

CURTIN UNIVERSITY
PROJECT DELIVERY GUIDELINES

**FIRE SERVICES TECHNICAL
REQUIREMENTS**

000330



Curtin University

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1 INTRODUCTION

1.1 INTRODUCTION

These technical requirements detail the minimum requirements for the design, supply, installation and commissioning of fire services and emergency warning systems. The requirements are split into five sections:

Section 1 – Introduction

Section 2– Scope of works

Section 3 – Electrically based systems

Section 4 – Gaseous extinguishing systems

Section 5 – Water-based systems.

1.2 SCOPE

These requirements shall be used for all fire services installations.

Contractual, financial, safety procedures and site-specific inductions are contained in other relevant Curtin University documents that may be included as part of a project document issue.

Throughout these instructions the word 'shall' is to be interpreted as mandatory and 'should' is used in an advisory or discretionary sense.

1.3 GENERAL REQUIREMENTS

Unless otherwise instructed by the Principal or Superintendent, the fire systems shall meet the relevant Australian standards, Building Code of Australia and the requirements of this specification.

Design, installation and commissioning shall be carried out by competent personnel with experience in the required field(s).

Equipment and systems provided shall be new, free from defects and meet with the technical specifications detailed forthwith.

1.4 DEFINITIONS

(Fire Services) Contractor	shall mean the person or persons, or corporation, whose tender to carry out the work that is the subject of this Contract has been accepted in the Letter of Acceptance
(Fire Services) Subcontractor	shall mean the person or persons, or corporation, engaged by the Contractor for part or all of the works
Principal	Shall mean Curtin University
Superintendent	shall mean Curtin University
Work	shall mean all the works, acts and matters specified in the Specification and other Tender documents and covered by the Tender as accepted

Contract	shall mean the Contract between the Principal and the Contractor and shall include all documents named therein
Consultant	shall mean the appointed fire services consultant as nominated by the Principal or the Principal's representative
Site	shall mean the site as scheduled within the Tender documents
Instructions	shall mean instructions to the Contractor issued by the Principal
Authorities	shall mean statutory bodies or inspectors of such bodies having jurisdiction over the Works under relevant current regulations and statutes

1.5 ABBREVIATIONS

EWIS/OWS	Emergency Warning and Intercommunication System/Occupant Warning System
DFES	Department of Fire & Emergency Services
FIP	Fire indication panel
A/C	Air conditioning
TPS	Thermal Plastic Sheath
SIP	Sub-indicator panel

1.6 REFERENCES

The following reference documents can be found within the Project Delivery Guidelines listings on the Guidelines page of the Properties, Facilities & Development website at:

<https://properties.curtin.edu.au/workingwithus/guidelines.cfm>

- 000346 PDG Services Metering Guidelines.

2 SCOPE OF WORKS OVERVIEW

The scope of works for the fire services contract shall generally include, but not be limited to the following:

- design, supply, and installation of new fire services as detailed
- testing and commissioning of the new works
- provision of construction workshop drawings
- warranty for the defects liability for 12 months from the date of practical completion
- contingencies as further detailed.

Specific requirements have been included in this specification and drawings that are not included in any of the current relevant Australian standards. These have been included as a client- or site-specific requirement. Consequently, any additional requirement noted within the specification or on drawings is required, regardless of its exclusion from standards.

2.1 MATERIALS AND WORKMANSHIP

All materials, equipment and work shall comply with the appropriate Australian standard specification or code or, if such has not been prepared, with the appropriate British or US standard.

All materials, equipment and work shall also comply with the relevant rules and regulations laid down by any statutory authority having jurisdiction over such work, and shall conform to the requirements of insurance underwriter's codes.

Any workmanship, material or installation, which on inspection by such authorities, is found to require modification to be acceptable to the authority concerned, shall be replaced, changed, modified, or otherwise put in a form to meet with the requirements of the relevant regulations. Such modifications shall be at the expense of the Fire Services Contractor at no cost to Curtin University.

2.2 EQUIPMENT

All equipment that forms part of the works specified herein shall be supplied, installed and commissioned, unless otherwise specified.

All materials and components shall be new and the best of their respective kinds, and shall be free from all defects.

Equipment shall be selected to be suitable for the specified duty, with due allowance for all static and dynamic loads and ambient operating conditions.

Details on types of preferred equipment to be used by the Principal have been detailed in later sections of this specification.

Ensure, as much as is practicable, standardisation and interchangeability of equipment throughout the installation.

Ensure that the equipment offered can be satisfactorily accommodated and serviced in the positions allocated.

2.3 DEFECTS LIABILITY

The Fire Services Subcontractor shall be required to make good any loss or damage or injury that may arise from faulty workmanship or defective materials during a period of 12 months from completion of testing and acceptance of the entire installation as complete.

Components replaced during the warranty period shall carry a further defects liability period of 12 months from the date of replacement.

3 ELECTRICAL FIRE AND WARNING SYSTEMS

3.1 OVERVIEW

These requirements shall be used to detail the minimum fire services and systems required by Curtin University. This technical section refers to electrically based fire and warning systems. Mechanical and water-based system requirements are detailed elsewhere in this document.

All electrical systems shall be supplied, designed, installed and commissioned in accordance with all other relevant Curtin University electrical specifications.

3.2 DESIGN

The minimum design requirements for fire detection and EWIS/OWS systems have been detailed in the following sections.

3.2.1 COMPLIANCE OF DESIGN

The design criteria shall comply in all respects with the requirements set out in current standards that are deemed applicable for current works with respect to, but not limited to, equipment, materials, workmanship and installation.

The design should comply with the following relevant codes, standards and regulations:

- National Construction Code (Formerly BCA)
- AS1670.1 Fire detection design, installation and commissioning
- AS1670.4 Sound systems and intercom systems for emergency purposes
- AS1668.1 Fire and smoke control in multi-compartment buildings
- AS1851 Maintenance of Fire Protection Systems
- AS2220.1 Emergency warning equipment design and manufacture.
- AS3013 Wiring for specific installations
- AS3000 Wiring rules
- AS4428.1 Control and indicating equipment
- Curtin University specific requirements
- DFES regulations and requirements – Note DFES requirements may change from time to time. Liaise directly with DFES at time of contract to ensure all current requirements have been met.

3.3 EQUIPMENT

The purpose of this section is to provide details of preferred equipment for use within Curtin University facilities and buildings.

3.3.1 FIRE DETECTION

3.3.1.1 Fire Indicator Panel

The fire indicator panel (FIP) shall be of Ampac Fire Finder type (or approved equivalent) and be manufactured in accordance with Australian Standard AS4428. The FIP shall be Activefire listed and have a minimum number of detection loops/zones as indicated on drawings. The FIP shall be provided with a minimum of two supervised bell output circuits.

Plant outputs shall be fully supervised. Disconnection of any field cable shall register as a fault on the FIP.

The FIP shall be an addressable type (unless otherwise noted) with integral power supply and sealed lead acid batteries. Disconnection of the battery shall indicate as a fault on the FIP.

The FIP shall be installed as shown on drawings in accordance with the height requirements of AS1670.1 The FIP controls shall be accessible with the use of an industry standard '003' key.

The FIP shall be provided with necessary network interface card (NIC) and MODBUS modem to interface to the site-wide monitoring system.

If appropriate, the FIP shall be located alongside other equipment such as fan controls or EWIS controllers and the like so that access to controls is not restricted. The door shall be hinged accordingly.

Fire indicator panels shall be kept separate from EWIS control systems. EWIS shall be housed in their own dedicated enclosure with designated Curtin locks and keys.

A 'Critech' or similar approved mains suppression unit shall be installed to prevent damage to systems due to intermittent voltage spikes being introduced into the system.

A 6 mm earth cable shall be installed to suit the requirements of the DFES end-of-line unit and run to the main distribution board earth bar.

The software program for the FIP shall incorporate all requirements of this specification. It shall be written and incorporated into the FIP within Australia, such that any future program changes can be carried out within Australia without undue delay.

The FIP shall be programmed such that the addressing of any field device is shown on the LCD and appropriate LED display at the FIP.

A copy of the software configuration on disk and hard copy format shall be included within each maintenance manual. An additional copy of the software disk shall be provided with a suitable plastic holder, labelled as to its contents, for storage by the Principal's maintenance engineer.

The FIP shall be powdercoat coloured to match existing adjacent panels or, if standalone, be white or cream in colour.

The FIP shall be provided with a minimum of 25 per cent spare capacity on loops, zones, power supply and batteries and all other circuits. No more than 75 per cent of each circuit shall be used to allow for future expansion.

The FIP shall be provided with suitably zoned dedicated manual controls or switches for the following interfaces:

- individual A/C shutdowns
- individual supply air, stair pressure and other AS1668 controls
- security doors
- automatic opening doors
- site monitoring system display isolate (inhibits screen alarms at Security and Building 110)
- any other interface as required.

Each control or switch shall be provided with a suitable illuminated indicator to show the individual control status. Provision of controls by keypad menu functions alone are not deemed adequate.

Controls shall be factory fitted and shall match the existing style and finish of the FIP.

Retrofitting of non-standard type switches, LEDs and the like is not acceptable.

Curtin University preferred equipment:

FIP Type	Ampac Fire Finder
Zones/Loops	As shown on drawings Sounder
Circuits	As shown on drawings Interface to
Other Systems	As shown on drawings

The FIP final configuration shall be password-locked and details provided to the Principal so that future modifications to the internal configuration cannot be carried out without authorisation from the Principal or Superintendent.

3.3.1.2 Smoke Detectors

Unless otherwise noted, all smoke detectors shall be of the analogue addressable type.

Detectors shall be fitted to the relevant listed base. The device shall be addressed as shown on drawings or as per design requirements.

Smoke detectors provided for new systems shall be from the Apollo range or approved equivalent with a relevant detector base. Detectors provided for existing systems shall match the existing type.

Detectors shall be installed so that the LED illumination faces the entry point of room or the direction of the path from the FIP.

Each detector shall be provided with a suitable address label on the base indicating loop and address. The label shall be UV-stabilised and of the permanently printed adhesive type. Marking of devices by hand or permanent marker is not permitted.

Detector sensitivity shall be set to suit the anticipated environment.

Where sensitivity of less than two per cent OBS/m is required, the multi –sensor shall be used.

Detectors for normal use shall be of the latching type. The LED shall remain illuminated until reset.

Detectors used for supply air ducts or pressurisation systems shall be configured as self-resetting or non-latching. These devices shall not initiate a general fire condition as they are used primarily for fan controls. Duct detectors shall be located to provide ease of access for maintenance. Consideration should be given to locate the device such that ladders or steps are not required.

Provide a permanent adhesive label adjacent to the detector housing for inspection date and signature marking, for a minimum of 10 inspections. Mark with 'Duct Detector Inspection Record'.

Smoke detectors shall be the photo-optical type unless specifically noted on drawings.

3.3.1.3 Heat Detectors

Unless otherwise noted, all heat detectors shall be of the analogue addressable type.

Detectors shall be fitted to the relevant listed base. The device shall be addressed as shown on drawings or as per design requirements.

Heat detectors provided for new systems shall be from the Apollo range or approved equivalent with a relevant detector base. Detectors provided for existing systems shall match the existing type.

Detectors shall be installed so that the LED illumination faces the entry point of the room or the direction of the path from the FIP.

Each detector shall be provided with a suitable address label on the base indicating loop and address. The label shall be UV-stabilised and of the permanently printed adhesive type. Marking of devices by hand or permanent marker is not permitted.

The following devices (or approved equivalent) shall be selected depending on the ambient temperature expected.

Normal Use	Apollo XP95 Type A Increased
Ambient	Apollo Discovery Type C
Increased Ambient	Apollo Discovery Type D (Fixed Temp) (Where rapid rise of heat may be expected)
Duct Probe	Thermac Type E – 100 °C.

3.3.1.4 Multi-sensor

Multi-sensors shall be installed to meet the requirements of the heat and smoke detectors described above.

Multi-sensors shall be of the Apollo Discovery type (or approved equivalent) and shall be installed as shown on drawings.

Where installed as part of a smoke control system or in an evacuation route, the heat detection function shall be disabled.

3.3.1.5 Flame Detectors

Flame detectors shall be designed to suit the environment and purpose. For safe areas, flame detectors shall be either ultraviolet (UV) devices or infra-red detectors. Systems provided with flame detectors require special attention in regard to location, type and range.

For external applications, triple band infra-red flame detectors shall be used.

Internal flame detectors may be infra-red or UV to suit the application.

Hazardous areas have special requirements as noted below.

Additional design certification may be required to verify that the flame detection system has been designed and installed in accordance with the manufacturer's recommendations and relevant Australian or other standard.

HAZARDOUS AREAS

Hazardous areas are areas that are considered to have flammable products present as defined in Australian Standard AS2430 for gas and AS61241 for dust. These areas require special attention to the type of equipment selected and installation methods used. This applies to all electrical equipment in a hazardous area.

Equipment shall be installed to meet the requirements of the AS2380 series of standards.

Where used, 'intrinsically safe' circuits shall also require special attention to cable types, marking, listed isolation barriers and will also require provision of energy calculations to verify the system meets AS2380.

3.3.1.6 Beam Detectors

Beam detectors shall be used where smoke detectors are not suitable e.g. aircraft hangers, places where dust may be present or the roof height exceeds that where point type detection is suitable or where access is not possible.

Beam detectors shall be the Hochiki type or similar approved. Transceiver types shall not be used unless prior approval is sought from the Principal. (Transceiver types require the use of reflectors, which can be unsightly in public areas.)

The beam detector shall be configured to latch when in alarm condition. The device shall be provided with a dedicated reset facility at the FIP or a reset via software configuration so that a general reset at the FIP results in the resetting of the beam detector.

3.3.1.7 Remote LEDs

Remote LEDs are to be provided for all ceiling void detection, electrical switchboards or inaccessible substations, inaccessible floor voids and normally inaccessible cupboards or rooms. These shall comply with AS1603.15-2002 Automatic fire detection and alarm systems – Remote indicators.

Remote LEDs shall be provided with a label indicating the detector loop and with the address number clearly shown. Detectors shall also be labelled. Refer to detector

labelling for requirements. The remote LED shall be factory marked accordingly. The type of remote LED to be used shall match the type of enclosure protected. The following shall be used as appropriate:

- 'Fire Alarm in Concealed Space'
- 'Fire Alarm in Roof Space'
- 'Fire Alarm in Room'
- 'Fire Alarm in Cupboard'
- 'Fire Alarm under Floor'
- 'Fire Alarm in Duct'.

Remote LEDs shall be located as follows:

Ceiling void or roof space	On ceiling directly below, within 600 mm horizontal radius of detector
Room	On wall directly above entry door, no more than 300 mm above top of door
Cupboard or enclosure	Directly above entry door or hatch, no more than 300 mm from opening
Underfloor	Flush fitting on wall directly perpendicular to detector, between 1,200 and 1,400 mm above floor
In duct	If concealed, directly below on ceiling or at entry point to concealed space. If duct detector is not visible from normal view, directly below surface mounted to duct or wall

3.3.1.8 Duct Probes

SMOKE DETECTORS IN DUCTED SYSTEMS

Smoke detectors for ducted systems shall be installed as part of a duct sampling system. The smoke detector shall be fitted inside a sampling chamber, which is fed from sampling tubes to meet with requirements of AS1603.13: Automatic fire detection and alarm systems – Duct sampling units.

Sampling tubes shall be fitted across the air flow to introduce a sample of air to the detector chamber. An air outlet shall discharge from the detector housing downstream of the duct.

The duct sampling tube shall be installed perpendicular to the air flow and shall transverse the duct width by at least 2/3rds of its width or height, whichever is the larger. The sampling tube shall be positioned at least 2/3rds of the vertical height in the duct.

All duct sampling detectors shall be configured on an individual detection zone. Where installed as part of a smoke control system, all cabling shall be fire rated accordingly to AS1603.13–1998 Automatic fire detection and alarm systems – Duct sampling units.

In addition to the loop and address, the duct housing shall be labelled with the zone number in text at least 5 mm high stating Supply/Return Air supply as appropriate in a permanently engraved or embossed label.

Where not visible from a normal access position by personnel, the detector shall be provided with a remote LED indicating loop, address or zone as appropriate in a location easily viewed.

In some cases such as fume cupboards, compliant duct detectors may not be suitable for the intended purpose (i.e. chemical interaction may damage the detector or trigger false alarms). Where this is the case, approval shall be sought from DFES and Curtin to monitor the fume cupboard manufacturer's fire detection probe with an addressable unit located at the fume cupboard that will monitor the manufacturer's detector and integrate with the FIP system through this unit.

HEAT DETECTORS IN DUCTS

Heat detectors shall be installed in all kitchen exhausts or other exhaust ducts that extract flammable or grease-laden vapours. A sealed probe-type device shall be installed in each duct as shown on drawings. The probe detector shall interface to the fire detection system via an addressable zone input module. An LED indicating the operation of the detector shall be easily visible. Where hidden from view, a remote LED shall be provided to indicate the operation of the detector. The remote LED shall be marked 'Fire in Duct'. Refer to the requirements for remote LEDs above.

Detectors shall be Type E fixed temperature, set to operate in the temperature range 85 to 110 °C, nominally 100 °C. Where ambient temperature is expected to be outside this range, then the operating temperature shall be selected accordingly.

Install the detector onto a steel (or similar material) removable plate with minimum dimensions of 100 x 100 mm to enable removal for routine testing or inspection. Make allowance to seal the plate with suitable rubber or airtight gaskets.

CARBON MONOXIDE DETECTORS

Unless otherwise noted, all carbon monoxide (CO) detectors shall be of the analogue addressable type. Detectors shall be fitted to the relevant listed base. The device shall be addressed as shown on drawings or as per design requirements.

CO detectors provided for new systems shall be from the Apollo range or approved equivalent with a relevant detector base. Detectors provided for existing systems shall match the existing type.

Detectors shall be installed so that the LED illumination faces the entry point of the room or the direction of the path from the FIP.

Each detector shall be provided with a suitable address label on the base indicating the loop and address. The label shall be UV-stabilised and of the permanently printed adhesive type. Marking of devices by hand or permanent marker is not permitted.

Detectors for normal use shall be of the latching type. The LED shall remain illuminated until reset.

Where CO detectors are used, the FIP shall be provided with a clear label 'Note CO Fire Detectors Installed' on the block plan or zone chart in text at least 5 mm high in a contrasting colour.

3.3.1.9 Break Glass Units

Break glass units shall be installed as shown on drawings. Break glass units shall be from the Ampac Discovery series (or an approved equivalent).

Where installed in damp or external locations, the break glass shall be weatherproof to IP65 addressable type specification.

All break glass units shall be installed at a height between 1,200 and 1,400 mm above finished floor or grade level.

The break glass unit shall be provided with an indication to verify operation in alarm. Provide a permanent label to indicate the zone and address/loop number.

Where not connected to a fire detection system or used for door release, simple alarm bells and the like, the break glass shall be rated and connected to Extra Low Voltage systems only.

3.3.2 SITE MONITORING

SITE MONITORING – DFES CONNECTIONS

Buildings and protected areas attended by DFES shall be connected to the DFES monitoring system.

The minimum signals to DFES shall be in accordance with the current connection requirements. The major signals to be provided are:

- Common Fire
- Sprinkler Activated
- Gas System Operated
- Other (as agreed with DFES).

The maintenance signals to be provided are:

- Common Fault
- Common Isolate
- Pump Run
- Low Pressure
- Low Battery.

Refer to the DFES website for details.

Cabling to DFES monitored systems shall comprise a fire-rated cable directly to the main distribution frame (MDF) terminated with a suitable junction box labelled 'Fire Alarm'. The final connection is to be by DFES DBA personnel.

Earth cabling (6 mm² min) shall be provided from the DFES monitoring device to the main distribution board in accordance with ACA requirements.

SITE MONITORING – GRAPHICS SYSTEM

All new fire detection systems shall be connected to the Curtin Campus site monitoring graphics system.

Each system shall be interfaced via the campus Ethernet LAN/WAN to provide all fire, fault and isolate signals directly to the computer monitoring systems at Bentley Security and Facilities Management locations. This shall require the configuration of the FIP, MODBUS Ethernet modem and the monitoring computer systems so that all detectors, devices and fire signals are independently identified at the monitoring system computers.

Each new system shall repeat all signals to the monitoring systems, which shall be provided with a graphics map for each building plan layout so that staff can identify its exact location.

The level of graphics maps required shall be nominated at the time of tender and shall be, as a minimum, at least the following:

- site plan showing building location in alarm or fault
- individual floor plans for each level showing fire zones
- detailed smaller floor plans where the building size is too large to be easily read on screen by staff
- each fire zone shall be highlighted on screen in normal and in alarm states
- other details as required by the Principal or Superintendent.

A dedicated rotary switch and indication LED (not key switch) shall be provided on the FIP so that the signal to each monitoring computer does not bring up an alert and display of devices being tested, though each fire fault or isolate shall still be logged on the site monitoring system. This is to provide records of devices tested on site without causing nuisance alarms to Curtin staff at Security and Facilities Management offices. The isolate switch shall still report isolate signals to DFES.

The site computer systems shall be modified by Ampac-trained personnel only. No works shall be performed on the site computer systems by the fire contractor. Contact Ampac for further details or requirements.

The systems shall be fully tested to prove all devices are repeated to the site monitoring system. This shall be logged on the site monitoring PCs and provided in printed form with commissioning documents. Practical completion shall not be achieved until commissioning documents are provided as required. Refer to the commissioning section for details.

SITE MONITORING – NETWORK PROVISION

The Fire Services Contractor shall engage the services of a Curtin-approved data communications contractor for the provision of cabling and equipment as required in this project. Liaise with Curtin University for network connections, CITS – Networks on (08) 9266 4455.

Each fire indicator panel location shall be provided with the following hardware:

Dual UTP RJ45 connections shall be located within the FIP enclosure to avoid tampering. Each socket shall be connected to the local area network and be configured with a fixed IP address, as nominated by CITS – Networks. The IP address shall be recorded at each socket by a permanently affixed label adjacent. One socket shall be used for connection to the FIP; the other is for maintenance use by CITS – Networks.

The data subcontractor shall install all necessary cabling, patch connections and necessary hardware to each FIP so that a data connection can be established between each FIP and the Security office graphics system.

All equipment and installations shall meet the requirements of current Curtin specifications for data installations.

3.3.3 **LINEAR HEAT DETECTION**

Linear heat detection (LHD) cable shall be installed as shown on drawings. In most cases linear heat detection shall be used where maintenance access is limited or where environmental conditions limit the use of other detection equipment.

Linear heat detection cable shall be listed with Factory Mutual (FM) or Underwriters Laboratories (UL).

Linear heat cable shall be Fire Buys Thermocable (or approved equivalent), temperature-selected to suit ambient conditions. For normal operation, fixed temperature LHD 68 °C shall be used. Concealed spaces and the like shall make use of 88 °C cable.

LHD cable shall be installed in accordance with manufacturer's recommendations.

LHD cable shall be affixed between 15 and 100 mm from the ceiling or roof structure using the manufacturer's recommended fixings or other suitable means. LHD shall be fixed at intervals no more than one metre apart. Catenary supports and fixings may be provided but care should be taken to ensure the maximum approved distance to the ceiling is not exceeded.

LHD cable minimum bending radius shall be no less than 100 mm or as per the manufacturer's recommendations.

Connection to the fire detection system shall be via a suitable junction box within the protected area. When interfacing to an addressable system, a zone input module shall be used. The zone input module shall be located in an easily accessible location and provided with an alarm indication or remote LED as appropriate. Each zone interface module shall be labelled indicating zone, loop and address details.

To provide a routine annual testing facility, a 2-metre test loop shall be provided at the end of the circuit, adjacent the end-of-line junction box to allow 5-yearly testing in accordance with AS1851.8-1987 – Maintenance of fire protection equipment. Note that AS1851:2005 requires annual testing but this is considered not suitable for fusible type cable.

Linear heat detection cable shall be terminated within the protected zone, without passing through other zones.

3.3.4 **AUDIBLE ALARMS**

Audible alarms shall be provided as shown on drawings. Where shown fitted to walls, alarms shall be installed at a height of between 2,200 and 2,400 mm above finished floor level.

Conventional electronic sounders shall be Ampac Vantage or similar approved. These shall be capable of providing sound output of at least 100 dBa at one metre.

A maximum of 20 sounders are to be connected to one sounder output from the FIP.

All sounder circuits shall be monitored for open circuit.

Addressable sounders shall be Apollo-type, suitable for use on Ampac FireFinder loops, or similar approved. The maximum number per loop shall be 50 per cent of the maximum total sounder load allowable.

Loop calculations shall be provided as part of the documentation requirements to verify the load.

3.3.5 **AUDIBLE/VISIBLE ALARMS**

'Fire Door Closing', 'Fire Alarm' and similar illuminated audible warning signs shall be provided where shown on drawings. The alarm shall be of Ampac manufacture or similar approved.

Signs shall be housed in steel enclosures and shall be of low power consumption, making use of LED-type illumination.

Where used externally, the device shall be a minimum of IP65-rated and provided with an aluminium or stainless steel sunshade which protrudes at least 100 mm beyond the fascia of the display at the top. The shade shall be powder coat coloured to match the alarm unit.

3.3.6 **STROBES**

Strobe alarms shall be provided as shown on drawings. Strobes shall be Ampac ASL30 5W type, or similar approved equivalent, to meet with AS1603.11. Red strobes shall be 24 V DC and provide a minimum of 150 Kcp.

External strobes shall be mounted on a conduit box or similar approved weatherproof box. Cable entries shall be IP66-glanded or via a rear entry conduit. Surface mounting of the strobe without a rear conduit box or similar weather protection is not acceptable. Provide a permanently engraved label adjacent to each strobe with the text 'Fire' at least 25 mm high in contrasting colour. All strobe cabling shall be monitored.

3.3.7 **ASPIRATED DETECTION**

The smoke detection system shall be installed as shown on the drawings and shall provide coverage in accordance with the spacing and location requirements of AS1670.1.

A detailed design of the proposed layout shall be prepared and approval sought prior to installation. The system shall be designed and verified by the detection system supplier's proprietary software to confirm system operation.

Capillary sampling devices shall be used for room space protection at ceiling level where a main sampling pipe can be concealed above. Ceiling spaces and under-floor voids shall use standard sampling methods. All sampling points shall be marked in accordance with the requirements of AS1670.

Air conditioning units shall have sampling points installed across the return air grilles. Sampling points shall be fitted facing downwards to avoid the ingress of dust or debris.

The aspirated system controller shall be a VESDA Laser plus c/w display or equivalent approved.

The sensitivity of each sampling point shall be not less than 2.5% obs/m.

3.3.8 **EXTERNAL BELL AND STROBE**

The installation of a fire alarm bell is a requirement from DFES. The strobe is required as part of AS1670.1. These should be accompanied with a sign/label 25 mm in height with the text 'FIRE' and should be clearly visible from the nearest entry door which leads to the FIP location.

The type of external bell and strobe to be used is as follows:

206-0001 – Ampac 200 mm Bell complete with weatherproof box or similar approved equivalent, with final approval by DFES

3.3.9 **BATTERIES**

Sealed lead acid batteries shall be housed within the FIP and EWIS/OWS or adjoining dedicated battery enclosures.

The batteries shall be of minimum capacity to provide 24-hour standby and 30 minutes of alarm as per the requirements of AS1670.

The batteries shall be sized to suit calculations of alarm and quiescent loads and allow for an additional 25 per cent future expansion. These loads shall be verified during commissioning.

Batteries shall be labelled with their installation date. All terminations shall be via dedicated crimp type terminals. Use of bare conductors on screw or post terminals is not acceptable.

Battery cabling shall be neat and tidy with suitable fixings and looming within the FIP or battery enclosure.

3.3.10 **POWER SUPPLY UNITS**

Where additional power supplies are used to support ancillary devices or where separate from FIP, these shall Activefire-listed.

The power supply shall be able to supply power at full load without batteries. Batteries shall be sized as noted in this specification.

External power supply units shall be monitored for power fail or battery low alarms. These shall indicate as a fault on the FIP.

3.4 LABELLING AND MARKING

All detectors shall be marked with permanent labels indicating loop and address. Labels shall be of the printed type. The labels shall be fitted to address tags dedicated to the detector type. The following format is required:

L1001

 Loop one, device one and so forth per loop

Labelling the face of the detector or around the base is not acceptable.

All break glass units shall be labelled with zone, loop and address number on permanently printed labels.

Strobes shall be labelled as appropriate. Refer to the strobe section for details. Supply air detectors shall be provided with permanent engraved labels stating the zone in addition to the loop and address detail.

All A/C shutdown and interface relays shall be labelled accordingly. Where provided inside mechanical services switchboards, relays shall be labelled within and on the cabinet door stating 'Fire Alarm Relay within'.

All 240 V AC supplies and labelling shall comply with AS3000 and be marked accordingly so that they are easily distinguished from Extra Low Voltage circuits. The 240 V supply breaker at the main switchboard shall be marked with a permanently engraved label stating 'FIRE ALARM' in text 10 mm high (minimum). An Origin of Supply label is to be fitted to the fire panel.

3.5 INTERFACING

INTERFACING – MECHANICAL SERVICES

All signals to mechanical services shall be via dedicated circuits or via software-operated loop devices. Where interface relays are required to be powered by the fire alarm system, additional loads shall be included in the power supply and battery calculations. All cabling to mechanical services shall be fire-rated to meet the minimum AS3013 requirements.

INTERFACING – DFES

Connections to DFES equipment shall be at the FIP. Cabling for telephone connections shall be fire-rated. A terminal rail shall be provided within each FIP, as nominated in current DFES connection requirements. Contact Chubb Monitoring and the Direct Brigade Alarm Contracts Manager of DFES (Tel 08 9395 9319) for further details.

INTERFACING – AUTO DOORS

Where automatic sliding doors are located on site, provide all interconnections as required to each door to open in event of fire to allow egress by occupants as necessary. Provide fire-rated cable to each auto door, either in loop configuration with addressable relays or via dedicated cable to each from the FIP. Mark each door on the

fire zone plan or tactical fire plans. Liaise with the specialist door contractor to carry out all tests necessary to demonstrate the system operates as required to the satisfaction of the Superintendent.

INTERFACING – ACCESS CONTROL SYSTEM DOORS

Where security doors are located on site, provide all interconnections as required to each security system door to open in event of fire to allow egress by occupants as necessary. Provide fire-rated cable to each door, either in loop configuration with addressable relays or via dedicated cable to each from the FIP. Mark each door on the fire zone plan or tactical fire plans. Liaise with the security system door contractor to carry out all tests necessary to demonstrate the system operates as required to the satisfaction of the Superintendent.

INTERFACING – EWIS/OWS SYSTEMS

Provide an individual signal from the FIP for each EWIS/OWS zone required. Cabling is to be fire-rated unless the EWIS/OWS control panel is directly adjacent.

INTERFACING – SITE MONITORING COMPUTER GRAPHICS SYSTEM

All new fire systems or major fire system upgrades involving replacement FIPs shall require the inclusion of the necessary equipment to interface to the site monitoring systems. This shall include provision of graphics and the configuration of relevant computer systems. A dedicated rotary switch and indication LED (not a key switch) shall be provided on the FIP so that the signals to each monitoring computer do not bring up an alert and display of devices being tested, though each fire fault or isolate shall still be logged on the site monitoring system.

INTERFACING – INTERFACES AND FINAL TESTING

All interfaces to other systems shall be fully tested in full alarm mode to demonstrate the system operates in a full simulated fire condition and under full load. Where this involves zoned shutdowns, AS1668 systems or security systems and the like, each zone shall be tested to simulate an alarm within that zone or zones to the satisfaction of the Principal.

3.5.1 SMOKE CONTROL SYSTEMS

Where required by BCA or AS1668, the fire detection system shall provide necessary signals and indications at the FIP and relevant mechanical services switchboards.

All cabling to smoke control systems shall be fire-rated to meet the requirements of AS3013 and other relevant standards.

3.5.2 SPARE PARTS

All fire detection system installations shall be provided with the following minimum spare parts. These shall be new, unused and be stored in the original packaging.

- five spare glasses (where any frangible-type glass unit is used)
- five of each type of detector used

- five of each type of speaker used
- ten smoke detector dust covers.

3.5.3 **EWIS/OWS SYSTEM**

Emergency warning speakers shall be installed throughout the building as shown on drawings and as described below. All alarm tones and warnings shall be in accordance with AS1670.4.

OFFICES, CORRIDORS AND PUBLIC AREAS

Each area shall be provided with an emergency warning speaker mounted at a high level.

Where the speaker cannot be installed flush, the use of surface-mounted units is allowed. The speakers shall be set so that an audible alarm level of no less than 65 dB(a) is obtained throughout. Speakers shall be provided with a suitable grille to match the surrounding ceilings and colour.

PLANT ROOMS AND NOISY AREAS

Flush and surface-mounted speakers shall be provided in all common areas, offices and the like to provide a minimum of 65 dB(a) within. For areas with high levels of ambient noise the minimum sound pressure level obtained shall be no less than 10 dB(a) above ambient levels. Where ambient noise level exceeds 95 dB(a), additional visual strobes shall be provided.

Where existing speaker circuits are being extended, speakers can be selected to match existing for that circuit only. Ensure the amplifier is capable of handling the additional load.

3.5.3.1 EWIS/OWS Control Panel

The EWIS/OWS control panel shall be of Ampac EV3000/EV120 or similar approved type. The EWIS/OWS control panel shall be coloured to match the FIP.

Amplifiers shall be sized to a maximum of 50 per cent total speaker load e.g. for a 60 W load, a 120 W amplifier shall be used for that zone. All amplifiers shall be 120 W per zone.

Each EWIS control panel shall be provided with at least one Warden Intercom Point (WIP) circuit per warning zone. Zones shall be as marked on drawings.

Unless directly adjacent to the FIP, all interface cabling shall be fire-rated. Interconnection to the FIP shall be via multiple input/outputs so that each EWIS zone can be alerted individually. Refer to the drawings for each zone required.

The EWIS control panel shall be mounted alongside the FIP. The cabinet door shall be hinged opposite to the FIP so that an operator can have easy access to both systems without having to move around the door.

Where a fire alarm break glass is located nearby (on the FIP) the white break glass unit on the EWIS control panel shall be removed. The EWIS control panel shall be factory ordered without the break glass unit fitted.

3.5.3.2 Operation

The EWIS system shall operate immediately upon receiving a fire alarm signal.

The system shall operate in 'alert' mode' for 120 seconds then switch to 'evacuate' mode.

Unless stated on drawings or elsewhere, the system shall be configured to operate all zones upon receipt of a fire alarm signal.

The EWIS system shall provide an isolate signal to the FIP so that when switched to 'Isolate' the fire system repeats an Isolate signal to the fire brigade directly.

Where there are loop sounders or other electronic sounders incorporated into the fire detection system, these shall be operated in conjunction with the EWIS system i.e. a manual 'alert' or 'evacuate' shall provide a signal to the fire alarm system, which in turn shall initiate the sounders.

3.5.3.3 Surface-mounted Speakers

The type of surface-mounted speaker to be used is as follows:

C0715 – One Shot 100 V line dual cone, 8" White, SPL 1W@1m 93 Db 1.25–5 W.

These shall be located as shown on drawings. Unless stated elsewhere, surface-mounted speakers shall be mounted between 2,200 and 2,400 mm above floor level where shown on walls.

Unless shown on drawings, all speakers shall be set for 1.25 W for corridors and 0.66 W for rooms.

3.5.3.4 Ceiling-flush Speakers

The type of ceiling flush speaker to be used is as follows:

- C2122C – Redback Fast Fix Speaker & Grille Combination, Fire/Evac twin cone 4" White, SPL 1W@1m 90 dB
- C2126B – Redback Fast Fix Speaker & Grille Combination, Fire/Evac twin cone 8" White, SPL 1W@1m 92 dB.

Grilles shall be steel or aluminium. Plastic grilles shall not be used.

Unless shown on drawings, all speakers shall be set for 1.25 W for corridors and 0.66 W for rooms.

3.5.3.5 Horn-type Speakers

Horn speakers are to be avoided whenever possible but for areas requiring higher than normal sound levels or where water ingress is possible, the type of horn speaker to be used is as follows:

- C2122C – Redback 10 W Plastic Horn Speaker – EWIS, IP66-rated, Grey, UV-stabilised, SPL 1W@1m 104 dB.

These shall be terminated with an IP66 junction box complete with suitable IP66 glands and cable terminations.

3.5.3.6 Warden Intercom Points

Warden Intercom Points (WIP) are to be located as shown on design drawings or such locations that enable authorised personnel to control the evacuation of occupants in emergency situations and are required to be installed as per AS1670.4.

WIPs are to be mounted at a height of between 1,200 mm and 1,800 mm above the floor level. Each WIP is to be clearly identified and shown on the tactical fire plan.

The type of WIP to be used is as follows:

- 219-0007 AMPAC Warden Intercom Phone (Red) or similar approved.

3.5.3.7 Break Glass Units

Should break glass units be required as part of the EWIS system refer to section 3.3.1.9 Break Glass Units for details on mounting heights, labelling and specific type to be used.

3.5.3.8 Strobe Units

Where ambient noise levels are higher than 90 dB, or where occupants may make use of ear defenders or similar hearing protection, visual flashing strobes shall also be installed. Unless shown on drawings these shall be located in a prominent position within the protected space so that occupants can easily see them within their normal field of vision i.e. on walls or pillars no higher than 3,000 mm above floor level.

The strobes shall be a combined red and amber unit to indicate 'alert' and 'evacuate' conditions. Each strobe shall be provided with a label adjacent as described below.

3.5.3.9 Labelling and Marking

Labels shall be provided on all EWIS equipment as detailed below.

- On all WIPs stating EWS Zone and WIP Number as shown on fire plan and on EWS controls
- On all red/amber strobes shall have a label adjacent to each strobe indicating 'Alert' or 'Evacuate Building' alongside the relevant strobe unit. Text shall be at least 25 mm high on UV-stabilised permanently engraved Traffolyte or similar approved material. Paper stickers or the like are not acceptable.
- The EWIS control panel shall be labelled as appropriate for each zone, WIP circuit or other control.

3.5.3.10 Power Supply

The primary power supply shall be connected in accordance with AS3000. This power supply is to be an AC supply from an electricity authority or a source that is equivalent to the supply from an electricity authority. The power supply should be capable of operating both the fire detection system and the occupant warning systems.

Should the primary power supply fail, a secondary power supply is to be provided. This secondary power supply should also be capable of operating both the detection

and warning systems. This supply should be in the form of rechargeable stationary batteries.

Battery calculations should be undertaken to ensure the capacity of the batteries matches that required to operate the required load.

3.5.3.11 Batteries

For further details on batteries please refer to 3.3.9 for details on requirements.

3.6 INSTALLATION

The Fire and EWIS systems shall be installed by suitably qualified electrical tradespersons. Qualified installers may be required to produce evidence of qualifications prior to starting work on site or as requested by the Principal.

Apprentices and other non-qualified workers shall not be engaged on the project unless approved by the Principal.

Upon contract award, the Contractor shall submit a list of all project employees including any subcontractors. A supervisor shall be nominated for each project together with relevant contact details.

The project supervisor shall be contactable throughout the contract's duration.

The Contractor shall supply at his own expense all labour, equipment and consumables for installation, testing and commissioning, and all plant and equipment necessary for the efficient and effective execution of the work as specified therein.

Where work is carried out in operational or existing Curtin University buildings, works can be carried out in normal hours but access is dependent upon any current operations in each department.

The contractor shall liaise with the Principal to arrange access as required. Some work may be required to be completed outside normal operating hours and should be included as part of the tender.

All equipment, software, materials and spares and warranties purchased on behalf and paid for by the Principal shall become the property of the Principal.

The Contractor shall furnish all necessary ladders, access or tools and equipment as required.

3.6.1 CABLE INSTALLATION

All cabling shall be installed as per the requirements set out within the following standards:

- AS3013 Wiring for specific installations
- AS3000 Wiring rules
- TS009 Austel (ACMA) installation requirements for customer cabling (wiring rules)
- AS1670 Fire detection, warning, control and intercom systems
- AS2053 Conduits and firings for electrical installations.

Together with the above standards, manufacturers' recommendations should also be taken into account. Cabling should be installed parallel to existing wiring whenever possible to allow for ease of access and repair/relocation.

3.6.1.1 Cable

All cabling shall be concealed where possible. Ensure cables are segregated as per AS3000 and TS009 with suitable barriers as required.

All detection, audible cabling permanently fixed to the building structure. The laying of cables on ceiling panels directly is not acceptable.

Where cables pass through fire or smoke walls, all penetrations shall be sealed using suitable fire-rated sealing materials to AS1530. The Principal may request the Contractor to supply certification by an independent authorised inspector to verify fire compartment integrity if deemed appropriate. Alarms and break glass cabling shall be in red TPS, EWIS/OWS shall have TPS cabling with a trace colour, (clarify with the Superintendent) or TPS housed in conduit. Cabling for A/C shutdown shall be a minimum of 2-core 1.0 mm² hour fire-rated in compliance with AS3013.

Where cabling is installed in ceiling space, it shall be run in a symmetrical and workmanlike manner. All cables shall be correctly fixed with proprietary cable ties and saddles where required.

ELV circuits shall be segregated from other systems and shall meet with the requirements of AS3000:2000 and ACMA (Austel) where appropriate.

Cables shall be supported with cable tray, conduit or on catenary

3.6.1.2 Cable Duct

Steel galvanised or painted cable duct shall be used. Plastic is not acceptable.

Refer to the Curtin University electrical specification for further details.

3.6.1.3 Conduit

Where conduits are installed, they shall be minimum 20 mm LD for general work and 25 mm HD for plant rooms and external locations. External conduit shall be UV-stabilised or steel galvanised.

Flexible conduit shall not be used anywhere on the project.

3.6.1.4 Access Hatches for Routine Testing

Where access is required for concealed device testing or maintenance, access hatches shall be a minimum of 450 x 450 mm and be of the hinged screw lock type. Hatch doors shall be gloss white in finish. Approved types are Kimberley Products hinged manhole KMHM03 or larger as required or similar approved. When beam detectors are used in ceiling spaces, all access hatches shall have warning labels applied detailing this information.

Gyprock or similar plasterboard hatches shall not be acceptable. Where provided for initial installation and there is no need for maintenance, ceiling hatches shall be cut and repaired, patched and painted to original finish and condition.

3.6.2 **INSTALLER QUALIFICATIONS**

Each installer shall have an ACMA-accredited open licence.

Where any low voltage work is being performed, licensed electricians shall be used to carry out the works.

Evidence of qualifications or licence/s may be requested by the Principal prior to or during the duration of the contract.

3.7 **TESTING AND COMMISSIONING**

3.7.1 **INDEPENDENT INSPECTION**

The Contractor shall appoint a suitably qualified independent inspector to check, review, inspect and certify the system design and operation. On award of contract, the system design shall be reviewed and authorised to ensure the system meets the requirements of AS1670 and DFES.

Upon completion of installation, the independent inspector shall review to ensure the project is installed in accordance with AS1670.1 and this specification.

A certificate of compliance shall be provided to verify design and installation.

Items requiring attention shall be rectified and reinspected as necessary.

3.7.2 **COMMISSIONING**

The Fire Services Contractor shall commission the system in accordance with the requirements of the applicable Australian standards.

The Contractor shall advise the Principal when commissioning testing is planned so that final testing may be witnessed by Curtin University or other nominated personnel.

All systems and equipment shall be fully tested to ensure correct operation. Further testing shall be carried out where required by DFES or any other bodies having jurisdiction. Note that all detectors, sampling points, speakers, devices, inputs, outputs, relays and hardware shall be fully tested.

Occupant warning system sound levels shall be recorded for each zone. Where sound levels fall below required levels, suitable adjustments shall be made to each device as necessary or additional speakers/sounders added to the system. Refer to the levels required. It is important sound pressure levels do not exceed standards as hearing damage may result, Where this is the case, the matter must be taken back to the engineer for design review and rectification. Sound levels are to be tested outside of normal working hours or as noted elsewhere.

Systems with smoke control shall be fully tested to demonstrate each smoke control zone operates as required. This shall involve single point testing of all smoke control compartments to ensure all fire modes and fire dampers operate as designed. Where required, the nominated Curtin mechanical services supervisor or contractor shall be consulted and/or involved in the commissioning process.

Mechanical and smoke control Cause and Effect Matrices shall be completed and signed off for each operation by the Contractor and witnessed by the nominated independent inspector.

Documentation shall be provided to the project manager to verify the system has been fully tested and commissioned in accordance with relevant Australian standards. This shall be supplied as part of the system documentation.

3.7.3 MAINTENANCE

The Fire Services Subcontractor is responsible for all maintenance works during the defects liability period, after which routine testing shall be carried out by Curtin University's nominated maintenance contractor.

3.7.4 OPERATOR TRAINING

The Contractor shall:

- provide sufficient operator training and instruction for all new control and monitoring systems
- use suitably qualified staff to carry out training to a minimum of three Curtin University specified representatives
- ensure training courses are a minimum of one hour's duration and are to be conducted within one week of the system being commissioned when it is in full operation
- provide operator's handbooks to all trainees detailing all essential information, including all necessary drawings, charts, notes and support information in the handbooks
- ensure the handbooks become the property of Curtin University
- give the Superintendent one weeks' notice of the proposed training to enable the appropriate staff to attend the training.

3.8 MAINTENANCE

Upon completion of the works the Fire Services Subcontractor is to perform all scheduled and preventative maintenance in accordance with the appropriate standards, this specification and the maintenance specification.

The Fire Services Subcontractor is responsible for all maintenance works during the defects liability period.

All maintenance and repair works shall be at the Fire Services Subcontractor's own expense, not the Principal's.

Records shall be kept to indicate maintenance carried out, in accordance with AS1851.

3.9 DOCUMENTATION

3.9.1 DRAWINGS

The Fire Services Contractor shall provide two copies of each of the following drawings and documents within two working weeks prior of completion of the project.

All drawings shall be completed using AutoCAD to AS1100 Drawing Standards and Curtin University's CAD Standards:

- plan showing detection and speaker layout and cable routes (ISO A1 min)
- system schematics (single line diagram) (ISO A3 min)
- standby battery calculations signed and verified (A4)
- Cause and Effect Matrices where required (A3/A4 min).
- commissioning details to AS1670 requirements.

Additional details shall be provided on relevant drawings, which shall include:

- Speaker power tapping for each speaker
- Address and zone of each detector and input device
- Cable sizing, routing and type for all cables.

3.9.2 COLOURED ZONE BLOCK PLAN

A zone block plan is required to be provided as per AS1670.1. The block plan is required to be a minimum size of A1 and be on UV-stabilised material.

The plan is to identify each zone protected via individual shades of colours that are not similar to adjacent colours. The main fire indicator panel, sub-indicator panels, mimics and repeater panels are to be shown on the plan. The plan is also to show any warning systems and intercom systems.

The block plan should be clearly legible without the need to attempt to read/convey the information within and should display room numbers or areas such as 'Departures' to clearly identify where the alarm is located.

The block plan is to be displayed in the correct orientation of the building from the point it is being viewed and should be laminated and securely mounted in a frame adjacent to the main FIP, any SIP, mimics or repeaters.

Emergency telephone numbers shall be included on the plan.

The fire plan shall be UV stabilised, sealed from ingress of moisture and housed in a fixed glass-covered frame permanently affixed to the wall.

All main switchboard locations are to be shown.

Where the system is part of a smoke control system, the additional DFES requirements shall apply. Refer to www.dfes.wa.gov.au regarding smoke control systems.

The words 'In the event of a fire ring 000 to ensure fire service response' should be clearly visible on each plan.

A3 laminated sub-plans shall be fitted at FIPs, with details to include detector location, address and zone information. Liaise with Curtin University regarding the fixing method.

3.9.3 **FIRE INDICATOR PANEL CONFIGURATION DATA**

A copy of the software configuration on disk and in hard copy format shall be included within each maintenance manual. An additional copy of the software disk shall be provided with a suitable plastic holder, labelled as to its contents, for storage by the Principal's maintenance engineer.

A printed copy of all device tests shall be obtained from the site monitoring system computers and shall be included in final commissioning documents. This shall show all devices tested and necessary commissioning tests as required by AS1670.

3.9.4 **OPERATIONS AND MAINTENANCE MANUAL**

The operations and maintenance manuals shall be prepared and submitted within two weeks of practical completion. The manuals shall include the following sections:

- index
- general overview of the system
- all programming details and database information
- detailed description of operations, including details of all switches, indications, interfaces and the like so that all equipment and interfaces and operations are described in full
- emergency contact details
- details of the FIP
- details of the OWS
- certificate of compliance (AS1670)
- independent inspector's certification
- details and data sheets of all installed field devices and components
- maintenance routines
- A3 drawings (As-constructed issue only)
- coloured copies of each graphic map for site monitoring system.

Provide two copies of the manual. The 'As-constructed' issue of the manuals shall be bound in a plastic or vinyl jacket.

Additionally upon completion, in addition to requirements above, all documents and drawings shall also be supplied in following format:

- Drawings: AutoCAD and PDF electronic format
- Manuals: MS Word and PDF electronic format.

Practical completion will not be achieved until all drawings, documents and electronic files have been delivered to the satisfaction of the Principal.

Failure to provide all the documentation listed, and in the formats specified, will result in the manuals being rejected until such time as all omissions have been included and resubmitted for approval.

3.9.5 **COMMISSIONING DOCUMENTS**

All commissioning documents shall be included in the final issue of the Operations and Maintenance Manual.

Where required, all signatures must be signed by hand (electronic signatures are not acceptable).

AS1670 standard commissioning documents for alarm and sound systems shall be provided.

Final as-constructed documents for warning systems shall include the sound pressure levels obtained in the most disadvantaged area of each warning zone with all relevant doors closed. This shall be recorded for each zone on the drawings with date and dB(a) level.

Signed and verified copies of battery calculations shall be provided.

Cause and Effect Matrix diagrams shall be provided and witness tested (where applicable).

3.9.6 **CALCULATIONS**

Battery calculations for the fire and EWIS/OWS systems shall be provided in accordance with the requirements of AS1670. Upon completion of the works, the battery calculations shall be checked by testing of the quiescent and alarm loads.

Sound level testing should also be carried out and recorded so as to ascertain that those adequate sound levels can be achieved in all areas. The required level to be maintained in all areas should be 65 dB unless the ambient noise is greater than this level, in which case sound levels should be set to be 10 dB above ambient.

Sound intelligibility testing, as required by AS1670.4, shall be carried out throughout and all results recorded.

Calculations are also required for the installation of high sensitivity smoke detection (aspirated) systems to ensure the system is balanced.

The final calculation documents submitted shall verify that the standby batteries are sufficient for the system loads. All calculations should be signed and verified.

3.9.7 **LOG BOOKS**

Log books shall be supplied with all new systems. These shall meet with the requirements stated in AS1851 – maintenance of fire detection and warning systems.

3.10 HANDOVER

Complete the testing and commissioning of all systems. Provide all commissioning and performance data for the installation including post-contract drawings prior to handing over the installation.

Provide documented completion certificates for the fire system as required by the Australian standards.

Practical completion will not be granted until the above requirements have been met.

4 GASEOUS EXTINGUISHING SYSTEMS

4.1 GENERAL OPERATION

The system shall be designed to detect a fire automatically and activate the gaseous extinguishing system. Audible and visual alarms shall be provided to alert occupants.

BASIC PRINCIPLE OF OPERATION

A fire detected by the smoke detectors shall initiate the following:

- indicate an alarm on the detector
- indicate a zone alarm at the FIP
- operate the Stage 1 audible alarms (alert)
- shut down A/C plant
- transmit a signal to the main fire detection system.

Upon receipt of an alarm from a second smoke detector, the following shall operate:

- visual alarms 'Evacuate area' and 'Do not enter signs'
- operate the Stage 2 audible alarms (evacuate)
- initiate the gas discharge sequence (30-second delay).

Following discharge of the extinguishing gas, the system pressure switch shall provide signals to the FIP and to DFES confirming gas has been released.

The audible alarms shall be configured so that a 'bell isolate' or 'sounder isolate' function of the FIP shall silence all of the audible alarms when operated. Use of the reset function to silence audible alarms shall not be deemed as compliance with this requirement. The visual alarms shall remain operative until the pressure switch has been reset.

The A/C plant shutdown facility shall be configured so that the shutdown of the A/C plant can be isolated by a 'plant isolate' facility on the FIP.

4.2 DESIGN

4.2.1 GASEOUS SYSTEM DESIGN

The design criteria shall comply in all respects with the requirements set out in current standards that are deemed applicable with current works in respect to, but not limited to, equipment, materials, workmanship and installation.

The design should comply with the following codes, standards and regulations:

- AS1670.1 – Fire detection design installation and commissioning
- AS1851.8 – Maintenance of fire detection systems
- AS2220.1 – Emergency warning equipment design and manufacture
- AS4428.1 – Control and indicating equipment

- AS14520.1 – Gaseous fire extinguishing systems
- AS3013 – Wiring for specific installations
- AS3000 – Wiring rules
- AS/ISO14520.1 Gaseous fire-extinguishing systems – Physical properties and system design – General Requirements
- Curtin University specific requirements
- Building Code of Australia
- DFES regulations and requirements
- Government agency/body governing works
- ACMA (Austel Requirements).

Other standards not noted in this specification may be referenced in the above and as such shall be applicable.

Where there is a conflict between the standards and this specification, the requirements of the Australian standards shall take precedence.

The design requirements of the Gaseous Fire Suppression System shall meet with the minimum requirements set out in AS14520.1.

Mechanical services interfacing

The design shall incorporate A/C system shutdowns as necessary to maintain gas concentration for the required period.

Pressure relief dampers shall be provided for all gaseous systems. These shall be installed by the mechanical services contractor. Liaise with mechanical services contractor as necessary.

4.3 ELECTRICAL CONTROL AND WARNING

4.3.1 LOCAL CONTROL STATION

The local control station (LCS) shall be fitted adjacent to the entry door to the computer room. Facilities on the LCS shall include manual release, discharge inhibit and indications showing operated and inhibited.

The LCS shall be installed at 1,500 mm above finished floor level. This shall be of Ampac manufacture or equivalent approved.

4.3.2 SUB-INDICATOR CONTROL PANEL

A sub-indicator panel (SIP) is required to be installed for all gas systems. The SIP is to be manufactured in accordance with AS4428.

The SIP shall be SSL/Activefire-listed and have a minimum of four detection zones with a minimum of two supervised bell output circuits. The solenoid and plant shutdown outputs shall also be fully supervised. Disconnection of any field cable shall register as a fault on the SIP.

The SIP shall be a conventional type with integral power supply and sealed lead acid batteries. Disconnection of the battery shall indicate as a fault on the SIP.

The SIP shall be installed as shown on drawings in accordance with the height requirements of AS1670.1 The SIP controls shall be accessible with the use of an industry standard '003' key.

The SIP shall be powder-coated white or cream in colour.

4.3.3 **BATTERIES**

Sealed lead acid type batteries shall be housed within the FIP or adjoining dedicated battery enclosure. The batteries shall be of minimum capacity to provide 24-hour standby and 30 minutes of alarm as per the requirements of AS1670.

If an aspirated smoke detector controller is to be powered by the SIP, then the additional load shall also be included in the sizing requirements of the batteries. The Fire Services Contractor shall supply a copy of the standby battery calculations verifying compliance with this requirement, as part of the design documentation.

Where used, secondary power supplies shall meet with the requirements of AS4428.

4.3.4 **DO NOT ENTER AND EVACUATE WARNING**

'Do Not Enter' and 'EVACUATE' illuminated signs shall be installed above or adjacent to the entry door as shown on the tender drawings. These signs shall meet the requirements of AS14520.1. These shall be of Ampac manufacture or equivalent approved.

4.3.5 **SYSTEM INOPERATIVE WARNING**

A 'system inoperative' sign shall be fitted external to the computer room and shall operate whenever the system has been isolated as required by AS14520.1. These shall be of Ampac manufacture or approved equivalent.

4.3.6 **AUDIBLE ALARMS**

Audible alarms shall be installed as shown on the drawings and shall be installed at a minimum height of 2,200 mm above floor level. The audible alarms shall be capable of providing alert and evacuation tones as required in AS170.4.

The audible alarms shall be Ampac Vantage or equivalent approved.

4.3.7 **FLASHING STROBES**

Strobe alarms shall be provided as shown on drawings. Strobes shall be Ampac ASL30 5W type or similar approved equivalent to meet with the requirements of AS1603.11.

Red strobes shall be 24 V DC and provide minimum of 150 Kcp.

These shall remain on following a gas discharge until the pressure switch has been reset.

4.3.8 **SOLENOIDS**

Solenoids shall be provided for the automatic operation of the system. The solenoid shall be suitable for connection to a fire indicator panel and be suitable for 24 V DC operation.

The detection system shall operate the appropriate solenoid. The solenoid shall be supervised for open or short circuit.

The individual solenoid shall be operated as indicated on the Cause and Effect Matrix.

4.3.9 **PRESSURE SWITCH**

The pressure switch shall be configured so that following operation, the strobes, 'Do Not Enter' and 'EVACUATE' signs remain illuminated until reset.

4.3.10 **A/C SHUTDOWN INTERFACE**

The fire detection system shall provide a shutdown signal to mechanical services switchboards via interface relays. These relays (where required) shall be installed adjacent to, or inside each MSSB. Relays and cabling shall be supplied and installed by the fire services Contractor.

This shutdown shall operate in the event of a fire as noted in the Cause and Effect Matrix (if provided). Operation of the 'plant isolate' function shall inhibit A/C shutdown. The cabling to the A/C relays shall be supervised for open circuit and shall raise a fault if disconnected.

4.3.11 **OTHER INTERFACING**

Provide all necessary interface relays and equipment as required by AS14520.1 or as directed by the Principal.

4.4 MECHANICAL

4.4.1 **AGENT CONTAINERS**

Provide agent cylinders suitable for use, generally arranged as shown on the drawings and as described below. Cylinder capacity shall be suitable for the quantity of agent required. The cylinders shall be provided with a pressure gauge and liquid level indicator.

Suitable labelling shall be provided indicating the capacities, fill level and weight information.

4.4.2 **NOZZLES**

Nozzles shall be selected to suit the calculated discharge requirements. Each nozzle shall be suitably stamped and identified. Drawings shall also include relevant nozzle data so that each nozzle is correctly installed. Nozzles shall be located to match system calculations. Nozzles shall be located so that they are not obstructed by nearby objects such as ducts, cable trays, fittings and the like.

4.4.3 **MECHANICAL OPERATION**

The mechanical manual release shall be provided adjacent to the cylinder, either as part of the electric control head or as a separate control. The release shall be provided with a safety pin and seal to prevent accidental operation. A warning sign shall be provided adjacent to each manual control.

4.4.4 **PNEUMATIC CONTROL HEAD**

Where required, a pneumatic control head shall be provided so that all cylinders for the relevant protected area discharge at the same time. A flexible tube shall be provided so that the control head can be removed. Rigid connections can be used but the final connection to the control head must be flexible.

4.4.5 **PAINTING**

All exposed piping shall be painted Signal Red, factory finished to a high standard. Touch up any minor damage to paintwork on site.

Where plant and equipment is not factory painted, paint with one coat of zinc chromate or similar metal primer and two coats of full gloss Signal Red enamel.

Paint galvanised steel surfaces with one coat of an etching primer and two coats of full gloss enamel after cleaning the surfaces of all oil and protective coatings.

Paint systems and equipment to colours as scheduled. Colour codes relate to AS2700 – Colour Standards for General Purposes.

4.4.6 **PIPING**

Supply and install all piping specified herein and/or indicated on the accompanying drawings, together with all necessary fittings, supports, etc.

Pipe – All piping is to be ASTM Schedule 40 Grade B seamless hot dipped galvanised after fabrication. All pipes are to comply with API5L-B – American Petroleum Institute Section 5 Line pipe – Grade B.

Where pipes are welded, the weld joints shall comply with AS1554. All threads are to NPT.

All screwed fittings shall comply with ANSI B16.113000 lbs, suitable for the working pressures nominated in AS14520.1.

Use screwed joints for pipes up to 50 mm diameter and flanged, fully welded or mechanical roll grooved joints for pipes over 50 mm diameter suitable for the maximum working pressure of the system as stated in AS14520.1. All threads are to NPT.

Roll groove couplings shall be Victaulic Style 77 galvanised or similar, approved for use for pipe sizes greater than 50 mm. No roll grooves are to be cut type. All proposed roll groove couplings shall be suitable for the maximum working and test pressure nominated in AS14520.1.

Roll groove fittings -shall be Victaulic galvanised or similar approved for use for pipe sizes greater than 50 mm. All proposed roll groove fittings shall be suitable for the maximum working and test pressure nominated in AS14520.1.

Note: Should any repairs be required to hot-dipped galvanised piping, it shall be carried out using a 'hot galvanising stick' process. Zinc metallising or zinc-rich paint shall not be used.

The drawings indicate the sizes of pipes and the manner in which the system shall be run. They do not, however, show all minor pipe work included in the Contract.

Where possible, the Contractor shall adhere to the piping layout indicated. Where this is not possible, due to the type and arrangement of the particular equipment to be installed, approval shall be obtained from the Superintendent to depart from this.

Pipework shall be installed to approval to suit the building structure and to avoid interference with all existing services. The piping installation shall be in accordance with best modern practice and be strictly in accordance with the manufacturer's recommendations.

All pipework shall be suitable for its respective service under the actual operating conditions of temperature and pressure. Piping shall be arranged in a workmanlike manner, true to alignment and grade.

Pipes shall not be installed above electrical switchboards, or in electrical ducts, risers, cabinets or switch rooms.

4.4.7 **FIXINGS**

All pipe supports shall be designed and installed in accordance with AS14520.1.

For specialised brackets, refer to drawings for type, design and locations. All manufactured brackets are to be hot dipped galvanized.

All proprietary brackets, threaded rods, nuts and washers are to be galvanised.

All concrete anchors are to be Hilti HKD (or similar approved) type and be installed as per manufacturers' specifications. All fixing bolts into embedded anchors are to be as a minimum galvanized (or similar approved).

Where pipes run close to walls, floors or ceilings, a minimum distance of 50 mm shall be maintained between the pipes and the nearest surface. Clearances for insulated pipes shall be such that the required insulation system can be correctly applied and sheathing installed (if nominated).

Pipes shall be positioned such that all valves etc. installed therein are readily accessible from the service pits and can be easily and properly operated.

Piping shall be kept closed against moisture and foreign matter when stored on the site and shall be thoroughly cleaned of all burrs and scale before erection.

4.5 **INSTALLATION**

Gaseous system equipment, cylinders and piping installations shall be carried out by qualified pipe installers. Installers shall be accredited for the handling and installation of gaseous systems. Qualifications may be requested prior to or during project duration by the Principal.

4.6 TESTING AND COMMISSIONING

4.6.1 TESTING GENERAL

The Fire Services Subcontractor shall carry out all testing and commissioning procedures necessary to render the installation fully operational to the satisfaction of the Superintendent's representative and in accordance with AS14520.1.

These procedures shall include the following minimum requirements:

- hydrostatic and pneumatic pressure testing of all pipework systems
- testing to indicate all pipework is clear of debris or obstruction
- integrity testing of the enclosure as required
- operation of electric control head (coordinate with fire detection subcontractor).

The Fire Services Subcontractor shall give at least three working days' notice to the Superintendent's representative of their intention to carry out any of the specified tests, or such other period of notice as may be reasonable under the prevailing circumstances.

Unless otherwise agreed, the tests shall be carried out in the presence of the Superintendent's representative.

4.6.2 PIPEWORK TESTING

All piping shall be hydrostatically and pneumatically tested to a pressure 1.5 times the maximum working pressure of the system.

Test pressure shall be maintained for minimum of two minutes.

Any leaks shall be rectified and the pipes re-tested to the satisfaction of the Superintendent's representative.

The commissioning records shall contain all test and commissioning results to the final commissioned installation, derived from the tests and procedures specified in this section.

4.6.3 INTEGRITY TESTING

The protected area is to be tested to prove integrity of the enclosure so that the system will operate and hold the concentration of agent as required by AS14520.1.

Allow for tests as necessary. The Contractor shall provide a system that is capable of maintaining the agent concentration above the height of the highest risk within the protected area as required by AS14520.1.

4.6.4 COMMISSIONING RECORDS

Commissioning records shall be submitted to the Superintendent's representative. Two bound copies of the complete commissioning records shall be provided.

The commissioning records shall be bound and titled in a similar form to the Operations and Maintenance Manuals.

4.7 DOCUMENTATION

4.7.1 OPERATIONS AND MAINTENANCE MANUAL

Submit for approval of the fire services consultant one copy of the Operations and Maintenance Manual prior to commencement of the site installation. Bind the manual in a white vinyl hard-back A4 folder with a cover page.

Prior to practical completion, submit four copies of the Operations and Maintenance Manual to the Superintendent. Practical completion will not be granted until all documents have been received.

Format the cover as follows. Include the title 'Fire Services' on the spine.

SPINE	FRONT COVER
XXXXXXXXXX	GAS
SUPPRESSION (DESCRIPTION OF INSTALLATION)	SYSTEM

Include the following contents and format in the manual as follows:

SECTION 1 – INDEX:

- Include sections and subsections.
- Include list of drawings.

SECTION 2 – SYSTEM DESCRIPTION:

- Include a general description of the system and its components, including FIP connections.
- Include schedule of capacities for all equipment.
- Include calculations.

SECTION 3 – INSTALLATION MAINTENANCE AND OPERATING INSTRUCTIONS:

- Include detailed maintenance log sheets for each item of equipment.
- Include the manufacturer's installation, maintenance and operating instructions for each item of equipment.

SECTION 4 – OPERATING INSTRUCTIONS:

- Include a complete description and correct sequence of all actions necessary for the starting up, operation and shutting down of the fire system.
- Details of all isolation procedures of gas systems and/or plant shutdowns and the like.
- Emergency shutdown procedure.

SECTION 5 – PERFORMANCE TEST RESULTS.

- Include commissioning data, performance test results and authorities test certificates.
- Independent authorised inspector's certificates / documents.
- Hydrostatic test results.

SECTION 6 – DATA SHEETS:

- Data sheet index
- Include manufacturer's literature for all equipment.

SECTION 7 – INSTALLATION DRAWINGS:

- Drawing index
- Include full-size and A3 copies of all construction drawings.
- Gas suppression system node drawing.
- A CD, containing the as-constructed drawings in AutoCAD format, and include all data sheets and commissioning sheets in electronic format.

4.7.2 LOG BOOKS

Log books shall be supplied with all new systems. These shall meet with requirements stated in AS1851 – maintenance of fire systems.

4.7.3 CALCULATIONS

The following calculations shall be provided:

- battery calculations for all standby batteries (verified and witnessed on site)
- hydraulic calculations for the gas discharge
- aspirated detection system calculations (if applicable) (verified & witnessed on site)
- integrity test data showing hold time and descending interface details
- Include comment on highest protected equipment.

4.7.4 CERTIFICATION

The Contractor, (with the approval of the Superintendent) shall appoint a suitably qualified independent inspector to check, review, inspect and certify the system design and operation. On award of the contract, the system design shall be reviewed and authorised to ensure the system meets with the requirements of AS14520. Upon completion of the installation, the independent inspector shall review to ensure the project is installed in accordance with AS14520.1 and this specification.

A certificate of compliance shall be provided to verify design and installation.

Items requiring attention shall be rectified and reinspected as necessary.

4.7.5 **DRAWINGS**

The fire services Contractor shall provide the following drawings and documents within two working weeks of completion of the project.

All drawings shall be completed using AutoCAD to Curtin University CAD and AS1100 Drawing Standards. Two copies of each shall be provided.

- plan showing detection and device layout and cable routes (A1 min)
- system schematics (single line diagram) (A3 min)
- standby battery calculations signed and verified (A4)
- Cause and Effect Matrices where required (A3/A4 min)
- commissioning details to AS14520 requirements.

4.8 **HANDOVER**

Complete the testing and commissioning of all systems. Provide all commissioning and performance data for the installation including post-contract drawings prior to handing over the installation. Provide documented completion certificates for the gaseous extinguishing system as required by Australian standards.

Practical completion will not be granted until the above requirements have been met.

4.8.1 **OPERATOR TRAINING**

Provide sufficient operator training and instruction for all new control and extinguishing systems.

Use suitably qualified staff to carry out training of a minimum of three Curtin University-specified representatives.

Ensure training courses are a minimum of one hour's duration and are to be conducted within one week of the system being commissioned when it is in full operation.

Provide operator's handbooks to all trainees detailing all essential information.

Include all necessary drawings, charts, notes and support information in the handbooks.

The handbooks are to become the property of Curtin University.

Give the Superintendent one weeks' notice of the proposed training to enable the appropriate staff to attend the training.

4.9 **MAINTENANCE**

Upon completion of works, the fire services Subcontractor is to perform all scheduled and preventative maintenance in accordance with appropriate standards, this specification and the maintenance specification.

The fire services Subcontractor is responsible for all maintenance works during the defects liability period. All maintenance and repair works shall be at the fire services Contractor's expense.

5 WET SYSTEMS

5.1 OVERVIEW

This specification shall detail the minimum fire services and systems required for Curtin University (to Australian standards and BCA).

This section refers to water-based systems.

All systems shall be supplied, designed, installed and commissioned in accordance with all other relevant Curtin University electrical specifications.

It is a requirement of Curtin University that wet fire systems designed and installed for its third-party developer lots shall be metered. The detailed requirements for metering can be found in *000346 PDG Services Metering Guidelines*.

5.2 DESIGN

5.2.1 SPRINKLER SYSTEM

The design criteria shall comply in all respects with the requirements set out in current standards that are deemed applicable with current works with respect to but not limited to equipment, materials, workmanship and installation.

The design should comply with the following codes, standards and regulations.

- National Construction Code (Formerly BCA)
- AS2118.1 – Automatic Fire Sprinkler Systems
- AS1851 – Maintenance of Fire Protection Systems
- Water Corporation requirements
- Curtin University specific requirements
- DFES regulations and requirements.

Where an Australian standard is not available for the type of system required, the use of the relevant NFPA standard shall be applied.

5.2.2 DELUGE SPRINKLER SYSTEMS

Deluge sprinkler systems shall be designed to meet with the requirements of AS2118.3. Where required, the relevant NFPA standard shall be applied.

5.2.3 HYDRANT AND HOSE REELS

The design of hydrants and hose reels systems is to comply with the requirements set out in the current applicable Australian standards and the National Construction Code (BCA). This applies to all equipment, materials, workmanship, installation and the like.

The design should comply with the following codes, standards and regulations:

- National Construction Code (Formerly BCA)
- AS1221:1997 – Fire Hose Reels

- AS2419.1:2005 – Fire Hydrant Installation
- AS2419.2 – Fire Hydrant Installations – Fire Hydrant Valves.
- AS2419.3 – Fire Hydrant Installations – Fire Brigade Booster Connections.
- AS2441:2005 – Installation of Fire Hose Reels
- AS1851:2005 – Maintenance of Fire Protection Systems (Parts 2 & 4)
- Water Corporation requirements
- Curtin University specific requirements
- DFES regulations and requirements
- government agency/body governing works.

5.2.4 **WATER SUPPLIES**

New systems shall make use of existing water supplies. Connect into existing services or town mains as shown on the drawings.

When connecting into town mains, backflow prevention shall be provided to meet with WA Water Corporation requirements. Allow for all connections and equipment required to provide full installation.

5.3 **EQUIPMENT**

The purpose of this section is to provide details into which equipment sprinkler heads, piping, pumps and the like are preferred by the Principal to be used during installations.

5.3.1 **FIRE SPRINKLERS**

Sprinkler systems shall be designed, supplied and installed in accordance with relevant Australian standards and building codes. Wet-type sprinkler systems shall be installed in all areas unless otherwise specified.

Pre-action, deluge and tail-end systems may be required to suit the environment. These are detailed on the drawings.

5.3.1.1 *Sprinkler Alarm Valve Assembly*

Design, supply and install a fire sprinkler control valve and trim assembly (Reliable or similar approved) and ancillary piping as per AS2118 and manufacturers' recommendations, complete with a direct brigade alarm pressure switch, low pressure switch, pump start pressure switch assembly, jacking pump start-stop pressure switch assembly and new water alarm gong complying with AS2118 requirements. Refer to drawings for sizing and location.

The fire services Contractor is to provide details to the electrical contractor of the pressure switches used and the connection criteria and purpose, to enable connection to the fire alarm system and pump start control system.

An annubar flow test facility shall be provided so that the system demand duties, as shown on the block plan, can be periodically tested. The annubar flow test shall be

provided with a drain suitable for full discharge of the system throughout a normal test period. Liaise with the plumber to ensure drains are adequate.

5.3.1.2 Sprinkler Heads

The following sprinklers shall be used where appropriate:

- below ceiling fire sprinkler heads Reliable F1 (or equivalent) DN 15 white pendant 68 °C spray pattern heads glass bulb type. Provide escutcheon plates to match the existing type/profile/finish
- exposed warehouse or similar – DN15 brass 93 °C glass bulb
- concealed space fire sprinkler heads, Reliable F1 (or equivalent) DN 10 brass pendant 93 °C spray pattern heads glass bulb type
- external canopy exposed pendant Reliable G (or equivalent) DN 20 brass pendant 141 °C spray pattern heads glass bulb type
- ESFR pendant fire sprinkler heads Reliable ESFR K 14 (or equivalent) brass pendant 74 °C heads, with Factory Mutual and SSL approvals. NOTE: the installation of the ESFR sprinkler directly below skylights shall be avoided. Where this is unavoidable, a 400 mm² 16 g sheetmetal shield shall be installed directly above the sprinkler head. The shield shall be fixed to the fire sprinkler piping. The sprinkler heads requiring shields shall be clearly marked on the contractor's drawings
- Where sprinkler heads are installed in the vicinity of electrical switchboards and major electrical equipment, deflectors must be fitted to the heads to inhibit direct water impingement. Alternatively, if suitable, sidewall sprinklers may be used if configured to avoid direct contact with electrical switchboards.
- Cool rooms – dry pendant dropper-type heads to be used. Where refrigeration equipment is run to defrost ensure the sprinkler temperature is above expected room conditions.

Where sprinkler heads are installed below 2,290 mm above floor level, manufacturer's impact guards shall be fitted where indicated on the drawings.

A stock of spare sprinklers shall be provided, complete with the necessary replacement tools required.

The spare sprinklers shall be stored with the tools in a suitable spare sprinkler cabinet (located adjacent to the alarm valves). Spare sprinklers shall be stocked for all types and/or temperature ratings installed within the protection systems but in any case shall not be less than six of each type of rating.

There shall be a minimum of 26 heads provided in the cabinet.

5.3.1.3 Drains

Provide drain points complete with isolating valves and drain lines in accordance with AS2118 and, where required, at low sections of the pipe work to enable the systems to be completely drained.

Drain valves shall be placed in easily accessible positions, be clearly labelled And be locked in the closed position. The location of all drains shall be indicated on the fire safety Subcontractor’s workshop drawings.

5.3.2 PIPING

Construct piping installations using the following materials:

PIPING SYSTEM	MATERIAL	DESIGN CONDITIONS
Fire Sprinkler	Black mild steel, medium to AS1074	Maximum operating pressure 1,400 kPa
Dry Fire Sprinkler System	Stainless steel to AS2118.9	Maximum operating pressure 1,400 kPa
Control, vents and drains	Galvanised mild steel, medium to AS1074	Maximum operating pressure 1,400 kPa
External piping	Galvanised mild steel, medium to AS1074	Maximum operating pressure 1,400 kPa

Note: Should any repairs be required to hot-dipped galvanised piping, it shall be carried out using a 'hot galvanising stick' process. Zinc metallising or zinc-rich paint shall not be used.

5.3.3 DELUGE SYSTEM

The sprinkler deluge system shall be installed as shown on drawings. The system shall be designed, supplied and installed in accordance with AS2118.3 and, where further specified, NFPA15.

5.3.3.1 General Operation

The deluge system shall be operated by the detection system as shown on drawings. The interface shall be via electrical solenoids at the deluge valve set.

5.3.3.2 System Design

The deluge system shall be designed to operate upon activation of the detection system. The deluge valves shall be located so that the discharge operation time is less than 30 seconds from detection to full system discharge.

The system shall be designed so that maximum imbalance between the least favoured and most favoured nozzles is no more than 10 per cent.

5.3.3.3 Water Supply

Connect the deluge system to the existing water supply as shown on drawings.

5.3.3.4 Deluge Valve Assembly

Deluge valves shall be sized as shown on drawings. The trim assembly shall be proprietary supplied and be FM/UL listed for use as a deluge system.

The trim shall be based on electrical activation with solenoid operation. Deluge trim shall incorporate the following components:

- deluge-tripped pressure switch
- operate solenoid (24 V DC)
- monitored isolation valves above and below the alarm valve
- valve anti-tamper switches on all isolation valves
- gauges and isolation valves to suit approved trim configuration and to AS2118.

5.3.3.5 Nozzles

Nozzles shall be selected to suit the calculated discharge requirements. Each nozzle shall be suitably stamped and identified. Drawings shall also include relevant nozzle data so that each nozzle is correctly installed.

5.3.3.6 Detection Heads

The system shall make use of an electrical detection system for operation. Wet-type sprinkler heads shall not be required.

5.3.4 PIPING SYSTEMS

Construct and install all components of piping systems including pipework, valves, fittings, drains, supports and anchors in accordance with the requirements of this specification.

Provide all associated equipment such as valves and supports necessary for the safe and efficient operation of the fire sprinkler system and as necessary to allow effective maintenance of the plant and equipment.

Install pipework to achieve a neat workmanlike appearance, laid out with adequate provision for expansion and contraction, grading, alignment and access for maintenance.

Arrange pipework to permit the removal of any item of equipment without cutting pipework and without breaking any structure.

Fabricate bends ensuring a smooth finish without any discernible flattening or corrugation and with a centreline radius of 1.5 times the diameter. Fabricated reducers shall be of a 'butt-weld' type as appropriate to meet the drainage requirements of AS2118.

Support and restrain all piping systems to ensure maintenance of alignment and prevention of undue stresses on the piping systems and building structure under all operating conditions.

Design the support and expansion systems including clamps and fittings to take account of the combined loads of the pipework, valves, fittings, insulation, fluid and reactions due to thermal expansion/contraction, fluid discharge and movement of the building structure.

Supports shall be designed in accordance with AS 2118, Part 9 – Code for Automatic Fire Sprinkler Systems – Piping Support and Installation.

Construct all supports and associated fittings where exposed to moisture, condensation or weather from galvanised steel.

Space pipe supports, both vertical and horizontal, in accordance with the requirements of AS2118, Part 9 – Code for Automatic Fire Sprinkler System.

Fix single pipe supports to the building structure with masonry anchors connected directly to hanger rods or clamped to structural members as applicable.

Fix multiple pipe supports from common channel sections. Connect to the building structure with masonry anchors or by clamping or welding to structural steel members.

Make due allowance for pipework movement in the method of support, using spring mounts and hanger rods.

Use hanger rods where the maximum movement of pipe is less than 11 per cent of the length of the rod. Incorporate spring/neoprene hangers where sufficient rod length cannot be provided to take up the movement.

Comply in all respects with ASS1554 – Structural Steel Welding.

Obtain approval from the fire services Consultant for the design of all support, anchor and expansion systems, for support locations and for loads to be applied to the building structure prior to the commencement of manufacture and installation of the systems.

5.3.4.1 *Painting*

Paint, identify and label the plant and equipment including piping systems, associated fittings and supports. Do not paint normally bright and polished components.

Paint the following:

- all plant and equipment exposed to view
- pipework, valves, fittings exposed to view
- factory-painted valve equipment.

Do not paint:

- fire sprinklers.

Supply plant and equipment factory-finished to a high standard, to the fire sprinkler Consultants approval. Touch up minor damage to paintwork on site.

Where plant and equipment is not factory-painted, paint with one coat of zinc chromate or similar metal primer and two coats of full gloss Signal Red enamel or to a colour specified by the Principal.

Paint galvanised steel surfaces with one coat of an etching primer and two coats of full gloss enamel after cleaning the surfaces of all oil and protective coatings.

Paint systems and equipment to colours as scheduled. Colour codes relate to AS2700 – Colour Standards for General Purposes.

SYSTEM, EQUIPMENT	COLOUR SCHEME
Exposed piping in public areas	To match ceiling and fittings to architect's requirements
All other internal piping	R13 Signal Red or as specified by the architect
External piping	To match existing surfaces
Dry piping (stainless steel) system	Unpainted
Drains, pipework	Black

5.3.4.2 Fittings

All piping is to be AS1074 medium quality black steel piping.

Use screwed joints for pipes up to 50 mm diameter and flanged, fully welded or mechanical roll grooved joints for pipes over 50 mm diameter suitable for the maximum working pressure of the system as stated herein. Roll groove coupling shall be Victaulic or similar, approved for use for pipe sizes greater than 50 mm.

5.3.4.3 Isolation Valves

All isolation valves shall be monitored for any abnormal state. Main isolation valves shall also be provided with chain/strap and padlock to meet AS2118 requirements.

5.3.4.4 Test and Drain Valves

Test and drain valves shall be supplied as shown on drawings. Where drained to internal buildings, suitable drains shall also be provided so that the system can be tested/drained without the need for additional temporary pipework and the like. Drains shall be provided by the plumber where shown on drawings. All test and drain valves shall be locked closed and labelled.

5.4 INSTALLATION

5.4.1 EQUIPMENT AND MATERIALS

Maintain uniformity of the manufacturer and type of all materials and equipment. Use only new, current manufacture, first quality materials and equipment. Comply with the manufacturer's recommendations with respect to installation techniques. Ensure compatibility of materials and equipment with respect to ambient temperatures, utilities supplies and vibration.

5.4.2 **BUILDING PENETRATIONS**

All pipes penetrating fire-rated walls shall be fire-sealed using Hilti CP606 fire prevention sealant, or approved equivalent. Refer to architects drawings for locations of all fire-rated walls and ceilings.

Where the penetration is exposed to view it shall be fitted with sheetmetal escutcheon plates. For external penetrations they shall be sealed with silicon sealant and fitted with weatherproof over-flashing.

5.4.3 **FIXINGS**

Install fixings to the structure by drilling holes and using metal expansion devices or self-tapping metal screws. All piping and extinguishing system fixing types are to be shown in detail on the workshop drawings, including maximum spacing and quantities. All fixings are to be compliant with the AS14520.1. Explosive charge fixing devices, green rawplugs or wooden plugs shall not be used.

5.4.4 **WELDING**

No on-site welding is permitted without the express permission of the Contractor. Off-site welding of pre-fabricated piping is to be carried out using competent, qualified tradesmen holding a current certificate of competency to carry out pipe welding. Ensure all welds conform to the requirements of the relevant Australian standards.

Provide suitable fire extinguishers whenever welding is carried out on site. Adhere to Curtin University hot work procedures.

5.4.5 **FLAME CUTTING**

All hot work shall require a hot work permit. Do not carry out flame cutting in members carrying stress at the time of cutting or members that will later be subjected to stress, or without prior approval.

Do not use flame cutting equipment to enlarge holes or slots through which bolts will pass unless prior approval has been received from Curtin University. Provide suitable fire extinguishers whenever flame cutting is carried out on site.

Ensure all flame cutting conforms to the minimum requirements of the Curtin University hot works permit procedures and AS1674 – Fire Precaution during Cutting, Heating, Welding Operations.

5.4.6 **COORDINATION WITH OTHER SERVICES**

Coordinate the installation of the works with all trades to ensure a logical, sequenced approach. The Contractor shall pay all costs associated with delays, rework, making good or additional works resulting from delays, or deficiencies in coordination of the works or provision of information.

5.5 TESTING AND COMMISSIONING

5.5.1 COMMISSIONING

The Fire Services Contractor shall commission the system in accordance with the requirements of the applicable Australian standards.

All systems and equipment shall be tested to ensure correct operation. Further testing shall be carried out when required by DFES or any other bodies having jurisdiction.

Documentation shall be provided to verify the system has been fully tested and commissioned in accordance with the relevant Australian standards. This shall be supplied as part of the system documentation.

5.5.1.1 *Sprinkler Pre-commissioning Procedures*

Carry out the following works prior to the commencement of the commissioning of the systems:

- Pressure and leak test piping systems.
- Clean and flush out all water systems including connected equipment.
- Clean out the Valve/Pump Room.
- Provide manufacturers' test certificates for all plant, equipment and electrical components.
- Submit a compliance and commissioning certificate to the Fire Services Consultant for approval.
- For all instrumentation to be used (i.e. gauges/Eagle Eye flow meters etc.), submit all test log sheets and instrumentation calibration certificates 15 days prior to the proposed test date.
- Check to ensure that all ancillary warning devices operate as specified.
- Check interconnection with fire indicator panel to ensure correct operation.
- Check and ensure all labels/signage/straps/locks have been correctly installed.

5.5.1.2 *Sprinkler Commissioning Procedures*

Carry out all commissioning and testing necessary to ensure the systems operate in a stable, safe, automatic and integrated manner providing optimum efficiency under all load conditions. Include the following commissioning and testing:

- Check and prove all pressure and flow activate controls, and respective fire mode operations.
- Check and prove all tamper switch valve monitoring.
- Carry out Annubar flow tests to prove that the town main complies with the minimum requirements for the fire sprinkler system, as shown on the construction drawings and Block Plan.

5.5.1.3 Instrumentation

Provide all instruments and apparatus necessary to carry out the commissioning and performance testing.

Calibrate all test instruments at an approved laboratory prior to carrying out the tests. Provide appropriate documentation as proof. Copies of the relevant documents are to be issued to the fire engineer.

Calibrate and test all gauges and instruments forming part of the permanent installation. Replace any gauges or instruments not maintaining calibration. Provide appropriate documentation for each gauge. Copies of the relevant documents are to be issued to the fire engineer.

5.5.1.4 Performance Tests

Carry out performance tests on the complete fire sprinkler system to the satisfaction of the relevant authorities. During the tests, log flow and pressure readings for the system, delays in alarm activation.

5.5.1.5 Commissioning and Performance Data

Submit for approval, two bound copies of all data recorded during commissioning and testing of the installation, together with all necessary calibration/ test logs of instrumentation used, within days of completing the works.

5.5.2 OPERATOR TRAINING

The Contractor shall provide training on the new systems. This shall include Curtin Universities' maintenance staff, terminal operations and fire wardens. Training shall provide relevant detail for each discipline.

5.6 MAINTENANCE

Upon completion of works, the fire services Subcontractor is to perform all scheduled and preventative maintenance in accordance with appropriate standards, this specification and the maintenance specification.

The fire services Subcontractor is responsible for all maintenance works during the defects liability period. All maintenance and repair works shall be at the fire services Subcontractor's own expense and not the Principal's.

5.7 HANDOVER

Complete the testing and commissioning of all systems. Provide all commissioning and performance data for the installation including post-contract drawings prior to handing over the installation. Provide documented completion certificates for the fire sprinkler system, as required by the Australian standards.

Practical completion will not be granted until the above requirements have been met.

5.7.1 **OPERATOR TRAINING**

Provide sufficient operator training and instruction for all new control and monitoring systems.

Use suitably qualified staff to carry out training to a minimum of three Curtin University-specified representatives.

Ensure training courses are a minimum of one hour's duration and are to be conducted within one week of the system being commissioned when it is in full operation.

Provide operator's handbooks to all trainees detailing all essential information.

Include all necessary drawings, charts, notes and support information in the handbooks.

The handbooks are to become the property of Curtin University.

Give the Superintendent one weeks' notice of the proposed training to enable the appropriate staff to attend the training.

5.8 FIRE EXTINGUISHERS

Fire extinguishers shall be located as shown on the drawings. Extinguishers shall be mounted to suit AS2444. Labelling shall be provided at each location as shown.

Where located externally, stainless steel extinguishers shall be provided.

In dusty or dirty locations, protective dust covers shall be fitted.

Tag all extinguishers with suitable metal tags to the requirements of AS1851.

Provide a schedule of all extinguishers, complete with all details, location size, class, size and supply date.

5.9 FIRE HOSE REELS

Fire hose reels shall be located where shown on the drawings. The fire hose reels shall comply with the requirements of AS1221 and shall be installed to comply with AS2441. Hose reels shall not pass through fire doors provided in a fire wall or part of a fire compartment.

The fire hose reel shall be 36 m long providing a 4-metre stream to all areas of the protected area. Fire hose reels shall be of the swing-out type and shall be installed in a steel cabinet, which shall be marked with suitable labelling.

The fire hose reel shall be positioned within four metres of a compartment exit door (as per Building Code of Australia requirements E.1.4.b.iv), and shall allow the hose to be drawn freely. Hose reels shall not be located adjacent to any electrical switchboard.

The contractor is ensure that a minimum nozzle pressure of 210 KPa with a minimum flow rate of 19.8 litres per minute is achieved to comply with the requirements of AS2441 and NCC.

Piping to hose reels shall comply with AS3500.

5.10 FIRE HYDRANTS

Fire hydrants are to be located as shown on the drawings. Fire hydrants shall be installed, designed and commissioned in accordance with the National Construction Code (BCA), AS 2419.1 and this specification.

Where external fire hydrants cannot provide necessary coverage to all areas of the building, internal hydrants shall be provided.

All fire hydrants shall be BIC fitting, provided with caps and chains. Hand wheels shall be a minimum of 150 mm diameter and shall be provided with 100 mm clear space around to allow ease of operation.

All external hydrants shall be the dual head type. Internal hydrants may be single head.

The Fire hydrant valve shall be of Dobbie Dico manufacture (or equivalent), with the key lock on the valve outlet being in the 12 o'clock position. The Fire hydrant shall have a plastic plug attached by a chain, to prevent the egress of foreign materials into the valve. The valve can be installed in the vertical or horizontal positions, as per the requirements of AS2419.

5.10.1 WATER SUPPLY UNDERGROUND PIPING

Peg the route and obtain approval from the Principal prior to excavating. Install piping systems with a maximum of 600 mm cover below finished natural ground levels and a minimum of 750 mm cover below roadways.

Segregate services by a minimum of 200 mm for general services and 1,000 mm for gas services.

Bed-in piping systems with a minimum of 150 mm clean sand all around. Backfill the trench with selected site material free from large stones and vegetable matter. Where trenches are excavated under carparks or roadways, backfill with quarry rubble.

Underground piping can be either:

- UVPVC Blue Brute piping class 18, installed strictly as per manufacturer's recommendations, with the required thrust/anchor blocks at elbow and tee junctions, as described in section 6.0 of AS2419.1
- polyethylene UPVC PN 20 (nominal working pressure of 2,000 kPa at 20 °C), all joints are to be electro fusion welded as per manufacturer's recommendations
- copper Type B, using 15 per cent silver solder for all welded joints as described in Section 6.0 of AS2419.1
- steel tubing to be ASTM schedule 40 grade b seamless, hot dipped galvanized after fabrication. Protect all underground steel pipework with an application of 'Denso Rockwrap 4000' (or similar) tape. Apply as per the manufacturer's requirement and procedures. Underground pipe protected by 'Denso' (or similar) is to be inspected prior to installation by the Superintendent's representative. No backfilling is to occur until the inspection has been completed.

Notify the Superintendent's representative no less than 48 hours before inspection. Use tape widths as recommended by the manufacturer with minimum tape width being 75 mm. Ensure that the tape extends a minimum 300 mm along the pipe (UVPVC, UPVC or copper) past the steel pipe joint.

All piping is to be installed as per AS2419, and, where applicable, to manufacturers recommendations.

Where UVPVC or UPVC piping is used, particular care shall be taken to ensure thrust blocks/anchor points are installed strictly to manufacturer's recommendations. Full details of these blocks are to be shown on the as-constructed drawings, including location/size/shape/calculated thrust/concrete mass/soil quality.

5.10.2 ABOVE-GROUND PIPING

Above-ground piping can be either:

- copper Type B, using 15 per cent silver solder for all welded joints as described in Section 6.0 of AS2419. Note: copper piping shall not be used within a building, where it can be exposed to fire, without having protective materials that will provide an FRL of not less than -/60/60
- steel tubing to be medium grade AS1074, ASTM schedule 40 seamless, hot dipped galvanised after fabrication.

All above-ground piping shall be jointed and supported as described in AS2419.1 sections 4.0 and 6.0.

All above-ground piping is to be painted as per the requirements of AS2419.1.

5.10.3 TESTING OF UNDERGROUND PIPING

A hydrostatic test shall be conducted, to a piping test pressure of 1.7 MPa (1,700 kPa) for a period of two hours (as per clause 7.2.2 of AS2419.1), and witnessed by the Superintendent or Superintendent's representative. Should the test fail, the leak(s) shall be repaired to the Superintendent's satisfaction, and the test reconducted, until satisfaction is achieved.

5.11 FIRE BOOSTER

The fire brigade booster connection shall be of Dobbie Dico manufacture (or equivalent), and shall have dust caps attached to the valve body by chains, a gauge, and a drain cock. The booster inlet connection shall be of a nominal bore of 65 mm and permit a fire main to be pressurised without the need to operate valves manually. The booster assembly shall also have facilities for the fire brigade to draw water directly from the town main, as described in AS2419. The booster connection assembly shall be installed nominally 1,000 mm above ground level, as per the requirements of AS2419.1-2005 – Fire hydrant installations – System design, installation and commissioning. The location of the booster connection is to be shown on the drawings

Supply a fire brigade booster and suction cabinet as shown in AS-2419.1-2005 – Fire hydrant installations – System design, installation and commissioning Figure 5.2. Paint the cabinet as per the colour requirements indicated by Curtin University or Signal Red

as required. Provide all signage as per AS2419 and DFES requirements. Allow for a concrete floor to the cabinet and apron in front of the cabinet, being a minimum of 2 000 mm wide and the full length of the cabinet, with a 2-degree slope for water drainage.

Provide a site block plan that indicates notice of working and test pressures (clause 5.6.7 of AS2419.1) The plan shall be manufactured from durable UV-stabilised materials, reverse engraved Rowmark (or similar approved equivalent), detailing all the information required by AS2419.1 Fire hydrant installations – System design, installation and commissioning section 5.3. The plan shall be orientated correctly and shall be suitably located so that it may be easily read by firefighting personnel.

5.12 DOCUMENTATION

Each system shall be provided with drawings and documents as further detailed. Practical completion shall not be achieved until all documents have been issued and accepted by Curtin University.

Documents and drawings required as part of this project:

- site plans
- sections
- termination details
- schematics
- general assembly drawings
- device termination details
- operators maintenance and user manuals
- commissioning and test documents
- compliance certification.

5.12.1 DRAWINGS

The Fire Services Contractor shall provide the following drawings and documents within two working weeks of completion of the project (two copies of each). All drawings shall be completed using AutoCAD to Curtin University CAD and AS1100 Drawing Standards.

- dimensioned plan showing all sprinkler heads and pipes
- section and details
- calculation node drawings
- alarm valve general assembly detail
- site plan showing water supplies and other relevant details such as thrust blocks, connections other services.

5.12.2 **BLOCK PLANS**

Block plans shall be permanently engraved on UV-stabilised material and permanently fixed to the wall adjacent to the fire control valves.

System duties, water supplies and emergency procedures are to be shown.

Block plans shall provide at least the minimum information as required by relevant Australian standards and DFES/Curtin University requirements.

Text shall be no smaller than 2.5 mm.

If the system is part of an alternative solution, the report reference should be noted on the block plan. Refer to the fire Consultant for further information.

5.12.3 **CALCULATIONS**

All sprinkler and hydrant systems shall be fully hydraulically calculated using a suitable computer model or accepted industry methods.

Calculations shall be submitted for review by the fire Consultant.

Drawings shall be provided that show software nodes or other relevant information such as area of operation.

All calculations shall be provided with a technical summary indicating results and design criteria. Multiple pages of numbers without description or summary will be rejected.

Deluge systems shall require additional calculations to verify run-out time and thrust block data if required.

5.12.4 **OPERATIONS AND MAINTENANCE MANUALS**

Submit one copy of the Operations and Maintenance Manual for approval of the Fire Services Consultant prior to commencement of the site installation. Bind the manual in a white vinyl hard-back A4 folder with a cover page.

Prior to practical completion, submit four copies of the Operations and Maintenance Manual to the Principal. Practical completion will not be granted until all documents have been received.

Format the cover as follows. Include the title 'Fire Services' on the spine.

<p>SPINE</p> <p>XXXXXXXXXX (DESCRIPTION OF INSTALLATION)</p>	<p>FRONT COVER</p> <p>FIRE SERVICES (SPECIFY TYPE)</p>
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Format contents in the manual as follows:

SECTION 1 – INDEX

- Include sections and subsections.
- Include a list of drawings.

SECTION 2 – SYSTEM DESCRIPTION:

Include general description of the system and its components including:

- FIP connections
- a schedule of capacities for all equipment
- design criteria.

SECTION 3 – INSTALLATION MAINTENANCE AND OPERATING INSTRUCTIONS

- Include detailed maintenance log sheets for each item of equipment.
- Include manufacturer's installation, maintenance and operating instructions for each item of equipment.

SECTION 4 – OPERATING INSTRUCTIONS

- Include a complete description and correct sequence of all actions necessary for the starting up, operation and shutting down of the fire system.
- emergency shutdown procedure
- Isolation procedures.

SECTION 5 – PERFORMANCE TEST RESULTS

- Include commissioning data, performance test results and authorities test certificates.
- Independent authorised inspector's certificates/documents.
- Annubar test results.

SECTION 6 – DATA SHEETS

- Data sheet index
- Include manufacturer's literature for all equipment.

SECTION 7 – INSTALLATION DRAWINGS

- drawing index
- Include full-sized and A3 copies of all construction drawings.
- fire sprinkler system calculations and associated node drawing
- A CD containing the as-constructed drawings in AutoCAD format, and include all data sheets and commissioning sheets in electronic format.

5.12.5 **COMMISSIONING DOCUMENTS**

Each system shall be tested to the relevant Australian standard and each test shall be documented:

- hydrostatic tests required for all wet systems, either in part or wholly
- flow tests to verify meets demand
- calibration data of test equipment.

5.12.6 **CERTIFICATION**

On award of contract, the system design shall be reviewed by an authorised independent inspector to ensure the system meets with the requirements of AS2118.1 Automatic fire sprinkler systems – General systems, AS2419.1 Fire hydrant installations – System design, installation and commissioning or AS2441 Installation of fire hose reels and this specification and DFES.

Upon completion of installation, the independent inspector shall review to ensure the project is installed in accordance with AS2118.1 Automatic fire sprinkler systems – General systems, AS 2419.1-2005 Fire hydrant installations – System design, installation and commissioning or AS 2441-2005 Installation of fire hose reels, and this specification.

A certificate of compliance shall be provided to verify design and installation. Items requiring attention shall be rectified and reinspected as necessary.

5.12.7 **LOG BOOKS**

Log books shall be supplied with all sprinkler and hydrant systems.