1.1 Introduction

In the case of a new or major refurbishment of a building at the university which does not have a fully integrated BMS, the works are to include the design and installation or upgrade of a BMS which meets the criteria in this document.

In the case of the refurbishment of a building with an existing BMS, the works are to include the maintenance, refurbishment or extension of that BMS in a manner that meets the criteria in this document.

For the avoidance of doubt the BMS of a university building may include surrounding structures and annex buildings. In some cases components of the BMS will be installed or are to be installed in other buildings. In these cases the word building in this document is to be interpreted as inclusive of these structures, annexes and components.

A BMS is a building management and control system incorporating distributed electronic controls for other building components such as fans, pumps, lighting etc. The control elements are interconnected through a standard open communication network.

The BMS is to be designed and installed to control, monitor and provide a prioritised alarm system for the following services of the university:

- Energy monitoring
- Mechanical services
- Fire Alarm services, including fire trip and general plant alarms
- Hydraulic services, including main pumps
- Lift services
- Environmental monitoring
• Internal air quality
• Gas detection
• Any other controllable service or plant in the project brief

BMS will provide complete control, monitoring and alarming of every accessible system point and parameter

<table>
<thead>
<tr>
<th>1.2 MAIN PAGE</th>
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<tbody>
<tr>
<td><strong>Left Frame</strong></td>
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<tr>
<td>Menu:</td>
</tr>
<tr>
<td>1. Main Page</td>
</tr>
<tr>
<td>2. Timeclock &amp; Occupancies</td>
</tr>
<tr>
<td>3. Floor Plan Layouts</td>
</tr>
<tr>
<td>4. Systems (Chilled, Condensor, Hot Water, Fan, Fire)</td>
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<tr>
<td>5. Pressure Control,</td>
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<td>6. Units (FCU, A/C, Water Cooled PAC)</td>
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<tr>
<td>7. Zone Conditioning</td>
</tr>
<tr>
<td>8. Monitoring (Hydraulics, Electricity, Lifts, Gas and Air)</td>
</tr>
<tr>
<td>9. Control Schematics</td>
</tr>
<tr>
<td>10. Legend</td>
</tr>
<tr>
<td>11. Alarm View</td>
</tr>
<tr>
<td>12. Help</td>
</tr>
<tr>
<td>13. Site / System Administration</td>
</tr>
<tr>
<td>14. Logout</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th>1.3 MENU DISPLAY</th>
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<tbody>
<tr>
<td><strong>Unexpanded Menu</strong></td>
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<tr>
<td>Occupancies</td>
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<tr>
<th>1.4 SYSTEM GRAPHICS AND USER INTERFACE</th>
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<tbody>
<tr>
<td><strong>General</strong></td>
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<tr>
<td>Floor / Plant Room Layout</td>
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<tr>
<td>System Schematic</td>
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</table>
systems - ie plant items will be show with interconnection of pipework and air flow schematics - not just plant in itself.

**Equipment Schematic**
- Selection of specific plant items: (e.g. chillers, boilers, fan coil units, fans, etc.)
- Will activate diagnostic details and show all system points
- Schedule, trend log, set point parameters and actual operating parameters.
- Provide a link to plant operation description.

**Normal and Alarms status**
Provide sensible alarm readings with colour arrangement for ease of quick visual observation.

**Schedule page**
Graphical Display of the following:
- Weekly, monthly and yearly schedules with holidays bypass for individual, group or global control of equipment
- Allow user to retrieve, override, re-schedule and regroup of all schedules.

**Summary Page**
Provide a complete graphical presentation of system and equipment in spreadsheet format with actual operating status for trouble shooting and quick overview of system.

**Energy/Utility Page**
Provide full graphical presentation of:
- Electricity,
- Gas and
- Water
Demand and consumption trend logs for up to minimum sixty days historical data for the total building, HVAC, light and power, and all distribution boards and mechanical services switchboards.

**Simulation Page (Troubleshooting)**
Provide simple individual, group or global control of system or equipment parameters to simulate and troubleshoot the performance of the installed system.

### 1.5 ENERGY SAVINGS AND MONITORING

| Sensing (Occupancy and daylight) | BMS is to be designed, installed and programmed to optimise energy efficiency in lighting control by providing occupancy control and daylight sensing |
| HVAC Systems | The BMS is to be programmed to optimise energy efficiency in hvac systems by including the following: |
| | - Start to operation schedule |
| | - Optimum start/stops |
| | - Supply air reset |
| | - Economy cycle - full outside air cycle |
| | - Zero energy band/load reset |
| | - Load shedding |
| | - Energy calculation |
| | - Optimum plant operation |
| | - Practicable occupancy sensing and control arrangements |
| | - As directed by the project brief |

### 1.6 BMS SYSTEM ACCESS, CONTROL & MONITORING

| Normal Operation and Monitored Points | Temperatures, |
| | humidity, |
| | Equipment statuses, |
| | Plant alarms, |
| | Flow rates, |
| | Energy consumption and Main Switchboards kVA, kW, kWh and PF, |
| | Uninterruptible Power Supply alarms |
| | Emergency Power Supply |
| | Any maximum or minimum demands |
### 1.7 SYSTEM REQUIREMENTS

#### Software
The software will also utilise an industry standard database e.g. Oracle 8i or MSSQL to provide JAVA database connectivity. Communication method between BMS and Client applications will include at least Java Messaging.

#### Integration
Work across multiple intelligent services throughout the site, including lighting, air conditioning, energy and power quality monitoring, fire protection, security, and access
Provide high level interfaces to lifts and other intelligent systems.

#### Functionality
- Collect trends from defined points, collect and forward alarms from the systems.
- Enable efficient management of user rights
- Forwarding high priority alarms to mobile phones using SMS
- Provide details of the alarm history for reporting and statistical purposes.
- Include a object model of the building, its components, spaces and networked systems.
- Include an open interface for other applications to interact with the networked systems.

#### Programming
**Design and Implement the following functionality:**
- Showing Schematic of Chillers, Pumps, valves and status (on/off)
- Values of Differential Pressure, set points, valve opening (%), temperatures, alarm points, direction of flow.
- Differential pressure set point (kPa)
- Supply and Return temperatures (in degrees celcius) from chillers and AHU’s
- Bypass mixed return, heat exchange mixed return and field return temperatures
- Bypass and heat exchange mixing valves percentage open
- System differential pressure (kPa)
- 15 minute profile data is to be exported from the BMS Server in real time to a computer file server which is accessible to the Utility Information System
- Gas sensors to recording peak levels and continuous time weighted averages. This updates the TWA at each sample period, which must be less than 6 minutes apart

#### Software Changes
- The software is to include tools to create, modify, and debug custom application programming

#### Scheduling
- The operator workstation is to retrieve and display weekly schedules stored in an easy-to-read 7-day (weekly) graphical format for each schedule along with any applicable exception day schedules for holidays or special events.
- The operator workstation is to retrieve and display exception date schedules in an easy-to-read monthly format. Exception schedule data is selected by highlighting a date or range of dates, or by specifying a re-occurring weekday (for example, a given day of a given week each month

#### Trend Log Displays and reports
- The operator workstation may retrieve and display trend logs of historical object data stored as well as maintain trend log files saved to disk for subsequent use in spreadsheet or database programs

#### Gas detection actions
- When tunnel gas levels exceed recommended explosive levels the red lights will turn on, the warning light will flash and an alarm will be sent to the control system
- An analogue sign will enable the current TWA valve to be displayed on the control system
### Gas Detection recording
- Gas sensors to recording peak levels and continuous time weighted averages. This updates the TWA at each sample period, which must be less than 6 minutes apart.

### Flashing Sign
- A flashing sign located adjacent to the side door which reads “DO NOT ENTER WITHOUT BREATHING APPARATUS” and with an internationally recognised no entry symbol.

### Web Server
- BACnet system will be completely accessible through a Web based server using simple web based programs.

### Web Client
- Web Based browser will incorporate remote access through the internet from any location with correct internet system password and access provisions to be established by the University.

### System Help
- On-line help system to assist the operator in managing and editing the system.

### System Security
- Operators are to log on to the system with a user name and password to gain entry into the operator workstation software. System security is to be role based and selectable for each individual operator and include a provision for granting privileges.

### Operator Display
- The operator workstation software is to display and provide operator access to all BACnet and proprietary objects associated with the project as specified in the drawings and/or points list.
- Right-clicking an object is to bring up a context sensitive pop-up menu of commands and functions that can be initiated directly for the highlighted object without opening the object.
- Properties may be created, edited, deleted and printed on command.

### Operator Authority
- Authorised operators are able to initiate manual override commands, acknowledge alarms and change operator settings directly from this menu window.

### Operating System
- The operating system is to be Microsoft Windows and support the use of other common software applications that operate under Microsoft Windows.

#### 1.8 NETWORK /COMMUNICATION /SIGNALLING REQUIREMENTS

| BACnet | The BMS system is to be interconnected to all other BMS systems via the BACnet protocol over IP and across the university computer network.
- No BMS subnet or controller is to operate that is not BACnet compliant, and all devices are to be BACnet addressable.
- Pass data in a bi-directional manner across all routers, gateways on the University network.

| Network Routing capacity | The BACnet communication network will have a minimum total routing capacity for 1000 Network and System Controllers.

| Equipment | Native equipment is to be designed and installed in preference to emulation equipment.

| Maintenance Supervision | The system is to be designed and installed to be able to totalise run-times for all binary input objects and monitor equipment status and generate maintenance messages based upon use designated run-time, starts, and/or calendar date limits.

| Sequencing | Sequence the connected output devices and prevent all controlled equipment from simultaneously restarting after a power outage. The order in which equipment (or groups of equipment) is started, along with the time delay between starts, may be user-selectable.

| PID Control | The BACnet loop object complete with self-tuning PID algorithm to calculate a time-varying analog value that is used to position an output or stage a series of outputs. The set point and PID properties are to be user-selectable from the operator interface.

| Control Relay | Design and install a high impedance relay to produce a dry contact.

| Digital inputs | Digital inputs to be voltage free contacts opening for the ON or ALARM condition.

| Digital outputs | Digital outputs to be voltage free closing for the ON condition and suitable for switching of 24V 50Hz supplied from the mechanical services switchboard.

| Input Capability | All inputs are to be individually configurable for digital contacts, thermistor, 0-5 VDC, 0-1 VDC, and 4-20mA without the addition of interface devices. Each input is to also have visual LED for local status indication and be electrically protected against short circuit connections.
### Output Capability

All universal outputs must be individually configurable for 0-10 VDC analog device control and relays for binary device control.

An output status LED and a MANUAL/OFF/AUTO override switch is to be provided for each binary output device connected to the system controller. All MANUAL/OFF/AUTO override switches for binary output devices is to be monitored to provide dynamic indication of the switch status.

### Transformers

Current transformers (CT) are to be designed and installed on all major air conditioning and associated plant and interface the 0-5amp, 0-5volt or 4-20mA CT outputs to analogue inputs of the system.

### Power Supplies

#### General

- All transformers and power supplies for field devices to be located within designated control enclosures.
- Power may not be obtained by tapping into miscellaneous circuits that could be inadvertently switched off.

#### Locations

- Provide all power to cabinets, panels necessary for the complete and satisfactory operation of the entire BMS.

#### Surge Diverts

- Provide surge diverts connected so as to protect the sensing devices and all BMS equipment from damage or spurious operation caused by voltage surges in the power source.

#### Dedicated Circuits

- All power for controls equipment will be from dedicated circuits. Where a controller is dedicated to controlling a single piece of equipment power may be obtained directly from that equipment.

#### Spare

A minimum of 10% spare universal input and output points is to remain available onboard and ready for connection at the completion of the project.

### 1.9 MATERIALS, INSTALLATION, LABELLING AND SIGNAGE

#### General

- Only new and currently manufactured materials and products are to be documented and installed in the works.
- The contractor's supplier is to confirm that an inventory of spare parts is commercially available for a period exceeding five years after completion of the installation.
- Will be backed up with manufacturer's warranty, maintenance recommendations listing all performance details with comprehensive rating and certified test data on their products installed.

#### Prior Approval

To verify selection submit prior to installation the following to the CIS Mech Services Contracts Manager:

- Valve make and model
- Valve pressure drop at design flow.
- Valve flow coefficient (kv),
- Pressure drop of item served at design flow and valve actuator

#### Control Panel Location

Panels and cabinets mounted in dedicated telecommunication rooms, where provided or elsewhere to suit the concentration of equipment, subject to approval and in accordance with manufacturers recommendations.

Wall mounted panels are to be approximately 1600mm from the centre of the panel to the floor.

#### Wiring

All wiring line and low voltage works are to be installed in full compliance with the latest edition of Australian Standard 3000. Nothing in this document overrules a requirement of this standard.

#### Mechanical Switch Boards

The MSB will contain the following:

- all transformers and power supplies for equipment located within the cabinet. (No control transformers or power supplies are to be installed in ceiling spaces)
- Line filters for all power, supplying control equipment within the cabinet.
- Computer network access port to log onto the DDC system.
(If the cabinet is located further than 2 metres laterally from the nearest outlet, a 240 VAC outlet is to be installed to power a laptop PC.)

Transformers and other peripheral equipment are to be mounted in panels.

The University will **not accept** Peripheral equipment to be mounted in ceiling spaces.

<table>
<thead>
<tr>
<th>Rigid Conduit</th>
<th>In plant rooms all cables are to be installed in heavy duty, rigid PVC conduit, on cable tray, or in cable duct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexible Conduit</td>
<td>Terminations for field devices (e.g. temperature sensor) are to be made from flexible conduit. Use shielded cable where required to provide protection against induced noise. Use stranded ca with a minimum cross section of 8 mm$^2$</td>
</tr>
<tr>
<td>Control Supplier</td>
<td>The control supplier is to wire control cabling to mechanical switchboards and terminate cables in terminal strips provided in each board</td>
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<tr>
<td>Main control Panel enclosures</td>
<td>The MSB will contain the following:</td>
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<td>• All transformers and power supplies for equipment located within the cabinet. (No control transformers or power supplies are to be installed in ceiling spaces)</td>
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<tr>
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<td>• Where main control panel enclosures are located in plantrooms with variable speed drives, the minimum size will be 7/0.80</td>
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<tr>
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<td>• Main control panel enclosures located in plantrooms are to be securely earthed with minimum size 7/0.67 cable</td>
</tr>
<tr>
<td>False ceiling spaces</td>
<td>• All wiring within false ceiling spaces is to be neatly grouped and suspended as far as is practical. Cabling between control panels and control devices is to be installed without splicing</td>
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<td>• All wiring is to be terminated at numbered DIN rail mounted terminal blocks</td>
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<td>• Control cables are to be terminated with insulated pin lugs and approved slip-on ferrules numbered at both ends to correspond to the as-built/installed drawings</td>
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<tr>
<td>Network Cabling</td>
<td>• Ethernet LAN cables are to be “home run” to Hubs/Switches in accordance with standard Ethernet networking practice</td>
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<td>• ARCnet LAN cables are to be wired in a daisy chain. Star or tee connections are not permitted unless specifically recommended by the manufacturer in published installation procedures</td>
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<td></td>
<td>• Install LAN cabling between control panels without splicing</td>
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<tr>
<td></td>
<td>Ethernet cable terminations are to be done using appropriate connectors and crimping tools. Crimping using pliers is not acceptable</td>
</tr>
<tr>
<td>Cable Types</td>
<td>• Cabling for inputs and outputs is to be double insulated 7/0.30 Twisted and Shielded with a drain wire grounded at the control panel end only unless otherwise specified</td>
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<tr>
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<td>• Cabling for RS485 communication networks is to be double insulated 7/0.30 Twisted and Shielded with a drain wire continuous throughout network and grounded at the main control panel</td>
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<td>• Cabling for Ethernet communication networks is to comply with University communications cabling standard. Cabling for Power Supplies to remotely mounted control panels is to be double insulated with a minimum size of 7/0.30 and a maximum size of 7/0.50. Circuits that require cable sizes outside this range should be avoided</td>
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<tr>
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<td>Cabling for Power Supplies to main panels located in plant rooms will be a minimum 7/0.67</td>
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</table>
### Automatic control valves

**General**
- Size control valve actuators provide a tight close off against system head pressures and pressure differentials.
- Design and materials of valves and motors to be such that leakage of water from the stem packing does not cause corrosion of any working part.

The University will not accept Butterfly or ball valves for control through coils.

**Resistance**
- Minimum fully open resistance to the flow of 1.5 times that of the combined pressure drop of the branch pipe and the item served.

**Power**
- Valve actuators will have 0-10 volt DC control voltage except where two position control is specified.

### Damper Actuators

**General**
- Motors to be selected conservatively motors for the duty required.
- Select or adjust operating speeds so that the motor will remain in step with the controllers without hunting, regardless of motor variations.
- A motor operating in sequence with other motors to have adjustable operating ranges and starting points to permit adjustment of the control sequence as required by the operating characteristics of the system.
- Actuators to be direct coupled for either modulating or two position control.

**Power**
- Actuators to be powered by an overload-proof synchronous motor. Provide 0-10 VDC control voltage for all proportional applications and either line or low voltage actuators for all two position applications.

**Signal**
- Accept analogue or pulsed digital signal directly from the BAS control unit.

**Life Span**
- Life span to be in excess of 50,000 open-close operations.

### Transducers

**Accuracy**
- Employ active type with an accuracy of +1% of span.
- Accuracy to 3% of span and repeatable to 3% of span.

**Signal**
- Accept a signal from the necessary transformers (current and/or voltage) and convert the signal(s) to a signal compatible with the BAS control unit.
- Supply transducers to the relevant switchboard supplier for installation.

**Types**
- Use electronic to pneumatic transducers of industrial quality.

**Temperature**
- Temperature compensated over the full span of the device.

**Input Range**
- Input range of 0 - 10 volts DC or 4 - 20 mA.

### Control Relay (Solid State)

**Capacity**
- 40v 10amp capacity.

**Applications:**
- Normally open or normally closed to suit the application, suitable for switching inductive AC loads.

### Current Sensor (Analog)

**Accuracy**
- Accuracy OF IS to be +/- 2% of full scale at each range.

### Sensors

**Humidity Sensor**
- Capacitance type compatible with BAS system.

**Duct Sampling**
- Complete with duct sampling devices.
- Protected from airborne dust particles and free air moisture.

**Temperature Compensated**
- Relative humidity sensors to be temperature compensated such that when used in conjunction with the BMS or separate controller.

**Accuracy**
- Accuracy of the display is +/- 3% of operating range.

### Differential Pressure Sensor (Air)

**Type**
- Provide static pressure sensors of the differential pressure type.

**Adjustable**
- Sensor range (span) to be adjustable.

**Accuracy**
- Accuracy of sensor including controller to be +/- 1% of span.

**Capacity**
- Sensors to be capable of withstanding a total pressure differential of 1000 Pa.

### Differential Pressure Sensor (Water)

**Type**
- Provide static and differential pressure sensors complete with span and zero point adjustment from both software and hardware techniques.

**Accuracy**
- Accuracy of sensor to be +/- 1% of span.

**Capacity**
- Sensors to be capable of withstanding pressure ranges of vacuum to 2000 kPa without permanent effect on the operation of the device.
### Duct Temperature Sensor
- **Type**: Sensor encapsulated in a copper or stainless steel probe
- **Accuracy**: ±0.1 deg C
- **Assembly**: Assembly complete with wiring housing and mounting flange

### Outdoor Air Temperature Sensor
- **Type**: Thermistor sensor encapsulated in a probe, with weatherproof enclosure, sun shield and mounting bracket
- **Accuracy**: Accuracy to be ±0.3 deg C over the entire operating range

### Pipe Temperature Sensor (Well)
- **Type**: Thermistor sensor encapsulated in a long probe, with screw fitting for insertion into a standard thermowell
- **Accuracy**: Accuracy to be ±0.3 deg C over the entire operating range

### Pipe Temperature Sensor (Strap-On)
- **Type**: Thermistor sensor complete with solid state circuitry in an enclosure and connecting cable to the thermistor
- **Accuracy**: Accuracy to be ±0.3 deg C over the entire operating range

### Room Temperature Sensors
- **Type**: Temperature sensors of the thermistor type.
- **Rapid Response**: Mount sensors to ensure a rapid response to changing temperature
- **Accuracy**: Accuracy to be ±0.1 deg C over the entire operating range

### Gas Sensors
- **Type**: The detector element will be of the plug in type with either a 24V, 4-20mA output signal.
- **Casing**: Include sensing elements and electronics mounted in an aesthetics single piece casing.
- **Measurement**: Provide analogue measurement to the control system.
- **Sensor Range**: Provide a sensor range of zero to 2000 ppm
- **Accuracy**: with less than ±5% accuracy of full scale
- **Certification**: Be NATA tested with a certificate provided at time of commissioning
- **Portability**: Portable atmospheric gas sensors are to be used when specified and be also NATA tested as above

### Gas Sensing Display
- **Display**: Four digit LCD display
- **Safe Lights (Operating Normally)**: Two green safe lights illuminated
- **Danger Lights**: When tunnel gas levels exceed recommended explosive levels the red lights will turn on. Two red lights will turn on, the warning light will flash and an alarm will be sent to the control system
- **Analogue sign**: Will enable the current TWA valve to be displayed on the control system
- **Alarm Level**: Set point adjustment
- **Alarm Flow**: Flow fail alarm
- **Power Supply**: 12 hour battery life (rechargeable, unit complete with recharger
- **Casing**: IP65 casing
- **Accuracy**: 0-3000 ppm with ±5% full scale accuracy

### Breathing Apparatus
- **Location**: Wall mounted in lockable cabinet outside the space
- **Labelling**: BREATHING APPARATUS

### Fan Status Indicator
- **Airflow Switches**: Airflow switches to be of the differential pressure type
  - Have adjustable setpoint incorporating a single pole throw switch mechanism arranged to changeover on a pressure rise and vice versa
  - Switches are to be complete with pitot tubes to sense the differential pressure between the suction and discharge sides of the fan
- **Location**: Position tubes to eliminate blockage of tube openings
Labelling and Signage

<table>
<thead>
<tr>
<th>General</th>
<th>Engraved black on white multi-layered durable laminate with chambered edges. Attach to equipment to double sided tape adhesive.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switchboards</td>
<td>At the switchboard circuit breaker from which power is obtained for the BAS, label the circuit breaker 'BUILDING AUTOMATION SYSTEM- PLEASE DO NOT SWITCH OFF'</td>
</tr>
<tr>
<td>Breathing Apparatus</td>
<td>Above cabinet 'BREATHING APPARATUS'</td>
</tr>
<tr>
<td>Flashing Sign</td>
<td>• A flashing sign located adjacent to the side door which reads &quot;DO NOT ENTER WITHOUT BREATHING APPARATUS&quot; and with an internationally recognised no entry symbol</td>
</tr>
<tr>
<td>(Gas Detection)</td>
<td>• One green and red light wall mounted within the space</td>
</tr>
</tbody>
</table>

2.0 Documents and Certification Review

<table>
<thead>
<tr>
<th>Documentation Requirements</th>
<th>• System architecture</th>
</tr>
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<tbody>
<tr>
<td>The following must be submitted:</td>
<td>• LAN concept</td>
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<tr>
<td></td>
<td>• Technical data sheets for each BACnet device including typical detailed connection diagrams for all devices</td>
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<td>• Compliance statement - areas of non-compliance are to be included in the tender submission</td>
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<tr>
<td></td>
<td>• BACnet Protocol Implementation Conformance Statements (PICS) and BACnet Interoperability Building Block (BIBB) summaries showing device profiles for Operator Interfaces, the Network and Unitary Controllers</td>
</tr>
<tr>
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<td>• Resume of all technical support staff nominated with the project</td>
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<td>• Details of current and completed native BACnet projects undertaken by the tenderer</td>
</tr>
</tbody>
</table>

BMS System Design and Functional Specification

<table>
<thead>
<tr>
<th>The BMS system documentation is to include a detailed design and functional specification develop by the consultant and is to include:</th>
<th>• System objectives and deliverables</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>• Integration plan</td>
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<td></td>
<td>• Test plan</td>
</tr>
<tr>
<td></td>
<td>• Detailed schematic</td>
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<td></td>
<td>• Performance levels and capacity provided</td>
</tr>
<tr>
<td></td>
<td>• System control mechanism</td>
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<td>• Functional details</td>
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<td></td>
<td>• Point schedules - establish specific list for each project</td>
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<td></td>
<td>• Set point description, function, type and interface requirements</td>
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<td></td>
<td>• Set up of viewable and controllable parameters</td>
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<td></td>
<td>• Monitoring and interrogation design and user interface</td>
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<td></td>
<td>• Graphics and displays</td>
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<td></td>
<td>• Calendar and scheduling</td>
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<tr>
<td></td>
<td>Any other associated details and system requirements</td>
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</tbody>
</table>
Commissioning

The design and installation of the works is to include a detailed commissioning plan and time schedule, approved by the university and its consultants, which includes the following:

- Allocation of space for hardware
- Installation of server hardware (if required)
- Backup of existing systems and data
- Installation or upgrade of server database and software
- Installation of client software (if required)
- Integration with other systems and software such as email, IIS and UIS
- Creation of operator accounts, roles and passwords
- Testing (as per the test plan)
- Quality assurance measures to ensure compliance with project specification
- Demonstrate and confirm that all systems are programmed and operating correctly
- Provide access to customer support services

Once the Commissioning Plan is approved, the contractor /Supplier may execute the plan and report on progress to the university.

Testing and verification

The Design and installation of the works are to include a detailed testing plan, approved by the University which includes the following:

- Test cases
- Testing methodology
- Expected results
- Methodology for evaluation of test results
- Quality assurance measures employed to ensure the testing process is in conformance with the Test Plan
- Review methodologies.

Test cases will be included for each device, technical requirement and for an “integrated” test between all components of the system that are under BMS control. Test cases will involve the supplier undertaking remote interrogation and control (at all levels) of existing University owned BACnet I/O devices using the supplier’s software. In addition, a remote interrogation and control test of the vendor supplied I/O field devices will be undertaken using the existing University existing front end BACnet system.

Once the Test Plan is approved, the supplier may execute the plan and report the results to the University.

Documentation- CHECK CONTRACT REQUIREMENTS

The Contractor is required to prepare and submit the following as-built documentation in relation to the project at least one month prior to the proposed date for practical completion. Practical completion will not occur until this has been submitted in full and the university has either accepted that the documentation is complete and accurate.

The required documentation is as follows:

- An Operations and Maintenance Manual comprising a description of the system, a guide to its operation, procedures for maintenance and troubleshooting the installed configuration including default settings and the sequence of operations
- As-installed control drawings, prepared in AutoCAD format and identifying all items of control equipment
- An equipment schedule
- Set points, operating ranged and zero positions of all instruments
- Specifications for all devices and controllers
- Source code for programming scripts
- Up to date licensed original program disk(s) and documentation proving registration for all software programs provided as a part of this contract
- Copy of the final programs that include all point definitions, weekly and annual schedule setting, controller set points and tuning parameters, and documented programmed sequences of operation
Warranty
The contractor is to provide a warranty for all hardware and software components supplied under this contract for a period of twelve (12) months from the date of practical completion. The warranty is to be included in tender documentation. The warranty must include all parts and labour during the warranty period.