

F3200 Fire Alarm System Engineer's Specification

A Modular Fire Alarm System up to 64 Zones

ENGINEER SPECIFICATION

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0 ADVICE TO ENGINEERS ON SYSTEM CONSTRUCTION

This specification describes a conventional (collective) fire alarm system, which provides a cost effective and reliable means of fire detection, fire alarm indication and ancillary control. Its programmable functions and input and output handling capabilities render it suitable for a wide range of applications.

The F3200 Fire Alarm System is also extremely flexible in its construction. A series of 19" Rack Cabinets is available, with the cabinet sizes ranging from 8U to 40U. The standard 15U base panel may house an alphanumeric liquid crystal display (LCD) which can by itself provide full display facilities for a single fire alarm panel or multiple fire alarm panels where networking is utilised. The LCD may be programmed to display a unique text alarm message for each zone.

The LCD may be supplemented with LED zone indicators providing separate alarm, fault and isolate indications for each zone. These indicators are expandable in groups of sixteen (16) Zones to the system maximum of sixty-four (64) Zones. A complete F3200 system with 64 zone indications may be accommodated in the 15U base panel. Networking multiplies this capability.

A number of networked panels (up to 64 depending on the application) can communicate on one network segment. Intelligent Hubs allow network segments to be joined resulting in an upper limit of total system size that far exceeds current requirements.

The flexibility of this system and the range of options require the specification for each project to be selected to suit the application. For this reason optional specification clauses are tagged with an asterisk throughout this specification and can be deleted or inserted as required.

Appendix 1, as mentioned in Section 7, is to be provided by the Engineer and should list each Air Conditioning System to be controlled and its type, i.e., Supply, Return, Smoke Spill.

1 GENERAL REQUIREMENTS

1.1 SCOPE - FIRE DETECTION

A fire detection and alarm system shall be installed throughout (ADD NAME OF PREMISES)*. The fire detection and alarm system shall be low voltage and modular in full compliance with all applicable codes and standards.

The contractor shall provide, install, test and commission the fire detection and alarm system as specified herein and as shown on the tender drawings. The system shall include all required hardware, interconnecting wiring and software to accomplish the requirements of this specification and the tender drawings, whether itemised or not.

(CAD based floor plans for map generation on a colour graphics display terminal shall be included in this contract.)*

1.2 MATERIALS AND SERVICES

The system shall include, but not be limited to the following elements:

- Fire Indicator Panel (FIP) and associated modules.
- Power supplies, batteries and battery chargers.
- Equipment enclosures.
- Fire detectors, manual call points, flow switches and other actuating devices required for performance to this specification.
- Mimic panels, remote LCD displays, printers and computer colour graphics displays where shown on the drawings.
- Software and firmware as required to provide a complete functioning system.
- Wiring and enclosures.
- Installation, testing, commissioning, and completion of installer's statement as required by AS 1670.1.

1.3 APPROVALS

All fire alarm control and indicating equipment shall be independently tested and certified to AS 4428.1. All equipment shall be listed by SSL (Scientific Services Laboratory).

All smoke detectors shall comply with AS 1603.2 and shall be listed by SSL.

All heat detectors shall comply with AS 1603.1 and shall be listed by SSL.

Tenderers shall provide copies of approvals for the works specified herein.

1.4 QUALIFICATIONS OF THE INSTALLER

Before commencing work, data shall be submitted showing that the contractor has successfully installed fire alarm systems of the same type and design as specified, or that they have a firm contractual agreement with a subcontractor having the required manufacturers' training and experience.

1.5 STANDARDS - FIRE DETECTION

The following standards are referred to in this Specification:

AS 1603	Automatic Fire Detection and Alarm Systems
AS 1603.1	Part 1 - Heat Detectors
AS 1603.2	Part 2 - Smoke Detectors
AS 1603.5	Part 5 - Manually Operated Fire Alarm Call Points
AS 1603.6	Part 6 - Fire alarm bells.
AS 1670	Fire detection, warning control and intercom systems - System design, installation and commissioning.
AS 1670.1	Part 1: Fire
AS 1851	Maintenance of fire protection equipment
AS 1851.8	Part 8 - Automatic fire detection and alarm systems.
AS 2118	Automatic Fire Sprinkler Systems
AS 2220	Emergency warning and intercommunication systems in buildings.
AS 2220.2	Part 2 - System design, installation and commissioning
AS 3000	SAA Wiring Rules
AS 3013	Electrical installations- Wiring systems for specific applications.
AS 4428	Fire detection, warning, control and intercom systems - Control and indicating equipment
AS 4428.0	Part 0 - General requirements and test methods
AS 4428.1	Part 1 - Fire
AS 4428.5	Part 5 - Power supply units
AS 4428.6	Part 6 - Alarm signalling equipment

SITE COPY Keep on the site a copy of AS 1670.1.

1.6 INSTALLER'S STATEMENT - FIRE DETECTION

REQUIREMENT: Before practical completion provide an installer's statement and certificate in the form set out in AS 1670.1, Appendix B.

1.7 DRAWINGS & DIMENSIONS - FIRE DETECTION

DIAGRAMMATIC LAYOUTS: Drawings showing fire detector layouts are diagrammatic only. Before commencing work, determine the exact positions of the detectors in conjunction with the Engineer, having regard to building features, other services, and the requirements of regulatory authorities.

1.8 (FIRE STATION CONNECTION - FIRE DETECTION)*

REQUIREMENT: (Connect the main FIP to the nearest fire monitoring service provider with a direct data link to a fire dispatch centre. The alarm signalling equipment used for this connection shall comply with AS 4428.6)*

The contractor shall pay all fees associated with the initial connection to the monitoring service provider. The principal shall pay the monitoring costs as they occur.

2 SYSTEM DESCRIPTION

2.1 GENERAL

The requirements of "Conditions of the Contract" apply to this work. This specification intends to describe an "on premises" fire alarm system that is to be programmable and modular. All reference to model numbers and other pertinent information herein is intended to establish minimum standards of performance, quality and construction, and is based upon the F3200 Fire Alarm System. It is not the intent of these specifications to eliminate competitive equipment. Any equipment proposed as equal to that specified herein shall conform to the standards herein, and the manufacturer must supply proof of having produced similar equipment, now giving satisfactory service. Where alternative equipment is proposed the manufacturer's name, model numbers, and three copies of working drawings and engineering data sheets shall be submitted for approval. Included in the submittal shall be a written statement from the manufacturer of the substituted equipment that it does in fact equal the features, functions, and performance of the specified equipment.

Systems that do not meet the performance criteria of this specification will not be accepted.

The system as described shall be installed, tested and delivered to the owner in first class condition.

The system shall include all required hardware, interconnecting wiring and software to meet the requirements of this specification and to meet the requirements of the contract drawings, whether itemised or not. The configuration of the system, and its operation and annunciation of alarms shall be as described in this specification and as shown on the drawings.

Smoke and heat detection, manual call points and sprinkler flow switches shall be supported by the system. (In addition, supervisory functions such as the monitoring of sprinkler valve tamper circuits and fire pumps, and control and interface with air conditioning systems shall be provided.)*

Comprehensive programming facilities shall be provided to enable output control logic functions to be performed and the resulting outputs to be activated.

2.2 DESCRIPTION

The system shall be a complete, electrically supervised, fire alarm system, designed and installed in accordance with AS 1670.1. The configuration of the system, and its operation and annunciation of alarms shall be as described in this specification and as shown on the drawings.

The system shall utilise heat and smoke detection, manual call points and sprinkler flow-switches connected by two-wire, supervised circuits to alarm zone circuit facilities at the fire alarm panel.

Each zone circuit shall be provided with a variety of field programmable configuration options as specified herein. Separate configuration facilities on each zone circuit shall provide flexible interfacing to the actuating devices shown on the drawings.

The system shall be easily expandable from a minimum of 8 zone circuits to a maximum of 64 zone circuits by adding plug-in modules to the fire indicator panel. Similarly, the output capabilities of the control panel shall be expandable by adding plug-in relay modules.

The standard system control logic and input/output programming facilities provided by the indicator panel shall be sufficient to support all air conditioning fire control logic without the need for separately programmed PLCs or computers.

Display of system information shall be possible at up to 8 remote locations over a serial communications link.

The system shall support an external 80 column printer, as supplied by the system manufacturer. All alarm, fault, reset or isolate events shall be logged to the printer.

The system shall support a fully compatible colour graphics computer display system, supplied by the system manufacturer.

2.3 SYSTEM OPERATION

The operation of the system in response to the activation of input circuits shall vary according to the programmed parameters for each zone as indicated on the drawings and in the specification below.

Activation of any fire alarm initiating device shall cause the following actions and indications:

- Indicate a fire alarm condition at the fire indicator panel and any remote indicator panels that are installed.
- Operate the fire indicator panel sounder and the external bell. The fire indicator panel sounder shall be able to be silenced by an alarm acknowledge key on the fire indicator panel. The external bell shall operate until isolated from the fire indicator panel or until the alarm has been reset.
- (Cause the building fire warning system to operate as detailed in Section 6.2.) OR (Communicate the operated zone to the building emergency warning system as detailed in Section 6.2)*
- Log the alarm condition and its location to the printer (if fitted) and to the system history file.
- Close all smoke doors and smoke dampers shown on the drawings to prevent the spread of smoke.
- Operate air handling units and smoke removal fans as shown on the drawings.
- (Send an alarm signal to the fire monitoring service provider.)*

Activation of any supervisory circuit, (supervised valve closure, air pressure abnormal, low temperature, fire pump fault) shall cause the following actions and indications:

- (Indicate the supervisory condition at the fire indicator panel.)*
- (Activate the audible sounder at the fire indicator panel until it is acknowledged (as for a fire alarm).)*
- (Log the activation to the printer (if fitted) and to the system history file.)*

The occurrence of a fault condition (e.g. open or short on a zone circuit or supervised output, fire indicator panel fault, open or short on remote display communications wiring) shall cause the following actions:

- Indicate the fault condition at the fire indicator panel.
- Activate the audible sounder at the fire indicator panel until it is acknowledged.
- Log the fault event to the system printer (if fitted) and to the system history file.
- (Send a fault signal to the fire monitoring station.)*

If any alarm zone is isolated, then an isolate indication shall be displayed at the fire indicator panel (, and an isolate signal shall be sent to the fire monitoring service provider)*.

The occurrence of a condition that effectively disables the system (all alarm zones isolated, system power supply failure, system processor failure) shall activate a separate output. (This output shall be used to signal this condition to the fire monitoring service provider.)*

2.4 SYSTEM ZONING

The system shall be divided into zones as indicated on the drawings. An alphanumeric LCD (and LED indicators)* on the fire alarm panel shall provide indication of the status of each zone in the system.

The alphanumeric LCD shall provide a unique programmable message specifying the location of the zone and the associated alarm type (Smoke, Heat, Flow Switch etc.) for each zone.

The location text shall be up to 30 characters in length and the system shall provide for the display of up to 16 different programmable alarm type designations.

3 FIRE INDICATOR PANEL

3.1 GENERAL

The fire indicator panel shall be mounted in the position indicated on the drawings. It shall be modular in construction and shall include, but not be limited to, the hardware, software and firmware required to perform the major system functions that are described below.

Programming shall be unnecessary for the operation of the system in a standard configuration, but comprehensive programming facilities shall be provided allowing customisation of the installation, both on commissioning and as required for future modifications and additions. Access to the programming facilities shall be via the standard, built-in control panel.

All programmed information shall be stored in non-volatile memory. Access to the system programming shall be protected by a programmable access code. Up to ten (10) access codes shall be able to be assigned for use at the same time to enable up to ten system users to be separately identified. A record of the last user of the programming facility shall be retained in the system database.

Included in the programmable parameters shall be the following general system facilities:

- enter new programming access password
- enter current date, time and system name
- enter location text for each zone.

The system shall be able to down-load and restore all programmed configuration parameters to and from a PC for back-up storage on a floppy disk or similar media. Systems not capable of mass down-loading and restoration for off-site back-up will not be considered acceptable. The down-load and restoration facilities shall include a verification function allowing a saved database on disk to be verified against the database in the fire indicator panel. In addition, the system shall be able to down-load the complete programmed parameters to a printer or a PC in human-readable text to enable maintenance and service personnel to understand how the system operates.

3.2 FIRE INDICATOR PANEL ENCLOSURE

The enclosure of the fire indicator panel shall be a surface mounted, 19 inch rack format, steel cabinet with indicator viewing window, hinged door and cylinder lock. It shall be factory finished in baked epoxy powdercoat Cream Wrinkle BFF998CW. A manual call point shall be mounted either on the front of the cabinet, or immediately adjacent to it. The wiring to this call point shall be supervised and the call point connection to an alarm zone shall be program selectable.

3.3 CONTROLS AND INDICATIONS

Behind the indicator viewing window, an operating panel shall be located, incorporating a 2 line by 40 character LCD alphanumeric display, discrete indicators for ALARM, ISOLATED, FAULT, WARNING SYSTEM ISOLATED, EXTERNAL BELL ISOLATED and ACKNOWLEDGE, RESET, ISOLATE, WARNING SYSTEM ISOLATE, EXTERNAL BELL ISOLATED, NEXT and PREV controls. The operating panel shall comply with the Firefighter Facility (FF) requirements of AS 4428.1.

With no abnormal conditions present on the system, the alphanumeric display shall show the name of the system and the current date and time.

An unacknowledged alarm condition shall cause the following information to be clearly indicated on the alphanumeric display: zone location, zone status, alarm type and total number of zones in alarm.

An unacknowledged fault condition shall cause a user programmable fault action message to be displayed on the LCD to advise the operator of the action to take to deal with the fault condition.

When abnormal conditions (including *acknowledged* alarms or faults) exist in the system the alphanumeric display shall clearly show the number and nature of the conditions present, and shall provide the means to readily recall the conditions to the display. Other controls and indicators, clearly delineated from those of the FF, shall be provided for other fire indicator panel operating functions (e.g. recall and test).

An event history log shall be maintained in the fire indicator panel memory. This data shall be able to be recalled on the alphanumeric display and shall contain a date and time stamped log of not less than the previous 400 events in the system.

3.4 (DISCRETE LED INDICATORS)*

Apart from the LCD on the operating panel, the fire indicator panel shall contain discrete zone LED indicators to show:

1. Operation of detectors within each fire zone.
2. Operation of detectors on each floor.
3. (Operation of each sprinkler system pressure switch.)*
4. (Operation of each sprinkler system flow switch.)*
5. (Indication of all pump run and ancillary indicators as required under AS 2118.)*
6. Indication of all ancillary device isolations, including any door holders, air-conditioning trips and evacuation system outputs.

Zone LED indicators shall include three (3) individual LEDs for each zone.

Red	-	Alarm
Yellow	-	Fault
Yellow	-	Isolate

The fire indicator panel front fascia shall provide space adjacent to each group of LEDs for two (2) lines of typed text at 24 characters per line.

3.5 TEST FACILITIES

Test facilities shall be provided at the fire indicator panel to manually activate a full system test, a test of the display only, or a test of individual or a range of zones. In addition, automatic system test facilities shall be incorporated that tests all microprocessor components and alarm zone inputs. Automatic system tests shall be activated at regular intervals by the system software, and means shall be provided in the programmable parameters to inhibit automatic testing on specific dates.

The automatic system test, whilst testing all zones and functions, shall not activate signals to the fire monitoring station or any ancillary equipment such as air-conditioning shut-down and magnetic door holders. Separate facilities shall be provided to manually test these functions. Failure of an automatic test shall be indicated on the fire indicator panel.

The fire indicator panel shall also provide facilities to activate an automatically-resetting one-person walk test mode which shall be able to be applied over a single zone or a range of zones. When this test is applied, the system shall remain fully functional in all other areas.

3.6 INPUT/OUTPUT CAPABILITIES

The input and output capabilities of the control panel shall be easily expandable by adding input or relay modules in groups of 8 zones or relays to a maximum of eight 8 way modules (i.e. 64 zones with no relay modules added).

In a minimum configuration, with no relay modules added, the panel shall be capable of handling 8 alarm zone circuits, and shall provide a separate programmable open collector output for each zone (i.e. 8 outputs per 8 zone module). These outputs shall be provided with transient protection and be suitable for connection to field wiring extending outside the fire indicator panel

Seven programmable relay contact outputs shall also be provided in a minimum system. The function of these relays shall normally be designated as follows:

- Alarm relay; 1 set of isolated changeover contacts.
- Fault relay; 1 set of isolated changeover contacts.
- Isolate relay; 1 set of isolated changeover relay contacts.
- Standby relay; 1 set of changeover contacts. This relay shall be normally energised.
- Warning System relay
- External Bell relay
- Ancillary relay.

The ancillary, warning system and external bell relay outputs shall provide output supervision, with supervision also available on all outputs from 8 way relay modules. The output supervision available for the warning system shall enable the warning system circuit to be wired with up to 3 parallel branches while maintaining supervision of the wiring to all warning devices. The output supervision available for the ancillary relay shall be programmable to provide supervision of a normally energised load (e.g. door-holders) or a normally de-energised load.

Field wiring terminations to the printed circuit modules within the fire indicator panel shall be of the de-mountable or plug-in type to enable prompt servicing of each module and easy removal of field wiring for testing purposes.

Supervised serial communications capabilities shall be provided for the operation of remote displays, the connection of an optional event printer, connection to building management systems and connection to fire alarm system networking facilities.

(A modem shall be provided at the fire alarm panel and shall be connected to the panel programming port. The modem shall provide dial-in, password-protected access to the fire alarm system diagnostics and programming commands and also provide remote front panel-operation and remote display of the LCD messages on a computer.)*

3.7 INPUT CONFIGURATION OPTIONS

The field programming facility shall allow zone circuits to be designated according to their basic type e.g. smoke, heat, flow-switch, manual call point, tamper valve, pressure switch, sprinkler. The function as designated shall appear on the LCD display when a circuit is activated. Where detectors and manual call points are connected on the same zone circuit the LCD display shall display the correct type text for the device that has operated.

Each circuit shall have programmable operating modes to allow operation with a wide range of actuating devices including high and low current "20 volt" detectors, infrared beam detectors, UV flame detectors, high resistance circuits and tamper valves. The tamper-valve monitoring mode shall provide Grade A Tamper Resistance as specified by SSL.

Programmable time delays shall also be available for each circuit. Time delay options shall include alarm verification as defined by AS 4428.1, and delays for flow-switch monitoring. Configuration for the operation of air-conditioning smoke detection and Fire Fan Control shall be available in the configuration options including specific settings for supply air and return air detection. Alarm verification shall not cause a delay in recognition of manual call point operation. Operation of manual call points that are connected to detector circuits shall not cause any detectors that are already in alarm to be reset.

Without programming, zones shall be latching and mapped to operate the Alarm Signalling, External Bell, Warning System and Ancillary relays on an alarm condition, but these settings shall be able to

be separately changed by specific programming. Specific programming shall allow the zones to be separately mapped or not mapped to each of these outputs.

The zones to be displayed on the FF control panel shall also be programmable with options including all zones displayed or display of zones mapped to the alarm, fault and isolate relays only.

3.8 OUTPUT LOGIC

The system software shall provide field programmable output control logic capable of controlling any combination of the system output functions using as logic factors; input circuit or zone status, system conditions, states of up to 256 dummy variables, up to 64 timers (adjustable 0 to 250 seconds), NOT, AND, OR, XOR logical operators.

All programmed parameters shall be accessible directly from the control panel via a menu-driven programming interface.

3.9 REAL TIME CLOCK

The fire indicator panel shall maintain an internal real time clock and calendar, which shall be used to time-stamp history events and printer events (if printer fitted). The Clock shall be Year 2000 compliant and shall maintain time synchronised with the mains power supply frequency (programmable for 50 or 60 Hz) while mains power is turned on. Under mains power fail conditions, the Clock shall continue to function. The time and date shall be able to be adjusted manually from the control panel of the fire indicator panel. The clock shall automatically make adjustments for local daylight saving (if any).

Where a system contains more than one remote LCD display or networked fire indicator panel, the system shall provide facilities to regularly and automatically synchronise the time and date so that the time indicated by each device in the system does not vary by more than 15 seconds.

3.10 SYSTEM PROCESSOR

The fire indicator panel shall contain the system processor and associated electronics to provide system operation to this specification. The processor shall be supervised by watchdog circuitry furnishing automatic restart after loss of activity, and providing an external relay output signal should processor control not be regained. No manual input shall be required to re-start the system processor in the event of a complete power down condition. It shall return to an on-line state as an operating system performing all programmed functions upon power restoration. Non volatile memory shall be provided for storage of the system data base, logic, and operating system.

3.11 POWER SUPPLIES

Power for the fire indicator panel and fire alarm battery charger shall be obtained from the mains supply in accordance with AS 4428.1, AS 4428.5, AS 3000 and AS 1670.1.

Sealed electrolyte batteries shall be provided for the fire alarm system. The battery capacity shall be calculated to meet the requirements of AS 1670.1 including the factor specified in this standard to compensate for deterioration and ageing during the battery life cycle. Battery calculations shall be submitted to justify the battery size. Batteries shall be housed within the control cabinet.

The power supply shall be an integral part of the FIP and shall be available in 3 Amp and 6 Amp versions. It shall supply dc power to the fire alarm system and maintain the fire alarm system battery in a fully charged condition, meeting the recharge requirements of AS 1670.1.

The charger shall be automatic in design, adjusting the charge rate to the condition of the batteries and the terminal voltage shall be temperature compensated to suit the battery manufacturer's data. The battery charging facilities shall be suitable for the battery type used.

Automatic battery test facilities shall be included to verify the battery connection and capacity.

Two pairs of separately fused, battery backed power supply output terminals shall be provided for the separate connection of fire brigade signalling equipment and external loads. The fuses on these outputs shall be supervised, and shall illuminate a fault indication if the fuse is not intact.

3.12 (PRINTER)*

Install a printer within, or adjacent to the fire indicator panel, in the position shown on the drawings.

The printer shall produce a printed record of time, date, event type and location of each event occurring on the system. The printer shall be a type supplied and approved for use with the system by the fire alarm system manufacturer.

The printer shall be capable of operation under mains fail conditions for the same length of time as the fire indicator panel can operate under mains fail conditions.

The printer output of the fire indicator panel shall have an internal storage buffer capable of storing up to 400 events, so that the print-out is not lost when the printer is temporarily switched off line for a short time for maintenance.

3.13 (NETWORKING)*

Due to the size and complexity of the installation and limited space within the Fire Control Room, the system shall be made up of a number of sub fire indicator panels. These panels shall be located as shown on the drawings and shall communicate with each other and the main fire indicator panel via a communications network complying with the requirements of AS 1670.1 Section 3.

The network shall be compatible with a range of readily available fire alarm panels and ancillary equipment to give flexibility in system design and future expansion. The range of available equipment shall include network mimic panels, FF LCD displays capable of operating on a network-wide basis, network printers, network colour graphics system, and an interface to an automatic alphanumeric paging system. (A Bridge to the Modbus RTU protocol shall be available to allow connection of information from the network to a BMS)*.

The fire control panels and network communication devices shall be approved by SSL for operation in a networked system and evidence of this approval shall be submitted with the tender submission (ref. Clause 1.3).

Each networked sub-indicator panel shall include a LCD and FF complying with Clause 3.3. Each sub-indicator panel shall be capable of operating its own pre-programmed functions in the event of failure of any of the other fire indicator panels and/or the network.

The networked fire alarm panels shall provide the following capabilities as programmable options:

- Annunciation of local alarm conditions on the LCD and FF of remote indicator panels.
- Use of the alarm relay status of remote indicator panels to control alarm relays of the local panel.
- Zone Reset, Isolate and Test functions for remote panels from local panel(s).
- Control of remote warning systems and panel sounders from local panel(s).
- Operation of local output control logic functions based on both remote and local panel statuses.

Diagnostic functions shall be provided at each networked fire alarm panel to enable network communications to be examined, analysed and tested. A servicing facility shall be provided at each networked panel that will allow front panel operations of any remote panel to be carried out and the LCD messages on the remote panel to be viewed on a computer.

4 DETECTORS

4.1 GENERAL

Provide manual call points, ionisation smoke detectors, photoelectric smoke detectors, CO smoke detectors and heat detectors where shown on the drawings. All detectors and manual call points are to be approved and SSL listed for use with the fire indicator panel. The detectors shall be arranged in the circuits that are indicated diagrammatically by the single line drawing and shall be connected back to the fire indicator panel.

4.2 (IONISATION SMOKE DETECTORS)*

Ionisation smoke detectors shall be capable of detecting both visible and invisible products of combustion, and be of the dual ionisation chamber type. They shall be small and of modern appearance to blend unobtrusively into the architectural surroundings and shall be listed by SSL as approved for use as commercial smoke detectors.

The detectors shall be base compatible with heat, photoelectric, high performance photoelectric and carbon monoxide fire detectors to permit upgrading or system alteration with a minimum of cost.

4.3 (PHOTO-ELECTRIC SMOKE DETECTORS)*

Photoelectric smoke detectors shall be of the solid state photo-electronic type and shall operate on the light scattering principle. All detectors shall be factory set and shall be designed to ignore invisible air borne particles or smoke densities that are below the factory set alarm point. Maximum stability against effects of ageing and dust and film accumulations shall be provided by the use of self-compensating circuitry within each detector. The detectors shall have a symmetrical optical system and a protective cover to allow good penetration of smoke, while maintaining high immunity to the effects of wind and dust accumulation. An LED (light emitting diode) shall be utilised as the detector light source. The detectors shall be designed to latch into alarm condition after a number of pulses verify the presence of smoke in the sensing chamber.

The detector shall be small and of modern appearance to blend unobtrusively into the architectural surroundings and shall be listed by SSL as approved for use as a commercial smoke detector. They shall be base compatible with heat, ionisation, high performance photoelectric and carbon monoxide fire detectors to permit upgrading or system alteration with a minimum of cost.

Where detectors are used in conjunction with air conditioning or ventilation systems, they shall be of the photoelectric type mounted in an air-sampling device. The unit, detector and sampler shall be approved for this purpose and the tenderer shall submit documentary evidence of this approval with this tender. The contractor shall coordinate with the mechanical services contractor to ensure correct positioning of these units.

4.4 (HIGH PERFORMANCE PHOTOELECTRIC DETECTORS)*

High performance photoelectric smoke detectors shall be of solid state design and shall incorporate both a photoelectric smoke sensor and a heat-sensing element. The sensitivity of the detector shall be dependent on the rate-of-rise of heat as sensed by the heat-sensing element as well as the smoke density. The detector shall provide enhanced response to fast burning fires producing little smoke or very dark smoke when compared to the response of standard photoelectric detectors. Sensitivity shall be factory set to give an alarm threshold of 8% per metre under standard conditions. The detector shall be designed to minimise the effects of dust and dirt on detector performance. Its smoke measuring chamber shall incorporate concentric light baffles that exclude ambient light and achieve the low signal to noise ratio required for enhanced performance.

The detector shall be small and of modern appearance to blend unobtrusively into the architectural surroundings and shall be listed by SSL as approved for use as a commercial smoke detector. It

shall be base compatible with heat, ionisation, photoelectric, and carbon monoxide fire detectors to permit upgrading or system alternation with a minimum of cost.

4.5 (CARBON MONOXIDE FIRE DETECTORS)*

Carbon monoxide fire detectors shall be of solid state design and shall utilise an electrochemical cell to detect the build-up of carbon monoxide generated by fires. Sensitivity shall be factory set to give an alarm threshold of 40ppm. Integral temperature compensation shall ensure that sensitivity remains constant over the detector's specified operating temperature range. The detector shall be designed to minimise the effects of dust and dirt on detector performance.

The detector shall be small and of modern appearance to blend unobtrusively into the architectural surroundings and shall be listed by SSL as approved for use as a commercial smoke detector. It shall be base compatible with heat, ionisation, photoelectric, and high performance photo-electric fire detectors to permit upgrading or system alternation with a minimum of cost.

4.6 (HEAT DETECTORS)*

Heat detectors shall be available in types A, B, C and D. Generally Type A shall be installed but the tenderer shall select, subject to approval, the most suitable type for the environment. All types of detectors shall be compatible electrically and physically, and be approved for a capacity of 40 detectors connected per zone circuit.

The heat detectors shall operate using two distinct modes of operation - rate of rise and fixed temperature. They shall be also be rugged and unaffected by vibration, with all exposed parts adequately insulated and protected against corrosion. When the detector is in the alarm condition an LED indicator on the detector or on the detector mounting base shall be illuminated.

The detector shall be small and of modern appearance to blend unobtrusively into the architectural surroundings and shall be listed by SSL as approved for use as a commercial heat detector. The detectors shall be base compatible with ionisation, photoelectric, high performance photoelectric and carbon monoxide fire detectors to permit upgrading or system alteration with a minimum of cost.

4.7 (MANUAL CALL POINTS)*

Manual call points, meeting the requirements of AS 1603.5, shall be furnished and installed where indicated on the drawings. The call points shall be connected back to the fire alarm indicator panel and the method of connection shall comply with AS 1670.1 clause 8.8. Operation of a manual call point on the same alarm zone circuit as detectors shall not cause any previously lit detector indicator on that circuit to turn off.

5 MIMIC PANELS (& COLOUR GRAPHICS)*

5.1 (REMOTE FF LCD DISPLAY)*

Remote FF Alphanumeric LCD displays incorporating the following features shall be furnished and installed where shown on the drawings.

The display on each panel shall incorporate a Firefighter Facility (FF) complying with the requirements of AS 4428.1. The layout of the display and FF controls shall be the same as that on the master fire indicator panel. It shall incorporate a numeric keypad and controls in order to be able to recall, reset, isolate and acknowledge alarm and fault conditions, and isolate the warning system and external bell. The system software shall enable the Engineer to specify which of the functions on the keypad are utilised under this contract.

(The display enclosure shall be low profile, measuring no more than 180 mm in height, 455 mm in width and protruding from the mounting wall no more than 60 mm.)* (The display enclosure shall be flush mounting with built-in surround to cover wall penetrations. It shall measure no more than 220 mm in height, 505 mm in width (including the surround) and shall be inset into the wall.)*

Power for the display shall be wired from the main fire indicator panel and the display shall be equipped with all necessary equipment to communicate with the main fire indicator panel via the remote display unit communications port or the network port provided at the fire indicator panel.

The wiring between the remote display and the fire indicator panel shall be supervised such that loss of communication with the fire indicator panel shall indicate a system fault condition at the fire indicator panel and at the remote display. Loss of power to the remote display shall indicate as a system fault condition at the fire indicator panel.

On-site programmable facilities shall enable the display to be programmed to annunciate all alarms in the system, or alarms from selected zones only. Each remote display shall be programmed to display the zones noted on the drawings. The programming facilities shall also provide various levels of operation of the display, ranging from full acknowledge, reset and isolate facilities, to automatic operation including acknowledging of alarms, with no operator intervention.

5.2 (REMOTE MIMIC)*

Graphic-style remote mimic panels incorporating the following features shall be furnished and installed where shown on the drawings.

(The display on each panel shall incorporate a Firefighter Facility complying with the requirements of AS 4428.1. The layout of the display and FF controls shall be the same as that on the master fire indicator panel. It shall incorporate a numeric keypad and controls in order to be able to recall, reset, isolate and acknowledge alarm and fault conditions, and isolate the warning system and external bell. The system software shall enable the Engineer to specify which of the functions on the keypad are utilised under this contract.)*

An engraved, screened or anodised graphic layout of the annunciated area noted on the drawings shall be clearly shown on the panel. The Engineer shall approve the graphic layout, method of printing and its colour and the location of the LED indicators before fabrication.

(The mimic shall incorporate power supply and batteries. The power supply shall comply with the requirements of AS 4428.1, AS 4428.5 and AS 1670.1)*

All necessary equipment shall be included in the mimic in order to communicate with the main fire indicator panel via the remote display unit communications port or the network port provided at the fire indicator panel. The wiring between the mimic and the fire indicator panel shall be supervised such that loss of communication with the fire indicator panel shall indicate a system fault condition at

the fire indicator panel and at the remote display. Loss of power to the remote display shall also indicate as a system fault condition at the fire indicator panel.

The mimic shall be on-site programmable with the capability to annunciate all alarms in the system, or alarms from selected zones only, and shall be programmed to display the zones indicated on the drawings.

The programming facilities shall also provide various levels of operation of the mimic display, ranging from full acknowledge, reset and isolate facilities, to automatic operation including acknowledging of alarms, with no operator intervention.

5.3 (REMOTE ZONE DISPLAY UNIT)*

Remote zone display units incorporating the following features shall be furnished and installed where shown on the drawings.

The display on each panel shall incorporate a Firefighter Facility complying with the requirements of AS 4428.1. The layout of the display and FF controls shall be the same as that on the master fire indicator panel. It shall incorporate a numeric keypad and controls in order to be able to recall, reset, isolate and acknowledge alarm and fault conditions, and isolate the warning system and external bell. The system software shall enable the Engineer to specify which of the functions on the keypad are utilised under this contract.

Discrete LED indicators shall be provided on the display unit to indicate the operation of each of the fire detector zones, sprinkler pressure switches, sprinkler system flow switches, pump run and ancillary indications as shown on the drawings. Each group of LED indicators shall include three (3) individual LEDs.

Red	-	Alarm
Yellow	-	Fault
Yellow	-	Isolate

Space shall be provided adjacent to each group of LEDs for two (2) lines of typed text at 24 characters per line.

The display shall be equipped with all necessary equipment to communicate with the main fire indicator panel via the remote display unit communications port or the network port provided at the fire indicator panel. The wiring between the remote display and the fire indicator panel shall be supervised such that loss of communication with the fire indicator panel shall indicate a system fault condition at the fire indicator panel and at the remote display. Loss of power to the remote display shall indicate as a system fault condition at the fire indicator panel.

On-site programmable facilities shall enable the display to be programmed to annunciate all alarms in the system, or alarms from selected zones only. Each remote display shall be programmed to display the zones noted on the drawings. The programming facilities shall also provide various levels of operation of the display, ranging from full acknowledge, reset and isolate facilities, to automatic operation including acknowledging of alarms, with no operator intervention.

The mimic shall incorporate power supply and batteries. The power supply shall comply with the requirements of AS 4428.1, AS 4428.5 and AS 1670.1.

5.4 (COMPUTER COLOUR GRAPHICS DISPLAY)*

5.4.1 GENERAL REQUIREMENTS

The contractor shall supply, install and commission into service an automatic computer-based colour graphic fire alarm display system including all computer hardware, software, wiring and connections to the fire indicator panel. The system and components shall be supplied by one manufacturer of established reputation and experience who shall have produced similar equipment and be able to refer to similar installations providing satisfactory service.

5.4.2 SYSTEM DESCRIPTION

The colour graphics display system shall consist of a Microsoft Windows NT based computer system, complete with keyboard, hard disk drive, printer, colour monitor and fire indicator panel interface, in accordance with the drawings. The colour graphics display system shall be capable of connecting to and displaying information from the fire alarm network as described in Section 3.13. Operating parameters for the system shall be field programmable via the system keyboard and/or the mouse supplied with the system. Access to the programming function shall be via a password. The software operation shall be graphics based with common functions driven by "point and click" action using a mouse (or touch-screen)*, and capable of being operated by a person with little previous experience with computer operation.

On the event of a non-normal condition the following shall occur:

- Display on the computer the initial location plan with the location of the affected system or zone highlighted in an appropriate colour (e.g. red for alarm).
- Sound an audible sounder at the colour graphics display location.
- Write the details of the actuation to a system log file on the colour graphics system hard disk drive.
- Print the details of the actuation to the logging printer.
- (If the event is an alarm condition, automatically print a predefined graphic map of the first zone to alarm to the graphics printer.)*

It shall be possible to manually obtain a graphic print of any screen being displayed. Graphic screen prints must be printed in less than 60 seconds.

The graphic screens shall be designed in a hierarchical manner to provide a single screen overview of the complete system with on-screen navigation buttons or similar to "zoom" into any area and view the status of individual zones and points. Zones shall be able to be labelled with custom location text. The location text shall be able to be unique for each point and zone and shall be a minimum of 70 characters long.

The system shall have the capability of acknowledging, isolating, de-isolating and resetting alarm and fault zone conditions on the fire indicator panel, from the computer screen. Alarms shall be prioritised over faults and other conditions, and any new alarm shall be automatically displayed.

A disk based file shall be kept for all alarm, fault, isolate, acknowledge and reset zone events. These logs are to be continually appended so as to provide complete historical information of all events. This log information shall not be lost upon power failure or fire indicator panel reset. A built-in application shall be provided to display this log information on the screen.

5.4.3 EQUIPMENT

Furnish a PC with a minimum of a Pentium III processor at a processing speed of 500 MHz. The power supply shall be rated at a minimum of 180 watts continuous load. The computer shall have at

least one high-density floppy diskette drive and be equipped with the amount of random access memory recommended by the producer of the colour graphics software for the system size. The computer shall have two serial RS232 input/output ports configured as COM1 and COM2 for communications with the fire alarm network. Communications with the fire alarm network shall be via an interface module connected to one or more of the serial ports. The hard disk drive shall be sized to suit the installation with 25% spare space, and with a minimum of 4 gigabytes. The hard disk controller shall provide a minimum of 450 kilobytes per second data throughput when operating with the hard disk drive. The monitor shall be high resolution with a resolution of 1024 vertical and 768 horizontal lines. Screen size shall be a minimum of 350 mm diagonal measurement, unless detailed otherwise on the drawings. Optional screen sizes of 400 mm and 475 mm shall be available.

The monitor shall also be fitted with a "touch screen" if required by the drawings. The touch screen shall consist of a transparent membrane fitted to the monitor screen and shall be an integral part of the monitor. The touch screen must be capable of being operated by a gloved hand.

A colour printer shall be installed adjacent to the graphics terminal as shown on drawings. This printer shall be a type supported by the software and shall be connected to the LPT1 printer port of the computer and shall be used to log events. Carriage width shall be a minimum of 275 mm allowing for 80 characters per line.

The printer head shall be a minimum of 9 pin dot matrix. At least two (2) fonts and an option for compressed print shall be available via a selector panel on the printer.

An inkjet graphics printer shall be connected to LPT2 for printing screen graphics.

5.4.4 SOFTWARE

The software shall control the operation, functions and display of the graphics system and provide for automatic boot up and run from the hard disk drive of the computer. Instructions and utilities shall be provided for reinstalling the software onto the computer. All project specific or zone specific custom programming shall be capable of being carried out on site via password access. Instructions and utilities shall be provided for backing up all custom programmed data.

5.4.5 INSTALLATION

A 240 Vac 50 Hz 10 Amp supply shall be made available by others at the location of the graphic system(s). Wiring shall be carried out in accordance with AS 3000 or AS 1670.1 as applicable. Connections to graphics system components shall be via flexible cable with plugs compatible with the equipment. All plugs shall have protective shrouds and be secured against accidental removal. Equipment shall be installed in a dry, dust free, environment and protected against mechanical damage. Where installed in areas accessible to the public, the equipment shall be located in a locked enclosure.

6 ANCILLARY DEVICES

6.1 EXTERNAL BELL

Provide a fire alarm bell in the position shown on the drawings. Fire alarm bells shall comply with the requirements of AS 1603.6. A fault condition on the bell circuit wiring shall cause the fire indicator panel to register a fault condition as required by AS 4428.1 clause 2.6.

6.2 (WARNING SYSTEM)* / (EWIS INTERFACE)*

WARNING SYSTEM

(The contractor shall supply, install and wire a warning system to AS 4428.1 clause 2.5 and AS 1670.1 clause 8.7(b). Speakers shall be installed in the positions shown on the drawings. The speakers shall be connected to an electronic tone generator installed at the fire indicator panel. The wiring to the speakers shall operate at industry standard 100 volt line levels and shall be supervised for open and short circuit fault conditions. A fault condition on the speaker wiring shall cause the fire indicator panel to register a fault condition as required by AS 4428.1 clause 2.5.

(Zoned activation of the warning system shall be provided where activation of nominated zones on the fire indicator panel shall cause activation of selected warning system areas as shown on the drawings.)*

When activated, the tone generator shall cause the speakers to produce the evacuate tone specified in AS 2220 (including the AS 2220 verbal message)*.

The verbal message shall be clear and intelligible and shall state...

("Evacuate as directed. Evacuate as directed".)*

(or "Evacuate the building using the nearest fire exit.)*

(or "Please evacuate the building immediately via the nearest fire exit. Do not use the lifts.)*

(or other message as appropriate.)*

The power output of the tone generator system shall be able to be readily increased by adding further tone generator modules to accommodate future expansion in system size.

(The fire warning system shall provide emergency public address throughout the building by means of a paging microphone installed within the fire indicator panel. The emergency public address system shall be activated when the "push to talk" switch on the paging microphone is activated and shall broadcast speech from the microphone throughout the building, while the switch remains activated. Release of the "push to talk" switch shall cause the warning system to revert to its previous state.)*

(The contractor shall install a non-emergency paging microphone, located in the position shown on the drawings. The microphone shall be connected to the fire warning system tone generator to provide non-emergency paging throughout the building. Under emergency conditions (ie. when the fire alarm system is activated) the functions of this microphone shall be overridden by the evacuate tones and emergency public address from the fire indicator panel.)*

(The contractor shall provide a low-level audio input to the warning system input at the location marked on the drawings. When the warning system is not activated, and any public address facilities are not in use, the warning system shall distribute background music at low volume level from a program source (provided by others) connected to this input.)*

EWIS INTERFACE

(The contractor shall provide an interface for the connection of the fire alarm system to the emergency warning and intercommunication system in the position shown on the drawings and in accordance with AS 2220.2 clauses 2.1.3 and 5.2. (The interface shall provide an isolated relay

contact closure for each of the evacuation zones noted on the drawings. All alarms originating within the evacuation zone area shall cause the operation of the contacts.)* / (Communicate the operated zone to the EWIS by means of a supervised high-level data link. The data transferred to the EWIS system shall indicate the alarm status of each evacuation zone shown on the drawings.)**

6.3 (MAGNETIC DOOR HOLD-OPEN DEVICES)*

The contractor shall supply and install all necessary power supplies, ancillary control circuits, magnetic hold-open devices and release switches to automatically release all fire doors as marked on the drawings.

Flush and surface mount door-holders shall be available and flush units shall be installed where the wall construction permits. The door holder magnet shall include a release switch built into the faceplate of the unit.

6.4 (FLOW SWITCHES)*

The contractor shall connect the fire alarm system to sprinkler flow switches at the locations shown on the drawings. The fire indicator panel shall supervise all flow switch circuits.

6.5 (SPRINKLER ANTI-TAMPER SWITCHES)*

The contractor shall connect the fire alarm system to approved sprinkler anti-tamper switches where shown on the drawings. Anti-tamper switches shall be SSL listed for use with the fire alarm system as providing Grade A Tamper Resistance to SSL specifications. The sprinkler contractor shall supply the anti-tamper switches.

6.6 (PUMP INDICATIONS)*

Wire fire indicator panel circuits to terminate at a position adjacent to the sprinkler pump panels in the fire pump room. These inputs shall accept sprinkler pump-run/pump-fail indications for all sprinkler pumps. Each indication shall be displayed separately at the fire indicator panel by means of LED indicators.

6.7 (BMCS INTERFACE)*

The fire alarm system shall provide a high level data interface to the building management and control system in compliance with AS 1670.1 clause 2.2. The data transferred to the BMCS shall indicate the status (alarm, fault, and isolate) of every zone of the fire alarm system. The Interface shall use the industry standard MODBUS RTU protocol.

6.8 (TELEPAGER INTERFACE)*

The contractor shall provide a telepager interface to enable the fire alarm system to send event messages to an alphanumeric paging system. The telepager interface shall be compatible with the TAP protocol and shall support up to 60 agents (telepager system and pager numbers). It shall be site programmable to route fire alarm event messages to any agent depending on the event source (e.g. zone, system), event type (e.g. alarm, fault, isolate) and zone range. The actual message routing shall be decided in conjunction with the Engineer before final commissioning.

7 (AIR CONDITIONING CONTROLS)*

7.1 SYSTEM DESCRIPTION

The contractor shall provide automatic smoke detectors and ancillary control device circuits to achieve fire and smoke control operation.

The system shall interface to all A/C units as specified in Appendix 1 at the end of this specification.

7.2 INTERFACE WIRING/SUPERVISION

Cabling for the fire fan controls shall be installed by the Fire Services trade and connected to the fire indicator panel. The fire fan control cabling shall be fire resistant and mechanically protected to AS 3013 classification WS51W.

Loss of any conductor within the system, including all interface wiring between the fire indicator panel output terminals and Mechanical Services Board (MSB) terminals shall cause a fault signal to be generated for each fan affected.

It shall be the responsibility of the Fire Services contractor to run cables from the (MSB) terminals to the fire indicator panel and the fire fan control panel.

7.3 (FIRE FAN CONTROL PANEL (FFCP))*

The Fire Fan Control Panel shall be constructed to comply with Clause 3.2 of this Specification and with the requirements for fire and smoke ventilation and airconditioning control panels that are applicable to this contract.

7.4 (MIMIC DIAGRAM)*

Position the controls and indicators appropriate for each Air Handling Plant on a photo-anodised fascia to form a mimic diagram of the A/C system. This diagram should be coloured in accordance with (New South Wales)* Fire Brigade requirements for Tactical Fire Plans to show airflow paths for all A/C systems involved with Fire Fan Controls. The mimic fascia shall comply with standard practice for Fire Fan Control Panel layout.

7.5 AIR FLOW SWITCHES

Air Flow switches shall be installed downstream of each Controlled Fan to indicate fan status. Air Flow switches shall be installed by the Fire Services Contractor and wired back to the Motor Control Centre in cable fire rated to classification WS51W of AS 3013. Airflow Switches shall be "JOHNSON" Controls, Type P32 Series or equivalent.

8 COMMISSIONING

8.1 COMMISSIONING TESTS

The entire installation shall be tested in accordance with AS 1670.1 and witnessed by the Engineer.

The acceptance inspector shall be notified before the start of the required tests. All items found at variance with the drawings or this specification during testing or inspection by the acceptance inspector, shall be corrected.

Test reports shall be delivered to the acceptance inspector as completed.

All test equipment, instruments, tools and labour required to conduct the system tests shall be made available by the installing contractor. The following equipment shall be a minimum for conducting the tests:

- Ladders and scaffolds as required to access all installed equipment.
- Multimeter for reading voltage, current and resistance.
- Two way radios, flashlights, smoke generation devices and supplies.
- Decibel meter.

In addition to the testing specified to be performed by the installing contractor, the installation shall be subject to test by the acceptance inspector.

All fire alarm circuits shall be tested, for continuity, earth faults, and short circuits.

8.2 ACCEPTANCE TESTING

A written acceptance test procedure (ATP) for testing the fire alarm system components and installation will be prepared by the engineer for compliance with this specification. The contractor shall be responsible for the performance of the acceptance test, demonstrating the function of the system and verifying the correct operation of all system components, circuits and programming.

A complete listing of all zone labels for alphanumeric annunciator displays and logging printers shall be prepared by the installing contractor prior to the ATP.

The acceptance inspector shall use the system record drawings in combination with the specification during the testing procedure to verify operation as programmed. In conducting the ATP, the acceptance inspector shall request demonstration of any or all input and output functions. The items tested shall include but not be limited to those listed below.

System wiring shall be tested to demonstrate correct system response and correct subsequent system operation in the event of:

- Open and shorted remote display unit communications circuit.
- Open and shorted zone circuits.
- Removal of detectors.
- Power failure at the fire indicator panel.

System indications shall be demonstrated as follows:

- Correct message display for each alarm input at the control panel and each remote display.

- Correct LED indications for each alarm input at the control panel and each remote display.
- If printer fitted, correct printer logging for all system activity.

System off-site reporting functions shall be demonstrated as follows:

- Correct signal transmitted for each alarm input.
- Fault signals received when alarm zone circuits are disconnected.

Battery and battery charger capabilities shall be demonstrated as follows:

- Mains power shall be disconnected for 24 hours. At the end of that period, an alarm condition shall be created and the system shall perform as specified.
- Mains power shall be restored for twenty four hours and system charging current shall be normal charge rate for a fully charged battery bank.
- System battery voltages and charging currents shall be checked at the fire indicator panel.

In the event of system failure to perform as specified and programmed during the acceptance test procedure, at the discretion of the acceptance inspector, the test shall be terminated.

The installing contractor shall re-test the system, correcting all deficiencies and providing test documentation to the acceptance inspector.

The acceptance inspector may elect to require the complete ATP to be performed again if, in his opinion, modifications to the system hardware or software warrant complete re-testing.

8.3 DOCUMENTATION

System documentation shall be furnished to the owner and shall include but not be limited to the following:

- System as built drawings and wiring details including one set of reproducible masters.
- System operation, installation and maintenance manuals.
- Written documentation and two backup 3.5 inch floppy disks for all system parameters and output logic as programmed.
- Documentation of system voltage, current and resistance readings taken during the installation, testing and ATP phases of the system installation.

8.4 SERVICES

The contractor shall warrant the entire system against mechanical and electrical defects for a period described in the contract general conditions. This period shall begin upon completed certification and test of the system or upon first beneficial use of the system, whichever is earlier.

The fire alarm system subcontractor or manufacturer shall offer for the owner's consideration at the time of system submittal a priced inspection, maintenance, testing and repair contract in full compliance with the requirements of AS 1851.8 (Weekly Testing not required)*.

The services offered under this contract shall be performed at no charge during the first year after system acceptance and the owner shall have the option of renewing for single or multiple years upon completion of the warranty period.

The contractor performing the contract services shall be qualified and accredited to maintain ongoing certification of the completed system to the relevant authority having jurisdiction.

APPENDIX 1: AIRCONDITIONING SYSTEMS