

FIRE DETECTION SYSTEM**PART 1 – GENERAL****1.1 WORK DESCRIPTION**

1. This specification is intend to cover intelligent (microprocessor based) Automatic Fire Detection & Alarm Early Evacuation System
2. It is not the intent to specify completely herein all the aspects of design and construction features of equipment and details of Work to be carried out, nevertheless the equipment, accessories and the Work shall conform in all respects to high standards of engineering and designs, workmanship and shall be capable of performing in continuous commercial operations in a manner acceptable to the Owner.

1.2 CODES & STANDARDS

- A. The system and the associated equipment shall have the approvals as well as listing from the following:
 - a. Under writer's laboratories US/Canada (UL).
 - a. UL864-U0JZ: Control Units for Fire Protective Signaling Systems
 - b. UL268: Smoke Detectors for Fire Protective Signaling Systems.
 - c. UL268A: Smoke Detectors for Duct Applications.
 - d. UL 521: Heat Detectors for Fire Protective Signaling Systems.
 - e. UL464: Audible Signaling Appliances.
 - f. UL1638: Visual Signaling Appliances.
 - g. UL38: Manually Activated Signaling Boxes.
 - h. UL346: Water flow Indicators for Fire Protective Signaling System.
 - i. UL1480: Speakers for Fire Protective Signaling System.
 - j. UL1481: Power Supplies for Fire Protective Signaling Systems
 - k. UL1711: Amplifiers for Fire Protective Signaling Systems.
 - b. Fire Officer's Committee (FOC) London.
 - c. Factory Mutual (FM) USA.
 - d. Tariff Advisory Committee (TAC) India (for the system operation only).
 - e. All other local codes (local CFO) and authorities having jurisdiction for the system operation and TAC approvals.
- B. The equipment shall comply with the latest applicable standards.

IS: 2189:Codes of Practice of Automatic Fire Alarm system (Selection, Installation & Maintenance).

IS: 11360:Specification for Smoke Detectors for use in automatic electrical fire alarm system.

IS: 2175-76:Heat Sensitive Fire Detectors.

IS:2148:Specification for flame proof enclosure of electrical apparatus.

IS: 5571:Selection of equipment in hazardous areas.

IS: 694:Copper conductor PVC insulated cables.

N.F.P.A 71/72:National Fire Protection Association.

NEC:National Electric Code.

IS: 4237:General requirements for switchgear and control gear.

IS: 8421:Method of marking for identifying electrical equipments for explosive atmosphere.

IS: 5469:Code of Practice for use of semi-conductors junction devices.

IS: 3700:Essential ratings for characteristics of semi-conducting devices.

IS: 5780:Intrinsically safe electrical apparatus and circuits.

IS: 8884:Specification for manual call point.

IS: 5:Colors for ready mixed paints and enamels.
 LPC:Loss prevention council recommendations.
 IS: 732:Electrical wiring installation (system voltage not exceeding 650 volts).
 IS: 9537-1983:M.S. Conduit for electrical installation.

In case of any contradictions between the aforesaid standards and the stipulations specified herewith (in the technical specifications), the most stringent requirement shall prevail.

1.3 SITE CONDITIONS

All the equipment under this specification shall be suitable for tropical country with ambient temperature of 50 Deg. C. (Max.) and 0 Deg. C. (min.) and altitude not exceeding 300 meters above mean sea level humidity up to 95%.

1.4 SCOPE OF WORK

- A. The scope of work under this specifications shall include design, manufacture, supply, loading-unloading, storage, erection, testing and commissioning of the following items for intelligent automatic fire detection cum alarm system (microprocessor based) of the 'Zoned'- 'Non-Coded', General Alarm (two stage) type including public address system with or without call back facility and emergency evacuation system. It shall be complete with necessary hardware, software and memory specifically tailored for this installation. It shall be possible to modify permanently the software on site by using a plug in programmer.
- B. All labor, tools tackles and plants including supply of hardware, consumable, minor civil works are included in the contract but not limit to the following:
 1. Microprocessor based fire alarm control panel.
 2. Analogue addressable smoke/optical smoke detectors, heat detectors, manual call point (microprocessor based) with non-volatile memory complete with response indicators.
 3. Sprinkler water flow alarm switch.
 4. FDV/Air Handling system / Lift pressurization fan shut down control.
 5. Audible notification appliances, siren, speakers, with or without strobe.
 6. Central station alarm connection control.
 7. Sprinkler supervisory switches, tamper switch supervision.
 8. Battery backup and charging unit including health of the battery.
- C. Conduit, wiring, cabling underground/surface/concealed conduit system. Any alteration to meet the TAC requirement for approval shall be carried out by the contractor. All wiring shall be with 'A' class (2 wires) close loop system.
- D. Drawings required for submission to local CFO/TAC shall be prepared by the contractor based on the inputs given by owner. Contractor shall be responsible for getting approval of system and installation from local CFO/TAC.
- E. Cable trays/channel (wire way duct) and their fixing etc. (cable tray/'c' channel to be approved by Owner/Consultant).
- F. Integrated with FA control panel for evacuation and Public Address System complete with amplifier, amplifier rack, microphone, speakers with strobe etc.
- G. Sensor's/ switches (flow/level detectors) required for fire pump, sprinkler pump medium velocity spray water flow, fire water tank level, tube well, AHU/FDV fan shut down shall be included by the contractor.
- H. The contractor shall engineer the Intelligent Fire Detection, Alarm and Evacuation cum Public Address System with or without call back facility system as called for in accordance with the operating concept and performance specifications detailed herein.

- I. The contractor shall furnish all equipments, parts, materials, cables, conduits and any other supplies required to satisfactory effect the complete installation of this Fire Detection and Alarm Evacuation cum Public Address System in a professional manner.
- J. The work herein specified shall be performed by fully competent workmen in a thorough professional manner. All materials furnished by the contractor shall be new and shall conform to applicable standards.
- K. All equipments except portable equipments shall be held firmly in place except to the extent those proper performance criteria dictate the use of resilient shock absorbing mounting. All fastening and supports shall be adequate to support their loads with a safety factor of three (3). All switches, connectors' outlets etc. shall be clearly, logically and permanently marked during installation. Adhesive Tape Markers and screen painted markers liable to erasure during use are not being acceptable.
- L. The contractor shall take precautions as are necessary to guard against electromagnetic and electrostatic interference to provide adequate ventilation and to install the equipment to ensure maximum safety to the operators and other personnel in the area.
- M. Care shall be taken in wiring so as to avoid damage to cable and equipment. All terminals joints and connections shall be made with resin cored solder or with suitable connectors. All wiring shall conform to the code of practice for electrical wiring/installations as laid down in IS: 732 of 1963 including their up to date revisions wherever applicable.
- N. Various types of smoke/fire detectors shall be provided to effectively cover all floors of the building. Response indicators shall be provided for the rooms.(for the detectors installed above false ceiling as per the site requirement)
- O. All AHU's will have Duct able type smoke detectors with sampling chambers installed in the return air duct. Actuation of any such detector should result in closing of AHU's motor dampers provided in the HVAC/FDV ducts (provided by other contractor) and also switch off the AHU/FDV motor of the relevant AHU/FDV. Indication for confirming the above operation should be available on the Fire Alarm Panel.
- P. Transients should not result in any alarm. Any electrical sparking, RFI (Radio Frequency Interference), operation of the cellular phones in the plant, vibration etc. should also not result in any alarm on the system.
- Q. The duty personnel attending to the panel should be able to supervise (Audio Visually) Fire Alarm, Fault Alarm, (short/open circuit of any zone or detectors, defective PCB (Printed Circuit Boards) etc. Power Failure, Back up battery status and other relevant data.
- R. The main Fire Alarm Panels shall be connected to Audio Power Amplifiers through which it shall be possible to direct an alarm or an announcement to the first affected zone or zones including PA system without call back facility as called for in a minimum from 3-4 different places of different plan. Necessary control and hardware for zone selection, tone generation for ALERT and EVACUATE tones, shall be integrated with the Fire Alarm Panel. It shall be possible to direct an announcement to a particular zone or zones, both automatic (in the event of fire) as well as manually through selection switches. Strobe cum loudspeaker installed at strategic locations in each zone shall sound the fire alarm or announcement. The hooters shall be looped driven system voltage shall be as per manufacturer. In case of mains failure fire alarm shall work on 24 VDC back-up batteries. Contractor shall submit calculation for sizing and back up batteries. However, contractor shall be determining amplifier size and nos. with spare 20% capacity to meet any eventuality to increased scope.
- S. The system should be designed to work from 230V 50 HZ AC Mains Supply. Fluctuation of voltage up to + 10% or any other type of transient should not cause false alarm or affect the working of the system in any way.
- T. In case of Mains failure, the system as a whole should continue to work on the associated back-up battery for a period of 30 minutes under full load condition continuously without any deterioration in the performance of the system. Change over from mains to battery back up and vice-versa should be fully

automatic. Volt meter for AC and DC supplies, ammeters to indicate battery charging current and other necessary indications shall be provided.

- U. Back-up batteries shall be maintenance free type, suitable for such type of use and able to stand overcharging/under charging without any damage. Battery should be housed within the panel mounted in suitable pocket having acid resistant paint and numbering for cell position. The contractor will submit calculation for sizing of battery and battery charger.
- V. Detectors locations and area to be covered should conform to NFPA, FOC or equivalent applicable standards and should also conform to IS: 2189 of 1988. The contractor shall mark the position of detectors in co-ordination with other services on the building drawing and shall be responsible for getting the same approved without any change in quoted price and quantities by Chief Fire Officer of State, Fire Brigade, after the award of work. A copy of the standard followed in connection with design offered should be attached with the tender.
- W. One set each make and break, potential free isolated contacts are to be provided for each zone, on the fire alarm panel for actuating any external circuits. It should also be possible to sense additional parameters such as water pressure in Hydrant/F.H., etc. and activate equipment such as jockey pump automatically through I/O Interface Units.
- X. In addition to Fire Alarm on the Fire Alarm Panel, all loudspeakers should actuate in the concerned zone automatically. A switch at the fire alarm panel should be provided for change over this automatic speaker actuation to switch selectable Speaker actuation. Also, a switch shall be provided for switching over from the Alarm mode to the Mic mode for making public announcements as well.
- Y. The contractor shall submit the testing and commissioning procedure to be adopted at site for review. Also factory test manuals and certificates to be submitted.
- Z. In order to cater to changes in detector locations pattern, the detector cable shall be terminated in a three way terminal block duly enclosed in metal junction boxes of suitable sizes, complete with ferrules at cable entry and exit points. Detector sockets shall be wired to these junction boxes using suitable length of twisted pair flexible cable. This flexible cable is to be enclosed in UPVC conduits/flexible conduit pipe to make the same rodent proof.

1.5 CO-ORDINATION & RELATED WORK

- A. The contractor shall co-ordinate work of this section with all other related agencies work or equipments provided in other agencies but related to fire alarm system shall include but not limited to:
 1. The contractor shall coordinate with contractor of work such as F.F., FDV, A,C. etc. for integration of the system.
 2. Duct smoke detectors will be installed and wired by Fire Alarm and Detection System supplier but the FDV contractor shall furnish necessary duct opening to install the duct detectors.
 3. Air Handling and Smoke Exhaust system fan control circuit and status contacts shall be furnished by HVAC contractor.
 4. Fire Pump supervision contacts by fire fighting system supplier.

1.6 APPROVALS & PERMITS

- A. The contractor shall obtain approvals and permits from Local CFO/TAC prior to start of work (drawings and appliances, acceptance of system) and after the completion of installation.

1.7 DRAWINGS & DOCUMENTATION

- A. The contractor should submit all the dimensions of all equipments including the complete technical details and the schematic diagram of system to be adopted with equipments.

- B. The contractor shall also submit within 15 days from the date of signing of agreement the following:
1. Preparing of shop drawings based on consultant basic layout drawing coordinating with other services such as civil/architectural, HVAC, Plumbing, Piping and Plant System supplier and electrification contractors etc. and submit to the consultant for approvals prior to commencing the work. These shop drawings shall indicate all details and routes with physical dimensions of equipments and accessories as well as detailed wiring diagrams etc. All the work shall be carried out on the approvals of these drawings. However, approval of these drawings do not relieve the contractor of his responsibility to meet with the intent of the specifications, standards and satisfactory working.
 2. The contractor shall submit the following as built drawings:
 - a. On completion of the installation and before issue of substantial completion certificate, the contractor shall submit to the consultant 4 sets and 1 soft copy (CD) of as built drawings etc. but not limited to:
 - i. Detailed Specifications of equipments.
 - ii. Block diagram of the system with brief descriptions.
 - iii. Working diagram of the complete system.
 - iv. Schematic and detailed circuit diagram of unit/module wise diagram and stage by stage description along with calculation.
 - v. Data flow chart with data at different points during operations and testing.
 - vi. Detailed technical data of all active components (transistors, ICs) and modules being used in the system with DC voltages and input-output data clearly marked.
 - vii. List of components/units/PCBs module wise with value, tolerance, part no., type and circuits reference.
 - viii. Servicing/maintenance instruction including preventive maintenance schedule. Indicate type of test equipments to be used for maintenance.
 - ix. Trouble shooting chart with proper test sequence, voltage and data at various test points supported by calculation and documents.

1.8 GUARANTEE

- A. The system shall be guaranteed for 12 months from the date of commissioning and acceptance by Consultant/Owner as per guarantee and defects liability clause of conditions of contract. Tenderer must indicate the guaranteed MTBF (meantime between failure) of each unit and the system as a whole. In case of failure before the quoted MTBF, the guarantee-period will be proportionately extended. In this regard the decision of the Owner will be final and binding.

1.9 DEVIATION

- A. Any deviation with respect to the particular specification must be indicated clearly with comparison on separate sheets at the time of offer. In absence of such a statement, it will be assumed that the requirements of a specification are not without exceptions.

1.10 SPECIAL CONDITIONS

- A. The tenderer shall be provided with a set of building drawing plans along with the Work Order.
- B. The tenderer shall:
1. Mark on these drawings with inks of different colors, the routing of all the different types of cables and the locations of various types of detectors/sensing devices, evacuation speakers, panels that shall be required to provide effective protection to the building as well as plants as per the standards laid down in IS:2189.
 2. On the basis of these drawings work out the exact quantity of each type of cable, detectors and other sensing devices that shall be required for the system and record the break up and the total of these cables, detectors etc. in the drawings.

3. Submit the drawings duly signed with the required quantity of cables, detectors etc. indicated on it to the owner for approval within 15 days of the receipt of the detailed work order .
- C. The quantity of cables, detectors, sensing devices etc. indicated in the schedule of quantity is approximate. It shall be the contractor's responsibility to ensure that he supplies the exact quantity of cables, detectors, other sensing devices including public address system etc. as worked out by him required for successful commissioning of the system. This quantity may not necessarily tally with the quantity indicated in the schedule of quantity.
 - D. Drawings indicating the design of different types of mounts, controls, consoles, mechanical fixtures, housings etc. shall be submitted to the Local CFO & TAC for approval within one month of the receipt of detailed order. The drawings shall indicate all minute details about the dimensions, gauge, thickness, type of materials, approximate weight, cross-section etc. in the elevation, plans and third angle projections. A pictorial view of the same shall also be depicted in the drawings. No materials shall be taken up for fabrication or shall be delivered at site without submission of drawings and without prior approval for the same from the owner.
 - E. Since the delivery of the cables and allied are to be made first, the inspection of cables is to be arranged immediately after the cabling scheme in consultation with the Owner has been finalized, however, fifteen days notice is to be given for such an inspection.
 - F. No material shall be delivered at site without submission of the system design drawing and the proposed zoning/loops of the building plan as stated elsewhere in this contract without obtaining approval for the same from the owner.
 - G. After completion of work contractor shall carry commissioning tests for owner/consultant satisfaction. Required copies of test certificates for all test carried out along with copies of type test certificates shall be submitted.

PART 2 - SYSTEM OPERATION AND PRODUCTS

2.1 BASIS OF DESIGN

- A. It is proposed to install fire alarm main panel on the ground floor near entrance as indicated on drawing in fire control room.
- B. The intelligent microprocessor based Fire Detection, Alarm, Annunciation and Evacuation cum Public Address System integrated with FAC panel. The system shall consist of central processing units, various man machine interface modules and transmission systems, microprocessor based fire alarm control panels, printer, LCD/Video display unit, addressable and interface units as applicable.
- C. In the proposed system, analogue addressable have been contemplated. The system shall have provision to connect output interface units as per site requirement at no extra cost to owner.
- D. Number of various types of detectors/manual pull stations, Fire Alarm Panels/various man machine interface modules etc. indicated in the Bill of Quantities are approximate only. The exact quantities shall be worked out by the contractor in order to effectively cover the entire area from fire hazard.
- E. No. of loops available in the offered system for connecting addressable sensors shall be clearly indicated by the contractor in the Technical Bid. Cost of additional loops required for future expansion shall be indicated by the contractor in the Commercial Bid.
- F. System shall have Self Test Routine. The system shall also have auto supervision of all the sensors and input/output interface units. Any defect in the system shall be reported Audio Visually with a Hard Copy for detailed analysis of defect.
- G. In case of analogue addressable detectors, the offered fire alarm system shall have provision for automatically checking and correcting the sensitivity by scanning all the detectors. The

sensors/detectors having poor sensitivity or due for maintenance must be identified by the proposed Fire Alarm System.

- H. Proposed Fire alarm System shall also support the Fire Sensors like Infra Red Type Beam Detectors.
- I. Design should be FAIL SAFE and conform to IS:2189. ON-LINE replacement of defective modules etc. should be possible without any difficulty.
- J. The offered system should have modular concept. Different modules should have proper guide ways ensuring that plugging in of wrong modules is not possible. On-line removal or plugging in of any module should be possible without causing any damage to the system. Individual PCB cards and modules should also be protected from damage arising due to any defect that may have occurred in other PCBs, modules etc. of the systems.
- K. All the PCB Cards/Modules etc. should be coated for protection against corrosion and made suitable for use in 95% non-condensing humid climate.
- L. The entire system shall work on mains 230V, 50 HZ, single phase power supply. In case of power failure, the complete system shall function in normal condition on maintenance free back-up batteries for a minimum period of 48 hours duration. The bidder will submit calculations based on system offered. Owner shall provide 230 V A.C supply to the bidder at the point. Bidder shall inform to the Owner its capacity required to operate the system.
- M. Contractor will also provide standard test samples (for creating smoke), Mixtures Bottles along with the system.

2.2 SYSTEM DESCRIPTION

- A. The main analog addressable Fire Alarm Control Panel (FACP) shall be located in ground floor Fire Control Room near main entrance. The system being addressable type all the detectors shall be individually addressed. In the event of fire the FACP, LCD's shall annunciate the fire condition along with an English language display of the location of the fire. Any message or a signal can be acknowledged through the panel. Addressable manual pull station will be placed in the corridors at strategic location and staircase, when pulled in the event of fire shall also indicate, the exact location of fire. Alarm speaker with strobe will be activated only in the effected zones. The FACP shall control the operation of AHU's in the event of fire. In case of fire "FACP" decides as being programmed to monitor or control the above mentioned facilities through monitor/control modules.
- B. The FACP shall have integrated voice evacuation cum paging system. P.A evacuation/paging microphone shall be part of the fire alarm control panel. All corridors, lobby as indicated on drawings in Building shall be provided with speakers which shall broadcast any programmed message in case of fire. The P.A. system shall have the facility of paging any message through the same speakers to any or all of the zones as required. The panel shall be capable of 1000 events storage capacity.

2.3 VOICE EVACUATION CUM PUBLIC ADDRESS SYSTEM

A. System Description

1. The system is to cover entire building for making announcement in individual area or as a whole. Before each announcement in any of the section there will be call attention 'Ding -Dong' sound. Also in each section zonal announcement along with the all call will be available. Provision shall also be made from telephone exchange operator desk for making priority announcement.
2. The System shall be solid state amplifiers rack mounted, with loudation wattage (RMS) of loud speakers/amplifier capacities are approximate, the exact numbers shall be worked out on the basis of calculation (the capacity of amplifier) shall be submitted along with technical bid by the bidder along with technical brochures for deciding perfect workable voice evacuation cum P.A. system along with F.A. system. The system shall be fully integrated with Fire Alarm System.

B. Console

The control console shall be fabricated out of 1.6mm CRCA sheet steel duly powder coated to match with the F.A. panel. The console shall house (complete with) goose neck/telephone handset type microphone with selector switch/switches for making zonal/all area announcement, the preamplifier shall have the bass, treble and presence control for better speech quality. All electronic modules used shall be plug in type.

C. Amplifier Rack

The amplifier rack shall be complete with number of required standby amplifiers with selected electronic zoning, automatic changeover from (working to standby) monitoring etc. along with plug in type electronic circuit boards with mains -D.C. panel, terminals and connectors etc. The amplifier/rack main frame shall be fabricated out of 2.5mm and doors with 1.6mm thick CRCA sheet steel duly painted with powder coated of approved color to match with F.A. panel as required. The amplifier capacity shall have at least 20% additional spare capacity to meet the unforeseen requirement. Bidder shall submit calculations with basis.

D. Microphone

Goose neck type microphone shall be dynamic pressure gradient type of receiver having cardioid directional characteristic. It shall have wired and pop shield and bronze grill and built in ON -OFF switch.

E. Speaker

1. Ceiling Ring Type: Speakers with line matching transformer and strobe unit shall be with false -ceiling ring suitable for mounting in ceiling for various floors.
2. Wall Mounted Type: Speakers with line matching transformer and strobe unit shall be wall mounted type suitable for mounting in columns as well.
3. Horn Type: Speaker with line matching transformer and strobe unit shall be wall/column mounted type.

F. Amplifier

1. The amplifier may be operated either in 2 channel mode or in bridge mode doubling the power. In the 2 channel mode the amplifier may be used to drive independent or stereo programmed sources whereas in the bridge mode shall drive a single programmed source. This mode is suitable for driving high voltage loud speakers lines without the use of an output transformer with the input power supply of 220/240V. The system shall respond uniformly over and audio signal.
2. Frequency range from 20 Hz to 20 KHz with distortion less than 0 - 5% at rated input.
3. Public Address Control Rack shall have the following:
 - a) Test tone signal.
 - b) Selection switches with circuitry for alarm/evacuation/speech.
 - c) Routing/switching matrix tone/speech signal to required zone automatically.
 - d) Pre-amplifiers and line amplifiers as required.
 - e) Power amplifiers.
4. No. of amplifiers one or two in operation and one as switchable standby fully wired.
5. Power rating of each amplifier: Data by contractor.
6. Standard: IEC 268-3, IEC 65.

2.4 FIRE ALARM CONTROL PANEL

- A. The Fire Alarm Panel shall be microprocessor based system suitable for addressable sensors, alarm output modules for external hooter & lamp control output modules for various control functions through relay contacts and communication modules for interfacing with the outside world. The processor shall interact with the other modules through a common bus. The system shall store all basic system functionality and job specific data in non-volatile memory. All site specific and operating data shall survive a complete power failure intact. Password shall protect any changes to system operations. The panel shall be powered with high efficiency SMF battery and battery charger. The bidder will submit all relevant calculation for approval.
- B. The Fire Alarm Panel shall have the facility to process the Input Signals and control the output functions either directly or through I/O Interface Modules as per the requirements.
- C. The Fire Alarm Panel shall continuously scan the various loops for conditions of Fire, Fault (Open circuit as well as short circuit) and provide audio-visual Alarm and Messages as the case may be. Each loop shall be capable for connecting upto 100 addressable units and detectors.
- D. The Fire Alarm Panel shall be protected against any kind of short circuit, open circuit, over voltage and under voltage. In case of any abnormality, the system shall display appropriate message. The panel should have a CPU watch dog circuit to initial trouble should the CPU fail.
- E. The system should perform Fire Pattern Recognition. For this purpose, it shall offer the following features:
1. Smoke entering a detector for a short duration (e.g. cigarette smoke) shall not cause any alarm.
 2. A fast build up of smoke shall result in quick alarm generation.
 3. A gradual build up of smoke shall be detected early by reducing the pre-warning limit automatically (without disturbing the alarm level).
 4. A slow build up of dirt in detectors shall be recognized and the alarm level shall be suitably modified without generating any false alarms. For this purpose, the Fire alarm Panel shall have necessary Hardware and Software filters, details of which must be submitted by the tenderer in the technical bid.
 5. The system shall have a UL listed detector sensitivity test feature, which will be a function of the smoke detectors and perform automatically every four hours.
- F. The Fire Alarm Panel shall have the under mentioned additional features:
1. Logging an alarm, time and action text on printer.
 2. Status check of disabled alarm addresses before they are restored.
 3. Storing of alarms and the possibility of internal organization of alarms.
- G. Offered Fire Alarm Panel shall have high degree of flexibility with:
1. The possibility of expanding to a bigger system with several control panels, and control and information units.
 2. Programmable actuation of control output relays for tripping ventilators, closing of fire doors, closing of fire dampers, etc. in case of fire. The system shall also provide a manual over-riding facility to operate/de-activate the above.
 3. Connection to addressable.
 4. Possibility of monitoring general purpose inputs such as the level of water in overhead tanks, battery voltage, water pressure in Hydrants etc. and activating programmed equipment as per requirements such a water pumps, motors, fans etc.
- H. Fire Alarm panel shall have memory storage for last 1000 events (with date and time of occurrence) and an alarm counter for number of alarms occurred after the system is installed.
- I. For reasons of reliability and preventing inadvertent changes, the software/database shall be maintained in Non-volatile Memory. It shall be possible to reprogram the software by authorized

personnel only. Fire Alarm Panel shall provide Access Protection via Password (multilevel), Hard-ware protection shall be via a security lock and key arrangement.

- J. Offered Fire Alarm Panel shall automatically scan the whole system and confirm the user entered configuration. It shall also generate the appropriate messages.
- K. System should check up all the detectors periodically (by scanning) for the sensitivity of the detectors. Whenever any detector sensitivity goes down due to soiling or dust accumulation it should provide the required biasing to bring the detector's sensitivity upto the required level. In case any detector goes below the minimum sensitivity level, it should issue a warning tone for cleaning the detector manually. Therefore each analog detector shall be monitored for maintenance alert.
- L. The System shall support distributed processor intelligent detectors with the following operational attributes; integral multiple differential sensors, automatic device mapping electronic addressing, environmental compensation, pre-alarm, dirty detector identification, automatic day/night sensitivity adjustment, normal/ alarm LEDs, relay bases, sounder bases and isolator bases.
- M. The Fire Alarm Control Panel shall support interactive Color Graphics Package with 19" XGA touch screen monitor and mouse. The unit shall provide interactive control with history logging. Manual and over ride control of the system shall be accomplished through on screen touch switches. All the zone shall be displayed with color coded graphics that indicate the status of each zone and its location.
- N. The Fire Control Panel shall be equipped with integrated fire fighters telephone system which shall automatically dial one or more programmed fire fighter's telephone numbers and convey pre-programmed messages in the event of fire in any of the zone, The fire panel should have a Dialer Alarm Communicator Transmitter (DACT) module to transmit alarm, supervisory and trouble signal to a Central Monitoring Station (CMS). The DACT shall support dual telephone lines, 20 pps 4/2 communication and configured for Dual Tone Multi-Frequency (DTMF) or pulse modes. The system should also be integrated to a voice dialer (U.L, listed) to transmit voice messages to specified telephone Nos. such as Fire Station.
- O. Indications as mentioned hereunder shall be available on the Fire Alarm Panel.
 - 1. RED and AMBER high power LED to indicate any zone on fire and fault respectively. Zone number and the area should be displayed on alphanumeric 2 lines by 80 character (160 character total) backlit alphanumeric graphical LCD display on the control panel. Nature of fault shall also be indicated on the LCD display. The main LCD panel and operator console shall be in modular form and the same should be used as a repeater panel thus enabling full featured remote operation of the fire alarm system.
 - 2. Mains -on (Green). In case of mains failure, SYSTEM ON BATTERY LIGHT (AMBER) should come up.
 - 3. Battery under voltage should be indicated by flashing RED LED with 1KHz. broken audio signal.
 - 4. Other indications as per requirement and system design.
 - 5. It should have the facility for the connection of printers.
- P. CPU with the following minimum specification shall be provided with Main Fire Alarm Panel.

CPU's with the following Minimum Specifications: Eg. HP DX 6100

 - i. Intel Pentium Original Motherboard
 - ii. Pentium-IV(CPU) 2.8 GHZ (HT) processor with 400 MHZ front side bus
 - iii. 512 KB on chip cache memory
 - iv. 512 MB DDR RAM (400 MHZ bus speed)
 - v. P-IV ATX cabinet with 300 watts Power Supply
 - vi. 80 GB IDE HDD (7200 RPM)

- vii. Integrated AGP sound card
- viii. CDROM Drive COMBO (Reader+ Writer) – 52x/ 56 x
- ix. 1.44 MB FDD (Floppy drive – 3 ½ “)
- x. Multi media Keyboard
- xi. Scroll Mouse/ Pointing device
- xii. 100 MBPS Ethernet (Network) Card (Onboard)
- xiii. 2 serial + 1 Parallel + 2 USB ports
- xiv. High resolution graphics 19” monitor
- xv. Operating System Software – Windows 2003 server
- xvi. System Software for power monitoring

- Q. The system on demand shall provide analog detector sensitivity report. The system shall also provide history report of verification cycles per detector and the system status reports of detector analog reading both on computer and Visual Display Unit as well as in the form of hard copy through the printer once in a week or on demand. The system shall support the use of bar code readers to assist custom programming functions.
- R. The intelligent remote driver cards in control panel shall be as per standard and codes and the panel shall have the provision for connecting 1 No. of Repeater Panels. (For future)
- S. Modular system design, with a layered application design concept including an "operational layer" and a "human interface layer" to allow maximum flexibility of the system with a minimum physical size requirement. The panel should be dust and vermin proof.
The panel should support 128 service groups within the system program to allow the testing of the installed system based on the physical layout of the system, not on the wiring of the field circuits connected to the FACP.
- T. All the metal portions of the panel shall be powder coated and earthed properly,
Input: 775 mv
Distortion: <0.5% at rated input, 1 KHz.
Frequency response: 23 Hz to 20 KHz + 1-3 db
Power Supply: Operation of 230V AC, 50 Hz and 24 V DC
Operating Temp: 10 to 50 Deg.C ambient

2.5 RESPONSE INDICATOR

- A. The response indicator shall be of box type, mounted rectangular/octagonal box (recessed/surface).
- B. Two LED.

2.6 ADDRESSABLE MANUAL CALL POINT

- A. Manual call points shall be addressable and electrically compatible with standard range of automatic detectors so that it can be collected directly into supervised loop of the standard range of control units.
- B. The manual call points shall be of pleasant, streamlined and flat appearance permitting its use as flush and surface mounted units as per site conditions.
- C. The cover must be secured against unauthorized removal. Every removal of the cover must release an alarm.
- D. All inscriptions, texts and marks must be on the manual call point front plate.
- E. The manual call point shall be designed for fail safe operation.
- F. The manual call point may have a built in LED, lighting up automatically to confirm its actuation.
- G. Operation instructions must be clearly marked near the Manual call point both in English & Hindi on a custom based aluminium/ vinyl strip.

2.7 ADDRESSABLE DETECTORS

- A. Detector shall have an integral microprocessor capable of making alarm decisions based on fire parameters information stored in the detector head. Distributed intelligence shall improve response time by decreasing the data flow between detector and analog loop controller. Detector not capable of making independent alarm decision shall not be acceptable. Maximum total analog loop response time for detectors changing state shall be 0.5 seconds. The addressable detectors shall be designed to detect one or more characteristics of fire, smoke or heat. The prime function of an addressable detector shall be to detect a fire in its early stages by one of its characteristic phenomena, both visual and indivisible and convert the same into an electrical signal for initiating the local and remote alarm.
- B. The addressable detectors shall be suitable for column/ceiling mounting.
- C. The detector shall be suitable for class A (ring main) preferable.
- D. The detectors shall be plug-in type and shall have common base.
- E. An indicator LED shall be provided on the detector which illuminates when the detector has reached a pre set alarm level. The indicator shall be operated independently of the detector from the central control panel.
- F. Provision shall be made for an output from the detector suitable for operating a remote indicator or other device with a current limitation of 4 mA. The output shall be operated independently of the smoke detector from the central control panel.
- G. The detector shall be capable of operating within the following environmental limits:
 - Temperature operating range -10 Deg.C to + 50 Deg.C.
 - (without condensation) Humidity Operating Range: 0 to 95% R.H. (without condensation).
 - The detector's sensitivity remains stable in wind velocity upto 500 ft. /min. (2. 5m/sec.)
- H. Separate mounting bases shall be required which enable ready removal of detectors for maintenance. The bases shall be fitted with stainless steel terminal springs and stainless steel terminal screws and saddles.
- I. The construction of the detector and bases shall be in white self-extinguishing poly carbonate plastic. Full circuitry must be protected against moisture and fungus. Smoke entry points must be protected against dust and insect ingress by corrosion resistant gauze. The detectors must be unobtrusive when installed.
- J. The installation and fixing of the detectors must confirm to IS: 2189.
- K. Data transmissions to and from the fire control panel from the detector shall be via a communications module which is factory fitted to a detector by the original detector manufacturer and forms a complete and integral part of the detector.
- L. The detector shall be supplied complete, fully tested and calibrated, and each should bear the serial no. and seal of the approving laboratory/body.
- M. The detector shall be capable of automatic electronic addressing/custom addressing without the use of DIP or rotary switches. Devices using DIP or rotary switches for addressing, either in the base or on the detector shall not be acceptable.
- N. There shall be facility on the mounting base for writing in indelible ink the address of that base. The address code shall be obscured from sight when detector is fitted to the base.
- O. The build-up of dirt or similar contamination on the radio-active source will cause the output signal from the detector to gradually change. The control panel shall be capable of monitoring this slow change in signal and at a predetermined level indicate that the detector is in need of servicing.

- P. The detector shall be capable of being remotely tested from the control panel by the transmission of a 3-bit code to the addressed detector. This shall result in a healthy detector transmitting back an analogue value in excess of the recommended fire alarm threshold. The control panel shall recognize this as a test signal and shall not raise an alarm against this signal. These results should also be stored in the detector.

2.8 IONISATION TYPE SMOKE DETECTORS

- A. Ionization smoke detectors shall respond to invisible and visible smoke and combustible gases-
- B. Ionization smoke detectors shall have an inherently stable sensor with built-in automatic compensation for changes in ambient condition.
- C. All electronic circuits must be solid state devices and virtually hermetically sealed to prevent their operation from being impaired by dust, dirt or humidity.
- D. All circuitry must be protected against usual electrical transients and electromagnetic interference.
- E. Reversed polarity or faulty zone wiring shall not damage the detectors.
- F. The detector shall have no moving parts or components subject to wear and tear and shall have serial no. and seal of the approving laboratory/body.
- G. All radioactive part of the detectors shall be safeguard against tempering. The radioactive source shall be fully gold plated.
- H. The response sensitivity of each detector shall be field adjustable to one or at least two pre-determined (factory calibrated) levels. It shall be possible to test the sensitivity of a detector in the field.
- I. The response (activation) of a detector shall be clearly visible from the outside by a flashing light of sufficient brightness.
- J. The smoke entry windows of the detector shall be field adjustable to match local air current patterns.
- K. A built-in barrier shall prevent entry of insects into the sensor.
- L. The detector shall be designed for fast and simple laboratory cleaning.
- M. The detector shall be inserted into or removed from the base by a simple push-twist mechanism to facilitate exchange for cleaning and maintenance.
- N. The manufacturer shall produce and provide test equipment allowing to test and exchange ionization type smoke detectors upto 7 Mtr. (23 ft.) above floor level.
- O. Specifications
1. Normal operating temperature : 10 Deg. C to 50 Deg.C.
 2. Relative Humidity without condensation : Max. 95% RH continuous.
 3. Ambient air velocity : 0 -500 ft. /min. (2.53 m/sec.)
 4. Operating Voltage : 24V DC nominal (18V-30V)
 5. Protection category : IEC 529 : IP-43
 6. Quiescent current : 60 micro amps.(max)
 7. Alarm current : 100 milli amps. (max)
 8. Strength of Radio active source : less than 1 micro curie
 9. Approval by : NFPA/FOC/FM/UL or any other International Standard Agency.

2.9 PHOTOELECTRIC OR OPTICAL SMOKE DETECTORS

- A. The photoelectric or optical smoke detector shall respond predominantly to light white smoke.
- B. The photoelectric or optical smoke detectors must exhibit uniform response behavior in course of item.
- C. The light source intensity shall automatically adjust to compensate for possible effects of dirt and dust accumulation in the sensor/lens.
- D. Smoke density in the chamber shall be measured by a symmetrical optical system.
- E. The detectors shall have no moving parts or components subject to wear and tear and shall have serial no. and seal of the approving laboratory/body.
- F. The detection principle shall employ a multiple light pulse coincidence circuit in order to prevent the false alarms.
- G. All electronic circuits must be solid state devices and virtually hermetically sealed to prevent their operation from being impaired by dust, dirt or humidity.
- H. All circuitry must be protected against usual electrical transient and electro- magnetic interference.
- I. Reversed polarity or faulty zone wiring shall not damage the detector.
- J. The response sensitivity of each detector shall be field adjustable to a minimum of two pre-determined (factory calibrated) levels. It shall be possible to test the sensitivity of a detector in the field.
- K. The response (activation) of a detector shall be clearly visible from the outside by a flashing light of sufficient brightness.
- L. A built-in (optional) integrated circuit shall allow the suppression of brief deceptive phenomenon.
- M. The smoke entry windows of the detector shall be field adjustable to match local air current pattern.
- N. A built-in barrier shall prevent entry of insects into the sensor.
- O. The detector shall be designed for fast and simple laboratory cleaning.
- P. The detector shall be inserted into or removed from the base by a simple push-twist mechanism to facilitate exchange or cleaning and maintenance.
- Q. The manufacturer shall produce and provide test equipment allowing to test and exchange the detectors upto 7 Mtr. (23 ft.) above floor level.
- R. SPECIFICATION
 - 1. Normal Operating Temperature -10 Deg.C to 50 Deg.C
 - 2. Relative Humidity: Max. 95% RH without condensation.
 - 3. Approval by: NEPC/FOC/FM/UL or any other inter-national standard agency.
 - 4. Operating Voltage: 24V DC nominal (18 V-30V)
 - 5. Quiescent current: 120 Micro amps maximum.
 - 6. Alarm current: 100 milli amps maximum.

2.10 AIR DUCT PROBE UNITS (AIR SAMPLING UNIT/SAMPLING CHAMBER)

- A. The unit shall allow the application to standard smoke detectors for monitoring of air streams inside air-conditioning and ventilation ducts between 1 meter per second (3 ft. per second) and 20 meter per second (66 ft. per second).

- B. The unit shall deviate a small amount of air from regular to high velocity air-conditioning and/or ventilation ducts into a special chamber which contains a standard smoke detector.
- C. The unit shall not have to be adjusted to air streams between 1 meter per second (3 ft. per second) and 20 meter per second (66 ft. per second).
- D. The unit shall accommodate an ionization smoke detector or a photoelectric light scattering detector, both matching with the built-in base.
- E. The unit shall be suitable for detector testing at sites.
- F. The unit shall have a transparent cover over the detector so that the degree of soiling can be checked without opening the unit.
- G. The unit shall be designed so that all maintenance work can be carried out without affecting the duct systems.
- H. The unit shall be equipped with a circuit monitoring the presence of the smoke detector head.
- I. The alarm indicator shall be clearly visible from outside. A response indicator may be used for the purpose.
- J. The housing shall be made of UL-approved plastic material, shock-proof and vibration proof.
- K. The air duct detector assembly and its covers shall be joined via a rubber lip to prevent unwanted passage of air or smoke.
- L. The unit shall be equipped with a terminal block with screw less terminals accepting wires between 0.25 sq.mm and 1.5 sq.mm (SWG 23 and 15) and equipped with built-in strain limits.
- M. The unit shall be designed for complete sealing of the duct penetrations necessary for the sampling tubes and for fastening the air duct detector assembly.
- N. The unit shall be designed so that there is a complete separation between detection chamber and the compartment containing the affiliated electronics.
- O. The unit shall be supplied with the appropriate sampling tubes.
- P. SPECIFICATIONS
 - a) Admissible Airflow Speed: 1-20 Mtr. (3-66' per sec).
 - b) Protection category IEC (outside Duct): IP-64.
 - c) Amb.Temperature: (-)10Deg. C to (+)40Deg.C.
 - d) Max. RH: 95% (without condensation)
 - e) Connection Terminals for wire cross sectional area: 0.25 -1.5 sq.mm
 - f) Compliance with standards: EN 54 and UL 268 A.

2.11 PLUG-IN BASES

- A. The detectors of all types shall fit into a common type of standard base.
- B. Once a base has been installed, it shall be possible to insert, remove and exchange different types of detectors by a simple push twist movement.
- C. The standard base shall be equipped with screw less wiring terminals capable of securing wire sizes upto 1.5 sq.mm (SWG 15) and with built in strain limits to prevent permanent terminals deformation and weakening of contact pressure.
- D. The standard base shall be supplied with a sealing plate, preventing dirt, dust, condensation or water from the conduit reaching the wire terminals or the detector contact points.

- E. All standard bases shall be supplied with a removable dust cover to protect the contact area during installation and construction phase of the building. It must allow the inspection and verification of the zone wiring before insertion of any detectors. This dust cover shall be removable by a special tool upto 7m (23 ft.) above floor level.
- F. The standard base shall feature a built-in mechanism which allows mechanical locking of any installed detector head, thus preventing unauthorized removal of tampering while maintaining.
- G. The detector contact points shall be designed to retain the detector safety and to ensure uninterrupted contact also when exposed to continuous severe vibrations.
- H. All electronic components of bases and modules must be solid state and virtually hermetically sealed to prevent their operations from being impaired by dust, dirt or humidity.
- I. All circuitry must be protected against usual electrical transients and electromagnetic interference.
- J. The standard base shall allow snap-on insertion of an (optional) electronic module to drive remote visual alarm indicators.
- K. Reversed polarity or faulty zone wiring shall not damage the detectors.
- L. The standard base shall have a built-in alarm indicator which is repeatable by connecting a simple two core wire to the base. No changes in the zone wiring shall be required to operate the additional alarm indicator.
- M. A special tool shall enable removal and insertion of dust covers or detectors by a push-twist mechanism, even if the locking device has been activated, upto 7M(23 ft.) height from floor level.
- N. Bases shall be of the same make as that of the detector supplied.

Note:

Addressable detectors/modules, Addressable Manual call point, line fault isolator shall be as per system design and all these items also be listed by International Testing Laboratory.

2.12 WIRING AND CABLING

- A. All FRLS PVC insulated copper conductor stranded wires/cables shall be 650 volts grade and shall generally conform to IS-694-1977 and meet the signal cabling requirement of the system manufacturer.
- B. While drawing insulated wires/cables into the conduits, care shall be taken to avoid scratches and kinks which may cause breakage of insulation/ conductors. No joint shall be allowed in the length of the conductors. Insulation shall be shaved off like sharpening of a pencil and it shall not be removed by cutting it square to avoid depression/cutting of conducting material.
- C. Strands of wires shall not be cut to accommodate and connect to the terminals. Terminal shall have sufficient cross-sectional area to take all the strands.
- D. No wire shall be drawn into any conduit until all work of any nature that may cause injury to wire is completed. Before the wires are drawn into the conduit, the conduits shall be thoroughly cleaned of moisture, dust, dirt or any other obstruction. Where wires are connected to detectors, or panel, sufficient extra length of wires shall be provided to facilitate easy connections and maintenance.
- E. Only licensed Supervisors/Wiremen shall be employed for wiring/cabling and other connected work. The wires/cables shall be brought to the site in original packing.
- F. Conduits and accessories shall conform to relevant Indian Standard. 16 gauge screwed mild steel conduits with stove enameled surface shall be used. Size of conduit as called in Schedule of Quantities, shall be used for carrying out wiring. Burrs etc. shall be removed from mouths of conduits to avoid scratches on wires.

- G. These shall be measured on linear basis including the fittings required like sockets, bends, junction, etc.
- H. The wiring shall conform to a two wire loop i.e. 'A' class for fire alarm system.
- I. The cabling work shall conform to IS:732 of Low/Medium voltage system.

2.13 REPEATER PANELS

- A. Each remote panel in the installed system shall include remote control and display enunciators. These annunciators shall have integral membrane style, tactile push button control switches for the control of system function and LEDs with programmable (software controlled) flash rates and slide in labels for annunciation of system events.
- B. It shall provide the system with individual zone and device annunciation also with zone or device disable.
- C. It shall provide the system with individual alarm and trouble annunciation per zone/device.
- D. It should support 8x21 characters on its LCD screen indicating current date and time, custom system title, alarm history of the system.
- E. There should be common control keys and visual indicators for; reset, alarm, silence, trouble silence, drill and one custom programmable key/indicator.

2.14 INFRARED TYPE BEAM DETECTOR

- A. A beam detector shall be four wire 24V DC and powered from the control panel 4 wire smoke power source.
- B. The unit shall consist of separate emitter and collector capable of being powered separately or together.
- C. The unit shall operate in either a short range of 30 to 100ft. (9.14 to 30.4m) or a long range of 100 to 300ft. (30.4 to 90. 14m).
- D. The detector shall feature a bank of four alignment LEDs on both the collector and emitter that are used to ensure proper alignment without the use of special tools.
- E. The beam detector shall feature automatic gain control which will compensate for gradual signal deterioration from dirt accumulation on lenses.

2.15 HEAT DETECTOR (COMBINED RATE OF RISE AND FIXED TEMPERATURE)

- A. Combined rate of rise and fixed temperature heat detectors shall consists of two independent thermistors, designed to automatically compensate changes in ambient conditions.
- B. All electronics circuits must be solid state devices and virtually hermetically sealed to prevent their operations from being impaired by dust, dirt or humidity.
- C. All circuitry must be protected against usual electrical transients and electromagnetic interference.
- D. Reverse polarity or faulty zone wiring shall not damage the detectors.
- E. The detector shall have no moving parts or components subject to wear and tear and shall have serial no. and seal of approving laboratory/body.
- F. It shall be possible to test the detector in the field.

- G. The response (activation) of a detector shall be clearly visible from the outside by a flashing light of sufficient brightness.
- H. The detector shall be installed into the base by a simple push-twist mechanism to facilitate exchange for cleaning and maintenance.
- I. It shall be possible to test the sensitivity of detector in the field.
- J. The manufacturer shall produce and provide test equipment allowing to test and exchange the detectors upto 7 Mtr. (23 ft) above floor level.

K. SPECIFICATIONS

- | | | |
|----|--------------------------|---|
| 1. | Normal Operating Temp. : | 0 Deg.C to 90 Deg.C. |
| 2. | Approval by : | NFPA/FOC or any other International Standard Agency. |
| 3. | Operating Voltage : | 24V DC nom. (18V -30V). |
| 4. | Quiescent Current : | 100 milli amps. (maximum). |
| 5. | Alarm Current : | 75-80 deg.C. for rate of temp. rise of 2 Deg.C/min. and air velocity of 1m/s. |
| 6. | Operating Fixed : | 75-80 deg. C for rate of temp. rise of 2 Deg. C/min. and air velocity of 1 m/s. |
| 7. | Operating Time : | 70-90 sec. for rate of rise of 22 deg. C/min. and air velocity of 1 m/s. 180- 320 second for rate of rise of 15 deg. C/minute and air velocity of 5cm per second. |

- L. The Contractor shall clearly indicate the operating temperature range of the Heat Detector .
- M. The addressing of all the detector shall to be done through software from fire alarm panel only. Addressing from dip switches/rotary switches shall not be permitted.

2.16 SPEAKER /HOOTER WITH STROBE

- A. Fire alarm horn/strobe/speaker should operate from 24V D.C. and should have a facility to be selected for temporal pattern or steady tone output. The unique microprocessor based unit should be completely self synchronized when set to temporal signal and should not require external synch control modules. A moveable jumper provided should have a choice for high (98 dbA) or low (94 dbA) outputs. The synchronized strobe should be supplied with "FIRE" wall orientation) as the standard/s marking. It should be suitable for indoor and outdoor installation as per B.O.Q. Same unit shall also be used for P.A. system application.

2.17 ADDRESSABLE MONITOR MODULES

- A. The monitor module shall provide address setting and shall also store an internal identifying code which the FACP shall use to identify the type of device. Modules using binary jumper or dip switch setting are not acceptable. An LED shall be provided which shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.
- B. The same shall also be comparable to take status of conventional detectors loops.

2.18 ADDRESSABLE CONTROL MODULES

- A. The control module shall provide address setting and shall also store in internal identifying code which the FACP shall use to identify the type of device. Modules using binary jumper or dip switch setting are not acceptable. An LED shall be provided which shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.
- B. This should also be used in conjunction with Notification Appliance Circuit/Speaker Ckts/AHU/FDV shut off.

2.19 ADDRESSABLE FAULT ISOLATOR

- A. The fault isolator device shall detect and isolate a short circuited segment of a fault tolerant loop.
- B. The devices shall automatically determine a return to normal condition of the loop and restore the isolated segment.
- C. Devices shall be placed every 20 detectors/modules/field devices to limit the number lost in the event of short circuit.
- D. Systems without fault isolation capability as described above shall not contain more than 20 devices on a circuit.

2.20 ISOLATOR DETECTOR BASE

- A. All the above features of detectors shall be included in the fault isolator detector base, besides its normal function.

2.21 DEVIATIONS

- A. Deviations from specifications must be stated in writing at the quotation stage.
- B. In absence of such a statement, it will be assumed that the requirements of the specification are met without exception.

END OF SECTION