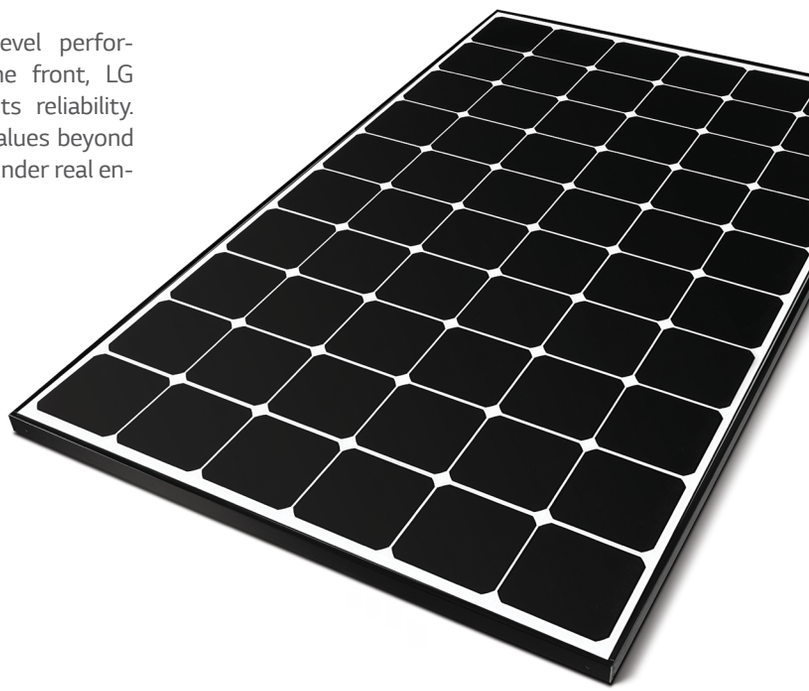
LG NeON® R

60

LG365Q1C-A5 | LG360Q1C-A5 | LG355Q1C-A5 | LG350Q1C-A5

365W | 360W | 355W | 350W

LG NeON® R is new powerful product with global top level performance. Applied new cell structure without electrodes on the front, LG NeON® R maximized the utilization of light and enhanced its reliability. LG NeON® R demonstrates LG's efforts to increase customer's values beyond efficiency. It features enhanced warranty, durability, performance under real environment, and aesthetic design suitable for roofs.



Feature

Enhanced Performance Warranty

LG NeON® R has an enhanced performance warranty.
After 25 years, LG NeON® R is guaranteed at least 88.4% of initial performance.

Extended Product Warranty

LG has extended the product warranty of the LG NeON® R to 25 years which is top level of the industry.

Aesthetic Roof

LG NeON® R has been designed with aesthetics in mind: no electrode on the front that makes new product more aesthetic. LG NeON® R can increase the value of a property with its modern design.

High Power Output

The LG NeON® R has been designed to significantly enhance its output making it efficient even in limited space.

Better Performance on a Sunny Day

LG NeON® R now performs better on a sunny days thanks to its improved temperature coefficient.

Outstanding Durability

With its newly reinforced frame design, LG NeON® R can endure a front load up to 6000 Pa, and a rear load up to 5400 Pa.

About LG Electronics

LG Electronics is a global big player, committed to expanding its operations with the solar market. The company first embarked on a solar energy source research program in 1985, supported by LG Group's vast experience in the semi-conductor, LCD, chemistry and materials industries. In 2010, LG Solar successfully released its first MonoX® series to the market, which is now available in 32 countries. The NeON® (previous. MonoX® NeON), NeON®2, NeON®2 BiFacial won the "Intersolar AWARD" in 2013, 2015 and 2016, which demonstrates LG Solar's lead, innovation and commitment to the industry.

LG NeON®R

LG365Q1C-A5 | LG360Q1C-A5 | LG355Q1C-A5 | LG350Q1C-A5

Mechanical Properties

Cells	6 x 10
Cell Vendor	LG
Cell Type	Monocrystalline / N-type
Cell Dimensions	161.7 x 161.7 mm / 6 inches
Dimensions (L x W x H)	1,700 x 1,016 x 40 mm
	66.93 x 40.0 x 1.57 in
Front Load	6,000Pa / 125 psf*
Rear Load	5,400Pa / 113 psf*
Weight	18.5 kg / 40.79 lb
Connector Type	MC4 (MC), 05-8 (Renhe)
Junction Box	IP68 with 3 Bypass Diodes
Cables	1,000 mm x 2 ea / 39.37 in x 2 ea
Glass	High Transmission Tempered Glass
Frame	Anodized Aluminium

* Please refer to the installation manual for the details

Certifications and Warranty

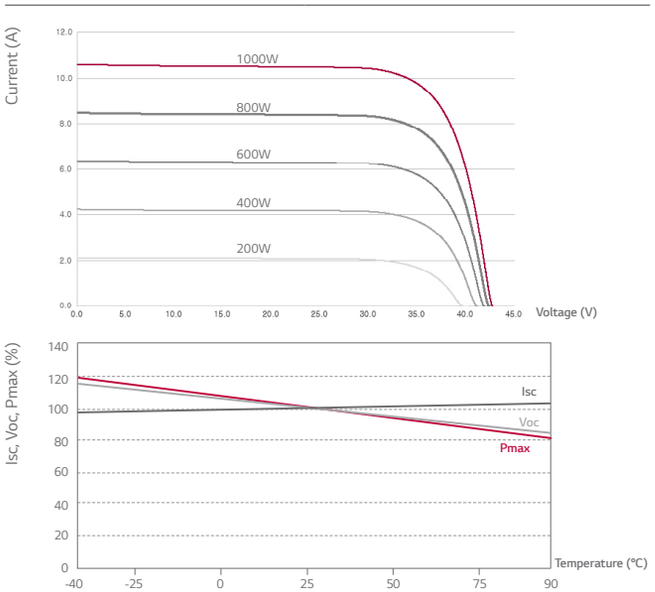
Certifications	IEC 61215, IEC 61730-1/-2
	UL 1703
	IEC 61701 (Salt mist corrosion test)
	IEC 62716 (Ammonia corrosion test)
	ISO 9001
Module Fire Performance	Type 1 (UL 1703)
Fire Rating	Class C(ULC/ORD C1703, IEC 61730)
Product Warranty	25 years
Output Warranty of Pmax	Linear Warranty*

* 1) First year : 98%, 2) After 1st year : 0.4%p annual degradation, 3) 25 years : 88.4%
* This warranty shall apply to all NeON®R modules manufactured after July 1, 2017

Temperature Characteristics

NOCT*	[°C]	44 ± 3
Pmax	[%/°C]	-0.300
Voc	[%/°C]	-0.240
Isc	[%/°C]	0.037

Characteristic Curves



Electrical Properties (STC*)

Model		LG365Q1C-A5	LG360Q1C-A5	LG355Q1C-A5	LG350Q1C-A5
Maximum Power (Pmax)	[W]	365	360	355	350
MPP Voltage (Vmpp)	[V]	36.7	36.5	36.3	36.1
MPP Current (Impp)	[A]	9.95	9.87	9.79	9.70
Open Circuit Voltage (Voc)	[V]	42.8	42.7	42.7	42.7
Short Circuit Current (Isc)	[A]	10.80	10.79	10.78	10.77
Module Efficiency	[%]	21.1	20.8	20.6	20.3
Operating Temperature	[°C]	-40 ~ +90			
Maximum System Voltage	[V]	1,000 (UL / IEC)			
Maximum Series Fuse Rating	[A]	20			
Power Tolerance	[%]	0 ~ +3			

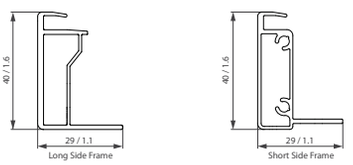
The nameplate power output is measured and determined by LG Electronics at its sole and absolute discretion.
* STC (Standard Test Condition): Irradiance 1000 W/m², Cell Temperature 25 °C, AM 1.5

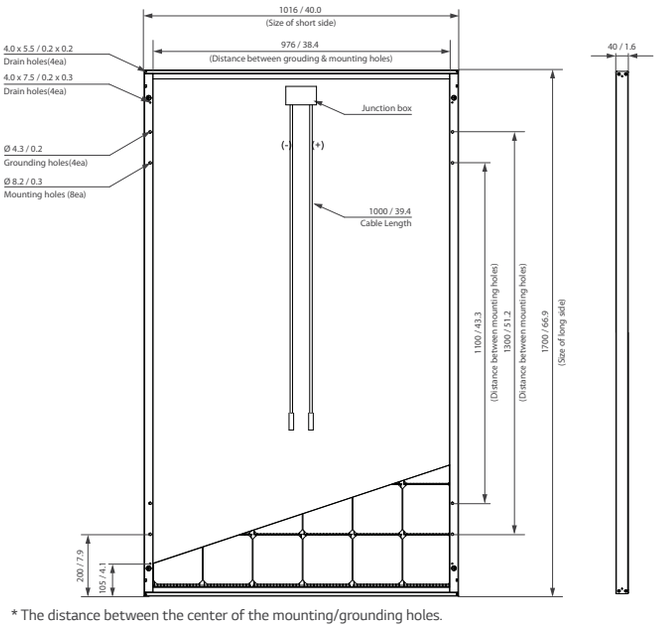
Electrical Properties (NOCT)

Model		LG365Q1C-A5	LG360Q1C-A5	LG355Q1C-A5	LG350Q1C-A5
Maximum Power (Pmax)	[W]	275	271	267	264
MPP Voltage (Vmpp)	[V]	36.6	36.4	36.2	36.0
MPP Current (Impp)	[A]	7.51	7.45	7.39	7.32
Open Circuit Voltage (Voc)	[V]	40.2	40.2	40.2	40.1
Short Circuit Current (Isc)	[A]	8.70	8.69	8.68	8.67

* NOCT (Nominal Operating Cell Temperature): Irradiance 800 W/m², ambient temperature 20 °C, wind speed 1 m/s

Dimensions (mm / inch)





* The distance between the center of the mounting/grounding holes.

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Product specifications are subject to change without notice.
DS-Q1-60-C-G-F-EN-80517

APPENDIX 'J'

BUILDING MANAGEMENT SYSTEM SPECIFICATION

AUTOMATIC CONTROLS AND BUILDING MANAGEMENT SYSTEM

General

New control panels shall be provided and installed in the plantroom and the Contractor shall note the limited access to the boiler room when constructing this panel.

The Contractor should design, supply, install, electrically wire and connect, test and commission complete automatic control systems for the new building.

The new system shall be a trend system.

All systems shall be fully commissioned and all faults by the Contractor prior to handover. The system shall be demonstrated in full to the Engineer during commissioning simulating fault conditions where necessary.

The controls specialist shall review the descriptions of each system within this specification for control philosophy.

A period of two days shall be allowed in the tender for the Contractor to be permanently on site, post contract, to explain the operation of the systems to the Clients staff.

Control Systems

All controls and power wiring shall be carried out by the Specialist Sub-Contractor from control panels located in the plant rooms. Controls shall be generally as Trend.

Each plant control panels shall be provided and installed in the plant room.

The Specialist Contractor shall supply and install a form 2 two section control panel within the plant room and shall be floor standing type and of a size determined by the contractor.

The panels shall be constructed to BS EN 61439-1: 2011 and shall fully comply with this Specification. The panel shall be painted white internally and finished externally with semi-gloss stove or cellulose enamel paint colour.

All starters and MCB's shall be MEM or Merlin Gerin and shall be suitably rated contactor type with adjustable over loads for each motor terminal. Starters and MCB's shall be mounted in the panel and shall be provided with rail mounted sub bases. All starters shall be direct on line.

All panel lights shall be of the LED type.

All components and detectors etc shall be fully compatible with the controls system and shall be permanently labelled.

Control Panel

This panels shall be supplied and installed within the new plant as shown on the drawings by the controls specialist.

The control panels shall house the control and switching facilities for the following plant new plant.

<u>Community Centre</u>

- 1 No Dirty Extract Fan
- 1 no plant room supply fan

- 2 No Heating Pumps
- 1 No HWS Return Pump
- HWS De-stratification pump
- Air source heat pump system
- Pressurisation Unit
- All heat recovery units
- Integration of the Mitsubishi control system

Health care centre

- 1 No New Supply and Extract Air Handling Unit.
- 1 No Run-A-Round Coil Pumps.
- 4 No Heating Pumps.
- 1 No HWS Return Pump.
- Air source heat pump system.
- Heat pump system units serving AHU.
- HWS De-stratification pump.
- Pressurisation Unit.
- Cold water booster set.
- Integration of the Mitsubishi control system
- DX cooling to comms room

The panels shall be complete with all necessary 'Run, Auto, Off, Hand and Fault' lamp indication, selector switches, etc.

Control panels shall be manufactured from 2mm thick mild steel of welded or folded construction suitably IP rated for the proposed location. Size shall be related to the amount of equipment contained.

The location of all lamps, switches, etc. shall be arranged in a logical manner and be complete with purpose made engraved identification labels.

Each panel shall include a door interlocked isolator. The incoming electrical supply shall not enter the panel via a terminal strip. The incoming supply cable shall be terminated into a suitable panel isolator.

Live connections of the supply side of the isolator shall be shrouded with a warning label fitted.

All individual cables shall be individually numbered at either end and relate to the panel wiring diagrams.

Individual circuits shall be protected to BS 88 Part II by HRC fuses. MCB's shall not be permitted. Spare fuses of at least 50% of each fuse rating are to be supplied and installed in a suitable fuse holder.

All starters shall be of the same manufacturer.

All equipment mounted within the panel shall be clearly labelled, these labels shall uniquely identify each item of plant controlled, this particularly applies to starters.

A pocket shall be fitted within panels for housing a panel wiring diagram and controls schematic. A fuse chart shall be fixed at the inside of panel doors.

Indication lamps for all fans, pumps, boilers etc. shall be installed including all items associated with the AHU's. Indication lamps for each item of plant shall take the following form.

Plant Live	Amber
Plant Off	Blue
Plant Run	Green
Plant Alarm	Red
Control Circuit Fuse Failed	Red

A lamp test circuit shall be included and all lamps shall be of the transformer type.

The panels shall be sized to include 20% free space for future expansion/modification.

All circuits, protective and bonding, in the control panel must be connected to individual terminals. Whenever screwed terminals are used, ferrels shall be put on small multicore wires.

The Control panels and distribution equipment shall be provided with starting equipment with suitable time relays etc. to reduce the starting current.

Each outstation located within the main control panel, or local control panels adjacent to package plant, shall have the facility for local interrogation via a hand held plug in terminal. The terminal shall provide the same level of access (including security restrictions) as that provided within the main BMS supervisory station.

Remote Controls Equipment

The Contractor shall supply, install, electrically wire and connect and finally commission the following remote automatic controls and monitoring components in the following locations and in the positions indicated on the drawings.

1] AHU Pressure differential sensors shall be installed across the supply and extract fans and these shall be constant pressure.
2] Pressure differential sensor shall be installed across all filters.
3] Temperature detector to be installed in the air handling unit after each component for temperature control and monitoring.
4] All heat recovery units
5] All dx condensers
6] Temperature detector to be installed in the air handling unit after each run a round circuit for temperature control and monitoring.
7] All motorised dampers shall be monitored on the control panel and on the BMS indication open / closed
8] Pressure differential sensors shall be installed across all new pumps
9] Pressure differential sensors shall be installed across the run-a-round coil pump set
10] A low limit pressure sensor shall be installed on the run-a-round coil system.
11] High and low level float switches two of each cold water storage tank
12] Pressurisation units
13] Temperature sensors

Community Over heating control

The system shall monitor each heat recovery unit and provide night time cooling for each area, along with the control of each dx cooling system.

Health Care Air handling Unit

The automatic control/BMS System shall, in conjunction with the listed components and suitably configured computer software, ensure that the following functional requirements are achieved in respect of the air handling unit, air conditioning and associated system :-

Air Handling Unit

The following control and monitoring arrangements shall apply to all new ventilation systems.

Air volume

The fans shall be controlled to maintain a constant air volume when the pressure drop across filters increase by varying the fan speeds.

Plant Start Up

The air handling units shall be started automatically under the dictates of the BMS. Each air handling plant shall have a separate time clock and shall be initiated under these timed operating programme set up on the BMS.

Filter Dirty Alarms

Differential pressure sensor shall be positioned across the panel and bag filters and shall provide a filter dirty alarm on the BMS when the differential pressure exceeds 150 pascals.

Fan Alarms

Differential pressure sensors shall be positioned across the supply and extract fans and shall provide an alarm on the BMS on fan failure.

Fire Alarm Condition

Upon receipt of a fire alarm signal all plant shall stop.

Heating & Cooling Coils

1] The heat pump associated with the AHU shall be controlled by the Mitsubishi control system. The BMS system shall integrate with this system and control the heating and cooling modes of the unit. The BMS will also control the off coil conditions.

2] The ASHP (LTHW) associated with the AHU frost coil shall be controlled by the Mitsubishi control system. The BMS shall maintain the off coil condition via a 3 port valve The BMS system shall integrate with this system and control the heating of the unit. The BMS will also control the off coil conditions.

3] The control of heated supply air shall be constant temperature and shall be normally be controlled by sequential operation vis the Mitsubishi control system and control the heating coil in response to the temperature detectors installed in the ductwork to the suite.

4] The AHU shall supply a constant 22°C when the outside air temperature is below 16°C. When the external temperature exceeds 20°C the cooling shall be energized.

5] The Cooling shall be controlled to maintain a supply temperature of 20°C during the summer.

6] The relative position of all valve actuators and the readings of all temperature detectors shall be indicated on the graphics at the Central Supervisor. It shall be possible to adjust the position of all set points from the BMS control supervisor.

Main Plant Room

Each area shall be provided with a dedicated MCC Panel

On the face of the control panel the following items shall be provided :-

The Community centre

i] Main Isolator interlocked with door
ii] No 1 / No 2 / ON/Off / Auto rotary switch for each heating pump circuits with run and trip lights for each pump.
iii] On / Off / Auto rotary switch for the heating pressurisation unit with on lamp and fault lamp.
iv] On / Off / Auto rotary switch for each air source heat pump with on lamp and fault lamp.
v] On / Off / rotary switch for Cat 5 Booster set with on lamp and fault lamp.
vi] On / Off / Auto rotary switch for each heat recovery unit system with on lamp and fault lamp. 4no
vii] Fault lamp for the smoke damper panel
viii] On / Off / Auto rotary switch for the hot water de-stratification pump
ix] On / Off / Auto rotary switch for the hot water secondary return pump with run and trip Lights
x] On / Off / Auto rotary switch for the primary run and standby heating pumps.
xi] On / Off / Auto rotary switch for the secondary run and standby heating pumps.
xii] Alarm buzzer and mute switch and test switch.
xiii] Lamp test switch
xiv] Control circuit fuse healthy light.
xv] Panel live light.
xvi] On / Off / Auto rotary switch for each heat recovery unit system with on lamp and fault lamp. 5no

The Health care centre

i) Main Isolator interlocked with door
ii) No 1 / No 2 / ON/Off / Auto rotary switch for the supply and extract of the air handling unit.
iii) ON/Off / Auto rotary switch for the supply heating/cooling heat pump on the air handling unit.
iv) No 1 / No 2 / Off / Auto rotary switch for each heating pump circuits with run and trip lights for each pump.
v) On / Off / Auto rotary switch for the heating pressurisation units with on lamp and fault lamp.
vi) On / Off / Auto rotary switch for each air source heat pumps with on lamp and fault lamp.
vii) On / Off / Auto rotary switch for the hot water de-stratification pump.
viii) On / Off / Auto rotary switch for the hot water secondary return pump with run and trip Lights
ix) On / Off / Auto rotary switch for the primary run and standby heating pumps.

x) On / Off / Auto rotary switch for the primary run and standby HWS heating pumps.
xi) On / Off / Auto rotary switch for the secondary run HWS heating pumps.
xii) Alarm buzzer and mute switch and test switch.
xiii) Lamp test switch
xiv) Control circuit fuse healthy light.
xv) Panel live light.

Control Element

The specialist subcontractor shall supply and install the following remote controls associated with these systems :-

The contractor shall be provided with the following on the health Care and Community Centre control system.

1] Monitoring / control temperature detectors in the following locations :-
i] Heat pump common heating flow and return for constant temperature of each heating circuit systems.
ii] Hot water flow and return temperature for the system.
iii] External air temperature.
iv] 2 No sensors located in the building for optimum start and stop
v] Each heat pump fault only.
vi] 2no heat meters
vii] 4no pulsed water meters
viii] Community centre pulse electricity meters located in the community centre main panelboard
ix] Health centre pulse electricity meters located in the health centre main panelboard
x] CAT 5 booster set fault
xi] All pumps
xii] Cold water booster set
xiii] Each air source heat pumps
xiv] Air handling unit heat pumps
xv] Cold water storage tank 2no temperature sensors
xvi] High and low level tank switches 4no
2] Differential pressure switches to monitor/control the performance of :-
i] The air source heat pump.
ii] Each of the heating pump sets
iii] Each fan system
3] CT monitoring of HWS circulation pump.
4] Three port valve for heating and hot water hot water priority.
5] Three port valves for variable temperature circuit.
6] Three port valves for CT temperature circuit AHU7

Plantroom Control Operations

The control system shall monitor, provide feedback and adjustment of each the air source heat pump and the AHU cooling/heating heat pump system via the Mitsubishi central controller

Each heat pump system shell be standalone from each other but each one integrated into their system BMS

i] Variable Temperature Heating
The VT circuit shall respond to external and internal temperature conditions. Facilities shall be provided through the BMS to independently shut off the circuit when the areas are not in use.
The VT pumps shall be constant pressure and controlled from the BMS. The specialist shall allow for position pressure differential sensor 2/3 of the way along the circuit.
The primary circuits and secondary circuit shall be provided with an extension timer on the face of the panel to enable the zone to be run for up to an additional 4 hours in one hour increments.

ii] Pump Sharing
All pumps shall be monitored by differential pressure switches which shall, through the controls automatically change from run to standby by pump on flow failure. A facility shall be built into the system for user defined automatic pump duty sharing. during periods of low usage each pump shall be run for 10 minutes once a week.
Nonspecific alarms from the pressurisation units, etc. shall be wired back to the main panel by the specialist sub-contractor and arranged to indicate on the panel fascia and through the controls system

iii] Pressurisation Units
The pressurisation units shall be interlocked with the ASHP and arranged to shut down the ASHP in the event of a fault.

iv] Fire Alarm
The fire alarm system shall be linked through the controls system to shut down the ventilation in the event of an alarm.

v] Hot Water and Heating
A 2 no 3 kW immersion heaters shall be provided with each unit, which shall be used to top up the cylinder to ensure the calorifier temperature is a minimum of 60deg
To maintain temperature stability in the calorifier system a de-stratification pump shall be supplied and installed and controlled
The system shall go through a pasteurisation regime once a week a raise the temperature to 65deg. This shall be incorporated into the controls system.
The heating and hot water system shall be hot water priority.

Building Energy Management System

A Trend Building Energy Management System (BEMS) shall be supplied, configured and commissioned by a BEMS specialist contractor. In completing the works, the specialist shall comply in all aspects with the design criteria as defined by Trend.

The BEMS Specialist is to tender for the works as specified tender which generally comprise :-

- The complete design, supply, configuration, documentation and commissioning of the BEMS including all hardware, software and supply of all connected sensors and actuators.
- Manufacture, and commission of the Motor Control Panels.
- Controls wiring including the provision of conduit and trunking.
- Power Wiring to all pump's motors etc, plant, detectors etc.,

The system shall comply in all respects with this equipment specification and with the particular controls performance specification appended as drawings and schedules.

The BEMS tenderer shall provide a points schedule showing each proposed connected point to the system. The points shall be arranged as schedules showing the points allocated on a plant by plant basis, the controller specification(s) selected, I/O capacity supplied and the spare I/O available for future use. Any points schedule supplied with this specification shall be considered as supporting information only. The BEMS specialist shall be responsible for ensuring the correct allocation of points required for meeting the performance specification.

Where a system comprises more than a single network, a diagram shall be supplied with the tender showing the lay-out of the LAN's and interconnections

Where safety circuits are required, including fire safety interlocks with air handling units, fireman's override switches and frost thermostats, these shall be achieved by means of hard wired interlocks with the action sensed by controller inputs and duplicated in software.

System Features Configuration

Prior to commencing work on inputting of the controller strategy the BEMS specialist shall supply to the Engineer for approval a plain English description of the schemes to be implemented. This shall be supported at an appropriate time by diagrams showing the configuration of all control and monitoring schemes, identifying the modules used, their interconnections and setting parameters, copy print-outs showing the individual outstation module configurations and sequences.

To ensure accuracy configuration and documentation shall be carried out using an appropriate software tool.

Alarm levels and inhibits to be configured as directed by the engineer.

Trend logs shall be set up to record/display all analogue inputs and calculated flows and totals.

Archives are to be set up recording the daily total for every energy and utility monitoring meter.

The BEMS contractor shall implement a password strategy as agreed with the engineer. The password facility shall be set up for the client's engineer.

Degree days shall be calculated from the outside temperature input to the base 18°C and trend logged each day.

Following a mains power failure, the plant at the MCC's shall start in a sequenced manner with time delays incorporated so as to limit the total surge in demand.

Field Devices

In order to allow for site standardisation Trend devices are to be fitted where-ever these are available. A schedule of field devices shall be submitted with the tender cross-referenced to the points schedule showing the total number and specification of the device to be supplied, and shall show the manufacturer model, range, accuracy, flow characteristics, working, operating and static pressure ranges, all as applicable to the transducer or actuator. The BEMS specialist shall be responsible for the correct output and positioning for sensors. Where sensor positions are indicated on drawings, he shall advise any corrections to the engineer at an early stage of the project.

In order to allow for site standardisation Trend control valves and actuators shall be used on all applications where available.

INSTALLATION

General

The BEMS shall be installed complying with all :-

- National and local statuary regulations,
- Health & Safety at Work Acts,
- IET Regulations (18th Ed.),
- Equipment manufacturer's instructions.
- Regulations and conditions of BT, and utilities companies.

Cables

All extra-low voltage BEMS cables shall be run in screened twisted pair cables to specifications as dictated by Trend. They shall be affixed to tray, drawn into conduit or trunking and protected as agreed with the engineer to suit the various environmental, social and mechanical locations. No joints will be allowed in cables, where these are unavoidable, the cables shall be joined using an approved housing, securely fixed and having cable securing clamps. Any such connecting boxes shall be shown on the record drawings.

No trays, conduits or cables are to be affixed horizontally at floor or pedestal level. Where cables are connected to sensors measuring extreme heat, the necessary thermal breaks, local connecting cables are to be supplied. No BEMS data cable shall be installed in the same conduit as any power cable nor affixed within 25mm if surface/tray mounted. Where cables are run in trunking or with others clipped to tray of a similar type they shall be identified either by colour or labels every 2m.

Special care shall be taken to ensure that the manufacturer's recommendations with respect to earthing data cables and outstations are obeyed.

Each BEMS field device shall be identified (internally on space temperature and humidity sensors) with a common code used on points and wiring schedules, parts lists, control strategy, MCP and installation diagrams/drawings.

Where a MCP is fitted with Hand/Off/Auto switches, a common circuit shall monitor their auto condition, which shall cause an alarm when any switch is moved from the auto position.

All BEMS cables shall be suitably identified with sleeves at the terminations. These shall be recorded on the installation diagrams and wiring schedules.

Sensors, actuators, switches and all field devices shall be mounted according to the manufacturer's instructions. All will be installed with clearance to allow for servicing, and the conduit connected by methods to allow easy replacement.

Where outstations switch circuits having potentially different mains voltage supply feeds, extra low voltage relay circuits shall be employed. A notice shall be fixed inside the outstation detailing how all mains feeds into it can be isolated. Consideration shall be given to employing an extra low voltage control circuit for motor starter and contractor coils and shall be mandatory where MCP with separate cubicles for motor starters are employed.

In each riser cupboard and plantroom through which network cables pass and not having an outstation a loop of cable will be made to allow future system expansion.

Network cables will be supplied with at least two spare pairs to allow for future system expansion.

Each outstation shall be provided with a schedule identifying the points connected to the I/O terminals inside the panel door.

During the installation period the BMS specialist shall provide dust protection for his PC equipment to minimalise damage from dust anticipated during the works.

Wiring within the outstations shall be completed in a neat and professional manner with lacing/cable ties. No wired connector shall be in tension by wires cut too short, earthing braids/wires shall be neatly terminated. Prior to commissioning each outstation enclosure shall be cleaned of all cable waste.

COMMISSIONING

General

a] The BEMS specialist shall be responsible for the full commissioning of his system and any other controls equipment supplied by him. Commissioning shall be in accordance with the "CIBSE Commissioning Code; Series C, Automatic Controls".

b] All safety interlocks, overrides and fail-safe conditions are to be operational prior to starting the plant. Demonstrate as agreed with the engineer prior to starting plant in BEMS auto mode.

c] Fault conditions for all critical alarms, safety devices and control interlocks shall be simulated and proved effective as soon as practical once BEMS control mode is selected.

d] Sensors shall be checked to ascertain accuracy within limits, pressure switches checked for switch points and hysteresis. Humidity sensors shall be checked for accuracy using a wet/dry bulb thermometer.

e] All the necessary test equipment and materials used in commissioning shall be supplied by the BEMS specialist. All test equipment shall have valid test certificates.

f] Trend graphs will be provided to demonstrate the stable control of the plant. Simulated inputs will be employed to check stability over the design environmental range.

g] See separate section for repeat visits for fine tuning. The BEMS contractor shall include in his tender an allowance for system tuning via auto-dial or visit to check correct operation of all plants which may exhibit changes in stability due to settling in or seasonal conditions.

h] Commissioning documentation and schedules shall be submitted for approval during the design phase showing each plant, point, interlock and control algorithms, and the stages of checks and commissioning required. Each cleared item to have date and engineer reference. Completed copies shall be available to the engineer prior to acceptance testing. A complete set of the commissioning documentation is to form part of the system documentation.

i] Once any item of plant is commissioned and left running to the dictates of the BEMS, documentation showing the overrides, control and software configuration shall be available on site at all times.

j] Seasonal commissioning must also be included.

Acceptance Demonstrations

The BEMS specialist shall give seven days' notice to the engineer of his intention to provide the acceptance demonstrations once the commissioning is complete. The operation of all safety interlocks shall be tested and ten per cent of all points shall be selected by the engineer and demonstrated for operation/accuracy. Should more than 1% fail performance test, a further ten per cent may be selected. If above 1% fail he may at his discretion demand 100% demonstration. The BEMS specialist shall supply sufficient man-power/test equipment, consumable items and portable telephones to conduct the demonstration efficiently. Testing shall also incorporate an audit of the wiring and hardware installation, demonstration of safety interlocks, start of system from power-down and review of time schedules and alarm levels, grouping and selected control parameters.

System Handover

- The BEMS specialist shall ensure the following are completed at hand-over :-
- Any snagging to be documented and agreed date determined for clearance.
- All passwords/PIN numbers, levels and operators recorded.
- SD card copies of all system and data files supplied.
- Proprietary software manuals & SD Card.
- All equipment access keys handed over.

Complete sets of O&M manuals left with system, any agreed amendments/additions required to be documented and a target date for completion agreed.

Documentation

[a] Operation and Maintenance Manuals :

Three copies of all final operating and maintenance manuals will be supplied within two weeks of hand-over in A4 binders. Preliminary copies shall be available to the client during this time.

Operating Manuals shall comprise instructions on equipment safety checks, start-up and close-down procedures, daily operation and full descriptions of operating features. These shall match and comply fully with the software supplied, provide examples of operation with supporting flow/strategy diagrams. Diagrams shall show the full diagrammatical (network structures, outstations and peripherals) and physical layout of the system and components.

Maintenance Manuals shall comprise full descriptive and maintenance details on each and every item of equipment supplied. Suppliers and spare parts references, contacts, telephone numbers, and addresses shall be supplied where relevant. Wiring schedules shall show the connection of each item of equipment to the field equipment. Data sheets and maintenance instructions shall be provided for each item of equipment. Diagrams showing the configuration of all control and monitoring schemes, identifying the modules used, their interconnections and setting parameters, copy print-outs showing the individual outstation module configurations and sequences. A plain English description of control and monitoring schemes shall be included.

[b] New Build: Record drawings of the installation will be supplied electronically which will be free-issued to the BEMS specialist.

[c] All drawings relating to the BEMS will be supplied A3/A4 sizes bound into A4 ring binders. These shall include system, outstation and user terminal configuration diagrams, listings and flow charts.

Back-up copies of all system configuration files and master software shall be supplied in an appropriate lockable storage facility. All system and data files shall be current as at the hand-over date, cards to be suitably identified and directories and files cross-referenced in the maintenance manuals. The storage unit and key shall be handed to the client's engineer at hand-over.

Site / User Training

The BEMS specialist shall supply the following training for the clients engineering staff :-

[a] Engineer & selected staff :-

On-site: While the clients engineer will attend the acceptance demonstrations, the BEMS specialist shall instruct him in the specific application of the system the structure and the control strategies adopted to meet the specification.

Warranty Support Period & Maintenance Contract

The warranty period shall run for twelve months following hand-over, during which time the following facilities shall be available to the client :-

i] Call-out within 24 hours and same working day if before 10.00am

ii] Replacement and labour for defective parts.

iii] Fault diagnosis and rectification.

iv] Three support visits at four monthly intervals each of one full working day to advise operation, check and adjust operational parameters, re-tune any control as maybe required by change in the control system load conditions or bedding-in of the plant and generally ensure the plant is operating to specification.