GENERAL SPECIFICATION

FOR

FIRE SERVICE INSTALLATION

IN

GOVERNMENT BUILDINGS

OF

THE HONG KONG SPECIAL ADMINISTRATIVE REGION

2001 EDITION

BUILDING SERVICES BRANCH
ARCHITECTURAL SERVICES DEPARTMENT

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2. This General Specification is solely compiled for use on fire service installation in Government buildings of the Hong Kong Special Administrative Region.

3. It is hereby declared that the specification contained therein may not be pertinent or fully cover the extent of installation carried out by others. Prior consent by the Director of Architectural Services must be obtained for adoption of this General Specification on installations of other nature or locations.

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SECTION A1
SCOPE OF SPECIFICATION

A1.1 INSTALLATION TO COMPLY WITH THIS SPECIFICATION

This General Specification details the intrinsic properties (including materials and workmanship) required of a fire service installation including hydrant/hosereel system, sprinkler system, manual and automatic fire alarm system, audio/visual advisory system, gas extinguishing system, portable appliances, emergency lighting, exit signs, emergency generator, ventilation and air conditioning control system, pressurisation of staircases system, smoke extraction system and all associated electrical equipment and wiring carried out for or on behalf of Architectural Services Department, the Hong Kong Special Administrative Region.

A1.2 INSTALLATION TO COMPLY WITH THE PARTICULAR SPECIFICATION & DRAWINGS

The fire service installation shall comply in every respect with this General Specification unless otherwise specified in the Particular Specification, the Drawings and/or Contract documents relating to a particular job or modified by written instruction of the Architect. In case of conflict, the order of authority shall follow the requirement as specified in Section A2.6 of this General Specification.

A1.3 SCOPE OF THE WORK

The scope of the Works in this General Specification, the Particular Specification and the Drawings relating to a particular project consists of the whole of the labour and all materials necessary to form a complete installation and such commissioning, adjustments, tests and maintenance as prescribed or as necessary. It shall include not only the major items of plant and equipment shown or specified but all the incidental sundry components necessary together with the cost of labour for installing such components for the completion of the Works and for the proper and functional operation and maintenance of the installation whether or not these sundry components are mentioned in detail in the Contract. It shall also include co-operation with other contractors involved on the Contract site in respect of co-ordination, programming, scheduling and sequencing of installation of the works in all circumstances where stipulated in the Contract or proven as necessary in practice.

A1.4 DEFINITIONS, INTERPRETATION & ABBREVIATIONS

In this General Specification, the following words or expressions shall have meaning hereby assigned to them except when the context otherwise requires: -

A1.4.1 Terminology and Glossary of Terms

"Approved" or "Accepted" means approved or accepted by the Architect.

"Architect" means the person, company or firm appointed from time to time by the Employer and notified in writing to the Contractor (or the Contractor of the Main Contract in the sub-contracting arrangement) to act as the Architect for the purpose of the Contract. The person appointed may be described by name or as the holder for the time being of a public office.

"Building Contractor" means the person, firm or company whose tender has been accepted by the Employer for building construction, including the Building Contractor's personal representatives, successors and permitted assigns. (The word "Building Contractor" may also mean the Contractor of the Main Contract, as the context requires in sub-contracting arrangement.)

"Building Services Branch" means the Building Services Branch of Architectural Services Department of the Government of the HKSAR.

"Contract" means the Articles of Agreement, the Tender and the acceptance thereof by the Employer (including such further agreed documents as may be expressly referred to in or by the same), Drawings, General Conditions of Contract, Special Conditions of Contract (if any), Specification and priced Bills of Quantities or Schedule of Rates. (The word "Contract" may also mean domestic or nominated sub-contract as the context requires.)

"Contractor" means the person, firm or company whose tender for the fire service installation has been accepted by the Employer and includes the Contractor's personal representative, successors and permitted assigns. (The word "Contractor" may also mean domestic or nominated sub-contractor as the context requires.)

"Drawings" means the drawings referred to in the Specification or Bills of Quantities and any modification of such drawings approved in writing by the Architect and such other drawings as may be from time to time be furnished or approved in writing by the Architect.

"Electrical Contractor" means the person, firm or company contracting, or sub-contracting to the Building Contractor, for the electrical installation, including the Electrical Contractor's personal representatives, successors and permitted assigns.

"Employer" means the Government of the HKSAR.

"Maintenance Period" means the maintenance period named in the Appendix to the Form of Tender commencing on the day following the date of Completion of the Works or any Section or part thereof certified by the Architect in accordance with the Contract.

"Particular Specification" means the specifications referred to in the Contract for a particular project.

"Specification" means the specifications referred to in the Contract and any modification thereof or addition thereto as may from time to time be furnished in writing or approved in writing by the Architect.

"Specified" means specified elsewhere in the General Specification or in the Particular Specification or on the Drawings.

"Temporary Works" means all temporary work of every kind required for the construction, completion and maintenance of the Works.

"Works" means the work or services including work or services to be carried out by Nominated Sub-Contractors to be constructed, completed, maintained and/or supplied in accordance with the Contract and includes Temporary Works.

A1.4.2 Abbreviations

"ANSI" means American National Standards Institute.

"ASTM" means American Society for Testing and Materials.

"BS" means British Standards, including British Standard Specifications and British Standard Codes of Practice, published by the British Standards Institution.

"BS EN" means European Standard adopted as British Standard.

"FM" means the Factory Mutual, USA.

"FOC" means the Fire Offices' Committee, UK.

"FSD" means the Fire Services Department of the Government of the HKSAR.

"FSDCOP" means Codes of Practice for Minimum Fire Service Installations and Equipment and Inspection, Testing and Maintenance of Installations and Equipment published by Fire Services Department, the HKSAR.

"HKSAR" means Hong Kong Special Administrative Region.

"IEC" means the International Electrotechnical Commission Publications.

"IEE Wiring Regulations" means the Regulations for Electrical Installations (BS 7671) published by the Institution of Electrical Engineers, UK.

"ISO" means the International Operation for Standardization Publications.

"NFPA" means the National Fire Protection Association, USA.

"LPC" means the Loss Prevention Council, UK.

"LPCB" means the Loss Prevention Certification Board, UK.

"PBFE" means performance based fire engineering (or fire safety engineering or fire protection engineering) approaches, studies, analysis and applications or similar works.

"UL" means the Underwriters' Laboratory, USA.

"TC2" means Building Services Branch Testing and Commissioning Procedure No. 2 for Electrical Installation in Government Buildings, Hong Kong, issued by the Building Services Branch, Architectural Services Department, the HKSAR

"TC3" means Building Services Branch Testing and Commissioning Procedure No. 3 for Fire Service Installation in Government Buildings, Hong Kong, issued by the Building Services Branch, Architectural Services Department, the HKSAR

A1.5 SINGULAR AND PLURAL

Words importing the singular only also include the plural and vice versa where the context requires.

SECTION A2
STATUTORY OBLIGATIONS, REGULATIONS AND SPECIFICATIONS

A2.1 INSTALLATION TO COMPLY WITH OBLIGATIONS, REGULATIONS AND SPECIFICATION

The installation shall comply with this General Specification, and with the following statutory obligations, regulations and specifications currently in force in the HKSAR:

(a) Fire Service (Installations and Equipment) Regulations, Fire Services Ordinance, Chapter 95, Laws of the Hong Kong Special Administrative Region.

(b) Buildings Ordinance, Chapter 123, Laws of the Hong Kong Special Administrative Region and all subsidiary Regulations and associated Codes of Practice published by the Building Department, the HKSAR.

(c) Dangerous Goods Ordinance, Chapter 295, Laws of the Hong Kong Special Administrative Region.

(d) Electricity Ordinance, Chapter 406, Laws of the Hong Kong Special Administrative Region and all subsidiary Regulations and associated Codes of Practice published by the Electrical and Mechanical Services Department, the HKSAR.

(e) Places of Public Entertainment Ordinance, Chapter 172, Laws of the Hong Kong Special Administrative Region.

(f) Fire Safety (Commercial Premises) Ordinance, Chapter 502, Laws of the Hong Kong Special Administrative Region.

(g) Residential Care Homes (Elderly Persons) Ordinance, Chapter 459, Laws of the Hong Kong Special Administrative Region.

(h) Waterworks Ordinance, Chapter 102, Laws of the Hong Kong Special Administrative Region.

(i) Radiation Ordinance, Chapter 303, Laws of the Hong Kong Special Administrative Region.

(j) Water Pollution Control Ordinance, Chapter 358, Air Pollution Control Ordinance, Chapter 311, Noise Control Ordinance, Chapter 400, Ozone Layer Protection Ordinance, Chapter 403, Laws of the Hong Kong Special Administrative Region and all subsidiary Regulations and associated Codes of Practice published by the Environmental Protection Department, the HKSAR.

(k) Occupation Safety and Health Ordinance, Chapter 509, Laws of the Hong Kong Special Administrative Region.

(l) Public Health and Municipal Service Ordinance, Chapter 132, Provision of Municipal Service (Reorganisation) Ordinance, Chapter 552, Laws of the Hong Kong Special Administrative Region.

(m) Codes of Practice for Minimum Fire Service Installations and Equipment and Inspection, Testing and Maintenance of Installations and Equipment published by Fire Services Department, the HKSAR.

(n) Requirements and Circular Letters of the Fire Services Department, the HKSAR (hereinafter referred as FSD Requirements and Circular Letters).

(o) Rules of the Fire Offices' Committee, United Kingdom, for Automatic Sprinkler Installations (for installations in existing buildings where the Rules apply) (hereinafter referred as FOC Rules for Sprinkler Installations).

(p) Loss Prevention Council Rules for Automatic Sprinkler Installations, United Kingdom (hereinafter referred as LPC Rules for Sprinkler Installations).

(q) Rules of the Fire Offices' Committee and Fire Offices' Committee of Ireland, United Kingdom, for Automatic Fire Alarm Installations for the Protection of Property, and where required by FSD, Loss Prevention Council Rules for Automatic Fire Detection and Alarm System for Protection of Property and/or BS 5839, and their amendments by FSD (hereinafter collectively referred as FOC Rules for AFA Installations).

(r) Rules of the Fire Offices' Committee, United Kingdom, for the Installation of External Drenchers.

(s) General Specification for Electrical Installation in Government Buildings, Hong Kong, issued by the Building Services Branch, Architectural Services Department, the HKSAR (hereinafter referred as General Electrical Specification).

(t) General Specification for Air Conditioning, Refrigeration, Ventilation and Central Monitoring and Control System Installation in Government Building, Hong Kong, issued by the Building Services Branch, Architectural Services Department, the HKSAR (hereinafter referred as General A/C Specification).

(u) General Specification for Building, issued by Architectural Services Department, the HKSAR.

(v) Building Services Branch Testing and Commissioning Procedure No. 3 for Fire Service Installation in Government Buildings, Hong Kong, issued by the Building Services Branch, Architectural Services Department, the HKSAR.

(w) Building Services Branch Testing and Commissioning Procedure No. 2 for Electrical Installation in Government Buildings, Hong Kong, issued by the Building Services Branch, Architectural Services Department, the HKSAR.

(x) Building Services Branch Testing and Commissioning Procedure No. 1 for Air-Conditioning, Refrigeration, Ventilation and Control Systems in

Government Buildings, Hong Kong, issued by the Building Services Branch, Architectural Services Department, the HKSAR.

(y) Design Manual : Barrier Free Access 1997 published by the Building Department, the HKSAR.

(z) British Standards and Codes of Practice issued by the British Standards Institution, or internationally recognised equivalent standards acceptable to the FSD and demonstrated to be equivalent in terms of the type of construction, functions, performance, general appearance and standard of quality of manufacture and approved by the Architect.

(aa) Where indicated, the codes, standards and guidelines issued by the following international institutions, or internationally recognised equivalent standards acceptable to the FSD and demonstrated to be equivalent in terms of the type of construction, functions, performance, general appearance and standard of quality of manufacture and approved by the Architect: -

- National Fire Protection Association, United States
- Loss Prevention Council, United Kingdom
- International Operation for Standardisation
- American National Standard Institute
- Committee for European Normalisation
- Japanese International Standard
- Factory Mutual, United States
- Underwriters' Laboratory, United States

(ab) Requirements from relevant authorities for licensed premises.

The installation shall comply with all the current requirements in the statutory regulations and codes and to the approval of FSD as the minimum whether they are shown in this General Specification, the Drawings and the Particular Specification or not.

A2.2 WATERWORKS ORDINANCE AND REGULATIONS

The plumbing work of the fire service installation shall comply with the Waterworks Ordinance and Regulations, Chapter 102, Laws of Hong Kong, and the Hong Kong Waterworks Standard Requirements for Plumbing Installation in Buildings and all the circular letters issued by the Water Supplies Department, The HKSAR.

A2.3 RADIATION ORDINANCE

The Contractor, where necessary, shall hold a valid Radioactive Substances Licence granted by the Hong Kong Radiation Board of the Department of Health and observe all conditions of licence, rules and regulations of the Radiation Ordinance and Radiation (Control of Radioactive Substances) Regulations in the storage, handling, installation, maintenance, disposal, etc. of ionisation type smoke detectors and other equipment carrying radioactive substances throughout the whole contract period and the subsequent whole Maintenance Period.

A2.4 SAFETY AND OCCUPATIONAL HEALTH REQUIREMENTS

Comply with all regulations on safety and occupational health aspects issued by the Works Bureau, the Labour Department and other authorities of the HKSAR from time to time. Particular attention is drawn to the following:

(a) Construction Sites (Safety) Regulations.

(b) Factories and Industrial Undertakings (Electricity) Regulations.

(c) Factories and Industrial Undertakings (Safety Officers and Safety Supervisors) Regulations.

(d) Factories and Industrial Undertakings (Confined Spaces) Regulations.

(e) Occupational Safety and Health Ordinance.

(f) Fire Services Ordinance.

(g) Electricity Ordinance.

(h) Dangerous Goods Ordinance.

(i) Waste Disposal Ordinance.

(j) Boilers and Pressure Vessels Ordinance.

(k) Gas Safety Ordinance.

(l) Public Works Programme Construction Site Safety Manual issued by the Works Bureau, the HKSAR.

A2.5 ADDITIONAL INFORMATION

Any requests for additional information, e.g. Architectural Drawings, shall be addressed to the Architect before submission of the Tender.

A2.6 IN CASE OF CONFLICT

In the case of conflict between the technical requirements of this General Specification and any other requirements, the following order of preference shall apply:

(a) The Particular Specification and/or the Drawings of specified work involved.

(b) This General Specification.

(c) Requirements and Circular Letters of the Fire Services Department, The HKSAR.

(d) Codes of Practice for Minimum Fire Service Installations and Equipment and Inspection, Testing and Maintenance of Installations and Equipment published by the Government of the HKSAR.

(e) Rules of Fire Offices' Committee, Rules of Loss Prevention Council, Codes and Standards of National Fire Protection Association.

(f) Standards and Codes of Practice issued by British Standards Institution.

A2.7 TECHNICAL STANDARDS AND QUALITY STANDARDS REFERRED TO

The IEC Standards, British Standards, NFPA Codes and other standards referred to within this General Specification indicate the basic requirements. Materials, equipment or products conforming to alternative internationally equivalent recognized standards acceptable to FSD, whenever offered, shall be demonstrated to be equivalent in terms of the type of construction, functions, performance, general appearance and standard of quality to the relevant British Standard or other standards specified in this General Specification.

A2.8 INTELLECTUAL PROPERTY RIGHTS

If the Contractor intends to use the intellectual property rights of another party in performing the Contractor's obligations under the Contract, appropriate licences shall be obtained from the relevant rights owners.

Where any software is provided in the Works, the Contractor shall submit documents showing that appropriate permission or licence has been obtained from relevant beneficial owners of intellectual property rights for the use of the software free of all fees for the whole operating life of the Works.

Where O&M manuals and as-built drawings are submitted, the Contractor shall obtain appropriate permission or licence from relevant beneficial owners of intellectual property rights to allow the Architect, the Employer and the subsequent owners or occupiers of the Works, and all parties responsible for the operation and maintenance of the Works free from all fees to make additional copies of the manuals and drawings in connection with the execution of the Works and/or the subsequent alteration, extension, operation and maintenance thereof.

A2.9 DESIGN RESPONSIBILITY

Where design is specified, the Contractor shall design the fire service installation to comply with the statutory requirements and the requirements in the Specification. Where design is not specified, the Contractor shall develop the design shown in the Drawings, complete the detailed design and installation details of the fire service installation and select the equipment design to comply with the statutory requirements and requirements of the Specification. All design drawings, calculation and installation drawings shall be submitted to the Architect for approval. Where design is specified, all design shall be checked and endorsed by a Registered Professional Engineer in Hong Kong under CAP 409 in approved disciplines (or equivalent approved professional qualification) specialised in fire service installation design employed by the Contractor and approved by the Architect or, when approved by the Architect for minor design, be checked and endorsed by a staff of the Contractor having the highest professional/technical qualification within the Contractor's company.

A2.10 EQUIPMENT APPROVAL BY FIRE SERVICES DEPARTMENT

All fire service equipment used shall be of approved type and shall possess the relevant approval by FSD as required. The fire service equipment requiring FSD's approval shall follow FSD Requirements and Circular Letters. The Contractor shall only submit to the Architect for approval equipment and materials that have been approved by FSD. A copy of the approval letter from FSD shall be submitted together with the equipment catalogue for approval. Where any equipment has been exempted from approval by FSD or does not require the approval by FSD, the Contractor shall provide the necessary information and/or evidence on the exemption in the submission to the Architect. For special equipment and installation or new type of equipment that has not used in Hong Kong, the Contractor shall submit them to the FSD for approval or for exemption.

The equipment used shall also possess approval letter/certificate by relevant authorities such as Water Supplies Department as necessary.

All fire service equipment shall be provided with necessary facilities, accesses and sundries for its proper maintenance, overhaul, testing and servicing after installation. Fire service equipment without consideration of maintenance provisions to the satisfaction of the Architect shall not be accepted.

A2.11 DATE COMPLIANCE

No value for current or future date/time will cause any interruption to operation which will affect the performance or functionality of all or part of the systems and/or equipment (including any supplied or supported embedded systems, hardware, software, firmware, micro-code and programmes).

A2.12 INTERNATIONAL SYSTEM OF UNITS

All installations shall use the International System of Units (SI).

SECTION A3
EXECUTION OF WORKS

A3.1 REGISTERED CONTRACTORS

The Works shall be carried out by a Contractor registered with the Fire Services Department of the Government of the HKSAR in accordance with the Fire Service (Installation Contractors) Regulations, Fire Services Ordinance, Chapter 95, Laws of Hong Kong in the Class or Classes relevant to the type or types of installation concerned.

Where electrical works are involved, the Contractor shall possess the relevant registration as required in the Electricity Ordinance and the works shall be carried out by electrical workers registered in the grade or grades relevant to the type or types of installation concerned.

Where ventilation works in building are involved, the Contractor shall possess the relevant registration required in the Buildings Ordinance.

A3.2 PROGRAMME OF WORKS

The Contractor shall submit a detailed programme of works showing the intended method, stages and order of proceeding with the Works in co-ordination with the building construction programme, together with the period of time estimated for each and every stage of Work. The programme shall include at least the following:

(a) Dates of order of equipment and materials.

(b) Dates of delivery of equipment and materials to site.

(c) Dates of commencement and completion of every stage of Works in line with the building construction programme, i.e. each floor level and/or zone area.

(d) Dates of expected completion of builder's work requirements, e.g. water tank, pump room, control valve room, etc.

(e) Dates of requirement of temporary and permanent electricity and water supply.

(f) Dates of submission of drawings to the FSD.

(g) Dates of submission for obtaining relevant licenses e.g. D.G., etc.

(h) Dates of completion, commissioning and testing.

(i) Dates of submissions and inspection by the Water Supplies Department.

(j) Dates of submission and inspection by the FSD.

(k) Dates of submission and inspection by relevant authorities if any.

Short term programmes showing the detailed work schedules of coming weeks and months shall also be provided to the Architect. Programmes shall be regularly updated to reflect the actual progress and to meet the obligations under the Contract.

In addition, detailed schedules and programme showing the installation drawing submission, equipment offer submission, and commissioning and testing shall be submitted to the Architect for approval. The formats and information of the schedules shall be as required by the Architect.

A3.3 BUILDER'S WORK

Where there is no Building Contractor carrying out the building work for a particular project, all builder's work for the fire service installation and all work by the Building Contractor in the Specification shall be carried out by the Contractor.

Where there is a Building Contractor carrying out the building work for a particular project, unless otherwise stated, all builder's work including forming openings, holes through the building structure, partition walls and all concrete bases, supports, ducts etc. required for the installation as shown on the Drawings will be carried out in the building work by the Building Contractor. Any additional items beyond those already included will also be carried out by the Building Contractor provided that the Contractor shall submit in good time to the Architect for approval, full details of such requirements, so that due consideration may be given before the Building Contractor commences work in the areas concerned. Following approval by the Architect, the Contractor shall be responsible for marking out the exact positions and sizes of all such work and for providing detailed information to the Building Contractor to facilitate him to carry out such work as it proceeds. The Contractor shall be liable for all expenses incurred which are brought about by the Contractor's failure to comply with the above requirements.

Approved pipe sleeves and pipe collars, and approved fire rated pipe sleeves and fire rated pipe collars where necessary, shall be supplied and installed by the Contractor for all fire service pipes and the like passing through compartments, walls, floors and any structural openings. Puddle flanges for inlet and outlet pipes of the tanks for fire service shall be supplied by the Contractor and will be installed by the Building Contractor unless otherwise specified.

A3.4 CO-ORDINATION OF CONTRACT WORKS

The Contractor shall co-ordinate the proposed programme of works and the actual work on site with the Building Contractor and any other contractors and sub-contractors and shall make any modification reasonably required to suit the coordination or as necessary to the satisfaction of the Architect in order to adhere to the approved overall construction programme.

Where there are fire service installations, related fire service installations and related fire service provisions in a particular project not carried out by the Contractor or not carried out by a registered fire service installation contractor but required for fire service inspection by the FSD, the Contractor shall co-ordinate, check and confirm their completion and readiness for fire service inspection by FSD. The Contractor

shall co-ordinate, obtain the drawings and information from relevant parties and include all such fire service installations, related fire service installations and related fire service provisions in the submission to the FSD for comment and inspection. The Contractor shall report the status of such co-ordination and any non-compliance with the requirements of FSD where found on the works carried out by others to the Architect.

The Contractor shall co-ordinate with relevant parties, inspect and witness the final tests on all related fire service installations, related fire service provisions and fire service installations in a particular project not included in the Works under Fire Service Installation or not carried out by a registered fire service contractor to identify any non-compliance with the requirements in the FSDCOP, FSD Requirements Circular Letters, and TC3. Any works found not complying with the fire service requirements of the FSD shall be rectified when they are included in the Works or be reported to the Architect when such works are carried out by others before arranging inspection with the FSD. The Contractor shall co-ordinate with relevant parties to carry out the final functional test and performance test. The Contractor shall co-ordinate to check that all fire service installations/equipment and items to be inspected by FSD are tested, rectified where necessary and certified by relevant parties before arranging inspection with the FSD. Unless otherwise specified, witnessing and inspection of such works of others by the Contractor shall be limited to those requirements in the FSDCOP, FSD Requirements and Circular Letters, and TC3.

A3.5 CO-OPERATION WITH OTHER CONTRACTORS

The Contractor shall co-operate at all times with the Building Contractor and all other contractors and sub-contractors in order to achieve efficient working on site.

Unless otherwise stated in the Contract, the Contractor shall be responsible for co-ordinating the work with others and for timely and satisfactory completion of the Contract.

Any significant problems beyond the Contractor's control shall promptly be reported to the Architect for advice and/or decision.

No extra claim for delay either financially or by extension of the Contract Period will be allowed if the Contractor fails to properly and adequately co-ordinate and programme the work at all times.

A3.6 TRAINING OF EMPLOYER'S STAFF

The Contractor shall provide training for the operation and where necessary maintenance of sophisticated equipment. The training shall include all training facilities, material and handouts etc. The Contractor shall submit a training schedule and proposal at least three (3) months prior to completion of the Works for the Architect's Approval.

The Contractor shall provide adequate training to the Employer's staff to operate the fire alarm control system and to monitor and to reset/mute alarms in the fire service installation at completion of the Works and before the commencement of the Maintenance Period. The Contractor shall provide adequate training to the Employer's staff on the operation of the fire service installation during fire alarm, fault alarm,

warning alarm and other emergency situations as appropriate. The Contractor shall provide contact telephone list as necessary to the Employer's staff.

The Contractor shall provide facilities and training programme to ensure that the Employer's operation and maintenance staff, as available, acquire full knowledge and appreciation of all aspects of the design, day-to-day operation, diagnosis and where necessary, breakdown and routine maintenance, and hence operate and maintain reasonably effectively and efficiently the system/equipment.

The Contractor shall provide training on the addressable fire alarm system as detailed in Section B8.13.

A3.7 SAMPLE BOARD

Prior to the commencement of installation work, the Contractor shall submit to the Architect for approval in good time sample boards of electrical and mechanical accessories proposed to be used for the Contract. Each sample shall be firmly fixed onto a rigid wooden or metal board and clearly numbered and labelled. A list shall be affixed to show the item description, make and brand, name of manufacturer, country of origin, accessories to be used and locations of installation (if not generally used). Only samples deemed to comply with the Specification shall be displayed and items shall be adequate for the whole installation unless otherwise clearly indicated as outstanding ones to be submitted later. Samples rejected by the Architect shall be replaced as soon as possible. Upon approval of all items in a sample board, the Architect will endorse the list of the sample board and the sample board shall be delivered by the Contractor to the Employer's site office for reference.

The following components shall be included in the sample board as a minimum. Additional items may be required by the Architect and/or specified in the Particular Specification.

(a) Pipework, fitting and support complete with fixing accessories.

(b) Cable and accessories.

(c) Conduit/trunking and accessories including adaptor for flexible conduit.

(d) Fire alarm call point, bell and flashing light.

(e) Sprinkler head complete with escutcheon and adaptor.

(f) Fire detector and remote indication unit.

(g) Flow switch, pressure switch and gauge.

(h) Exit sign.

(i) Emergency lighting.

(j) Duct detector with probe unit.

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(k) Fire damper complete with fusible link/electro-thermal link/actuator.

(l) Automatic actuating device for fire shutter.

(m) Indication lamp, switch, push button, etc for control panel.

(n) Gas discharge nozzle for gaseous extinguishing system.

Unless otherwise agreed by the Architect, the Contractor shall submit sample boards for approval within six (6) weeks of the award of the Contract. If six (6) weeks are practically insufficient, the Contractor may request the Architect in writing for an extension of time.

SECTION A4
INFORMATION REQUIRED FROM TENDERER

A4.1 INFORMATION FURNISHED WITH TENDER

The Tenderer shall complete the Equipment Schedule attached to the Tender Documents and also furnish the following information, where applicable, without which the Tender shall be considered incomplete:

(a) Name of manufacturer, country of manufacture, type and catalogue number, and full technical performance details, of all major items of equipment offered.

(b) Voltage of operation and current consumption, for all equipment and those for automatic heat, smoke and flame detectors, (a) under normal conditions and (b) under alarm conditions.

(c) Type and major size of wiring for alarm circuits.

(d) Evidence, or a signed statement, to the effect that all items of equipment requiring the approval of the FSD, LPCB, FM or the listing of UL are so approved or listed.

(e) Copies of test certificates showing compliance with the specified standards of the major offered equipment and materials issued by the British Standards Institution or any other internationally recognized testing authorities.

(f) Illustrated technical brochures in English or Chinese showing all major items of equipment and their installation requirements.

(g) Full technical details for engineered and pre-engineered systems.

SECTION A5
DRAWINGS AND MANUALS

A5.1 CONTRACT DRAWINGS

Should the arrangement and dimensions shown in the Drawings be considered inadequate for the Contractor to properly proceed with the work as specified, the Contractor shall draw the Architect's attention to the fact within twenty-eight (28) calendar days after the commencement of the Works together with details of amendments required.

A5.2 INSTALLATION DRAWINGS

Installation drawings including manufacturer's shop drawings shall be prepared and submitted to the Architect for perusal by the Contractor in sequence with the construction programme. They shall contain plan layouts, sectional drawings (elevations and plans), vertical plumbing line diagrams, schematic wiring diagrams, installation details, schematic air-side diagram for ventilation and air conditioning control, etc. and shall show the following particulars:

(a) Service routings and levels relative to the structure and other services.

(b) Plant and equipment locations with dimensions and weights.

(c) Service joints, supports and fixing details together with their locations.

(d) Maintenance accesses, facilities and all necessary details relating to the proper operation and maintenance of the systems.

(e) Calculation and data for gaseous extinguishing system, drencher system and other fire service installations.

(f) Method of control in ventilation and air-conditioning control system.

(g) Location and type of interfacing with other services for ventilation and air conditioning control system, fireman's lift and audio/visual advisory system.

The drawings shall include all design accessories and shall be drawn to match the materials and equipment supplied by the Contractor. Drawings showing details in spatial zones shall be prepared subsequent to proper co-ordination with the Building Contractor and other trades on site.

All drawings shall be dimensioned in S.I. units and suitably scaled to show all necessary details.

The manufacturer's shop drawings are drawings for equipment or plant to be manufactured by a specialist manufacturing supplier away from the Contract site. The drawings shall show detailed construction, principal dimensions and weights, clearances for maintenance, etc. Immediate after placing of any order or at any event within four (4) weeks unless otherwise agreed in writing by the Architect, the

Contractor shall forward to the Architect for comment and, where necessary, approval four copies of manufacturer's shop drawings' indicating detailed construction, principal dimensions and weights, clearances for withdrawals and/or cleaning, etc. No work shall proceed on or off the site unless these shop drawings have been approved in writing by the Architect.

The Contractor shall submit a detailed installation drawing submission schedule and programme to the Architect. The Contractor shall allow adequate time in the programme for vetting of the installation drawings by the Architect and for drawing re-submissions as necessary.

Four (4) sets of the preliminary installation drawings shall be submitted to the Architect who will then check, endorse and return two (2) sets to the Contractor for onward submission to the FSD for perusal. Works can only be commenced upon receipt of a set of drawings chopped/recorded by the FSD and written approval from the Architect. Six (6) sets of all such approved drawings shall then be submitted to the Architect. If there are changes in the course of installation, the Contractor shall submit the updated installation drawings which shall reflect the as-built installation to the FSD for perusal prior to the FSD inspection.

The Contractor shall keep on site a set of updated approved installation drawings available for inspection by the Architect at all times. The drawings shall be marked up with any modifications made during installation and commissioning and testing.

A5.3 WATER SUPPLIES DEPARTMENT APPROVAL OF DRAWINGS

Installation drawings showing the hydraulic systems connected directly to the water mains supply shall be submitted to the Water Supplies Department for approval. The Contractor shall submit the hydraulic system drawings approved by the Architect to the Water Supplies Department before commencement of work. The Contractor shall also complete the relevant water work standard application forms and submit the same to the Water Supplies Department after obtaining endorsement on the form by the Client or Architect.

A5.4 BUILDER' S WORK DRAWINGS

Unless otherwise agreed by the Architect, the Contractor shall submit to the Architect, within six (6) weeks of the award of the Contract, six (6) copies of drawings showing details of all builder' s work required for the fire service installation, and showing the weight and the load on each support of the equipment. Such drawings shall clearly indicate the details and positions of all holes, trenches and cutting required for pipework, drains, ventilation requirements, etc. and construction details for foundation plinths and equipment bases.

A5.5 AS-BUILT DRAWINGS

Supply three (3) sets of the first draft prints of as-built drawings at least fifty-six (56) calendar days prior to the commencement of commissioning of the installation/services/equipment. Any details not available at that time (e.g. commissioning and testing results) shall be provided with the penultimate drafts.

The Architect will check the drafts and return a set of marked up copies to the Contractor within forty-two (42) calendar days from the date of submission by the Contractor, together with comments necessary for final and approved documents.

The finalised approved as-built drawings shall be in three (3) sets of microfilm, two (2) sets of computer disk, one (1) set of reproducible copy and four (4) sets of prints, and shall be submitted as soon as possible but not later than one month after the completion of the Contract whichever date is earlier.

The detailed requirements and the media of as-built drawings shall also be as specified in the Preliminaries of the Contract. Where barcode labels are provided to the equipment, the code of the barcode shall be shown in the as-built drawings.

In addition, supply as-built main schematic drawings for various fire service installations, in non-fading prints, mounted in glass-frames and fix in all fire service pump rooms and, where provided, in the fire control centre where the fire alarm control and indicating panel/fire control centre is located. Glazing shall be polished plate of not less than 6 mm thickness mounted in natural finish, extruded and anodised aluminium frames with the prints mounted on acid free mounting board and the whole backed with marine grade plywood not less than 8 mm thick or as approved.

In addition to the above, supply one full bound set of as-built drawings in print and store them in a metal container provided by the Contractor and approved by the Architect in the fire control centre or in a location in the building to be determined by the Architect. The container shall be properly labelled and shall be of appropriate size to contain the folded drawings.

A5.6 SIZES OF DRAWINGS

Each drawing submitted shall conform to one or other of the following standard sizes :

(a) 841 x 1189 mm (A0)

(b) 594 x 841 mm (A1)

(c) 420 x 594 mm (A2)

(d) 297 x 420 mm (A3)

(e) 210 x 297 mm (A4)

A5.7 OPERATION AND MAINTENANCE MANUALS

Supply three (3) sets of the first draft of operation and maintenance manuals and the lists of recommended spare parts, recommended spare parts for one year's operation and special tools complete with prices to the Architect for comment at least fifty-six (56) calendar days prior to the commissioning and testing of the plant and equipment. Any details not available at that time (e.g. commissioning and testing results) shall be provided with the penultimate drafts.

The Architect will check the draft and return it to the Contractor within forty-two (42) days from the date of submission by the Contractor with comments necessary for final and approved documents.

The three (3) sets of finalised manuals shall be submitted as soon as possible but not later than one month after the installation/services/equipment has been commissioned. One set of the manuals shall be the original.

The detailed requirements, structure and contents of the operation and maintenance manual shall be as specified in the Preliminaries of the Contract. All commissioning and testing results, certificates and record photographs as necessary shall be included in the final manuals. In addition, the lists of recommended spare parts and special tools complete with prices shall be included in the final manuals.

The final manuals shall have pages of A4 size with A3 size folded where necessary. The pages shall be of good quality paper that is sufficiently opaque to avoid "see through". Unless otherwise specified in the Preliminaries of the Contract, the manuals shall be bound in durable loose-leaf ring binders of four ring type with hard covers. Where specified, instead of ring binder, the manuals shall be permanently bound and encased in durable hard covers. The manual shall have labels or lettering on the front and spine of the covers. The number of separate manual volumes required depends on the size and complexity of the installation concerned. The Architect' s agreement is to be obtained on this at the draft manual stage.

The Contractor shall include a set of original or certified true copies of all the licences required in Section A2.8 for the intellectual property rights in the manuals.

Together with the operation and maintenance manuals, the Contractor shall submit a key data summary sheet for all the installed equipment and system for use as a maintenance inventory record. Details and format of the key data summary sheet shall be submitted to the Architect for approval and shall include key data such as the type of equipment, rating and capacity of equipment, brand name and model number, code (barcode) of equipment where provided, construction material of the equipment, location of equipment/installation, total number of equipment of the same type, total length of pipes, key dimensions and thickness of equipment, agents in equipment, and other key data necessary for facilities management and inventory record. Three (3) hard copies and three (3) soft copies in CD-ROMs of approved software format of the key data summary sheet shall be submitted.

A5.8 ADDITIONAL REQUIREMENTS FOR ADDRESSABLE SYSTEM

Where addressable fire alarm, detection, control or similar system is supplied and installed, the operation and maintenance manuals and as-built drawings submitted shall include, but not limited to, the following details, in addition to all requirements as mentioned above:

(a) As-built interconnecting field wiring diagrams, or wiring lists, of the complete field installed system with complete, properly identified, ordering number of each device and system component.

(b) Operator manual with step-by-step procedures. The manual shall be indexed, and shall have a separate tabled section for each operator function.

(c) Operator's/Programmer's Manual with complete description of all programming functions, including sample written programs.

(d) Layout plan showing the fire control panel, field device locations and field device point list.

(e) Schedule of set points of the system.

(f) Complete description of the sequence of operation of the fire alarm control system with flow charts and decision trees.

The Contractor shall provide all the keys and passwords required for accessing all parts of the addressable system without restriction.

A5.9 SURVEYS AND MEASUREMENTS

The Contractor shall relate all horizontal and vertical measurements taken and/or applied, to establish bench marks such as design drawing grid lines, finished floor levels, etc. and shall thus establish satisfactory lines and levels for all work.

All works shall be installed to these established lines and levels and the Contractor shall verify all measurements on site and check the correctness thereof as related to the work.

Primary bench base line, datum level, horizontal reference grid, secondary grid and transferred bench mark on each structural level will be provided by the Building Contractor. The Contractor shall co-ordinate with the Building Contractor to obtain all necessary datum and reference grids prior to their surveys and measurements.

A5.10 ACCEPTANCE OF INSTALLATION/SHOP DRAWINGS, TECHNICAL LITERATURE AND MATERIAL SAMPLES

Where delays because of late drawing submissions by the Contractor and/or the effect of re-submissions (and particularly multi-resubmissions), the Contractor may be held responsible for any financial losses incurred and to the extent that the adverse effects can be demonstrated to have been incurred by the Contractor for having failed to produce acceptable drawings in reasonable and good time unless the delay is due to late comments/approval by the Architect. The time allowed for comments and resubmission shall be in accordance with the General Conditions of the Contracts and Special Conditions of Contracts.

The above conditions can also apply to submission and acceptance of other items such as technical literature and material samples.

A5.11 CHECKING DRAWINGS OF OTHER TRADES

The Contractor shall follow the design intent of the Drawings in planning and carrying out the work and shall cross check with other trades in order to verify the line, level, space and sequence in which the work is to be installed.

If directed by the Architect, the Contractor shall, without extra charge, make reasonable adjustments to the proposed installation drawing layouts as are necessary to prevent conflicts with the work of other trades or for the proper sequence of and execution of work. Where such modifications are of a nature and of such unforeseen complexity that they involve unreasonably extra work not covered by the Contract, they may be covered by variation order to be issued by the Architect wherever such a requirement is justified.

SECTION A6
GENERAL REQUIREMENTS OF THE WORKS

A6.1 GENERAL EQUIREMENTS ON MATERIALS, EQUIPMENT AND INSTALLATION STANDARDS

A6.1.1 Material and Equipment Standards

All materials, equipment and installation work shall be carried out by adoption of the best available quality materials and workmanship and shall, where applicable, comply with the latest edition of the appropriate standards and/or codes of practice issued by the relevant international Institutes and Standards and as specified in this General Specification. This requirement shall be deemed to include all amendments to these standards and codes up to the date of tendering.

A6.1.2 Compatibility of Materials and Equipment

Where different components of equipment are interconnected to form a complete system, their characteristics of performance and capacities shall be matched in order to ensure efficient, economical, safe and sound operation of the complete system.

A6.1.3 Equipment Catalogues and Manufacturer' s Specifications

Equipment catalogue and manufacturer's specification related to proposed items of equipment shall be specific and shall include all information necessary for the Architect to ascertain that the equipment complies with this General Specification and/or the Particular Specification and Drawings. Data and sales catalogue of a general nature are not acceptable. Unless otherwise agreed to by the Architect, all data and catalogues submitted must be in SI units i.e. mm, m, kPa, m/s, Hz, kW, l/s etc.

The Contractor shall submit catalogues and manufacturer's specification of the proposed equipment for the examination and approval of the Architect in writing before any equipment is ordered.

A6.1.4 Equipment Deviations

Subsequent to the award of the Contract, and only in exceptional circumstances where it is demonstrated in writing by the Contractor that the original equipment offered cannot be obtained, the Architect may consider and accept, in writing, alternative equipment and materials proposed by the Contractor provided always that these are fully in compliance with the relevant Specifications and Drawings and do not impose any additional contractual or financial liabilities onto the Employer. The Contractor shall bear in mind that submission of alternatives usually causes delay because of additional time required by the Architect to process further approval. The consequences of such delay shall be born by the Contractor.

Subject as always to the Architect's approval, where the Contractor proposes to use items of equipment other than those specified and dimensionally

different from the Drawings, the installation of which items requires any redesign of the structure, partitions, foundations, piping, wiring or any other part of the mechanical, electrical or architectural layout, then drawings showing the layout of the proposed equipment and any redesign involved shall be prepared by the Contractor at the Contractor's own expenses and be submitted to the Architect for approval.

Where the equipment deviation involves significant changes to the building, e.g. a larger plant room, this will unlikely be agreed unless the enlargement presents no significant problem and the Contractor is prepared to pay for the building alterations involved.

Where such approved deviation necessitates a different quantity and arrangement of piping, structural supports, equipment, controls, motors, starters, electrical wiring and conduits, and any other additional materials together with all necessary accessories from that originally specified or indicated in the Drawings, the Contractor shall supply and install such piping, structural supports, equipment, controls, motors, starters, electrical wiring and conduits, and any other additional materials together with all necessary accessories required by the system at no additional cost to the Employer. The contractor shall also be responsible for all other expenses by other contractors in view of the change. Any deduction of cost due to the change shall be deducted form the Contract.

The responsibility and detailed arrangement for abortive work and cost different for alternative equipment and material shall be in accordance with the Preliminaries of the Contract.

A6.1.5 Manufacturers' Technical Support in Hong Kong

All equipment requiring approval by the FSD shall be supplied through authorised agencies/sub-agencies of the manufacturers in Hong Kong or through the Hong Kong offices of the manufacturers. The Contractor may be required to produce such authorisation from the suppliers when required. These local agencies/sub-agencies or offices shall have adequate technical staff to provide pre-sale and after-sale services to the Contractor and to make submission to FSD to prove the compliance of the equipment with the FSD Requirements and Circular Letters.

A6.1.6 Materials Delivery Protection and Security on Site

For the purpose of accurate interim payment certification, all material delivered to site shall be accurately listed and recorded in the site record books maintained by the representatives of the Architect on site.

Once material and equipment delivered to site and paid for in interim payment, these material and equipment shall be the Employer's property and shall not be removed from site without the approval of the Architect in writing and appropriate deduction shall be made in the next interim payment in accordance with the Contract.

Where the Building Contractor is in overall control of the site, the Building Contractor may also be required to record details of all incoming/outgoing

materials. In this case the Contractor shall comply with the Building Contractor' s arrangements.

A6.1.7 Protection

Unless the responsibility is clearly defined in the Contract that the protection on site for delivered equipment, material and installation is solely by other contractors, the Contractor shall be responsible for the safe custody of all materials and the equipment as stored or installed by the Contractor until finally inspected, tested and accepted. Also unless otherwise specified, the Contractor shall protect all work against theft, fire, damage or inclement weather and carefully store in a safe and secure place all material and equipment received on site but not yet installed.

All cases of theft must immediately be reported to the Police, the Building Contractor, the Architect and the Architect' s representatives on site with full details of materials stolen.

In the case of fire, a similar report must be made to the nearest Fire Services Station, the Building Contractor, the Architect and the Architect' s representatives on site.

Where necessary the Contractor shall provide steel container type lockable storage or other equally secure enclosures placed within a securely fenced-in compound where the latter is to be provided by the Building Contractor on the site.

If rooms are required to secure the storage of sensitive and/or expensive items, the Contractor shall co-ordinate and shall ensure that the Building Contractor will provide clean, decorated, finished and lockable secure accommodation before their installation. If the Building Contractor fails to concede to such request, the Contractor shall report the shortcomings of the accommodation to the Architect.

If there is no Building Contractor, all the storage facilities and spaces shall be provided by the Contractor.

A6.1.8 Selection of Equipment

Selection of equipment shall be based on this General Specification, the Particular Specification, and the technical data contained in the Drawings for a particular installation.

Where items of equipment are interconnected to form an integral part of the complete fire service installation, their characteristics of performance and capacities shall be so matched as to give safe, reliable, efficient and economical operation of the complete air conditioning installation.

A6.1.9 Service Conditions

The following service conditions shall apply

(a) Climate : Hong Kong (tropical)

(b) Ambient temperature :
Peak -5°C to +40°C (continuously 4 hours)
Average 0°C to +35°C (over 24 hours)

(c) Altitude : up to 2000 m above sea level

(d) Relative humidity : 99% maximum non-condensing

A6.1.10 Voltage Covered by this General Specification

Unless otherwise specified, all apparatus, equipment, materials and wiring shall be suitable for use with a 3-phase and neutral, 4-wire, 380/220V ±6%, 50 Hz. ±2%.

A6.1.11 Tradesmen and Supervision

All tradesmen must be experienced in the trade and the work carried out shall be consistent with good practice in Hong Kong and to the satisfaction of the Architect.

The Contractor shall employ for the control and supervision of all work, one or more qualified and competent supervising engineers. The qualified and competent supervising engineer shall have minimum 5 years on site experience for similar type and scale of installation works. In case of minor nature of installation, the Contractor may propose to undertake the duties of the supervising engineer by the on site foreman as specified below. Approval by the Architect shall be obtained prior to any installation work.

The Contractor shall also employ a full time competent foreman on site for each trade. All trade foremen shall be registered tradesmen of the relevant trade.

The Contractor shall immediately replace any supervising engineer or trade foreman whose experience, skill or competency is, in the opinion of the Architect, found to be inadequate for the particular work.

A6.1.12 Tools and Instruments

Proper tools shall be used for the works. Adequate and accurate testing/measuring instruments shall be used to demonstrate compliance of the installations with the relevant specifications and regulations. The Architect has the right to stop any work in which the correct tools and/or instruments are not used.

Instruments used for acceptance tests shall be calibrated at an interval time of one year unless otherwise as required in the Contract for a particular project.

A6.1.13 Workmanship Standard

The installation works shall be in line with the good practice accepted by the local industry and verified by commissioning and testing results.

The installation works shall be in compliance with this General Specification, Particular Specification and Drawings of a particular project.

The installation shall be in compliance with the statutory requirements in respect of labour safety, fire safety, structural safety, electrical safety and environmental protection.

Apart from those requirements as stipulated in this General Specification and other statutory requirements, due care shall be taken to secure public safety and health both during the execution of the works and in the selection of equipment and materials.

A6.1.14 Warning Notice

Warning notices shall be provided as required by the Electricity Ordinance, Occupational Safety and Health Ordinance, the Code of Practice for the Electricity (Wiring) Regulations and other statutory regulations. In addition, the following warning notices in English and Chinese shall be provided at the appropriate positions: -

(a) A label having minimum size of 65 x 50 mm marked with the words 'DANGER - HIGH VOLTAGE' in red lettering not less than 5 mm high to be fixed on every container or enclosure of equipment for operating at voltages exceeding "Low voltage".

(b) A label to be fixed in such a position that any person may gain access to any moving parts of an item of electrical equipment or enclosure will notice or be warned of such a danger.

A6.1.15 Guard and Railing for Moving or Rotating Parts of Equipment

All moving or rotating parts of equipment shall be provided with an approved guard and railing complying with the Factories & Industrial Undertakings (Guarding an Operation of Machinery) Regulations, published by the Labour Department, together with any amendments made thereto.

Guards shall be rigid and of substantial construction and shall consist of heavy mild steel angle frames, hinged and latched with either heavy galvanised mild steel wire crimped mesh securely fastened to frames or galvanised sheet metal of 1.2 mm minimum thickness. All apertures shall be such that finger access to dangerous part is not possible. All sections shall be bolted or riveted. Railings shall be made of 32 mm dia. galvanised mild steel pipe and railing fittings.

During the execution of work, the Contractor shall ensure that all moving parts are adequately guarded by temporary guards. Adequate temporary guard railings etc. around dangerous floor/wall openings in the vicinity of any work for the protection shall be provided. Where there is a Building Contractor, for the safety of workers, guard railings etc. are to be provided by the Building Contractor, but in case they are not provided, the Contractor shall immediately report the matter to the Architect.

A6.1.16 Space for Plant

The Contractor shall ensure that all plants, material and equipment supplied by him can be accommodated and installed within the spaces as generally shown on the Drawings with adequate access and space for maintenance of all items supplied.

A6.1.17 Cutting-away and Making Good

Where there is a Building Contractor, all ' cutting-away' and ' making-good' as required to facilitate the Contractor' s works will be carried out by the Building Contractor as builder' s work, except for those minor provisions required for the fixing of screws, rawplugs, redhead bolts, etc. which shall be carried out by the Contractor.

The Contractor shall minimize the amount of cutting-away and making good necessary by giving timely and accurate instructions for the leaving of holes, etc. The Contractor shall at the necessary times in the course of the Contract Works mark out on the site or supply drawings to the Building Contractor for the latter' s attention to all cutting-away and preparing of ways. The Contractor shall ensure that the work is carried out strictly in accordance with the requirements or otherwise, the cost of all work and material in the event of negligence in allowing any unnecessary or incorrect cutting-away and making-good will be the Contractor' s responsibility.

A6.1.18 Water Proofing

Where any work requires piercing waterproofing layers or structures, the method of installation must have prior approval, in writing, from the Architect.

Unless otherwise specified or instructed, the Contractor shall provide all necessary sleeves, puddle flanges, caulking and flashing as appropriate to make these penetrations absolutely watertight.

A6.1.19 Quality Assurance Standards

All materials and equipment shall be manufactured by factories with acceptable quality assurance procedures. Factories having ISO 9001 or ISO 9002 certification are deemed to have acceptable quality assurance procedures. Other similar quality assurance standards may be accepted by the Architect on their individual merits. Details of such other quality assurance standards shall be submitted with the Equipment Schedule.

A6.2 GENERAL DESIGN REQUIREMENTS

All fire service installations and equipment shall meet with the following design objectives: -

(a) Complying with the statutory requirements.
(b) Effective in controlling and/or suppression and/or detection of fire and smoke.
(c) Providing life safety protection for people evacuation and for fire fighters.

(d) Providing and allowing adequate maintenance/overhaul facilities and accesses.
(e) Facilitating operation and alarm monitoring by the users.
(f) Providing a reliable installation with a reasonably long operating life.
(g) Reducing number of faults, false alarms and inaccuracies of the installation requiring attention.
(h) Allowing easy monitoring of the performance of the system and status of the equipment at any time.
(i) Minimizing maintenance and replacement of parts.
(j) Allowing adequate standby and spare facilities to cater for the failure of any part of the installation.
(k) Achieving cost effectiveness in term of life cycle costing on low operational and maintenance cost.
(l) Selection of equipment with optimum performance with reasonably good energy efficiency.
(m) Reducing noise, vibration and other nuisances to the occupants and neighbours.
(n) Complying with the safety requirements for future operation and maintenance with particular attention on the occupational safety and health of the workers.
(o) Using durable materials as well as equipment having a steady and reliable supply of parts and spares.
(p) Aesthetically acceptable for installation in exposed positions.
(q) Reducing the environmental impact and social effect as appropriate.
(r) Flexible to cater for future modification and expansion as appropriate.

Where design is included in the Works, the Contractor shall submit documentary evidence and demonstrate to the satisfaction and approval of the Architect that all the above design objectives as necessary are satisfied and complied with a reasonably satisfactory solution. Where selection of equipment is included in the Works, the Contractor shall ensure and may be required to demonstrate to the Architect when required that the equipment design and installation details shall meet with all the relevant design objectives as necessary. The Contractor shall select a design and/or equipment that can meet with all the design objectives as relevant and necessary and not part of them.

A6.3 GENERAL REQUIREMENTS ON OPERATION AND MAINTENANCE PROVISIONS

The Contractor shall provide and allow adequate facilities in the equipment offered for future inspection, monitoring, operation, maintenance, testing, overhaul and replacement. Such facilities shall be built-in during equipment installation. All heavy equipment shall be provided with lifting eyebolt or the like for lifting. All equipment that has a limited operating life shall be accessible and shall be easily removed for maintenance or replacement. Adequate and safe access shall be provided to all parts of the equipment. Adequate special tools shall be provided where necessary. The Contractor shall ensure that access to the plant and equipment is adequate to allow for its removal and/or ultimate replacement. Where this is considered not possible or necessary the Architect shall be consulted for alternative arrangements in the plant room.

The Contractor shall submit and use equipment that has a reliable and steady supply of spares and parts. The installation and equipment shall be provided with adequate

gauges, meters, measuring devices and monitoring facilities for indicating all the essential or necessary parameters for quick inspection. All such measuring and monitoring facilities shall deem to include in the Works whether they are shown in the Drawings or not.

Warning notices, operating instructions and working/maintenance instructions shall be provided as necessary adjacent to or near to the equipment. Adequate protective guards shall be provided.

The Contractor shall include in the builder's work drawings for approval the requirement of the builder's work for future maintenance facilities. This may include lifting I-beams, anchor eyebolts, access ladders, external working platforms, drain points, water points, etc. Where there is a Building Contractor and the builder's work for future maintenance facilities is approved by the Architect, such builder's work will be provided by the Building Contractor.

The Contractor shall allow adequate facilities in the installation for future tests during inspection and maintenance of the equipment. Drains shall be connected to the nearest drain points for carrying out water flow test for flow switch, etc.

PART B - FIRE SERVICE INSTALLATION

SECTION B1
PIPEWORKS, VALVES AND FITTINGS

B1.1 STEEL TUBES AND FITTINGS FOR EXPOSED PIPEWORK

All tubes and fittings up to and including 150 mm diameter shall, unless otherwise specified, be galvanised mild steel of at least medium grade to BS 1387 / ISO 65 - Steel tubes and tubulars for screwing to BS 21 / ISO 7/1 pipe threads. All other fittings shall be to BS 1740.

All tubes and fittings above 150 mm diameter shall, unless otherwise specified, be ductile iron to BS EN 545 Class K12 cold bitumen coated externally and internally to BS 3416 Type II.

Where specified for operation in high pressure from 1600 kPa, all tubes shall be suitable for operation under the design pressure conditions. All tubes above 150 mm diameter for high pressure from 1600 kPa shall be carbon steel of ERW 320 to BS 3601 - carbon steel pipes and tubes with specified room temperature properties for pressure purposes, and shall have dimensions to BS 3600 - Specification for dimensions and masses per unit length of welded and seamless steel pipes and tubes for pressure purposes. All fittings shall be butt-welding type carbon steel for pressure purposes to BS EN 10253-1. All tubes on or below 150 mm diameter for high pressure from 1600 kPa shall be galvanised mild steel pipe of heavy grade to BS 1387/ ISO 65.

B1.2 COPPER PIPEWORK

Copper pipework, where specified, shall comprise seamless hard drawn copper tubes manufactured to BS EN 12449 Table Z and of appropriate gauge to suit the working pressure of the system.

B1.3 UNDERGROUND PIPEWORK

Pipe laid underground shall conform to one of the following specifications: -

(a) BS 1387 / ISO 65 - Steel tubes and tubular of heavy grade for screwing to BS 21 / ISO 7/1 pipe threads.

(b) BS EN 545 - Ductile iron pipes and fittings, Class K12.

If not specified in the Particular Specification, ductile iron pipes and fittings shall be of Class K12 to BS EN 545.

Mechanical pipe couplings shall be used for joints in underground pipes. Mechanical pipe coupling shall comply with Section B1.5 where relevant. Suitable mechanical pipe coupling of approved type that can provide the required allowance for angular deflection and contraction and expansion shall be used.

B1.4 PIPE SIZES

Where pipe sizes are stated in this General Specification, this is intended to be the nominal bore in the case of steel tubes and the nominal outside diameter in the case of copper tubes.

B1.5 JOINTS IN STEEL PIPEWORK

Joints in steel pipework shall be made in accordance with the following general requirements, using only the highest quality materials and skilled labour.

Mechanical pipe couplings shall be employed for steel pipes of diameter larger than 65mm up to 150 mm unless otherwise specified. The pipes and fittings shall have grooved or shouldered ended suitable for the mechanical pipe couplings. It shall be a positive watertight couple providing some allowance for angular pipe deflection, contraction and expansion. The coupling assembly shall be securely held together by bolts and nuts with a water sealing gasket so designed that the internal water pressure increases the water tightness of the seal. Pipe couplings shall be of malleable iron castings and galvanised, or ductile iron castings. Pipe grooves may be cut or rolled without the removal of any metal. The entire coupling installation shall be in accordance with the published selected manufacturer's recommendations and designed to withstand two times of normal operating pressure. Where the pipes are laid underground, suitable mechanical pipe coupling of approved type that can provide the required allowance for angular deflection and contraction and expansion shall be used.

Flanged joints and flanged fittings shall be used for steel pipe of diameter larger than 150 mm. For aboveground steel pipes with normal operating pressure higher than 1600 kPa, flanged joints and flanged fittings shall be used for pipes of diameter larger than 65mm. For pipes exposed in public accessible areas, flanged joints and flanged fittings shall be used for pipes of diameter larger than 65mm. If prior approval is obtained from the Architect, mechanical pipe couplings may be used for steel pipes at such exposed locations up to 150 mm.

Steel pipes less than or equal to 65 mm shall be jointed with screwed fittings, screwed flanges, or screwed unions. Screwed joints shall have tapered threads to BS 21 / ISO 7/1 and shall be made with approved jointing material. Where the process of cutting of threads removes galvanisation, the Contractor shall apply an approved cold galvanising finish to restore the integrity of the pipe protective finish. Fittings shall be galvanised. Screwed fittings other than sockets shall be of galvanised malleable iron. The pipes shall be fitted with screwed flanges for jointing valves and other equipment having flange connections.

Where flanged joints and flanged fittings are specified, the flanged joints and fittings shall be of factory applied flange joints for galvanised steel and ductile iron pipes. Welded flanges are permitted for carbon steel pipes. Flanges shall be raised face to BS 4504. Flanges for steel pipe work shall be wrought iron or annealed steel, machined full face and galvanised, suitable for the working pressures to which they will be subjected. For flanged joint pipes, facilities and provisions shall be provided in the pipe system to absorb thermal movement, vibration and water hammering.

Jointing of steel pipes by welding is only permitted where specified or with the expressed permission of the Architect. Only ungalvanised pipes of 50 mm bore or larger may be jointed by welding.

B1.6 JOINTS IN COPPER PIPEWORK

Joint fittings for copper pipework of up to and including 54 mm shall be of the capillary or compression type to BS EN 1254 Part 1 and 2. For copper pipework above 54 mm, fittings shall be of the flanged compression type. Only non-corrosive type of flux shall be used for jointing.

B1.7 DISMANTLING FACILITIES

All pipe runs shall be arranged for ease of dismantling and re-erection. Disconnecting flanges, mechanical pipe coupling or screwed unions, as applicable, shall be supplied and installed at suitable locations and at valves and equipment. Unions shall be of ground-in spherical seated type. Unions for steel pipes shall be of forged steel heavy duty pattern and unions for copper pipes shall be of gunmetal. Unions shall have hexagon bodies.

B1.8 PIPEWORK INSTALLATION

Pipework installation shall be carried out in accordance with the following general requirements.

Pitcher tees, bends, twin elbows, etc. shall be of the same size as the pipework connected to them. Bushings shall not be used. Square tees shall only be used where short sweep fittings would cause air to be trapped.

Bends shall be of long radius wherever possible. Short radius bends and elbows may be used for pipe sized up to 65 mm diameter or for pipes installed inside false ceiling or concealed ceiling void. Use of short radius bends and elbows of larger size in areas other than false ceiling and concealed ceiling void are subject to the Architect's approval on consideration of space available for installation. Square elbow is not permitted.

Tubes shall be reamed after cutting and shall be free from burrs, rust, scale, and other defects and shall be thoroughly cleaned and treated for corrosion protection before and after erection.

Open ends left during the progress of the work shall be properly blanked off with approved metal or wood plugs or blank caps or counter flanges.

Joints shall not be made in the thickness of any wall, floor or ceiling.

Where pipes pass through ordinary walls or floors, the Contractor shall, unless otherwise specified,

(a) Cast or build in galvanised mild steel pipe sleeves with 2 to 25 mm clearance to allow for expansion and movement of pipe.

(b) Finish sleeves flush with the finished face of walls unless concealed inside false ceiling.

(c) Project sleeves at least 100 mm above finished floor level.

(d) Fill the annular space between pipe and sleeve for the full length with approved fireproof materials and non-flammable type sealant.

(e) Provide loose chromium plated steel cover plates where specified, to ends of sleeves visible in completed work. Plates shall be 50 mm larger than the external diameter of pipe and either clipped to the pipe or screwed or plugged and screwed to the adjacent surfaces.

When pipes pass through fire rated walls or floors, the Contractor shall, unless otherwise specified,

(a) Cast or build in fire rated pipe sleeve with 2 to 25 mm clearance.

(b) Finish sleeves flush with the finished face of walls unless concealed inside false ceiling.

(c) Project sleeves at least 100 mm above finish floor level.

(d) Fill the annular space between pipe and sleeve for the full length with approved fireproof materials of fire rated period not less than that of the wall and the floor through which the pipe penetrates.

(e) Provide loose chromium plated steel cover plates, where specified, to ends of sleeves visible in completed work. Plates shall be 50 mm larger than the external diameter of pipe and either clipped to the pipe or screwed or plugged and screwed to the adjacent surfaces.

Where pipes pass through building roofs, the Contractor shall, unless otherwise specified,

(a) Cast or build in fire rated pipe sleeves with 2 to 12 mm clearance projecting 150 mm above roof finish.

(b) Caulk space and void at both ends for the full length with approved fire rated sealant, e.g. mastic sealant.

(c) Cover top of sleeves with watertight stainless steel collars or similar cover as per roofing specification.

(d) Pipework shall not be embedded in the concrete structure or “grouted in” or otherwise installed in such a way as to make subsequent alterations difficult at a later date.

B1.9 PIPEWORK SUPPORTS

All pipework shall be properly supported with substantial hangers, anchors, brackets, saddles, guide, etc. to BS 3974 with adequate provision for expansion and contraction and for corrosion protection.

Pipework supports shall be arranged as close as possible to joints and changes of direction and each support shall take its share of the load. The spacing of the supports shall not exceed the centres given in the following table: -

Table 1 : Spacing of pipework support for mild steel and copper pipes

Nominal pipe size, mm	Spacing for vertical runs, m	Spacing for horizontal runs, m
Mild Steel		
15	2.5	2
20 and 25	3	2.5
32	3	3
40 and 50	3.5	3
65 and 80	4.5	3.5
100	4.5	4
125	5	4.5
150	5	5
200	7.5	7.5
Copper		
15	1.5	1
22 and 28	2	1.5
35 and 42	2.5	2
54	3	2.5
76 and 108	3.5	3

Vertical rising pipework shall be supported at the base or as indicated to carry the total weight of the riser. Branches from risers shall not be used as a means of support for the riser.

Where pipework up to 50 mm is fixed to solid structure, brackets may be of the screw-on or long shank built-in type. Fixings to timber or to light-weight structure shall be of screw-on pattern. Brackets and supports for mild steel tube shall be galvanised steel or malleable iron and galvanised. Brackets for copper tubes shall be brass or gunmetal. The pipe clip shall be detachable without disturbing the fixing.

Brackets screwed to walls shall be securely fixed by expanding plugs of adequate size or other purpose-designed fixing devices of non-combustible material. Wood plug is not permitted.

Pipework of 65 mm size and larger subjected to expansion and contraction shall be suspended on swivel hangers or hangers having equivalent functions and performance to cater for expansion and contraction. The pipe hangers and supports shall be galvanised steel or approved materials for supporting the load of the pipes.

Unless otherwise specified, hangers for horizontal pipework at high level shall be supported from angle or channel galvanised irons supplied and installed by the Contractor and suitable for building-in or otherwise secured to the structure. Tee hangers supported on two legs instead of angle hangers shall be used. Adjustable galvanised steel hangers shall be used. Pipe rings shall be of malleable iron or fabricated steel and galvanised, made in halves and secured by bolts or machine screws. Alternatively, galvanised malleable iron hinged pipe rings may be used. Calliper type hook is not permitted.

Where integral pipe hangers are required for housing the fire service pipes and pipes for other services, the integral pipe hangers shall be of a type approved by the Architect and supplied by one manufacturer with all the accessories. Structural

calculation shall be submitted for approval. The laying of pipes on the integral pipe hangers shall be fully co-ordinated with other parties before installation.

B1.10 EXPANSION JOINTS

Expansion joints shall be supplied and installed for all pipework passing through any building expansion joint and where necessary as specified. They shall be of axial pattern bellow type and shall have screwed or flanged ends as appropriate to facilitate replacement. They shall incorporate internal liners if required and shall be manufactured from 18/8 stainless steel or better material to the approval of the Architect and shall be designed to withstand at least two times of the system pressure. External protective sleeves shall be fitted. Each joint shall be securely held by guides on both sides. All expansion joints shall have a working life of not less than twenty years. Unless otherwise approved by the Architect, flexible connector of single sphere or double sphere type made from rubber, EPDM or similar materials shall not be used as expansion joint.

B1.11 PROTECTION OF UNDERGROUND PIPEWORK

Underground pipes shall be protected against corrosion and against mechanical damage. Pipework shall be cleaned after jointing and treated with two coats of good quality bituminous paint and wrapped with corrosion and water resistance self-amalgamating tapes and mastics having 55% overlapping before laying, and bedded in washed sand free of all salts or sieved soil before the trench is back filled. All joints and supports shall be appropriately wrapped. Pipework shall be hydraulically tested before the trench is back filled. Underground pipework shall be provided with suitable and approved couplings which provides allowance for angular deflection, contraction and expansion. Anchor blocks shall be made at appropriate locations to the approval of the Architect for thrust bearing. Anchor block, trench, backfilling of trench and sand bed are included under the builder' s works detailed in Section A3.3.

B1.12 PIPE ENTRIES INTO BUILDINGS

Pipe entries into buildings shall be sealed with mastic compound and plugged after installation of pipework to prevent the ingress or egress of water or vermin.

B1.13 VENTING AND DRAINING

Air vents and drain valves shall be provided at high points and low points respectively in all piping systems.

Automatic air vents, or air cocks where specified, shall be supplied and installed at the highest points of pipework and where necessary for the venting of air in the installation. They shall have gunmetal or brass bodies, stainless steel floats and guides, and non-corrodible valves and seats. Each automatic air vent shall be controlled by a lock-shield valve. Air release pipes shall be run to discharge at the nearest suitable visible point. Air cocks shall be nickel-plated, of the spoutless pattern and with screwed taper thread. At least two loose keys shall be provided for each type of cock installed.

Drain valves, or drain cocks where specified, shall be fitted on the lowest points of pipework or where necessary for the water drainage of the system. Plugs for drain cocks shall be ground-in. Two loose keys of forged mild steel shall be provided with each drain cock. Drain valves/cocks shall be connected to the nearest building floor drain or drain point of adequate size.

B1.14 VALVES, TAPS AND COCKS

Valves, taps and cocks shall be of the types and working pressures suitable for the systems to which they are connected and shall be accompanied with valid letters of approval issued by the Water Supplies Department.

Wherever applicable, the following British Standards for cocks and valves shall be relevant: -

BS 1010 Part 2	Draw-off taps and above ground stop valves.
BS 1552	Specification for manual shut-off valves for use with 1st, 2nd and 3rd family gases.
BS 5150	Cast iron gate valves for general purposes DN Series PN 16.
BS 5151	Cast iron gate (parallel slide) valves for general purposes DN Series PN16.
BS 5152	Cast iron globe and globe stop and check valves for general purposes DN Series PN16.
BSEN 12334	Industrial valves, cast iron check valves.
BS 5154	Copper alloy globe, globe stop and check, check and gate valves DN Series PN16.
BS 5156	Screw down diaphragm valves DN Series PN16.
BS 5159	Cast iron and carbon steel ball valves for general purposes DN Series PN16.
BS 5163	Key-operated cast iron gate valves for water works purposes DN Series PN16.

Valves and fittings of PN25 or heavier duty shall be used for high pressure system. All components in the fire service installations and equipment shall be designed to withstand at least two times the system pressure.

All valves shall be arranged so that clockwise rotation of the spindle closes the valve. Valves shall not be installed at locations with a change in direction of the pipework.

Isolating valves shall be of the full way gate type. Regulating valves shall be of globe type, unless otherwise specified. Globe valves shall be positioned so as not to prevent draining of the system.

Bodies of valves and cocks up to 50 mm shall be of cast gunmetal or bronze. Valves having heavy pattern hot-pressed bodies may be used subject to the approval of the Architect. Valves over 50 mm shall have cast iron bodies.

All working parts shall be of gunmetal or bronze or stainless steel. Spindles shall be of high tensile bronze, forged brass or stainless steel with Teflon or approved packing to the manufacturer's standard. Gate valves shall have split or solid wedge gates of bronze with bronze seats. Disc valves shall have renewable discs free to rotate on the spindle.

Valves and cocks for installation in screwed jointed pipework shall have taper screwed ends. Flanges of flanged valves shall be to BS 4504 for PN16 rating.

Operating handwheels shall be of malleable iron, or of approved composition having metal insert for securing positively to the stem.

Outlets valves on fire service water tanks, sprinkler installation, and elsewhere as specified, shall have padlocks and leather straps capable of locking the valves in the "OPEN" position.

Non-return valves shall have flaps of light construction pivoting on a gunmetal, bronze or stainless steel spindle. The valves shall be fitted with stops to prevent undue movement and sticking of the flap and shall be quiet in operation. The valve shall be so constructed that minimum resistance is offered in the normal direction of flow.

Pressure reducing valves for direct connection in hosereel branch pipes, and elsewhere as specified, shall be of approved spring-loaded relay-operated type or otherwise constructed to prevent high pressure build-up on the low pressure side, and shall be supplied and installed with strainer and by-pass valves. Pressure reducing valves for hydrant outlets (parity valves) shall be of the type having relief connection to drain (see Section B2.4) unless otherwise specified.

B1.15 PRESSURE GAUGES

Pressure gauges shall conform to BS EN 837-1 and shall have brass cases with dials not less than 100 mm diameter. They shall be calibrated in kPa to a maximum of not less than 1-1/3 times and not more than 2 times the operating pressure. Divisions of scale shall not exceed 20 kPa for a maximum scale value of 1000 kPa, 50 kPa for a maximum scale value of 1600 kPa and 100 kPa for maximum values in excess of 1600 kPa. An isolating valve/cock shall be supplied and installed for each pressure gauge.

B1.16 ELECTRIC ALARM PRESSURE SWITCHES

Electric alarm pressure switches shall have contact sets of silver or approved alloy rated to suit the working voltage and current of the circuits controlled and shall have independent adjustments for the cut-in and cut-out points and for the operating differential. Electric alarm pressure switches shall be of LPCB approved type or approved by similar widely recognised independent regulatory body. The maximum working pressures of all pressure switches shall be at least 300 kPa above the maximum pressure of the water inside the pipework at the points of installation of the switches. Pressure switch shall be supplied and installed with necessary ancillary facilities and isolating valves for maintenance and hydrostatic pressure test purpose

complying with LPC Rules for Sprinkler Installation and of arrangement shown in LPC Technical Bulletin TB 10. All isolating valves where provided shall be complete with padlocks.

B1.17 WATER FLOW ALARM SWITCHES

Water flow alarm switches shall be of magnetic type having the water side completely separated from the electrical side. Contacts shall be suitable for the working voltage and current of the circuits controlled, and shall be of silver or approved alloy. Water flow alarm switches shall be of a type approved by LPCB or approved by similar widely recognised independent regulatory body. They shall be capable of standing a test pressure of minimum 1500 kPa for six (6) hours without showing any sign of leakage.

B1.18 PIPELINE STRAINERS

Water strainers shall be installed in all pipelines upstream of all water pumps. For pipelines of nominal bores between 15 mm and 50 mm diameter inclusive, strainers shall be screwed gunmetal or bronze body "Y" type with brass or stainless steel screen. For pipelines of nominal bores of 65 mm diameter or above, strainers shall be flanged with "Y" type cast iron body, brass or stainless steel screen. Strainer screen shall have straining holes of 2 mm diameter.

B1.19 BALL FLOAT VALVES

Ball float valves up to 50 mm shall be of cast gunmetal or bronze body. Ball float valves over 50 mm shall be of cast iron body. They shall be with nickel alloy and stainless steel working parts. They shall be of a slow closing type and of PN10 pressure rating.

B1.20 VORTEX INHIBITORS

Vortex inhibitors shall be LPCB approved type or approved by similar widely recognised independent regulatory body for PN16 and flanged. They shall be used for operation under positive head conditions.

B1.21 ORIFICE PLATES

Orifice plates for system balancing, pump churning water circuits, where applicable, shall be supplied and installed as required for proper commissioning of the systems. Wherever necessary to suit the pump or system performance or in respect of system balance, an orifice plates shall be supplied and installed even if they are not indicated on Drawings.

Orifice plates shall be generally constructed and installed according to LPC Rules for Sprinkler Installations. They shall be manufactured by factories producing LPCB approved equipment and UL listed sprinkler equipment or equipment approved by similar widely recognised independent regulatory body, and acceptable to the FSD. Orifice plate that has been factory calibrated and produced by a factory with a quality

control system in place can also be used if they are acceptable by the FSD. The flow characteristic data of the orifice plate shall be included in the operation and maintenance manual.

B1.22 CLEANING AND DRAINING

All piping shall be cleaned and shall be free of scale, dirt, etc., before installation. During the course of the installation, all open ends of pipes shall be plugged or capped to prevent ingress of dirt. After installation and sealing of joints all piping shall be thoroughly flushed with clean water under pressure, to the satisfaction of the Architect. Water used for this purpose shall be discharged as directed.

Any temporary pipework and equipment necessary for the above cleaning work shall be provided by the Contractor.

SECTION B2
HYDRANT AND HOSE REEL SYSTEM

B2.1 GENERAL REQUIREMENTS

The general requirements of the hydrant and hose reel system and the individual equipment installations shall comply with FSDCOP and FSD Requirements and Circular Letters.

The fire service inlets, hydrant outlet valves and hose reels shall be approved by the FSD.

The fire service inlets and hydrant outlets if not stamped with the British Standard Mark shall be accompanied with a valid letter of approval issued by the Water Supplies Department.

B2.2 FIRE SERVICE INLETS AND HYDRANT OUTLETS

Fire service inlets shall be of twin type comprising screw-down globe type stop valve with male screwed outlet of suitable bore and two 65 mm horizontal male instantaneous inlet connections complete with integral spring loaded resilient-seated non-return valves.

Hydrant outlets shall be single or double type comprising screw-down globe type stop valve for each outlet branch and with male screwed inlet of suitable bore and 65 mm female instantaneous outlets. Outlet branches shall incline at 70° from the centre line of the hand wheel, and at 90° to each other where applicable. The coupling control shall be located at the side of each outlet branch. A bronze blanking cap held captive by a suitable chain shall be fitted to each female outlet.

The fire service inlets and hydrant outlets shall be of all gunmetal construction except for the handwheel which shall be of cast iron or hard aluminium alloy.

The inlet and outlets fittings shall be supplied and manufactured to the quality of material, construction, and dimensions as detailed in the following British Standard Specification: -

(a) Hydrant assembly to BS 5041 Part 1.

(b) Major valve components of gunmetal to BS EN 1982.

(c) Globe & check valve of service rating 1000 kPa to BS 5154.

(d) Male and female instantaneous terminals of 65 mm diameter to BS 336.

(e) All fittings shall be tested to at least 2000 kPa.

B2.3 VENTING AND DRAINING

All hydrant risers shall be supplied and installed with automatic air vents of 25 mm size at the highest points and drain valves at the lowest points of the systems as specified in Section B1.13.

B2.4 PRESSURE REDUCING HYDRANT OUTLETS

Pressure reducing hydrant outlet shall be supplied and installed at outlet locations where the static and pump pressure exceeds 700 kPa.

The pressure reducing hydrant outlet shall be in the form of a parity valve incorporated in the hydrant outlet and valve assembly and connected to a drain pipe not less than 40 mm diameter. Alternatively, where specified, the pressure reducing hydrant outlet can be in the form of self-contained type without the use of the parity valve and drain pipe. It shall be capable to reduce the running pressure and satisfy the flow test requirements. The pressure reducing mechanism of the valve shall be located at down stream of the valve seat. Pressure reduction shall be achieved by means of hydraulic pressure balancing with metal diaphragm. An 100% effectiveness pressure reducing performance shall be maintained at all times of operation.

B2.5 HOSE REELS

Hose reels shall be of fixed or swing-out type to suit the site installation conditions of the site. The construction, testing, performance, working pressure, etc. shall be to FSD Requirements. The length of hose shall be 30 m and bore 19 mm.

Drums shall be constructed of diecast light alloy, hydraulically balanced, free from denting and twisting, and finished in red enamel. The hub and shaft shall be of brass, fitted with a device to prevent overrun of the hose, having a glandless centre seal. The entire assembly shall be drip free. Hoses shall be of reinforced rubber or P.V.C. tubing approved by the FSD and shall be fitted with a copper alloy nozzle having slow-closure type lever-operated cock.

A hose guide complete with nylon or similar runners shall be supplied and installed adjacent to fixed type hose reels to enable the hose to be run out in any direction as required.

For the wall fixed pattern, wall-mounting brackets of substantial construction capable of supporting the entire weight of the hose reel and tubing under all operating conditions are required.

For the swing-out pattern, the support brackets and the swing-out arm shall be so designed as to enable the whole hose reel assembly be swung through 180^{o} in a horizontal plan.

Each hose reel nozzle shall be housed inside a glass fronted metal box. The box shall be fabricated from sheet metal not less than 0.8 mm thick with a hinged door with front break glass and padlocking facility. The metal box shall be painted and finished to the satisfaction of the Architect. The break glass shall be of fragile type not more than 1.5 mm thick. The break glass shall be easily replaced. Common key shall be used for the padlocks. Five common keys shall be provided. A metal or plastic striker

about 300 mm long, secured by steel chains, shall be provided for each box for the purpose of breaking the glass panel in case of emergency.

B2.6 CABINETS

Cabinets for the housing of fire service inlets, hydrant outlets and hose reels will be provided by the Building Contractor unless otherwise specified. The Contractor shall furnish all necessary information to enable these cabinets to be designed and constructed including proposed dimensions for the cabinets and the dimensions, weights, etc. of the equipment supplied by him. All information supplied shall be based on BS 5041 Part 4.

Where hose reels are located in cabinets or recesses to which doors are fitted, the doors shall bear the words "FIRE HOSE REEL (消防喉轆)" in both English and Chinese characters prominently and easily identifiable from all lines of sight in the surrounding. In the case of doors which can only be opened by pushing in first, they shall also be annotated "PUSH TO OPEN (按下開門)" in both English and Chinese. Hose reel cabinets fitted with doors shall not be locked and shall be easily identified and opened at time of emergency. All doors and markings will be provided by the Building Contractor unless otherwise specified.

B2.7 STREET HYDRANT SYSTEM

Street hydrants shall be of pedestal type manufactured of cast iron. The construction of the street hydrants shall comply with the requirements of the Water Supplies Department and the FSD. They shall be in accordance with the Standard Mains Laying Practice of the Water Supplies Department.

The hydrant, when tested in accordance with the provision of BS 1042 with one 65 mm outlet working, shall be capable of delivering not less than 2000 litres per minute (33.3 l/sec.) with a minimum running pressure of 170 kPa at the outlet. The minimum output and pressure as stated above shall be made available from two 65 mm outlets of the system delivering at the same time, i.e. a total output of not less than 4000 litres per minutes (66.7 l/sec.) at 170 kPa. Where the minimum standards are not possible from direct town mains, the water supply shall be augmented by water tank and booster pumps. The Contractor shall arrange to test the direct town mains water supply pressure and flow at a nearby location approved by the Architect at early stage after the commencement of the Contract. The Contractor shall submit to the Architect for approval soonest after the test proposal for providing booster pumps and tanks for the street hydrant system if the water supply pressure and flow from town mains are not adequate to meet with the requirements of FSD.

B2.8 TANKS AND WATER PUMPS

Tanks and pumps shall comply with Section B4.

Two sets of automatic fire pumps, one as duty and one as standby, each capable of delivering the required flow and pressure as required by the FSDCOP and FSD Requirements and Circular Letters, shall be supplied and installed.

The fixed fire pump for fire hydrant and hose reel system shall be actuated by the manual fire call point and shall continue to run until stop manually with start/stop buttons. Should the duty pump fail to operate within fifteen (15) seconds the standby pump shall be energized to become the duty pump.

The hydrant and hose reel systems shall be permanently primed with water. If the fire service water tank is located below the highest hydrant outlet or hose reel, a jockey pump shall be supplied and installed to maintain an adequate pressure for the entire system. The jockey pump shall be set to operate at 95% of the required system pressure and stop when the system pressure is restored to 100% level. Interlock shall be supplied and installed such that the jockey pump shall stop when the fire pump is put into operation.

The fire pumps for the street hydrant system shall be actuated by a flow switch. Should the duty pump fail to operate within fifteen (15) seconds the standby pump shall be energized to become the duty pump.

Where the tanks are not included in the Works under Fire Service Installation, the Contractor shall co-ordinate with relevant parties and shall check the net effective water storage capacity is adequate to meet with the fire service requirements.

B2.9 CONTROLS

The control system, where applicable, shall comply with Section B8 and the FSDCOP and FSD Requirements and Circular Letters. All associated electrical wiring and installation shall comply with Section B9.

SECTION B3
AUTOMATIC SPRINKLER SYSTEM

B3.1 STANDARDS

Sprinkler system shall be installed in accordance with the following Standards and Requirements:-

(a) The Loss Prevention Council Rules for Automatic Sprinkler Installations and the Technical Bulletins (as modified, see Item (4) below).

(b) Codes of Practice for Minimum Fire Service Installations and Equipment published by the Government of the HKSAR.

(c) Codes of Practice for Inspection and Testing of Installations and Equipment published by the Government of the HKSAR.

(d) Relevant FSD Circular Letters to modify the LPC Rules for Sprinkler Installations pertinent to Hong Kong.

(e) Rules of the Fire Offices' Committee for Automatic Sprinkler Installations (only be used where specified for existing installations in the Particular Specification).

(f) Relevant FSD Requirements and Circular Letters.

B3.2 DEFINITION OF TERMS

For the definitions of terms used for sprinkler systems, reference shall be made to the LPC Rules for Sprinkler Installations, the Code of Practice for Minimum Fire Service Installations and Equipment and relevant FSD Requirements and Circular Letters.

B3.3 TYPES OF SYSTEMS

Types of sprinkler systems are as defined in the LPC Rules for Sprinkler Installations.

B3.4 CLASSIFICATION OF FIRE HAZARD

The LPC Rules for Sprinkler Installations has defined various classes of fire hazard according to the occupancy of the building to be protected.

B3.5 GRADING OF SPRINKLER SYSTEMS

Sprinkler systems are graded according to the number and type of water supplies available. Reference shall be made to the LPC Rules for Sprinkler Installations.

B3.6 TYPE OF WATER

Unless otherwise specified, the sprinkler system shall be suitable for use with fresh water connected from the town mains.

B3.7 BRANCH CONNECTION TO WATER SUPPLY SYSTEM

Whenever a direct feed town mains, gravity tank or other supply systems are used to supply the sprinkler system, no branch connection for any other purpose, hosereels included, is permitted.

B3.8 ANTI-POLLUTION VALVE FOR DIRECT CONNECTION TO TOWN MAINS

For sprinkler systems without water storage tanks and supplied from a direct connection to town mains, an additional butterfly valve (anti-pollution valve), without stop screw and lock nut on handle and strapped in open position to the Water Supplies Department Specification shall be fitted to the sprinkler installation at a point between the town mains connection and the sprinkler inlet.

The anti-pollution valve shall be installed in accordance with the FSD Requirements and Circular Letters.

B3.9 SPRINKLERS

Sprinkler for general application shall be of LPCB approved conventional type or approved by similar widely recognised independent regulatory body. Spray sprinkler shall be used where specified and approved. The sprinkler shall not be altered in any respect nor have any type of ornamentation or coating applied after leaving the production factory. Unless otherwise specified, sprinkler shall be quick response type approved by LPCB or approved by similar widely recognised independent regulatory body. For sprinkler system designed to high hazard group, the sprinkler shall in addition be designed to provide appropriate water droplet sizes for the type of hazard and goods they protected.

Sprinkler shall be constructed with the appropriate characteristics, to suit each particular application. The sprinkler shall be of pendant, upright or side wall type to suit the installation requirements in accordance with the LPC Rules for Sprinkler Installations and FSD Requirements and Circular Letters. Each sprinkler may be defined by any of the following characteristics: -

(a) Nominal size of orifices.

(b) Type of heat-operated element.

(c) Operation temperature.

(d) Type of deflector.

Unless otherwise specified, glass bulb sprinkler shall be constructed with heat sensitive quartzoid bulb with temperature rating of 68^{o}C. Sprinklers installed in heated rooms,

e.g. kitchen cooking area, autoclave room, etc. shall have a temperature rating of 93^{o}C or as required by the FSD unless otherwise specified.

Sprinkler installed at the false ceiling shall be of flush pattern, pendant type and be supplied and installed with an adjustable screw type escutcheon and adaptor to be installed flush with the false ceiling with the yoke and heat sensitive element exposed below the false ceiling line. Sprinkler heads shall be installed at the centre line of the ceiling tiles. The sprinkler head assembly including the yoke arm, escutcheon, adaptor and cover plate installed in exposed locations shall be chromium plated or finished to a polyester white colour or a colour to be approved by the Architect. The sprinkler head concealed inside false ceiling shall be of natural brass finish or of the same finish as the sprinklers in exposed locations.

Dry pendent sprinklers where specified for pre-action system shall be of adjustable standard or recessed type providing vertical adjustment needed for accurate fit to false ceiling level. The escutcheon shall match the other sprinklers.

Dry pendent sprinklers shall consist of a valve mechanism which utilizes the centre strut in compression principle to seal water and air from the sprinkler pipe until the sprinkler is operated. Water shall then flow freely through the operated sprinkler and distributed by its deflector.

The sprinklers shall cover all areas in the sprinkler-protected building including staircases, common corridors and toilets except plant rooms/D.G. stores/cold storage and other special areas that are provided with other fire service systems acceptable to FSD.

B3.10 SPRINKLER GUARDS

Sprinklers shall be protected by approved metal guards at locations where they are installed at a height less than 2 metres from ground level or liable to accidental or mechanical damage or required by the FSD. Sprinkler guards shall be made from brass, wax coated or products having equivalent functions and performance for corrosion resistance. It shall be of size not more than 65 mm high.

B3.11 SPACING AND LOCATION OF SPRINKLERS

Spacing and location of sprinklers shall be in accordance with the LPC Rules for Sprinkler Installations.

The Contractor shall check the actual site conditions before and during installation works to ensure that the sprinkler installation complies with the LPC Rules for Sprinkler Installations. The Contractor shall inform the Architect well in advance of any necessary change of pipe sizes or sprinkler layout in order to suit the finished architectural layout. The Contractor shall be held responsible for the taking down and refixing works without charges if he/she fails to check and inform the Architect in good time about such alterations.

The Contractor shall supply and install metal baffles of the correct size between sprinklers wherever required by the LPC Rules for Sprinkler Installations.

B3.12 SPARE SPRINKLERS

The Contractor shall supply and install a cabinet containing a minimum number of spare sprinklers for each type of sprinklers as recommended by the LPC Rules for Sprinkler Installations or as specified. Sprinkler spanners as supplied by the manufacturers of the sprinklers shall also be provided and kept in the cabinet. Where quick response sprinklers or fast response sprinklers are provided in the Works, an adequate quantities of spare quick/fast response sprinklers shall be supplied and maintained as recommended by the LPC Rules for Sprinkler Installations or as specified. Where both conventional sprinkler heads and quick response / fast response sprinkler heads are provided in an installation, the number of spare sprinklers for each type of sprinkler head shall be considered separately and each shall comply with the recommendation in the LPC Rules for Sprinkler Installations for any hazard class.

B3.13 PIPEWORK INSTALLATION

Pipework installation for sprinkler systems shall be installed in accordance with the LPC Rules for Sprinkler Installations and as detailed in Section B1.

B3.14 PRESSURE GAUGES, VALVES AND ALARM DEVICES

Pressure gauges, various types of valve and alarm devices shall be installed in accordance with the LPC Rules for Sprinkler Installations.

B3.15 CABINETS FOR CONTROL VALVE SETS AND SPRINKLER INLETS

Cabinets for housing the sprinkler control valve sets and sprinkler inlets will be provided by the Building Contractor unless otherwise specified. The Contractor shall furnish all necessary dimensional information to enable these cabinets to be designed and constructed.

Construction of the sprinkler inlet shall be the same as fire service inlet described in Section B2. Labelling and lettering shall be in accordance with the FSDCOP and FSD Requirements and Circular Letters. The Contractor shall include all details in the builder' s work drawings for construction by the Building Contractor unless otherwise specified.

B3.16 TANKS AND PUMPS

Tanks and pumps shall comply with Section B4.

Two sets of automatic pumps, one as duty and one as standby, each capable of delivering the required flow and pressure as required by the LPC Rules for Sprinkler Installations for the appropriate hazard class shall be supplied and installed.

A jockey pump shall be supplied and installed to maintain the required system pressure.

The sprinkler duty and standby pumps and jockey pump shall be controlled by means of independent LPCB approved pressure switches suitable for starting pumps.

Automatic changeover shall be supplied and installed such that the standby pump shall be put into operation, after a preset time lag, in case there is a fault at the duty pump as sensed by the pressure switches at the common header. The sprinkler pump shall be set to operate when the system pressure has fallen by 200 kPa or to a value not less than 80% of the pressure attained when the pump is churning with the installation in the standby condition, whichever is the least reduction. The pump shall continue to run until stopped manually with start/stop buttons. In addition to pressure switches, the sprinkler pumps can also be activated at the pump room and the fire alarm control and indicating panel.

The jockey pump shall be set to operate at 95% of the system pressure and shall stop when the system pressure is restored to 100% level. The capacity of the jockey pump shall be so selected that it cannot support full flow of an operated sprinkler. Interlock shall be supplied and installed such that the operation of jockey pump shall stop when the sprinkler pump is put into operation in response to a reduction in system pressure.

A pump output test facility shall be supplied and installed to permit a running pressure test of the pump at full load condition or at nominal rating as appropriate. The test facility shall include a LPCB approved direct reading flow meter suitable for sprinkler service. The waste water discharge pipe shall be connected, wherever practical, back to the sprinkler water tank.

B3.17 CONTROLS AND ALARM INDICATIONS

The control and alarm indication shall comply with Section B8 and the LPC Rules for Sprinkler Installations. All associated electrical wiring and installation shall comply with Section B9.

Tamper-proof electric switch or approved indication to indicate the correct operational mode of each stop valve in the sprinkler system shall be supplied and installed complying with the LPC Rules.

B3.18 WATER FLOW ALARM SWITCHES

Water flow alarm switches as detailed in Section B1.17 shall be utilized for sending a signal back to the fire alarm control and indicating panel to indicate which location is under operation with both visual and audible alarms. LPCB approved high sensitive water flow alarm switch capable of actuation by operation of one sprinkler head shall be used.

Where specified, LPCB approved automatic flow switch testing system shall be supplied and installed for sprinkler flow switches installed in a position difficult to be accessed or checked in routine inspection such as those inside false ceiling, at level higher than 2m above ground, etc. The controlling test panels of the automatic flow switch testing system shall be wired and installed in sprinkler pump room or nearby plant room.

Where automatic flow switch testing system is not provided, the Contractor shall allow adequate drain points in the installation connected to the nearest drain for routine testing of all flow switches when the sprinkler installation is in operation.

B3.19 SUBSIDIARY STOP VALVES

Electric monitoring type subsidiary stop valves shall give visual signals back to the fire alarm control and indicating panel to indicate the open/close state. Audible signal shall also be given when the valve is not in fully open position.

B3.20 SPRINKLER CONTROL VALVE SETS

The control valve set comprising the associated pressure gauges, valves, alarm devices, water motor gongs, testing facilities, retarding chambers, etc. shall be in accordance with the LPC Rules for Sprinkler Installations. Electric monitoring device shall be fitted at each valve to give signals back to the fire alarm control and indicating panel to indicate the open/close state of the valve. Audible signal shall also be given when the valve is not in fully open position. Drain connection to the system shall be led to conspicuous positions as approved by the Architect and comply with the requirements of the Water Supplies Department. Sprinkler control valve set shall be of duplicate alarm valve arrangement or of alarm valve with bypass arrangement, and with alarm monitoring facilities.

B3.21 DRY PIPE INSTALLATION

Dry pipe installations shall be supplied and installed where specified or where the conditions are such that a wet pipe system cannot be used. For example, wet pipe installation cannot be used in buildings where the temperature is artificially maintained close to or below $0^{o}C$, such as in cold room, or where the temperature is maintained or may be raised above $70^{o}C$ such as in drying room, and where the pipework cannot be run outside the cold or hot areas.

The installation shall be pressurized with air within the pressure range recommended by the alarm valve manufacturer and shall not exceed 400 kPa. A drop of the pressure to a predetermined value opens the installation dry alarm valve and primes the installation. Each installation shall be served by an independent air supply system.

In cold room, automatic means shall be supplied and installed to automatically shut down the air circulation fans of cooling system when the sprinkler system operates. The Contractor shall co-ordinate with the parties for the installation of the cooling system and shall supply and install all necessary interfacing control, wirings, equipment and signals for shutting down the air circulation fans of the cooling system. The installation shall be fitted with upright sprinklers if the pipework runs in the cold room.

The air-supply pipework shall consist of copper pipe or pipe of other approved materials. The air-supply pipework shall be fitted with pressure relief valve, non-return valve, stop valve (normally open), suitably sized restrictor, and by-pass with stop valve (normally strapped and padlocked closed).

The air-supply pressure-relief valve shall be set to relieve at a pressure of not more than 500 kPa in excess of the air pressure requirement of the installation dry alarm valve.

The air-supply pipework shall be connected to the installation above the normal priming water level of the dry alarm valve.

With the installation valve primed in the ready position, it shall be possible to fully pressurize the installation in one (1) hour, at any time.

Where recommended by the air compressor manufacturer, air compressors shall be equipped with automatic off-loading devices to depressurise the compressor prior to start up.

Air-supplies to sprinkler installations possessing a cold store shall be dried by passing through a suitable air dryer or freezer.

The restrictor in the air-supply pipework shall be correctly sized to limit the mass flow of air from the air supply to the installation, so as to avoid delay of water discharge from the open sprinklers. Filter shall be supplied and installed at the upstream of the non-return valve and restrictor.

Restrictors shall be made from non-corrosive materials such as austenitic stainless steel or copper alloy having orifices with rounded edges.

Distribution and range pipes shall be of the terminal range configuration. Grid and loop configurations of pipework are not allowed.

A test facility shall be supplied and installed at the end of the hydraulically most remote range pipe on the installation, consisting of a 32 mm nominal diameter pipe and quick-acting test valve, with an outlet nozzle equivalent in size to the smallest sprinkler in the installation. The quick-acting test valve shall be located in an easily accessible position and shall be normally secured in the closed position with a suitable strap or chain. The end of the test line shall normally be capped or plugged.

Sprinkler installations in the dry-pipe mode shall either :

(a) have an internal volume of air-filled pipe not exceeding :

Light hazard	1.0 m^3
Ordinary hazard	2.5 m^3
High hazard	2.5 m^3

or

(b) discharge water from the test facility within sixty (60) seconds of opening the quick-acting test valve when the installation is in the normal stand-by condition.

The number of sprinklers on dry-pipe installations, including any tail-end extensions, shall comply with the LPC Rules for Sprinkler Installations.

B3.22 PRE-ACTION SYSTEM

Pre-action system shall be supplied and installed where specified. There are two types of pre-action installation as follows:

(a) Type 1, which shall be installed only to prevent a premature discharge of water from pipework or sprinklers that have suffered mechanical damage; and

(b) Type 2, which shall be installed only to facilitate an early discharge of water from a dry pipe installation by opening the installation main control valve, thus filling the installation control pipework with water, upon operation of a fire detection system.

For Type 1 system, the water shall normally flow into the pre-action pipework when the sprinkler is opened and the fire detection system is operated. For Type 2 system, the water shall fill the pre-action system pipework upon operation of a fire detection system before the sprinkler is operated.

Unless otherwise specified, Type 2 shall be used for pre-action system.

The sprinkler installation pipework shall be normally charged with air under pressure as detailed in Section B3.21, and monitored to give a warning indication on reduction of the air pressure. Complete loss of air pressure shall initiate the visual and audible indications for a fire alarm.

The fire detection system shall automatically give an alarm at the fire alarm control and indicating panel, pre-action system control panel and any repeater panels and shall operate two independent LPCB certified solenoid valves or actuator mechanisms either of which shall release (Type 1 or Type 2) pre-action alarm valves. The solenoid valves or actuator mechanisms may be energised or de-energised to operate a pre-action valve control system.

In Type 1 installations, sprinklers can be installed in the upright or pendent position. In Type 2 installations, sprinklers shall be installed in the upright position.

The number of sprinklers shall not exceed the following.

(a) In a light-hazard installation : 500 per installation.

(b) In an ordinary-hazard installation : 1000 per installation.

(c) In a high-hazard installation : 1000 per installation.

The pre-action system control panel shall incorporate the necessary relays, timers, key types switches, alarm and trouble lights essential to the operation of the system. The control panel shall employ printed circuit boards for the components and shall be completely factory-wired and ready for connection on site. The control panel shall comply with Section B8 where relevant and the following :

(a) The duration of the battery stand-by power supply shall be at least seventy-two (72) hours. At the end of the 72-hour stand-by period, the stand-by power supply shall be capable of operating the pre-action control panel and solenoid valve or actuator to release the pre-action alarm valve.

(b) The pre-action control panel shall initiate operation of the pre-action alarm valve immediately in the event of a fire alarm system fault (including a failure of the primary and stand-by power supplies) which may result in failure to execute the appropriate actions in the event of fire.

The pre-action control panel relays and circuitry operating the pre-action alarm valve solenoid valves or actuator mechanisms shall be duplicated and wired such that no single fault or failure shall render the installation inoperable.

Monitoring devices shall be supplied and installed to give: -

(a) indication that any stop valves down-stream of the installation control valve set are fully open;

(b) audible and visual warnings at the pre-action control panel that any monitored stop valve is not fully open;

(c) audible and visual warnings at the pre-action control panel that the cover to a condition indicator switch has been removed;

(d) audible and visual warnings at the pre-action control panel of short circuit or disconnection of the leads of any solenoid valve or actuator which is energised to open;

(e) audible and visual warnings at the pre-action control panel of short circuit or disconnection of the primary power supply, the secondary power supply or any battery charger associated with the operation of the pre-action system.

The fire detection system used to activate a pre-action sprinkler system shall comply with FOC Rules for AFA Installations where appropriate and the following: -

(a) Each room or compartment protected by sprinklers shall have sufficient fire detectors to initiate release of the pre-action installation without the operation of any detectors external to the room or compartment or located within equipment.

(b) Fire detection systems employing coincidence connection (requiring a response from two detectors to initiate operation of the pre-action alarm valve) may be used with Type 1 and Type 2 pre-action installations. Consideration shall be given to actuation of the pre-action alarm valve on operation of a single fire detector where fast-developing fires may occur.

(c) Any two detectors of a group of detectors that may initiate the operation of the pre-action alarm valve shall be separately connected to independent wiring circuits (coincidence connection).

(d) Consideration shall be given to the nature of the occupancy, building height, sprinkler thermal sensitivity, air movement and the recommendations of the FOC Rules for AFA Installations and the Technical Bulletin TB 21 of the LPC Rules for Sprinkler Installations.

B3.23 RECYCLING SYSTEM

Recycling system shall only be provided where specified and necessary for the following reasons: -

(a) to restrict water damage after a fire is extinguished;

(b) to avoid closure of the main installation stop valve if modifications are made to the installation pipework or if sprinkler heads are to be replaced;

(c) to prevent water damage caused by accidental mechanical damage of the installation pipework or sprinklers.

The complete installation including equipment, components and wiring shall be LPCB approved or approved by similar widely recognised independent regulatory body and accepted by the FSD. It shall be supplied from a proprietary manufacturer specialized in the manufacture of the system. The installation work shall also comply with the recommendations of the manufacturer.

The major components of each recycling installation shall consist of, but not limited to, the following: -

(a) Recycling heat detector

(b) Fire resisting detector cable

(c) Control panel

(d) Batteries and charger

(e) Electric alarm bell

(f) Pipework and fittings

(g) Sprinkler head

(h) Flow control and other auxiliary valves

(i) Air supply system including air compressor, piping and fittings

All major components shall be LPCB approved or approved by similar widely recognised independent regulatory body as an integral part of the recycling installation. The complete recycling system shall be approved by the FSD.

(a) Heat Detector

The heat detector shall be a heat sensitive, normally closed, electrical detector which shall operate at a fixed temperature. It shall be rate compensating and feature automatic recycling. Each detector shall be complete with a tell-tale of zinc alloy. The detector units shall be connected with fire resisting cable to the control panel. When a detector is heated to the temperature set point, a mechanical switch shall open and break the series circuit interrupting the flow of current. When the temperature drops below the set point, the circuit is re-established. It shall be able to be mounted at any angle. The heat probe shall be of stainless steel and the top shall be colour coded for temperature set point and spacing. The detector trip temperature shall be factory set and shall not be adjustable in the field. The detector shall be capable of withstanding 815^{o}C temperatures for short periods of time without damage. At 426^{o}C sustained ambient temperature the tell-tale tab shall drop away, indicating possible detector damage. The

conduit box attached to the detector shall be fire and explosive proof and constructed of copper-free aluminium with threaded conduit connections and adaptors provided for detector cables.

The detectors shall have a 60^{o}C detection rating which can monitor up to a maximum of 149 m^{2} of area under optimum conditions of a smooth ceiling. The detectors shall not be spaced for more than 12 m apart and 6 m from walls.

The detectors shall comply with the requirements in Section B6.2 where relevant and applicable.

(b) Fire Resisting Cable

The whole re-cycling pre-action system shall be wired with low smoke fire resisting cables to BS6387 Cat CWZ. The fire resisting cable shall consist of copper conductors and shall withstand 815^{o}C temperature for at least thirty (30) minutes. It shall be non-toxic, and no toxic or noxious fumes shall be emitted during a fire. It shall not allow a fire to propagate and no conduit shall be required. It shall be bent easily to match contours for easy installation. The cable shall be cut to length in field and may be spliced, but all splices must be made in conduit boxes which shall be flameproof and water proof.

The binding tapes used with the cables must be flame retardant.

The cables shall be installed in conduits, cable trays or other approved supports, and be fastened by approved fasteners or clamps specially designed and constructed for the purpose, to the satisfaction of the Architect.

(c) Mode of Operation

Water discharge cycling shall be controlled by heat detectors installed at the roof or ceiling which operate as an electrical interlock causing the water flow control valve to open and close. A timer shall be supplied and installed to delay closure of the flow control valve for a predetermined period of at least five (5) minutes in each cycle after lowering of the temperature of the heat detectors.

The fire alarm bell shall continue to sound until the reset button is pushed. Should the temperature rise to the trip point of any detector during any phase of the cycle, the system will continue to flow or immediately start the flow of water to the fire.

(d) Control Panel

The control panel shall be of FSD approved type and shall incorporate the necessary relays, timers, key type switches, alarm and trouble lights essential to the operation of the system. The panel shall be completely factory-wired and ready for connection on site.

The control panel shall allow the re-cycling pre-action system to be operated as a cycling pre-action system with the electrical detection circuit in service or as a dry system without the electrical detection circuit in service. An

ON/OFF light shall be incorporated to monitor the selection of the recycling ON/OFF switch. The control panel shall also incorporate a system tripped light and a low air pressure light. System operation or low air pressure shall activate the corresponding light and the audible trouble alarm and other alarms required which can be silenced by the ON/OFF switches.

Testing facilities shall be provided to simulate the opening of the detector circuit momentarily to cycle the system. A reset button on the panel shall reset the timer and alarm circuits after system operation.

The whole recycling installation shall be designed and constructed as a fail-safe installation. If the detector circuit and/or pressurized air are unavailable for service, the system shall turn into an ordinary automatic dry pipe or wet pipe system. All alarms except the low air pressure alarm shall operate constantly unless shut off and cycling features are negated.

(e) Flow Control Valve

The flow control valve shall be a quick opening, differential diaphragm valve with a spring loaded floating clapper. The flow control valve shall facilitate manual or automatic on/off control. It shall also be used to control water pressure or water flow rates. The flow control valve can be used as pressure reducing valve to limit or conserve water flow.

(f) Sprinkler Head

Where there is a danger of freezing, sprinkler head shall be installed in the upright direction. Otherwise, it can be installed in the upright or pendant position.

The number of sprinkler head shall not exceed 1000 per installation.

(g) Air Supply

Each recycling installation shall be supplied and installed with an independent air supply system.

The air supply system for each of the recycling installation shall consist of an compressor, pneumatic actuators, air maintenance devices, pressure monitoring valves, controls, wiring, copper pipework and fittings, and all other necessary accessories for the operation of the system. The compressor shall be operated by means of air pressure switches installed on the main pipe. On detecting air leakage reduced to a predetermined value, the compressor shall automatically cut-in, and shall cut-out after the air pressure has been built-up adequately. The air leakage will actuate the alarm system as mentioned earlier.

The compressed air system shall allow the recharging of the recycling installation manually after the sprinkler system has been operated and the actuated sprinkler heads are replaced.

The compressor of the compressed air system shall be an oil-free, permanently lubricated type. It shall be of direct driven type with no belts or gears, and shall be compatible with air maintenance devices and other

system components for effective operation, with no special source of air required. The compressor shall be complete with thermal protection, air filters, safety relief valve and other protective provisions.

The air maintenance device shall be an automatic, field-adjustable air maintenance provision for the compressed air system. It shall be equipped with pressure switch, restrictor check valve, strainer, bypass valve etc. for the optimum operation of the system, and to enable the compressor to be started under load. The device shall provide a balancing means to minimize on-off cycling of the compressor and the need to rapidly relieve the system pressure to the actuation point.

B3.24 DELUGE INSTALLATION

Deluge installation shall be supplied and installed where specified. The Contractor shall supply and install deluge installation to apply water over an entire area of protection. The deluge installation shall be fitted with open sprinklers and provided with a manual release and an automatic release. The automatic release shall be operated by a fire detection system opening a deluge valve or energising multiple valve controls.

The Contractor shall check and verify the pipework sizing by hydraulic calculation and submit fully calculated results to the Architect for approval. The Contractor shall calculate and check the storage water tank requirements for the deluge system. All calculations shall be included in the submission to FSD for approval.

B3.25 DRENCHER INSTALLATION

Drencher installation shall be supplied and installed where specified. Drencher system shall be designed to provide protection for openings, to separate an area of high fire risk such as in theatre stages with safety curtain provision, for exposure protection, to protect the marine filling station and to provide protection for the refuge floors to the approval of the FSD. The drencher installation shall comply with the relevant codes and requirements in FSD Circular Letters, Code of Practice for Fire Resisting Construction, licensing requirements for places of public entertainment and requirements for dangerous goods.

Drencher system shall be designed to provide a flow rate of not less than 10 l/min/m^2 protected surface area at all points on the protected surface or as approved by the FSD. This shall be checked and verified both by hydraulic calculation and on site verification. The system shall be designed to comply with Rules of the Fire Officers' Committee (Foreign) for the Installation of External Drenchers, FSDCOP and FSD Requirements and Circular Letters.

Drencher system shall be actuated by an automatic detection system or sprinklers installed in the same area. A manual release with operating instructions shall be supplied and installed near the deluge valve. Unless otherwise specified, sprinklers installed in the same area or pilot sprinklers, where provided, shall be used to actuate the drencher system. Where sprinklers are used to actuate the drencher system, the Contractor shall supply and install a local sprinkler flow switch with test facilities to the sprinklers installed in the same area or pilot sprinkler system for actuating the drencher system. The location of the local sprinkler flow switch shall be selected such

that actuation of the sprinklers in other area shall not cause the drencher system to operate. The sprinklers for drencher actuation shall be of fast response type. Where sprinkler system is not installed in the same area and where local sprinkler flow switch and pilot sprinkler system cannot be installed, heat detection system in coincidence connection shall be used to actuate the drencher system unless otherwise specified. Smoke detection system shall be used where specified. Where the drencher system is used to separate an area of high fire risk for life safety protection or to protect a compartment forming part of an escape route as indicated or where specified, the drencher system shall be actuated by smoke detection system in coincidence connection. Drencher system for refuge floor shall be actuated by heat detection system with coincidence connection where sprinkler system is not provided on the refuge floor.

For the detectors arranged with coincidence connection (cross-zone operation), the detectors shall be arranged each on either side of the drencher heads. The activation of one detector shall energise an alarm with audio and visual indication on the control panel. The activation of any two detectors arranged in coincidence connection shall operate the drencher installation. Where required by the FSD and approved by the Architect, activation of the detectors provided solely for the drencher system shall not energise the general fire alarm and shall not send the fire signal via the fire alarm direct link and alarm transmitter.

The drencher heads shall be designed to provide an even sideward and downward throw of water to protect a vertical surface. The Contractor shall calculate the number of drencher heads, select the types of drencher heads, their separation and their arrangement to provide an even flow of water over the entire vertical surface of the openings protected by the drencher system. The Contractor shall consider the effect of wind and air movement in surrounding environment of the protected area in the design and selection of equipment for drencher system.

The Contractor shall check and verify the sizing of pipework by hydraulic calculation and submit fully calculated results to the Architect for approval. The Contractor shall calculate and check the size of the water storage tank which shall be adequate for not less than thirty (30) minutes of operation of all the drencher installations that are required to be operated simultaneously. All calculations shall be included in the submission to FSD for approval.

For safety curtain provision in stage and auditorium, the drencher shall be designed to provide a protection of not less than one (1) hour FRP with the use of safety curtain. The water storage shall be enough for not less than one (1) hour operation.

Where specified, foam drencher system shall be supplied and installed with quick response sprinkler heads for areas with special hazard.

B3.26 OTHER AUTOMATIC FIXED INSTALLATIONS USING WATER

The Contractor shall design, supply and install other automatic fixed installations using water where specified. This includes water mist system, water spray system, foam water system, etc. Details shall be submitted to the Architect for approval.

SECTION B4
TANKS AND PUMPS

B4.1 WATER SUPPLIES

Water supplies for fire service installations and equipment shall be of types approved by the Water Supplies Department and the FSD.

B4.2 WATER TANKS

Water tanks forming part of the building construction will be provided by the Building Contractor unless otherwise specified.

Water tanks shall be constructed in compliance with the FSDCOP, LPC Rules for Sprinkler Installations, FSD Requirements and Circular Letters, and the requirements of Water Supplies Department, the HKSAR.

Puddle flanges for inlet and outlet pipes shall be supplied by the Contractor and installed by the Building Contractor unless otherwise specified. All other piping connections and valves shall be supplied and installed by the Contractor except overflow, drains and inlet piping which will be supplied and installed by Building Contractor unless otherwise specified.

The Contractor shall check the construction drawings for water tanks for fire service installation and verify their correctness for installation purposes, or submit proposals for modification to the design, as necessary, and shall assist in the supervision of their construction, in order to ensure their suitability and proper functioning.

B4.3 WATER PUMPS

Water pumps for sprinkler systems shall comply with the LPC Rules for Sprinkler Installations. Water pumps for hydrant/hosereel systems shall comply with the FSDCOP, FSD Requirements and Circular Letters, and BS 5306 Part 1 wherever applicable. Pumps shall be manufactured by a manufacturer possessing certified ISO 9001/9002.

Sprinkler pumps shall be LPCB certified pumps or approved by any similar widely recognised independent regulatory body acceptable by the Architect and FSD. Test certificate shall be submitted at the time of delivery. Section B4.13 is also relevant.

There shall be at least one standby pump in addition to the duty pumps for each pump set. In addition, there shall be at least one jockey pump in each sprinkler pump set.

B4.4 PUMP OPERATION

Pumps with stable characteristics for fire service installation shall be selected to suit the design requirements for capacity (flow rate) as specified and shall discharge at a pressure which shall produce running pressures within the statutory requirements at the

location concerned. In addition, the required net positive suction head of the selected pumps shall be compatible with the available net positive suction head in the installations. The design figures given on the Particular Specification and/or drawings are for guidance only. No adjustment in cost will be entertained if the actual required duty points (pressure and flow rate) are different from the specified figures. Close valve total pressure head shall not exceed 140% of the rated head.

The Contractor shall be responsible for carrying out a final accurate calculation of operating heads based upon the characteristics of the pipework systems including fittings, equipment and accessories as actually installed by him. Certified performance curves for the pumps shall be provided with the operating range clearly indicated.

Pump drive motor output power shall be rated to give 20% for hydrant system and 10% for sprinkler system more power in addition to the hydraulic power required for the rated flow of the system. Pump speed shall not exceed 50 rps.

Pumps shall be capable of running under conditions of zero or low "draw-off" continuously without overheating. This may be achieved either by pump design or by an automatic by-pass circuit arrangement. Details of this shall be shown on the Contractor's Installation Drawings. Overheat alarm devices may be supplied and installed if necessary but these shall not be arranged to shut down the pump automatically.

Pumps shall have acceptable low noise level and good energy efficiency to the approval of the Architect especially for the jockey pumps.

B4.5 PUMP CONSTRUCTION

Pumps shall be of centrifugal, horizontal end suction type unless otherwise specified having casings of close-grained grey cast iron to BS 1452 Grade 180. Horizontal split casing pump or multi-stage centrifugal pump shall be supplied and installed in lieu of the end suction type if necessary or as specified.

Flanges shall be to BS 4504 PN16. Impellers shall be of stainless steel to BS 970 Part 1 Grade 316S31. Shaft shall be of stainless steel to BS 970 Part 1 Grade 316S31 statically and dynamically balanced after assembly. Impeller rings shall be of cast iron and renewable secured from relative movement by stainless steel end rotation ring.

Salt water pumps if specified shall be generally of the similar type and construction to the fresh water pump, and the impellers and shafts shall be of stainless steel to BS 970 Part 1 Grade 316S31.

Pump seals shall be of the stuffing box gland type of appropriate depth to prevent leakage. Low pressure stuffing boxes shall be water sealed to prevent air leakage. Glands shall be of cast iron or bronze.

Bearings shall be of ball or roller type having an adequate safety factor to ensure long life. Housings shall be easily removable for servicing.

Grease nipples shall be provided on the pump casing adjacent to each bearing for lubrication of the bearings.

B4.6 PUMP SET INSTALLATION

The pump and motor shall be directly coupled and mounted on a substantial machined base plate of cast iron or of fabricated mild steel. Couplings shall be flexible of steel pin and synthetic rubber bushing type, accurately aligned, and fitted with guards.

Pumps shall be complete with all necessary water seal connections, vents, drains and priming plugs, and all installation materials including foundation bolts and anti-vibration mountings. Drain pipework shall be of copper and shall run to a nearby drain gully or as specified. Automatic priming equipment shall be included where necessary to ensure that the pumps are primed at all times.

The exposed shafts, couplings and moving parts of pumps shall be provided with suitable galvanised iron mesh guards coated with primers and finishing paint and shall be stoutly constructed and easily removable complete with lifting handles.

Each pump shall be provided with pressure gauges installed to indicate the suction and discharge pressure. The gauges shall be neatly mounted on a rigid wooden or metal board adjacent to the pump or rigidly fixed in-line with suction and discharge pipework. Suitable permanent labels in English and Chinese shall be affixed for each gauge to indicate its function. The gauges shall be suitable for the system pressure ratings concerned and shall comply with Section B1.15.

Duty/standby selector, manual start/stop buttons, voltmeters, ammeters, high/low level alarm, and associated indications shall be supplied and installed at the starter panel inside the pump room. Except the manual stop buttons, similar provisions shall also be supplied and installed at the main and/or repeating fire alarm control and indicating panels as specified in the Particular Specification. A lock-off type emergency stop shall be supplied and installed adjacent to each pump set. Visual and audible indication shall be provided on the pump control panel indicating the pump is stopped and locked by the emergency stop and shall remain on until the emergency stop is reset. Except for the proprietary package pump set and proprietary starter panel approved by FSD and with ISO 9001/9002 quality system, the starter panel shall be made from minimum 1.6 mm thick stainless steel to BS 970 Part 1 Grade 316S31.

The pumps shall be actuated at the pump room and the fire alarm control and indicating panel.

B4.7 MAINTENANCE FACILITIES

Pump installation shall be complete with adequate facilities for maintenance and future replacement of base plate. Lifting eyes shall normally be provided upon pumps, motors, and engines. Details of any requirements for overhead run-ways, hoists, etc., required for installation and maintenance shall be submitted to the Architect for approval. Where there is a Building Contractor carrying out the building work for a particular project, the overhead run-ways, hoists and hoisting beam will be carried out in the building work by the Building Contractor provided that the Contractor shall submit in good time to the Architect for approval, full details of such requirements, so that due consideration may be given before the Building Contractor commences work in the areas concerned. Where there is no Building Contractor, all facilities for maintenance shall be supplied and installed by the Contractor.

B4.8 MOTORS FOR PUMP DRIVES

Electric motor for pump drives shall be of the drip proof or totally enclosed fan-cooled (TEFC) squirrel cage induction motor to BS 4999 and BS 5000 Part 10 with Class F insulation. Drip proof motors shall be fitted internally with an anti-condensation heater of single phase pattern arranged so that the heater will be switched off automatically when the motor is started and switched on automatically after stopping. Totally enclosed fan-cooled motors shall be dust and moisture protected to IP 54. In damp situations or in underground pump houses, motor terminal boxes shall be of weather-proof type. The power factor of the motor shall not be less than 0.85 lagging under all normal operating conditions. Noise level of all motors shall be in accordance with or better than the recommendation of BS EN 60034-9 and shall comply with Environmental Protection Department's requirements. Motor and pump shall be properly balanced and aligned to avoid excessive vibration.

B4.9 MOTOR STARTING

The method of motor starting shall be selected according to the characteristics of the pump and shall comply with the Electricity Supply Co.'s limitations on starting current. The type of starter shall be as follows, unless otherwise specified:-

Condition 1 : For supply arrangement from company's overhead line

Up to 3.8 kW	Direct-on-line
3.8 kW to 22 kW	Star/delta
Above 22 kW	Automatic-transformer 60% tapping or star/delta

Condition 2 : For supply arrangement from company's non-overhead line system

Up to 11 kW	Direct-on-line
11 kW to 25 kW	Star/delta
Above 25 kW	Automatic-transformer 65% tapping or star/delta

B4.10 STARTERS

Starters shall be air break triple pole electromagnetic contactor type and shall comply with and be tested to BS EN 60947-4-1. Any no-volt release mechanism must be of the automatic resetting type such that on the restoration of the supply the motor can re-start automatically. Magnetic and thermal overload trips are not allowed. A phase failure protective device shall be incorporated. Utilization category shall be AC-3 of intermittent duty Class 0.1, 60% on-load factor. Each starter shall comprise on/off controls and indications.

Starters shall be supplied and installed complete with enclosures except where required to be mounted upon composite control panels and shall be in accordance with BS EN 60947-4-1. Enclosure shall provide protection of person against contact with live or moving parts inside the enclosure, protection against ingress of dust and liquid and protection against mechanical damage in accordance with BS EN 60947-1, BS EN 60947-4-1.

Star/delta and auto-transformer starters shall have approved timers for automatic transition, calibrated and adjustable.

All components shall be of non-hygroscopic, non-corroding material and tropicalised. Operating coils shall be wound on nylon or similar and vacuum impregnated with non-organic varnish or plastic encapsulated.

B4.11 PUMP SET ISOLATION MOUNTINGS

Unless otherwise approved by the Architect, motor driven pump set shall be mounted upon a common base plate supported by approved spring-type isolation mountings on concrete plinth. Where package fire pump set is specified, the fire pump, motor, couplings, controls, etc. shall be pre-assembled on the common base plate with spring type isolation mountings by manufacturer in a factory possessing ISO 9001/9002 quality system.

B4.12 JOCKEY PUMPS

Jockey pumps complete with TEFC driven motor for maintaining hydraulic pressure shall be of the multi-stage horizontal or vertical centrifugal type having construction generally in compliance with Sections B4.5 and B4.8 with stainless steel shaft and impellers. Alternatively, reciprocating pumps capable of performing the same duty may be acceptable. Reciprocating pumps shall be with stainless steel piston rod and piston, synthetic rubber seals and oil bath lubrication, mounted on a common base plate with the electric motor drive.

B4.13 FACTORY TEST AND CERTIFICATION

All sprinkler pumps before delivery shall be factory tested and certified on the performance. A factory test certificate and record shall be submitted. Where the manufacturer does not have an approved test facilities required by LPCB for the test in the factory, the Contractor shall, before delivery, arrange the test to be carried out by an independent testing organisation approved by LPCB or approved by any similar widely recognised independent regulatory body acceptable to the Architect and FSD. Site test shall not be accepted as a substitute for the factory test.

Package fire pump set shall be factory tested and certified similar to the sprinkler pump. Where specified, factory test and certification shall be required for other pumps similar to the sprinkler pump.

SECTION B5
GASEOUS EXTINGUISHING SYSTEM

B5.1 GENERAL

The Contractor shall be responsible for the design of the gaseous extinguishing system. Unless otherwise specified, gaseous extinguishing systems shall be of the total flooding type with pressurized open-ended piping installation on the distribution side. The automatic gas release mechanism shall be operated by means of fire detection units at the protected compartment or manually by a pull handle or push button as described below. Design the gaseous extinguishing system to comply with the standards published by National Fire Protection Association or internationally recognised equivalent standards acceptable to the FSD and demonstrated to be equivalent in terms of the type of construction, functions, performance, general appearance and standard of quality of manufacture and approved by the Architect. All proprietary design details from the manufacturer shall be submitted to the Architect and FSD for approval.

Carbon dioxide system shall be designed and installed in accordance with either BS 5306 Part 4 or NFPA 12 and shall only be used in normally unoccupied areas where egress of personnel can be accomplished in thirty (30) seconds.

Other gaseous systems shall be of clean agent type and designed and installed in accordance with NFPA 2001 or any recognised system design manual prepared by the manufacturer.

Unless otherwise specified or approved by the Architect, the clean agent used shall be FM200. For application in areas with high ceiling height or with low temperature or with limitation in storage spaces for the clean agent that makes the use of FM200 unsuitable, other clean agents such as FE13, FIC, etc. to the approval of the Architect will be considered. Other clean agents may require additional submission, tests and other information required by the FSD. The Contractor shall deem to allow the cost for all such submissions, requirements and tests to the satisfaction and approval of the FSD and the Architect when other clean agents are used.

The entire gaseous extinguishing system shall be a proprietary product certified by LPCB, UL or FM and has been approved by the FSD for use in Hong Kong. All components of the installation shall be compatible with the design of the system. Any add-on device shall be approved by the system manufacturer and shall not affect the proper functioning of the system.

The system shall be designed in according to an engineered computer programme approved by a recognized approving organisation as listed in the FSD Circular Letters or accepted by FSD, or alternatively, the system shall be of modular or pre-engineering type and installed in accordance with manufacturer's specifications.

B5.2 QUALITY OF EXTINGUISHING AGENTS

Carbon dioxide used shall be of good commercial grade, free of water and other contaminants that might cause container corrosion or interfere with free discharge

through nozzle orifices. In general, carbon dioxide obtained by converting dry ice to liquid will not be acceptable. The vapour phase shall not be less than 99.5% purity with no detectable off-taste or odour. The water content of the liquid phase shall not be more than 0.01% by weight. Oil content shall not be more than 10 ppm by weight.

Other clean agent gases shall comply with NFPA 2001, in particular, the acute toxicity, the ozone depletion potential and global warming potential.

B5.3 PERFORMANCE OF STANDARD TOTAL FLOODING INSTALLATION

Carbon dioxide total flooding systems shall be designed to achieve the necessary concentration, rate of application and duration to maintain the extinguishing concentration all as specified in BS 5306 Part 4 or NFPA 12 in accordance with the volume, hazard and environmental conditions of the protected enclosures. Unless otherwise specified, the rate of application in general shall comply with following requirements: -

(a) For surface fires, the design concentration shall be achieved within one (1) minute.

(b) For deep-seated fires, the design concentration shall be achieved within 7 minutes but the rate shall not be less than that required to develop a concentration of 30% in two (2) minutes.

Other clean agent gas flooding systems shall be designed to achieve an acceptable concentration stipulated in NPFA 2001 or any recognised system design manual from the manufacturer at room temperature acceptable to the FSD. Discharge of gas shall be substantially completed within ten (10) seconds and following discharge the concentration of clean agent shall develop throughout the protected compartment to achieve final extinguishments of fire within sixty (60) seconds.

B5.4 CONTRACTOR' S RESPONSIBILITY FOR SYSTEM PERFORMANCE

The compartment to be protected and the location of the gas cylinders shall be as indicated on the Contract Drawings. The layout of pipework and nozzles shown on the Contract Drawing is indicative. The Contractor is responsible for the design of the complete system in co-ordination with other services.

Notwithstanding that the Contractor has demonstrated by calculation to the satisfaction of the Architect that the system will perform to the standard required, the Contractor shall remain responsible for ensuring that under test the system does in fact perform in accordance with the Specification.

B5.5 DESIGN CALCULATION

To justify the selection of components and pipe sizes for the system, the Contractor shall provide with the tender submission the system manufacturer' s design manual and calculation for pre-engineered system; or either full mathematical calculation or computer model flow calculations for engineered system. Where the computer programme does not show all calculation steps it will be necessary for the Contractor

to produce evidence that the computer programme produces a design that will perform in accordance with the Specification as indicated by UL or approved by any similar widely recognised independent regulatory body acceptable by the Architect.

The calculation shall be based on the equipment offered. Valves, siphon tubes, distribution valves as well as bends and junctions shall be represented in the calculations as equivalent lengths of pipe. The actual size and location of pipes and nozzles and the number of nozzles shall be designed on the basis of the calculated flow rates and terminal pressures required to ensure successful operation. The calculation or computer programme shall provide all the information necessary to complete the installation including the total quantity of gas required to flood to the required concentration with allowance for losses, the flow rate, start and end pressure of each section of pipe and the orifice size for each nozzle.

The calculation shall show that the design concentration can be achieved and that the maximum allowable concentration shall not be exceeded at all conditions.

B5.6 CONTRACTOR TO PROVIDE A COMPLETE WORKING SYSTEM

The Contractor shall supply and install all components necessary for full operation of the system in the automatic or manual mode regardless of whether such components are specified or not.

B5.7 GAS STORAGE PRESSURE

All the gas extinguishing agents shall be stored in rechargeable cylinders to hold the pressurised agents in liquid form at ambient temperature. The Contractor shall select cylinders of commonly available sizes and types that can be recharged. The Contractor shall allow for at least 10% spare capacity in sizing of each cylinder.

For high pressure system, carbon dioxide shall be pressurised to a corresponding nominal pressure of 5860 kPa at 21°C. The normal filling density shall not be in excess of 68%. For low pressure system, carbon dioxide shall be kept at the design pressure of 2068 kPa by refrigeration system. The refrigerants in the refrigeration system shall have zero ozone depletion potential. Appropriate alarm and pressure relief shall be supplied and installed to cater for possible failure of the refrigeration system. Unless otherwise specified, carbon dioxide system shall be of high pressure system.

Clean agent cylinders shall be charged in accordance with NFPA 2001 or any recognised system design manual from the manufacturer.

Gas cylinders, distribution pipework, valves, nozzles and fittings shall be manufactured to standards designed to withstand the maximum pressure of stored agent allowing for variations in ambient temperature.

The gas cylinders shall be certified for the intended gas storage pressure and use and approved by FSD. A copy of approval certificate or letter for the gas cylinders by the FSD shall be submitted.

B5.8 GAS CYLINDERS

Carbon dioxide cylinders shall be of seamless steel construction to BS 5045 Part 1. For low pressure refrigerated system, it shall be in accordance with the manufacturer's design and certified by recognised bodies such as LPCB, UL, FM or approved by any similar widely recognised independent regulatory body acceptable by the Architect and FSD.

Clean agent cylinders shall be constructed in accordance with NFPA 2001.

Cylinders shall be securely mounted in a frame bolted to the wall and to be so arranged that the external parts may be readily inspected and corrosion cannot occur. Each cylinder shall be fitted with an automatic pressure release device for over pressure protection of the cylinder.

Each cylinder shall be complete with gas valve, actuator, pressure gauge, flexible hose, check valve and all other necessary accessories. Where the cylinder of a proprietary system approved by FSD is not fitted with a pressure gauge, the Contractor shall supply and install pressure gauge in the system pipework for each cylinder.

A device shall be supplied and installed for measuring the amount of liquid in the cylinder at any time. This shall be done by a method which does not require the cylinder to be detached from the manifold. If a weighing device of the type that requires suspension is proposed, means shall be supplied and installed above each cylinder for the attachment of the weighing device. The contents of the cylinders may alternatively be checked by the use of a liquid level indicator of a type approved by the Architect.

The liquid shall be discharged from the cylinder through a siphon tube. The pressure of the liquid stored in the cylinder shall be such that freezing cannot take place at the lowest possible ambient temperature.

Means shall be supplied and installed to prevent gas discharging into empty containers and to prevent loss if the gas is released when any of the cylinders is disconnected.

Gas cylinders shall be painted signal red as specified in BS 381C in accordance with the requirements of BS 5252. The cylinder shall be free from all rust and corrosion before painting is applied. The type of extinguishing agent, the tare weight, gross weight, liquid level at 21°C and also the degree of super pressurisation (for clean agent) where applicable shall be clearly painted on each cylinder with white paint.

Gas cylinders shall be of rechargeable and re-usable types. If the discharge of gas will require the irreversible rupture of any component of the system such that they are not reusable, the Contractor shall provide one spare set of such components for each installed cylinder. They shall be stored in a labelled and locked cabinet inside the gas cylinder room. Three keys shall be provided.

A copy of approval certificate or letter from the FSD for the gas cylinders shall be submitted.

Only gaseous extinguishing systems that can be recharged locally and the refilling of gas after discharge can be accomplished within a short time shall be approved and used. The Contractor shall submit details of the refilling arrangement including agency, address of local workshop, refilling time, etc. together with the equipment submission

to the Architect for approval. Equipment submission without details on the refilling arrangement shall not be approved.

The Contractor shall supply and install facilities to isolate or to lock the gas cylinders during routine maintenance or inspection work on the gas cylinders and control system in order to prevent accidental discharge of gas. The facilities shall give appropriate warning indication when it is switched to the 'isolated' mode.

B5.9 FIRE DETECTION AND SYSTEM CONTROL - AUTOMATIC RELEASE

Fire detection in the protected area shall be by means of smoke or heat detectors as specified. Sufficient detectors shall be supplied and installed to give duplicate coverage of the whole of the protected area and connected in cross-zones. The fire detection control panel and the detectors shall be compatible with each other and the fire detection system shall comply with Section B6.

Activation of a detector on one zone shall cause alarm bells to sound. Activation of detectors on two zones shall cause a siren or an approved horn to sound and red or amber flashlights in the protected area to light warning that the extinguishing agent is about to be discharged if the system is in the automatic mode. These warning signals will also be activated by the operation of the manual release before the discharge.

The gas extinguishing control panel shall control and monitor the gas release system. It shall include an automatic/manual lock-off unit controlled by key switches at each entrance to the protected area. Any one key switch shall be capable of switching the system on or off. The manual release mechanism will remain operative whether the system is on or off. A time delay unit which is adjustable in the range of 15 to 30 seconds shall be supplied and installed. Relays shall be supplied and installed to shut down ventilation and air-conditioning, to close openings and to switch off equipment as necessary. These relays will operate immediately when two zones of the fire detection system are activated or when the manual release is operated. Release of the gas will follow after the pre-set time delay.

The gas extinguishing control panel shall comply with Section B8 where relevant and with battery backup. The battery supply shall be able to actuate the system at the end of the standby period.

B5.10 MANUAL RELEASE

A manual release unit shall be supplied and installed in a suitable position outside each entrance to the protected compartment. The manual release unit shall consist of a pull handle or push button mounted in a box with "break glass" cover. The box shall be so designed that its glass front may be readily replaced and that its front cover can be opened with a key for the purpose of operating the switch without breaking the glass.

B5.11 EMERGENCY RELEASE

An emergency release handle with direct mechanism shall be supplied and installed in an accessible position at or near the gas cylinders. The emergency release shall require no power supply to operate and it shall be supplied and installed with a removable pin to prevent accidental release of gas. Provision shall be made for operation of the

emergency release to activate the relays to cause simultaneous shutdown of ventilation, air-conditioning, equipment etc. and to sound the alarm.

B5.12 GAS RELEASE MECHANISM

The operation of the gas release mechanism shall require minimum power from an external electrical, pneumatic or mechanical source and shall preferably be operated by a falling weight device. No springs shall be used in any position where their failure, or fracture would prevent the correct operation of the gas release mechanism or cause the inadvertent release of the gas.

All release devices and mechanisms shall be designed for the working conditions they will encounter and shall not readily be rendered inoperative or susceptible to accidental operation. They shall have proper protection from mechanical, chemical or other damage that would render them inoperative.

B5.13 GAS DISTRIBUTION SYSTEM

All pipework shall be non-combustible and able to withstand the expected pressures and temperatures without damage. Specification of materials and installation shall conform to the relevant international standards for the respective gas extinguishing agent used.

Pipes for high pressure open-ended carbon dioxide system shall be as follows: -

Up to and including 40 mm :	Heavy galvanised steel pipe to BS 1387 / ISO 65 butt welded or products having equivalent functions or performance
50 mm to and including 150 mm :	Electric resistance and induction welded carbon steel pipe to BS 3601 Schedule 80 with grade of steel 410 or ASTM A106-77 Grade A hot finished or cold Schedule 80

Pipes for clean agent system shall be as follows: -

Pipes to be used shall conform to the following relevant standards or NFPA 2001 or products having equivalent functions and performance or that recommended by the manufacturer for an approved proprietary system for a particular gas extinguishing system in accordance with the pipe size and pressure of the system. Special attention shall be paid, in particular, to the maximum allowable pressure for pipes and the minimum piping requirements.

ISO 65 (BS 1387), heavy grade	Screwed and socketed steel tubes and tubular and for plain end steel tubes suitable for welding or for screwing to ISO 7/1 (BS 21) pipe threads
BS 3601, schedule 80 with grade of steel 410 Or,	Carbon steel pipes and tubes with specified room temperature properties for pressure purposes

ASTM A106, grade A hot finished or cold schedule 80	
ASME B31.1	Power piping code
ASTM A120, heavy grade	Specifications for welded and seamless pipe
ASME/ANSI B31	Code for pressure piping

Pipe fittings to be used shall conform to the following relevant standards or NFPA 2001 or products having equivalent functions and performance or that recommended by the manufacturer for an approved proprietary system for a particular gas extinguishing system in accordance with the pipe size and pressure of the system. Special attention shall be paid, in particular, to the maximum allowable pressure for pipes and the minimum piping requirements.

BS 3799	Steel pipe fittings screwed and socket-welding for the petroleum industry
BS 1640 Part 3	Steel butt-welding pipe fittings for the petroleum industry : wrought carbon and ferritic alloy steel fittings
BS 1740 Part 1	Wrought steel pipe fittings (screwed BSP thread)
BS 143	Malleable cast iron and cast copper alloy threaded pipe fittings
BS 1560	Circular flanges for pipes, valves and fittings
ASME B31.1	Power piping code
ANSI B1.20.1	Standard for pipe threads, general purpose
ASTM A120	Specifications for welded and seamless pipe

Other standards adopted for proprietary systems that have been approved by the FSD can also be used when approved by the Architect

Pipes up to 100 mm shall be screwed and socketed, pipework over 100 mm shall use screwed flanges.

Threaded steel pipework and fittings shall be free of burrs and rust and shall be galvanised inside and outside. Screwed threads shall conform to the dimensions specified in BS 21. Screwed joints shall be made with P.T.F.E. tape or products having equivalent functions and performance but chemically inert to the extinguishing agent used. Compressed fibre gaskets free of asbestos shall be used for flange joints. Pipe work shall be painted signal red as specified and illustrated in BS 381C in accordance with the requirements of BS 5252. Brass fittings shall be left unpainted.

Pipework supports shall be arranged as near as possible to joints and changes of direction and each support shall take its share of the load. The maximum space between supports to take into the total mass of pipe and extinguishing agent shall be as follows: -

Table 2 : Minimum spacing of pipework supports for gaseous extinguishing system

Pipe size (mm)	15	20	25	32	40	50	80	100	150	200
Span (m)	1.5	1.8	2.1	2.4	2.7	3.0	3.6	4.2	5.2	5.8

Additional supports shall be supplied and installed where there are extra loads such as valves, where required by FSD and where recommended by the manufacturer.

Discharge nozzles shall be of robust construction and designed for use with the expected working pressure and temperature without deformation. The discharge orifices shall be made of corrosion resistant metal and have a permanent marking for identification and to show the equivalent single orifice diameter.

Flexible hose connections shall be selected, inspected and tested only by an engineer or technician suitably trained and shall be designed for service at the pressures and temperatures involved.

To prevent entrapment in pipework, a suitable excess pressure relief valve shall be supplied and installed at any section of high pressure piping blocked by valves at both ends and shall operate at the following pressures: -

Carbon dioxide high pressure system:	15 MPa ± 5%
Clean agent extinguishing system:	1.5 times the maximum system pressure

Valves shall be capable of being opened when subjected to the maximum operating pressure and shall be so equipped that they can be opened manually. Valves for carbon dioxide system constantly under pressure shall be designed for a working pressure of 19 MPa. Valves for other clean agents shall be designed for maximum working pressure plus a 50% safety factor.

Manifolds shall be tested for a duration of minimum five (5) minutes at the manufacturer' s works to the following minimum pressure: -

Carbon dioxide high pressure system:	19 MPa
Clean agent extinguishing system:	2 times the maximum system pressure

Pipework shall be earthed to prevent building up of to electrostatic charge.

Gas nozzles shall be of approved type and appropriately spaced in accordance with the manufacturer's design manuals. Gas nozzles shall be supplied and installed in all

voids and spaces to be protected by gas flooding. The Contractor shall submit calculation or manufacturer's manual to substantiate the nozzle spacing.

B5.14 GAS DISCHARGE SYSTEM TO BE SECURELY FIXED AND GUARDED

The gas discharge system including cylinders, pipework and nozzles shall be securely fixed to the structure with correctly spaced saddles or brackets in according with FSD Requirements and Circular Letters. All components shall remain in place when subjected to the pressures and forces produced during discharge. Fixings shall allow for movement due to thermal expansion.

The system shall be guarded so that the operation of any moving parts shall not be obstructed.

B5.15 INDICATOR LIGHTS, WARNING NOTICES AND LABELS

All gas storage compartments and compartments protected by a gas extinguishing system shall have a warning notice fixed on each entrance door to the compartment. Configuration, lettering, colour and size of the notice shall be in accordance with the FSD Requirements and Circular Letters for the respective gas extinguishing system. The notice shall be made of sheet metal plate not less than 1.6 mm thick or of material approved by the Architect.

For a total flooding system, protecting a normally occupied area, which is designed to operate automatically when unoccupied but to be in the manual mode when occupied, the following warning lights shall be installed together with explanatory/warning notices in English and Chinese. Such notices shall be clearly legible and painted or engraved on sheet metal plate or on substantial durable material approved by the Architect. Warning lights and notices for systems other than as described above, e.g. local application systems or systems designed to be in the automatic mode when the area is occupied, shall be equally informative and suitably substantial and shall be arranged and worded either as specified or as agreed with the Architect.

Inside the protected area, a flashing red light to indicate gas release imminent with a notice which shall read: -

"WARNING - *** gas release imminent. Leave the room at once."

Outside each entrance to the protected area: -

(a) a green light to show that the system is on manual control with automatic control locked off, with a notice which shall read: -

"Safe to enter. *** fire extinguishing system on manual control. When room vacated switch to automatic control".

(b) an amber light to show that the system is on automatic control, with a notice which shall read: -

"Not safe to enter. *** fire extinguishing system on automatic control. Switch to manual control before entering".

(c) a red light to show that the system has operated, with a notice which shall read: -

"DANGER - Do not enter. *** gas discharged".

*** denotes the extinguishing agent.

The manual/automatic lock off key switches, the manual release units and the emergency release handle shall all be labelled in English and Chinese so that it is clear what their purpose is and how to operate them.

B5.16 SYSTEM ODORISER

Odorisers where specified shall be capable of automatically treating the gas after releasing from the cylinder and shall be of citrus odour type, so that hazardous atmosphere can be recognised at once. Where odorisers are installed, a suitable notice to the effect that anyone detecting the citrus odour should leave the area immediately and report the occurrence to a responsible person. The notice shall be worded in English and Chinese.

B5.17 ROOM CONDITION

The Contractor shall check and co-ordinate with relevant parties on the exhaust requirements for the room after the discharge of gas extinguishing agent and shall submit requirements on additional facilities if the exhaust provisions are not adequate to meet with the relevant safety standards or that recommended by the manufacturer. Where specified, the Contractor shall supply and install exhaust facilities and fans recommended by the manufacturer for removing the gas after discharge. Unless otherwise specified, the Contractor shall supply and install approved dampers, curtains or products having equivalent functions and performance to shut off all room openings/door louvers/air ducts as shown on the Drawings during the discharge of gas.

The Contractor shall check and provide calculation for the rooms designed with gaseous extinguishing system on whether the design concentration can be maintained for the period required in the NFPA Standard. Where necessary, the Contractor shall conduct test such as door fan pressurization and depressurisation test to establish the data on room leakage rate. The Contractor shall allow carrying out on-site full discharge test after completion of the installation when required by FSD and in accordance with FSD's requirements to confirm the design conditions can be met. The Contractor shall refill the gas cylinders after the discharge test.

B5.18 OTHER AUTOMATIC FIXED INSTALLATIONS OTHER THAN WATER

The Contractor shall design, supply and install other automatic fixed installations other than water where specified. Details shall be submitted to the Architect for approval.

SECTION B6
MANUAL AND AUTOMATIC FIRE ALARM SYSTEM

B6.1 MANUAL CALL POINTS

Manual call point shall be of "break-glass" type complying with BS 5839 Part 2, or a type approved by the FSD and the Architect. Electrical contacts shall operate automatically upon breaking of the frangible element at the front of the unit. The cover shall be locked in position with a special key and the frangible element shall be clipped firmly into place.

The unit shall be of pleasing appearance and styling, constructed of non-combustible and corrosion resistant materials, and finish enamelled red. The words : "Fire : Break Glass **火警鐘掣**" shall be suitably engraved or embossed in English and Chinese on the front.

Contacts shall be of silver or approved non-deteriorating alloy of the normally-open or normally-closed type to suit the alarm system as specified in the Particular Specification. A concealed "test" device shall be included. The voltage and current ratings of the contacts shall be marked in the unit.

Call points shall be of flush mounting or surface mounting type as specified in the Particular Specification and suitable for direct connection to the wiring system of the type specified therein without the addition of unsightly surface boxes, glands, adapters, etc. Where special boxes are necessary for installation of the call points in a conduit system, the boxes shall be supplied and installed by the Contractor. Boxes recessed in concrete or plaster shall be of galvanised steel.

Terminals for external conductors shall be provided in the unit for connection of at least two conductors of size not less than 1.5 mm^2 each. When the call point is intended for use at voltage in excess of extra low voltage, it shall have suitable means for providing earth continuity between external circuits connected to it. Where the call point is located at outdoor or at a location subject to water damage, the call point shall be of waterproof type. Where the call point is located in hazardous areas or dangerous good store, the call point shall comply with Section B6.6.

Generally, manual call points shall be fixed at a height of 1.15 m above finished floor unless otherwise specified. They shall be surface mounted, or semi-recessed, in order to present a side profile area of not less than 750 mm^2.

Manual call points shall be provided at all escape routes and in particular at each hose reel point, all storey exits and all exits to open air.

B6.2 HEAT DETECTORS

Automatic heat detectors shall be of point-type complying with BS 5445 Part 5 (EN 54 Part 5) for ordinary usage and Part 8 for high temperature unless otherwise specified. The detector shall be LPCB approved or approved by similar widely recognised independent regulatory body and of manufacture and type approved by the FSD.

Detector shall be of Grade 1 sensitivity with combined fixed temperature and rate-of-temperature-rise as BS 5445 Part 5 (EN 54 Part 5) except as specified or where necessary to suit the actual environment of the space being protected. Grade 2 sensitivity detector (fixed temperature) shall only be provided for pantry, domestic kitchen and specified space where rapid increases in temperature can be experienced. Grade 3 sensitivity detector shall only be provided for boiler room, commercial kitchen and specified space where under normal conditions, high ambient temperatures and rapid changes in ambient temperature may be experienced. For high temperature environment, Grade 1 or 2 sensitivity detectors can be provided and where specified shall function correctly at ambient temperature between -20°C to +90°C. Detector shall be designed to assume protection rating of IP 43 or higher rating. They shall also be suitable for stable operation in the Hong Kong climate especially where high humidity conditions may exist without constant air-conditioning. The Contractor shall provide manufacturer's printed catalogue or certification proving that the detector is suitable for operation under relative humidity between 20% to 99% continuous non-condensing in the Hong Kong climate.

Detector unit shall be of flush or surface mounting type as specified in the Particular Specification. Detector unit in suspended ceilings shall be flush mounted and shall, in the case of modular constructed ceilings, be co-ordinated into the ceiling layout.

Installation of detector shall be in accordance with the FOC Rules for AFA Installations. Detector shall be mounted not less than 500 mm away from any walls or partitions and not less than 25 mm or more than 150 mm below the ceiling or roof. In open areas under flat horizontal ceilings, the horizontal distance between any point in the area and the nearest point-type heat detector shall not exceed 5.3 m.

Where the type of automatic detector is not specified, heat detectors shall be used for the automatic detectors in area vulnerable to unwanted alarm such as electrical/switch room, utility/plant room, kitchen, non-conditioned spaces/areas/voids, basement, car parks, semi-open/open areas, cold stores, inside concealed/false ceiling/raised floor without air-conditioning, lift shaft, riser ducts etc. unless otherwise specified and/or where required to satisfy FSD Requirements and Circular Letters.

B6.3 IONISATION SMOKE DETECTORS

The ionisation smoke detector shall comply with BS 5445 Part 7 (EN 54 Part 7), LPCB approved or approved by similar widely recognised independent regulatory body, and of manufacture and type specifically approved by the FSD. They shall function correctly at continuous ambient temperature between 0°C and 48°C, relative humidity between 20% to 95% continuous non-condensing. Where the smoke detector is installed in low temperature zone with temperature less than 10°C continuous or in high temperature zone with temperature higher than 40°C continuous, they shall function correctly at continuous ambient temperature between -20°C to 60°C. The Contractor shall provide factory certificate or printed catalogue on the applicable temperature and humidity range of the detector for approval. The smoke detectors shall be designed to assume protection rating of IP 43 or higher unless otherwise specified. They shall also be suitable for stable operation in the Hong Kong climate especially where high humidity conditions may exist without constant air-conditioning. In areas and locations where the relative humidity is higher than 95% continuous non-condensing, the Contractor shall use smoke detector of harsh type suitable for high humidity application and for dirty environment.

Detectors shall be of the type responding to both visible and invisible products of combustion and shall be of the radioactive isotope pattern having not less than two ionisation chambers, one for detection and one for reference, connected in electronic circuits. Radiation level from the isotopes shall be within the safety limit specified by EURATOM, i.e. less than 0.1 mr/h at a distance of 100 mm. The combined radiation activity of each detector shall not exceed 555 kBq for commercial/industrial buildings and 370 kBq for residential building.

The electronic circuitry shall be of solid-state type, operating at extra low voltage DC. The quiescent current consumption of the unit shall be minimal and shall not exceed 50 μA at 24V.

The detectors shall be of proprietary design to avoid unwanted alarm and the detector having one smoke chamber shall not be accepted. Alternatively, a multi-sensor detector with adjustable sensitivity settings for different environment to the approval of FSD and the Architect can be used.

Detectors shall be housed in a corrosion-proof plug-in unit designed to be mounted pendent, surface or semi-recessed as specified. Removal of the unit from its base shall cause a fault alarm signal to be given. Sensitivity shall be adjustable by means of a pre-set control only accessible by use of a special tool. Built-in wind-shields shall be supplied and installed to ensure that air currents of up to 10 m/s do not affect the proper operation of the detector. A built-in wire mesh shall be incorporated to prevent entry of insects into the interior. Detectors installed inside lift wells and outdoors shall be completed with wind-shields and shall be of harsh type designed for high temperature, high relative humidity and dirt accumulation. Static shielding shall be supplied and installed to protect against the operation interference of electrical noise.

The internal electronic circuitry shall be of highest possible reliability and protected against voltage spikes and surges. The detector shall be capable of operating satisfactorily under minimum variation of $\pm$25% in supply voltage. The circuitry shall also be protected against electromagnetic interference.

Installation of smoke detectors shall be in accordance with the FOC Rules for AFA Installations. A low-profile design detector that protrudes no more than 60 mm from the ceiling shall be used in all air-conditioned areas with false ceiling. Point-type smoke detectors shall be mounted not less than 500 mm away from any walls or partitions and not less than 25 mm or more than 600 mm below the roof or ceiling. In open areas under flat horizontal ceilings, the horizontal distance between any point in the area and the nearest detector shall not exceed 7.5 m.

Where signal integration feature is specified so as to avoid the unwanted alarms caused by transient interference, the smoke detector shall be characterised by a reversible response time delay from 15 to 30 seconds depending on the concentration of smoke continuously present before an alarm is initiated. Upon clearance of the transient interference within the time delay, the smoke detector shall resume its quiescent state without any alarm initiation.

The Contractor shall submit the total Americium 241 radiation level to Hong Kong Radiation Board for approval on behalf of the Employer where necessary before the certified date of completion of the Works and the commencement of the Maintenance Period. The Contractor shall also make all necessary arrangements, if required by the Hong Kong Radiation Board, for inspection of the installation by the authorised representatives of the Board. Where the total radioactivity of all detection devices and

fire service installations and equipment provided in a building exceeds 20Mbq, the Contractor shall provide the necessary documents for obtaining the licence from the Hong Kong Radiation Board and arrange the application of licence to the Hong Kong Radiation Board before the certified date of completion of the Works and the commencement of the Maintenance Period on behalf of the users of the building unless the building is exempted from such licensing requirement as informed by the Architect.

The Contractor shall limit the total radioactivity of all detectors in a building to below 20Mbq where possible and shall use detectors or other types of detectors having equivalent performance and functions and with lower radioactivity to the approval of the Architect and acceptable to the FSD.

Where the smoke detector is required to be installed in the air duct, duct type smoke detector of approved type with probe units shall be used. Where duct type smoke detector is provided for system in areas vulnerable to unwanted alarm, two duct type smoke detectors in coincidence connection and operation to the approval of FSD shall be used.

The ionisation smoke detectors, addressable and non-addressable, shall have a normal working life (mean failure time) of not less than 10 years. The Contractor shall submit documentary evidence from the manufacturer or from an independent testing body approved by the Architect certifying the normal life span of the detectors.

Use of smoke detector in area vulnerable to unwanted alarm shall be avoided where possible if it shall comply with FSD Requirements and Circular Letters. Where ionisation smoke detectors are required, the smoke detectors used in all non-conditioned spaces/areas/voids such as basement, plant rooms, car parks, open areas, cold stores, inside concealed/false ceiling/raised floor without air-conditioning, lift shaft, riser ducts, etc. shall be of approved harsh type designed to stand for extreme or hostile environmental conditions. Smoke detector of harsh type shall also be used in all areas where the relative humidity is likely to exceed 95% non-condensing and in dusty areas. Smoke detectors of harsh type shall be designed to function properly at accumulation of dirt, high wind, extreme temperature and/or high humidity (up to 99% relative humidity) and approved by the Architect. Anti-condensation facilities shall be included in the smoke detectors of harsh type where necessary to cope with high humidity. Alternatively, a special detection system or a multi-sensor detector with adjustable sensitivity settings for different environment to the approval of FSD and the Architect can be used instead. Where there is no ionisation smoke detector suitable for the environmental conditions of a particular application, the Contractor shall use special detection system or multi-sensor detector to the approval of FSD and the Architect.

Where specified, the Contractor shall wire the smoke detectors in cross-zoned operation (coincidence connection) where there are more than two smoke detectors installed in a zone or compartment. The activation of any one smoke detector shall activate a fire alarm with audible and visual indication on the control panel and shall at the same time activate a time delay unit which is adjustable in the range from 0 second to 10 minutes or as approved by the Architect. If the alarm still exists at the end of the time delay period and/or the second smoke detector in the coincidence connection is activated, a fire alarm shall be activated and the fire signal shall be sent via the fire alarm direct link and the alarm transmitter as appropriate. The setting of the time delay period shall be to the approval of FSD.

Where detection system is provided for the drencher system, fire shutters, fire doors and fire/smoke curtains, it shall be connected with cross-zoned operation and shall only operate when any two detectors in coincidence connection are activated. Activation of one detector shall give an alarm with audio and visual indication on the control panel. When required by the FSD and approved by the Architect, activation of detectors provided solely for such systems shall not activate the general fire alarm and shall not send the fire signal via the fire alarm direct link and the alarm transmitter.

B6.4 OPTICAL SMOKE DETECTOR

Optical (photoelectric) smoke detector, where specified, shall comply with BS 5445 Part 7 (EN 54 Part 7). It shall be approved by LPCB or similar widely recognised independent regulatory body and of manufacture and type specifically approved by the FSD.

They shall function at continuous ambient temperature between $0^{o}C$ and $+48^{o}C$, relative humidity between 10% to 95% continuous non-condensing. In areas and locations where the relative humidity is higher than 95% continuous non-condensing, the Contractor shall use harsh type smoke detector. The smoke detectors shall be designed to assume protection rating of IP 43 or higher. They shall also be suitable for stable operation in the Hong Kong climate especially where high humidity conditions may exist without constant air-conditioning.

The detector shall respond to the product of combustion based on photo detection of light scattered in a forward direction by smoke particles. The detection chamber shall consist of a horizontal optical bench housing an infra-red emitter and sensor arranged radically to detect forward scattered light. The sensor shall be of silicon DIN photo diode. The emitter shall be infra-red light emitting diode. The sampling and confirmation frequency shall not be less than once every ten (10) seconds and two (2) seconds respectively. Three consecutive sensed alarm signals shall be needed to trigger detector alarm. The detector shall have devices or labyrinth arrangement to prevent false/unwanted alarm due to an exterior high-energy light sources.

Where the smoke detector is required to be installed in the air duct, duct type smoke detector of approved type with probe units shall be used. Where duct type smoke detector is provided for system in areas vulnerable to unwanted alarm, two duct type smoke detectors in coincidence connection and operation to the approval of FSD shall be used.

The optical smoke detectors, addressable and non-addressable, shall have a normal working life (mean failure time) of not less than 10 years. The Contractor shall submit documentary evidence from the manufacturer or from an independent testing body approved by the Architect certifying the life span of the detectors.

Optical smoke detector shall comply with the requirements in Section B6.3 where relevant and applicable.

B6.5 MULTI-SENSOR DETECTOR

Multi-sensor detector shall be used where specified. It shall comprise a combination of heat sensing, optical detection, flame detection, gas detection, ionisation detection and/or other sensors as recommended by the manufacturer. Multi-sensor detector

comprising smoke sensor as one of the sensors shall be used. Multi-sensor detector having optical sensor for smoke detection will be preferred over that using ionisation sensor. The multi-sensor detector shall be of a type approved by FSD and shall be suitable for a particular application, environmental condition and hazard. The Contractor shall submit detailed equipment catalogue, description, technical data and test certificate to the Architect for approval. The Contractor shall submit information proving its suitability for a particular application and hazard for approval. The design operating life of multi-sensor detector shall be at least ten (10) years. The Contractor shall submit documentary evidence from the manufacturer to demonstrate the operating life of multi-sensor detector.

Where the type of smoke detectors is not shown on the Drawings or not specified, multi-sensor detectors shall be used unless otherwise approved by the Architect. Automatic smoke detector where specified and without the type stated shall be multi-sensor type. Ionisation smoke detector or optical smoke detector shall only be used where specified or at the approval of the Architect or as required by the FSD. Unless otherwise approved by the Architect, all multi-sensor detectors shall be of addressable type.

Intrinsically safe multi-sensor detector shall be used where specified for hazardous area applications.

Multi-sensor detector shall comply with the requirements in other parts of Section B6 where relevant and applicable.

B6.6 PROBE UNITS

Probe units for air duct insertion mounting shall be of robust corrosion-proof construction and capable of accurately sampling the air flowing in the duct over a wide range of velocities. Insertion of the probe shall cause negligible air flow head loss. Probe units shall be suitable for use with smoke detectors as specified above and shall be installed in the centre of a straight section of ducting that has a length at least 6 times its width. The probe unit shall be supplied and installed with filter and the filter element shall be designed such that it can be removed for routine cleaning without the need of removing the probe unit and it does not cause the detection system to raise an unwanted alarm.

B6.7 INTRINSICALLY SAFE DEVICES

Intrinsically safe manual call points, heat detectors, smoke detectors and multi-sensor detectors shall be supplied and installed in hazardous area and as required by the FSD Requirements and Circular Letters. Intrinsically safe heat detector shall be supplied and installed in Cat 2, Cat 5 and appropriate categories of dangerous good stores, fuel oil tank rooms, etc.

The intrinsically safe devices shall be certified Ex ia IIC T5 for used with all listed gases in accordance with IEC 60079. The certification shall cover the entire system and components and shall be approved by the British Approvals Services for Electrical Equipment in Flammable Atmospherics (BASEEFA) or other recognised certification bodies acceptable to FSD. The approval shall be to BS 5501 Parts 1 and 7 (EN 50014 and EN 50020).

The principle of operation and operating characteristics of the intrinsically safe manual call points, heat and smoke detectors shall be as specified in Sections B6.1 to B6.5. Remote LED indicator shall be a high efficiency red LED and certified for used with the detector. Each intrinsically safe circuit shall be restricted to a single zone and connected as a radial connection from the automatic fire alarm panel. Each circuit shall be provided with a "translator" and a safety barrier. The "translator" shall translate the system voltage to a level compatible with the intrinsically safe requirements and to boost the current pulses returned by the manual call points and detectors back to the panel. The "translator" shall be installed outside the hazardous area and within the safe area. Certification of the "translator" is not necessary.

A safety barrier shall be supplied and installed at the boundary of the hazardous and safe areas to stop the transmission of transient and fault interference from the system circuit into the intrinsically safe circuit. Unless otherwise specified, the safety barrier shall be of single channel 28 V/300 Ohm type. The safety barrier shall be completed to a high integrity safety earth by duplicate (two) copper cables, each of cross sectional area of 4 mm^2 or greater. The impedance of the earth connection from the connection point to the main power system earth shall be less than one ohm. The safety barrier shall be certified to E Ex ia IIC.

Each safety barrier shall not be connected to more than one intrinsically safe circuit in the hazardous area. The circuit shall not be connected to any other electrical circuit. The circuit in the hazardous area shall be installed in separate conduit and wiring system. The circuit shall be capable of withstanding a 500 V rms A.C. test voltage for at least one (1) minute. The manual call points, detectors and LED indicators shall be installed in such a way that all terminals and connections are protected to at least IP 20 when they are mounted on the bases.

B6.8 ALARM BELLS

Alarm bells shall be of minimum 150 mm diameter gong suitable for 24 V DC operation. Each alarm bell shall be capable of producing a minimum sound level of 80 dB(A) at 3 m. The bell shall consist of a micro motor as the driving unit offering high performance and reliability together with low current consumption and low starting voltage characteristics. The bells shall be painted red and labelled "FIRE ALARM **火警警鐘**" in both English and Chinese.

The alarm bells shall produce an alarm sound level complying with BS 5839 Part 1 in all accessible parts of the buildings and acceptable to FSD when the doors of the rooms are closed. They shall produce an alarm sound level of not less than 65dBA and not less than 5dBA above any background noise likely to persist for a period longer than 30s when the building is in use at a point anywhere in the building or in the case of domestic building at three metres from the main entrance door of the most remote flat with all doors shut except in areas not required by the FSD. A higher alarm sound level of minimum 75 dBA is required for sleeping accommodation. The alarm bells shown in the Drawings are the minimum requirements. The Contractor shall propose additional alarm bells for approval by the Architect to meet with the sound level requirement before commencement of the installation work. The Contractor shall submit calculation on the sound level to the Architect for approval. The alarm bell sound level at different locations shall be tested and verified on completion of installation work. High power alarm bells shall not be used. The alarm sound level at all accessible locations 3 m or farther away from the alarm bells shall not exceed 120 dBA.

The alarm bells shall be zoned such that only alarm bells in the pre-determined zones shall sound. The zoning of alarm bell shall be in accordance with FSD Requirements and Circular Letters and to the approval of FSD and shall be submitted to the Architect for approval. In general, zoning of fire alarm is for the phased evacuation in large building and in premises supervised by trained staff. It depends on many factors including type and height of building, provision of sprinkler system, presence of refuge floors and separation between occupancies. The Contractor shall submit details of the proposed alarm zoning for approval by the FSD and the Architect when such are not indicated on the Drawings.

B6.9 VISUAL ALARM SIGNALS

The visual alarm signal in the form of flashing light shall be a signalling strobe in accordance with Section 6-4 of NFPA 72 : National Fire Alarm Code, or where accepted by FSD, in accordance with BS5839. The strobe light shall consist a xenon flash tube or similar and associated lens/reflectors system. The unit shall be manufactured to BS EN 50081. Unless otherwise approved by the Architect and FSD, the flashing light shall be red. Flashing light of colour other than red and approved by FSD shall be submitted to the Architect for approval with reasons on the unsuitability of red flashing light for the installation.

The strobe shall be designed for one flash per second with continuously applied minimum voltage and providing a light output of not less than the requirements in NFPA 72 or as approved. The light output shall also not be so high as to cause difficulty in vision due to glare. The strobe shall have no measurable in-rush current in excess of the operating peak current. The Contractor shall select visual alarm units of appropriate light intensity and to position the units such that at least one of them can be seen at any part of the building accessible to the public. The number of visual alarm units and their positions shown on the Drawings are indicative only and the Contractor shall supply and install adequate number of visual alarm units to comply with the requirements of FSD and to the approval of the Architect at no additional cost. Where the number of visual alarm units can be reduced by using units of higher light intensity and approved by the FSD, the Contractor shall submit details for approval by the Architect. Where additional visual alarm units are required due to obstructions not shown in the Drawings, such visual alarm units shall be supplied and installed by the Contractor and the Contract Sum will be adjusted in accordance with the Contract as appropriate.

The unit shall be suitable for surface or semi-flush mounting and labelled "FIRE ALARM 火警" in both English and Chinese. The height of English letter and Chinese characters shall not be less than 10 mm and 15 mm respectively. They can be indicated on separate plate affixed nearby or engraved on the light cover.

Where more than one visual alarm units are supplied and installed in a room or in a common compartment, they shall be arranged to operate in synchronisation.

Back up power supply and battery supply shall be supplied and installed for the visual alarm units similar to the fire alarm bells.

Visual alarm units shall be supplied and installed in all public areas and all areas accessible to the public where manual fire alarm system is provided.

B6.10 ALARM INDICATOR LAMP FOR DETECTOR

Detectors shall have a built-in alarm indicator lamp protruding through the housing to be easily visible. The alarm indication shall be by means of a red LED or LED which emitting red light during alarm state. Unless otherwise accepted by the Architect, the LED indication shall be designed for 360^{o} viewing or with two LED indicators.

Detectors installed inside false ceiling and in concealed space shall have remote alarm indicator lamps connected and mounted at ceiling level near to and below the concealed detectors. The remote alarm indicator lamps shall be conspicuous from any position in the nearby area. Where detectors are installed inside mechanical plant rooms, electrical equipment rooms, store rooms, dangerous good stores, etc. which are unoccupied and normally kept locked, similar remote indicator lamps shall be supplied and installed above the doors of the rooms to show the alarm status. If there is more than one detector inside the room, the indicator lamps can be connected to a common remote indicator lamp.

B6.11 MOUNTING BASE

The mounting bases shall be designed to enable detectors to be plugged in with a simple clockwise motion without significant insertion force. Where detectors are mounted at level above 4 m, they shall be capable of being removed and re-fixed from below by means of an extended arm special tool. Removal of individual detector from the mounting base shall not affect the operation of other alarm devices in the system.

The detectors shall be polarity insensitive, so that identification of the positive and negative lines connection in the mounting base is not necessary except when connecting to remote alarm indicator lamps.

The detectors supplied under the same Contract for a building, complex or project shall be of the same series from one manufacturer. Any type of detectors of the same series shall be interchangeable and fit into a common mounting base.

B6.12 TEST FACILITIES

The end of line tester for each circuit of a conventional fire alarm system and where applicable shall be located at high level or concealed inside ceiling void but shall be easily accessible. The tester shall be flush mounted type with stainless steel plate surface marked with engraved characters indicating the function.

Provision shall be made so that individual detector can be tested without either sounding an alarm or requiring the complete system to be disabled to prevent such an alarm.

B6.13 INTELLIGENT ADDRESSABLE DEVICES

Unless otherwise specified, addressable fire alarm system and control system shall be used when the total number of all types of detectors for any fire service installation required in the Contract exceeds 100. All devices in the addressable fire alarm system shall be of analogue or approved addressable type and approved by FSD including the detectors, manual call points, flow switches, pressure sensors, etc. where appropriate.

Each device/detector shall be addressable via a mechanism approved by the Architect. The address shall be easily set and changed. The allowable address shall be adequate to cater for the whole fire alarm system with capacity for expansion. Dip switch type mechanism is generally not preferred. Unless otherwise approved by the Architect, the addressable mechanism shall be attached to the base of the device/detector so that the device/detector head can be changed without affecting the address or the need to re-set the address. The device shall constantly verify against the database in the addressable fire alarm control and indicating panel detailed in Section B8.4 via an addressable detection cable loop.

Addressable devices shall provide information for continuous monitoring and control of detector status and annunciate the need for immediate service. The decision on the control actions shall however be from the fire alarm control system and not on individual detector. Connection wires for the addressable devices shall be of approved type by the Architect and acceptable to FSD. Unless otherwise specified, twisted pairs in concealed conduits for point-to-point connection shall be used.

Detector shall be fully compensated for temperature, humidity and barometric changes in the surroundings. All electronic components shall be hermetically sealed to prevent their operation from being impaired by dust, dirt, humidity, corrosion or mechanical shock. All circuitry must be protected against typical electrical transients and electromagnetic interference according to BS 6667 Part 3 / IEC 801-3. The termination shall be so designed that the terminals are polarity insensitive. Built-in testing facility shall be provided.

One LED indicator designed for 360^{o} viewing or two status LED indicators shall be provided for each detector unless otherwise accepted by the Architect and they shall be so positioned that at least one LED can be seen from any angle. The detector shall have provisions to drive remote visual alarm indicator. Remote indicator shall be compatible with the detector so that the operation of the indicator shall not affect the brightness of the detector' s built-in LED.

(a) Addressable Heat Detector

In addition to the requirements stated in Section B6.2, addressable heat detector shall continuously measure the temperature of air and generate a proportional analogue output.

The detector shall employ two matched thermal sensing elements in a bridge configuration to give a response which depends both on temperature and the rate of change of temperature. The reference and sensing thermal sensors shall be fabricated under identical conditions to ensure good matching and excellent tracking with both temperature and ageing.

(b) Addressable Smoke Detector

In addition to the requirements stated in Section B6.3 and B6.4, addressable smoke detector shall continuously measure the products of combustion in the air and generate a proportional analogue output.

The measuring chamber shall be so designed to create a very low background signal in clean air condition. A specially designed device shall

be incorporated to control dust settlement on non-critical surfaces so that high dust level in the surroundings can be tolerated.

(c) Addressable manual call point

The addressable manual call point shall be of a type approved by FSD.

The addressable detectors (heat, smoke or others) shall be provided with the following features as a minimum:

(a) Remote adjustment of detector sensitivity to suit the occupancy and/or the environment of a detector at any time.

(b) Automatic compensation of sensor alarm threshold due to aging, humidity and accumulation of dirt and dust with time (automatic drift compensation).

(c) Adjustable time lag from the time of reaching alarm threshold to the time of issuing or communicating a fire alarm (pre-alarm, alarm verification).

(d) Different alarm levels are provided such as detection level, maintenance level, fire alarm level, etc. to give an early warning for maintenance to avoid false alarm (multi-sensitivity levels, day/night adjustment, and maintenance alert).

(e) Loop monitoring for error such as short circuit, open circuit, detector removed and detector communication failure (auto detector test, circuitry test).

B6.14 ADDRESSABLE INTERFACE MODULES

Various modules shall be provided for the Addressable Fire Alarm and Control System for the required functions, interfacing with non-addressable devices and other services. Modules shall be mounted into junction boxes for easy installation. The addresses of these modules shall be easily set, seen and changed.

The module shall have a conspicuously located LED, which blinks or does not blink, upon being scanned by the panel. Upon determination of an alarm condition, the LED shall be latched on and blink or not blink as assigned.

(a) Monitor Module

Monitor module allows the panel to interface with and monitor individual non-addressable monitoring alarms such as a manual call point, sensors, detectors, water flow switches, sprinkler supervisory devices etc.

The module shall provide addressable inputs for all N.O. or N.C. contact for continuous monitoring. In addition to the supervised state of the monitored device, the measurement of the supervision shall be sent to the Addressable Fire Alarm Control and Indicating Panel.

The monitor module shall also provide a supervised initiating circuit. An open-circuit or short-circuit fault shall be indicated at the Panel.

Facilities shall be provided for carrying testing at the monitor module during maintenance and diagnostics.

(b) Control Module

Control module supervises and monitors wiring to appliances of small connected load like alarm bell, flashing light units, indicator units, and interface relay. Upon command from the Addressable Fire Alarm Control and Indicating Panel, the module shall disconnect the supervision and connect the external power supply to the device and a signal shall then be sent to the Panel to indicate that the command was executed. The external power shall be isolated, so a trouble condition at the power supply shall not interfere with the rest of the system.

The connected alarm load shall be closely monitored for any open and short circuit conditions. The output circuit connected to the loading shall be short circuit protected.

(c) Fault Isolator Module

The non-addressable fault isolator module shall detect and isolate a short-circuited segment of a fault-tolerant loop whilst allowing the rest of the addressing circuit to function normally.

Fault isolator module shall be provided for at least every 20 intelligent addressable devices, i.e. detectors, monitor modules and control modules to limit the number of devices lost in the event of a short circuit.

(d) Facilities for interfacing with any other systems as shown on the Drawings or as specified in the Particular Specification.

B6.15 SPECIAL DETECTION SYSTEM AND DEVICES

Where specified, special detection system, addressable and non-addressable type, such as beam detectors, laser detectors, VESDA (very early smoke detection alarm system), linear detector, flame detector, aspirating smoke detection system, gas detector, etc. shall be used. The detection system shall be of a type approved by FSD and shall be suitable for a particular application, environmental condition and hazard. The Contractor shall submit detailed equipment catalogue, description, technical data and test certificate to the Architect for approval. The Contractor shall submit information proving the suitability of the special detection system and devices for a particular application and hazard for approval.

Where detection system is required in open-air/outdoor applications, the Contractor shall use and submit suitable detection system approved by FSD to the Architect for approval. Special detection system shall also be used where necessary to avoid unwanted alarm.

SECTION B7
AUDIO/VISUAL ADVISORY SYSTEM

B7.1 GENERAL

The Contractor shall be responsible for the design of the audio/visual advisory system and the selection of proper, correct and compatible equipment and components to achieve the performance specified. Detailed design layouts as well as full technical information and calculations for the system shall be submitted to the Architect and the FSD for their approval prior to ordering and installation.

The equipment and components offered shall be proven proprietary products with good quality for accomplishing the safe evacuation of occupants in the premises during a fire risk condition and to the acceptance of the Architect. They shall be operated at not more than 90% of the manufacturer's specified ratings. They shall be fully tropicalised and suitable for continuous operation with optimum performance in ambient temperature between 0^{o}C and 40^{o}C and with relative humidity up to 100% as normal condition, and also in fire conditions.

In selecting makes and types of equipment, the Contractor shall ensure that servicing facilities and replacement spare parts can be made available locally for future maintenance of the system.

In the event that these requirements cannot be met due to the use of improper, incorrect or incompatible components, the Contractor shall replace all such components and shall re-design the whole system all to the satisfaction of the Architect. All extra costs thus incurred shall be borne by the Contractor.

The audio/visual advisory system shall comprise coloured lights, flashing lights, illuminated and coloured signs, directional signs, low-level directional signs, microphones, amplifiers, cassette decks, loudspeakers and other accessories for providing indication to the exit routes and exits and for delivering verbal or direct transmission of emergency messages to the occupants.

Audio/visual advisory system shall be supplied and installed to all areas and places controlled and classified under Places of Public Entertainment Ordinance, Cap 172 and to other areas as required in FSD Requirements and Circular Letters.

B7.2 AUDIO SYSTEM

The audio system shall be designed and installed in accordance with the FSDCOP and FSD Requirements and Circular Letters. The system shall also comply with the General Electrical Specification, the General Requirements for Electronic Contracts issued by the Electrical and Mechanical Services Department, the General Technical Specification for Public Address System issued by the Electrical and Mechanical Services Department, BS EN 60849 / IEC 849 and BS 6840 / IEC 268.

The design of the system shall be such that special attention is paid to the following points: -

(a) System reliability and fail-safe.

(b) System damage caused by defective appliances and components.

(c) System feedback of sound level of operation for audio signals.

(d) Adequate output levels.

(e) Variable input levels.

The audio system shall be designed to ensure matching between amplifier and load. The variation in available power shall not exceed 3 dB between the outlet nearest to the amplifier and any other outlet in the system. Suitable and acceptable repeaters and signal conditioner shall be installed as necessary to maintain the sound power level. A load variation of 50% shall not affect the quality of sound or cause the output voltage at any outlet to vary by more than 6 dB.

The audio system shall be provided with pre-amplifier and amplifier of sufficient power to drive all the loudspeakers and other equipment in the system. Each pre-amplifier and amplifier shall have a 100% standby unit, so arranged that if any one unit failed, the corresponding standby unit shall take up the duty for the respective operation automatically within fifteen (15) seconds. The system shall be so wired and arranged as to achieve this function.

(a) Desktop Microphone

Desktop microphone shall be single zone type complete with condenser microphone on gooseneck for use with the amplifier. It shall complete with a minimum of 1m length cable and a plug.

(b) Amplifier

Amplifier shall be fully transistorised solid state device. They shall have sufficient power with at least 10% spare capacity to drive all the speakers within the broadcasting zone.

The rated power output of each amplifier shall have a regulation from no load to full load of 2 dB. The amplifier shall have an audio response level to within +2 dB from 50 Hz to 14 kHz at full output, and the total harmonic distortion shall not exceed 1% at full load.

The noise level of each amplifier shall be at least 40 dB below maximum output with all inputs and outputs correctly terminated. Sensitivity shall be such that full output can be obtained from a 2 mV microphone or equivalent input.

Amplifier shall maintain a damping factor of not less than three over the frequency range of 100 to 5,000 Hz. Amplifier shall have a low hum level and low over-shoot or ringing when a square wave generator is connected to the input level within the working range. The variable tone control shall provide attenuating of the high frequencies, i.e. 0 - 20 dB at 8 kHz.

Amplifier shall be of constant voltage output type not requiring dummy load to maintain matching of the amplifier output. The output shall be provided

with an overload protection device to prevent damage to the output stage from overload or a short circuit on the speaker lines.

The signal incoming leads shall terminate at the rear of the amplifier through suitable screened type plug mountings. Where more than one input is required, a screwdriver adjustment shall be provided at the rear for each additional input for preset balancing of the inputs. Input sockets and output terminals shall be well separated and in separate cut-outs in order to prevent coupling between the amplifier input and output.

Preamplifier shall be provided with connection to power amplifier, microphone, CD deck and cassette deck. It shall have built in On/Off switch, headphone outlet and volume control for each channel. An LED VU meter shall be provided to indicate the output level.

For single broadcasting zone, the power amplifier shall be completed with mixer. Power amplifier shall be capable of connecting with microphone, CD deck and cassette deck. Each power amplifier shall have built in On/Off switch, headphone outlet, volume control for each channel and matching transformers with tapping to enable loudspeakers to be driven at 100V, 70V or 50V up to 8Ω. An LED VU meter shall be provided to indicate the output level. The power output shall be adequate for the connected loudspeakers in the broadcasting zone.

For multiple broadcasting zones, each zone shall be provided with a power amplifier.

Power amplifier shall be provided with input transformers for audio inputs from the preamplifier and built-in loudspeaker matching transformer. It shall have built in On/Off switch, headphone outlet and an LED VU meter showing the output level. The power output shall be adequate for the number of connected loudspeakers within the zone.

(c) Loudspeaker

Loudspeaker shall provide a crisp, clear audio reproduction for voice and alarm tone signalling, designed for fast and easy surface/flush installation on ceiling or wall. It shall be constructed of sheet steel or high impact ABS plastic in white colour or as specified matching the false ceiling or wall finishes. The back of the loudspeaker shall have an enclosure to prevent ingress of dirt to the speaker zone. Loudspeaker installed on false ceiling shall be suitable for flush mounting with the body fully recessed into the false ceiling.

Loudspeaker installed in plant room or any other places without false ceiling shall complete with surface mounting boxes which include knock-out for surface conduit installation.

Loudspeaker shall be equipped with tapped transformer suitable for the system operating voltage and having individual attenuator. The attenuator shall be integrated with the speaker unit and shall comprise carbon type volume controls with adjustment.

Loudspeaker shall have a maximum output rating of at least 1 Watt and a frequency response of within +3 and -7 dB from 100 to 10,000 Hz with respect to 1 kHz.

The layout of the loudspeakers as shown on the Drawings is for the indication of the areas where the audio announcement is required to be provided. The Contractor shall design the audio system and co-ordinate with the Building Contractor and other sub-contractors for the exact quantity and positioning of the loudspeakers.

Where the loudspeakers specified are provided by others, the Contractor shall co-ordinate with relevant parties on the installation of the loudspeakers for completion of the audio system. The Contractor shall supply and install compatible equipment for operating the loudspeakers without affecting other systems connected to the loudspeakers.

(d) Cassette Deck

Cassette deck shall have two individual cassette players with standard interlocking set of play, stop, pause, fast forward and fast reverse buttons and auto-reverse playback feature. It shall have a playing tape speed of 4.75 cm/s and a nominal output signal of 1 V. Signal to noise ratio shall be better than 40 dB. It shall complete with a remote start-stop control from the monitor and control panel.

Two high quality cassette tapes of sixty (60) minutes shall be supplied. The tapes shall be fully recorded on both sides with the specified audio alarm messages repeatedly. A sample of the tape with the recorded messages shall be submitted to the Architect for approval.

Alternatively, the Contractor may use approved system with message recorded on an electronic chip. The Contractor shall propose details of the system using electronic chip to the Architect for approval.

(e) Control and Monitoring

The Contractor shall supply and install a wall mounted panel for the control and monitoring of the audio system as specified.

The monitoring and control system shall be backed up by battery and charger in Section B8.10. Except for the proprietary control panel approved by FSD and with ISO 9001/9002 quality system, the housing of panel and front panel shall be constructed from 1.6 mm thick stainless steel sheet to BS 970 Part 1 Grade 316S31 with engraved labels and lettering.

(f) Audio Alarm Messages

Audio alarm message in Cantonese and English shall be announced repeatedly with the audio alarm bell signal in sequence. The message shall be as required by the FSD and will be similar to the following:

“This is a fire alarm message. Please keep calm. Follow the flashing lights to the nearest exit. Do not use the lift”, and in equivalent Cantonese as:

"這是一個火警警報, 請保持冷靜, 依閃燈指示, 由就近出路牌方向離開, 切勿使用升降機。"

The message shall be audible in all areas within the specified zone of the building including toilets, stores, staircases, etc. The signal to noise ratio shall not be less than 40 dB when the loudspeaker output level in the area concerned is not less than 20 dB above the background noise level normally expected in the respective area during fire conditions. The variation in sound power level between the outlet nearest to and farthest from the amplifier shall not exceed 3 dB.

B7.3 VISUAL SYSTEM

The visual system shall consist of a system of coloured and illuminated exit signs and directional signs supplemented by low level directional signs in compliance with the FSDCOP and FSD Requirements and Circular Letters, BS 5499 and BS 4533.

(a) The design of exit signs shall be in accordance with Section B11.2.

(b) Directional signs shall be internally illuminated and in compliance with BS 5499 Part 1 Table 10. The lamp elements shall be positioned to produce the best illumination effect for the sign. A flashing light control gear shall be integrated with each sign. An independent circuit including a separate set of lamp-holder, wiring and protective gear shall be provided for each lamp element. In normal situation, the lamp elements shall be in the ON condition. Low level self-luminous directional signs not carrying radioactive substances can be used at the approval of the Architect when illuminated signs are not specified. The low level self-luminous directional signs shall be as approved by the FSD complying with BS 5499 Part 2.

The construction of the illuminated signs shall be as specified and in accordance with the requirements of the FSD. Each illuminated sign shall consist of lamps, battery, charger, automatic changeover device, inverter/ballast indications and switch.

The battery and charger for the exit sign and directional sign shall comply with Section B8.10 and as described below.

The battery shall be sealed, rechargeable and maintenance free nickel-metal hydride type or a type of better functions and performance and approved by the Architect. The total battery capacity shall be capable of maintaining light output of all lamp elements at not less than 50% of the nominal light output under the maintained mode for at least two (2) hours after mains failure. The charger shall be capable of recharging the batteries to full capacity within twenty-four (24) hours after a total discharge. Clear indications shall be provided on the sign box showing either the mains supply is normal or the battery is discharging and an integrated toggle test switch with "normal", "battery-off" and "test" positions for testing the proper functioning of the battery supply system.

Under normal supply, the battery shall be charged to maintain in a fully charged state and the lamps shall be operated by the mains supply. When the mains supply fails, the automatic changeover switch shall instantaneously switch to battery-powered operation until the restoration of the mains supply. It shall then switch back to normal and the battery shall be re-charged again.

B7.4 OPERATION OF THE SYSTEM

The audio/visual advisory system shall interconnect with the fire alarm system of the building. When the fire alarm is activated, the following operations shall be performed automatically: -

(a) The flashing light control gear of all the illuminated directional signs and exit signs which are incorporated with flashing lights within the fire alarm zone shall operate. The lamp elements shall be switched on and off continuously at a duration of 1 to 2 seconds. The flashing rate shall be continuously adjustable between 30 to 60 times per minute. All the lamp elements in the directional sign shall be lighted up and turned off simultaneously to produce the maximum visual effect. The process shall continue until the fire alarm is reset. Then the lamp elements shall be switched back to the normal ON condition automatically and shall be switched to the flashing mode again on receiving any further fire alarm signal.

(b) The alarm bells and flashing light units within the alarm zone shall operate. After ten (10) seconds, the alarm bells shall stop while the flashing light units shall continue to flash. Then the pre-recorded audio alarm messages shall announce within the alarm zone to alert the occupants and direct them to evacuate immediately following the directional and exit signs. The alarm bells and the audio alarm messages shall repeat in sequence continuously until the fire alarm has been reset at the fire alarm panel.

B7.5 CONTROL SYSTEM

The complete audio/visual system shall be equipped with all the necessary circuits and components for the proper control and operation of various functions, the indications of the health status of the system, and any fault diagnosis. The circuits and components shall be in printed circuit modular board design. The components shall include the following items and any other items necessary for the proper control and operation of the system to the satisfaction of the FSD:

(a) microphone control panel;

(b) speaker zone switchbank and annunciator module;

(c) tape transfer, power supervisor and remote transmission module;

(d) automatic timer sequencer which shall be a multi-function assembly to provide pre-recorded messages, timing sequences, transfer function plus supervisory signal to amplifiers;

(e) alarm failure transfer units which shall transfer audio output from main duty amplifiers to standby amplifiers upon detecting the absence of a supervisory signal;

(f) general alarm and all call module;

(g) alarm input transfer module for controlling the amplifiers.

The microphone control panel shall contain dual pre-amplifiers continuously supervised. It shall have the ability to transfer to the standby pre-amplifier upon failure of the duty unit. A noise cancelling hand microphone having a UL listed and supervised coil cord shall be provided. Provision for automatic alarm zone override of speaker switching shall also be included to ensure proper alarm zoning if the selector switches are left in an incorrect mode.

The speaker zone selector switchbank shall control the audio dispersion throughout the protected premises. Each switch shall permit the transfer of its zone of speakers into either all call, page and fire operation modes. Failure of any zone shall be indicated by the corresponding amber LED. Indicators for alarm and switchbank trouble shall also be supplied and installed.

Tape transfer, power supervisor and remote transmission module shall supervise the remote rack equipment, provide output and supervision of the remote transmitting function, and control the sequencing of evacuation tape messages and the selection of tape track.

The system shall not cause any interference with all electrical or electronic system, the telephone system, radio paging system, audible paging and other communication system and vice versa, whether they are in operation or not.

The operation of all controls shall be automatic and as simple as possible. The operating procedures shall be provided to give concise and clear indications. Where it is considered necessary, these indications shall be accompanied by the connection diagram which shall show the various operation alternatives available to each equipment.

All equipment shall be mounted in well ventilated but water protected stainless steel enclosure and equipment rack. Where permanently fixed in position, the top and undersides of the equipment shall be readily accessible by means of removable panels. The metal enclosures shall be secured and have sufficient space for cable routing and bending. Except for the proprietary equipment enclosure approved by FSD and with ISO 9001/9002 quality system, the housing shall be constructed from Grade 316S31 stainless steel of 1.6 mm thick minimum, well ventilated but shall be free from any dust and be vermin and corrosion proof. All operating controls and equipment shall be adequately labelled to assist ease of operation and maintenance of the system.

B7.6 WIRING INSTALLATIONS

The wiring installation for the audio/visual advisory system shall be supplied and installed by the Contractor except the power supply to the exit signs, the directional signs, the amplifiers and the monitoring and control panel as indicated on the Drawings.

The wiring to the loudspeakers and the directional signs shall be installed in concealed conduits, and the wiring shall be so arranged that any damage to the wiring for any one loudspeaker or directional sign shall not affect the proper operation of all other loudspeakers nor directional signs. All cables shall run continuously from the originating point to termination and no joint or connector shall be permitted. The amplifier output circuits to the loudspeakers shall use twin cables with low power loss and protected against interference. Care shall be taken to ensure that each loudspeaker is correctly phased.

SECTION B8
FIRE ALARM CONTROL SYSTEM

B8.1 GENERAL

The Contractor shall design, supply and install fire alarm control system, fire control centre and all necessary controls for all the fire service installation. Fire alarm control and indicating panels shall comply with BS 5839 Part 4. The panels shall be constructed of or enclosed with cabinet at least 1.6 mm stainless steel plate to BS 970 Part 1 Grade 316S31, except for the proprietary panels approved by FSD and with ISO 9001/9002 quality system. A glazed lockable door shall be supplied and installed for restricted access but allowing a full view of the visual indications. The panels shall afford a degree of protection to IP 52 and BS EN 60529. The fire alarm control system shall be of conventional hard wire type or a type approved by the Architect.

The system shall have devices to detect and raise alarm for open or short circuited condition of the system. Where a residual current device is required to comply with the statutory requirements for electrical installation, a fault on any other circuit or equipment shall not be capable of resulting in isolation of the supply to the fire alarm control system. The system loop design shall be such that the actuation of any detection device or when there is any fault in the loop shall not cause the loop to be disabled for any alarm and trouble signals to be followed.

The Contractor shall submit the layout, design and construction of all fire alarm control and indication panels for approval.

All wirings in the panels shall be neatly arranged and grouped together. Proper labels shall be supplied and installed.

The Contractor shall supply and install surge arresters for the fire alarm control system to prevent false alarm and malfunctioning of the fire alarm control system due to power surge.

Where time related system and/or transmission delay unit is specified, the system used shall be to the approval of FSD. The time delay shall be adjustable from 0 to 5 minutes and approved by FSD.

B8.2 CONVENTIONAL FIRE ALARM CONTROL AND INDICATING PANEL

The panel shall be equipped to suit the fire alarm system of which it forms a part. Conventional fire alarm control and indicating panel shall be supplied and installed to monitor centrally the manual fire alarm system, fire hydrant and hose reel installation, VAC control system and other fire service installations and equipment. Fire alarm signals may originate from manual call points, flow switches, pressure switches, gaseous flooding system alarm contacts, etc. as applicable. The connection of these devices in zone (alarm circuits) shall be as specified.

The panel shall include the following minimum provisions:

Service Features

(a) Relays, terminal strips, wiring, labels, etc. for the proper operation of the whole system including alarm bells.

(b) Auxiliary relay or additional relay contacts for automatic starting of water pumps and other devices as specified.

(c) Test facilities for each alarm zone.

User Control Switches

(a) System isolation key switch.

(b) Zone isolating key switch.

(c) Alarm silencing switch with warning buzzer and indication.

(d) Buzzer mute.

(e) Sound alarm switch for all indicator circuits and internal buzzer.

(f) System reset switch after clearance of an alarm or fault condition.

(g) Lamp test switch.

(h) Pump start switch.

(i) Key switches for isolating signals to the VAC control system, to the fire shutters and to the lift controls with visual warning indication.

(j) Other necessary controls for fire hydrant/hose reel system and sprinkler system as required by the FSD.

Visual Indicators

(a) "Supply On" visual indicator, green.

(b) "System On" visual indicator, green.

(c) "System or Device Isolated" visual indicator, amber with buzzer.

(d) "Fire" alarm visual indicator for each zone, red.

(e) "Zonal Fault" visual indicator, amber.

(f) "System Fault" visual indicator, amber.

(g) "Battery" condition (full/charging/low) visual indicator, green/amber/red respectively.

(h) "Battery Charger Fault" visual indicator, red.

(i) "Zone Disable" visual indicator, amber.

(j) "Tank Low Level" and "Tank High Level" visual indicators, amber.

(k) "Pump Running" visual indicator, green.

(l) "Pump fault" visual indicator, red.

(m) "Essential Power On" and emergency generator running visual indication, amber.

(n) Subsidiary sprinkler stop valves status visual indication, red (light up when valve closed).

(o) Sprinkler control valve set status monitoring, amber.

(p) Sprinkler flow switches activation visual indication, red.

(q) Fire alarm direct link fault/isolation indication, red.

(r) Emergency generator manual mode visual indicator, amber.

(s) Emergency generator fail to start visual indicator, red.

(t) Emergency generator fuel tank low level visual indicator, red.

(u) Other necessary indications for fire hydrant/hose reel system, sprinkler system, etc. as required by the FSD.

All visual indications shall be provided with twin indication lamps or twin LED. All visual indications shall be easily seen at 2 m away from the panel.

Upon operation of one or more triggering devices, the control equipment shall give a fire alarm by:

(a) At least one internal alarm sounder in or near the indicating equipment.

(b) At least one external alarm sounder.

(c) A visible indication for each zone in which a triggering device operates.

(d) Where specified, a signal transmitted to the FSD through the fire alarm direct link and the Computerized Fire Alarm Transmission System.

Fire alarm control system shall be arranged for continuous monitoring of all alarm circuits, including the wiring and the alarm signalling devices connected thereto.

Faults to be detected shall include open-circuits, short-circuits, and removal of signalling devices.

Indicator lamps shall be of a voltage rating 20% higher than the applied voltage, and shall be of extra low voltage type. Where A.C. mains operation is required, indicator lamps shall be operated at extra low voltage via a step-down transformer and be suitably rated for long life and reliability.

Alarm bell circuits shall be interleaved and separately fused at the control equipment.

Relays shall be of the potted type or similarly protected against dust and shall have solenoids with varnish-impregnated or plastic encapsulated windings.

Contacts shall be of silver and adequately rated. Additional contacts shall be supplied and installed as required for the operation of auxiliary controls.

The control equipment shall incorporate battery charger set with appropriate voltage regulators suitable for the rating of the interconnected triggering devices and the equipment shall incorporate overload cut-out or limiting devices to protect the external circuit against excessive current.

B8.3 AUTOMATIC FIRE ALARM CONTROL AND INDICATING PANEL

For system containing automatic alarm devices, the panel shall be of a make and type approved by the FSD for use in Hong Kong and shall be microprocessor based. At least one automatic fire alarm control and indicating panel shall be supplied and installed to monitor centrally the automatic fire alarm system and the like. For addressable fire alarm system, addressable fire alarm control and indicating panel shall be supplied and installed. Fire alarm signals may originate from heat detector, smoke detector and/or other automatic fire detection device as applicable. The micro-processor shall combine with a printed circuit board to form a simple and reliable controller with optimum performance.

The panel shall be able to transmit fire alarm signals to the FSD Computerized Fire Alarm Transmission System.

The panel shall allow detectors in any individual zone and sounders to be tested during commissioning or maintenance by a single person, i.e. one-man test facility.

The panel shall contain the following minimum provisions:

Service Features

(a) At least two alarm circuit.

(b) At least two pairs of auxiliary contacts.

(c) Comprehensive fault monitoring devices.

(d) One-man test facility.

(e) Integral power supply.

(f) Back up sealed nickel-metal hydride battery or other approved battery of better performance and functions.

User Control Switches

(a) Zone isolation switch with visual indication.

(b) Alarm silence switch with visual indication.

(c) System reset.

(d) Lamp test.

Visual Indicators

(a) Mains on, green.

(b) System isolated, amber.

(c) System fault, amber.

(d) Zone fire alarm visual indicator using twin LED, red.

(e) Zone fault/isolated LEDs indications, amber.

(f) Status of equipment controlled by detectors e.g. 'closed' status of fire shutter, amber.

The control equipment shall incorporate battery charger set with appropriate voltage regulators or supplied by the battery charger set in the conventional fire alarm control and indicating panel.

B8.4 AUTOMATIC SPRINKLER SYSTEM ALARM CONTROL AND INDICATING PANEL

The panel for automatic sprinkler system shall comply with the LPC Rules for Sprinkler Installations. At least one panel shall be supplied and installed for the sprinkler installation. It can be combined and integrated with the automatic fire alarm control and indicating panel and conventional fire alarm indicating panel where allowed and approved by FSD.

B8.5 ADDRESSABLE FIRE ALARM CONTROL AND INDICATING PANEL

Where specified and/or where addressable fire alarm and detection system is used, addressable fire alarm control and indication panel shall be supplied and installed. The addressable fire alarm control and indicating panel shall be addressable intelligent type with its own microprocessor and memory. The panel shall be of a make and type approved by the FSD for use in Hong Kong and shall be microprocessor based. All detection devices, sensing devices and control devices connected to the addressable panel and system shall be of compatible addressable types acceptable to FSD.

Unless otherwise specified and approved by the Architect, addressable fire alarm control system and addressable fire alarm control and indicating panel shall be used when the total number of all types of detectors in fire service installation exceeds 100.

Supply and install approved addressable system from manufacturer who shall provide all the programming information, software codes, details, keys, training and passwords to the Architect, to the users and to the maintenance bodies. The Contractor shall not select and use addressable system for the fire alarm control system/fire alarm control

and indicating panel/fire control centre from manufacturer who cannot provide/release all the programming/software codes and password information. The Contractor shall not supply addressable system from manufacturer who cannot provide training courses on the programming codes and on the operation/maintenance of the addressable system to other parties other than the manufacturer's agents. The Contractor shall be responsible to replace at the Contractor's own cost the installed addressable system with other approved one that can provide all the required information if the manufacturer of the installed addressable system fails to provide the required information for whatever reasons before certified completion date of the Works.

In addition to the intelligent functions, LED indicating lights and LCD panel together with audible alarm shall be included in the panel to provide alarm/detection zoning requirements as specified and in accordance with the Fire Services Department Requirements as well as the following monitoring signals, where applicable:

(a) Status of micro-switch for each sprinkler subsidiary stop valve.

(b) 'Closed' status of each fire resistant shutters operated by smoke detector.

(c) Running of each sprinkler pump.

(d) Running of sprinkler jockey pump.

(e) Fault/loss of power supply to sprinkler/jockey pumps.

(f) Sprinkler tank overflow alarm.

(g) Sprinkler tank low level alarm.

(h) Running of each fixed fire pump.

(i) Fault/loss of power supply to fixed fire pumps.

(j) Fire service tank overflow alarm.

(k) Fire service tank low level alarm.

(l) Running of each intermediate booster pump.

(m) Fault/loss of power supply to intermediate booster pumps.

(n) Running of each transfer pump.

(o) Fault/loss of power supply to transfer pumps.

(p) Transfer tank overflow alarm.

(q) Transfer tank low level alarm.

(r) Running of each foam system water pump.

(s) Fault/loss of power supply to foam system water pumps.

(t) Foam system water tank overflow alarm.

(u) Foam system water tank low level alarm.

(add running and alarm indications for other pumps and tanks as necessary)

(v) System fault.

(w) Circuit fault.

(x) Status of power supply including normal supply, essential power on, emergency generator manual mode, emergency generator fail to start and fuel tank low level.

(y) Line normal and line fault/isolation of fire alarm direct link.

(z) Four (4) nos. spare allowed on each panel for additional alarm points.

Also, the following control functions in the form of push button or key switch integrated as part of the panel shall be supplied and installed, where applicable :

(a) Manual starting of each fixed fire pump.

(b) Manual starting of each intermediate booster pump.

(c) Manual starting of each sprinkler pump.

(d) Manual starting of each transfer pump.

(e) Manual starting of each foam system water pump.

(Add controls for other pumps as necessary)

(f) Alarm test and lamp test facilities.

(g) Key switch for system isolation with visual indicator.

(h) Key switch for stopping transmission of fire signal to ventilation control system and lift installation with visual indicators.

(i) Alarm and buzzer mute.

and all the control and indicating functions of conventional fire alarm control and indicating panel and automatic fire alarm control and indicating panel as appropriate.

The wiring for addressable fire alarm control system shall be of a type approved by the Architect and FSD and shall best suit the functioning and maintenance of the system.

The panel shall drive four wire loops of addressable analogue fire/smoke sensing, signalling and monitoring devices. The panel shall have output ports for the connection of external printer and monitor to allow for expansion of the system. The loop shall be self powered for all sensing, monitoring and communication functions. Upon a communication failure anywhere on the loop or power failure, a failure alarm shall be reported. Each loop shall have a minimum of 10% spare for intelligent

sensors and 10% for addressable modules. The addressable panel shall have a minimum of 10% spare to cater for future expansion and modification.

The panel shall process all analogue values for trouble, normal, pre-alarm and alarm thresholds. Thresholds and sensor values shall be displayable, modifiable and reportable in decimal values. The panel shall have the minimum number of loop circuits as specified.

The panel shall be able to connect to intelligent sensors or conventional initiating circuits as specified. Independent modules for alarm zones (e.g. break glass zone, detector zone, flow switch zone) and trouble zones (e.g. subsidiary valve shut off) shall be provided on a floor by floor or zone by zone basis.

The panel shall provide all power, including backup batteries and battery charger, necessary for the devices connected to it.

Except for the panel approved by FSD and with ISO 9001/9002 quality system, the panel electronics shall be contained in a minimum 1.6 mm thick stainless steel enclosure to BS 970 Part 1 Grade 316S31 or other approved material by the Architect. Access to the panel switches and all electronics shall be via key lock; no other tools shall be required. Visual indicators of the panel status shall be visible and push buttons for pumps shall be accessible without opening the key locked cover.

All hardware and software which define the panel configuration and operation shall be supplied and installed. Memory data shall be contained in non-volatile memory. Memory data shall not be lost after long power failure.

The pre-alarm and alarm thresholds of fire detectors shall be adjustable through the panel. In addition, the panel shall be able to provide alarm verification features with field adjustable time from 0 to 60 seconds. If so implemented, only a verified alarm shall initiate the alarm sequence.

Location, type, address and condition of each device shall be displayed through a built-in LCD automatically in case of alarm or trouble. The display condition shall be in a user friendly format. It shall also be time stamped.

All other changes of status shall also be displayed in the LCD giving at least the following information

(a) Condition of point.

(b) Type of point (smoke/heat detector/sprinkler flow switch/break glass unit etc.).

(c) Location of point plus numerical system address.

(d) All other points appearing on the panel.

Individual red alarm and common yellow trouble LEDs shall be supplied and installed for each initiating and for each indicating zone. Devices on intelligent loop circuits shall be identified by display of their addresses, locations and types, and by their conditions (Alarm, Pre-alarm, Fault) on the built-in LCD. In addition, the conditions shall be displayed on the appropriate intelligent loop interface board.

Individual zone disconnect switches/facilities shall be supplied and installed for each indicating zone, which shall prevent operation of the zone for alarm but allow the remainder of the Panel to operate normally. While the disconnect switch is operated, a trouble condition shall be indicated on the zone as well as an indication for "Disconnect". Devices on intelligent loop circuits shall be capable of being disabled by authorized personnel from the panel.

It shall be possible to command test, reset, and alarm silence from the panel.

If communications with the central processing unit board inside the panel is interrupted for any reasons, the following critical control actions shall still occur at the panel. Upon determination of an alarm condition the panel shall :

(a) Activate the fire alarm signalling devices.

(b) Release fire shutters as specified.

(c) Capture the lifts and return them to the home landing as specified.

(d) Raise alarms in accordance with FSD Requirements and Circular Letters.

(e) Initiate the alarm transmitter to the Fire Services Department Computerized Fire Alarm Transmission System via telephone line.

(f) Activate various fire service water pumps and other fire fighting systems as specified.

(g) Stop ventilation system as specified.

(h) Display the sensor or module address and condition.

The panel switches/facilities shall allow authorized personnel to accomplish the following :

(a) Initiate a general alarm condition.

(b) Silence the local buzzer.

(c) Silence the alarm signals.

(d) Activate and reset the alarm transmitter to the Fire Services Department Computerized Fire Alarm Transmission System via telephone line.

(e) Reset all zones after all initiating devices have been returned to normal.

(f) Perform a complete system test with a visual indication of numbers of all detectors in normal working condition.

(g) Test all panel LEDs for proper operation without causing a change in the condition on any zone.

(h) Eliminate a device mismatch condition by changing the device type. The panel shall always operate with thresholds unique to the device type, and shall do so whether or not the mismatch has been eliminated.

An event printer shall be supplied and installed. The event printer shall be integrated into the panel unless a separate event printer is accepted by the Architect. It shall be activated either by a fire alarm condition or by commands entered through the panel for the printing of system data essential for preventive maintenance. The print out for each alarm or trouble signal shall at least provide the following information :

(a) Condition of point

(b) Type of point

(c) Location of point plus numerical system address

The printer shall be capable of printing a minimum of twenty four characters per line and the minimum operating speed shall be 2 lines per second.

Operation of the printer shall not inhibit, delay or affect the functioning of the alarm and control system in anyway.

Where a separate event printer is provided and accepted by the Architect, the Contractor shall supply and install a wall mounted stand/rack near the panel to the approval of the Architect for housing the printer. Details of the stand shall be submitted for approval.

B8.6 ALARM REPEATER PANEL

Alarm repeater panels having an indicator for each zone of the fire alarm system shall be supplied and installed at locations as specified. They shall be provided with battery charger sets or backed up by the battery charger set in the main control and indicating panel.

Mimic diagrams, where specified, shall be of engraved laminated plastic or other approved non-deteriorating materials as specified and all lettering shall be legible in both English and Chinese.

B8.7 COMPONENTS AND EQUIPMENT COMPATIBILITY

All the devices, components and equipment used in the system shall be of highest quality and suitable for humid tropical working conditions. They shall be fully compatible with one another within the whole system.

Special attention is drawn to the compatibility between automatic detectors and control and indicating equipment and the Contractor shall supply information of the detectors and the required electrical interface with the control and indicating equipment. All the components in such a system shall preferably be from one principal system manufacturer forming one compatible system approved by LPCB or similar widely recognised independent regulatory body. Where components are manufactured by different firms, certificates shall be provided at the time of tendering from each source to guarantee that the various items are totally compatible. In this respect, a certificate from one source will <u>not</u> be acceptable.

B8.8 ALARM TRANSMITTERS

The alarm transmitter, where specified, shall be compatible with the Fire Services Department Computerized Fire Alarm Transmission System.

The connection and the service charge for linking with the FSD's approved centre for the whole Maintenance Period shall be obtained by the Tenderers from the Operating Company of the FSD's approved centre and entered in the place provided on the Form of Tender. The cost entered shall be the actual net cost as quoted by the Operating Company. Any on-cost, etc. shall be included elsewhere. The Contractor shall be responsible to pay the charge for linking with the Fire Services Department's agency and associated telephone point for the whole Maintenance Period.

The Contractor shall initiate applications to the appropriate agencies within three (3) months after commencement of the Contract to allow the fire alarm direct link to be connected and tested before statutory inspections. The Contractor shall submit a copy of the application document to the Architect for record. The Contractor shall co-ordinate and shall closely monitor the status of completion of fire alarm direct link and the telephone line before fire service inspection by FSD. The Contractor shall apply for and provide at the Contractor's own cost the required telephone point for connection of the fire alarm direct link as required. The Contractor shall co-ordinate with relevant parties and shall arrange the power supply point for the fire alarm control and indicating panel and for the fire alarm direct link as necessary. The Contractor shall be responsible to pay the initial, rental and maintenance charges for the leased line for fire alarm direct link and associated telephone point for the whole Maintenance Period. The Contractor shall supply and install all conduit works for the fire alarm direct link and associated telephone point. If the Contractor cannot complete the fire alarm direct link by the date of fire service inspection by FSD, the Contractor shall be responsible to provide all necessary manpower and telephone equipment, at the Contractor's own expenses, solely for the purpose for a 24-hour/day full attendant service to substitute the fire alarm direct link up to the date of the completion of the fire alarm direct link.

B8.9 CONTROL FOR AUXILIARY SYSTEMS

Control for the operation of auxiliary systems, including intermediate booster pumps, fire damper release mechanisms, door release mechanisms, smoke extract fans, fireman's lift, etc., where specified, shall comply with the requirements of the FSD and the Contractor shall carry out all associated electrical control wiring and connections unless otherwise specified.

B8.10 BATTERIES AND CHARGERS

All equipment in the fire alarm control system shall be backed up by battery charger set(s). The battery charger set shall be a solid state secondary D.C. power supply unit operating in parallel with a battery bank. The exact rated capacity shall be designed by the Contractor to supply a constant voltage and current for the combined standing load and alarm load.

The battery and charger set shall be capable of maintaining the system in normal operation for a period at least twenty-four (24) hours longer than the maximum period for which the premises are likely to remain unattended without recharging and

thereafter shall remain capable of operating in the maximum "alarm" condition for at least thirty (30) minutes for all connected units and/or capable of actuating the fire service installation as required. If the system is connected by an alternative standby supply such as an automatically started emergency generator approved by the FSD, the capacity of the battery and charger unit may be reduced to that capable of maintaining the system in normal operation for eighteen (18) hours and thereafter capable of operating in the maximum "alarm" condition for at least thirty (30) minutes and/or capable of actuating the fire service installation as required. The unit shall be able to recharge and restoring the battery bank back to its constant potential voltage setting in not more than twenty-four (24) hours after fully discharged.

The Contractor shall submit calculation to demonstrate that the offered capacity of the battery and charger unit is able to cope with the power demand of the whole system. In any case, the ampere-hour rating of the battery shall not be less than 10 AH.

Where applicable, the battery shall be of sufficient voltage to transmit signals to the Fire Services Department Computerized Fire Alarm Transmission System via the alarm transmitter unit and the telephone lines.

The charger unit shall consist of a rectifier bridge which has the A.C. mains input supplied via an isolation transformer and has the ripples of its D.C. output smoothed by a D.C. filter before supplying the connected load under normal operation or the battery after discharging in A.C. mains failure. The charging process shall be automatically controlled and switched by a control logic unit made up of printed circuit boards.

The battery charger set shall be manufactured to confirm to the current editions of the relevant standards as indicated below -

BS EN 61204	Specification for Performance Characteristics and Safety. Requirements of Low-voltage Power Supply Devices, D.C. Output.
BS 5654 (IEC 478)	Specification for Stabilized Power Supplies, D.C. Output
BS 7430	Code of Practice for Earthing
IEC 950	Specification for Safety of IT Equipment, including Electrical Business Equipment

The battery shall be sealed, high rate maintenance free nickel-metal hydride type, or a type of better functions and performance and approved by the Architect and shall have a proven life expectancy of at least four (4) years. It shall not have any memory effect as to affect its usable life or performance. The nickel-metal hydride battery shall comply with BS EN 61436 and BS EN 61951-2 where applicable.

The battery charger shall be compatible with the batteries used.

The battery charger set shall be designed and manufactured by a reputable manufacturer which has continuously manufactured battery charger set to work in conjunction with a wide range of applications for at least 5 years and their manufacturing facility shall have a local agent to provide full technical support which

includes adequate spare holding and technical expertise in testing, commissioning and trouble-shooting.

The following technical requirements shall apply: -

Input Voltage:	220V A.C. ±10% via 13A fused supply provided by Electrical Contractor
Frequency:	50 Hz ±5%.
Output Ripple Voltage:	±5% of D.C. output
Output Voltage:	To suit the offered fire alarm panel.
Output Current:	To suit the fire alarm system
Overcurrent Protection:	Mains fuse, charger fuse, battery fuse against overload and short circuit conditions.
Control:	Fully automatic
Instrument:	D.C. output voltmeter, D.C. output ammeter
Indication:	Mains and charger healthy Battery low-volt

Except for the proprietary unit approved by FSD and with ISO 9001/9002 quality system, the charger and battery set shall be housed in an industrial grade cabinet constructed from stainless steel to BS 970 Part 1 Grade 316S31 or other approved material of minimum 1.6 mm thick side and back plate and 1.6 mm thick hinged front door with key lock. Protection class of the cabinet shall not be less than IP 52 for indoors and IP 65 for outdoor application as specified in BS 3490. If approved materials other than Grade 316S31 stainless steel is used, the entire enclosure surface shall be applied with chemical rust inhibitor, rust resisting primer coat and top coat to give maximum corrosion protection.

The logic printed circuit board, together with the isolation transformer and fused mains input terminals, shall be factory assembled on a plate located at the rear of the case. The power transistors shall be mounted on heat sinks, separated from the printed circuit board, on the back plate. The instruments and LED indicators shall be mounted on the front door of the cabinet. A lower ventilated compartment inside the cabinet provides adequate space for accommodation of the storage battery bank and ventilation.

The following technical information shall be submitted by the Contractor to the Architect for approval prior to the ordering of equipment: -

(a) Technical catalogues and specification, calculation sheet for charger and battery capacity.

(b) Power supply unit circuit diagram.

(c) Control circuit diagram.

(d) Power supply unit front plate layout.

(e) Power supply unit console details.

The battery chargers unit including the printed circuit board shall be factory assembled and tested prior to delivery on site according to the manufacturer's testing manual. The delivery of chargers to site must be accompanied by the original factory test certificate. A statement or certificate shall be produced by the charger and battery set manufacturer for the proof of the life expectancy of the power supply unit supplied.

B8.11 AUXILIARY BATTERY

Where battery operation of auxiliary control systems is required, a separate sealed nickel-metal hydride battery (or battery of better functions and performance and approved by the Architect) and charger for these systems shall be supplied and installed and suitably labelled for indication. The main fire alarm system shall not be connected directly to any auxiliary circuits, other than those essential to the detection and alarm system as specified.

B8.12 DATE COMPLIANCE

No value for current or future date/time will cause any interruption to operation which will affect the performance or functionality of all or part of the systems and/or equipment (including any supplied or supported embedded systems, hardware, software, firmware, microcode and programmes).

B8.13 TRAINING FOR ADDRESSABLE SYSTEM

The Contractor shall provide adequate and separate training courses to not less than eight persons nominated by the Architect to enable them to understand and familiarise with the use, maintenance, programming and re-programming of the addressable system. Details and the proposed training programme shall be submitted to the Architect for approval. The training shall be conducted during normal working hours by approved trainers of the manufacturer unless otherwise approved by the Architect. The training shall be so designed that after completion of the course, the trained persons shall be able to carry out all the functions as defined in their corresponding level of access. A certificate/ acceptance letter shall be issued by the manufacturer of the addressable system or the manufacturer's approved agent stating that they are satisfied with the ability of the trained persons to operate and modify the programs of the addressable system without affecting system operation.

B8.14 FIRE ALARM INDICATION COMPUTER SYSTEM

Fire alarm indication computer system shall be supplied and installed where specified. It shall comprise a computer system for indication and monitoring of all fire service alarm and installation information. The computer system shall consist of high-resolution colour display monitor, keyboard, printer, signal cabling and a central processing unit. The computer system shall be used only for indication and display of the information for monitoring purpose without control functions unless prior approval is given by the FSD. Details of the fire alarm indication computer system and the software to be used shall be submitted to the Architect for approval.

Where the computer system is not included in the Works under Fire Service Installation, the Contractor shall co-ordinate with relevant parties to link up the fire alarm control system with the computer system of others through RS232 or other suitable approved means so that fire alarm and installation status information can be transmitted to the computer system instantaneously without delay. The computer system in this case is normally the building management system that will serve other purposes in addition to fire alarm indication. The Contractor shall co-ordinate with relevant parties and shall supply and install interfacing equipment that are compatible with the computer system, protocols, software, data and other information required for the transmission and reading of fire service data and signals on the computer system. The Contractor shall co-ordinate with relevant parties on the format and design of display of the fire service information in the computer system.

The computer system shall not interfere with the operation of the fire alarm control system. When the computer system is down or not functioning or has faults, the fire alarm control system shall still perform without any interruption.

The computer system shall comply with the relevant sections in the General A/C Specification. The computer system shall have facilities for displaying and monitoring of all fire service installation information and alarm. The design of the display and the operation of the computer system shall be user friendly to the approval of the Architect. The computer system shall display the fire service installation information and status in an approved format. Where the system is also used to display information for other installations, the display shall be designed for easy operation and for easy switching the display from one to another. The computer system shall provide both visual and audio warning and alarm message. It shall automatically pop up a message for attention by the operator whenever an alarm signal is received. Muting facilities shall be included but the alarm indication shall not be removed until the alarm signal is cleared.

The computer system shall have sufficient capacity and memories to hold all the fire service data for not less than three months. The Contractor shall supply and install facilities for archiving the data and a printer for the computer system.

The Contractor shall be responsible for the design of the fire alarm indication computer system and the selection of proper, correct and compatible equipment and components to achieve the performance specified and to provide the monitoring function. Detailed design as well as full technical information for the system shall be submitted to the Architect for approval prior to ordering and installation.

The Contractor shall supply and install power supply including battery charger set for the computer system.

Where specified, the Contractor shall provide internet/network link or similar facilities for the computer system and/or fire alarm control system to link up remote computer system of others for data transmission for remote site monitoring of fire alarm signals and other data in the computer system, fire alarm control system and fire control centre from a remote location inside the building or at an external site. The equipment and facilities shall be co-ordinated and shall be compatible with the equipment in the remote location so that the data and signals can be transmitted, read and accessed as required. Details shall be submitted to the Architect for approval.

Where specified, the computer system shall be equipped with software, hardware and control devices for remote diagnosis, testing and commissioning of the fire service equipment. Details shall be submitted for approval.

Where a computer unit is specified for the central monitoring, testing and logging system for the emergency lighting installation included in the Works, the computer unit shall deem to be a part and included into the fire alarm indication computer system when provided unless otherwise approved by the Architect.

B8.15 REMOTE MONITORING FACILITIES

Where specified, the Contractor shall design, supply and install intelligent monitoring facilities for remote monitoring of the alarm and status of the equipment, plant room conditions, and other functions. The facilities shall comprise: -

(a) Remote camera installed at the sensor points, in plant room, in control room, near fire service equipment, etc. and connected to the fire alarm indication computer system and other computer systems as appropriate.

(b) Local area network, wide area network, intranet, internet and other network facilities as appropriate.

(c) All necessary computer software, local monitors/television sets, monitoring devices and computer hardware.

(d) Sensors, control equipment and all necessary accessories.

The intelligent monitoring facilities will be used as a supporting tool for checking the fire situation when an alarm is sounded, monitoring the status/condition of equipment, monitoring the plant room condition, monitoring the operation of various fire service equipment, carrying out remote inspection and test, maintaining security of the fire service equipment, etc. The intelligent monitoring facilities shall not interfere with the operation of the fire service installation and equipment and shall not cause any interruption to the fire service installation and equipment when any part of the intelligent monitoring facilities fails.

Details of the intelligent monitoring facilities shall be submitted to the Architect for approval.

SECTION B9
ELECTRICAL INSTALLATION

B9.1 SCOPE OF THE WORK

The electrical installation shall include all switchgear, trunking, conduits and wiring works commencing from the electricity supply points provided by others as specified. The installation shall also include the interconnecting wiring works with other specified services, e.g. lift control, signage, fire damper/shutter, smoke control, ventilation and air-conditioning control, central control and monitoring, direct telephone link, etc. The Contractor shall supply and install surge arrester to protect the fire service equipment against power surge in the electrical installation.

B9.2 GENERAL ELECTRICAL SPECIFICATION

The electrical equipment, installation materials, cables, wiring, and installation practice, shall be to the standard called for in the relevant sections of the General Electrical Specification.

The electronic circuits and components shall comply with the current edition of the General Requirements for Electronic Contracts issued by the Electrical and Mechanical Services Department.

The Contractor shall employ Registered Electrical Workers of the appropriate grades in accordance with the Electricity Ordinance to carry out the electrical works for the fire service installation. All relevant certificates/test reports shall be duly signed by the Contractor and the Contractor's Registered Electrical Workers and submitted to the Architect for record.

All electrical equipment shall be rated for continuous duties at designed capacity. The circuits and equipment of the electrical installation shall be selected in such a manner that they are not susceptible to external electrical and magnetic interference as well as to supply harmonics on their normal operations and performance. On the other hand, they shall not cause interference, harmonics or other adverse effects to the normal and essential electrical supply systems as well as to other electrical equipment.

B9.3 ELECTRICITY SUPPLY

The electricity supply shall be 380 Volt 3 phase 50 Hz and 220 Volt single phase 50 Hz. All equipment and installations shall be suitable to operate with this main supply conditions. All equipment and installations shall be sized with continuous ratings at the designed duties with optimum performances and efficiencies, and with minimum acceptable temperature rises.

B9.4 WIRING SYSTEMS

Wiring shall be laid in concealed steel conduit and in steel trunking inside a fire rated protected enclosures/rooms/ducts unless otherwise specified. They shall be grouped and installed together in a neat and tidy manner.

B9.5 CONDUCTOR SIZES

Conductor sizes for alarm circuit wiring to automatic detectors and addressable fire alarm and control system shall be in accordance with the FOC Rules for AFA Installations and achieve satisfactory operation of the system. However, the conductor size shall not be less than 1.0 mm^2 in any case. The wiring system shall also be capable of being installed, and subsequently maintained, easily and without damage.

Conductor sizes for other application shall be strictly as required by the General Electrical Specification.

B9.6 CONDUIT AND TRUNKING SYSTEMS

Conduit and trunking shall be of steel complying with the General Electrical Specification. PVC conduit and trunking shall not be permitted.

In general, conduits shall be concealed, except in protected rooms having approved FRP rating such as in fire control room, pump room and sprinkler control valve cabinet/room, or unless otherwise specified. Conduit and trunking shall be completely separated from those of other services, and used exclusively and solely for the purpose with no wiring of other services present. Trunking shall only be used in fire rated protected enclosures/ducts/rooms having approved FRP rating.

Flexible conduits shall be used for the final connection from rigid conduits/boxes or trunkings to equipment. Each flexible conduit shall not be longer than 2 m in length. Suitable adaptors shall be installed at both ends of the flexible conduit. The adaptor shall be constructed from brass. Each adaptor shall comprise two parts, an inner core which screws into the bore of the conduit together with a ferrule which caps off the end of the conduit, so that the adaptor can provide an extremely strong joint. The core shall lock against the outer ferrule and also isolate any sharp cut edges in the conduit which can damage cables on insertion or in use.

Conduit and trunking shall be routed and installed in such a way as to give maximum protection against mechanical damage. Where it is unavoidable to run conduits across other services conduits, water pipes, air conditioning ducts, etc., they shall be installed first and fixed closest to the structure.

Galvanised iron draw-wires of adequate size shall be provided in all empty conduits.

B9.7 EARTHING

Proper earthing shall be supplied and installed for the electrical and electronic equipment as well as bonding of all exposed conductive parts of the fire service installation to the main earthing system as specified in the General Electrical Specification. All conductive moving parts such as hinged door of panel, battery and

charger cabinet, etc. shall be properly and sufficiently bonded by suitably sized flexible insulated cables to the fixed conductive part of the panel.

B9.8 IDENTIFICATION OF CONDUCTORS, CABLES AND CABLE DUCTS

Identification of conductors and cables on LV power circuits shall be in accordance with BS 7671 as specified in the General Electrical Specification, except that ELV alarm circuit wiring shall be identified by the basic colour white (or grey). Colour tracers may be used, in addition, to distinguish cables one from another.

All surface conduits, cable ducts and cable trays, fire resistance cables, low smoke zero halogen cables, armoured cables, MICC cables, etc. forming part of the fire service installation supplied and installed by the Contractor, shall be colour coded in red in such a way as to permit ready identification. Banding by means of paint will be acceptable where this can be carried out permanently and effectively. Durable high quality red plastic self-adhesive tape may be used for armoured and MICC cables. Colour bands shall be applied at intervals not exceeding three metres.

Suitable identification plates shall be supplied and installed on all electrical equipment giving voltage, current, wattage or other ratings and manufacturer' s name, trademarks or other descriptive markings by which the organization responsible for the product may be identified.

Each disconnecting means required for all electrical equipment and each electrical source of supply shall be legibly marked to indicate its purpose unless so located and arranged that the purpose is clearly self evident.

All markings and identifications shall be of sufficient durability to withstand the environmental effects.

B9.9 FIRE RESISTANT CABLES

Unless otherwise specified, fire resistant cables shall be in compliance with IEC 60331 / BS 6387 Category CWZ and shall be approved by the FSD and LPCB or similar widely recognised independent regulatory body for use in relevant applications.

For mineral insulated copper cables, it shall comply with BS 6207 / IEC 60702.

B9.10 LOW SMOKE ZERO HALOGEN CABLES

Low smoke zero halogen cables shall comply with the following standards: -

BS 7211 and BS 6724

IEC 61034	minimum value of light transmittance
IEC 60754 : Part 1	0.5% maximum acid gas emission
IEC 60754 : Part 2	4.3 minimum pH level of gas evolved

B9.11 MOTOR STARTER AND CONTROL AND INDICATING PANEL

Except for the proprietary panel approved by FSD and with ISO 9001/9002 quality system, the panel shall be constructed of at least 1.6 mm steel plate with lockable door. The panel shall have a degree of protection not less than IP 65 as specified in BSEN 60529. The panel shall be finished in white colour internally and grey colour externally. All electrical live parts shall be properly covered and protected from accidentally touched.

Control cables inside panel shall be neatly laid out and securely fastened. They shall be terminated in connection blocks where a schedule ferrule numbering system shall be provided. The numbering system shall be clearly indicated on the as-built schematic diagram attached to the back of the panel front door.

B9.12 CABLES AND WIRING USED FOR FIRE SERVICE INSTALLATION

Unless otherwise specified, the Contractor shall use the types of cables in Table 3 for different parts of the fire service installation or cables of better performance to the approval of the Architect. Where wiring in concealed conduit is one of the acceptable methods, it shall be used wherever possible and suitable unless otherwise specified. Armoured cable shall be used where required and where necessary.

Table 3 : Use of cables/wirings in fire service installation

Type of fire service installation or location	**Use of cables/wrings in different parts of the installation**	**Type of cable/wiring (Note 1)**
Audio/visual advisory system	The power supply/signalling cables to speakers and flashing directional signs from control panel/console and AV equipment.	E
Automatic fixed installations using water	The power supply cable from main/sub-main switchboards to electric motor of pumps including transfer and intermediate pumps.	A
Automatic fixed installations other than water	The power supply cable from main control panels to fire extinguishing agent actuating devices.	A
Emergency generator/Main backup power source	All outgoing power supply cables from emergency generators and other main backup power sources to main switchboards and to main essential power supply boards.	A

General emergency lighting except those for cinemas, theatres and scheduled premises	The power supply cable from main switchboards, sub-main boards, central battery supply or other power sources to emergency lighting fittings except for self-contained emergency lighting fittings.	B or E
General emergency lighting for cinemas, theatres and other scheduled premises	The power supply cable from main switchboards, sub-main boards, central battery supply or other power sources to emergency lighting fittings.	B or E
Exit sign	Same as general emergency lighting	B or E
Fire alarm system	The power supply/signalling cables to alarm bells and visual alarm signal units from fire alarm control and indication panels	E
Fire detection system	The power supply/signalling cables to audio/visual alarm/detection devices from fire alarm control and indication panels	E
Fire hydrant/hose reel system	The power supply cable from main/sub-main switchboards to electric motor of fixed fire pumps and intermediate booster pumps	A
Fireman' s lift	The power supply cable from main/sub-main switchboards to traction motors/car lighting/power circuit of lift	A
Fixed foam system	The power supply cable from main/sub-main switchboards to electric motor of pumps	A
Pressurization of staircases system	The power supply cable from main/sub-main switchboards to electric motor of fans	A
Ring main system with fixed pumps	The power supply cable from main/sub-main switchboards to electric motor of pumps	A
Sprinkler system	The power supply cable from main/sub-main switchboards to electric motor of pumps	A
Pre-action Recycling Sprinkler system	Heat detector circuit cables from and to the control panel	C Also refers to Section B3.23

Smoke extraction system	The power supply cable from main/sub-main switchboards to electric motor of fans	D
Water spray system	The power supply cable from main/sub-main switchboards to electric motor of pumps	A
Street Fire Hydrant System	The power supply cable from main/sub-main switchboards to electric motor of pumps	A
Places of public entertainment	Cables/wirings within the compartment	B or E
Power circuits not covered in other items in this table and installed by the Contractor	Cables from main switchboards to control panels/consoles of various fire service installation	A (unless otherwise specified)
Hazardous areas/ Dangerous goods stores	Cables/wirings within the compartment	Depend on the hazard zone, 0,1,2. Also refers to Section B9.13

Note 1: Types of cables

Type A: Fire resistance cable complying with IEC 60331 / BS 6387 Category CWZ, or products having equivalent functions and performance.

Type B: Mineral insulated copper sheathed cable complying with IEC 60702 / BS 6207-1, or products having equivalent functions and performance.

Type C: Fire resistance cable same as type E and can withstand 815^{o}C temperature for at least thirty (30) minutes, or products having equivalent functions and performance.

Type D: Fire resistance cable same as type A and can operate continuously for at least one (1) hour at 250^{o}C temperature, or products having equivalent functions and performance.

Type E: Fire resistance cable same as type A approved by FSD and having low smoke zero halogen emission equivalent to BS 7211 or BS 6724 and tested to comply with Section B9.10 in according to IEC 601034 and IEC 60754, or products having equivalent functions and performance.

Except for the hazardous areas, the following are acceptable methods alternative to Table 3:

(a) Cables running in trunkings or in cable trays inside fire resistant plant rooms/enclosures of approved fire rating where termination of cables at both ends are located.

(b) Cables running inside concealed steel conduits embedded in concrete.

(c) Cables running inside underground cable ducts and reinforced concrete cable trenches of approved fire rating.

(d) Cables embedded inside soil or concrete.

(e) Cables running within fire resistant cable ducts and not mixing with other services and with fire resistant rating of cables ducts not less than that of the corresponding building compartment.

And the cables in the alternative acceptable methods (a), (b), (c), (d) and (e) shall comply with the following:

(i) Where cables run within cable ducts/conduits, they shall not be mixed with other services.

(ii) For cables connecting centrally supplied emergency luminaires, the cables shall be at least Category B cable to BS 6387 or IEC 60331.

(iii) For cables connecting emergency luminaires in cinemas, theatres and other specified premises used for entertainment, the cables shall be of Type B or E in Table 3 approved by FSD, and shall be fully segregated from the general distribution system.

(iv) For cables for fireman's lift, for emergency generator and for smoke extraction fan, the cables shall be at least Category CWZ to BS 6387 or IEC 60331.

(v) For cables to pre-action recycling sprinkler system, the cables shall withstand 815^{o}C for at least thirty (30) minutes.

(vi) For control cables to the smoke extraction system and pressurization of staircases system, the control cables shall be at least Category AWX to BS 6387 or IEC 60331 and shall be suitable for continuous operation at 250^{o}C for least one (1) hour.

(vii) For cables from essential power switchboards to all kinds of pumps in fire service installation including sprinkler pumps, fixed fire pumps, drencher pumps, street hydrant pumps, jockey pumps, intermediate booster pumps, foam pumps, ring main fixed pumps, transfer pumps, etc., the cables shall be at least Category AWX to BS 6387 or IEC 60331.

(viii) For cables other than the cases in (ii) to (vii), the cables shall be PVC insulated cables complying with General Electrical Specification in concealed steel conduits or PVC insulated and sheathed steel wire, with or without armour as required, complying with General Electrical Specification

in approved fire rated plant room, in approved fire rated cable ducts, in underground cable ducts, or embedded inside soil, or products having equivalent performance and function.

B9.13 ELECTRICAL EQUIPMENT IN HAZARDOUS AREAS

The electrical equipment used shall depend on the classification of the hazardous areas into zone 0, zone 1 and zone 2 in IEC 60079. Intrinsically safe equipment and materials complying with marking EX ia IIC T5 or EX d IIC T5 to IEC 60079 or products having equivalent or better functions and performance shall be used for all zone 0 and zone 1 hazardous areas. Special protection equipment and explosive proof equipment specially certified by an approved body for use in zone 0 can be used with the approval of the Architect for zone 0 and zone 1 hazardous areas. For zone 2 hazardous areas, spark-proof enclosure or intrinsically safe equipment complying with marking EX ib or EX e in IEC 60079 or products having equivalent or better functions and performance shall be used unless otherwise specified.

Unless otherwise specified, wirings in zone 0 and zone 1 hazardous areas shall be of mineral insulated metal sheathed cable to IEC 60702 / BS 6207 with compatible and explosive proof terminating glands or products having equivalent or better functions and performance. Wirings in zone 2 hazardous areas shall be in concealed conduits or of fire resistance cables of appropriate type. Terminations of cables shall use sealing fittings, ground continuity connection or explosive proof seal whichever is appropriate.

All electrical and electronic equipment used in hazardous areas shall be approved by the FSD and certified by the British Approval Service for Electrical Equipment in Flammable atmosphere (BASEEFA) or by other recognised certification bodies acceptable to FSD.

SECTION B10
PORTABLE HAND-OPERATED APPROVED APPLIANCES

B10.1 GENERAL

Portable hand-operated approved appliances include fire extinguishers, fixed sprayer units, fire blankets, sand buckets and any other fire service equipment used as an independent means for the purpose of extinguishing, attacking, preventing or limiting a fire. It shall also include the fixed automatically operated approved appliances installed in a room. Only portable appliances in the list approved by the Director of Fire Services will be accepted. All mounting fixtures and labour for installation shall be provided. Inspection, repair and maintenance of the portable appliances throughout the contract period shall be carried out by a person employed by the Contractor, who shall be registered with the FSD as a Registered Fire Service Installation Contractor in Class 3.

The Contractor shall be responsible for the supply, fixing and installation of the portable hand-operated approved appliances. Wall mounting brackets shall be supplied and installed by the Contractor.

Where there are several fixed automatically operated appliances of similar types in a compartment, the Contractor shall, unless otherwise not required by FSD, supply and install control such that the operation of any one unit will cause all similar units within the compartment to operate.

Where portable hand-operated approved appliance is installed in the public areas, the Contractor shall submit details of the fixing and the builder's work requirements to the Architect for approval with particular attention to the requirements for preventing the appliance from being stolen. Remote monitoring facilities shall be supplied and installed where specified which will be energised when the appliance is lifted up or removed. Portable hand-operated approved appliance located outdoors shall be installed inside a cabinet to the approval of the FSD and the Architect. Where the portable hand-operated approved appliance is installed outdoor, the Contractor shall include details of the cabinet requirement acceptable to the FSD for housing the appliance in the submission of builder's work requirement to the Architect for approval.

B10.2 FIRE BLANKETS AND SAND BUCKETS

Fire blankets and sand buckets shall conform to the requirements of the FSD. Buckets shall be of not less than 10 litres capacity and shall be galvanised steel and painted red.

B10.3 FIRE EXTINGUISHERS

Fire extinguishers shall be rechargeable hand-operated extinguishers of appropriate type to BS EN 3 Part 1 to 6, NFPA 10, ISO 7165 and BS 7863 for water, foam, dry powder, carbon dioxide, NASF III, FM200 or other approved agent type with a capacity as specified. Foam and powder type extinguishers shall be cartridge operated with a replaceable gas cartridge fitted into the extinguisher. Fire extinguishers of type requiring turning upside down before use are not acceptable. All fire extinguishers

shall be properly labelled with appropriate instructions of use and with indication of the expiry date.

Fire extinguishers shall be manufactured and tested to recognised international standards. The Contractor shall submit batch-approval certificate, batch-approval certification mark, or other evidence showing that the extinguisher has been batch-approved by recognised bodies or organisation acceptable to the FSD after manufacture. Extinguisher without batch-approval certificate/mark or other approval documents will not be accepted.

Where the type of fire extinguisher is not indicated, the Contractor shall submit the appropriate type of fire extinguisher for the hazard and the occupancy to the Architect for approval.

B10.4 FIXED SPRAYER UNITS

Fixed sprayer units shall be of self-contained automatically operated inert gas or dry powder type fitted with a sprinkler head which activates at 68^{o}C approximately. For rooms fitted with inert gas automatic extinguishers, identification symbols prescribed by the FSD shall be supplied and installed and fixed to each entrance door. The fixed sprayer unit shall be properly labelled with indication of the expiry date.

SECTION B11
EMERGENCY LIGHTING, EXIT SIGN AND EMERGENCY GENERATOR

B11.1 EMERGENCY LIGHTING

B11.1.1 General

Emergency lighting shall comply with BS 5266 Part 1 and shall be backed up by emergency power supply. Emergency lighting shall include the centrally supplied emergency luminaires or the self-contained emergency luminaires depending on the applications. Unless otherwise specified or approved by the Architect, centrally supplied emergency luminaires shall be used.

Emergency lighting shall be supplied and installed throughout the entire building and for all exit signs and routes in accordance with FSDCOP and FSD Requirements and Circular Letters.

B11.1.2 Lighting Luminaire

All emergency lighting luminaires shall be designed and constructed in accordance with BS EN 60598-2-22. The emergency lighting luminaires used on defined escape routes shall comply with the non-flammability (resistance to flame and ignition) provisions specified in BS EN 60598-2-22 and external parts shall be subjected to the 850^{o}C hot wire test and any burning parts shall self-extinguish within 30 s. For each enclosed space required to have emergency lighting luminaries, the number of emergency lighting luminaires or the lamps in the emergency lighting luminaries shall not be less than two. The emergency lighting luminaires shall be designed to activate within one (1) second upon power failure or within the time specified in FSDCOP whichever is earlier.

Emergency luminaires shall be capable of operating satisfactorily in the emergency mode at an ambient temperature of 70^{o}C for at least half of the rated duration.

For emergency luminaire that is normally off, the luminaire shall be energised to achieve at least 50% of rated lumen output in not more than five (5) seconds, or the time specified in FSDCOP whichever is earlier, after failure of the normal supply and full rated output in less than sixty (60) seconds after failure of the normal supply.

The nominal operating voltage of the emergency lighting system shall be clearly marked and readily identifiable, for centralized systems this shall be either on or adjacent to the control unit of central battery and for non-centralized systems this shall be on or adjacent to the appropriate luminaires. In addition, all luminaires providing emergency lighting shall be marked with details of the replacement lamp necessary to obtain the performance.

All emergency luminaires shall be backed up by battery system. Where emergency electrical power supply is available, the emergency luminaires shall be connected to the emergency electrical power supply in addition.

B11.1.3 Self-contained Emergency Luminaire

Self-contained emergency luminaires shall have adjacent to them or incorporate in them a device for charging the battery from the normal mains supply and an indicator visible in normal use which shows the following conditions:

(a) The battery is being charged.

(b) Circuit continuity exists through the lamp element.

Where an electrical light source indicator is used, it shall comply with the colour requirements of IEC 60073. When a single indicator provides dual functions, either red or green is acceptable.

Self-contained emergency luminaires shall incorporate a sealed nickel-metal hydride battery or battery of better functions and performance and approved by the Architect and is designed for at least four (4) years of normal operation, i.e. at the end of four years, the battery can still provide the rated duration.

The battery shall have ample capacity to maintain the output of the luminaire for a period complying with FSDCOP and BS 5266 Part 1 and for at least two (2) hours. For sleeping accommodation and premises required in BS 5266 Part 1 having no emergency generator, the duration of battery supply shall be at least three (3) hours. The light output from the luminaire shall not be less than 50% of the nominal light output throughout the discharging period in the rated duration at emergency mode. The batteries shall be designed to have an operating life of not less than four (4) years.

The battery charger shall provide the rated charge performance specified by the battery manufacturer to charge batteries within twenty-four (24) hours and within the time specified in FSDCOP and FSD Requirements and Circular Letters after a total discharge of the battery. The battery charger shall be compatible with the battery system.

Transformers built into self-contained emergency luminaires for charging the batteries shall comply with the relevant requirements stipulated in IEC 60742.

The Contractor shall ensure that the circuit and power supply arrangement of any self-contained emergency luminaire shall be such that the normal charging operation of the batteries in the luminaires shall not be affected or interrupted under all circumstances and even when the luminaire is switched off.

B11.1.4 Centrally Supplied Emergency Luminaire

The power supply to the centrally supplied emergency luminaires shall be fed from a central battery power supply system. Unless otherwise specified, AC emergency luminaires shall be used and the central battery power supply system shall provide AC power supply to the emergency luminaires. The central battery power supply system shall consist of rectifier/charger, inverter, storage battery, switchgears, controls and instrumentation for supplying AC mains power and charging the storage battery during the normal mode and for changing over to supply power from the storage battery and inverter during the emergency mode. Alternatively, uninterrupted power supply system consisting of static transfer switch with synchronizing and phase lock equipment, maintenance bypass switch, storage battery, charger, rectifier, inverter etc. providing equivalent functions and performance can be used for the central battery power supply system.

The central battery power supply system shall be designed to operate in the following modes:

Normal	AC mains supply shall be rectified into regulated DC voltage for float charging the battery. AC mains supply shall be provided to the centrally supplied emergency luminaires or be powering the inverter to supply the centrally supplied emergency luminaires.
Emergency (AC mains failure)	Upon failure of AC mains supply, the power supply shall be changed over and fed from the storage battery and inverter. The changeover shall be complete in less than one (1) second or within the time specified in the FSDCOP whichever is earlier. Normal mode shall be resumed after the AC mains supply is restored.

The central battery power supply system shall be designed to support non-maintained of emergency luminaries and/or maintained types of emergency luminaries or both as shown on the Drawings and in the Specification. Where there is only one central battery power supply system supplying power to both non-maintained types and maintained types of emergency luminaries, the central battery power supply system shall have at least two separate power circuits, or alternatively, two central battery/inverter sets, so as to provide separate control for non-maintained types and maintained types of emergency luminaries during normal mode and emergency mode.

The central battery power supply system shall be designed and manufactured by a reputable manufacturer which has continuously manufactured the system for at least 5 years and their manufacturing facility shall have a local agent to provide full technical support which includes adequate spare holding and technical expertise in testing, commissioning and trouble shooting. The central battery power supply shall be manufactured under recognized international standards of quality assurance programme such as ISO9001 or EN50091-2.

A monitoring, control and information panel shall be located on the front of the system cubicle. It shall be capable of acquiring, logging and reporting data, alarms and instruction reflecting the operating conditions of the central battery power supply system, which includes, but not limited to, the following and other data required for routine testing:

Power Input	Input mains voltage Input current Input mains frequency
DC Link	Battery voltage Rectifier output current Battery charge/discharge current Remaining capacity Battery cabinet temperature
Inverter Output	Output voltage Output current Output frequency

The following technical information shall be submitted by the Contractor to the Architect for approval prior to the ordering of equipment:

(a) Technical catalogues and specification of the central battery power supply system.

(b) Detailed calculation for charger and battery capacity with battery manufacturer's battery discharge data for verification purposes.

(c) Power supply unit circuit diagram.

(d) Control circuit diagram.

The battery and charger for the centrally supplied emergency luminaire system shall comply with Section B8.10 and as described below.

The battery for the centrally supplied emergency luminaire system shall be sealed, rechargeable and maintenance free nickel-metal hydride type, or a type of better functions and performance and approved by the Architect. The total battery capacity shall be capable of maintaining light output after mains failure of all the centrally supplied emergency luminaires at not less than 50% of the nominal light output for maintained emergency luminaires and the nominal light output for the non-maintained emergency luminaires for a period complying with FSDCOP and BS5266 Part 1 and for at least two (2) hours for buildings without emergency generators, cinemas, theatres and other scheduled premises, and for at least fifteen (15) minutes for other buildings with emergency generators. For sleeping accommodation and premises required in BS 5266 Part 1 having no emergency generator, the duration of battery supply shall be at least three (3) hours. The nominal light output for maintained emergency luminaire is based on the condition with mains supply. The nominal light output for non-maintained emergency luminaire is based on the condition with battery supply. The charger shall be compatible with the battery system and shall be capable of recharging the

batteries to full capacity within twenty-four (24) hours and within the time specified in FSDCOP and FSD Requirements and Circular Letters after a total discharge. The batteries shall be designed to have an operating life of not less than four (4) years.

B11.1.5 Testing Facilities

Each emergency lighting system shall have suitable means for simulating failure of the normal supply for test purposes.

For centrally supplied emergency luminaire system, testing facilities shall be supplied and installed for the following tests:

(a) Weekly voltage test and, where applicable, hydrometer test.

(b) Monthly discharge test of one (1) minute at 10-hour discharge rate.

(c) Annual lamp test for at least half of the rated duration.

(d) Lamp test for full rated duration in every three years.

For self-contained emergency luminaire, test facility (either with an integral test facility or with the means of connection to a remote test facility) shall be supplied and installed for the following tests:

(a) Monthly discharge test of one (1) minute at 10-hour discharge rate.

(b) Annual lamp test for at least half of the rated duration.

(c) Lamp test for full rated duration in every three years.

B11.1.6 Central Monitoring, Testing and Logging System

The central monitoring, testing and logging system refers to all kinds of automatic, self or remote system for central monitoring, testing and logging the performance of the emergency lighting installation to comply with the routine testing requirements of FSD as a central unit or as a stand alone remote control unit or as a portable unit. For automatic central monitoring, testing and logging system, all the emergency luminaires shall be connected to a computer unit supplied and installed by the Contractor running 32 bits or above through the RS232 serial port or other approved means via suitable interfacing units for monitoring and data logging. The computer unit shall comply with the relevant sections in the General A/C Specification.

Unless otherwise approved by the Architect, central monitoring, testing and logging system shall be supplied and installed for the self-contained emergency luminaires where they are installed at ceiling level higher than 3.5 m and/or where the total number of self-contained emergency luminaires plus exit signs required in the Contract is over 50 and/or where specified. Where the type of central monitoring, testing and logging system is not stated, the Contractor shall supply and install the automatic central monitoring, testing and logging system with the computer unit. Where agreed by the Architect, the Contractor may propose an appropriate type according to the locations and number of emergency luminaries for approval

by the Architect. Where self-contained emergency luminaires are identical in appearance with the non-emergency luminaires, suitable labels to the approval of the Architect shall be attached to the emergency luminaires for identification in visual inspection.

The automatic/self/remote central monitoring, testing and logging system shall have facility to initiate all tests required in the FSDCOP and FSD Requirements and Circular Letters for weekly, monthly and annual tests and to communicate with the luminaires and register failures from a remote location. Each luminaire shall be assigned with a unique address and the central monitoring, testing and logging system shall have a minimum capacity of communicating with at least 1000 luminaires or as specified.

The Contractor shall be responsible for the design of the central monitoring, testing and logging system and the selection of proper, correct and compatible equipment and components to achieve the performance specified. Detailed design as well as full technical information of the system shall be submitted to the Architect for approval prior to ordering and installation.

In selecting makes and types of equipment, the Contractor shall ensure that servicing facilities and replacement spare parts can be available locally for future maintenance of the system.

The central monitoring, testing and logging system shall provide a fully automated microprocessor based system providing detailed testing of all emergency luminaires (either self-contained emergency luminaires or centrally supplied emergency luminaires, or a combination of both) connected to the system. Tests can be programmed at dates and times to suit the end user's requirements to perform the following tests:

Table 4 : Routine test requirements for emergency luminaire

Centrally supplied emergency luminaire	**Self-contained emergency luminaire**
Weekly voltage test for the battery (and hydrometer test where applicable)	
Monthly discharge test of one (1) minute at 10-hour discharge rate	Monthly discharge test of one (1) minute at 10-hour discharge rate
Annual lamp test for half of the rated duration	Annual lamp test for half of the rated duration
Lamp test for full rated duration in every three years	Lamp test for full rated duration in every three years

The Contractor shall allow in their offer to modify the programme 2 more times at no extra cost during the Maintenance Period after the acceptance of the system to suit the end user's requirements.

B11.1.7 Wiring for Emergency Luminaire

The installation shall comply with BS 5266 Part 1 and BS 7671. The requirements in Section B9.12 shall be followed.

Unless otherwise specified, all wirings for the battery set, emergency luminaires and other equipment for the emergency luminaire installation shall be supplied and installed by the Contractor commencing from the power supply point(s) as shown on the Drawings.

Where emergency generator power supply is provided, the emergency luminaires shall also be connected to the emergency generator power supply.

B11.1.8 Segregation

The wiring of escape lighting installations shall be exclusive to the installation and separate from the wiring of any other circuits, either by installation in a separation conduit, trunking, or by separation from the conductors of all other services by a mechanically strong, rigid and continuous partition of non-combustible material. Any metal partition shall be electrically earthed to BS7671.

B11.1.9 Isolators, Switches and Protective Devices

Each isolator switch, protective device, key and operating device shall be marked "EMERGENCY", "ESCAPE" or "STANDBY LIGHTING" as appropriate and the marking shall indicate its use.

B11.1.10 Electromagnetic Compatibility

Emergency lighting systems shall be designed and installed such that they do not cause electromagnetic interference, in accordance with EMC Directive 89/336/EEC.

B11.1.11 Certifying the Installation

Where specified that there is emergency lighting installation in a particular project not included in the Works under Fire Service Installation or not carried out by a registered fire service contractor, the Contractor shall co-ordinate with relevant parties, inspect and witness the final tests on the emergency lighting installation to identify any non-compliance with the requirements in the FSDCOP, FSD Requirements and Circular Letters, and TC3. Any works found not complying with the fire service requirements of the FSD shall be rectified when they are included in the Works or be reported to the Architect when such works are carried out by others before arranging inspection with the FSD. The Contractor shall co-ordinate with relevant parties to carry out final functional test and performance test of the emergency lighting installation and their certification by relevant parties. The Contractor shall include the emergency lighting installation in the submission to the FSD.

B11.2 EXIT SIGN

Exit signs shall conform to BS 5499. Exit signs shall include all related directional signs in exit routes. Exit signs shall be internally illuminated bearing the words "EXIT 出口" in block letters and characters of not less than 125mm high with 15mm wide strokes. Colour contrast for translucent surrounds to lettering shall be either one of the following combinations or as specified:-

Colour	Contrasting Colour
Green	White
White	Green

The colour combination selected shall be consistent throughout the same building. The colour shall not deteriorate or become faint throughout the service life and lasts for at least ten years.

Where it is shown on the Drawings that a sign cannot be installed immediately above an exit or if an exit sign cannot be visible from normally occupied parts of the premises, an internally illuminated directional sign conforming to BS 5499 Part 1 shall be supplied and installed. The graphic design of directional sign shall conform to FSDCOP and FSD Requirements and Circular Letters.

Self-luminous exit signs carrying radioactive substances shall not be used. All illuminated exit signs shall be connected to the main supply. Self-contained exit signs shall be provided with secondary battery. Central supplied exit signs shall be connected to the central battery set of the emergency luminaire installation. Centrally supplied exit signs or self-contained exit signs shall be supplied and installed as specified. Where centrally supplied emergency luminaires are supplied and installed, centrally supplied exit signs shall be used unless otherwise specified. Where emergency power supply is available, the exit signs shall also be connected to the emergency power supply. The design operating life of the batteries shall not be less than four years. The battery, charger, wiring and testing facilities of the exit signs shall comply with the relevant requirements of the centrally supplied emergency luminaires or the self-contained emergency luminaires as specified in Section B11.1. The luminaires for exit signs shall be of maintained type.

The construction details, finishes and appearance of the exit signs shall be submitted to the Architect for approval before fabrication. The Contractor shall allow modifying the appearance and details of the exit signs to the satisfaction of the Architect.

All wirings for the exit signs commencing from the power supply points as shown on the Drawings shall be supplied and installed by the Contractor.

Where illuminated exit signs are supplied and installed in places like theatres, cinemas, stages, etc., with operation/performance mostly conducted in a dark environment, the exit sign shall be of such design that the illumination shall be kept to the minimum level enough to satisfy the statutory requirements but shall not be too bright as to cause discomfort to the public or to affect the operation/performance taking place.

B11.3 EMERGENCY GENERATOR

The emergency generator shall comply with the relevant requirements as specified in the General Electrical Specification and the Particular Specification, and certified by a Registered Professional Engineer in Hong Kong under CAP 409 in approved disciplines (or equivalent approved professional qualification). The Contractor shall be responsible to carry out all tests to the satisfaction of the Architect and the FSD on completion of the installation.

Where specified that there is emergency generator installation in a particular project not included in the Works under Fire Service Installation or not carried out by a registered fire service contractor, the Contractor shall co-ordinate with relevant parties, inspect and witness the final tests on the emergency generator installation to identify any non-compliance with the requirements in the FSDCOP, FSD Requirements and Circular Letters, and TC3. Any works found not complying with the fire service requirements of the FSD shall be rectified when they are included in the Works or be reported to the Architect when such works are carried out by others before arranging inspection with the FSD. The Contractor shall co-ordinate with relevant parties to carry out final functional test and performance test of the emergency generator installation. The Contractor shall include the emergency generator installation in the submission to the FSD.

During the test on emergency generator installation, the Contractor shall co-ordinate and check that all fire service installations and equipment and related fire service installations requiring emergency power supply at the time of fire outbreak and power interruption are tested to operate on emergency power as specified.

The emergency generator shall have a minimum continuous full load rating of not less than the consumption of all fire service installations and equipment and fireman's lifts connected thereto. It shall not be connected to other electrical load without the approval of the FSD and the Architect. Where the emergency generator is used to supply other electrical load in the emergency mode and approved by FSD, the Contractor shall supply and install visual and audio indication on the generator control panel and on the fire service control panel when the fuel storage for supplying the fire service installations and equipment and fireman's lifts is less than 7 hours. When the fuel storage is below the 6-hour requirement for the fire service installations and equipment and fireman's lifts, the Contractor shall supply and install facilities to cut off all other non-fire service related electrical load connected to the emergency generator with visual and audio indication. The Contractor shall provide a sign inside the emergency generator room and main switch room in accordance with FSDCOP to indicate the essential loading of the fire service installations and equipment and fireman's lifts connected to the emergency generator.

B11.4 INSTALLATION AND CERTIFICATION

The Contractor shall employ Registered Electrical Workers of the appropriate grades in accordance with the Electricity Ordinance to carry out the emergency lighting, exit sign and emergency generator installation. All relevant certificates/test reports shall be duly signed by the Contractor and the Contractor's Registered Electrical Workers and submitted to the Architect for record.

SECTION B12
MECHANICAL, SPECIAL AND RELATED FIRE SERVICE INSTALLATIONS

B12.1 MECHANICAL FIRE SERVICE INSTALLATION

Mechanical fire service installation shall include ventilation and air conditioning control system, pressurization of staircases system, smoke extraction system and automatic actuating devices.

Where specified that there are parts of the mechanical fire service installation in a particular project not included in the Works under Fire Service Installation or not carried out by a registered fire service contractor, the Contractor shall co-ordinate with relevant parties, inspect and witness the final tests on the mechanical fire service installation to identify any non-compliance with the requirements in the FSDCOP, FSD Requirements and Circular Letters, and TC3. Any works found not complying with the fire service requirements of the FSD shall be rectified when they are included in the Works or be reported to the Architect when such works are carried out by others before arranging inspection with the FSD. The Contractor shall co-ordinate with relevant parties to carry out final functional test and performance test of the mechanical fire service installation. The Contractor shall include the mechanical fire service installation in the submission to the FSD.

All automatic actuating devices controlled by automatic detection system and fire alarm system shall be supplied and installed by the Contractor. All power, controls and wiring shall be included.

All works for the mechanical ventilation system, smoke extraction system and pressurization of staircases system in the buildings shall be carried out by a contractor registered both with the FSD and with the Building Authority complying with the statutory regulations.

The Contractor shall design, supply and install the pressurization of staircases system and smoke extraction system and shall employ a Registered Professional Engineer in Hong Kong under CAP 409 in building services or mechanical discipline (or equivalent approved professional qualification) who emphasizes on and is specialized in mechanical ventilation and air handling installation to the approval of the Architect to carry out the design and supervision of the submission, installation and testing of the systems.

All linings for acoustic, thermal insulation and decorative purposes in ducting and piping shall be of Class 1 or 2 rate of surface spread of flame complying BS 476 Part 7, or brought up to the required standard by the use of an approved fire retardant product.

B12.2 VENTILATION AND AIR CONDITIONING (VAC) CONTROL SYSTEM

Unless otherwise specified, ventilation and air conditioning control system required by FSD shall be included in the Works under Fire Service Installation. The Contractor shall co-ordinate on the interfacing of the VAC control system with the ventilation and

air conditioning installation works and submit the drawings to the Architect and to the FSD for approval giving all details of the installation works including:

(a) Flow rate of each ventilation fan.

(b) Ventilation fans required to be tripped off.

(c) Method used to trip off the fans.

(d) Location of manual stop switch.

(e) Schematic diagram showing air side arrangement.

(f) Operating principles for tripping the fans.

(g) Location and layout of indication/control panel, or if any, interconnection with fire alarm control system.

The VAC control system shall be of fail-safe design. A bypass key switch with visual and audible indications in the panels shall be included for isolating the VAC control system temporarily during routine maintenance fire alarm testing. Three keys shall be provided.

Where required by the FSD and approved by the Architect, activation of detectors provided solely for the VAC control system shall not sound the general fire alarm and shall not send the fire signal via the fire alarm direct link and alarm transmitter. However, an alarm with audio and visual indications shall be provided on the control panels.

B12.3 PRESSURIZATION OF STAIRCASES SYSTEM

Pressurization of staircases system shall be supplied and installed where specified. The pressurization of staircases system shall comply with the requirements in the FSDCOP, FSD Requirements and Circular Letters, and BS 5588. The Contractor shall submit the design, drawings and the calculation of the pressurization of staircases system to the Architect and to the FSD for approval giving all details confirming compliance with the FSDCOP, operating principles, schematic diagram, layout, control and catalogues on the door sets and other equipment. The Contractor shall indicate the relationship between the pressures in various parts of the building especially in areas provided with air conditioning and the pressure in the staircase.

Where parts of the system or the whole of the systems are not included in the Works under Fire Service Installation or not carried out by a registered fire service contractor, the Contractor shall co-ordinate with relevant parties, check, inspect and witness the final tests to identify any non-compliance with the FSDCOP and FSD Requirements and Circular Letters. Any works found not complying with the fire service requirements of the FSD shall be rectified when they are included in the Works or be reported to the Architect when such works are carried out by others before arranging inspection with the FSD. The Contractor shall include the pressurization of staircases system in the submission to the FSD. The Contractor shall co-ordinate on various parts of the works particularly on the co-ordination on the builder's portions e.g. door frames and closers, etc. with the mechanical portions e.g. fans, etc. and electrical

portions e.g. cables, etc. to ensure the system meeting the functional and performance requirements.

(a) The compartment to be protected and the location of pressurization of staircases fans / equipment shall be as indicated on the Drawings. The layout of ductwork and associated accessories shown on the Drawings are indicative. The Contractor shall be responsible for the design of the complete system in according to the assessment of the final resistance and with allowance for adjustment, based on the actual duct run and the effects on performance with respect to the offered equipment used for the system.

(b) The Registered Professional Engineer employed by the Contractor for the pressurization of staircases system shall arrange all submissions including all necessary forms, drawings and technical information to FSD for the consent and inspection of pressurization of staircases system installation. The submission shall include all necessary schematic diagrams required to fully explain the operation of the installations including at least information on "normal", "fire", and "no power" modes with full co-ordination with other services. The Registered Professional Engineer shall sign and certify on the submission that the entire systems have been properly designed, selected, tested and checked, and that all components, materials and workmanship comply fully with the requirements of the FSDCOP, British Standard 5588 - "Fire Precautions in the Design of Buildings": Part 4 "Smoke Control in protected escape routes using pressurization" latest edition and the FSD Requirements and Circular Letters.

Notwithstanding that the Contractor demonstrates the whole system will perform to the standard requirements via numerical calculation to the satisfaction of the Architect and FSD, the Contractor shall be responsible for ensuring that the system under test does in fact perform in accordance with the Specification with fire compartment be maintained at all times.

The Contractor shall supply and install all components necessary for full operation of the system in automatic or manual mode regardless of whether such components are specified or not. The pressurization of staircases system shall be able to maintain minimum pressurization level at 50 Pa minimum inside the stairwell with all doors closed and all pressure relief systems remain operating. The maximum pressurization level shall be maintained such that under no circumstances shall the combined force, to overcome the pressure differential across any door and the action of the door closer, exceed 133 N or a figure approved by FSD when applied at the door opening handle or push plate position. The pressurization of staircases system shall maintain air flow through the open door of air velocity not less than 2 m/s or a figure approved by FSD during the open door situation. The number of open doors shall be as required by FSD.

(c) The Contractor shall supply and install pressurization fans as shown on the Drawings and where required to satisfy the pressurization requirements. For buildings with more than one pressurized staircase, duplicate motors for each fan shall be supplied and installed. The pressurization fans shall have variable flow control such that the pressurization requirements can be met within a period approved by FSD of a door being opened or closed.

When the pressurization fan is not installed inside a separate fire resistant plant room or when the plant room contains other services installations, the fan and motor assemblies shall be enclosed by fire resistant enclosure with a FRP not less than that of the staircase served.

The nominal motor for the ventilating fans (extraction or make-up) shall provide rating of minimum 20 % higher than the motor operating power input under nominal operating requirement. The motor windings shall be insulated to permit motor operation at design conditions for a period of one (1) hour in an ambient temperature of 250 °C.

(d) The Contractor shall supply and install pressurization ductwork and the associated fittings for the pressurization of staircases system. Unless otherwise specified, the fabrication and testing of all ductworks shall conform to DW 143 & DW 144 and the requirements stipulated in this General Specification. All ductwork shall be fabricated from galvanised sheet steel and aluminium sheets shall not be accepted.

All pressurization ductwork installed outside the pressurized staircase shall be enclosed by fire resistant enclosure with a fire rated period not less than the compartment served. Another arrangement is for ductwork section installed inside the designated plant room for pressurization of staircases system, which is protected from the other areas by fire resistant enclosure (including self-closing door) and contains no other services. In no case shall the FRP of the enclosure be less than two (2) hours.

(e) The power supply for the pressurization of staircases system shall feed from the building normal and essential supply sources fully comply with the requirements of FSD. The Contractor shall ensure that all wiring, cables, electrical equipment, starters relays, controls, etc shall be suitable for continuous operation at not less than 250 °C ambient for one (1) hour. Where the motor control panel is used in serving the pressurization of staircases plants, the motor control panel shall be a type tested cubicle form constructed to BS EN 60439-1 from not less than 2 mm thick panel steel. All sub-distribution boards, all wirings and cables etc. shall be installed inside a room or enclosure having a FRP of not less than two (2) hours and containing no other equipment.

(f) All systems shall be automatically actuated whenever any fire service installation in the building is activated and shall remain in operation until manually reset. Audio and visual indication shall be supplied and installed on the control panel. Actuation of all systems shall be directed from the fire alarm control system whenever that panel transmits a "Fire" signal. Dry contacts shall be provided for transmission of "Fire" signal in the actuation of the pressurization of staircases system. The installations for all out-going wirings and associated accessories connected between these dry contacts to the motor control panel of pressurization of staircases system shall meet FSD's latest requirement.

When in "fire" mode, the pressurization of staircases system shall not be controlled or under the influence of any other services and systems including the building management or automation system nor shall failure or close down of such systems prevent its operation. However, such systems may monitor the operations as required.

Each system shall be provided with a manual on / off control switch and indicator light at the fire control panel. The indicator lights to show manual on or off operation shall be provided with a red bezel and be flashing. Those indicating lights showing satisfactory operation of the fan(s) shall have a green bezel and be a steady light.

In each pressurization of staircases system fan intake duct, a smoke sensor shall be installed which, when sensing the passage of smoke, shall override all other controlling devices, and shut down the fan of the pressurization of staircases system.

Pressure sensors in the pressurized space shall be suitable for normal ambient conditions i.e. not less than 37 °C and 100 % R.H. All wirings used in connecting the pressure sensors shall be of high temperature grade P.V.C. to B.S. 6141 (minimum 135 °C). The cables shall run in either galvanised conduit within the pressurized space in fire resistance duct or embedded in concealed steel conduit as close as possible to the face of the wall in the space. The pressure sensors and associated equipment used in pressurization of staircases systems shall be of industrial process grade to BS EN 60654. Commercial quality for heating, ventilation and air-conditioning equipment shall not be accepted.

Barometric pressure relief damper shall be supplied and installed for the pressurization of staircases system for over-pressure relief. The framework of dampers shall be 3.2 mm minimum stainless steel sheet formed into a rigid channel section.

B12.4 SMOKE EXTRACTION SYSTEM

Smoke extraction system shall be supplied and installed where specified. The smoke extraction system shall include static and dynamic smoke extraction system. The smoke extraction system shall comply with the requirements in the FSDCOP, FSD Requirements and Circular Letters, and with the international standards acceptable to the FSD. The Contractor shall submit the design, drawings and the calculation of the smoke extraction system to the Architect and to the FSD for approval giving all details confirming compliance with the FSDCOP, operating principles, schematic diagram, layout, control and catalogues. The Contractor shall indicate the relationship between the pressures and flow in various parts of the building during fire scenarios. Where necessary, the Contractor shall use performance based fire engineering approach in the analysis, simulation and calculation. Where parts of the system or the whole of the systems are not included in the Contract, the Contractor shall check and co-ordinate to ensure the compliance with the FSDCOP and FSD Requirements and Circular Letters and to ensure the system meeting the functional and performance requirements.

For static smoke extraction system, the Contractor shall co-ordinate on the building design to provide the required smoke reservoirs and the smoke discharge. Fixing of the smoke curtains shall be by approved means to the recommendation of the manufacturers, complying with the fire service requirements and to the approval of the Architect.

For dynamic smoke extraction system, the Contractor shall supply and install systems most appropriate to the occupancy and the function of the concerned areas. Where smoke extraction system is provided only to parts of the building, the Contractor shall

adopt the worst scenarios in the calculation on the effect of air-conditioning and ventilation fans in various parts of the building.

The smoke extraction system shall comply with the following:

(a) The Contractor shall be responsible for the complete design and installation of the system, and have the system well co-ordinated with other parties. The Registered Professional Engineer employed by the Contractor for the smoke extraction system shall arrange the submissions to FSD for the consent and inspection of the smoke extraction system installation. The submission shall include all necessary forms, drawings and technical calculation / information required to fully explain the full operation modes including at least information on "normal", "fire", and "no power" conditions. The Registered Professional Engineer shall sign and certify that the entire systems have been properly designed, selected, tested and checked by him, and all components, materials and workmanship shall comply fully with the requirements of the smoke extraction system as stated in the FSD's latest requirements.

Notwithstanding that the Contractor demonstrates by calculation to the satisfaction of the Architect that the system will perform to the standard required, the Contractor shall be responsible for ensuring that the system, under test at any time, does in fact perform in accordance with the Specification.

The smoke extraction system shall be able to maintain the smoke travel at counter-flow mode and away from that of the egress/escape route. Within the protected fire compartment, the make-up air and smoke extraction paths shall be arranged such that a "scouring" or "cross-flow" effects occurs in all areas. The supply of make-up air shall enter at low level and / or in such a manner as to avoid premature mixing with the hot gases. Whenever the make-up air is not mechanically propelled, the air path shall be as directly with shortest route as possible. The points of smoke extraction shall be at high level in the space concerned and shall be reasonably distributed such that the smoke shall not be travelled at more than 30 m before entering the nearest inlet of the extraction system, and at least one extraction point shall be supplied and installed within each 500 m^2 unit of floor area.

The Contractor shall supply and install suitable types of supply diffusers / extraction grilles / louvers etc. to maintain maximum velocities as follows, calculated using free area: -

(i)	Make-up air inlets where not mechanically propelled	3 m/s
(ii)	Make-up air inlets where mechanically propelled	6 m/s
(iii)	Extraction grilles or outlets	6 m/s

The Contractor shall maintain minimum supply or make-up air rate at minimum 80 % of the overall extraction rate. When supply or make-up air is provided by mechanical means, this shall be supplied by an independent supply air system. Where it is acceptable to use normal air conditioning system to supply the make up air, the Contractor shall supply and install facilities to the air conditioning system such that the system can be changed

over during fire from the normal operating mode to that extracting full outside air to the required compartment.

The Contractor shall ensure that all system and installation are fail-safe to maintain free passage of smoke with all equipment / components necessary for the full operation of system under automatic or manual mode regardless of whether such equipment / components are specified or not.

(b) Smoke Extraction / Supply Air Fan

The Contractor shall supply and install smoke extraction and supply air fans which shall meet all specified requirements including construction, capacity, efficiency, motor size, sound rating, and constraints on physical dimensions as may be imposed by the design and to suit the smoke extraction requirements.

All smoke extraction fans shall be coated with finishing materials capable of withstanding exposure to an ambient temperature of at least 250 °C for a period of not less than one (1) hour, without producing smoke or any sort of toxic fumes. The respective manufacturer shall certify with substantiation that such coating finishes shall be factory-applied with specified requirement complied. The fans shall be connected directly to outside by non-combustible ductwork including flexible connection, if installed. When smoke extraction / make-up air fans are installed within the service compartment, the system including fans, motors, drives, electrical works, ductwork linking fans and the boundary of compartment etc. shall be protected by a fire resisting material of rating not less than one (1) hour.

The motor for the ventilating fans (extraction or make-up) shall provide nominal rating of minimum 20 % higher than the motor operating power input under nominal operating requirement. The motor windings shall be insulated to permit motor operation at design conditions for a period of one (1) hour in an ambient temperature of at least 250 °C. The fan motor shall be installed outside the hot air stream where possible.

In order to prevent re-circulation of smoke, the discharge points of smoke shall be separated by not less than 5 metres in any direction from all air inlets or other openings into any buildings. The discharge of smoke into any means of escape or a fireman's staircase is strictly prohibited.

The Contractor shall note the following requirements: -

(i) The smoke shall not be discharged at the underside of any canopy or overhang.

(ii) No discharges shall be at a height less than 3 metres measured from the surrounding horizontal surface to the bottom of the outlet and where the height is below 6 metres, the smoke shall not be discharged downwards.

(c) Ductwork and Fittings

The Contractor shall supply and install ductwork and associated fittings for smoke extraction system installation as shown on the Drawings and as

required to suit the smoke extraction requirements. Unless otherwise specified, the fabrication and testing of all ductworks shall conform to DW 143 & DW 144, industrial grade, and the requirements stipulated in this General Specification. All ductwork shall be fabricated from galvanised sheet steel and aluminium sheets shall not be accepted.

The smoke extraction system ductwork shall not be provided with fire and smoke dampers and any other restrictions in the ductworks unless otherwise approved by the FSD. Exceptions will be where only one extraction or supply system is used to serve several compartments where motorized fire and smoke dampers to the approval of the FSD may be required. Also, motorized fire and smoke dampers to the approval of the FSD shall be required at the main exhaust outlet louvre and / or main supply intake louvre. If smoke extraction system ductworks passes through compartments, all parts of the ductwork outside the served compartment shall be covered with fire resistance materials having minimum fire resistance period of thirty (30) minutes in compliance with the requirements of Building Department, such part shall be fire resisting to B.S. 476 : Part 24 or to be totally enclosed by fire resistant construction to B.S. 47 : Part 20 to the same fire resistant period as the served compartment or the compartment containing the ductwork whichever is higher.

Motor operated fire and smoke dampers shall comply with U.L. 555s Class I or other international standards approved by the Architect and FSD. The damper shall be complete with electric motor actuator enclosed with suitable fire rated enclosure. Damper module installations shall be fully sealed by gaskets between the module frame and the mounting frame. The gasket material shall be capable of withstanding exposure to an ambient temperature of at least 250 °C for not less than one (1) hour without producing smoke or any toxic fumes. Damper manufacturer shall certify that the assembled dampers, including all accessories and controls, can withstand 250 °C for the duration of one (1) hour without distortion, buckling, damage to seals, bearings, or any deleterious effect upon the proper performance and operation as specified herein.

(d) Electrical Installation

The essential power supply and distribution systems feeding the smoke extraction & make-up air supply system shall fully comply with the requirements of FSD. All wiring, cables, electrical equipment, starters relays, controls, etc. from the building primary and secondary sources of supply shall be suitable for continuous operation at 250 °C ambient for one (1) hour minimum.

When the motor control panel are used for supplying the smoke extraction & make-up air supply systems, the motor control panel shall be of a type tested cubicle form constructed to BS EN 60439-1 from not less than 2 mm thick panel steel and all sub-distribution boards, wirings, cables etc. shall be located in a room or enclosure having a fire resistance period of not less than two (2) hours and containing no other equipment.

(e) Control and Actuation

All system shall be automatically activated whenever the smoke detector and any control/sensing device designated as its actuation device is activated and shall remain in operation until manually reset with audio and visual monitoring indications. The system shall also be activated by manual control switch and/or designated sprinkler flow switch in the same area in case the smoke detection system fails to activate the smoke extraction system before sprinkler operates. Where the smoke extraction system is installed in areas vulnerable to unwanted alarm, suitable special detection system to the approval of the Architect and FSD shall be supplied and installed. Where the smoke extraction equipment are not installed by the Contractor, the Contractor shall co-ordinate, supply and install dry contacts for transmission of "fire" signal for actuating the smoke extraction systems which shall connect directly from the fire alarm control system. All outgoing wirings and accessories from these dry contacts to the motor control panel of smoke extraction system shall comply with FSD's requirement.

When in "fire" mode, no smoke extraction system connected therewith shall be controlled or under the influence of any other building services systems nor shall failure or close down of such building services systems prevent its operation. However, such building services systems may monitor the operations of smoke extraction system as required.

Each system shall be supplied and installed with a manual on/off control switch and indicator light at the fire control panel. The indicator lights to show manual on or off operation shall be supplied and installed with a red bezel and be flashing and those showing satisfactory operation of the fan(s) shall have a green bezel and be a steady light.

Unless otherwise specified, the detection system selected for the dynamic smoke extraction system shall be of early detection types. For clean areas, very early smoke detection alarm (VESDA) system or system having equivalent functions and performance as approved shall be adopted. For unclean areas and areas with high humidity, detection system shall be generally of early response type appropriate to the applications which can respond at an early stage of fire with low smoke. The system shall however be equipped with necessary facilities such as cross-zoned design (coincidence connection) to the approval of FSD, compensation for high humidity, sensitivity drift adjustment, etc. to avoid false alarm and unwanted alarm. Special detection system shall be used as necessary or specified. For cross-zoned design, an alarm with audio and visual indication on the control panel shall be raised when one detector is activated. Smoke extraction system shall operate with the actuation of any two detectors in coincidence connection. Where required by the FSD and approved by the Architect, activation of the detectors provided solely for the smoke extraction system shall not sound the general fire alarm and shall not send the fire signal via the fire alarm direct link and the alarm transmitter.

Control switches shall be supplied and installed in the control panels and in the main fire alarm control and indicating panel/fire control centre for activating and switching off each fan of the dynamic smoke extraction system manually.

B12.5 AUTOMATIC ACTUATING DEVICES

Automatic actuating devices controlled by fire/smoke/explosion detection system or automatic facilities such as sprinkler flow switches, etc. shall be supplied and installed where indicated on the Drawings, for protection of compartment, for closing an area for gas flooding system, for licensed areas and where required. The automatic actuating devices shall be of approved type and shall be suitable for the hazard class in the area protected.

Automatic actuating devices for fire shutters shall be operated by smoke detectors and complete with manual controls on both sides except for fire shutters located in carpark areas and in kitchens which shall be operated by heat detectors or special smoke detection system with manual controls.

Unless otherwise specified, the automatic actuating device for the dampers installed on a door shall be of electromagnetic remote damper release type. The electromagnetic remote damper release unit shall be suitable for mounting outdoor for remote actuation. The unit shall be of fail-safe design such that the damper shall be released at no power supply due to damage in control wiring or by a fire signal. The actuating mechanism shall be durable and reliable. It shall consist of a sheathed steel wire connected to the electromagnetic remote damper release unit at one end and the fire damper locking device at another end or similarly approved facilities. The sheathed steel wire shall be anchored at strategic points such that the steel wire can move freely relative to the outer skin. A fire signal shall actuate the unit by spring return mechanism or similar that will pull the steel wire and release the damper. The design shall be such that none or only a small section of the sheathed wire is located outside the room for good appearance and the unit installed outdoor shall be mounted inside a dust and moisture proof stainless steel box recessed in the external wall. The electromagnetic remote damper release unit shall be complete with power on indication and damper reset facilities.

When required by the FSD and approved by the Architect, activation of detectors provided solely for the automatic actuating devices shall not sound the general fire alarm and shall not send the fire signal via the fire alarm direct link and alarm transmitter. However, an alarm with audio and visual indications shall be provided on the control panels. The detectors for the automatic actuating devices shall be wired in coincidence connection when two or more detectors are provided unless otherwise specified.

B12.6 SPECIAL FIRE SERVICE INSTALLATION

Special fire service installation include, but not limited to, fixed and mobile foam system, dry chemical system, foam water system, water mist system, explosion protection system, water spray system, dust detection system, dry powder system, wet chemical system, restaurant fire suppression system, gas detection system, life safety system, industrial fire protection system for high hazard areas and other fire service systems not covered in other parts of this General Specification. Special fire service installation shall be supplied and installed where specified and as required. The Contractor shall design, supply and install the special fire service installation to comply with the statutory requirements and with careful consideration on the factor of maintenance, reliability and standby requirements. Unless otherwise approved by the Architect for minor design, the Contractor shall employ a qualified professional engineer to carry out the design for special fire service installation. The engineer

employed shall be a Registered Professional Engineer in Hong Kong under CAP 409 in building services discipline (or equivalent approved professional qualification) who is specialised in fire service installation design.

The Contractor shall submit the detailed design of the special fire service installation including drawings, calculation, equipment catalogues and other information for approval by the Architect. For proprietary system, the design and design calculation shall be supported by manufacturer's data and according to manufacturer's design manual. The Contractor shall obtain approval from the Architect on the design before ordering of equipment and carrying out installation work on site. The installation shall follow manufacturer's recommendation and the best practices in appropriate standards such as NFPA codes, BS standards, etc. to the acceptance of FSD and the approval of the Architect.

Where pre-engineered system is used, the Contractor shall provide the system manufacturer's design manual and calculation. Where engineered system is used, the Contractor shall submit full mathematical calculation or computer model flow calculations with manufacturer's design manual. Where computer programme is required to complete the design and the computer programme does not show all calculation steps, the Contractor shall produce evidence that the computer programme produces a design that shall perform in accordance with the relevant international standards and to the approval of FSD.

B12.7 RELATED FIRE SERVICE INSTALLATIONS AND PROVISIONS

Related fire service installations and provisions shall include all those fire service installations/equipment and fire service provisions that are not included in the Works under Fire Service Installation or not carried out by a registered fire service contractor, but they are required to be inspected by FSD at the time of completion of installation of a particular project. They shall also include all the related fire service provisions such as building provisions to fulfil the fire service requirements, requirements for licensed premises, etc. Related fire service installations shall include, but not limited to, water supplies, supply tanks, ring main systems, street hydrants, interfacing signals between fire service systems and various electrical and mechanical systems, gas detection system, dust detection system, electrical fire service installation, fire shutters and fixed automatically operated approved appliances. Related fire service provisions shall include, but not limited to, fireman lifts, emergency vehicular access, gas extraction system, fire dampers, fire doors, fire seals, fire insulation, fire fighting and rescue stairways, materials for separation of compartments, passive fire protection, ventilation system, exhaust system for gas flooding system, electrical installation, cubicle switchboard installation, telephone wiring, provisions for dangerous goods stores, labels and signs, etc.

Where there are related fire service installations and provisions in a particular project, the Contractor shall co-ordinate with relevant parties, inspect and witness the final tests on all related fire service installations in a particular project not included in the Works under Fire Service Installation or not carried out by a registered fire service contractor to identify any non-compliance with the requirements in the FSDCOP, FSD Requirements Circular Letters, and TC3. Any works found not complying with the fire service requirements of the FSD shall be rectified when they are included in the Works or be reported to the Architect when such works are carried out by others before arranging inspection with the FSD. The Contractor shall co-ordinate with relevant parties to carry out final functional test and performance test of the related fire service

installations. The Contractor shall include the related fire service installations in the submission to the FSD.

The Contractor shall co-ordinate to check that all fire service installations/equipment and items to be inspected by FSD are tested, rectified where necessary and certified by relevant parties before arranging inspection with the FSD. The Contractor shall co-ordinate and shall obtain the information and/or certification from relevant parties on all the related fire service provisions, which are not classified as fire service installation or not carried out by the Contractor, to confirm their completion and readiness for inspection by FSD. The Contractor shall employ a commissioning engineer approved by the Architect to co-ordinate and oversee the completion of all works in a particular project required to be inspected by FSD irrespective whether the installation of such works are included in the Works or not. The Contractor shall in particular pay attention to the interfacing and fire signal communication between different installations.

All related fire service installations and provisions shall comply with the FSDCOP, the FSD Requirements and Circular Letters, the codes issued by the Building Authority and relevant statutory requirements.

Where certificates and licences are required by FSD for completion of the fire service inspections, the Contractor shall co-ordinate with relevant parties to obtain all the licences and certificates required before arranging the inspection. The licences and certificates may include, but not limited to, the licences required for emergency generator room, fuel tank rooms and dangerous goods stores, tests certificate for gas cylinders, radioactive substances, LPG installation and medical gas installation.

Where related fire service provisions are included in the Works, the Contractor shall submit the drawings with calculation where necessary to the Architect and to FSD for approval. For licensed premises, the Contractor shall use equipment of appropriate types such as explosive proof, flameproof, weatherproof, corrosive resistance, spark-proof, intrinsically safe, etc. to suit the applications. For mechanical ventilation system in licensed premise, all necessary fire dampers and smoke dampers shall be included. The ventilation system shall be interlinked with the gas detection system and other detection systems, where supplied and installed in the licensed premise and when required by FSD.

SECTION B13
MISCELLANEOUS

B13.1 LABELS AND NOTICES

Labels and notices shall be supplied and installed for all pumps, valves, switches, gauges, indicators, cables, internal wiring terminals and all other equipment to facilitate operation and proper maintenance of the fire service installation. All labels shall make cross reference to the operation and maintenance manuals and as-built drawings

Labels and notices required by statutory requirements shall be inscribed accordingly whereas other labels shall indicate name and purpose of the equipment together with ratings and commissioned set values where applicable.

Labels for equipment identifications shall be made of red plastic material or multi-layer formica with white lettering or as approved. Lettering shall be engraved on the plastic material or formica. All wording shall be in both Chinese and English. All labels shall be of adequate size as to give clearance between lettering and fixings to ensure an aesthetic arrangement on completion.

Notices for safety warning and instructions shall be constructed of heavy gauge aluminium sheets painted with symbols or wording as appropriate.

Notice for instruction for operation and use of the equipment shall be provided as appropriate and necessary. Instructions for use shall be provided to all equipment for use by the general public and for operation by the operating staff.

Labels and notices shall be fixed by screws. Where drilling and tapping is impracticable, approved adhesive may be used subject to prior approval by the Architect. For pipelines or valves, where applicable, labels shall be fixed by means of a key ring attached to the upper corner of the pipe mounting bracket or the hand wheel of valves. The labels shall be suspended from brass or stainless steel chain loops over the relevant pipe.

All major fire service equipment and components such as pumps and motors, flow switches, alarm valves, expansion joints, pipes and fittings, etc. shall have factory applied permanent nameplates indicating, where relevant: -

(a) Name of Manufacturer.

(b) Model.

(c) Serial Number.

(d) Design Flow Rate, Pressure, etc.

(e) Rated Duty.

(f) Operating Voltage, Phase, Ampere, and Frequency.

(g) Full Load Current and Power.

(h) Starting Method and Current.

(i) Power Factor.

(j) Date of Manufacture.

(k) IEC, British Standards or other Authorities' markings to indicate their compliance and grades of application.

(l) Any other necessary data to conform to specified requirements and to indicate the equipment performance.

Instructions for oiling and/or greasing of all fans, motors, etc. shall be attached to the relevant greasing or oiling points.

Where the equipment has an operating life less than or equal to ten (10) years, the expiry date or the ' end of service life' date has to be stated on the label attached to the equipment. Labels of approved types shall be supplied and installed for fire extinguishers, fixed sprayer units, batteries, detectors and gas extinguishing system showing the expiry date of design operating life. Unless otherwise barcode labels are provided, the label shall have a serial number of the equipment and the serial number shall be recorded on the as-built drawings.

Identification to the approval of the Architect shall be supplied and installed for emergency luminaires of the same appearance as other non-emergency luminaires for quick identification in routine inspection.

All isolators and protective devices that can isolate the supply to the fire alarm system shall be properly labelled to the approval of the FSD.

The Contractor shall supply and fix barcode labels to the portable hand-operated approved appliances, all types of detectors, batteries, gas extinguishing cylinders, and all other fire service equipment that has a design operating life of less than or equal to ten (10) years. Where it is impossible to fix the barcode label on the equipment, it can be fixed on the wall adjacent to the equipment. Where specified, the Contractor shall supply and fix barcode labels to all other fire service equipment. Details of the coding on barcode labels and the fixing method shall be submitted to the Architect for approval. The barcode labels shall be of durable design to the approval of the Architect. The serial number of the barcode shall be recorded on the as-built drawings.

Where the barcode labels are installed, the Contractor shall provide a full list or table showing the items of equipment and the corresponding barcodes in hard and soft copies. The soft copy shall be of approved software format. Three hard copies and three soft copies in CD-ROMs are required.

Where specified, the Contractor shall supply portable handset equipment for scanning and reading the barcodes and for storing the data for transfer/download to a personal computer. It shall be complete with LCD display, storage batteries and software for categorising the data. Details shall be submitted to the Architect for approval. The portable handset equipment shall be stored in a separate wall mounted cabinet with locks provided by the Contractor in the pump room or in the control room as approved by the Architect. Where specified, the Contractor shall supply and install the software for producing facility management reports and inspection reports from the data

downloaded from the portable handset equipment. Details shall be submitted for approval.

B13.2 DANGER NOTICES

Danger notices worded : DANGER-PLANT ON AUTOMATIC START (**危險-機器隨時開動**) in English and Chinese shall be supplied and installed adjacent to all automatically controlled motor-driven and engine-driven pumps.

Notices, instructions of use complying with the requirements of Labour Department and Occupational Safety and Health Ordinance, Chapter 509, shall be supplied and installed.

B13.3 PAINTING, FINISHING, PROTECTION AND IDENTIFICATION

Painting shall follow General Specification for Building unless otherwise specified.

Paint all surfaces including cable trunking/conduit, panel, box, enclosure, cladding, pipework, equipment, fitting, etc. except otherwise specified.

Self-finished surfaces like stainless steel, anodised aluminium, chrome plated, bronze, plastic, etc. are not required to be painted.

Galvanised pipework concealed in false ceiling or galvanised duct not normally accessible and/or seen need not be painted unless otherwise specified, but appropriate colour code indication shall be applied.

Equipment with factory applied paints or epoxy coatings need not be painted.

Painting and coatings for the purpose of protecting the materials from corrosion including those inside concealed spaces shall be required.

All surfaces, unless otherwise specified, shall be finished in first class paint work. All metallic surfaces shall be wire-brushed and cleaned to make it free from rust, scale, dirt and grease prior to painting. All work shall be carried out by qualified tradesmen. Water based paints with reduced volatile and preservative content or paints with reduced solvent content formulated for minimal volatile organic compound emissions complying with reputable international standards shall be used in occupied areas and renovated areas without good natural ventilation. In addition, all paints shall contain no mercury, lead, hexavalent chromium or cadmium compounds. All painting works shall be completed and left in ventilated environment for at least 1 week, or the curing period recommended by the paint manufacturer whichever is longer, before occupation or handover of the renovated area to minimize volatile organic compound exposure. All surfaces shall be painted and finished as specified in the Particular Specification to meet and match the aesthetic architectural design as required.

Painting shall be of approved type and shall be generally to CP 231 and as described below: -

(a) Do not carry out painting work in wet, humid or foggy weather or on surface that is not thoroughly dry or if there is excessive dust in the air.

(b) Ensure that all holes, cracks and other defects in surface have been made good prior to painting.

(c) Ensure the surface is thoroughly clean and dry prior to painting. Loose material shall be removed by dry brushing with stiff broom or brush.

(d) Keep surface clean and free from dust during coating and drying.

(e) Protection freshly applied surface coating from damage.

Primer shall be applied to metal surface before the application of under and finishing coats of paint. Primer for non-galvanised metal surface shall be metallic zinc-rich primer to BS 4652, Type 2, and for galvanised surface shall be calcium plumbate primer or approved etch primer. Bare copper tubing shall be polished bright and coated with approved heat resisting clear synthetic varnish. All surfaces shall receive one primer coat, one under coat and 2 finishing coats.

The primer, under coat and finishing coat of paint shall be from the same manufacturer. The painting procedure shall be strictly in accordance with the manufacturer's instruction.

For anti-corrosion paint and primer, the correct type of thinner/activator shall be used and the mixing method shall follow the manufacturer's instructions.

Colour of the finishing coats shall be to the approval of the Architect. Pipes and pipelines shall be complete with the identification colour code indicators when the colour of the finishing coat is not in accordance with ISO 3864.

The street hydrant body shall be painted red if it is connected to fresh water supply and painted yellow if it is connected to salt water supply. If the street hydrant is removed from service, the blank cap shall be painted blue.

Copper pipes and fittings shall be polished bright by sanding, wiped with mineral spirits and coated with an approved heat resisting clear synthetic varnish.

Where normal painting is not practicable, all possible measures to prevent corrosion to the plant shall be applied such as special protective coverings, special anti-corrosive paints, etc. as recommended by the supplier or specified in the Particular Specification. For protection against system internal corrosion, appropriate chemical treatment, provision of sacrificial anodes and bonding to eliminate electrolytic action shall also be applied wherever applicable.

For temporary protection, all stainless steel parts shall be covered with PVC wrapper of tape until handover. All ferrous parts shall be painted or greased (whichever is most suitable). All bright parts (chrome plates, polished stainless steel or aluminium, etc.) which are liable to deterioration shall be covered with tallow or a suitable protective coating during the progress of work. Upon completion of work, the protective coating shall be removed and the parts polished as appropriate. Any damage to the primer or protective coatings shall be made good. When it is necessary to remove, or partly remove the protection for installation or making connections, the Contractor shall ensure that the standard of protection provided originally is re-applied at the earliest possible time. All plants, pipes valves, and fittings shall be, as far as possible, thoroughly cleaned and cleared of rust and other foreign matters both before erection and before subjection to pressure tests. For temperature and/or humidity

sensitive electrical or electronic control panels and equipment, the Contractor shall where necessary protect them against high humidity and/or temperature by operating portable or temporary dehumidifiers and/or air conditioners in the enclosures containing these equipment. In order to protect the equipment against dust infiltration, the Contractor shall store them in a dust free room or enclose them in heavy duty PVC sheets or bags. Where necessary, filters shall be provided in the temporary air conditioning systems.

B13.4 SPARES AND TOOLS

For plant and/or equipment included in the Contract, the Contractor shall provide the types of spare parts generally wherever these are appropriate to the plant and/or equipment involved plus any additional items for the particular plant and/or equipment. Unless specified in detail, the criteria by which the Contractor shall judge the need for spare parts to be included shall be any part or component of the plant or equipment that is subject to frictional wear, vibration or temperature fatigue, rupture to safety (or otherwise), corrosion, erosion, decay, limited operating life, unacceptable deposits and/or saturation, normal fair wear and tear and is likely to fail or reach an unacceptably low performance level.

The Contractor shall provide sets of spare parts and special tools including spare sprinkler heads, detectors, replacement break glass plates, indicator lamps, special keys, fuses, parts for the gas extinguishing system after discharge, etc. as required by the statutory rules, required by specifications in Section A2 and in Section B3.12, for one year operation and maintenance after expiry of the Maintenance Period, and as required by other parts of this General Specification at the time of completion of the Works and before commencement of the Maintenance Period. The Contractor shall supply and install locked cabinet or cabinets in the plant room(s) and/or control room(s) for housing the spares and tools. Such sets of spare parts and special tools shall be submitted to the Architect for approval within four (4) months after commencement of the Contract, or in such period as has been agreed by the Architect in writing.

The Contractor shall also supply all the spare parts and special tools required for the whole Maintenance Period for operation and maintenance of the plant and installation. The spare parts and special tools shall be in addition to the requirements in the second paragraph of this section. At the end of the Maintenance Period, the Contractor shall ensure that the spare parts and special tools required in the second paragraph of this section are provided and stored in the cabinet. The Contractor shall replenish and supply spare parts that may have been used during the Maintenance Period.

In addition, the Contractor shall include in the operation and maintenance manual a complete manufacturer's recommended list of all the replaceable parts, spares and special tools with model number, part number and price which are likely to prove necessary to service the plant and/or equipment. The list shall be complete with prices and the prices listed shall be fixed and open for acceptance up to the end of the Maintenance Period. The list shall include diagrams or catalogue details of the parts concerned and bona fide manufacturer's published price lists. The Contractor may add the net shipping costs for each item plus a 15% margin to cover overheads and profit. Where appropriate, the prevailing exchange rate must be stated.

The Contractor shall submit information on the design operating life for equipment such as batteries, detectors, fire extinguishers, gas extinguishing system, etc. that are required to be replaced some years later.

The Contractor shall provide three keys for each key operating facilities, locks and switches unless otherwise specified.

B13.5 PROVISION FOR WATER METER

Metering of water supplies to fire service installation is not required. Provision shall, however, be made for the possible future connection of the Water Supplies Department meter at each point of connection to the main, immediately downstream of the main stop valve. The position of this future meter shall be shown on the installation drawings. The Contractor shall co-ordinate with the Building Contractor to obtain the information where necessary.

B13.6 NOISE AND VIBRATION

The Contractor shall take all necessary steps to prevent the transmission of any objectionable noise and vibration which affects the occupied areas of the building.

Pumps and motors shall be balanced and aligned such that the measured vibration velocity at all three axis shall not exceed 1.8 mm/s rms in the range of 10 to 1000 Hz as defined in BS 4675, ISO 2954 and ISO 10814.

Motor driven pump set shall be mounted upon a common base plate supported by approved spring-type isolation mountings on concrete plinth.

Flexible connectors shall be installed at pump connections to take up vibration. Unless otherwise specified, flexible connector of single sphere or double sphere type made from rubber, EPDM and similar materials shall not be used. Construction of flexible connectors shall be as specified in Section B1.10 for expansion joint using stainless steel. Flexible connector shall be used to absorb the vibration and shall not be used to take care of the misalignment during installation. All pumps and pipes shall be properly aligned on completion.

Pumps shall be of low noise rating especially for the jockey pump set and other equipment requiring frequent operation. Acoustic treatment shall be provided as necessary and approved by the Architect.

Acoustic treatment shall be provided to the emergency generator installation and other fire service installations and equipment to comply with statutory requirements on noise and vibration.

B13.7 EQUIPMENT BASES

All bases and supports for plant and equipment shall be supplied and installed by the Contractor, except concrete plinths and blocks, which will be provided by the Building Contractor unless otherwise specified but shall be designed by the Contractor to suit the actual equipment.

Plinths and blocks shall be designed to project approximately 100 mm above the finished floor level.

B13.8 SAFETY FACILITIES

Facilities for operational and maintenance safety shall be supplied and installed to comply with the Occupational Safety and Health Ordinance and with the requirements of Labour Department. All moving parts shall be appropriately covered and emergency stops shall be supplied and installed where necessary. Adequate spaces and facilities shall be allowed for maintenance and access.

B13.9 SCHEMATIC DIAGRAM AND KEY LAYOUT DRAWINGS

Schematic diagrams and where relevant key layout drawings shall be provided to all major plant rooms and fire service control rooms. The diagrams and drawings shall be mounted in glazed frames and installed in appropriate locations in the rooms.

SECTION B14
PERFORMANCE BASED FIRE ENGINEERING

B14.1 GENERAL

Where performance based fire engineering, fire safety engineering, fire protection engineering or similar approaches, studies, analysis and applications are specified for the assessment, design, analysis, selection and evaluation of the fire service equipment, materials, system, design and performance, the Contractor shall employ competent and qualified professional engineers specialising and experienced in fire engineering study and application as specified for particular installation or project to the approval of the Architect to carry out the works on PBFE. Details of the name, curriculum vitae, qualification and experience of the professional engineer specialised in fire engineering shall be submitted to the Architect for approval. The professional qualification of the professional engineer shall be at least equivalent to a corresponding Registered Professional Engineer in Hong Kong under CAP 409 in approved disciplines (or equivalent approved professional qualification) specialised in fire service installation design with additional professional/academic qualification and experience on fire engineering.

B14.2 STANDARDS AND GUIDES

The performance based fire engineering approaches, studies, analysis and applications or similar works shall follow internationally accepted fire safety engineering standards, codes and guides approved by the Architect and acceptable to FSD and Building Authority. Some known guides include, but not limited to, Society of Fire Protection Engineers Engineering Guide to Performance Based Fire Protection, BS DD 240 on Fire Safety Engineering in Buildings, Chartered Institution of Building Services Engineers Guide E on Fire Engineering, Recommendations of the International Organisation for Standardisation Sub-Committee ISO/TC92/SC4, BS ISO 13387 and its associated standards, Performance Based Option in NFPA 101A, Performance Based Building/Fire Codes in U.K./Sweden/Australia/New Zealand/Japan/other developed countries, and others. The Contractor shall select the most appropriate standards and methodologies for the works and shall obtain the approval of FSD, Building Authority and the Architect in the use of relevant standards and approaches for the evaluation and study.

B14.3 COMPUTER SOFTWARE AND TOOLS

Where the completion of PBFE requires the use of computer software and tools for modelling, analysis and calculation, the cost of all such facilities and computing works including the access to and the use of the software shall deem to be included. Hard and soft copy of the computed result shall be submitted. The Contractor shall allow the cost for demonstrating to the Architect the computed result locally on the computer facilities provided by the Contractor. The Contractor shall provide accreditation/validation certificate, evidence and/or substantiation showing the acceptance of the computer software by internationally recognised bodies. The Contractor shall give details of the principles, formulae and calculation adopted in the computer software when and where required. All calculation and computed results

shall be checked and endorsed by the professional engineer employed by the Contractor in Section B14.1.

B14.4 TESTS

Where the completion of PBFE require site tests and laboratory tests for completion of the studies and evaluation, all such tests including mock-up tests, simulation tests, fire tests, field tests and trial tests, on site and off-site, shall deem to be included in the Works.

B14.5 INDEPENDENT CHECKING

Where PBFE is used for the fire service/safety design, selection of fire service system/equipment, evaluation of alternate solutions for compliance with statutory requirements, evaluation of new fire service system, major modification works, and assessment of building/structural fire protection and life safety provisions such as fire compartments and occupant evacuation, the Contractor shall employ an independent qualified professional checking engineer specialised in PBFE to the approval of the Architect to check, validate and audit on all the design, calculations, computer models, submissions and works on PBFE by the Contractor and to report all the findings independently to the Architect. The professional qualification and experience of the independent checking engineer for PBFE shall be at least equal to or better than that of the professional engineer employed under Section B14.1 and shall be approved and accepted by the Architect.

B14.6 PROGRAMME AND SUBMISSION

The Contractor shall provide a detailed programme for the PBFE including the time allowed for consultation with various authorities and parties. Since the results of fire engineering will affect the provisions of fire service installation, the Contractor shall allow for carrying out the fire engineering studies and applications in the early stage of the Contract before commencement of the installation works.

The Contractor shall collect all the data, statistics and information for the study and evaluation in fire engineering. The Contractor shall obtain the comments and approvals from FSD, Building Authority and relevant government departments and authorities on the assumptions, the statistical figures and the results. The Contractor shall allow the cost for making interim submissions, re-submissions and discussion with relevant parties and authorities before finalising the study and evaluation.

The Contractor shall submit the results of the PBFE and reports in a format acceptable to the Architect covering details of methodologies, principles, assumptions, statistics, data, formulae, risk analysis, computer modelling, figures, diagrams, models, evaluation, results, solutions, recommendations and other relevant information. The Contractor shall submit and re-submit as necessary to the Architect both hard and soft copy (stored in CD-ROMs) of the documents on the results/reports of the PBFE and at least 3 copies each are required. The soft copy shall be in file format as specified or approved by the Architect. Before submission of the final results to the Architect for approval, the Contractor shall submit and obtain the approval of relevant authorities such as FSD and Building Authority on the results, solutions and recommendations. The professional engineer employed under Section B14.1 shall endorse all documents

before making the submission. The documents shall also be endorsed by the independent checker where provided. After approval by relevant parties, the Contractor shall include the results and reports of PBFE in the operation and maintenance manuals.

Before carrying out the detailed PBFE study, the Contractor shall submit preliminary report to seek comments from the Architect, the FSD and the Building Authority on the approach and scope in the study. The preliminary report shall cover but not limited to the following: -

(a) Objectives.

(b) Assumptions.

(c) Acceptance criteria and risk level.

(d) Hazard identifications.

(e) Fire scenarios.

(f) Functional, performance and code requirements.

(g) Alternate solution/trial concept design to be investigated.

(h) Evaluation method and level.

(i) Tools/tests/software to be used.

The final reports of PBFE shall include but not limited to the following: -

(a) Objectives, code requirements, assumptions, functional statements, performance statements, alternate solutions, recommendation and all other sections as required in relevant standards, codes and guides.

(b) Qualitative assessment and quantitative assessment (deterministic and probabilistic) for item (a).

(c) Sensitivity analysis of the assumptions and data.

(d) Risk assessment, except for simple case where comparative method and verification method are applicable.

(e) Assessment on the safety factors, redundancy and contingency provided in the solution.

(f) Precautions and requirements in the study to be observed and followed by the users/operators in future.

B14.7 ACCEPTANCE CRITERIA

PBFE aim to improve the fire safety in the buildings and the analysis and evaluation shall target to improve the building and fire service design and provisions to satisfy the most appropriate fire safety requirements and the concerns on the risk particularly for

those parts of the design not adequately covered in the prescriptive based fire codes and regulations. The Contractor shall not use fire engineering as the tool to reduce the building and fire service provisions in the prescriptive based fire codes and regulations as redundancy, standby, spare, safety factor and contingency may have been built into the provisions for the purpose of fire safety. The Contractor shall allow adequate safety margin, redundancy and allowances in the fire engineering studies and applications to maintain equivalent or better fire safety standards in comparison to other buildings in the territory.

The Contractor shall not use PBFE as the tool to delete any requirement in the prescriptive based fire codes and regulations unless otherwise alternate and/or additional fire safety measures to the approval of the Architect, FSD and Building Authority shall be provided. Use of PBFE to prove the building is fire safe on deleting some requirements in the prescriptive based fire codes and regulations but without corresponding alternate/ additional measures will not be approved.

The following are the minimum criteria to be considered in the assessment: -

(a) Occupant's/public life safety.

(b) Fire fighter's life safety.

(c) Fire spread to adjacent compartments and buildings.

(d) Property loss/structural fire protection.

(e) Loss of business operation/opportunities as appropriate.

(f) Damage to heritage buildings where applicable.

(g) Environmental and community impact as appropriate.

(h) Cost effectiveness where appropriate and not at the sacrifice of fire safety.

B14.8 RESULT OF THE STUDY

Where the approved result of PBFE indicates or requires modification of the design, materials, equipment and installation details of the fire service installation or building design to comply with the requirements in the statutory regulations, unless otherwise specified, all such works and/or modifications shall be deemed to be included in the Works at no additional cost and at the approval of the Architect. Where the result of fire engineering indicates the deletion of some parts of fire service systems or fire resistance materials in whole in a zone or in a room can be made, the deletion of such systems or materials shall not be carried out without the prior approval of the Architect and the cost saving for the deletion of such part of the fire service systems shall be assessed and the Contract Sum will be adjusted in accordance with the Contract as appropriate.

PART C - COMMISSIONING, TESTING AND MAINTENANCE

SECTION C1
COMMISSIONING AND ACCEPTANCE TEST

C1.1 ADJUSTMENTS, COMMISSIONING, FUNCTIONAL AND PERFORMANCE TESTS

The Contractor shall commission the installation and carry out complete functional and performance tests for all equipment and systems installed by him/her or them, make all necessary adjustments, including setting all controls and checking the operation of all protective and safety devices in accordance with the manufacturers' instructions, the requirements of the statutory rules and regulations and to the satisfaction of the Architect before the installations will be accepted. Prior to any tests, the Contractor shall submit detailed commissioning and testing procedures, methods, format of test records and a programme for the commissioning and testing to the Architect for approval at least three (3) months before commencement of commissioning and testing or within four (4) months after commencement of the Contract whichever is earlier. They shall be updated as the work progresses towards completion. All commissioning and testing procedures for works that are required to be tested during construction shall be submitted in good times for approval.

The detailed procedures submitted shall follow TC3 and TC2 with additional details and tests proposed by the Contractor to the approval of the Architect and in accordance with the manufacturer's recommendation, relevant standards and statutory regulations. Detailed commissioning and testing procedures shall be submitted for all special systems and systems not covered in TC3. The detailed procedures shall be prepared in two main parts covering the following: -

(a) Testing that is required to be carried out during the construction period when part of the Works is installed.

(b) Commissioning and testing required for certifying completion of the Works and before commencement of the Maintenance Period.

Immediately after each test, the Contractor's CEIC shall sign the data record sheet on site with endorsement by the Architect's representative witnessing the test, irrespective whether the test is successful or not, and submit a copy of the data record sheet to the Architect. For testing that is required to be carried out during the construction period, the Contractor shall submit a formal commissioning and testing report or certificate for each test and endorsed by the Contractor's CEIC within fourteen (14) calendar days after the test.

Commissioning and testing shall include, but not limited to: -

(a) Factory tests and off-site tests.

(b) Visual inspection and checking.

(c) Setting to work, safety and quality tests.

(d) Commissioning, regulations, tuning and adjustment.

(e) Functional tests.

(f) Performance tests.

(g) Final mock-up tests.

(h) Statutory tests and inspections.

Visual inspection and checking shall include verification of the installed equipment being the approved models. The Contractor shall submit relevant documents including delivery orders and payment vouchers to substantiate the equipment installed on site being the approved models if the identification of the manufacturer and model name cannot be seen easily on site.

The Contractor shall note that completion of commissioning and testing and the associated statutory inspection by FSD is one of the considerations for certifying completion of the Works. The Contractor shall make a detailed plan on the programme of the commissioning and testing works at the commencement of the Contract, in order to ensure that all of such works can be completed within the Contract period. The commissioning and testing programme submitted shall detail the types of commissioning and testing works required, the breaking down of the programme into floor-by-floor and area-by-area basis, the tests that are required during construction and at the time before the completion of the Works, the period of tests with float time allowed, the milestone dates on connection of fire alarm direct link, final mock-up test and statutory/licensing inspections, and the programme for the completion of various builder's works such as pump rooms, control rooms, water supply, electrical supply, etc. The Contractor shall in particular plan the programme so as to minimise the overlapping of different tests arranged simultaneously in different locations.

The Contractor shall arrange to enable the Architect or the Architect's representatives to witness all the commissioning and testing. Unless otherwise approved by the Architect, commissioning and testing carried out by the Contractor in the absence of the Architect or the Architect's representatives shall not be accepted. The Contractor shall give at least 72 hours notice, in writing, when any part or parts of the installation will be tested.

Any defects of workmanship, materials and performance, maladjustments or other irregularities which become apparent during commissioning and testing shall be rectified by the Contractor at no additional cost to the Employer and the relevant part of the commissioning or testing procedure shall be repeated at the Contractor's expenses.

If considered appropriate, the Contractor shall be required to carry out demonstration to dismantle those parts/components of the installation which are considered difficult/impossible for maintenance access. The Contractor shall be responsible for carrying out all necessary modification work at no extra charge to the Employer to alleviate the difficulties associated with dismantling or maintenance access.

The Contractor shall not wait for completion of every part of the work but shall arrange for a progressive commissioning programme to achieve practical overall

completion and have the whole work ready to be handed over by a date to suit the Contract completion date or any other agreed programme date.

C1.1.1 Factory Tests and Off-site Tests

Factory test shall deem to be included. Factory test and off-site tests shall be carried out at the manufacturer's works, or by an approved independent testing body/laboratory where specified, or elsewhere as approved. Where indicated, 'type-tests' on items of equipment to demonstrate compliance shall be carried out. 'Type-tests' certificates shall be submitted in duplicate to the Architect. Factory quality and general inspection test recommended by the manufacturer shall be required. Where indicated or necessary, factory performance test shall be carried out for each of the offered equipment before delivery. Factory test certificate certified by qualified factory engineer shall be submitted in duplicate to the Architect for approval. This approval shall normally be required before the materials or equipment are dispatched from the manufacturer's works. Factory test shall be witnessed by an independent approved agency where indicated.

The Contractor shall note that the Architect may require to witness tests and inspections of manufactured equipment during construction at the manufacturer's works. Where this requirement is indicated in the Contract, the Contractor shall allow for making the necessary arrangements.

C1.1.2 Visual Inspection and Checking

Site inspections of 'work in progress' will be made by the Architect or the representative from time to time. The Contractor shall keep such inspection record for checking from time to time. Works to be permanently covered up shall be subjected to inspection, pressure test and other tests before cover up. During the inspection, if the Architect discovers any work that has been covered up before inspection and testing, this work shall be uncovered for inspection and testing to the Architect's satisfaction. The cost involved in uncovering the work, inspecting, testing and re-concealing the work together with any consequential losses shall be paid by the Contractor at no additional cost to the Employer. Any defective works and installation of poor workmanship found during visual inspection shall be rectified or replaced before proceeding with further tests.

C1.1.3 Setting to Work, Safety and Quality tests

Prior to any commissioning and testing works, the Contractor shall check the completion of the works, the associated builder's work, the related fire services provisions and the associated building services installations, to ensure that commissioning can be proceeded without obstruction.

Before any installation is subjected to commissioning and site testing, it shall be thoroughly cleaned both internally and externally.

The Contractor shall be responsible for initially setting the plants to work including: -

(a) Preliminary checks to ensure that all systems and system components are in a satisfactory and safe condition before start up.

(b) Preliminary adjustment and setting of all plant and equipment consistent with eventual design performance.

(c) Carrying out pressure test, hydraulic test and other tests required before energising the equipment and plant.

(d) Checking the proper functioning of the protective devices and safety valves in the installation and carrying out all necessary safety testing.

(e) Energising and setting to work on all plants.

(f) Initial regulation and demonstration that the installation delivers the correct rate of flow at the conditions specified in the Contract.

The Contractor shall arrange for any specialist plant or equipment to be commissioned and tested by the specialist equipment manufacturer' s skilled commissioning engineer and/or technician.

C1.1.4 Commissioning, Regulations, Tuning and Adjustment

The Contractor shall regulate, balance, tune, commission and adjust the installation and equipment as appropriate and necessary to deliver the conditions and requirements specified in the Contract. The Contractor shall allow carrying out such adjustment and re-adjustment as necessary until all the requirements are met and the installation is accepted by the Architect.

C1.1.5 Functional Tests

The Contractor shall demonstrate to the satisfaction of the Architect the functioning of the installation, system and equipment complying with the operational and functional intent and the requirements in the Contract. The Contractor shall demonstrate and test the proper operational mode, control and the sequence of the operation in various parts of the system and installation.

C1.1.6 Performance Tests

The Contractor shall carry out tests to prove the performance of the installation, system and equipment in term of flow, pressure, current, sound level, and other technical/design aspects complying with the requirements in the Contract and the statutory requirements. The Contractor shall regulate, balance, tune, adjust and modify the installation, system and equipment as necessary till the performance requirements are met. The final setting and operational parameters of all equipment shall be recorded.

Where necessary, the Contractor shall carry out full load test by simulation or other approved method to prove the performance of the installation at full load condition.

C1.2 LABOUR AND MATERIALS

The Contractor shall despatch competent and experienced commissioning engineers and technicians to carry out the commissioning and testing of the installation. All labour and materials necessary for carrying out the work shall be provided by the Contractor, except that the Building Contractor will supply electricity and water as required unless otherwise specified. The Contractor shall supply any necessary diesel, gas or other fuel oil for engine-driven pumps and generators provided in the Works, sufficient gases required for the discharge tests of the gaseous extinguishing system installations, etc.

The Contractor shall employ a competent and experienced commissioning engineer in-charge (hereinafter referred as CEIC) approved by the Architect to be responsible for the overall arrangement, co-ordination, supervision and certification of the commissioning and testing of all fire service installations and equipment. The CEIC shall have minimum 5 years on site experience for similar type and scale of commissioning and testing works. The CEIC shall also oversee and check with relevant parties the completion of all related fire service installations and provisions required in Section B12.3. The CEIC shall be responsible for the submission of detailed commissioning and testing methodologies and procedures, co-ordination of the programme and sequence of commissioning and testing works, arranging the test and re-test of the installations, supervising the commissioning and testing works, and certifying results of the tests. The CEIC shall lead and co-ordinate the final mock-up test as well as the statutory inspection with FSD. The Contractor shall submit details of CEIC together with the commissioning and testing programme to the Architect for approval.

The Contractor shall replenish all fire extinguishing media and other materials expended or used during the test and ensure that the entire installation is in "as new" condition at the conclusion of the tests.

The Contractor shall properly drain the water and exhaust the gas during and after the test as required. The Contractor shall provide and adopt measures to avoid damage to the building, installations, decorations and fixtures during the tests for any fixed fire service installations and equipment.

C1.3 WATER SYSTEM TESTS

Water systems and circuits shall be tested hydraulically to a minimum pressure of 1000 kPa or 1.5 times the working pressure whichever is higher applied at the highest point of the system and held for a period of not less than 15 min without leaks appearing.

All pipework shall be thoroughly cleaned and flushed before test. The Contractor shall ascertain that there is adequate drainage nearby to discharge by large hose in order to ensure flooding of low level areas will not occur. Where necessary, the Contractor shall provide chemical cleaning to the pipes. After flushing out the pipework, a flow test shall be performed on the hydrant/hosereel system in accordance with the requirements of the Code of Practice for Minimum Fire Service Installations and Equipment.

A water supply test with the drain and test valves fully opened shall be made on the sprinkler system in accordance with the requirements of the LPC Rules for Sprinkler

Installations. An alarm test for at least thirty (30) seconds on the water gong shall also be carried out by opening the test valve to ensure that it shall sound continuously after water flow in the system is detected. All controls and air supply system for the pre-action system, recycling pre-action system and dry pipe system shall be tested.

An actual water discharge test shall be performed on the drencher/deluge/water spray/water mist system and where required for other automatic fixed installations using water to test the water flow and discharge pattern of the nozzles.

For street hydrant system without pumps, the Contractor shall test the incoming water supply pressure at a nearby supply point and at such time as agreed with the Architect before the completion of the installation to establish the adequacy of the water supply pressure. If the supply pressure is inadequate, the Contractor shall propose remedial measures for the approval of the Architect. The Contractor shall find and select the most appropriate nearby supply point for the test.

The Contractor shall provide whatever hoses or drainage channels required to safely remove the test water discharged while carrying out these tests in order to ensure that no damage to the building and property will be caused by the test water.

The Contractor shall submit hydraulic test certificates/reports that shall be signed by the Contractor's CEIC and by the Architect or the representative who has witnessed the test. The test certificates/reports shall contain the following particulars:-

- Date of test
- Apparatus or section under test
- Makers number (if any)
- Nature, duration and conditions of test
- Result of test
- Name of Contractor's representative (in block letter) in charge of test
- Name of Employer's representative at witness the test

C1.4 ELECTRICAL AND ALARM SYSTEM TESTS

Electrical wiring systems shall be tested generally as required by the General Electrical Specification. Low voltage wiring shall be insulation tested to a D.C. voltage of twice the normal working voltage of the system. Any tests that are liable to cause damage to the delicate components such as those incorporating electronic circuits shall be carried out with the components disconnected.

Smoke detectors shall be checked for correct sensitivity settings by means of manufacturer's test set and for operation by simulated smoke tests.

Rate-of-rise heat detectors shall be tested by gentle application of a heat source such as hair dryer. Fixed temperature heat detectors must not be tested other than using simulated tests.

Battery capacity shall be tested by discharging through the alarm circuits and being charged via the incorporated charger unit. The specific gravity of the electrolyte shall be tested with a clean hydrometer where applicable.

The Contractor shall arrange power failure load tests to prove proper functioning of the fire service installation and the associated control during power failure and fire mode.

The input D.C. supply to the alarm supervisory circuitry shall be checked for correct voltage and stability such as to match the signal and alarm triggering devices.

For fire alarm direct link to FSD or FSD's agency, the Contractor shall initiate applications to the appropriate agencies within three (3) months after commencement of the Contract to allow the fire alarm direct link to be connected and tested before statutory inspections. The Contractor shall submit a copy of the application document to the Architect for record. The Contractor shall co-ordinate and shall closely monitor the status of completion of fire alarm direct link and the telephone line before fire service inspection by FSD. The Contractor shall apply for and provide at the Contractor's own cost the required telephone point for connection of the fire alarm direct link as required. If the Contractor cannot complete the fire alarm direct link by the date of fire service inspection by FSD, the Contractor shall be responsible to provide all necessary manpower and telephone equipment, at the Contractor's own expenses, solely for the purpose for a 24-hour/day full attendant service to substitute the fire alarm direct link up to the date of the completion of the fire alarm direct link.

The fire alarm direct link shall be tested after connection.

C1.5 GASEOUS EXTINGUISHING SYSTEM TESTS

Gaseous extinguishing system and manifolds shall be tested in accordance with Section B5.13 and FSD Requirements and Circular Letters. Pipework shall be tested for ten (10) minutes to a minimum of 1.5 times the operating pressure of the system and 10 bars whichever is larger. A 'puff' test(s) to the installed pipework is required.

The Contractor shall allow carrying out on-site full discharge test after completion of the installation when required by FSD to confirm the design conditions can be met and to the satisfaction of FSD. The Contractor shall follow relevant FSD Requirements and Circular Letters such as Circular Letter No. 2/97 and its subsequent amendments on the requirements of discharge tests. The Contractor shall refill the gas cylinders with the design agents and reset all equipment after the discharge test.

C1.6 EMERGENCY LIGHTING AND EXIT SIGN TESTS

Each self-contained luminaire and internally illuminated exit sign shall be energized from its battery by simulation of a failure of the normal supply to the lighting for a period of the rated duration of the battery. During this period all luminaires and/or signs shall be examined and tested in accordance with BS 5266 to ensure that they are functioning correctly.

Each central battery system shall be energized from its battery by simulation of a failure of the supply to the normal lighting for a period of the rated duration of the battery. During this period all luminaires and/or signs shall be examined and tested in accordance with BS 5266 to ensure that they are functioning correctly. All tests required in the Code of Practice for Minimum Fire Service Installations and Equipment and Inspection, Testing and Maintenance of Installations and Equipment and in TC3 shall be carried out and recorded.

For those emergency lighting system with battery and backed up by emergency generators, each emergency generator shall be started up and allowed to energize the emergency lighting system for a continuous period of at least one (1) hour. During this period all luminaires and/or signs shall be examined visually to ensure that they are functioning correctly.

For emergency lighting system and exit signs provided with central monitoring, testing and logging system, the system shall be tested in accordance with the manufacturer's specification and to meet the requirements in the Code of Practice for Minimum Fire Service Installations and Equipment and Inspection, Testing and Maintenance of Installations and Equipment and TC3.

Where specified that there are the emergency lighting installation and/or exit signs in a particular project not included in the Works under Fire Service Installation or not carried out by a registered fire service contractor, the Contractor shall co-ordinate with relevant parties, inspect and witness the final tests on the emergency lighting installation and/or exit signs to identify any non-compliance with the requirements in the FSDCOP, FSD Requirements and Circular Letters, and TC3. Any works found not complying with the fire service requirements of the FSD shall be rectified when they are included in the Works or be reported to the Architect when such works are carried out by others before arranging inspection with the FSD. The Contractor shall co-ordinate with relevant parties to carry out the final functional test and performance test. The Contractor shall include the emergency lighting installation in the submission to the FSD.

C1.7 EMERGENCY GENERATORS TESTS

The Contractor shall carry out full visual inspection, safety check, functional and performance test for the emergency generator installation. The tests shall include measurement on noise confirming compliance with the statutory requirements and/or as required by the Environmental Protection Department, the HKSAR

After full test of the fire service installations in a building or premises have been carried out, with all systems connected to the mains electricity supply, the mains electricity supply shall be switched off to simulate power failure and the emergency generator shall start automatically.

When the emergency generator has gained its capacity and is ready to accept the fire service load, each fire service installation shall be switched on until all installations are in operating conditions. If an automatic starting programme or device is provided for controlling the starting sequence of the equipment using emergency power supply, the programme or device shall be allowed to operate and test. A 'simultaneous running' test shall then take place and shall last for a continuous period of one (1) hour. During this period the performance of each fire service installation shall be monitored and recorded.

After one (1) hour of testing, the emergency generator set shall be examined and all instruments, safety devices etc. shall indicate normal running of the generator.

Where specified that there is emergency generator installation in a particular project not included in the Works under Fire Service Installation or not carried out by a registered fire service contractor, the Contractor shall co-ordinate with relevant parties,

inspect and witness the final tests on the emergency generator to identify any non-compliance with the requirements in the FSDCOP, FSD Requirements and Circular Letters, and TC3. Any works found not complying with the fire service requirements of the FSD shall be rectified when they are included in the Works or be reported to the Architect when such works are carried out by others before arranging inspection with the FSD. The Contractor shall co-ordinate with relevant parties to carry out the final functional test, performance test of the emergency generator installation and on load test of all fire service installations and equipment using the emergency generator power supply. The Contractor shall include the emergency lighting installation in the submission to the FSD.

C1.8 HOT SMOKE TEST

Hot smoke test shall be carried out where specified or required. The Contractor shall arrange, co-ordinate and carry out the hot smoke test to meet the purpose for simulating the prototype of a real fire under specific dynamic buoyant flow of smoke and heat intensity in a controlled manner and for assessing the performance of smoke management system, smoke control system and smoke extraction system with the given building geometry. Hot smoke test shall follow Australian Standard AS 4391 "Smoke Management System – Hot Smoke Test" or approved international standards and practices and to the approval of FSD. The Contractor shall obtain comments from FSD and all relevant parties on the detailed requirements and arrangement for the hot smoke test at early stage of the Contract.

The Contractor shall provide all materials, equipment, facilities, fuels, manpower and the like for hot smoke test. The Contractor shall co-ordinate and arrange with the Building Contractor to provide all necessary temporary protection to the building finishes, parts, fixtures, furniture and other building works during the test. The Contractor shall submit the details of such requirements to the Building Contractor in good times before the test and to the Architect for approval. The Contractor shall supply and install all necessary protections and allow all appropriate provisions to other parts of the building not covered by the Building Contractor so as not to cause any damage, and to keep any disturbance to the possible minimum to any occupants or services during hot smoke test. The Contractor shall co-ordinate with the Building Contractor and the FSD and shall propose a suitable location and a suitable fire size to the approval of FSD for carrying out the hot smoke test. The Contractor shall carry out a risk assessment of the hot smoke test and allow adequate protection and provisions for the risk. The Contractor shall employ a standby fire fighting team during hot smoke test for the purpose of fire safety. The Contractor shall deem to allow all necessary insurance coverage for the hot smoke test when such or any part of it is not covered under the general insurance policy of the Building Contractor for the site of a particular project.

The Contractor shall arrange and co-ordinate with relevant parties in carrying out the hot smoke test. The Contractor shall employ a qualified professional engineer to arrange the details and co-ordinate the hot smoke test. The engineer employed shall be a Registered Professional Engineer in Hong Kong under CAP 409 in building services or mechanical discipline or equivalent approved professional qualification.

Where hot smoke test indicates deficiency in smoke management system, smoke control system, smoke extraction system and the like included in the Works, the Contractor shall allow to rectify them to the satisfaction of the Architect and FSD at no

additional cost. Where the smoke management system is not included in the Works, the Contractor shall report the deficiency to the Architect and propose improvement measures. The Contractor shall submit a detailed test report at the end of the test that shall include all the recommendations and improvement measures.

C1.8.1 General Arrangement

The hot smoke test can be conducted in existing buildings or in new development just prior to final completion. Until the specific performance requirements for the system can resemble the conditions under which the system is intended to operate including criteria as differential pressures, air velocities and exhaust rates etc., the hot smoke test shall be arranged for FSD's inspection.

All details on the arrangements / objectives / methods / apparatus / test set up of the required operational and functional tests shall be agreed with FSD and be approved by the Architect before such test(s) be commenced. The submission shall include, but not limited to, the following items:

(a) Submission shall include drawings presented in the format as set out in the FSD Requirements and Circular Letters issued with associated schematic diagrams which fully explain the operation of the installations including at least information on "normal", "fire", and "no power" modes as well as a fully written description thereof.

(b) The Contractor shall submit proposal and list out the procedures for equipment set up, test process and safety precautions necessary for carrying out the hot smoke test. The full set up shall be carefully sized for safe application and simulation of the anticipated interior fire conditions to the building envelope including the dimension of equipment, the estimated quantity of fuel required to suit individual building geometry, acceptable designed fire size, fire load, active fire suppression system and fire growth rate etc.

(c) The Contractor shall submit all details, certificates, etc. concerning the accuracy and reliability of all test equipment on item-by-item basis or on a complete system basis.

(d) The Contractor shall ensure that the installation of dynamic extraction systems shall be completed; satisfied the design intent and functioning correctly before the final full test and demonstration take place with FSD.

(e) The Contractor shall submit full set of test and functional operation check records to and request for the attendance of FSD. Accompanying the records, the submission shall be checked and signed by the Registered Professional Engineer employed by the Contractor stating the Registered Professional Engineer's satisfaction that the installations are operating in accordance with the requirements of FSD.

(f) Full and complete records shall be taken of tests and the results thereof including not less than:

(i) Make, serial no., type and owner of all instruments used, with a copy of the calibration certificates.

(ii) Data on actual measurements taken.

(iii) Data on corrected measurement, if any.

(iv) Data on resulting air flows.

(v) Make, serial no., type and use of every device checked.

(vi) Date and time of test.

(vii) Signature of operator or supervisor and any witness for each test.

(viii) Signature on acceptance of whole system by the Registered Professional Engineer.

C1.8.2 Hot Smoke Test Preparation

The Contractor shall ensure all smoke management systems under normal operating mode shall be capable of handling the smoke volume generated during the test under reasonable time period to the satisfaction of the Architect and FSD. Furthermore, the systems in the test compartment shall be operated continuously and shall be under closely monitoring such that no adverse internal environmental conditions caused by air stratification and air velocities are generated.

The format / method / procedures / apparatus of the required operational and functional test for hot smoke test shall be agreed with FSD before any tests be commenced. The hot smoke test shall be used to validate the effectiveness of the smoke removal system against the following and with reference to the latest version of all corresponding international standards (e.g. AS 4391; NFPA 92A etc.).

(a) The air flow patterns (i.e. scouring or cross flow effect with low level supply and high level extract).

(b) Smoke removal rate.

(c) Integration between smoke extraction and detection system.

The Contractor shall provide all test apparatus, equipment and materials for the test that shall include but not limited to the following. The Contractor shall agree with FSD on the detail arrangement and any other extra equipment or apparatus used in performing the test and all details shall be submitted to the Architect for approval.

(a) Smoke generators.

(b) Fire chamber.

(c) Stainless steel tray for load cell; water bath & sand base.

(d) Combustion fuel.

(e) Temperature monitoring tree.

(f) Fire fighting equipment.

(g) Safety measures and procedure to be agreed with FSD.

Some guidelines for hot smoke test are listed below for reference. The Contractor shall obtain the approval of the Architect and FSD for the criteria used in respective test.

Test Fire Size	:	1MW to 2 MW or as agreed by FSD
Minimum Smoke Clear Height	:	2.5m
Temperature at Plume and Smoke Layer Interface	:	Not less than 10°C below temperature rating of ceiling sprinkler, around 45 °C to 50 °C maximum.
Combustion Fuel	:	Non-contaminating industrial grade methylated spirit
Smoke Generator	:	Non-toxic oil-based Type
Safety Measures	:	Fire Suppression Equipment & Personnel

C1.8.3 Fire Safety during Hot Smoke Test

The Contractor shall prepare flowchart & working procedures for the hot smoke test and perform trial runs before the actual testing be conducted with FSD. The Contractor shall employ a team of experienced fire fighters / fire watchers to the approval of the Architect to oversee the test procedure and who shall be present throughout the test. These personnel shall be equipped with full fire fighting apparel including self-contained breathing apparatus, fire extinguisher and charged fire brigade hose. The Contractor shall employ an auxiliary team of experienced fire fighters to the approval of the Architect fully equipped with fire fighting apparatus acting as the standby safety officers in order to monitor the impact of smoke movement, cumulative smoke layer and internal temperatures and to take all necessary action to ensure that the test will not generate any adverse effect caused to the observers and damage to the property. The Architect or the Contractor can terminate the test if it is considered that continuation of the test may cause damage to the property or may have a great adverse effect to the people inside the building. The Contractor shall re-arrange the hot smoke

test at no additional cost until the test is completed to the satisfaction of the Architect and the FSD. The Contractor shall ensure sufficient number of personnel station in appointed position to control the test fire and providing guidance to the observers / attendees. The Contractor shall provide sufficient training to all the Contractor's employees and staff present in the test to aware that prolonged exposure to tracer smoke may cause irritation and breathing difficulties.

The Contractor shall ensure that the temperature of hot smoke plume shall be carefully controlled for not causing damage to building structure and finishing and not triggering the automatic sprinkler system.

C1.9 TESTS ON OTHER FIRE SERVICE INSTALLATIONS

Tests on fire service installations other than those in Section C1.3 to C1.8 shall be in accordance with TC2, TC3, FSDCOP, FSD Requirements and Circular Letters, and the approved testing and commissioning procedures proposed by the Contractor and approved by the Architect. The Contractor shall propose and submit detailed testing and commissioning procedures for all fire service installations for approval by the Architect where such details of testing and commissioning are not available in TC2, TC3 and FSDCOP, e.g. pressurization of staircases system, smoke extraction system, etc. The testing and commissioning procedures submitted shall be comprehensive and sufficient to demonstrate the functioning and performance of all the systems and equipment.

C1.10 FINAL MOCK-UP TEST

Before arranging statutory inspections with FSD, the Contractor shall arrange a final mock-up test with the Architect to demonstrate all the items required for the statutory inspections have been completed and tested to the satisfaction of the Architect.

Before the final mock-up test, the Contractor shall ensure that all documents required for statutory inspections shall be available on site.

Further mock-up tests shall be required if the installation fails to meet with the satisfaction of the Architect in the test. The Contractor shall not arrange inspection with FSD till the satisfactory acceptance of the mock-up test by the Architect. The Contractor shall allow adequate time in the commissioning and testing programme for re-testing of the system in case of failure. The Contractor shall indicate the mock-up test and the inspection by FSD as the milestone events in the critical path programme to be submitted to the Architect at the commencement of the Works.

C1.11 FIRE SERVICES DEPARTMENT INSPECTIONS AND WITNESS OF TESTS

Additional tests, where not specified above, shall also be carried out to meet the requirements of the Codes of Practice for Minimum Fire Service Installations and Equipment to the satisfaction of FSD. The Contractor shall make all necessary applications to FSD and attend inspections conducted by their representatives for the purpose of these tests and inspections. The Contractor shall note that completion of

the statutory inspection and acceptance of the fire service installation by FSD is one of the considerations for certifying the completion of the Works.

C1.12 TESTING OF FIRE SERVICE INSTALLATIONS NOT INSTALLED BY REGISTERED FIRE SERVICE CONTRACTOR OR INSTALLED BY OTHERS

The Contractor shall carry out and allow the cost for inspecting, checking, witnessing the final tests and co-ordinating all fire service installations and equipment required in FSDCOP and FSD Requirements and Circular Letters in a particular project not installed by a registered fire service contractor and/or installed by others, and to identify any non-compliance of the installations with the FSDCOP, FSD Requirements and Circular Letters, and TC3. Any works found not complying with the fire service requirements of FSD shall be rectified when they are included in the Works or be reported to the Architect when such works are carried out by others before arranging inspection with FSD. The inspection, checking and witnessing the final tests on works by others shall be confined only to those items that are required for inspection by FSD and/or required to satisfy the requirements of FSD. The Contractor shall co-ordinate on the inspection, checking and witnessing the final testing of the fire service installations and equipment after completion by relevant parties. Upon completion of the testing certified by relevant parties and with no non-compliance found by the Contractor, the Contractor shall include all the fire service installations and equipment of a particular project in the submission to FSD for inspection. Section B12.7 is also relevant. The Contractor shall co-ordinate, obtain the drawings and information from relevant parties and include all fire service installations and equipment, related fire service installations and related fire service provisions in the submission to the FSD for comment and inspection.

Where some fire service works in a particular project are carried out by other registered fire service contractors, the Contractor shall be responsible to co-ordinate with relevant parties to confirm the completion of the installation and testing of such fire service works and to include them in the submission to FSD for comment and inspection.

C1.13 CLEANING OF DETECTORS

The Contractor shall allow where necessary cleaning of all the detectors using manufacturers' recommended methods before the tests as well as before inspection by FSD. Before the time of tests and during building construction, the Contractor shall supply and install suitable protection to the detectors to protect them from dirt and dusts after they are installed. After inspection by the FSD, the Contractor shall further allow to take down and clean "in-situ", and test if necessary, all the detectors in accordance with manufacturer's recommendation at completion of the Works at the time when the users of the building will occupy the building. The Contractor shall co-ordinate on the time programme for carrying out such cleaning work and shall obtain the approval of the Architect on the programme especially when the users of the building may arrange fitting-out works. Cleaning of detectors carrying out without notifying the Architect shall not be accepted and the Contractor shall be required to clean the detectors again no matter whether they have done so or not. Where the detectors are required to be factory-cleaned, all detectors removed for factory cleaning

shall be replaced with spare units to cover the unprotected areas as resulted. All expenses for the above work shall be borne by the Contractor.

C1.14 COMMISSIONING AND TESTING REPORT AND CERTIFICATE OF COMPLETION

All commissioning and testing results shall be properly recorded during commissioning and testing at the witness of the Architect. Immediately after the commissioning and testing, the Contractor's CEIC shall endorse the data record sheet on site with endorsement by the Architect's representative witnessing the commissioning and testing, irrespective whether the tests are successful or not, and submit a copy of the data record sheet to the Architect. A full commissioning and testing report shall be forwarded to the Architect within fourteen (14) calendar days after completion of commissioning and testing of the installation. The report shall be in accordance with the TC3 and the checklist stipulated in the FSDCOP or as required by FSD. The report shall be checked, verified, certified and signed by a Registered Professional Engineer in Hong Kong under CAP 409 in approved disciplines (or equivalent approved professional qualification) employed by the Contractor or, when approved by the Architect for minor installation, be checked, verified, certified and signed by a staff of the Contractor having the highest professional/technical qualification within the Contractor's company. The CEIC shall check, verify, certify and sign the report before the endorsement by the Registered Professional Engineer. Different parts of the report shall also be signed and certified by relevant parties such as registered electrical contractors/workers employed for the electrical fire service installation/electrical installation, registered professional engineers employed for the smoke extraction system, pressurisation of staircases, hot smoke test and emergency generator, relevant contractors of related fire service installations and related fire service provisions, qualified persons for the surveyor certificates, design engineers as appropriate, independent checker where provided, etc. The commissioning and testing report shall also be included as an appendix in the operation and maintenance manual.

Together with these, a certificate of completion signed by the Contractor shall be issued to the Architect with a copy forwarded to the Director of Fire Services in conformity with Regulation 9 of the Fire Service (Installations and Equipment) Regulations.

C1.15 COMPLETION OF OUTSTANDING WORKS

Within one month of receiving the Architect's substantial completion certificate, the Contractor shall complete all outstanding works listed thereon and rectify any defects that have arisen up to that time.

SECTION C2
MAINTENANCE DURING MAINTENANCE PERIOD AND FINAL TESTING

C2.1 GENERAL MAINTENANCE REQUIREMENTS

The Contractor shall furnish free maintenance services for the complete fire service installation for the whole Maintenance Period unless otherwise specified. This free maintenance services shall include the following: -

(a) Routine quarterly inspections, tests and maintenance services, and routine inspections, tests and maintenance service as necessary.

(b) Emergency inspections, tests and repairs.

(c) Final inspections, tests and maintenance services, and annual inspections, tests and maintenance services.

(d) All the services and requirements in Section C2

All inspections, tests, maintenance services and repairs shall be carried out generally in accordance with the manufacturers' recommendations/instructions and to the satisfaction of the Architect. The maintenance service is to maintain the fire service installation in a good and functional working condition. The maintenance service shall include preventive maintenance and all spare parts and spares required in the Maintenance Period.

The Contractor shall despatch competent and experienced engineers and technicians equipped with the appropriate testing instruments, tools, equipment, etc. to inspect, service, test, adjust and maintain the fire service installation in a satisfactory operating condition. The Contractor shall allow for carrying out such inspection, service, testing, adjustment and maintenance at a time outside normal office hours including general holidays where and when required. The Contractor shall submit a list with at least two names, telephone and pager numbers and addresses of the Contractor's English-speaking and Cantonese- speaking representative to who services calls should be directed.

Particularly in the case of complex fire service installation, the Contractor shall provide at least two senior servicemen being thoroughly familiarised with all aspects of such installation to be responsible for inspection, maintenance and testing of the installation. In this type of installation the Contractor must be prepared to provide a high level of service, allowing for more frequent service of environmentally sensitive equipment and when necessary, to ensure prompt rectification of the faults resulting in unacceptably high rate of unwanted alarms all at the expenses of the Contractor.

All labour and materials necessary, e.g. fire alarm contacts, detectors, bells, buzzers, lamp bulbs, etc., including cleaning materials, lubricants, battery electrolyte, tools, instruments, replacement of parts, etc., and transportation required for carrying out routine and emergency inspections, tests, repairs, replacements and maintenance services shall be included in the Contract. Any renewals or repairs necessitated by reason of negligence or misuse of the equipment or by reason of any other cause beyond the Contractor's control (with the exception of ordinary wear and tear) shall be carried out at an additional cost with prior notice to the Architect.

The Contractor shall also replenish at the Contractor's own cost all fire extinguishing media and other materials expended or used during the tests including diesel or petrol fuel and ensure that the entire installations are in a satisfactory operational condition at the conclusion of each visit.

The Contractor shall be responsible for all repairs necessary to maintain the fire service installation in a safe, reliable and operative condition at all times. The Contractor must ensure that the Contractor's servicing staff shall carry out the necessary repairs by utilising manufacturer's original replacement parts. Any component taken down for services shall be reinstated within two (2) hours or otherwise replaced by a spare unit at the Contractor's expenses.

The Contractor shall ensure minimum interruption to the functioning of the fire service installation during each inspection, testing, repair or maintenance service. The Contractor shall inform the FSD of the commencement and completion of each job whenever the disconnection, reconnection or testing of the fire service communication direct line is involved. Where any part of the fire service installation is out of service temporarily during the progress of work, the Contractor shall place a suitable notice in a prominent position on the control panel so that the client is aware of the situation and the FSD will not be called out unnecessarily. This is, however, not to be construed as an authority to leave any part inoperative for an undue length of time.

The Contractor shall, as and when instructed by the Architect, repair or replace at the Contractor's own cost any part of the system proved to be defective by reason of Contractor's negligence, faulty design, inadequate routine maintenance and supervision, workmanship or materials. No claim whatsoever shall be made by the Contractor for such repair or replacement if it is within the scope of the Contractor's responsibility.

After each routine quarterly inspection, testing and maintenance service, the Contractor shall furnish to the Architect within fourteen (14) calendar days a report complete with the following details: -

(a) Date and time of inspection, testing and maintenance service.

(b) Persons carrying out the task.

(c) Details of inspection and maintenance service.

(d) Results of all tests performed.

(e) Any external factors significantly affecting the service and test results.

(f) Any follow-up actions as required.

(g) The record of all fault callouts in Section 2.2 since last routine quarterly inspection, testing and maintenance service.

(h) The record of the fire alarm direct link being temporarily disconnected since last routine quarterly inspection with date and time.

The Contractor shall, at the Contractor's own expenses, make all suitable arrangements to avoid damage to property or installations provided by others during the course of the

Works. The Contractor shall be responsible for all losses and claims for injury or damage to any person or property arises out of or in consequence of the execution of the maintenance work.

A log book shall be provided by the Contractor and retained in the fire service plant room, fire control centre, management office or building supervisor's office as approved by the Architect for recording all events for the fire service installation in the Maintenance Period. The Contractor shall record all the details of operation: faults and corrective actions taken, routine servicing, maintenance and periodic operation, inspection, testing, results, actions, etc.; including dates, time of calls, time of attending, hour meter readings, cause of faults, time to remove faults, workers/supervisors names and signatures, location and identification of faults, description of equipment serviced, etc. for all the fire service equipment, materials, system and installation. The Contractor shall also record the date, time and period on any temporary disconnection of the fire alarm direct link in the log book and in the routine quarterly report submitted to the Architect.

Where barcode labels and barcode equipment are included in the Works, the Contractor shall submit inventory and service records taken by the barcode scanning devices in a format approved by the Architect. Details shall be submitted for approval.

No replacement of plant or parts of plant shall be carried out at any time unless the Architect has been notified and given approval.

Where fire retardant paint or spray are applied on site to any surface to meet with requirements of the rate of surface spread of flame, the fire retardant paint/spray shall be repainted at the end of Maintenance Period.

The Contractor shall carry the final inspection, testing and maintenance of the fire service installation at the end of the Maintenance Period. Where the Maintenance Period is longer than one year, the Contractor shall also carry out annual inspection, testing and maintenance of the fire service installation annually in the Maintenance Period complying with the requirements of FSD. The requirements of annual inspection, testing and maintenance shall be the same as that of the final inspection, test and maintenance unless otherwise required by FSD.

C2.2 EMERGENCY INSPECTIONS, TESTS AND REPAIRS

Emergency service including overtime work for minor repairs and adjustments shall be included under the Contract.

The Contractor shall be responsible for immediate answering of breakdown calls during the day or night including public holidays, whether true or false, and attention to such calls both inside and outside the normal working hours in the shortest possible time and using the quickest means of transport. In general a response time of less than one (1) hour will be expected unless special arrangement is made and approved for very remote locations.

Any necessary repairs shall be carried out with the most practicably expeditious means to ensure minimum interruption to the operation of the fire service installation.

The Contractor shall arrange to refill the gas cylinders for the gaseous extinguishing system upon discharge and put the system into normal operation within a time as short

as possible but in no case shall be longer than seven (7) calendar days. Unless otherwise there are evidences that the discharge of gases in the gaseous extinguishing systems is due to a fire, smoke that generated a fire alarm, or the default operation/act of the occupiers of the building, the cost for refilling the gas cylinders of the gaseous extinguishing systems after discharge in the Maintenance Period shall be borne by the Contractor.

The Contractor shall keep a clear and legible record of all fault callouts and shall submit this record within three (3) calendar days upon request by the Architect for inspection. The Contractor shall also include the record of all fault callouts in the report in Section C2.1 submitted after each routine quarterly inspection, testing and maintenance service. The record shall indicate the date, time of callout, time of attending, persons attending, brief description of the fault, location/identification of fault, cause of fault, and subsequent time of clearance for each occasion. The record will be returned to the Contractor after perusal by the Architect but shall subsequently be submitted and kept by the Architect at the end of the Maintenance Period during the handover inspection of the installation.

C2.3 ROUTINE QUARTERLY INSPECTION, TESTING AND MAINTENANCE OF FIRE DETECTION AND ALARM SYSTEM

The Contractor shall visit the installation at least once every three months to carry out tests, repairs and adjustments. All environmentally sensitive devices, e.g. smoke and heat detectors, air filters at the end of the probes for duct type detectors, electronic sensors, relay contacts, plug and socket contacts, printed circuit boards, edge connectors, etc. shall be inspected, cleaned, adjusted, and calibrated. During the visits, the following tests and checks shall be made: -

A test sequence shall be carried out in accordance with the manufacturer's instructions. The test sequence shall prove: -

(a) That the condition of the wiring, controls and indicating equipment of all zone circuits are in good working order.

(b) That the alarm condition on each zone will activate the common alarm circuits. If manual call points are fitted the alarm conditions shall also be initiated by the operation of one such call point in each zone. A different manual call point shall be used on each occasion and a record must be kept by the Contractor.

(c) That activating the common alarm circuits will result in the operation of the alarm bells and the satisfactory transmission of the alarm signal to FSD or FSD's agency if equipped with a fire alarm direct line connection.

(d) That activating the common alarm circuits will result in the starting/stopping of the ventilating fans and/or fire booster pumps as desired and result in the operation of any lift, if control circuits for such operation are provided in the system.

The operation of alarm bells and the transmission of the alarm signal may be suppressed during tests (a) and (b). Test (c) and (d) will prove that all system alarms and relevant controls are operating correctly.

In the course of the test sequence, the correct operation of all indicators including fault warnings and all alarm bells shall be noted and checked. All indicating lamps shall be checked and if found defective shall be replaced by the Contractor at the Contractor's own expenses.

About 20% of the detectors chosen at random with at least one unit in each zone shall be subjected to a simulated functional test. Smoke detectors shall be tested with simulated smoke and rate-of-rise heat detectors with an artificial heat source, e.g. hair dryer.

Battery and chargers shall be examined and tested to ensure they are in good and proper serviceable condition. Battery terminals and connectors shall be tightened and the former shall be cleaned and protected with petroleum jelly. Electrolyte shall be topped up as necessary and its specific gravity shall be measured and corrected to the appropriate value if required. Battery shall also be discharged and recharged to ensure compliance with the specified requirements.

When false alarm from the fire detection system is reported in the Maintenance Period, the Contractor shall take down, clean 'in-situ" and test all detectors in the Works irrespective whether such detectors have caused the alarm. All detectors that cannot pass the test or cannot be cleaned shall be replaced with new one at the cost of the Contractor. Where the detectors are required to be factory-cleaned, all detectors removed for factory cleaning shall be replaced with spare units to cover the unprotected areas as resulted. All expenses for the above work shall be borne by the Contractor. The Contractor shall check and re-adjust the setting of the detector and control panel as necessary. The Contractor shall also check and identify the causes of the alarm and submit a full report to the Architect. All faults shall be rectified immediately to the satisfaction of the Architect and FSD. Unwanted alarm, that is the alarm caused by uncommon human activities in the area at the time of alarm such as welding, smoking, etc., will not be counted as false alarm. All other alarms with or without known reason except true fire alarm shall be taken as false alarm. All alarms reported shall be recorded in the log book and in the routine quarterly report submitted to the Architect.

C2.4 FINAL/ANNUAL INSPECTION, TESTING AND MAINTENANCE OF FIRE DETECTION AND ALARM SYSTEM

At the final/annual inspection, the Contractor shall, in addition to the quarterly inspection and testing, take down all smoke detectors, clean them 'in-situ' in accordance with the manufacturer's instructions, test them for correct operation with the manufacturer's test set before reinstate them for service. Any defective detectors shall be replaced or 'factory cleaned' to the manufacturer's recommendation before reinstated for service. Any smoke detectors subjected to dust and dirt accumulation shall also be despatched for factory cleaning as instructed by the Architect. All detectors removed for factory cleaning shall be replaced with spare units or alternatively a separate surveillance system shall be supplied and installed to cover the unprotected areas as resulted. All expenses for the above work shall be borne by the Contractor. All equipment reaching expiry date of service life shall be replaced.

C2.5 ROUTINE QUARTERLY INSPECTION, TESTING AND MAINTENANCE OF GASEOUS EXTINGUISHING SYSTEMS

The Contractor shall visit each installation at least once every three months and carry out the following tests including necessary repairs and adjustments: -

(a) All electrical components, including cables, detectors, relays, alarm panel and bells, batteries, etc. shall be tested and examined as specified in Section C2.3.

(b) All automatic/manual release mechanism shall be checked and serviced in accordance with the manufacturer's instructions to ensure their proper operation. The Contractor shall be responsible for ensuring that all such mechanisms are properly lubricated and kept free from corrosion.

(c) All pipes and fittings shall be checked for leakage and corrosion and repaired or repainted as necessary. All valves shall be checked for freedom of operation and nozzles shall be cleaned by removing the dust, dirt and other obstacles deposited on them.

(d) All cylinders containing the chemical extinguishing agents shall be checked to ensure that the contents are up to the specified standard and are so marked with paint on the outside of cylinders. The Contractor shall recharge any cylinders to the specified content level if carbon dioxide cylinders are found to exhibit a 10% loss and other gas cylinders a 5% loss of content by weight except where the discharge (usually total) is due to genuine fire, false alarm or accident caused by others. However, where the discharge is due to a faulty detector or other part of the equipment the Contractor shall recharge the system at the Contractor's own expenses.

(e) All warning notices and operating instructions shall be checked to ensure that they are fixed in the proper position, are in a readable condition and are both in English and Chinese unless otherwise confirmed in writing by the Architect.

(f) All time delay and lock-off devices shall be inspected and tested to ensure that they are in correct working condition.

(g) The coincident unit shall be checked for proper function by actuating detectors of two separate zones.

(h) All ancillary functions of the system such as shutting off air-conditioning/ventilation plant, lowering fire shutters/dampers or curtains, etc. shall be checked for proper operation.

C2.6 FINAL/ANNUAL INSPECTION, TESTING AND MAINTENANCE OF GASEOUS EXTINGUISHING SYSTEMS

The Contractor shall carry out the same amount of work as the quarterly inspection, testing and maintenance services. All equipment reaching expiry date of service life shall be replaced.

C2.7 ROUTINE QUARTERLY INSPECTION, TESTING AND MAINTENANCE OF FIXED FIRE PROTECTION SYSTEMS USING WATER AS AN EXTINGUISHING AGENT

The Contractor shall visit the installation at least once every three months and carry out the following inspections, tests, adjustments and repairs: -

(a) All electrical components including cables, alarm panel and bells, batteries, control relays, starters, etc. shall be inspected and tested as specified in Section C2.3.

(b) All pipes and fittings shall be checked for leakage and corrosion and repaired or repainted as necessary. All valves shall be checked for freedom of operation, all control valves kept locked in the 'open' position by strapping as applicable, inlet valves correctly bonded to earth, water supplies maintained in service, etc.

(c) Inspection shall be carried out to ensure that all sprinkler heads are maintained in good working condition, clean and free from corrosion and are not covered with distemper, paint, dust, fluff, etc. Any sprinkler heads found defective and suspected of being defective shall be replaced.

(d) Water and air pressure gauges must be inspected to ensure that correct pressures are maintained. Gauges shall be calibrated at regular intervals. Water levels and air pressure in pressure tanks must be checked to ensure that they are maintained in proper condition.

(e) An alarm test shall be made on the sprinkler system by opening the test valve and the time taken to sound the alarm gong noted. The alarm shall be allowed to ring for about thirty (30) seconds in order to ascertain that it is not ringing intermittently. Any repairs or adjustments which may prove to be necessary after the test shall be carried out with no delay.

(f) All metallic elevated, priming and pressure tanks constructed by the Contractor shall be inspected for sediments, rust and corrosion. The Contractor shall remove sediments, rust and repaint the corroded parts as necessary.

(g) The Contractor shall grease the valves, the bearing and other relevant mechanical parts of the pumps, motors and engines as recommended by the manufacturers. An automatic pump starting test and a test run of at least 10 min. shall be performed on each pump to ensure the pumping systems are in satisfactory operating condition. Engine driven pumps shall be capable of starting in 30 sec. or less. All manual and automatic starting and control mechanism, components, switches, etc. shall be checked for proper functioning.

(h) All sprinkler flow switches shall be checked for correct functioning.

The Contractor shall replace as required all parts such as bearings, valve seats, packing, etc. due to wear and tear. In addition the Contractor shall maintain in good working order the engines, the motors and the electrical power supply to the pumps from its electrical isolator or switch, including changeover switches, starters, fixed and flexible conduits between isolator/switch and cables therein. The Contractor shall also

maintain all pump control pressure and level switches in good order and inspect circuitry as previously indicated for electrical systems.

C2.8 FINAL/ANNUAL INSPECTION, TESTING AND MAINTENANCE OF FIXED FIRE PROTECTION SYSTEMS USING WATER AS AN EXTINGUISHING AGENT

At the final/annual inspection, the Contractor shall, in addition to the quarterly inspection and testing, carry out the following inspections, tests, adjustments and repairs as required: -

(a) Inspection and testing, by means of wet drill on the hydrant and hosereel installation, shall be carried out in accordance with the Fire Services Department requirements. The wet drill shall consist of coupling lengths of hose to two or more hydrants and opening the valve to produce water at the nozzles. Great care and precise liaison with all concerned must be exercised by the Contractor to guard against flooding and seepage of water. The Contractor shall be liable to bear the full cost of any damage due to flooding and seepage. Hydrants not used at the wet drill shall each be fitted with a blank cap over the outlet, and checked by opening and closing the valve and spindle to ensure that they are free in operation.

Testing of the pressure and flow of the water supply on the hydrant and hosereel installation shall be done from the outlets at the highest point. The opening of two or more outlets and directing the water from the roof tanks is sufficient to indicate the state of the water supply, but if there is any doubt as to the flow or pressure of the water, a more accurate test with suitable gauges shall be carried out.

After the test or wet drills, care shall be taken to see that the hose is thoroughly drained, dried and aired before being replaced.

(b) Each length of hose shall be uncoiled, laid out straight and examined, particular care being taken to see that the washers in the female couplings are intact and in good condition and that the hose is not damp or attacked by mildew.

(c) Each water supply to the sprinkler installation shall be tested individually. Before making the test on any one water supply, it is necessary to shut off all the other supplies. The test shall be made with the drain and test valves fully open in accordance with the requirements of the LPC Rules for Sprinkler Installations.

(d) After shutting off all water supplies and draining the installation via the flow test/drain valve, the Contractor shall remove the sprinkler control valve front cover to inspect and maintain its internal components. The work shall include checking the freedom of movement of the main clapper assembly and cleaning as required, greasing and replacing worn seals and gaskets, replacing all valve glands as necessary and replacing any worn seats in small bore valves, etc. The sprinkler control valve front cover shall then be replaced and the installation shall be re-commissioned.

(e) The concrete water tanks constructed by the builder shall be inspected for rusting and sediments. The Contractor shall inform the Architect in writing if any cleaning and rectification on the tanks are necessary.

C2.9 ROUTINE WEEKLY/MONTHLY INSPECTION, TESTING AND MAINTENANCE OF EMERGENCY LIGHTING AND EXIT SIGNS

The Contractor shall visit each installation at least once every month (or once every week if weekly voltage test on emergency luminaire is involved) and carry out the following tests including necessary repairs and adjustments: -

(a) Each self-contained luminaire and internally illuminated exit sign shall be energized from its battery by simulation of a failure of the supply to the normal lighting for a period of at least one (1) minute at 10-hour discharge rate and sufficient to ensure that each lamp is illuminated. The period of simulated failure shall not exceed one quarter of the rated duration of the fully charged battery or sign. During this period all luminaires and/or signs shall be examined and tested in accordance with BS 5266 (or tested by the Central Monitoring, Testing and Logging System as mentioned in Section B11.1.6) to ensure that they are functioning correctly. At the end of this test period the supply to the normal lighting shall be restored and any indicator lamp or device checked to ensure that it is showing that the normal supply has been restored.

(b) Each central battery system shall be energized from its battery by simulation of a failure of the supply to the normal lighting for a period of at least one (1) minute at 10-hour discharge rate and sufficient to ensure that each lamp is illuminated. The period of simulated failure shall not exceed one quarter of the rated duration of the fully charged battery. During this period all luminaires and/or signs shall be examined and tested in accordance with BS 5266 (or tested by the Central Monitoring, Testing and Logging System as mentioned in Section B11.1.6) to ensure that they are functioning correctly. All tests required in the Code of Practice for Minimum Fire Service Installations and Equipment and Inspection, Testing and Maintenance of Installations and Equipment shall be carried out and recorded. At the end of this test period the supply to the normal lighting shall be restored and any indicator lamp or device checked to ensure that it is showing that the normal supply has been restored.

(c) For emergency lighting system backed up by emergency generators, the emergency lighting shall be tested during on-load test of the emergency generator. After the emergency generator was started up, it shall be allowed to energize the emergency lighting system for a continuous period of at least one (1) minute and sufficient to ensure that each lamp is illuminated. During this period all luminaires and/or signs shall be examined visually (or tested by the Central Monitoring, Testing and Logging System as mentioned in Section B11.1.6) to ensure that they are functioning correctly. At the end of this test period the normal supply to the lighting shall be restored and any indicator lamp or device checked to ensure that it is showing that the normal supply has been restored.

Where central battery system is supplied and installed, the Contractor shall in addition visit the installation at least once every week and carry out weekly voltage and hydrometer test.

Section B11.1.6 where relevant shall also be followed.

C2.10 FINAL/ANNUAL INSPECTION, TESTING AND MAINTENANCE OF EMERGENCY LIGHTING AND EXIT SIGNS

The Contractor shall carry out the following tests annually and at the end of the Maintenance Period including necessary repairs and adjustments: -

(a) Each self-contained luminaire and internally illuminated exit sign shall be energized from its battery by simulation of a failure of the normal supply to the lighting for a continuous period of half of the rated duration of the fully charged battery. During this period all luminaires and/or signs shall be examined and tested in accordance with BS 5266 to ensure that they are functioning correctly. At the end of this test period the normal supply to the lighting shall be restored and any indicator lamp or device checked to ensure that it is showing that the normal supply has been restored.

(b) Each central battery system shall be energized from its battery by simulation of a failure of the normal supply to the lighting for a continuous period of half of the rated duration of the fully charged battery. During this period all luminaires and/or signs shall be examined and tested in accordance with BS 5266 to ensure that they are functioning correctly. All tests required in the Code of Practice for Minimum Fire Service Installations and Equipment and Inspection, Testing and Maintenance of Installations and Equipment shall be carried out and recorded. At the end of this test period the normal supply to the lighting shall be restored and any indicator lamp or device checked to ensure that it is showing that the normal supply has been restored.

(c) For those emergency lighting system backed up by emergency generators, the emergency lighting shall be tested during on-load test of the emergency generator. After the emergency generator was started up, it shall be allowed to energize the emergency lighting system for a continuous period of at least ten (10) minutes. During this period all luminaires and/or signs shall be examined visually to ensure that they are functioning correctly. The test shall be repeated for five (5) minutes with the emergency generator shut off and the lighting supplied by the battery system only. At the end of the test period the normal supply to the lighting shall be restored and any indicator lamp or device checked to ensure that it is showing that the normal supply has been restored. The fuel tanks shall be filled up and the oil and the coolant levels topped up as necessary.

Where the emergency lighting installation and/or exit signs are not included in the Works under Fire Service Installation, the Contractor shall co-ordinate with relevant parties and collect the information on the final/annual inspection/testing on emergency lighting installation/exit signs to confirm their compliance with the requirements of the FSD. Any works found not complying with the fire service requirements of the FSD shall be reported to the Architect.

All equipment reaching expiry date of service life shall be replaced.

C2.11 ROUTINE MONTHLY INSPECTION, TESTING AND MAINTENANCE OF EMERGENCY GENERATORS

The Contractor shall visit each installation at least once every month and carry out the following tests including necessary repairs and adjustments: -

The emergency generator shall be run once per month under design load conditions for a period of not less than thirty (30) minutes. During this running period all operating conditions shall be checked. Following this running period functional tests shall be carried out on all automatic and manual starting devices and safety controls.

The Contractor shall record all the details of operation: faults and corrective actions taken, routine servicing, maintenance and periodic operation, inspection, testing, results, actions, etc.; including dates, time of calls, time of attending, hour meter readings, cause of faults, time to remove fault, workers/supervisors names and signatures, location and identification of faults, description of equipment serviced, etc. in the log book in Section C2.1 for the unit, batteries, compressors, etc.

C2.12 FINAL/ANNUAL INSPECTION, TESTING AND MAINTENANCE OF EMERGENCY GENERATORS

The Contractor shall carry out the following tests including necessary repairs and adjustments: -

The emergency generator shall be run under design load conditions for a period of one (1) hour. During this running period all operating conditions shall be checked. Following this running period functional tests shall be carried out on all automatic and manual starting devices and safety controls.

Where the emergency generator installation is not included in the Works under Fire Service Installation, the Contractor shall co-ordinate with relevant parties and collect the information on the final/annual inspection/testing on the emergency generator and on all fire service installations and equipment using the emergency generator power supply to confirm their compliance with the requirements of the FSD. Any works found not complying with the fire service requirements of the FSD shall be reported to the Architect.

C2.13 QUARTERLY AND FINAL/ANNUAL INSPECTION AND MAINTENANCE OF PORTABLE FIRE EXTINGUISHERS

Portable fire extinguishers and appliances supplied and installed by the Contractor shall be inspected and checked quarterly to ensure that they are in good working condition. Any extinguisher and appliance found not in proper working condition shall be reconditioned and/or recharged/replaced to the required standard. All equipment reaching expiry date of service life shall be replaced.

C2.14 INSPECTION, TESTING AND MAINTENANCE OF OTHER FIRE SERVICE INSTALLATION

The Contractor shall carry out routine quarterly and final/annual inspection, testing and maintenance of all other fire service installation. The inspection, testing and maintenance shall follow the statutory requirements, the recommendation of the manufacturers, good engineering practice in the fire service trade, the relevant standards and the Specification to maintain the fire service installation in an operable and functional status.

C2.15 CERTIFICATE OF MAINTENANCE

After completion of the final inspection, testing and maintenance service to the fire service installation at the end of the Maintenance Period to the satisfaction of the Architect, the Contractor shall within fourteen (14) calendar days issue to the Architect a certificate of maintenance signed by the Contractor with a copy forwarded to the Director of Fire Services. Where the Maintenance Period is longer than one year, the Contractor shall also submit to the Architect a certificate of maintenance after the completion of the annual inspection, testing and maintenance to the satisfaction of the Architect with a copy forwarded to the Director of Fire Services in compliance with the requirements of FSD.

C2.16 HANDOVER OF FIRE SERVICE INSTALLATION

The fire service installation shall not deem as acceptable for handover to the Architect until the installation is in good working order and all as-built drawings, instruction and maintenance manuals, spare parts lists, test reports, test certificates, etc. have been submitted to the Architect.

APPENDIX 1

LIST OF TECHNICAL STANDARDS AND QUALITY STANDARDS IN THE GENERAL SPECIFICATION

The following is the list of technical standards and quality standards quoted in this General Specification. The technical standards and quality standards indicate the basic requirements. The Contractor may offer products, materials and equipment complying with alternative internationally recognized equivalent standards acceptable to the FSD and demonstrated to be equivalent in terms of the type of construction, functions, performance, general appearance and standard of quality to the relevant standards or other standards specified in this General Specification to the Architect for approval.

ANSI B1.20.1	Standard for pipe threads, general purpose
AS 4391	Smoke Management Systems – Hot Smoke Test
ASME/ANSI B31	Code for pressure piping
ASTM A120	Specification for welded & seamless pipe
BS 21	Pipe threads for tubes & fittings where pressure-tight joints are made on the threads (metric dimensions)
BS 143	Malleable cast iron and cast copper alloy threaded pipe fittings
BS 336	Fire hose couplings & ancillary equipment
BS 381c	Colours for identification, coding & special purposes
BS 476 Part 24	Method for determination of the fire resistance of ventilation ducts
BS 970	Specification for wrought steels for mechanical & allied engineering purpose
BS1010 Part 2	Draw-off taps and above ground stop valves
BS1042	Measurement of fluid flow in closed conduits
BS1387	Screwed & socketed steel tubes and tubulars & for plain end steel tubes suitable for welding or for screwing to BS 21 pipe threads
BS1552	Specification for manual shut-off valves for use with 1st, 2nd and 3rd family gases.
BS1560	Circular flanges for pipes, valves and fittings

BS1640 Part 3	Steel butt-welding pipe fittings for the petroleum industry: wrought carbon and ferritic alloy steel fittings
BS1740	Wrought steel pipe fittings
BS1965	Specification for butt-welding pipe fitting for pressure purpose
BS3416	Bitumen-based coating for cold application, suitable for use in contact with potable water
BS3601	Carbon steel pipes & tubes with specified room temperature properties for pressure purposes
BS3799	Steel pipe fittings screwed and socket-welding for the petroleum industry
BS3974	Specification for pipe supports
BS4504	Circular flanges for pipes, valves & fittings
BS4652	Zinc-rich priming paint (organic media)
BS4675	Mechanical vibration in rotating machinery
BS4999	General requirements for rotating electrical machines
BS5000 Part 10	General purpose induction motors
BS5041 Part1	Fire hydrant system equipment - Specification for landing valves for wet risers
BS5150	Cast iron wedge and double disk gate valves for general purposes DN Series PN 16
BS5151	Cast iron gate (parallel slide) valves for general purposes DN Series PN16
BS5152	Cast iron globe and globe stop and check valves for general purposes DN Series PN16
BS5154	Copper alloy globe, globe stop and check, check and gate valves DN Series PN16
BS5156	Screw down diaphragm valves DN Series PN16
BS5159	Cast iron and carbon steel ball valves for general purposes DN Series PN16
BS5163	Key-operated cast iron gate valves for water works purposes DN Series PN16
BS5252	Framework for colour co-ordination for building purposes

BS5266 Part 1	Code of practice for the emergency lighting of premises other than cinemas & certain other specified premises used for entertainment
BS5306 Part 4	Specification for carbon dioxide systems
BS5445 Part 5 (EN 54 Part 5)	Heat sensitive detectors-point detectors containing a static element
BS5445 Part 7 (EN 54 Part 7)	Specification for point-type smoke detectors using scattered light, transmitted light or ionisation
BS5499 Part 1	Specification for fire safety signs
BS5499 Part 2	Specification for self-luminous fire safety signs
BS5501 Part 1	Electrical apparatus for potentially explosive atmospheres
BS5501 Part 7	Electrical apparatus for potentially explosive atmospheres – intrinsic safety `I'
BS5654	Specification for stabilized power supplies, DC Output
BS5839	Fire detection and alarm systems for buildings
BS6141	Insulated cables & flexible cords for use in high temperature zones
BS6207	Mineral-insulated copper-sheathed cables with copper conductors
BS6387	Performance requirements for cables required to maintain circuit integrity under fire conditions
BS6724	Armoured cables for electricity supply having thermosetting insulation with low emission of smoke & corrosive gases when affected by fire
BS6840	Sound system equipment
BS7211	Thermosetting insulated cables (non-armoured) for electric power & lighting with low emission of smoke & corrosive gases when affected by fire
BS7430	Code of practice for earthing
BS7671	Requirement for electrical installation. IEE Wiring Regulations
BS7863	Recommendation for colour coding to indicate the extinguishing media contained in portable fire extinguishers
BSDD 240	Fire safety engineering in buildings

BSEN 3 -1	Description, duration of operation, class A & B fire test
BSEN 545	Ductile iron pipes, fittings, accessories and their joints for water pipelines. Requirements and test methods
BSEN 837-1	Pressure gauges. Bourdon tube pressure gauges. Dimensions, metrology, requirements and testing
BSEN 1254 Part 1 and 2	Copper and copper alloys, plumbing fittings
BSEN 1982	Copper & copper alloy, ingots and castings
BSEN 10253-1	Butt welding pipe fittings - Wrought carbon steel for general use and without specific inspection requirements
BSEN 12334	Industrial valves, cast iron check valves
BSEN 12449	Copper and copper alloys, seamless, round tubes for general purposes
BSEN 50081	Electromagnetic compatibility. General emission standards
BSEN 60034-9	Rotating electrical machines - noise limits
BSEN 60439 -1	Type-tested & partially type-tested assemblies
BSEN 60849	Sound systems for emergency purposes
BSEN 60947-1	Specification for low-voltage switchgear & controlgear – General rules
BSEN 60947-4-1	Specification for low-voltage switchgear & controlgear – electromechanical contactors & motor starters
BSEN 60529	Degrees of protection provided by enclosures
BSEN 61204	Specification for Performance Characteristics and Safety. Requirements of Low-voltage Power Supply Devices, D.C. Output.
BS EN 61436	Secondary cells and batteries containing alkaline or other non-acid electrolytes. Sealed nickel-metal hydride rechargeable single cells.
BS EN 61951-2	Secondary cells and batteries containing alkaline or other non-acid electrolytes. Portable sealed rechargeable single cells. Nickel-metal hydride.
BSISO 13387	Fire Safety Engineering
CIBSE Guide E	Fire Engineering

IEC 950	Specification for Safety of IT Equipment, including Electrical Business Equipment
IEC 60079	Electrical apparatus for explosive gas atmospheres
ISO 7-1	Pipe threads where pressure-tight joints are made on the threads - Part 1: Dimensions, tolerances and designation
ISO 7-2	Pipe threads where pressure-tight joints are made on the threads -- Part 2: Verification by means of limit gauges
ISO 65	General requirements for bodies operating product certification systems
ISO 2954	Mechanical Vibration of Rotating and Reciprocating Machinery – requirements for instruments for measuring vibration severity
ISO 3864	Safety colours and safety signs
ISO 7165	Portable fire extinguishers – Performance and construction
ISO 9001	Quality systems -- Model for quality assurance in design, development, production, installation and servicing.
ISO 9002	Quality systems -- Model for quality assurance in production, installation and servicing
ISO 10814	Mechanical Vibration – Susceptibility and sensitivity of machines to unbalance
NFPA 10	Standard for portable fire extinguishers
NFPA 72	National fire alarm code
NFPA 92A	Recommended Practice for Smoke-Control Systems
NFPA 101A	Guide on alternative approaches to life safety
NFPA 2001	Standard on clean agent fire extinguishing systems
UL 555 Class I	Leakage rated dampers for use in smoke control system