heating in the range -10°C DB to 15°C DB. Achieve this by automatic control of compressor motor frequency, head pressure control (by varying fan speeds) and hot gas bypass.

Heat Recovery System

Utilise a heat recovery system such that individual indoor units may cool or heat independently of other indoor units connected to the same system and that waste heat can be directed to an independent heat exchanger for domestic hot water heating.

Indoor Fan Coil Units

Provide indoor units with the following:

Electronic Expansion Valve: Fit each fan coil unit with an electronic proportional expansion valve which controls the refrigerant flow in response to the load variations in the room. The electronic proportional expansion valve is to be controlled via a computerised PID control sensing the return air temperature,

refrigerant inlet and outlet temperatures. During the cooling operation the electronic expansion valve linearly controls the refrigerant superheat degree at the evaporator.

Indoor Unit Fans: Direct driven of the DWDI multi-blade type, statically and dynamically balanced to ensure low noise and vibration free operation.

Coils: Direct expansion, constructed from copper tubes expanded into aluminium fins to form a mechanical bond.

Supply Air Discharge Louvres: Provide auto swing of the supply air louvres for cassette and under ceiling type fan coil units capable of providing continuous swing operation or fixed in any direction as required.

Radiant Heat Control: Incorporated as standard for cassette and under ceiling type and capable of automatically raising the thermostat set point during the heating mode on detection of radiated cold from walls, windows and floors, to ensure stable and even heat distribution in the rooms.

Unit Control Board: Include in the fan coil unit a printed circuit board complete with power input fusing, address switches for a variety of operation controls, emergency operation switch and fault/operation indication LED's. Thermally protect fan motors.

Unit Casing: Fully insulate the fan coil unit casing (ceiling mounted units) and seal to prevent condensation.

Condensate Drain: Install a 25mm condensate drain pipe from each fan coil unit to the nearest waste. Insulate condensate pipes.

Unit Control: In case of individual and group control, set the addresses of each fan coil unit automatically by the system to minimise commissioning time. In case of centralised control, set the addresses by the liquid crystal remote controller. Dip and rotary switches are not acceptable.

Condensing Units

Provide fully weatherproofed, factory assembled and pre-wired with all necessary electronic and refrigerant controls. Construct the casing from mild steel panels coated with a baked enamel finish. Provide the condenser coil with a corrosion resistant finish.

Sound Pressure Level: Not to exceed 57 dBA measured horizontally one metre away from the unit and 1.5m above ground level.

Modular Design: Allow for side by side installation, by the modular design of the condensing units.

Fan Motor Speed Control: Provide multiple speed control to fan motors operation to maintain constant head pressure control in all ambient temperatures and modes of operation. Use fan motors of high static resistance type of 30Pa as standard.

Drain Tray (Field Installed): Provide each outdoor unit with a field supplied condensate tray of galvanised sheet steel construction. Connect the condensate tray with the nearest floor waste with a 25mm (min.) drain.

Compressors: Provide highly efficient hermetic scroll type compressors. Provide the inverter compressor with electronic controls, capable of changing speed to follow the variations in cooling and/or heating loads, using a HIDECS/R circuit (Hi Inverter Drive and Electronic Control System Recovery). Provide inverter control together with independent multi variable PID (Proportional Integrated Derivative) control for precise monitoring of status of the system. For efficiency and quietness provide IGBT (Insulated Gate Bipolar Transistor) type inverters.

Heat Exchanger: Construct the heat exchanger from HI-X (rifle bore), seamless copper tubes mechanically bonded to aluminium fins to form a cross fin coil. Treat the aluminium fins with an anti-corrosion resin film.

Refrigerant Circuit: Complete the refrigeration circuit of the condensing unit with refrigeration compressors, motors, fans, condenser coils, electronic expansions valve, solenoid valves, 4 way valve, distribution headers,

capillaries, filters, shut off valves, service ports, receivers and accumulators and all other components which are essential for safe and satisfactory operation.

Safety Devices: Provide the following safety devices as a part of the outdoor unit: High pressure switch, fuses, crankcase heater, fusible plug, over current protector for inverter and short re-cycling guard timer.

Oil Recovery: Equip the units with an oil recovery system to ensure stable operation for systems with long refrigerant piping. Operate the oil recovery system after the first hour of operation and then every consecutive eight hours of operation. Also fit high efficiency oil separators to the discharge side of the compressor together with an oil equalisation system.

Selection Switches: Fit the condensing unit printed circuit board (PCB) with selection switches for the length of pipework, ambient range selection, emergency operation switches and service mode switches, together with LED indications for the number of fan coil units connected, frequency status and operation/fault indication.

Control

Use computerised PID control to maintain a correct room temperature. For the fan coil units incorporate an on/off switch, fan speed selector, thermostat setting and liquid crystal display which indicates temperature setting, operational mode, malfunction codes and filter clean reminder.

Fan-Coil Control: Accomplish by the use of individual controllers for each fan coil unit. The individual controllers to be capable of controlling a maximum of 16 fan coil units as a group.

Fault Diagnosis: Equip the system with a self-diagnostic function for quick and easy maintenance and service. Retain the most recent malfunction code for easy maintenance.

Automatic Changeover Cool/Heat: Provide automatic changeover from heating to cooling (and vice versa) of the invertor and heat recovery system as a result of demand from the fan coil units. Provide as part of the systems control logic.

Master Unit Control Cool/Heat: Accomplish changeover of the inverter system by the appointment of a master fan coil unit in each system. This master fan coil unit shall determine the operating mode of that system.

Selector Switch Changeover Cool/Heat: Accomplish changeover of the inverter system by the use of a selector switch for each system.

Multi Function Centralised Controllers

Supply and install a Multi Function Centralised controller as scheduled or indicated on the drawings capable of controlling up to 64 zones or groups (each group consisting of up to 16 fan coil units). Functions available from the centralised controllers include:

- Temperature setting for each zone, group or fan coil unit.
- Group on/off control.
- Indication of operating condition.
- Select one of ten operation codes.

Control Wiring: Wire the controller by a non-polar two wire transmission cable, to a maximum length of 200m.

Refrigerant

Factory assemble and test both the fan coil unit and condensing unit. Charge with refrigerant at the factory. Weigh in additional refrigerant on site. Clearly label each condenser and fan coil unit with appropriate labels and numbering system. The unit shall operate using one of the following refrigerants: R134a / R410a / R407c.

Refrigeration Piping Distance Limits

Refrigerant piping runs up to 40m between the condensing unit and fan coil units with 15m level difference without any oil traps or double risers are permitted.

Branch Selector Unit

Supply and install branch selector unit boxes to the manufacturer's specifications. Utilise the branch selector (BS) units whenever individual simultaneous heating and cooling is required. Select each BS unit for controlling a maximum of six fan coil units.

Solenoid Valve Control: Provide each with two solenoid valves which are opened by a signal to cool or heat from the remote controller. Provide a temperature differential switch to set the heating/cooling set point band between 0-7K, on the branch selector PCB.

Factory Assembly: Provide branch selector units completely pre-wired and pre-piped and internally insulated.

Narara Ecovillage

Revision 1 – 08 November 2016

BEAST SOLUTIONS

Reverse Cycle Air Source Heat Pump – Specification Sheet

Standards

- National Construction Code (Building Code of Australia)
- AS/NZS 3000 Electrical Wiring Rules
- AS 1677 Refrigerating Systems –Safety Requirements for Fixed Applications
- AS/NZS 3823 Performance of electrical appliances - Air conditioners and heat pumps

Requirement

Provide air cooled, reverse cycle split type multi-unit heat pump system, consisting of a singular condensing unit connected to multiple fan coil units, each having the capability of individual set point control, centred on one refrigerant circuit.

Warranty

Provide 5-year factory warranty.

Efficiency

Energy efficiency ratio cooling = 2.8 (at 35 ^{O}C and 50% RH ambient conditions).

Energy efficiency ratio heating = 3.2 (at 5 ^{O}C and 80% RH ambient conditions).

Ambient Conditions

Indoor and outdoor (condensing) units shall be capable of operating within a wide range of ambient temperatures. Select condensing units to provide cooling within an ambient range of -5°C DB to 43°C DB, and heating in the range -10°C DB to 15°C DB. Achieve this by automatic control of compressor motor frequency, head pressure control (by varying fan speeds) and hot gas bypass.

Indoor Fan Coil Units

Provide indoor units with the following:

Electronic Expansion Valve: Fit each fan coil unit with an electronic proportional expansion valve which controls the refrigerant flow in response to the load variations in the room. The electronic proportional expansion valve is to be controlled via a computerised PID control sensing the return air temperature, refrigerant inlet and outlet temperatures. During the cooling operation the electronic expansion valve linearly controls the refrigerant superheat degree at the evaporator.

Indoor Unit Fans: Direct driven of the DWDI multi-blade type, statically and dynamically balanced to ensure low noise and vibration free operation.

Coils: Direct expansion, constructed from copper tubes expanded into aluminium fins to form a mechanical bond.

Supply Air Discharge Louvres: Provide auto swing of the supply air louvres for cassette and under ceiling type fan coil units capable of providing continuous swing operation or fixed in any direction as required.

Radiant Heat Control: Incorporated as standard for cassette and under ceiling type and capable of automatically raising the thermostat set point during the heating mode on detection of radiated cold from walls, windows and floors, to ensure stable and even heat distribution in the rooms.

Unit Control Board: Include in the fan coil unit a printed circuit board complete with power input fusing, address switches for a variety of operation controls, emergency operation switch and fault/operation indication LED's. Thermally protect fan motors.

Unit Casing: Fully insulate the fan coil unit casing (ceiling mounted units) and seal to prevent condensation.

Condensate Drain: Install a 25mm condensate drain pipe from each fan coil unit to the nearest waste. Insulate condensate pipes.

Unit Control: In case of individual and group control, set the addresses of each fan coil unit automatically by the system to minimise commissioning time. In case of centralised control, set the addresses by the liquid crystal remote controller. Dip and rotary switches are not acceptable.

Condensing Units

Provide fully weatherproofed, factory assembled and pre-wired with all necessary electronic and refrigerant controls. Construct the casing from mild steel panels coated with a baked enamel finish. Provide the condenser coil with a corrosion resistant finish.

Sound Pressure Level: Not to exceed 57 dBA measured horizontally one metre away from the unit and 1.5m above ground level.

Modular Design: Allow for side by side installation, by the modular design of the condensing units.

Fan Motor Speed Control: Provide multiple speed control to fan motors operation to maintain constant head pressure control in all ambient temperatures and modes of operation. Use fan motors of high static resistance type of 30Pa as standard.

Drain Tray (Field Installed): Provide each outdoor unit with a field supplied condensate tray of galvanised sheet steel construction. Connect the condensate tray with the nearest floor waste with a 25mm (min.) drain.

Compressors: Provide highly efficient hermetic scroll type compressors. Provide the inverter compressor with electronic controls, capable of changing speed to follow the variations in cooling and/or heating loads, using a HIDECS/R circuit (Hi Inverter Drive and Electronic Control System Recovery). Provide inverter control together with independent multi variable PID (Proportional Integrated Derivative) control for precise monitoring of status of the system. For efficiency and quietness provide IGBT (Insulated Gate Bipolar Transistor) type inverters.

Heat Exchanger: Construct the heat exchanger from HI-X (rifle bore), seamless copper tubes mechanically bonded to aluminium fins to form a cross fin coil. Treat the aluminium fins with an anti-corrosion resin film.

Refrigerant Circuit: Complete the refrigeration circuit of the condensing unit with refrigeration compressors, motors, fans, condenser coils, electronic expansions valve, solenoid valves, 4 way valve, distribution headers, capillaries, filters, shut off valves, service ports, receivers and accumulators and all other components which are essential for safe and satisfactory operation.

Safety Devices: Provide the following safety devices as a part of the outdoor unit: High pressure switch, fuses, crankcase heater, fusible plug, over current protector for inverter and short re-cycling guard timer.

Oil Recovery: Equip the units with an oil recovery system to ensure stable operation for systems with long refrigerant piping. Operate the oil recovery system after the first hour of operation and then every consecutive

eight hours of operation. Also fit high efficiency oil separators to the discharge side of the compressor together with an oil equalisation system.

Selection Switches: Fit the condensing unit printed circuit board (PCB) with selection switches for the length of pipework, ambient range selection, emergency operation switches and service mode switches, together with LED indications for the number of fan coil units connected, frequency status and operation/fault indication.

Control

Use computerised PID control to maintain a correct room temperature. For the fan coil units incorporate an on/off switch, fan speed selector, thermostat setting and liquid crystal display which indicates temperature setting, operational mode, malfunction codes and filter clean reminder.

Fan-Coil Control: Accomplish by the use of individual controllers for each fan coil unit. The individual controllers to be capable of controlling a maximum of 16 fan coil units as a group.

Fault Diagnosis: Equip the system with a self-diagnostic function for quick and easy maintenance and service. Retain the most recent malfunction code for easy maintenance.

Automatic Changeover Cool/Heat: Provide automatic changeover from heating to cooling (and vice versa) of the invertor and heat recovery system as a result of demand from the fan coil units. Provide as part of the systems control logic.

Master Unit Control Cool/Heat: Accomplish changeover of the inverter system by the appointment of a master fan coil unit in each system. This master fan coil unit shall determine the operating mode of that system.

Selector Switch Changeover Cool/Heat: Accomplish changeover of the inverter system by the use of a selector switch for each system.

Multi Function Centralised Controllers

Supply and install a Multi Function Centralised controller as scheduled or indicated on the drawings capable of controlling up to 64 zones or groups (each group consisting of up to 16 fan coil units). Functions available from the centralised controllers include:

- Temperature setting for each zone, group or fan coil unit.
- Group on/off control.
- Indication of operating condition.
- Select one of ten operation codes.

Control Wiring: Wire the controller by a non-polar two wire transmission cable, to a maximum length of 200m.

Refrigerant

Factory assemble and test both the fan coil unit and condensing unit. Charge with refrigerant at the factory. Weigh in additional refrigerant on site. Clearly label each condenser and fan coil unit with appropriate labels and numbering system. The unit shall operate using one of the following refrigerants: R134a / R410a / R407c.

Refrigeration Piping Distance Limits

Refrigerant piping runs up to 40m between the condensing unit and fan coil units with 15m level difference without any oil traps or double risers are permitted.

Narara Ecovillage

Revision 1 – 08 November 2016

BEAST SOLUTIONS

Reverse Cycle Air Source Heat Pump Hot Water Unit – Specification Sheet

Standards

- National Construction Code (Building Code of Australia)
- AS/NZS 3000 Electrical Wiring Rules
- AS 1677 Refrigerating Systems –Safety Requirements for Fixed Applications
- AS/NZS 3823 Performance of electrical appliances - Air conditioners and heat pumps
- AS/NZS 3500 Plumbing and Drainage

Requirement

Provide air source heat pump system, consisting of a singular condensing unit connected to a single hot water storage tank, having the capability of individual set point control, centred on one refrigerant circuit.

Warranty

Provide 5-year factory warranty.

Efficiency

Energy efficiency ratio heating = 3.8 (at 5 ^{O}C and 80% RH ambient conditions).

Ambient Conditions

The outdoor (condensing) unit shall be capable of operating within a wide range of ambient temperatures. Select condensing unit to provide heating in the range -10°C DB to 40°C DB. Achieve this by automatic

Condensing Units

Provide fully weatherproofed, factory assembled and pre-wired with all necessary electronic and refrigerant controls. Construct the casing from mild steel panels coated with a baked enamel finish. Provide the condenser coil with a corrosion resistant finish.

Sound Pressure Level: Not to exceed 57 dBA measured horizontally one metre away from the unit and 1.5m above ground level.

Fan Motor Speed Control: Provide multiple speed control to fan motors operation to maintain constant head pressure control in all ambient temperatures and modes of operation. Use fan motors of high static resistance type of 30Pa as standard.

Drain Tray (Field Installed): Provide each outdoor unit with a field supplied condensate tray of galvanised sheet steel construction. Connect the condensate tray with the nearest floor waste with a 25mm (min.) drain.

Compressors: Provide highly efficient hermetic scroll type compressors. Provide the inverter compressor with electronic controls, capable of changing speed to follow the variations in cooling and/or heating loads, using a HIDECS/R circuit (Hi Inverter Drive and Electronic Control System Recovery). Provide inverter control together

with independent multi variable PID (Proportional Integrated Derivative) control for precise monitoring of status of the system. For efficiency and quietness provide IGBT (Insulated Gate Bipolar Transistor) type inverters.

Heat Exchanger: Construct the heat exchanger from HI-X (rifle bore), seamless copper tubes mechanically bonded to aluminium fins to form a cross fin coil. Treat the aluminium fins with an anti-corrosion resin film.

Refrigerant Circuit: Complete the refrigeration circuit of the condensing unit with refrigeration compressors, motors, fans, condenser coils, electronic expansions valve, solenoid valves, 4 way valve, distribution headers, capillaries, filters, shut off valves, service ports, receivers and accumulators and all other components which are essential for safe and satisfactory operation.

Safety Devices: Provide the following safety devices as a part of the outdoor unit: High pressure switch, fuses, crankcase heater, fusible plug, over current protector for inverter and short re-cycling guard timer.

Oil Recovery: Equip the units with an oil recovery system to ensure stable operation for systems with long refrigerant piping. Operate the oil recovery system after the first hour of operation and then every consecutive eight hours of operation. Also fit high efficiency oil separators to the discharge side of the compressor together with an oil equalisation system.

Selection Switches: Fit the condensing unit printed circuit board (PCB) with selection switches for the length of pipework, ambient range selection, emergency operation switches and service mode switches, together with LED indications for the number of fan coil units connected, frequency status and operation/fault indication.

Control

Use computerised PID control to maintain a correct water temperature.

Fault Diagnosis: Equip the system with a self-diagnostic function for quick and easy maintenance and service. Retain the most recent malfunction code for easy maintenance.

Refrigerant

Factory assemble and test the condensing unit. Charge with refrigerant at the factory. Weigh in additional refrigerant on site. Clearly label each condenser and fan coil unit with appropriate labels and numbering system. The unit shall operate using one of the following refrigerants: R134a / R410a / R407c.

Refrigeration Piping Distance Limits

Refrigerant piping runs up to 20m between the condensing unit and hot water storage tank with 5m level difference without any oil traps or double risers are permitted.

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