Design Guidelines

Fire Safety Works

Document contact officer:  Gary Higgins

Approval:

Approval Authority:  Director, Property Development and Commercial Services Office

Revision History:  [Most recent approval should appear at the bottom of the table]

<table>
<thead>
<tr>
<th>REV</th>
<th>DATE</th>
<th>BY</th>
<th>CHK'D</th>
<th>APPR'D</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0.0</td>
<td>22/11/2012</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2013:01</td>
<td>13/12/2013</td>
<td>SF, GH</td>
<td></td>
<td></td>
<td>Review of entire document and reformatting throughout.</td>
</tr>
<tr>
<td>01.02</td>
<td>25/07/18</td>
<td>GH/KB/SC</td>
<td>KB</td>
<td>Andrew Wildy</td>
<td>Complete review and amalgamation of fire services DG from hydraulics and Electrical DG’s</td>
</tr>
</tbody>
</table>
## Contents

1. Document intent .......................................................................................................................... 3
2. Introduction .................................................................................................................................... 3
3. Scope ............................................................................................................................................ 3
4. General Requirements ..................................................................................................................... 3
5. Environmental considerations ...................................................................................................... 4
6. Definitions ....................................................................................................................................... 5
7. Scope of works ............................................................................................................................... 5
8. Contract Drawings ......................................................................................................................... 6
9. Electrical Systems ......................................................................................................................... 6
10. Gaseous Extinguishing Systems ................................................................................................... 30
11. Wet Systems ............................................................................................................................... 41

*Appendices* .................................................................................................................................. 64
1. **Document intent**

The Fire Services Work comprises the supply, installation, testing, commissioning, maintenance and defects liability service of materials, labour and equipment for the complete Fire Services installations detailed in the sections of this specification and on the Contract drawings. The Work shall include all necessary minor and incidental work required to implement the intent and meaning of this specification and associated drawings.

Whether or not the words “supply and install” appear in this specification or on the drawings, unless clearly excluded, all items of equipment for the complete installation are required and shall be supplied and installed.

2. **Introduction**

This technical specification details the minimum requirements for the design, supply, installation and commissioning of fire services and emergency warning systems.

This specification is split into five sections.

- Section 1 - Introduction
- Section 2 - Scope of works
- Section 3 - Electrical based systems
- Section 4 - Gaseous Extinguishing systems
- Section 5 - Water based systems

3. **Scope**

This specification shall be used for all fire services installations. Contractual, financial, safety procedures and site specific inductions are contained in other relevant Murdoch University documents which 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.

4. **General Requirements**

The fire systems shall meet the relevant Australian standards, National Construction Code 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.
These design guidelines are intended to set out Murdoch University’s preferences and/or minimum standards for some aspects of construction works on campus. In the event that contractors are not able to comply with aspects of these guidelines then they should consult with the University Liaison. These guidelines are not intended to constitute a complete design manual and it is assumed that professional knowledge and good practice will be applied by contractors at all times.

5. **Environmental considerations**

See *Environmental/Ecological Guidelines – Design Guidelines* for details on Murdoch University’s commitment to the environment and its potential impact on this project.

Consultants must show that their designs have viable energy efficient capabilities. Where this results in a higher capital cost a payback calculation shall be provided to estimate the savings over a period of time.
6. Definitions

<table>
<thead>
<tr>
<th>Consultant</th>
<th>Shall mean the appointed fire services consultant as nominated from by the Principal or the Principal’s representative.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contract</td>
<td>Shall mean the Contract between the Principal and the Contractor and shall include all documents named herein.</td>
</tr>
<tr>
<td>Contractor</td>
<td>Shall mean the person or persons, or corporation, whose Tender to carry out the Work that is the subject of this Contract accepted in the Letter of Acceptance.</td>
</tr>
<tr>
<td>Instructions</td>
<td>Shall mean instructions to the Contractor issued by the Principal. &quot;Authorities&quot; Shall mean statutory bodies or inspectors of such bodies having jurisdiction over the Works under relevant current regulations and statutes.</td>
</tr>
<tr>
<td>Principal</td>
<td>Shall mean Murdoch University.</td>
</tr>
<tr>
<td>Site</td>
<td>Shall mean the Murdoch University as scheduled within the Tender Documents.</td>
</tr>
<tr>
<td>Sub-Contractor</td>
<td>Shall mean the person or persons, or corporation, engaged by the contractor for part or all of the works.</td>
</tr>
<tr>
<td>Superintendent</td>
<td>Shall mean Murdoch University nominated supervisor.</td>
</tr>
<tr>
<td>Work</td>
<td>Shall mean all the works, acts and matters specified in the Specification and other Tender Documents and covered by the Tender as accepted.</td>
</tr>
</tbody>
</table>

7. Scope of works

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. b) 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

NOTE:

Specific requirements have been included in this specification and drawings, which 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 requirements noted within the specification or on drawings are required, regardless of its exclusion from standards.

7.1. Materials and Workmanship

All materials, equipment and work shall comply with the appropriate Australian Standard Specification or Code, or if such have not been prepared, with the appropriate British or U.S. 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 Murdoch University.

7.2. Equipment

All equipment, which 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 Principal have been detailed in later sections of this Specification.

Ensure, as much as is practicable, standardisation and interchange ability of equipment throughout the installation. Ensure that the equipment offered can be satisfactorily accommodated and serviced in the positions allocated.

7.3. Defects Liability

The Fire Services Sub-Contractor will 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.

8. Contract Drawings

Drawings associated with and forming part of this specification are listed available from the Campus & Facilities Management Office.

9. Electrical Systems

9.1. Overview

This specification shall be used to detail the minimum fire services and systems required by Murdoch University. This technical section refers to electrical based fire and warning systems. Mechanical and wet 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 Murdoch University electrical specifications.
9.2. General
In principle, all Murdoch University buildings shall be fitted with an Automatic Fire Detection system complying with the latest version of AS 1670. However, the Consultant shall confirm with the University that a Fire Detection system is required for their specific project.

All new or replacement Automatic Fire Detection systems shall be of the addressable type Fire Indicator Panels (FIP) shall be located at the Main Entrance of all buildings. The location of the FIP shall be confirmed with the DFES, the Architect and the University.

All Automatic Fire Detection systems shall be monitored by DFES WA.

New Buildings
Where the project comprises the construction of a new, independent, building it shall be fitted with an Automatic Fire Detection and Warning system.

Refurbishment of, or Extensions to, Existing Buildings
Where the project comprises the refurbishment of, or an extension to, an existing building the existing Automatic Fire Detection system shall be investigated and a report provided to the University setting out the status and condition of the existing Fire Detection system and a recommendation as to the approach to be adopted using the following guidelines:

- If the existing installation is an addressable system, consideration shall be given to the retention of the system and its modification/upgrade to suit the refurbished building and/or the extension, as appropriate.
- If the existing system is of the conventional type then, depending on the work involved in the project, the following points shall be considered:
  - If the refurbishment is extensive, or the extension is large in comparison to the existing building: Replace the entire existing installation. In which case all of the installation, including all equipment and cabling, shall be stripped out and replaced by a new addressable installation.
  - If the refurbishment is minor, or the extension is small in comparison to the existing building: Retain the existing installation and adapt it to suit the refurbished building and/or the extension, as appropriate.
- Where existing devices are >10 years old they shall be replaced with new devices.

In all instances shall the refurbishment, or the extension, result in the Main Entrance of the finished building being relocated then it is a requirement that the Fire Indicator Panel, Fire Zone Panel, Fire Bell and Strobe light are relocated to suit the new entrance and this shall be taken into consideration when making the recommendation to the University.

Where an existing system is being adapted to suit a building refurbishment, or an extension, the new work shall include all necessary additional equipment, in both the existing building and the extension, such that the final system complies fully with AS 1670.1

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

9.3.1. Detection and Emergency Warning systems
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 relevant codes, standards and regulations.

- National Construction Code (Formerly BCA)
- AS1670.1:2015 Fire detection design, installation and commissioning
- AS1670.4:2015 Sound systems and intercom systems for emergency purposes
- AS1668.1:2015 Fire and smoke control in multi-compartment buildings
- AS1851:2012 - 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
- DFES regulations and requirements
- Murdoch University requirements
- Government Agency/Body governing works

9.4. Equipment

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

9.4.1. Fire Detection

9.4.1.1. Fire indicator panel (FIP)

The fire indicator panel (FIP) shall be of Ampac Fire Finder type (or approved equivalent) and be manufactured in accordance with Australian Standards AS4428. This is to maintain consistency throughout all Murdoch University sites. Any alternatives must be approved by the principal.

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 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 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.

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.

A "Critech" or approved equal mains suppression unit shall be installed to prevent damage to systems due to intermittent voltage spikes being introduced into the system. A 6mm earth cable shall be installed to suit requirements of DFES end of line unit and run to main distribution board earth bar.

The software programme 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 programme 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 powder coat coloured to match existing adjacent panels or if stand alone white or cream in colour.

The FIP shall be provided with a minimum of 25% spare capacity on loops, zones, power supply and batteries and all other circuits. No more than 75% 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
- Any other interface as required.

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

Controls shall be factory fitted and shall match existing style and finish of the FIP. Retrofitting of non-standard type switches, LED's and the like are not acceptable.

Murdoch University preferred equipment:

<table>
<thead>
<tr>
<th>FIP Type:</th>
<th>Ampac Fire Finder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zones I Loops:</td>
<td>As shown on drawings</td>
</tr>
</tbody>
</table>
9.4.1.2. **Smoke Detectors**

Unless otherwise noted, all smoke detectors shall be of the analogue addressable type. Detectors shall be fitted to 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 the Apollo manufacture range or approved equivalent with relevant detector base. Detectors provided for existing systems shall match existing type.

Detectors shall be installed so that LED illumination faces entry point of room or direction of path from 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 permanently printed adhesive type. Marking of devices by hand or permanent marker is not permissible.

Detector sensitivity shall be set to suit the anticipated environment. Where sensitivity of less than 2°/o OBS/m is required, the Multi-Sensor shall be used.

Detectors for normal use shall be of latching type. 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 in a location that provides ease of access for maintenance. Consideration should be given to locate the device so that ladders or steps are not required. Provide permanent adhesive label adjacent the detector housing for inspection date and signature marking for minimum of 10 inspections. Mark with "Duct Detector Inspection Record"

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

9.4.1.3. **Heat Detectors**

Unless otherwise noted, all heat detectors shall be of the analogue addressable type. Detectors shall be fitted to 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 the Apollo manufacture range or approved equivalent with relevant detector base. Detectors provided for existing systems shall match existing type.
Detectors shall be installed so that LED illumination faces entry point of room or direction of path from 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 permanently printed adhesive type. Marking of devices by hand or permanent marker is not permissible.

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

<table>
<thead>
<tr>
<th>Normal use</th>
<th>Apollo XP95 Type A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased ambient</td>
<td>Apollo Discovery Type C</td>
</tr>
<tr>
<td>Increased ambient (Where rapid rise of heat may be expected)</td>
<td>Apollo Discovery TypeD (Fixed Temp)</td>
</tr>
<tr>
<td>Duct probe</td>
<td>Thermae Type E - 100°C</td>
</tr>
</tbody>
</table>

9.4.1.4. **Multi-sensor**

Multi sensors shall be installed to meet requirements of heat and smoke detectors noted above.

Multi sensors shall be 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.

9.4.1.5. **Flame Detectors**

Flame detectors shall be designed to suit the environment and purpose. For safe areas, flame detectors shall be either Ultra Violet 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.

9.4.1.5.1. **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 with the requirements of AS2380 series of standards.

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

9.4.1.6. **Beam Detectors**

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

Beam detectors shall be Hochiki type or approved equal. Transceiver type shall not be used unless prior approval is sought from the principal.

(Transceiver type require the use of a reflector 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 reset via software configuration so that a general reset at the FIP results in the resetting of the beam detector.

9.4.1.7. **Remote LED’s**

Remote LED’s are to be provided for all ceiling void detection, electrical switchboards or inaccessible sub stations, inaccessible floor voids and normally inaccessible cupboards or rooms. These shall comply with AS1603.15:2002

Remote LED’s shall be provided with a label indicating detector loop and address number clearly shown. Detectors shall also be labelled. Refer 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 LED’s shall be located as follows:

<table>
<thead>
<tr>
<th>Protected area</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceiling void or roof space</td>
<td>On ceiling directly below within 600mm horizontal radius of detector.</td>
</tr>
<tr>
<td>Room</td>
<td>On wall directly above entry door no more than</td>
</tr>
<tr>
<td>Location</td>
<td>Installation Details</td>
</tr>
<tr>
<td>----------------</td>
<td>---------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Cupboard or enclosure</td>
<td>Directly above entry door or hatch no more than 300mm from opening.</td>
</tr>
<tr>
<td>Underfloor</td>
<td>Flush fitting on wall directly perpendicular to detector. Between 1200-1400mm above floor.</td>
</tr>
<tr>
<td>In duct</td>
<td>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.</td>
</tr>
</tbody>
</table>

9.4.1.8. Duct probes

9.4.1.8.1. 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 that is fed from air sampling tubes to meet with requirements of AS1603.13.

Sampling tubes shall be fitted across the airflow 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 air flow and shall transverse the duct width by at least 2/3 of its width or height, whichever is the larger. The sampling tube shall be positioned at least 2/3 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 AS3013.

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

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

9.4.1.8.2. Heat Detectors in Ducts
Heat detectors shall be installed in all kitchen exhaust 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 requirements for remote LED’s 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 to a steel or approved equal material removable plate with minimum dimensions of 100 x 100mm to enable removal for routine testing or inspection. Allow to seal the plate with suitable rubber or airtight gaskets.

9.4.1.9. **Carbon Monoxide Detectors**

Unless otherwise noted, all Carbon Monoxide (CO) detectors shall be of the analogue addressable type. Detectors shall be fitted to 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 the Apollo manufacture range or approved equivalent with relevant detector base. Detectors provided for existing systems shall match existing type.

Detectors shall be installed so that LED illumination faces entry point of room or direction of path from 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 permanently printed adhesive type. Marking of devices by hand or permanent marker is not permissible.

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

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

9.4.1.10. **Break Glass Units**

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

Where installed in damp or external locations the break glass shall be weather proof to IP65 addressable type.

All break glass units shall be installed at height between 1200 and 1400mm above finished floor or grade level.

The break glass unit shall be provided with indication to verify operation in alarm. Provide a permanent label to indicate 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 & connected to
Extra Low Voltage systems only.

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

Minimum signals to DFES shall be in accordance with the current connection requirements. These are:

Major Signals to be provided:
- Common fire
- Sprinkler Activated
- Gas System operated
- Other (as agreed with DFES)

Maintenance Signals
- Common fault
- Common Isolate
- Pump Run
- Low Pressure
- Low Battery

Refer to DFES website for details.

Cabling to DFES monitored systems shall comprise of a fire rated cable directly to the main distribution frame (MDF) terminated with a suitable junction box labelled "Fire alarm" Final connection by DFES DBA personnel.

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

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

Linear heat detection cable shall be listed to 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 shall be installed in accordance with manufacturer’s recommendations.

LHD shall be affixed between 15-100mm from the ceiling or roof structure using manufacturers recommended fixings or other suitable means. LHD shall be fixed at intervals no more than 1m apart. Catenary supports and fixings may be provided however care should be taken to ensure maximum
distance to ceiling is not exceeded.

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

Connection to fire detection system shall be via a suitable junction box within the protected area. Where 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 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 2m 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 AS1851:1987. Note AS1851:2005 requires annual testing; however, this is considered not suitable for fusible type cable.

Linear heat detection cable shall be terminated within the protected zone, i.e. not passing through other zones.

9.4.1.13. 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 2200-2400mm above finished floor level.

Conventional electronic sounder shall be Ampac Vantage or approved equal or similar approved. These shall be capable of providing sound output of at least 100d8a@ 1m.

Maximum of 20 sounders to be connected to one sounder output from FIP.

All sounder circuits shall be monitored for open circuit.

Addressable sounders shall be Apollo type suitable for use on Ampac Firefinder loop or approved equal. The maximum number per loop shall be 50% of maximum total sounder load allowable. Loops calculations shall be provided as part of document requirements to verify load.

9.4.1.14. Audible I visual alarms

"Fire Door Closing", "Fire Alarm" and similar illuminated audible warning signs shall be provided where shown on drawings. The alarm shall be of Notifier Inertia manufacture or approved equal. Sings shall be housed in steel enclosure and shall be low power consumption making use of LED type illumination.

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

9.4.1.15. Strobes

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

External strobes shall be mounted on conduit box or approved equal weatherproof box. Cable entries shall be IP66 glanded or via rear entry conduit. Surface mounting of the strobe without rear conduit box or approved equal weather protection is not acceptable.

Provide a permanent engraved label adjacent each strobe with the text "Fire" at least 25mm in height in contrasting colour. All strobe cabling shall be monitored.

9.4.1.16. 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 main sampling pipe can be concealed above. Ceiling spaces and under floor void shall utilise 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 ingress of dust or debris.

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

Sensitivity of each sampling point shall be not less than 2.5o/o obs/m.

9.4.1.17. 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 25mm in height with the text "FIRE" and should be clearly visible from the nearest entry door that leads to the FIP location.

The type of External Bell and Strobe to be used is as follows;

206-0001 -AMPAC 200mm Bell c/w weatherproof box or approved equal.
9.4.1.18. **Batteries**

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

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

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

Batteries shall be labelled with 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, tidy with suitable fixings, and looming within FIP or battery enclosure.

9.4.1.19. **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 fault on the FIP.

9.4.1.20. **Labelling & Marking**

All detectors shall be marked with permanent label indicating loop and address. Labels shall be printed type. The labels shall be fitted to address tags dedicated to the detector type. 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 permanent printed label. Strobes shall be labelled as appropriate. Refer strobe section for details.

Supply air detectors shall be provided with permanent engraved label stating zone in addition to 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 240v AC supplies shall be marked accordingly so that they are easily distinguished from extra low voltage circuits.
9.4.1.21. 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 power supply and battery calculations. All cabling to mechanical services shall be fire rated to meet with minimum AS3013 requirements.

**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 Jeff Morton of Almos Systems for further details.

**Auto Doors**
All electrically operated sliding door sets that are required to provide exit from the building/s shall be interfaced to the fire detection system so that a fire alarm in the building relevant shall open the door to allow egress. The FIP shall be provided with a control to isolate this function during routine testing.

**Access Control System Doors**
Where access control system provides doors that may impede egress to exits or fire exit routes, the door shall be set to open automatically on a fire alarm within the building concerned. The interface requirements are shown on tender drawings. The FIP shall be provided with a control to isolate this function during routine testing.

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

9.4.2. 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 original packaging.

- 5 Spare Glasses (where any frangible type glass unit is used)
- 1 of each type of detector used.
- 1 of each type of speaker used.
- 10 off smoke detector dust covers.

9.4.3. EWIS 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 high level. Where the speaker cannot be installed flush, the use of surface mounted units are allowed. The speakers shall be set so that an audible alarm level of no less than 65dB (a) is obtained throughout. Speakers shall be provided with suitable grille to match 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 65dB (a) within. For areas with high levels of ambient noise the minimum sound pressure level obtained shall be no less than 10dB (a) above ambient levels.

Where ambient noise level exceeds 95d8 (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 amplifier is capable of additional load.

9.4.3.1. EWIS control panel
The EWIS control panel shall be of Ampac EV3000 or approved equal type.

The EWIS control panel shall be coloured to match the FIP.

Amplifiers shall be sized to maximum of 50/o total speaker load. E.g. for 60W load a 120W amplifier shall be used for that zone.

Each EWIS control panel shall be provided with at least one 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 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.

9.4.3.2. 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 fire alarm signal.

The EWIS system shall provide an isolate signal to the FIP so that when switched to "Isolate" the fire system repeats and Isolate signal to 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.

9.4.3.3. **Speakers surface mounted**

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

C0715- One Shot 100V line dual cone, 8" White, SPL 1W@1m 93d8

1.25-SW units should be utilised.

These shall be located as shown on drawings. Unless stated elsewhere, surface mounted speakers shall be mounted at between 2200-2400mm above floor level where shown on walls.

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

9.4.3.4. **Speakers ceiling flush**

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

C2122C- Redback Fast Fix Speaker & Grille Combination, Fire I Evac twin cone 4" White, SPL 1W@1m 90dB

C2126B- Redback Fast Fix Speaker & Grille Combination, Fire I Evac twin cone 8" White, SPL 1W@1m 92dB

Grilles shall be steel or aluminium. Plastic grilles shall not be used. Unless shown on drawings, all speakers shall be set for 1.25W for corridors and 0.66W for rooms.

9.4.3.5. **Speakers horn type**

Horn speakers are to be avoided however 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 10W Plastic Horn Speaker- EWIS, IP66 Rated, Grey, UV Stabilised, SPL 1W@1m 104dB
These shall be terminated with an IP66 junction box complete with suitable IP66 glands and cable terminations.

9.4.3.6. **Warden Intercom Points (WIP)**

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 AS1670.4:2004

WIP's are to be mounted at a height of between 1200mm and 1800mm above the floor level. Each WIP is to be clearly identified and this identity shown on the tactical fire plan.

The type of warden intercom point to be used is as follows;
219-0007 AMPAC Warden Intercom Phone (Red) or approved equal.

9.4.3.7. **Break Glass Units**

Should break glass units be required as part of the EWIS system refer to section 3.3.1.10 Break Glass Units for details on mounting heights, labelling and specific type to be utilised.

9.4.3.8. **Strobe units**

Where ambient noise levels are higher than 90dB, or where occupants may make use of ear defenders or approved equal 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 view within their normal field of vision. i.e. on walls or pillars no higher than 3000mm 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.

9.4.3.9. **Labelling & marking**

Labels shall be provided on all EWIS equipment as detailed;

All WIP's shall be provided with permanent engraved labels 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 each strobe indicating "Alert" "Evacuate Building" alongside relevant strobe unit. Text shall be at least 25mm high on a UV stabilised permanently engraved traffolyte or approved equal 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. Labels shall present to match the quality of existing markings on the control panel and have professional quality finish.
9.4.3.10. Power Supply

The primary power supply shall be connected in accordance with AS3000. This power supply is to be an A.C. supply from an electricity authority or a source that is equally as adequate to the supply from an electricity authority. This 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 operating the required load.

9.4.3.11. Batteries

For further details on batteries, please refer to 3.3.1.18 for details on requirements.

9.5. 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 project award, the contractor shall submit a list of all project employees including any sub-contractors. A supervisor shall be nominated for each project along with relevant contact details.

The project supervisor shall be contactable throughout the project duration.

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

Where work is carried out in operational or existing Murdoch University buildings, works can be carried out in normal hours however 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 of 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.

9.5.1. **Cable Installation**

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

- AS3013:2005 - Wiring for specific installations
- AS3000:2018 - Wiring rules
- TS009:1991 - Austel (ACA) Installation requirements for customer cabling (wiring rules)
- AS1670:2004 - Fire detection, warning, control and intercom systems
- AS2053:2001 - Conduits and firings for electrical installations

Along with the above standards manufacturers’ recommendations should also be taken into accounts. Cabling should be installed parallel to existing wiring where possible to allow for ease of access and repair/relocation.

9.5.1.1. **Cable**

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

All detection, audible alarms and break glass cabling shall be in red tps or tpi housed in conduit. Cabling for A/C shutdown shall be a minimum of 2 core 1.0mm 2 hour fire rated in compliance with AS3013.

Where cabling is installed in ceiling space, it shall be run in a symmetrical and good workmanship like 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 and AS3000:2000 and ACA (Austel) where appropriate.

Cables shall be supported with cable tray, conduit or on catenary cabling permanently fixed to the building structure. 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.

9.5.1.2. **Cable Duct**

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

Refer Murdoch University electrical specification for further details
9.5.1.3.  Conduit

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

Flexible conduit shall not be used anywhere on this project

9.5.2.  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.

The principal prior to or during the project duration may request evidence of qualifications or licence/s.

9.6.  Testing & Commissioning

9.6.1.  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 with 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 re-inspected as necessary.

9.6.2.  Commissioning

The fire services contractor shall commission the system in accordance with the requirements of applicable Australian Standards.

The contractor shall advise the principal when commissioning testing is planned so that final testing may be witnessed by Murdoch 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/Murdoch University or any other bodies having jurisdiction. Note: 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 contingencies required. Sound levels are to be tested outside of normal working hours or as noted elsewhere.

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.

9.6.3. **Maintenance**

The Fire services sub-contractor is responsible for all maintenance works during the defects liability period, after which routine testing shall be carried out by Murdoch Universities’ nominated maintenance contractor. This shall be for 52 weeks following practical completion.

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

Specify that any defects that are noted at the time of Practical Completion shall be rectified within one month of the date of the Practical Completion inspection. In addition specify that any defects that occur during the defects liability period shall be rectified within two weeks of the defect being reported.

9.6.4. **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 3 Murdoch University specified representatives.

Ensure training courses are a minimum of 1 hour's duration and are to be conducted within 1 week of the system being commissioned when it is in full operation.

Provide Operators Handbooks to all trainees detailing all essential information. Include all necessary drawings, charts, notes and support information in the Handbooks.

Handbooks to become the property of Murdoch University.

Give the Superintendent 1 week's notice of the proposed training to enable the appropriate staff to attend the training.

9.7. **Documentation**

9.7.1. **Drawings**

The fire services contractor shall provide the following drawings and documents prior to practical completion of the project (electronic. All drawings shall be
completed using AutoCAD to AS11-00 Drawing Standards

- Plan showing detection & speaker layout and cable routes (ISO A1 min)
- System schematics (single line diagram) (ISO A3 min).
- Standby Battery Calculations Signed & Verified (A4)
- Cause and Effect 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 & input device.
- Cable sizing, routing and type for all cables.

9.7.2. Coloured Zone Block Plan

A zone block plan is required to be provided as per AS1670.1:2015. The block plan is required to be a minimum size of A3 and UV stabilised.

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, mimic 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 the main FIP, any SIP, mimics or repeaters.

Emergency telephone numbers shall be included on this 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. The plan shall be orientated correctly and shall be suitably located.

Details to include detector location address and zone information. All main switchboard locations to be shown.

Where the system is part of a smoke control system, the additional DFES requirements shall apply. Refer to http://www.dfes.wa.gov.au/Pages/default.aspx re smoke control systems.

Lastly the words "In the event of a fire ring '000' to ensure fire service response." Should be clearly located and visible on each plan.

A3 laminated coloured sub-plans shall be fitted at FIP's, details to include detector location, address and zone information. Liaise with Murdoch University regarding fixing method.
9.7.3. **FIP configuration data**

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.

9.7.4. **Operators Manual**

The operator’s 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 & database information.
- Detailed description of operation
- Emergency contact details
- Details of the FIP
- Details of the BOWS/EWIS
- 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)
- Provide 2 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 times that all omissions have been included and resubmitted for approval.

9.7.5. **Commissioning Documents**

All commissioning documents shall be included in final issue of OMM Where required; all signatures must be signed by hand (electronic signature not acceptable)

AS1670 standard commissioning documents for alarm and sound systems referencing NCC and all relevant Australian Standards.
Final as built 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.

Cause & Effect diagrams, witness tested, as per AS1851, Baseline data shall be provided, including Cause and Effect Matrix.

### 9.7.6. Calculations

Battery Calculations for the Fire & EWIS / OWS systems shall be provided in accordance with 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 as to ascertain that adequate sound levels can be achieved in all areas. 65dB should be maintained in all areas unless the ambient noise is greater than this level in which case sound levels should be set to be 10dB above ambient. 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 standby batteries are sufficient for the system loads. All calculations shall be signed and verified.

### 9.7.7. Log Books

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

### 9.8. 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 fire system as required by the Australian Standards.

Practical Completion will not be granted until the above requirements have been met.
10. Gaseous Extinguishing Systems

10.1. 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)
- Shutdown 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)
- Open barometric damper (as required)

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

10.2. Design

10.2.1. 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 ISO 14520.1:2009 – Gaseous fire-extinguishing systems
  – Physical properties and system design-General Requirements.
• Murdoch University specific requirements
• National Construction Code
• DFES regulations and requirements
• ACA (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 minimum requirements set out in AS14520.1

10.2.2. Mechanical services interfacing

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. The mechanical services contractor shall install these. Allow to liaise with mechanical services contractor as necessary.

10.3. Electrical control & warning

10.3.1. Local Control Station

The local control station (LCS) shall be fitted adjacent 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 1500mm above finished floor level. This shall be of Ampac manufacture or equivalent approved.

10.3.2. Sub Indicator Control Panel

A Sub Indicator Panel (SIP) is required to be installed for all gas systems. 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 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 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 coat white or cream in colour.

10.3.3. 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 alarm as per requirements of AS1670.

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

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

10.3.4. Do Not Enter and Evacuate area Warning

ONE and EVAC illuminated signs shall be installed above or adjacent the entry door as shown on the tender drawings. These signs shall meet with the requirements of AS14520.1. These shall be of Ampac manufacture or equivalent approved.

10.3.5. 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 equivalent.

10.3.6. Audible alarms

Audible alarms shall be installed as shown on the drawings and shall be installed at a minimum height of 2200 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.
10.3.7. Flashing strobes

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

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

10.3.8. 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 24V de 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 schedule.

10.3.9. Pressure Switch

The pressure switch shall be configured so that following operation, the strobes, ONE and EVAC signs remain illuminated until reset.

10.3.10. 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 diagram (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.

10.3.11. Other interfacing

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

10.4. Mechanical

10.4.1. 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 quantity of agent required. The cylinder shall be provided with a pressure gauge and liquid level indicator.

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

10.4.2. 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.

10.4.3. Mechanical operation

The mechanical manual release shall be provided adjacent 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 each manual control.

10.4.4. 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 tub shall be provided so that the control head can be removed. Rigid type connections can be used however the final connection to the control head must be flexible type.

10.4.5. 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 1 coat of zinc chromate or approved equal metal primer and 2 coats of full gloss Signal Red enamel.

Paint galvanised steel surfaces with 1 coat of an etching primer and 2 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 Australian Standard 2700 - Colour Standards for General Purposes.

10.4.6. 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 to be ASTM Schedule 40 Grade B Seamless hot dipped galvanised after fabrication. All pipe is to comply with AP1SL-B—American Petroleum Institute Section 5 Line pipe—Grade B.

Where pipes are welded, the weld joints shall comply with AS 1554. All threads are to NPT.

Screwed Fittings—All screwed fittings shall comply with ANSI B16.11 3000 lbs, suitable for the working pressures nominated in AS 14520.1 Utilise 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 AS14520.1. All threads are to NPT.

Roll Groove Couplings—shall be Victaulic Style 77 galvanised or approved equal for use for pipe sizes greater than 50mm. All roll grooves are not to be cut type. All proposed roll groove couplings shall be suitable for the maximum working and test pressure nominated in AS 14520.1.

Roll Groove Fittings—shall be Victaulic galvanised or approved equal for use for pipe sizes greater than 50mm. All proposed roll groove fittings shall be suitable for the maximum working and test pressure nominated in AS 14520.1.

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 Superintendents to depart from this.

Pipe work 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 pipe work shall be suitable for its respective service under the actual operating conditions of temperature and pressure.

Piping shall be arranged in workmanlike manner, true to alignment and grade. Pipes shall not be installed above electrical switchboards, or in electrical ducts risers, cabinets or switch rooms.
10.4.7. **Fixings**

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

For specialized brackets, refer to drawings for type, design & locations. All manufactured brackets are to be hot dipped galvanized. All proprietary brackets, threaded rod, nuts & washers are to be galvanized.

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

Where pipes run close to walls, floors or ceilings, a minimum distance of 50mm 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.

10.5. **Installation**

Gaseous system equipment, cylinders and piping installation shall be carried out by qualified pipe installers. Installers shall be accredited for handling and installation of gaseous systems.

Qualifications may be requested prior to, or during project duration by the principal.

10.6. **Testing & Commissioning**

10.6.1. **Testing General**

The Fire Services Sub-Contractor shall carry out all testing and commissioning procedures necessary to render the installation fully operational to the satisfaction of the Superintendents representative and in accordance with AS14520.1.

These procedures shall include the following minimum requirements:-

- Hydrostatic and pneumatic pressure testing of all pipe work systems.
• Testing to indicate all pipe work is clear of debris or obstruction.
• Integrity testing of the enclosure as required.
• Operation of electric control head (coordinate with fire detection sub-contractor)

The Fire Services Sub-Contractor shall give at least three (3) working days notice to the Superintendents representative of his 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 Superintendents representative.

10.6.2. Pipe work 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 2 minutes.

Any leaks shall be rectified and the pipes re-tested to the satisfaction of the Superintendents 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.

10.6.3. Integrity Testing

The protected area is to be tested to prove integrity of the enclosure so that the system will operate and hold concentration of agent as required by AS14520.1. Allow for tests as necessary. The contractor shall provide a system which is capable of maintaining the agent concentration above the height of the highest risk within the protected area as required by AS14520.1.

10.6.4. Commissioning Records

Commissioning records shall be submitted to the Superintendents representative. Two (2) bound copies of the complete commissioning records shall be provided.

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

10.7. Documentation

10.7.1. Operators Manual

Submit for approval of the Fire Services Consultant 1 copy of Operation
and Maintenance Manuals prior to commencement of site installation. Bind the manual in a white vinyl hard-back A4 folder with a cover page.

Prior to practical completion, submit 4 copies of the Operation and Maintenance Manual prior to the builder. 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.

<table>
<thead>
<tr>
<th>SPINE</th>
<th>FRONT COVER</th>
</tr>
</thead>
<tbody>
<tr>
<td>MURDOCH UNIVERSITY</td>
<td>GAS SUPPRESSION</td>
</tr>
<tr>
<td>(DESCRIPTION OF INSTALLATION)</td>
<td>SYSTEM</td>
</tr>
</tbody>
</table>

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

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.
- 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 I 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 a full size and A3 copies of all construction drawings.
- Gas suppression system node drawing.
- A CD, containing the "as built" drawings in AutoCAD format, and include all data sheets and commissioning sheets in electronic format.

10.7.2. Log Books

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

10.7.3. Calculations

The following calculations shall be provided:

- Battery Calculations for all standby batteries (Verified & 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.

10.7.4. Certification

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 with the requirements of AS14520. Upon completion of 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 re-inspected as necessary.

10.7.5. Drawings

The fire services contractor shall provide the following drawings and documents within two working weeks of completion of the project. (2 copies of each) All drawings shall be completed using AutoCAD to
Murdoch University and AS1100 Drawing Standards

- Plan showing detection & device layout and cable routes (ISO A1 min)
- System schematics (single line diagram) (ISO A3 min)
- Standby Battery Calculations Signed & Verified (A4)
- Cause and Effect where required (A3/A4 min)
- Commissioning details to AS14520 requirements

10.8. 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.

10.8.1. Operator Training

Provide Sufficient Operator training and Instruction for all new Control and Extinguishing Systems.

Use suitably qualified staff to carry out training to a minimum of 3 Murdoch University specified representatives.

Ensure training courses are a minimum of 1 hour’s duration and are to be conducted within 1 week of the system being commissioned when it is in full operation.

Provide Operators Handbooks to all trainees detailing all essential information. Include

All necessary drawings, charts, notes and support information in the Handbooks.

Handbooks to become the property of Murdoch University.

Give the Superintendent 1 weeks' notice of the proposed training to enable the appropriate staff to attend the training.

10.9. Maintenance

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

The fire services sub-contractor is responsible for all maintenance works during the defects liability period. All maintenance and repair works shall be at the fire services contractors' expense.
11. Wet Systems

11.1. Overview

This specification shall be used to detail the minimum fire services and systems required by Murdoch University (to AS and NCC). This technical section refers to water based systems.

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

11.2. Design

11.2.1. 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 in 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)
- AS2118.1:2017 Automatic Fire Sprinkler Systems
- AS1851:2012 Maintenance of Fire Protection Systems
- Water Corporation requirements
- Murdoch 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.

11.2.2. 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.

11.2.3. Hydrant & Hose reels

The design of hydrants and hose reels systems are to comply with the requirements set out in current applicable Australian Standards and the National Construction Code (NCC). 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
• AS1851:2012 Maintenance of Fire Protection Systems (Parts 2 & 4)
• AS2444 Fire Extinguisher Code
• Water Corporation requirements
• Murdoch University specific requirements
• DFES regulations and requirements
• Government Agency/Body governing works

11.2.4. Water supplies

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

Where connecting into towns mains, backflow prevention shall be provided to meet with WA corporation requirements. Allow for all connections and equipment required to provide full installation.

11.3. Equipment

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

11.3.1. 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.

11.3.2. Sprinkler alarm valve assembly

Design, supply and install a fire sprinkler control valve and trim assembly (Reliable or approved equal) and ancillary piping as per AS 2118 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 & new water alarm gong complying to AS 2118 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 as necessary.
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 drain suitable for full discharge of the system throughout a normal test period. Liaise with plumber to ensure drains are adequate as necessary.

11.3.2.1. Sprinkler Heads

The following sprinklers shall be used where appropriate;

- Below Ceiling Fire Sprinkler Heads Reliable model F1 (or equivalent) DN 15 White pendant 68°C Spray Pattern heads glass bulb type. Provide escutcheon plates to match the existing type I profile I finish.
- Exposed warehouse or approved equal- DN15 brass 93°C glass bulb.
- Concealed Space Fire Sprinkler Heads, Reliable model F1 (or equivalent) DN 10 Brass pendant 93°C Spray Pattern heads glass bulb type.
- External Canopy Exposed Pendant Reliable model G (or equivalent) DN 20 Brass pendant 141 Degree C Spray Pattern heads glass bulb type.
- ESFR Pendant Fire Sprinkler Heads Reliable ESFR K 14 (or equivalent) Brass pendant 74 Degree C heads, with Factory Mutual & SSL approvals. NOTE- The installation of the ESFR sprinkler directly below skylights shall be avoided. Where this is un-avoidable, a 400mm square 16 g sheet metal 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 contractors drawings.
- Where wet type 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 Pendent dropper type heads to be used. Where refrigeration equipment is run to defrost ensure sprinkler temperature is above expected room conditions.

11.3.2.2. Sprinkler Guards

Where sprinkler heads are installed below 2290 mm above floor level, manufacturers impact guards shall be fitted where indicated on the drawings.

11.3.2.3. Spare Sprinklers

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 the alarm valves). Spare sprinklers shall be stocked for all types and I or temperature ratings installed within the protection systems but in any case shall not be less than 6 of each type of rating. There shall be a minimum of 26 heads provided in the cabinet.
11.3.2.4. Drains

Provide drain points complete with isolating valves and drain lines in accordance with Australian Standard 2118 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 and clearly labelled. (Locked in the closed position) The location of all drains shall be indicated on the FS sub-contractors workshop drawings.

11.3.2.5. Piping

Construct piping installations using the following materials:

<table>
<thead>
<tr>
<th>Piping System</th>
<th>Material</th>
<th>Design Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire Sprinkler</td>
<td>Black mild steel, medium to AS 1074</td>
<td>Maximum operating pressure 1400 kPa</td>
</tr>
<tr>
<td>Dry Fire Sprinkler System</td>
<td>Stainless Steel to AS 2118.9</td>
<td>Maximum operating pressure 1400 kPa</td>
</tr>
<tr>
<td>Control, vents and drains</td>
<td>Galvanised mild steel, medium to AS1074</td>
<td>Maximum operating pressure 1400 kPa</td>
</tr>
<tr>
<td>External piping</td>
<td>Galvanised mild steel, medium to AS1074</td>
<td>Maximum operating pressure 1400 kPa</td>
</tr>
</tbody>
</table>

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.

11.3.3. Deluge System

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.

11.3.3.1. General operation

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

11.3.3.2. 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 least favourable and most favourable nozzles are no more than ±10%.
11.3.3.3. **Water Supply**

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

11.3.3.4. **Deluge valve assembly**

Deluge valve shall be sized as shown on drawings.

Trim assembly shall be proprietary supplied and FM/UL listed for use as deluge system.

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

- Deluge tripped pressure switch.
- Operate solenoid (24v 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.

11.3.3.5. **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.

11.3.3.6. **Detection heads**

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

11.3.4. **Piping systems**

Construct and install all components of piping systems including pipe work, 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 pipe work to achieve a neat workmanlike appearance, laid out with adequate provision for expansion and contraction, grading, alignment and access for maintenance.

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

Fabricate bends ensuring a smooth finish without any discernible flattening or corrugation and with a centre line radius of 1.5 times the diameter. Fabricated reducers shall be of a "butt-weld" type as
appropriate to meet 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 pipe work, 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 Australian Standard 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 Australian Standard 2118, 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 clamped / welded to structural steel members.

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

Utilise hanger rods where maximum movement of pipe is less than 11\% 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 Australian Standard 1554 - Structural SteelWelding.

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.

All piping is to be flushed prior to final connection as to be free from debris and dust which may impede functionality of the system.

11.3.4.1. Painting
Paint, identify and label the plant, 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.
- Pipe work, valves, fittings exposed to view.
- Factory Painted Valve equipment.

Do not paint:

- Fire sprinklers.
- Normally bright and polished components.

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 1 coat of zinc chromate or approved equal metal primer and 2 coats of full gloss Signal Red, enamel or to a colour specified by the principal.

Paint galvanised steel surfaces with 1 coat of an etching primer and 2 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 Australian Standard 2700 - Colour Standards for General Purposes.

<table>
<thead>
<tr>
<th>System, Equipment</th>
<th>Colour Scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposed piping in public areas</td>
<td>To match ceiling and fittings to architects requirements</td>
</tr>
<tr>
<td>All other internal piping</td>
<td>R13 Signal Red or as specified by the Architect</td>
</tr>
<tr>
<td>External piping</td>
<td>To match existing surfaces.</td>
</tr>
<tr>
<td>Dry piping (stainless steel) system</td>
<td>Un-painted</td>
</tr>
<tr>
<td>Drains, pipe work</td>
<td>Black.</td>
</tr>
</tbody>
</table>

11.3.4.2. Fittings

All piping is to be AS 1074 Medium Quality black steel piping.

Utilise 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 approved equal for use for pipe sizes greater than 50 mm refer herein.

11.3.4.3. 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.

The hand wheel shall be positioned to enable easy access for maintenance staff and operation.

The valves shall be fitted with a unique traffolyte label (or approved equivalent), clearly defining the valve purpose, normal operating position, and shall be chained and locked (using 003 keyed padlock) in their normal operating position, as required by AS 2118.

The roll groove couplings either side of the isolation valve shall of zero flexibility type, and shall be designed to inhibit the valve from being moved either vertically or horizontally.

11.3.4.4. Test/Drain Valves

Test and drain valves shall be supplied as shown on drawings. Where drain to internal buildings, suitable drains shall also be provided so that the system can be tested/drain without the need for additional temporary pipe work and the like.

Drains shall be provided by plumber where shown on drawings. All test & drain valves shall be locked/closed and labelled.

11.4. Installation

11.4.1. 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 manufacturers recommendations in respect to installation techniques. Ensure compatibility of materials and equipment in respect to ambient temperatures, utilities supplies and vibration.

11.4.2. 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 they shall be fitted with sheet metal escutcheon plates. For external penetrations, they shall be sealed with silicon sealant and fitted with weatherproof over-flashing.

11.4.3. Fixings

Install fixings to the structure by drilling holes and utilising 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 Australian Standards AS 14520.1. Explosive charge fixing devices, green rawplugs or wooden plugs shall not be used.

11.4.4. **Welding**

NO on-site welding is permitted without the express permission of the builder. 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 relevant Australian Standards.

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

11.4.5. **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 Murdoch University. Provide suitable fire extinguishers whenever flame cutting is carried out on site.

Ensure all flame cutting conforms to the minimum requirements of Murdoch University hot works permit procedures and Australian Standard 1674- Fire Precautions in Cutting, Heating, Welding Operations.

11.4.6. **Co-ordination with other Services**

Coordinate the installation of the works with all trades to ensure a logical, sequenced approach. 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.

11.4.7. **Storage and Protection**

Store and protect all materials and equipment required for the works and obtain approval for the location of the storage areas on site.

Immediately, upon delivery to site, stack and protect from the weather, dampness and dust, all materials and equipment. Provide a storage shed and/or enclosures as necessary for the security of the materials and equipment. Cover the ends of all open pipes to prevent the ingress of foreign matter.

Protect the building surfaces from damage potentially arising from the storage of materials and equipment. Make good any damage arising from the storage procedures.
11.4.8. **Site Cleanliness and Rubbish Removal**

Remove from site all rubbish, debris, material cuttings and other redundant materials, which result from the works, progressively and whenever directed.

11.5. **Testing & Commissioning**

11.5.1. **Commissioning**

The fire services contractor shall commission the system in accordance with the requirements of applicable Australian Standards.

*All systems and equipment shall be tested* to ensure correct operation. Further testing shall be carried out where 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 relevant Australian Standards. This shall be supplied as part of the system documentation.

11.5.2. **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 piping systems connected equipment.
- Clean out the Valve I pump Room.
- Provide manufacturer’s test certificates for all plant, equipment and electrical components.
- Utilise the relevant completion certificates, or submit for fire services consultant approval the proposed commissioning certificates.
- For all instrumentation to be used (i.e. Gauges I Eagle Eye flow meters I 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 I signage I straps /locks have been correctly installed.

11.5.3. **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's main complies with the minimum requirements for the Fire Sprinkler System, as shown on the construction drawings and Block Plan.

11.5.4. 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 builder.
• 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 builder.

11.5.5. 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.

11.5.6. Commissioning and Performance Data

Submit for approval, two (2) bound copies of all data recorded during commissioning and testing of the installation together with all necessary calibration I test logs of instrumentation utilised within 7 days of completing the works.

11.5.7. Operator Training

The contractor shall provide training on the new systems.

This shall include Murdoch University Maintenance Staff and Fire Wardens. Training shall provide relevant detail for each discipline.

11.6. Maintenance

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

The fire services sub-contractor is responsible for all maintenance works during the defects liability period. All maintenance and repair works shall be at the Fire Services sub-contractors own expense not the Principals.

11.7. 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

### 11.7.1. 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 3 Murdoch University specified representatives.

Ensure training courses are a minimum of 1 hour's duration and are to be conducted within 1 week of the system being commissioned when it is in full operation.

Provide Operators Handbooks to all trainees detailing all essential information. Include

All necessary drawings, charts, notes and support information in the Handbooks.

Handbooks to become the property of Murdoch University.

Give the Superintendent 1 week's notice of the proposed training to enable the appropriate staff to attend the training.

### 11.8. 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 and in accordance with DFES requirements.

Where located externally, stainless steel type extinguishers shall be provided.

In dusty or dirty locations, protective dust covers shall be fitted. Tag all extinguishers with suitable metal tags to AS1851.

Provide a schedule of all extinguishers, complete with all details, location size, class, size and supply date. Schedule shall be in MS Excel or approved electronic format.

### 11.9. Fire Hose Reels

Fire Hose reels shall be located where shown on the drawings. The Fire Hose reels shall comply with the requirements of AS 1221, and shall be installed to
comply with AS 2441. 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 36m long providing a 4 metre stream to all areas of the protected area. Fire hose reels shall be of swing out type and shall be installed in a steel cabinet. Cabinet shall be marked with suitable labelling.

The fire hose reel shall be positioned within 4 metres of a compartment exit door (as per National Construction Code requirements E.1.4.b.iv), and shall be capable of 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 19.8 litres per minute, is achieved to comply with the requirements of AS 2441 & NCC.

Piping to hose reels shall comply with AS3500.

11.10. 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 (NCC) and Australian Standards 2419.1:2005 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 minimum 150mm diameter and shall be provided with 100mm clear space around to allow ease of operation.

All external hydrants shall be 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 AS 2419.

11.10.1. Water Supply Underground Piping

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

Segregate services by a minimum of 200 mm general services and 1000 mm gas services.

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

Cap all open ends of piping during underground installation to prevent ingress of debris or other matter during construction.

Underground piping can be either;

- UVPVC Blue Brute piping class 18, installed strictly as per manufacturers recommendations, with the required thrust I anchor blocks at elbow and tee junctions, as described in section 6.0 of AS 2419.1.
- Polyethylene UPVC PN 20 (nominal working pressure of 2000 kPa @ 20 Degrees C), all joints are to be electro fusion welded as per manufacturers recommendations.
- Copper Type B, utilising 15 o/o silver solder for all welded joints as described in section 6.0 of AS 2419.1.
- Steel tubing to be ASTM schedule 40 grade b seamless, hot dipped galvanised after fabrication. Protect all underground steel pipe work with an application of 'Denso Rockwrap 4000' (or approved equal) tape. Apply as per manufacturers’ requirement and procedures. Underground pipe protected by "Denso" (or approved equal) is to be inspected prior to installation by the client’s representative. No backfilling is to occur until the inspection has been completed. Notify the client’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 300mm along the pipe (UVPVC, UPVC or copper) past the steel pipe joint.

All piping is to be installed as per AS 2419, and where applicable to manufacturers recommendations.

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

All piping is to be flushed prior to final connection as to be free from debris and dust which may impede functionality of the system.

11.10.2. Above Ground piping

Aboveground piping can be either;

- Copper Type B, utilising 15 o/o silver solder for all welded joints as described in section 6.0 of AS 2419.

Note: Copper piping shall not be used within a building, where it can be exposed to fire, without having protective materials which will provide a
FRL of not less than -/60/60.

- Steel tubing to be either medium grade AS 1074, ASTM schedule
- 40 seamless, hot dipped galvanised after fabrication.

All above ground piping shall be jointed and supported as described in AS 2419.1 sections 4.0 & 6.0

All above ground piping is to be painted as per the requirements of AS 2419.1.

All piping is to be flushed prior to final connection as to be free from debris and dust which may impede functionality of the system.

11.10.3. Testing of underground piping

Prior to any hydrostatic testing, the entire system is to be completely flushed to ensure no debris or material is present in the system.

A Hydrostatic test shall be conducted, to a piping test pressure of 1.7MPa (1700 kPa) for a period of 2 hours (as per clause 7.2.2 of AS2419.1), and witnessed by the client or clients representative. Should the test fail, the leak(s) shall be repaired to the client's satisfaction, and the test re-conducted, until client satisfaction is achieved.

11.11. 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's main, as described in AS 2419. The booster connection assembly shall be installed nominally 1000mm above Ground Level, as per the requirements of AS 2419. The location of the booster connection is shown on the drawings.

Supply a Fire Brigade Booster & Suction cabinet as shown in AS 2419.1 figure 5.2. Paint the cabinet as per the colour requirements indicated by Murdoch University or signal red as required. Provide all signage as per AS 2419 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.

Where tanks are installed, a storz connection shall be provided to the booster cabinet to the satisfaction of DFES

Provide a site block plan which indicates notice of working & test pressures (clause 5.6.7 of AS 2419.1) The plan shall be manufactured from durable UV stabilised materials, reverse engraved Rowmark (or approved equivalent), detailing all the information required by AS 2419 section 5.3. The plan shall be
orientated correctly and shall be suitably located so that it may be easily read by fire fighting personnel.

11.12. Fire Pumps

11.12.1. Fire Pumps- Pumpset

Where the use of pumps is required on site, two fire service pumps shall be provided, one diesel and one electric. Each pump shall be capable of providing the necessary flow and pressure independently. Starting pressures shall be set as follows:

The fire pump sets are to be mounted on skid base incorporating the control panel, wired and tested in accordance with AS 2118, AS2419 and AS2941 prior to shipment. All electrical terminations shall be made at the control panel so that additional wiring to pressure switches and valves on the skid are not required. The control panel terminations shall make allowance for separation of low and extra low voltage connections in accordance with AS3000.

The pumps shall be complete with all necessary hardware and control equipment. The installation shall comply with Australian Standard AS2941 & AS 2118, 2419 and any additional requirements of this specification.

Pumps shall be of the centrifugal casing type of "Ajax-Econo-pump" manufacture or approved equivalent. Pumps shall be of adequate design for the particular temperature and pressure to which they will be subjected.

Pump selections shall be based on the requirements of AS2118, AS2419, AS2941 and the calculated hydraulic system pressure. The Fire pumps shall be selected to deliver the required minimum water quantity when operating against the total head of the system.

The Fire pumps shall be designed with a maximum 85o/o impeller size, and the motor designed to cater for a 100o/o impeller, should it be required in the future to accommodate any changes to the system desired by the client / owner.

Pumps shall have cast iron casings, bronze impellers and stainless steel shafts. Pumps casings shall be vertically split casing design. To provide easy access for removal of the impeller, the drive shaft shall incorporate any necessary spacer couplings.

Impeller assemblies shall be statically and dynamically balanced prior to assembly of the pump and shall be designed to have non-overloading characteristics. Gland-wells shall be drained directly to the nearest floor waste as shown on the drawings.

The cooling system on the Diesel Pump units shall be a closed system utilising a heat exchanger. The Fire Pumps shall take water from the pump discharge, pass through a heat exchanger, and discharge to waste, all as per
AS 2941 requirements.

The pumps shall each be mounted on a sturdy galvanised mild steel base frame, complete with all necessary lifting lugs and fixing points as required by AS 2941.

The fire pumps shall be designed manufactured and installed in accordance with AS2941. The pumps shall be capable each of providing the minimum duty as calculated.

Note Hydrant systems shall require minimum 800kPa at half of the demand flow.

The pumps shall be designed to start automatically upon demand from the operation of one hydrant or sprinkler. The pumps shall remain running until manually stopped.

For hydrant systems, a manual pump start push button shall be provided remotely at the fire booster location. This start push button shall initiate the electric pump.

Provide an annubar test line returning to the tanks to enable flow testing of the pumps.

11.12.2. Jockey Pump

The fire pump skid shall also include a jockey/jacking pump. This shall be capable of providing 251litres/min @ 400kPa, to a maximum of 700kPa. The pump shall operate automatically to maintain system pressure.

Normal static pressure in the hydrant or sprinkler system shall set to 600kPa.

11.12.3. Over Pressure Relief & Circulation

The fire pumps shall be fitted with over-pressure and circulation relief valves (one for each fire pump), as per AS 2941 and manufacturers recommendations. Downstream of these valves provide a sight flow indicator, suitable for the maximum pump pressure comply with the requirements of AS 2118 & 2941. The pump manufacturer is to confirm details of the termination point size, location, and orientation to enable connection of all necessary drain piping return to the fire tank by the fire services contractor.

11.12.4. Control Panels

The control panels shall be skid mounted & complete, fully assembled, wired and tested prior to dispatch from the pump supplier’s workshop. Terminals shall be provided for connections between the panels and field equipment. All cable connection shall be bottom entry type &
configuration.

All control panels shall be vibration isolated from the main pump frame. All necessary wiring & flexible cabling shall be provided to allow for all necessary movement & vibration.

The Vendor shall supply complete and detailed project documentation for all equipment. As a minimum, the control panels shall comply with the latest edition of the following standards and reference documents:

- AS3000 Electrical Installations (Wiring Rules)
- AS2941 Fixed Fire Protection Installation- Pumpset Systems

All materials and equipment shall be the Vendor's standard and shall be in an as new condition. Superseded or discontinued products shall not be used.

11.12.5. Fire Pump Spare Parts

The fire contractor shall include a list of spare parts necessary to maintain the equipment for an operational period of 3 years. The list shall nominate the recommended holding quantities and prices for each item. All spares are to be placed into a toolbox, and be located in the pump house.

11.12.6. Fire Services Pump Room

A separate pumproom is to be provided to house the fire pumps and fire sprinkler control valve assembly. This pump room is to be constructed to relevant standards and regulations.

11.13. Fire Water Tanks

Firewater services tanks are to be provided in accordance with Australian Standard 2304:2011 and AS3500.1.

Backflow prevention shall be installed to the incoming water supply to WA corporation specifications. Dual back flow devices shall be supplied and installed where shown on drawings.

A vortex inhibitor plate is to be provided on the tank suction line. This plate is to be a minimum of 10mm thick, adequately protected from corrosion and have vertical legs connecting to the base plate to prevent suction of the tank liner.

A roof access hatch and platform shall be installed to allow for ease of inspection and maintenance. This hatch is to be located adjacent to the external access ladder. Internal ladders are to be provided for internal inspection, maintenance and diver access.
The tank shell is to be coated with an industrial strength powder coating both inside and out as to prevent corrosion potential. The tanks are to have a minimum base metal thickness of 2.0mm for bolted steel tank wall plates/shell.

Tank liners are required to be fixed to the top circumference of the tank shell with a maximum fastener spacing of 300mm to minimise potential for the liner to sag. Liners for tanks with a height of 4.0m-6.0m are required to have intermediate liner supports.

The tank is required to be adequately sealed to the ring beam as to prevent water ingress under the tank and liner and adequately sealed between joints and fixings to prevent water ingress between joints and panels. Sealant is to be selected to the environmental conditions of the site including but not limited to salinity, humidity and UV exposure.

11.13.1. Fire Water Tank Maintenance

Where tanks are installed to service a hydrant system they should also comply with the requirements set out in AS2419.1.

Where multiple tanks have been installed for a hydrant system at no time during normal maintenance routines should both firewater tanks be isolated/drained down concurrently. As required under AS2419.1 clause 4.3.3 at least 50o/o of the required volume is to remain available for use at all times.

11.13.2. Fire Water Tank Commissioning

The fire services contractor shall commission the system in accordance with the requirements of relevant Australian Standards.

The fire services contractor shall test the system in accordance with the requirements of AS2304:2011 & AS3500.1:2003.

All fire tanks, including accessories shall be tested to ensure correct operation. Further testing shall be carried out where required by DFES or any other bodies having jurisdiction.

Commissioning is to include:

- Structural inspection of both tanks prior to filling the tanks.
- Inspection and positioning of tank accessories.
- Inspection of operation of all valves and components to confirm correct performance.
- Hydrostatic inspection of each tank after the filling to maximum capacity.
- Recording and repair of any defects prior to commissioning.
- Submission of practical completion certificates, noting completion date, warranty and defects liability period.
Documentation shall be provided to verify the system has been fully tested and commissioned in accordance with Australian Standards. This shall be supplied as part of the system documentation.

11.14. 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 Murdoch University. Documents & 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

11.14.1. Drawings

The fire services contractor shall provide the following drawings and documents within two working weeks of completion of the project (2 copies of each). All drawings shall be completed using AutoCAD to Murdoch University and AS1100 Drawing Standards

- Dimensioned plan showing all sprinkler heads & pipes.
- Section & 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.

No work shall be undertaken without approved construction drawings. The Fire services contractor shall submit drawings for approval in accordance with the program requirements of this project. As part of this requirement, verification calculations shall be provided also. The principal shall reserve the right to instruct the fire services contractor to remove any such installation which has not been approved by the fire services consultant at no cost to the principal.

11.14.2. Block Plans

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

System duties, water supplies and emergency procedures to be shown.
Block plans shall provide minimum information as required by relevant Australian standard and DFES/Murdoch University requirements. Text shall be no smaller than 2.5mm.

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

11.14.3. Calculations

All sprinkler and hydrant systems shall be fully hydraulically calculated using suitable computer model or accepted industry methods. Calculations shall be submitted for review by the fire consultant. Drawings shall be provided which 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.


Submit for approval of the Fire Services Consultant 1 copy of Operation and Maintenance Manuals prior to commencement of site installation. Bind the manual in a white vinyl hard-back A4 folder with a cover page.

Prior to practical completion, submit 2 copies of the Operation and Maintenance Manual prior 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.

<table>
<thead>
<tr>
<th>SPINE</th>
<th>FRONT COVER</th>
</tr>
</thead>
<tbody>
<tr>
<td>MURDOCH UNIVERSITY</td>
<td>FIRE SERVICES</td>
</tr>
<tr>
<td>(DESCRIPTION OF INSTALLATION)</td>
<td>(specify type)</td>
</tr>
</tbody>
</table>

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 general description of the system and its components including FIP connections.
• Include 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 I 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 a full size and A3 copies of all construction drawings.
• Fire sprinkler system calculations and associated node drawing.
• A CD containing the "as built" drawings in AutoCAD format, and include all data sheets and commissioning sheets in electronic format.

11.14.5. Commissioning Documents

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

• Hydrostatic tests required for all wet systems, either in part of wholly.
• Flow tests to verify meets demand
• Calibration data of test equipment

11.14.6. Certification

On award of contract the system design shall be reviewed an authorised independent inspector to ensure the system meets with the requirements of
AS2118.1, AS2419 or AS2441 and DFES. Upon completion of installation the independent inspector shall review to ensure the project is installed in accordance with AS2118.1, AS2419 or AS2441 and this specification. A certificate of compliance shall be provided to verify design and installation.

Items requiring attention shall be rectified and re-inspected as necessary.

11.14.7. Log Books

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

Fire Services Works - Appendices
# A. SCHEDULE OF APPROVED EQUIPMENT

<table>
<thead>
<tr>
<th>Clause</th>
<th>Clause Title</th>
<th>Approved Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.4.1.1</td>
<td>Fire Indicator Panel</td>
<td>AMPAC Fire Finder</td>
</tr>
<tr>
<td>9.4.3.1</td>
<td>Emergency Warning Control Panel</td>
<td>AMPAC EV3000</td>
</tr>
<tr>
<td>11.2.3</td>
<td>Fire Hydrants</td>
<td>Model 381301 RG-GE BS fire hydrant valve 654 BIC with top butterfly cap painted</td>
</tr>
<tr>
<td>11.2.3</td>
<td>Fire Hydrants - BSP Inlet</td>
<td>Model 381301 RG-GE BS fire hydrant valve 65 BIC with top butterfly cap painted – roll groove inlet</td>
</tr>
<tr>
<td>11.2.3</td>
<td>Hydrant Stands</td>
<td>Model 381384-GE galvanized dual head fire hydrant valve support frame</td>
</tr>
<tr>
<td>11.2.3</td>
<td>Hydrant Covers</td>
<td>Model 381331-GE tamper resistant dual fire hydrant valve cover complete with chain and padlock – DFES approved locks</td>
</tr>
<tr>
<td>11.2.3</td>
<td>Fire Hose Reels</td>
<td>Fixed fire hose reel with swing guide arm model 383026 to suit application.</td>
</tr>
<tr>
<td>11.2.3</td>
<td>Fire Hose Reels</td>
<td>Model 382523-GE GI swing fire hose reel with flexible water way to suit installation</td>
</tr>
<tr>
<td>11.2.3</td>
<td>Fire Hose Reels</td>
<td>Model 383224-GE LI free sanding fire hose reel with stand and sun shield to suit installation</td>
</tr>
<tr>
<td>11.2.3</td>
<td>Fire Hose Reel Supports</td>
<td>Model 383263-GE galvanized fire hose reel channel bracket to suit installation</td>
</tr>
<tr>
<td>11.2.3</td>
<td>Fire Hose Reel Supports</td>
<td>Model 383307-GE Galvanised fire hose reel channel bracket to suit installation</td>
</tr>
<tr>
<td>11.2.3</td>
<td>Fire Hose Reel Cabinets</td>
<td>Type to suit installation</td>
</tr>
</tbody>
</table>