SECTION 28 31 00

FIRE DETECTION AND ALARM SYSTEM

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Fire alarm system requirements

B. Fire alarm equipment

C. Fire alarm peripheral devices

1.02 RELATED SECTIONS

A. Basic electrical materials and methods are specified in Specifications Section 20 70 26 - Common Materials and Methods for Electrical Systems.

B. Training of BART personnel is specified in Specifications Section 01 79 00 - Demonstration and Training.

1.03 MEASURMENT AND PAYMENT

A. General: Fire detection and alarm systems, as specified herein, will not be measured separately for payment but will be paid for as part of the contract lump sum price for Electrical Work as indicated in the Bid Schedule of the Bid Form.

1.04 REFERENCES

A. California Code of Regulations (CCR):

1. Title 24, Part 2, California Building Code
2. Title 24, Part 3, California Electrical Code
3. Title 8, Cal OSHA
4. Title 19, Public Safety

B. National Fire Protection Association (NFPA):

1. NFPA 70 National Electrical Code (NEC)
2. NFPA 72 National Fire Alarm Code
3. NFPA 72D Installation, Maintenance, and Use of Proprietary Protective Signaling Systems
4. NFPA 72H Testing Procedures for Local, Auxiliary, Remote Station, and Proprietary Protective Signaling Systems

5. NFPA 101 Life Safety Code

6. NFPA 130 Fixed Guide Way Transit Systems

C. Americans with Disabilities Act (ADA)

D. Underwriters Laboratory (UL)

1. UL 268 Smoke Detectors for Fire Protective Signaling Systems

1.05 SUBMITTALS

A. General: Refer to Section 01 33 00 - Submittal Procedures, and Section 01 33 23 - Shop Drawings, Product Data and Samples, for submittal requirements and procedures.

B. Shop Drawings and Product Data: Detection and alarm system submittals shall include, as a minimum, the following information, data, and drawings:

1. Complete descriptive data indicating UL listing for all system components;

2. Complete sequence of operation of the system; and

3. Complete system wiring diagrams for components capable of being connected to the system and interfaces to equipment supplied by others.

C. Testing Program: The completed fire alarm system shall be fully tested in accordance with NFPA 72 under the observation of the Engineer and subject to approval by the Local Fire Marshal. Submit test procedures before performing tests. Testing program shall include the following information, listings, and instructions:

1. Statement of procedure objective, scope of test, and list of equipment/system to be tested.

2. List of equipment required to set up and perform the tests.

3. List of prerequisite tests that need to be completed before the procedure can be performed.

4. Description of the required procedure setup, including diagrams illustrating test equipment connections and identifying test points, where applicable.

5. Step-by-step instructions for performing the procedure, identifying the points where data is to be recorded and the limits for acceptable data.

6. Provisions for recording pertinent test conditions and environment at time of test.

7. Instructions for recording data on data sheets and verifying that procedure steps have been completed.

D. Test Reports: Submit results of electrical continuity, insulation, and ground continuity tests performed on installed wiring.

E. Operation and Maintenance Manual: Submit operation and maintenance data, where not provided under other Sections, for the equipment and systems provided, in accordance with Section 01 78 23 - Operation and Maintenance Data.

F. State Fire Marshal: Separate Shop Drawings of the fire alarm and detection system shall be submitted to the State Fire Marshal and local fire jurisdiction for approval. Approval shall be obtained before beginning installation work. The Contractor shall submit a copy of the Contractor's transmittal to the State Fire Marshal and local fire jurisdiction for the Engineer's information. Contractor shall be responsible for obtaining necessary permits and certifications for all fire detection and alarm systems work.

1.06 QUALITY ASSURANCE

A. Each and all items of the fire alarm system shall be listed as a product of a single fire alarm system manufacturer under the appropriate category by the Underwriters Laboratories Inc. (UL), and shall bear the "UL" label. Control equipment shall be listed under UL category UOJZ as a single control unit. Partial listing will not be acceptable.

B. In addition to the UL-UOJZ requirement specified above, the system controls shall be UL listed for Power Limited Applications in accordance with California Electrical Code, Article 760. All circuits shall be marked in accordance with California Electrical Code, Article 760-22.

1.07 SITE CONDITIONS

A. Inspect surfaces and structures to, and on, which products will be installed before the work of this Section begins. Provide surfaces and structures capable of supporting the products. Surfaces that will be concealed by products shall be finished before products are installed.

PART 2 - PRODUCTS

2.01 FIRE ALARM SYSTEM

A. Furnish and install a complete addressable fire alarm system as indicated. The system shall be wired, connected, and left in first-class operating condition. Performance and capacities of signaling line circuits shall be in accordance with NFPA 72, Class A, Style 2 alpha, and initiating device circuits shall be in accordance with NFPA 72, Class A, Style D. The system shall be electrically supervised, and shall use closed loop initiating device circuits with individual zone supervision, individual indicating appliance circuit supervision, incoming and standby power supervision. Provide a control panel, manual pull stations, automatic smoke and heat detectors, annunciator, all wiring, connections to devices, outlet boxes, junction boxes, and all other material and accessories as necessary for a complete operating system.

B. All panels and peripheral devices shall be the standard product of a single manufacturer and shall display the manufacturer's name on each component.

C. The system alarm operation subsequent to the alarm activation of any manual pull station, automatic detection device, or sprinkler flow switch shall be as follows:

1. The appropriate initiating device circuit's red LED shall flash on the control panel and the remote annunciator until the alarm has been silenced at the control panel or the remote

annunciator. Once silenced, this same LED shall latch on. A subsequent alarm received after silencing shall flash the subsequent zone alarm LED on the control panel.

2. A pulsing alarm tone shall occur within the control panel until silenced.

3. All alarm-indicating appliances shall sound in a Continuous Ringing Alarm pattern or Designated State Code pattern until silenced by the Alarm Silence Switch at the control panel or the remote annunciator.

4. All visual alarm lamps shall operate in a continuous pattern until extinguished by the Alarm Reset Switch.

5. Activate a supervised signal to notify BART Operations Control Center or other specified notifying parties.

6. Manual Pull Station: Use metal, recessed pull-lever, open circuit type manual pull stations to permit transmission of an alarm for fire drills or tests. To protect the station, install a tamper-proof, clear polycarbonate shield and frame that fits easily over the pull station. When the shield is lifted to gain access to the pull station, a loud piercing warning horn shall be sounded. The warning horn shall be powered by the Fire Alarm Control Panel (FACP). Finish of the pull station shall consist of a base color of red with white lettering instructions. All outdoor or trackway pull stations shall be water-proof; protected with appropriate water tight housing and shall meet ADA requirements.

D. The alarm indicating appliances may be silenced by authorized personnel upon entering the locked control panel and operating the Alarm Silence Switch or by use of the key operated switch at the remote annunciator. A subsequent zone alarm shall reactivate the signals.

E. The alarm activation shall, in addition to the operations specified above, cause the elevator cabs to be recalled. If the alarmed detector is on any floor other than the main level of egress, the elevator cabs shall be recalled to the main level of egress.

F. The activation of any system smoke detector shall initiate an Alarm Verification operation whereby the control panel shall reset the activated detector and wait for a second activation. If, after reset, a second alarm is reported from the same or any other smoke detector within one minute, the system shall process the alarm in accordance with the operations listed above. If no second alarm occurs within one minute, the system shall resume normal operations. The Alarm Verification shall operate only for smoke detectors. Other activated initiating devices shall process alarms immediately.

G. Activation of Standpipe or Sprinkler Tamper Switch and Trouble Silence Switch:

1. The activation of any standpipe or sprinkler tamper switch shall activate a distinctive system supervisory audible signal and illuminate a "Sprinkler Supervisory Tamper" LED at the system control panel and the remote annunciator. There shall be no confusion between valve tamper activation and opens and grounds on fire alarm initiation circuit wiring.

2. Activating the Trouble Silence Switch will silence the supervisory audible signal while maintaining the Sprinkler Supervisory Tamper LED indicating the tamper contact is still activated.

3. Restoring the valve to the normal position shall cause the audible signal and LED to pulse at a March Time Rate.

4. Activating the Trouble Silence Switch will silence the supervisory audible signal and restore the system to normal.

H. Actuation of the program "Test Set-Up" switch at the control panel shall activate the "Walk Test" mode of the system that shall cause the following functions to occur:

1. Control relay functions shall be bypassed.

2. The control panel shall show a trouble condition.

3. The alarm activation of any initiation device shall cause the audible signals to pulse one round of code identifying the initiation circuit (e.g., an activated smoke detector connected to Zone 4 shall pulse the audible signals four times in rapid succession).

4. The panel shall automatically reset itself.

5. Any momentary opening of an initiating or indicating appliance circuit shall cause the audible signals to sound for four seconds to indicate the trouble condition.

I. Activation of an auxiliary bypass switch shall override the automatic functions either selectively or throughout the system and shall initiate a trouble condition at the control panel.

J. Supervision of the system shall include the following features and functions:

1. All auxiliary manual controls shall be supervised so that all switches will be returned to the normal automatic position to clear system trouble.

2. Each independently supervised circuit shall include discrete amber "Trouble" LED to indicate disarrangement conditions per circuit.

3. The incoming power to the system shall be supervised so that any power failure shall be audibly and visually indicated at the control panel and the annunciator. A green "power on" LED shall be displayed continuously while incoming power is present.

4. The system batteries shall be supervised so that disconnection of a battery shall initiate audible and visual indication at the control panel and the annunciator.

5. The System Expansion Modules connected by ribbon cables shall be supervised for module placement. Should a module become disconnected from the CPU, the system trouble indicator shall illuminate and an audible trouble signal shall sound.

6. Wiring to a remote annunciator shall be supervised for open and ground conditions. An independent annunciator trouble indicator shall illuminate and an audible trouble signal shall sound at the control panel.

K. The system shall include the following electrical power requirements:

1. The control panel shall receive 120 V ac power via a dedicated standby circuit.

2. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal 120 V ac power in a normal supervisory mode in accordance with NFPA 72. The system shall automatically transfer to the standby batteries upon power failure. All battery charging and recharging operations shall be automatic. Batteries, once discharged, shall recharge at a rate to provide a minimum of 80 percent capacity in 12 hours.

3. The supervised standby battery power shall operate the entire system for 4 hours under normal system conditions. At the end of 4 hours, the standby battery shall power the system under fire alarm conditions for 5 minutes.

4. All circuits requiring system-operating power shall be 24 V dc and shall be individually fused at the control panel.

5. Faults on ancillary circuits shall not interfere with the operation of the alarm and detection system.

L. The system shall be an addressable fire alarm system complete with built-in or portable reprogramming capabilities so that all reprogramming or reconfiguration of the fire alarm system can be accomplished without removal of any solid-state devices. Hardware, software, and passwords used in programming the system and the I/O Map shall be submitted to the Engineer.

2.02 EQUIPMENT

A. Fire Alarm Control Panel (FACP):

1. Each FACP shall be capable of supporting up to 800 addressable devices. Use twisted pairs shielded solid wire for addressable loops. Tapping is permitted.

2. Each addressable device shall have a unique address. The manufacturer shall program each address to a system input zone and correlate to output operations as indicated. Non-functioning, non-addressed and non-programmed devices shall report trouble. Provide for site modification to the addressable programming. Provide for removal of devices without the necessity of readdressing any other devices.

3. Provide installation flexibility by ensuring that the physical sequence (placement) of the devices on the loop need not determine the device address. Installation tables shall be furnished to identify all device addresses.

4. The FACP shall provide an integral service console that allows qualified service technicians to complete the following operations:

   a. Enable/disable system options;

   b. Configure a remote annunciator;

   c. Set periods for various system timers;

d. Set evacuation signal rate;

e. Program relays and signals;

f. Set system time and date; and

g. Perform verification tests.

5. The FACP shall be provided with a 40-column, panel-mounted printer.

6. The FACP shall be provided with a built-in Field Programming Tool/Diagnostics Tool. This tool shall allow a qualified service technician to perform multiple level programming, detailed system diagnostics, and to print system summary reports.

7. The FACP shall provide independent dry contacts on all alarm zones, including system trouble for remote annunciation on a 24 V dc Supervisory Control and Data Acquisition (SCADA) system.

8. Provide a handset in the FACP for connection to the P.A. system via PABX for convenient use. Provide modular components.

9. The system shall be housed in a NEMA 12 wall-mounted cabinet, red in color, with a door and viewing windows. All annunciator indications, operating controls, and instructions shall be clearly visible through the viewing window. The door shall be provided complete with a lock and two keys.

10. A Liquid Crystal Display (LCD) of 2 lines by 40 characters shall be provided to annunciate each addressable device in zones, and represent these zones by alarm or trouble LEDs. Locate the LEDs on the control panel.

11. The FACP shall provide LED annunciation for all alarm zones with the following indications and controls: power on, reset, silence, trouble, and alarm.

B. System Power:

1. The primary operating power shall be 120 V ac, 60 Hz, no-break system power supplied with integral battery chargers capable of recharging the standby batteries to 80 percent capacity within 12 hours.

2. The supervised secondary battery power shall operate the entire system for 4 hours under normal system conditions. At the end of 4 hours, the standby source shall power the system under fire alarm conditions for 5 minutes.

3. Ancillary devices shall have separate power source. Faults on ancillary circuits shall not interfere with the operation of the alarm and detection systems.

C. Common Controls/CPU:

1. The CPU shall be self-configurable and able to map to the display module by I/O module type. It shall have field-programmable software capable of being programmed and configured on site using either a built-in service console or a serial port for connection of a portable laptop computer. A set of diagnostic equipment including laptop computer, cable connections, and associated software shall be provided.

2. Provide an LCD/Common Control with an 80-character LCD display and membrane switches for common control and programming functions.

3. Universal display modules with LEDs and membrane switches shall connect to the CPU and shall provide all zone annunciation and/or control functions. A slide-in designation label shall be provided to simplify changes to zone designations and language.

4. Provide the following common control switches and indicators: Detection Signal Operated LED, Common Trouble LED, Power ON LED, Enable Zone LED, Enable Zone Disconnect Switch and LED, Detection Signal Replay Sequence, Disable all Auxiliary Relays, Standby Power Trouble, Test All Lamps, All Clear, Annunciator Trouble, Ground Fault, and Reset System.

5. In addition, the LCD CPU/Common Control shall provide the following switches and functions: Alarm Queue Switch and LED, Supervisory Queue Switch and LED, Trouble Queue Switch and LED, Display I.D. Switch, Program Menu Switch, Cancel Switch, Previous Switch, Next Switch, and Enter Switch. These switches provide operator interface to the system software and function as programming keys.

   a. The Liquid Crystal Display (LCD) shall be of the super twist high contrast type with 80 characters. Provide non-interleaving event display by type sorting input events into queues. Types shall be fire alarm, supervisory alarm, trouble, and monitor.

   b. Provide a LED for each queue to indicate the presence of events. Provide queue select control switches to allow user selection of the event type to display. Provide previous and next control switches to allow scrolling through a list of events. Provide all that is required to support site programming. Use a smart menu scheme to guide the user through programming sequences. Initiate trouble if programming input is incomplete.

D. Remote Annunciator:

1. The remote annunciator shall provide LED annunciation for all alarm zones with the following indications and controls: power on, reset, trouble, and alarm.

2. The remote annunciator shall indicate alarm conditions for serial wiring supervision, data integrity, and power. A common trouble alarm indication shall be provided for grounds, opens, and shorts. The remote annunciator enclosure shall be flush-mounted and of NEMA 3R construction with stainless steel door.

E. Alarm Input Modules:

1. The input module shall be power-limited circuits and field programmable for any of the following operations:

   a. Class B non-verified or verified Alarm input;
   b. Normally open or normally closed Supervisory Inputs;
   c. Monitor inputs; and
   d. Remote Switch Inputs.

2. Each normally open sprinkler supervisory device shall be connected to a dedicated addressable transponder. Each supervisory addressable input device alarm or trouble operation shall be annunciated on the FACP and remote annunciator LCD's. Each supervisory device shall have an individual status LED.

2.03 FIRE ALARM PERIPHERAL DEVICES

A. Manual Pull Stations: Provide metal, recessed pull-lever breakglass, open circuit type manual addressable pull station, utilizing spring retention feature (glass rod not acceptable), capable of being reset with the same key as for the FACP. By using the key, authorized personnel can activate the manual pull station. Finish the station in red with white lettered instructions, which shall read: "Local Alarm - Does Not Alert Fire Department."

B. Automatic Detectors:

1. Provide stable, solid state, addressable, unipolar ionization detectors capable of detecting visible and invisible products of combustion. Provide the detectors with a measuring chamber and a protected reference chamber sensitive to changes in temperature and humidity only. Protect the measuring chamber from damage and insects.

2. Provide a built-in five second delay to minimize detection signals due to transient smoke. Safeguard radioactive parts and protect circuitry against electrical transients, electromagnetic interference, and polarity reversal. Factory set the detector sensitivity and provide for field adjustment within the range of UL defined sensitivity.

3. The detector shall be tamper-resistant and plug-mounted to a separate base. A built-in shorting device shall permit checking of the installation wiring before detector installation.

C. Auxiliary Devices:

1. Provide remote control relays connected to supervised auxiliary circuits for control of fans, dampers, door releases, automatic fare gate releases, and escalator shutdown. Relay contact ratings shall be 5 A at 120 V ac resistive or 2.5 A at 120 V ac inductive for a 0.50 power factor.

2. Provide a normally open dry contact from the FACP to initiate an automatic announcement on the station public address system upon activation of the manual pull station. Also provide a 90-second delay timer circuit in the FACP as indicated that shall initiate shutdown of station escalators upon activation of the manual pull station.

3. Provide a dry contact for initiation of elevator recall to egress level.

D. Visual Alarms: Provide visual alarms (strobe lights) for the hearing impaired in accordance with applicable requirements of the Americans with Disabilities Act (ADA) and the following requirements:

1. Lamps shall be a xenon strobe type or equivalent. Color shall be clear or nominal white (unfiltered or clear filtered white light.)

2. Maximum pulse duration shall be 0.2 second with a maximum duty cycle of 40 percent. Pulse duration is defined as the time interval between initial and final points of 10 percent of maximum signal.

3. Intensity shall be a minimum of 75 cd.

4. Flash rate shall be a minimum of 1 Hz and a maximum of 3 Hz.

5. The appliance shall be placed 80 inches above the highest floor level within the space or 6 inches below the ceiling; whichever is lower.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Interface and Coordination: Indicated diagrams and details show the general location and arrangement of equipment, conduit, wiring, and devices. Provide outlets, control and detection devices, and equipment properly located and readily accessible. Control and detection devices, equipment, and outlets shall be located to avoid interference with mechanical, architectural, and structural features.

B. Wiring Methods:

1. All wiring shall be installed in a continuous GRS conduit system. All conduits shall be concealed.

2. Prepare and submit a Fire Alarm Riser Diagram indicating type and quantity of devices and size and quantity of conductors and conduits.

3. No wiring other than that directly associated with fire alarm detection, alarm, or auxiliary functions shall be permitted in fire alarm conduits. Wiring splices shall be avoided to the extent possible and if needed, they shall be made only in junction boxes and shall be connected with crimp-type connectors. Wire nut-type connections are not acceptable.

4. Transposing or changing color-coding of wires will not be permitted. All conductors in conduit containing more than one wire shall be labeled on each end with wire markers conforming to the requirements of Specifications Section 26 05 24 - Low Voltage Wires and Cables. Conductors in cabinets shall be carefully formed and harnessed so that each drops off directly opposite to its terminal. Cabinet terminals shall be numbered and coded. All controls and function switches shall be clearly labeled on all equipment panels.

5. All wiring shall be checked and tested to ensure that there are no grounds, opens, or shorts. The minimum allowable resistance between any two conductors or between conductors and ground is 10 MΩ as checked by a Megger after all conduit, conductors, and detector bases have been installed, but before the detector devices are plugged into the bases or end-of-line devices installed.

6. All conduits entering or leaving the terminal cabinets and junction boxes shall be numbered in a logical and consecutive manner. A number shall be used only once.

7. All conductors shall be tagged, labeled, and color-coded. Color-coding shall be by wire insulation, not taping or banding. The numbering and color-coding shall be continuous for each circuit wire.

8. Wire shall be numbered at each connection, termination, and junction point. Wire numbering tags shall be professionally manufactured wire-markers. Each group of wires shall be tagged with its destination at each panel, terminal box, or junction box.

C. Control Panels: Control and other panels shall be mounted with sufficient clearance for observation and testing. All fire alarm junction boxes shall be clearly marked for easy identification. Flexible connectors shall be used for all detection device-mounting boxes. Junction boxes and panels shall be securely hung and fastened with appropriate fittings to ensure positive grounding throughout the entire system.

D. Pre-testing: The system shall be completely pre-tested prior to final acceptance testing. All points shall be tested from point of initiation to the final point or points of annunciation. All circuits shall be tested for continuity and ability to transmit the required signal correctly to the FACP. Any problem due to wrong wire type, wire twist, impedance, mismatches, noise filtering, or shielding shall be corrected during pre-testing and prior to any final acceptance tests. Pre-testing shall include every device in the system. Coordinate with other trades as necessary for testing. Provide the following tests and procedures:

1. Sprinkler Flow Switches: Record time delay from water flow to alarm, and adjust as necessary for 30 to 50 seconds delay.

2. Valve Tamper Switches: Verify "trouble" signal is received on closing of each valve.

3. Smoke Detectors: Test with actual or approved artificial smoke. Verify that reset does not occur when devices are cleared of smoke. Verify supervisory circuit function.

4. Elevator Recall: Verify that elevators recall to designated floor.

5. Central Notification: Verify that one set of conductors in the terminal cabinet becomes a short circuit on any "trouble" condition and that the other set becomes a short circuit on any "Alarm" condition. Verify that the conductor groups are labeled properly.

3.02 FIELD QUALITY CONTROL

A. Provide the testing program, qualified technical personnel, tools, test equipment, and other items required to perform the tests. The Engineer shall witness all tests and certify the recorded results.

B. Furnish written notice as to when installed equipment will be tested so that the Engineer and Authority Having Jurisdiction can be present to witness the tests. A minimum of 30 calendar days prior notice of a proposed test shall be provided.

C. At the Contractor's option, a representative of the equipment manufacturer may be present to witness the tests and verify the results.

D. These tests shall not alter the Contractor's guaranty of the equipment. Replace and retest work and materials found to be not in compliance with Specification requirements.

E. Test splice points back to previous splice or terminal points before encapsulant is placed around the splice point.

F. Maintain test data sheets showing the results of tests performed. Provide data sheets listing the acceptable or specified test limits and the values actually measured. Furnish one set to the Engineer. Retain one set.

G. Provide data sheets showing the test set-up, the equipment used, the names of persons performing the test, the names of witnesses, the date, the location, and the serial number of the equipment under test. The test data sheets will be reviewed by the Engineer and accepted as submitted, or additional tests may be required. If additional tests are required because initial test results do not comply with these Specifications, the retesting shall be documented and submitted as before, at no additional cost to the District.

H. Perform tests in accordance with Article 3.01.B.5 above.

I. Perform inspection of control panel as follows:

1. The inspection shall first cover a physical check of panels in reference to the following items:

   a. Proper model numbers.

   b. Arrangement of instruments per Shop Drawings on panel front.

   c. Arrangement of back-mounted accessories for proper clearance, operation, and maintenance.

   d. Installation of wiring and accessories for conformance with the Contract Drawings and Specifications.

   e. Finish of panel.

   f. Tagging of wiring.

2. After completion of the physical inspection, perform circuit checkouts as required to verify the correct operation of the system.

3. Check electrical instruments and each electrical circuit for continuity either by checking entire "loops" if within panel or by simulating field conditions or operations. This test shall include instruments, alarms, relays, and pressure switches that are part of the panel

circuits. When full simulation is not possible or practicable, wires shall be given a point-to-point continuity check.

J. Perform final checkouts and test. Ship panels only after required factory tests are performed and required modifications or corrections are made. A factory certificate of inspection is required before shipment and shall accompany the shipping documents.

3.03 TRAINING SESSIONS

A. In addition to the requirements of Section 01 79 00 - Demonstration and Training, comply with the specific training requirements specified herein.

B. Provide two 4-hour training sessions in the operation and maintenance of the fire detection and alarm systems for BART maintenance personnel prior to acceptance by the Engineer of the installed systems. Training sessions shall be conducted by a representative of the fire detection and alarm system's manufacturer or supplier. The training sessions shall enable a qualified service technician to troubleshoot and maintain the system.

C. The Engineer will provide a classroom facility for such training sessions located in a BART facility. Approximately fifteen BART maintenance persons will attend each training session.

D. The Contractor shall schedule the training sessions through the Engineer at a time convenient to the District. The Contractor shall notify the Engineer of the proposed training session dates at least six weeks prior to those dates. The sessions shall include the following training:

1. Classroom-type training, giving course participants an understanding of the overall system and its operation.

2. Hands-on training, giving course participants actual trouble-shooting and maintenance experience. This shall include training in user-level programming of the FACP to perform routine maintenance tasks such as deleting a device or zone, or reprogramming the FACP to recognize a substitute or replacement device.

E. Provide professionally prepared training manuals to supplement the Operation and Maintenance Manuals and submit them to the Engineer for review and approval at least two months prior to the start of classroom instruction. The training manuals shall be prepared specifically for use as training aids as follows:

1. Each course participant shall receive copies of the Operation and Maintenance Manuals, training manuals, and other pertinent material prior to the commencement of training sessions.

2. The District shall retain the master and two additional copies of all training manuals and materials as reference documentation.

3. Upon completion of each course, instructor's manuals, Operation and Maintenance Manuals, training manuals, and training aids shall become the property of the District. Throughout the Contract and guaranty period, it shall be the responsibility of the Contractor to supply the District with all changes and revisions to the training manuals and other documentation.

4. The District reserves the right to copy all training materials and aids for use in the District-conducted training courses.

5. The Contractor shall provide all special tools, equipment, training aids, and any other materials required to train course participants. The number of special tools and other training equipment shall be adequate for the number of participants attending the course.

F. The District shall have the right to videotape any and all training courses presented by the Contractor. The District shall also have the right to use these videotapes to train District personnel in the future.

END OF SECTION 28 31 00