



Issue Date:
Issued To:
Revision:

FUNCTIONAL DESIGN SPECIFICATION

Specification Number: SP-XXXX

	Company	Name	Signature	Date
Issued By:	Manutec Ltd.			
Approved By:				
Approved By:				
Approved By:				
Approved By:				
Authorised By:				



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1.0 INTRODUCTION

1.1 Purpose of this Specification

1.2 Conformance Statement

Where the words 'must' or 'shall' appear in this document, the requirements with which they are associated are mandatory.

1.3 Abbreviations Used

<i>AHU:</i>	Air Handling Unit
<i>BMS:</i>	Building Management System
<i>CHW:</i>	Chilled Water
<i>DHW:</i>	Domestic Hot Water
<i>EAF:</i>	Extract Air Fan
<i>HEPA:</i>	High Efficiency Particle Absorption
<i>HVAC:</i>	Heating, Ventilating and Air Conditioning System
<i>ICC:</i>	Inter-Controller Communication
<i>I/O:</i>	Input/Output
<i>I.T.:</i>	Information Technology
<i>LAF:</i>	Laminar Airflow Unit
<i>LPHW:</i>	Low Pressure Hot Water
<i>LTHW:</i>	Low Temperature Hot Water
<i>MCC:</i>	Motor Control Centre
<i>RAF:</i>	Return Air Fan
<i>R.O.:</i>	Reverse Osmosis
<i>SAF:</i>	Supply Air Fan
<i>VSD:</i>	Variable Speed Drive



1.4 Document Control

1.4.1 Superseded Documents

<i>Issue</i>	<i>Date</i>	<i>Author</i>	<i>Reason for Change</i>

1.4.2 Change Summary

<i>Issue</i>	<i>Summary of the Changes Made</i>



1.5 Reference Documents

1.5.1 Enquiry Documentation:

1.5.2 P&ID and HVAC Drawings:



2.0 SYSTEM HARDWARE AND SOFTWARE

2.1 System Architecture

The system will consist of 1 No. computer running supervisory control and data acquisition software, communicating with individual plant control outstations over a dedicated BMS plant network. All hardware, firmware and software will be certified as being Year 2000 compliant.

2.2 Network

(Trend)

The Trend physical network consists of a loop, linking a series of network controllers to the BMS PC.

On failure of an outstation, a fail-safe loop back device ensures that the network continues to function for the remainder of the connected nodes.

(Unitron 32.Net)

The Unitron 32.Net is an Ethernet peer-to-peer communications controller used to network Unitron 32 I/O controllers together on its fieldbus. It can also communicate with other Unitron 32.Nets and with PCs via an Ethernet link and other peripherals via its RS-232/485 protocols. It communicates with other UC.32 Nets over an Ethernet network in a peer to peer arrangement, using an ethernet switch.

2.3 Outstation Controllers

Each plant control outstation shall be separately powered and run its own control program which must be retained on power failure. Each outstation node shall have a unique address set by an internal switch and must continue to function even if the network connection is broken.

The full specifications for each outstation controller, inputs, outputs and the field devices associated with them, are contained in Points Schedule.



2.5 Supervisory Computer

The supervisory computer must be an Intel-based Pentium 4 PC (or better) with a clock speed of 2.5 GHz or higher, 1 GB of RAM and at least 80 GB of hard disk space for historical data archiving. The operating system must be Windows XP Professional - service pack 2 (minimum)

2.6 Supervisory Software

The supervisory computer is required to run Trend 963™/Unitron Command Centre software, providing interactive operator display and control screens, alarming and historical trend data archiving on the hard disk of the supervisory computer.

2.7 Alarm Handling

All alarms must be based on either the measured or derived value of a process variable, or on the status of a discrete alarm input. Derived and discrete alarms are defined in the process system description sub-section to which they relate.

The alarm values of individual measured process variables that require alarms are contained in Attachment xx of this document. In addition, an alarm must be raised if the value of a process variable falls outside its measured range, indicating a faulty sensor.

2.8 Password Levels

All personnel must be able to view plant data, but only authorised personnel shall be able to carry out any function that can affect the system. Two level of password authorisation shall be provided. These are:

2.8.1 System Administrator

The administrator shall have full access to all functions. Any action taken by the system administrator must be carried out in accordance with change control procedure.

2.8.2 Technicians

Technicians shall be assigned authorisation to:

- Acknowledge alarms.
- Start and stop equipment.



- Change set points.
- Set up graphs.



3.0 PROCESS SYSTEM DESCRIPTIONS

3.1 Fan Coil Units (Airside)

These fan coil units are required to provide a temperature controlled supply to individual offices within the packaging building. They are serviced from AHU xx and share its time zone.

3.1.1 Fan Coil Unit No 1

Area Served: xxx.

The system run pre-requisite must be enabled by the time zone occupancy period. Once the time zone is enabled the space temperature in the area is compared to a set point, and bypass dampers will be modulated to achieve temperature control.

3.1.2 Fan Coil Unit No 2

Area Served: xx.

The system run pre-requisite must be enabled by the time zone occupancy period. Once the time zone is enabled the space temperature in the area is compared to a set point, and bypass dampers will be modulated to achieve temperature control.

3.2 Fan Coil Units (Airside)

These fan coil units are required to provide a temperature controlled supply to individual offices within the packaging building. They are serviced from AHU xx and share its time zone.

3.2.1 Fan Coil Unit No 1

Area Served: xxx.

The system run pre-requisite must be enabled by the time zone occupancy period. Once the time zone is enabled the space temperature in the area is compared to a set point, and the associated LPHW and CHW valves will be modulated to achieve temperature control.



3.2.2 Fan Coil Unit No 2

Area Served: xxx.

The system run pre-requisite must be enabled by the time zone occupancy period. Once the time zone is enabled the space temperature in the area is compared to a set point, and the associated LPHW and CHW valves will be modulated to achieve temperature control.

3.3 Fan Coil Constant Temperature Heating Pumps

A duty/standby pair of pumps must be provided to supply LPHW to the fan coil units in the --.

Pumps xx and xx

3.3.1 Fan Coil Heating Pumps run pre-requisite

The run pre-requisite for the fan coil heating pumps is decided by the FCUs heat demand.

3.3.2 Fan Coil Duty/Standby Constant Temperature Heating Pumps

The Duty Pump must be enabled by the system run pre-requisite provided that there is no frost alarm. If after 30 seconds there is no proof of flow then the standby pump shall operate. The standby pump shall also be enabled should the duty pump trip. Alarms are raised at the BMS PC should the standby pump need to be operated. The duty change over shall normally occur on a weekly basis.

3.4 FCU Chilled Water Temperature Control

A chilled water circuit provides cooling water to the FCUs in the packing hall. Pumps xx and xx

3.4.1 FCU Chilled Water Temperature Control run pre-requisite

The run pre-requisite for the fan coil heating pumps is decided by the FCUs time zone.

3.4.2 Chilled Water Duty/Standby Pumps

The Duty Pump must be enabled by the system run pre-requisite provided that there is no frost alarm. If after 30 seconds there is no proof of flow then the



standby pump shall operate. The standby pump must also be enabled should the duty pump trip. Alarms are raised at the BMS PC should the standby pump need to be operated.

The duty change over shall normally occur on a weekly basis.

3.4.3 Chilled Water Temperature Control

Once there is proof of flow established via the duty/standby pumps then the chilled water temperature control shall commence. A 3 port valve must be modulated to maintain the chilled water flow temperature at a set point.

3.4.4 Chilled Water Temperature Monitoring

A temperature sensor is located in the supply and return lines of the chilled water circuit. Graphs of the temperature over the previous 24hours will be available at all times, with data archival occurring every day.

3.4.5 Chilled Water Fill and Expansion Unit.

The BMS must monitor the chilled water fill and expansion unit, monitoring the low pressure alarm and common fault. Alarms must be sent to the BMS PC.

3.5 Steam/LPHW Heat Exchanger

A heat exchanger is required to provide LPHW for the associated AHU/DHW/Underfloor circuit.

3.5.1 Steam/LPHW Heat Exchanger Run Pre-requisite

The heat exchanger will be enabled when a demand for heating exists from the associated AHU/DHW/underfloor circuit.

3.5.2 LPHW Duty/Standby Pumps

The duty pump must be enabled by the system run pre-requisite provided that there is no frost alarm. If after 30 seconds there is no proof of flow then the standby pump shall operate. The standby pump shall also be enabled should the duty pump trip. Alarms are raised at the BMS PC should the standby pump need to be operated. The duty change over shall normally occur on a weekly basis.

3.5.3 H.E Temperature Control

Once there is proof of flow established via the duty/standby pumps then the H.E temperature control shall commence. The isolation valve shall open first. Then the



steam control valve shall warm through by initially opening first at 5% for 10 minutes and then at 10% for 10 minutes. Once the warm through period has been completed, the valve will modulate to maintain the required temperature set point. Should the duty pump trip, or no flow be detected then both the modulation valve and isolation valve shall close. Once the pump trip alarm or no flow is resolved, the warm through period must be enabled before normal control is allowed.

3.6 Constant Temperature Pumps

A duty/standby pair of constant temperature pumps is provided to supply LPHW to the heating coils in the air handling units in the --.
Pumps xx and xx

3.6.1 Constant Temperature Pumps Run Pre-requisite

The run pre-requisite for the constant temperature pump set is decided by the heating demand of the associated air handling units, namely AHU xx. If any of the heating valves are open more than 5% then the duty pump must be enabled.

3.6.2 Constant Temperature Duty/Standby Pumps

The Duty Pump must be enabled by the system run pre-requisite provided that there is no frost alarm. If after 30 seconds there is no proof of flow then the standby pump shall operate. The standby pump shall also be enabled should the duty pump trip. Alarms are raised at the BMS PC should the standby pump need to be operated. The duty change over shall normally occur on a weekly basis.

3.6.3 Flow/Return Heater Temperature Monitoring.

Temperature sensors in the flow and return headers provide monitoring of the temperature. Graphs of the temperate over the previous 24 hours will be available at all times, with data archival occurring every day.

3.6.4 LPHW Fill and Expansion Unit.

The BMS must monitor the LTHW fill and expansion unit, monitoring the high pressure alarm and common fault. Alarms must be sent to the BMS PC.



3.7 Radiator Circuit

All the radiators in this zone are controlled using a mixing valve. Weather compensation temperature control must be provided using the outside air temperature and water flow temperature.

3.7.1 Radiator run pre-requisite

The office radiator circuit must be enabled using an independent time zone, provided there is no frost alarm activated.

3.7.2 Radiator Circuit Duty/Standby Pumps

The Duty Pump must be enabled by the system run pre-requisite provided that there is no frost alarm. If after 30 seconds there is no proof of flow then the standby pump shall operate. The standby pump must also be enabled should the duty pump trip. Alarms are raised at the BMS PC should the standby pump need to be operated. The duty change over shall normally occur on a weekly basis.

3.7.3 Radiator Temperature Control

Once there is proof of flow established via the duty/standby pumps then the radiator temperature control shall commence. The set point for the circuit is calculated by multiplying the outside air temperature by a weather compensation set point called "The Slope". This slope must be user adjustable and must ensure that the set point shall be higher during colder weather, and shall drop lower as the outside air temperature rises. The set point shall be restricted between a minimum of 25degC and a maximum of 75degC (User- adjustable). Should a low flow temperature be detected the mixing valve shall be opened to 99% until the condition has been cleared.

3.8 AHU Chilled Water Temperature Pumps

A duty/standby pair of chilled water pumps is provided to supply chilled water to AHU xx.
Pumps xx and xx

3.8.1 AHU Chilled Water Temperature Pumps run pre-requisite

The run pre-requisite for the chilled water temperature pumps shall be if any of the cooling valves are open more than 5% then the duty pump must be enabled.



3.8.2 AHU Chilled Water Temperature Duty/Standby Pumps

The Duty Pump must be enabled by the system run pre-requisite provided that there is no frost alarm. If after 30 seconds there is no proof of flow then the standby pump shall operate. The standby pump shall also be enabled should the duty pump trip. Alarms are raised at the BMS PC should the standby pump need to be operated. The duty change over shall normally occur on a weekly basis.

3.8.3 Chiller On/Off Enable and Temperature Control.

The chiller must be enabled when CHW flow is established.

3.9 Cooling Tower Control

The cooling tower consists of single speed cooling air fan, immersion heater, and outflow or sump temperature transmitter.

3.9.1 Cooling Tower run pre-requisite

The run pre-requisite for the cooling tower is determined by the tower outflow temperature dropping below a predetermined set point. It shall continue to run until the temperature has dropped 1degC below this set point.

3.9.2 Cooling Tower Frost Protection.

If the outflow temperature drops below 2degC this must enable the immersion heaters. The circulation pumps and trace heating must also be switched on.

3.10 Standard Air Handling Unit x

This system is required to control and monitor air supply to the xxi

3.10.1 AHU-xxx Fans Run Pre-requisite

The AHU-xxx fans run pre-requisite must be enabled by the time zone occupancy period provided that the frost stat is not activated.

3.10.2 AHU-xxx Controls Enable Pre-requisite

The AHU-xxx controls enable pre-requisite must be enabled by fans run pre-requisite and by the detection of airflow from both the AHU's SAF and RAF.



3.10.3 AHU-xxx Supply Air Fan

AHU-xxx SAF must be enabled by the fans run pre-requisite. A differential pressure switch across the fan must be used to prove it's running status and generate an alarm on fan failure.

3.10.4 AHU-xxx Return Air Fan

AHU-xxx RAF must be enabled by the fans run pre-requisite. A differential pressure switch across the fan must be used to prove it's running status and generate an alarm on fan failure.

3.10.5 AHU-XXX Temperature Control

The control valves on AHU-XXX heating and cooling coils must be enabled by the control enable pre-requisite.

If the frost stat detects a supply duct temperature below 3°C the heating valve must be fully opened. The valves must be regulated in sequence to maintain the AHU-XXXX return air duct temperature to a set point. Minimum and maximum supply duct levels (user-adjustable) must be adhered to. X No. space temperature sensors are used to monitor the area.

3.10.6 AHU-XXX Air Filters

The differential pressures across pre filter, bag filter and HEPA air filters must be monitored and activate an individual dirty filter alarm on high differential pressure.

3.10.7 AHU-XXX Dampers

AHU-XXXX dampers must be enabled by the control enable pre-requisite. They must have a minimum fresh air position of 20% (user-adjustable). They must modulate under the dictate of the control strategy to ensure the least heating or cooling load is required.

3.10.8 General Extract Fan

The general extract fan must be enabled by the system run pre-requisite after the AHU-XX SAF has been running for a preset period and then run continuously at a fixed speed. A differential pressure switch across the fan must be used to prove it's running status and generate an alarm on fan failure.

3.10.9 AHU-XXX Humidity Control

The control valve on AHU-XXX cooling coil and the humidifier must be enabled by the control enable pre-requisite.



The cooling valve and humidifier must be regulated in sequence to maintain the AHU-XXXX return air duct humidity to a set point. Minimum and maximum supply duct levels (user-adjustable) must be adhered to. In the event of a supply duct humidistat high alarm, the humidifier must be disabled and an alarm indicating this condition shall be raised at the supervisory BMS.

3.10.10 AHU-XXX Pressure Control

(option 1)

The supply fan VSD shall be enabled by the fans run pre-requisite. The supply fan VSD must be modulated to maintain the supply duct static pressure to a set point (user-adjustable). The extract fan VSD shall be enabled by the fans run pre-requisite. The extract fan VSD must be modulated to maintain the extract duct static pressure to a set point (user-adjustable).

(option 2)

The supply fan VSD shall be enabled by the fans run pre-requisite. The supply fan VSD shall be maintained at a constant speed to ensure the correct number of air changes is obtained. The VSD speed setpoint shall be determined by the air balancing engineer during commissioning. The extract fan VSD shall be enabled by the fans run pre-requisite. The extract fan VSD must be modulated to maintain the room pressure to a setpoint (user-adjustable).

3.10.11 AHU-XXX Fire Strategy

On receipt of a signal from the Fire panel the fans will shut down. When this signal is removed system will restart. On receipt of a smoke alarm signal the fans will shut down and an alarm will be generated. When this signal is removed system will restart.



3.11 Plantroom Controls

3.11.1 LTHW System Frost Protection

If the outside air temperature (located on north facing Wall) drops below 3degC all heating pumps shall be called on irrespective of time zone setting and heating demand. If the header temperature drops below 10degC the boilers shall be called on, irrespective of heating demand and will run until the return temperature reaches 25degC

3.11.2 Pressurisation Unit High & Low Pressure Switches

In the event of a high pressure situation being detected in the flow header by the high pressure switch, the following actions will be carried out:

All LPHW pumps/pump sets will be enabled via the controller, to dissipate system heat.

All Boilers will be disabled via the controller. An alarm indicating this condition will be raised at the supervisory BMS PC.

In the event of a low pressure situation being detected in the flow header by the low pressure switch, the following actions will be carried out.

All LPHW pumps/pump sets will be switched off via hardwiring. All Boilers will be disabled via hardwiring. An alarm indicating this condition will be raised at the supervisory BMS PC.

3.12 Boilers Control

3.12.1 Boiler Run Pre-requisite

The boilers run pre-requisite must be enabled when a demand for heating exists from the associated LPHW circuits, provided there is no fire alarm, gas alarm or LPHW pressurisation unit alarm. The boilers run pre-requisite must also be enabled when an immersion frost condition exists in the LPHW header as detected by an immersion frost stat or immersion temperature sensor.

3.12.2 Boiler Shunt Duty/Standby Pumps



The duty pump must be enabled when a demand for heating exists provided that there is no frost alarm. The shunt pump shall be enabled prior to enabling the boiler and shall have a run-on period after the boiler has been disabled. This run-on period is to ensure heat dissipation within the boiler and avoid a high temperature condition. If after 30 seconds there is no proof of flow then the standby pump shall operate. The standby pump must also be enabled should the duty pump trip. Alarms are raised at the BMS PC should the standby pump need to be operated. The duty change over shall normally occur on a weekly basis.

3.12.3 Boiler Control

The boiler system must be enabled by the boiler run pre-requisite.

(Single Boiler)

The boiler shall be enabled as long as a demand for heating exists. The boiler shall be disabled once the heating demand has been met. The boiler shall have a minimum run time to ensure there is no excessive stop-starting of the boiler.

(Multiple Boiler System)

The boilers shall operate on a duty standby arrangement with a weekly changeover of the duty boiler. The changeover shall also take place should a boiler lockout be detected on the duty boiler. The boilers shall be required to maintain a LPHW return header temperature setpoint. Should the duty (lead) boiler be unable to meet demand, the standby (lag) boiler shall also be enabled until the temperature setpoint can be achieved.



3.13 Underfloor Heating Controls

This system is required to control and monitor air supply to the xxl

3.13.1 Underfloor Run Pre-requisite

The underfloor run pre-requisite must be enabled by the time zone occupancy period provided that the temperature high limit stat is not in alarm.

3.13.2 Underfloor Circuit Duty/Standby Pumps

The Duty Pump must be enabled by the system run pre-requisite provided that there is no high limit alarm. If after 30 seconds there is no proof of flow then the standby pump shall operate. The standby pump must also be enabled should the duty pump trip. Alarms are raised at the BMS PC should the standby pump need to be operated. The duty change over shall normally occur on a weekly basis.

3.13.2 Underfloor Circuit Temperature Control

The system must be enabled by the system run pre-requisite. The under floor flow temperature shall be controlled to a weather compensated set point by modulation of the underfloor mixing valve. The set point for the circuit shall be calculated by multiplying the outside air temperature by a weather compensation set point called "The Slope". This slope must be user adjustable and must ensure that the set point shall be higher during colder weather, and shall drop lower as the outside air temperature rises. The set point shall be restricted between a minimum of 25degC and a maximum of 45 degC. The space temperature in the area shall provide space trim, where by the flow setpoint shall be raised and lowered by up to 10 degC should the space temperature be more that 2degC above or below its space setpoint.

3.13.3 Underfloor Circuit Warm-up Temperature Controls

On initial start-up, or should the system be disabled for a period of greater than 72 hours, the underfloor temperature controls must undergo the following warm-up period.

On start-up the underfloor flow temperature shall be maintain to a setpoint of 25 degC, for a period of X hours. Once this period has been completed the flow temperature shall be raised by 5 degC every X hours until a temperature of 45 degC has been maintained for X hours. Once the warm-up period has been completed the system will changeover to normal temperature control.



3.13.4 Underfloor Circuit Warm-up Temperature Controls

A further safeguard in the form of a high limit stat, installed in the flow pipe work, shall close the control valve and disable the pump set should a temperature in excess of 50 degC be recorded. In the event of a high limit stat activation the slam-shut valve located on the flow circuit shall be hardwired to close until the temperature high limit alarm has cleared.



4.0 ATTACHMENTS

4.1 Outstation I/O Specifications

4.1.1 Outstation xx I/O Specification