SECTION 28 - PLC DETENTION MONITORING AND CONTROL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. This Section includes Control Electronics system requirements that shall be applicable to all Work.
2. All requirements described in the Basic Requirements Section shall be required by this Section as if written herein.

B. Products Supplied But Not Installed Under This Section:

1. Refer to “Extra Materials” in the maintenance article of this Section.

C. Related Sections:

1. 01 77 00 - Closeout Procedures
2. 01 78 23 - Operation and Maintenance Data
3. 01 78 39 - Project Record Documents
4. 01 79 00 - Demonstration and Training
5. 26 00 00 – Basic Electrical Requirements
6. 26 05 26 – Grounding and Bonding For Electrical Systems
7. 27 11 16 – Communications Cabinets, Racks, Frames, and Enclosures
8. 27 51 53.63 - Detention Intercommunications and Program Systems
9. 28 00 00 - Electronic Safety and Security
10. 28 05 53 - Identification For Electronic Safety and Security
11. 28 06 20 - Schedules For Electronic Monitoring and Control
12. 28 16 13 - Touch Screen (GUI) System
13. 28 23 00 - Video Surveillance, IP System
14. 28 23 19 – Video Surveillance, Analog System

D. Alternates:

1. Provide PLC redundancy as required by this Section and shown on the drawings.

1.2 REFERENCES

A. ANSI/EIA, RS-232C.

B. ANSI/RS-310.

C. ANSI/RS-422.

D. ANSI/RS-485.

E. CSA

F. FCC, Part 15.

G. IEC,1131-3, International Electrotechnical Commission, March 1994, Standard for Programming Programmable Logic Controllers (“IEC 1131”).

H. IEEE

I. JIS

J. NEMA, ICS

K. NEMA, 1

L. U. L.

1.3 SYSTEM OF DESCRIPTION

A. Design Requirements: The Control Electronics shall consist of Smart programmable logic controller (PLC) system with the following topology.

1. Distributed Smart PLC’s at each PLC location.
2. Each Smart PLC panel shall be provided with its own on board processor. Any PLC I/O controller without its own on board processor shall be backed up with hot standby redundant processors and programmed for automatic switchover upon fault detection. The system shall indicate to the primary officers’ workstation that a smart PLC panel is offline or a standard PLC is in redundant mode and may have a power bus failure.
3. Provided interposing relays for all gate and door control circuits and all other control circuits that exceed 60% of the Smart or Standard PLC output point current rating.
4. Provide data communications between the PSIM (Physical Security Information management System) and the microprocessor based intercom system for annunciation and intercom station selection and control on the touch screen system.
5. Provide interface to internet for off-site trouble shooting and program up-load/down-load. Connect through (Citrix). Provide automatic e-mail to service provider throughout the warrantee period.
6. Provide interfaces to the following systems for control from the Control Panel and Touch Screen Systems:

    a. Detention Intercommunications and Program System,
    b. Touch Screen System,
    c. Surveillance Television System,

7. Use materials and equipment that comply with referenced standards and manufacturers' standard design and construction, in accordance with published product information. Coordinate the features of all materials and equipment so they form an integrated system, with components and interconnections matched for optimum performance of specified functions.
8. Provide with the appropriate digital I/O cards and/or blocks, and PLC power supplies. Mount in processing equipment racks and enclosures which shall contain all necessary terminal blocks, connectors, wiring ducts, 12 and 24 VDC power supplies, mounting hardware, and other accessories.
9. The PLC site shall be capable field expansion. Leave at least three unused rack slots for additional Smart PLC I/O.
10. The system shall be a distributed process system network. Smart PLC CPU's or communication failures shall not affect other PLC’s or touch screen control station(s) on the network.
11. Provide class 2 power supplies as required.

a. Provide 12, 18, and 24V power supplies in both AC and DC versions as necessary.
b. Use only power supplies meeting the requirements of the powered devices. For example: do not utilize 24V power supplies for powering 12V or 18V devices.

12. Refer to Schedules For Electronic Monitoring and Control for additional requirements.

B. Performance Requirements: The system shall provide monitoring and control of the following systems.

1. Detention Intercommunications and Program Systems: PSIM Server shall be programmed and wired to the Intercom system as described in the Detention Intercommunications and Program System, and Touch Screen System Sections.
2. Touch Screen System Interface: Data transfer to and from the Touch Screen System as described in the Touch Screen System Section.

a. All I/O shall be through high-speed data transfer or Lonworks.

3. Surveillance Television System Interface: PSIM Server shall be programmed and input and output points programmed to the CCTV System as described in the Video Surveillance, and Touch Screen System Sections. Where applicable, data connections are acceptable provided:

a. All drivers and interfacing hardware, firmware, and software is provided as necessary for data communications between the two systems. It is the Low Voltage System Specialty Contractor's responsibility to procure this interfacing equipment as necessary for the systems to communicate.

b. All drivers and interfacing hardware, firmware, and software have been in production and use in at least 3 detention facilities for a period of at least 6 months at the time of bid.
c. The requirements of the applicable ANSI standard (RS-232C, RS-485, RS-422, and Lonworks) are maintained.

4. Duress Alarm System Interface: Smart PLC cards shall be programmed and input and output points wired to the Duress Alarm System as described in the Duress Alarm System, and Touch Screen System Sections. Where applicable, data connections are acceptable provided:
5. Each Smart PLC input point change in state and each Smart PLC output point change in state shall be logged including the time of day and the date. This information shall be retrievable by the Touch Screen system for report generation. Refer to the Touch Screen System Section for additional requirements.
6. Door Monitoring and Control System:

a. Door Monitoring:

1) Provide low voltage power to door position and lock switches which combine to indicate the secure or unsecure status of doors (i.e., hinge position, latch position, bolt position, limiting switches, etc.). Indication shall be as described in Related Sections.
2) Where a surveillance camera is associated with the door position monitoring, provide signaling to the CCTV system to select and route the camera to the designated alarm CCTV monitor and video archival system as required. Refer to Related Sections.

b. Door Control:

1) Provide remotely controlled operating power to door operating devices including, but not limited to, electrically controlled door locking mechanisms. Refer to door hardware and detention hardware for motorized and solenoid operated locking definitions and additional requirements.
2) Provide door remote control as indicated on the Drawings. Refer to Related Sections for additional requirements.
3) Wire electric door locks and gate operators to Smart PLC system outputs. Provide relay output modules of sufficient rating, capacity, and quality to control all required functions. Provide an interposing relay with form-C contacts for each door control output.

c. Vehicle Detection:

1) Where shown on the Drawings, connect to vehicle loop detectors to initiate a call to its designated control point for entry request.

1.4 SUBMITTALS

A. Equipment Submittal:

1. All Smart or Standard PLC components shall be identified with manufacturer's part and/or catalog number.

a. All processor firmware shall be identified and revision levels indicated.

2. Include throughput calculations for each function. Refer to the Touch Screen Section of functional and operational descriptions.
3. Include testing procedures.
4. Include testing forms.
5. Point-to-point wiring data shall be provided, utilizing a combination of AutoCAD generated drawings and security control point schedules. The schedules shall be created utilizing an interrelational database manufactured by Microsoft and shall cross-reference the point-to-point wiring diagrams provided in the shop drawings. Schedules shall detail all equipment being provided and controlled/monitored by the PLC and Touch Screen Systems. The schedules shall be organized according to different system functionality. Typical schedules shall include, but not be limited to, sections for cabling information, control locations, door hardware interface, intercom, paging, cameras, CCTV monitors, duress, etc. The drawings and schedules shall indicate the wiring of components and all connections to be made. Terminal connections in the equipment shall be numbered to correspond to drawings and schedules for use in making connections.

B. Drawings for the Smart PLC configuration shall include model numbers of each component used and all required switch settings for proper operation and configuration of the system.

C. Shop Drawings:

1. Block diagram showing each Smart PLC system component layout and its electronic relationship with other components of this Section and all related Sections.
2. To scale mechanical Drawings showing physical arrangement and mounting details of each component.

3. Wire numberings associated with each I/O point. This information shall be on the Drawings at the I/O point, not in a schedule format.

D. Design Data, Test Reports, Certificates, Manufacturers Instructions, Manufacturers Field Reports:

1. Submit certificate of successful pre-testing prior to equipment delivery. Also submit written request for consultant's attendance at the pre-test.

E. O&M Manuals:

1. Include a custom developed detailed description of each interface including those to the local intercom and paging systems, the elevator control system, the lighting control system, and all other systems.
2. Include completed testing forms.

1.5 QUALITY ASSURANCE

A. Qualifications

1. The entire system shall be designed and laid out by factory trained and factory authorized personnel.
2. All control electronics cabinets shall be UL approved for process control equipment.

B. Regulatory Requirements

1. All equipment shall be laid out and installed as per NEC requirements.
2. Locate all control electronics Smart PLC's and I/O in cabinets that are UL approved for process control equipment.

C. Certificates

1. System pre-testing shall be accomplished and certified in the Low Voltage System Specialty Contractor's shop prior to delivery.
2. Prior to equipment delivery, provide a written statement from a factory trained and factory authorized technician that the system has been tested and functions as specified.

D. Mock-ups

1. System shall be fully mocked-up and tested at the Low Voltage System Specialty Contractor's shop prior to delivery.

E. Pre-Test Meeting

1. The consultant will review the mock-up pre-test after preliminary testing and prior to delivery.

F. Preliminary Testing

1. Shop test before the pre-test meeting and delivery:

a. Under full load. Provide a test jig that simulates:

1) An output module with all outputs active and under full load of steady state current of electrically controlled locking mechanisms being powered and with one experiencing the in-rush of an electrically controlled lock being energized.
2) All discrete Smart PLC input points being having their status changed at a test rate of 1 change per minute per point. Demonstrate that the system does not significantly slow and continues to meet the specified throughput time.
3) All Smart PLC Controllers must be capable of Peer to Peer Communication. Any host dependant controller to controller communication system shall not be acceptable.
4) All points shall be programmed to minimize the GUI commands by using Smart PLC Peer to Peer technology Commands.

1.6 PROJECT/SITE CONDITIONS

A. Existing Conditions:

1. No existing PLC equipment exists.
2. Existing door controls and door monitoring lamps are mounted on custom control panels to be replaced.
3. Existing door control signaling is through relays mounted beneath or behind the control panels. All existing door control relays are to be replaced with new. Any existing relay blocks and backplanes shall not be re-used.

1.7 SEQUENCING

A. Do not install Smart PLC equipment until the electrical/electronics room is clean, climate controlled and sealed.

1.8 SCHEDULING

A. Coordinate interruptions in existing system operations with the Owner. Interruptions of the existing systems shall not exceed a total of 2 weeks.

1.9 SYSTEM STARTUP, OWNER'S INSTRUCTIONS, COMMISSIONING

A. Test, Inspection

1. Field test before delivery of control electronics: Continuity of all field wiring and remote device operation.
2. Test all I/O and programming for adherence to the requirements of this Section and all related Sections.
3. Simulate controller fault and verify orderly shutdown functions. Also verify electronics (comm) fault annunciation.
4. Test for fail-secure operation of each door upon a simulated power outage. Repeat this test 20 times. Test for fail safe locks as applicable including magnetic door locks.
5. Test all door monitoring and locking mechanisms. Test every:

   a. Lock along with its combination of door position and lock position switches.

b. Sliding, coiling, bi-fold, and arm gate door mechanism along with its position indication limit switches.

B. Verification of Performance

1. Field test after delivery and installation of control electronics: Each controlled device, each monitored device. Each element of touch screen icon requirements for meeting the segment description requirements of the touch screen Section.

1.10 MAINTENANCE

A. Extra Materials

1. Provide 10% or one whichever is greater spares inventory of all active electronics, including I/O boards, communications boards, processors, and power supplies.

a. All Smart PLC's shall be hot swappable without effecting the other I/O controllers in the PLC Rack.

b. Spare processor shall be equipped furnished with all software and licensing necessary for plug and play operation. Include battery back-up to maintain memory and/or power supplies as necessary to maintain memory and programming for a minimum of 5 years.

2. Provide 10% spares inventories of all consumable items including fuses, switches and LED's used.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. All Smart PLC's and their respective I/O modules shall be by a single manufacturer.

1. All components of the Smart PLC System shall be of normally recognized industry standards and regularly sold to the Security market.
2. The Smart PLC manufacturer must guarantee the availability of spare parts for a period of 10 years.
3. All switches and other operator-controlled devices shall be of the size and durability for their intended use as is normally offered for Security applications.
4. Utilizing different models of Smart PLC's within a given manufacturer at various locations is acceptable provided:

a. All are capable of being networked together on a common Lonworks network.
b. The I/O modules of each type shall be interchangeable.
c. All Smart PLC's utilize the same instruction codes and commands.
d. All Smart PLC's are programmable from a common programming unit or Server from a single location.

B. The Smart PLC shall be defined to be that which is regularly found in security environments controlling automated access and process controls.

1. Fire alarm, Non Smart PLC access control, environmental, or custom manufactured

control systems are not acceptable.

2. Logic control components manufactured by companies other than those expressly approved shall not be acceptable.

C. Low Voltage System Specialty Contractors requesting pre-approval for alternate Smart PLC Manufacturers shall demonstrate that the proposed equipment meets all of the requirements of this Section and:

1. Is utilized in at least 100,000 automation applications.
2. Is manufactured in a facility that meets ISO 9000 and the ISO 9001 quality standards.
3. All parts are stocked by distributors, not including the manufacturer or systems Low Voltage System Specialty Contractor, in at least 3 locations within 100 miles from the project site.
4. Programming software support shall be available by 3rd party vendors without consultation of the systems integrator.

D. The following PLC system manufacturers are pre-approved.

1. Smart PLC

   a. OSSI MAC Series

2. Standard PLC

   a. GE
   b. Square D, Modicon
   c. Allen Bradley
   d. Omron

2.2 EXISTING PRODUCTS

A. To Be Determined

2.3 EQUIPMENT

A. Programmable Controller Assemblies

1. Provide assembled programmable controllers, power supplies, and all input and output modules, racks and associated hardware complete with memory.
2. Continually run a self-diagnostic program and initiate an orderly shut down upon fault detection.
3. Components comprising the system commercially manufactured, not custom fabricated.
4. Individual diagnostic indicator lights on the controller shall indicate memory parity error, processor error and power supply low level.
5. The Smart PLC Rack shall have:

   a. Lonworks port, lonworks Interface or an accompanying Ethernet PLC module that interfaces the Smart PLC CPU directly to Ethernet.
   b. EEPROM or Compact Flash Card for each CPU provided (transferable to non-volatile disc.
   c. RAM and EEPROM/Compact Flash Cards: sized to meet the functional requirements of the system plus 20% memory for future expansion.
   d. Remote diagnostic indications. This includes PLC status and I/O status.

e. The ability to be programmed remotely over a dial up connection.

6. Provisions for saving program and current output status during power outage. When power is applied, the processor status and output states shall be the same as before the power outage.
7. Battery back-up capable of powering volatile memory for a six-month outage. A low battery conditions shall be alarmed by the systems diagnostics.
8. Controller capable or run mode programming.
9. Mountable by means of no screws. Replacement consists of Removing the retaining clip and unplugging the input/output.
10. Temperature range: Operational from 0 degrees C. to 60 degrees C.
11. Relative humidity: Operational from five percent to 95 percent (non-condensing).
12. Input voltage range: 12Vdc or 24Vdc.
13. Provide power line filters as necessary to eliminate line conducted spurious noise. Provide additional power conditioning as necessary to prevent malfunctions from line variations, dropouts or other power service irregularities.
14. All major assemblies and sub-assemblies, circuit boards and devices shall be identified using permanent labels or markings each of which indicates the manufacturer's catalog number and a product manufacturing date code.
15. The alarm processing functionality shall time-stamp and log system and I/O faults into dedicated fault tables respectively.

16. Input-Output Rack and Modules

    a. Unit consists of an input/output rack, integral bus interface, and individual input/output modules.
    b. Modules removable mechanically through the use of connector sockets.
    c. Input/output modules shall have on or off status displayed by an individual diagnostic light.
    d. Field wiring shall be connected by screw terminals large enough to accept #20, #18, #16 and #14 AWG stranded wire minimum. Where field wiring is #12, terminate on external terminal strip and connect using #14 cable.
    e. Output modules individually fused to protect output circuitry from electrical shorts. Fuses easily replaced without disturbing field wiring.
    f. Input/output modules constructed of solid state devices with a life expectancy in excess of one million operations.
    g. Other input/output modules shall be of a type (for example, AC, DC, dry contact, etc.) required by the devices and functions of the system.
    h. DC input modules (per Input):

        1) Voltage range: 12 VDC
        2) Input impedance: 900 ohms minimum.

    i. DC output modules (per output):

        1) Voltage range: 10-240 AC or DC
        2) Current rating: 500mA 60 degrees C.
        3) Surge current: 4A for 10 ms, repeatable every one second.

    j. The complete I/O system shall be capable of continuous operation from 0 to 60 degrees C. and five percent to 95 percent humidity (non-condensing).
    k. The diagnostics shall be selectable, once selected shall function automatically without additional user programming. Information provided by the diagnostics shall be made available to user in plain English language message form.

17. The I/O modules shall have the capability to interface 12/24/48 VDC.

18. Software: Low Voltage System Specialty Contractor is responsible for providing, installing and modifying all software required for the system to meet the performance and operational specifications of this Section.

19.
    a. The standard programmer interface shall be via a local or remote serial interface or Ethernet to Lonworks Converter.
    b. The programming device shall have access to the application program, the system configuration, all registers, I/O system fault status, I/O override, and system diagnostic relays.
    c. Application programs may be loaded or stored while the CPU is running without an impact on the scan time.

B. Duress Switch (Desk Mount): Sentrol, 3050; GE, 3050; or approved equal.

1. Guarded or pinch type duress switch for covert under counter mounting.
2. The switch shall be constructed and configured to eliminate the possibility of accidental actuation from the user bumping it with his/her knee or chair arm rest from any direction. Unit to utilize a pull or pinch motion for alarm initiation.
3. The unit shall include an on-board LED to indicate power and initiation status. Initiation status to be latching.
4. Reset may either be from the HMI or through the provision of an on-board keyswitch.
5. Coordinate voltages and reset requirements as necessary.
6. Equip with 12’ cord with locking jack.
7. Equip with locking plug/jack wall outlet: ABC Company; or approved equal.

C. Interposing Relays: Phoenix Contacts; or approved equal.

1. Provide interposing relays for all 120 VAC gate and door control circuits.
2. Provide interposing relays for all circuits exceeding 60% of the PLC output circuit specified capacity.
3. All interposing relays shall be rated for 200% of the inrush current of the connected device.
4. Provide snubber circuits to all solenoid connected devices.

D. Power Supplies:

1. All power supplies shall be rated for 100 percent duty cycle.
2. Class 1 power supplies shall be sized such that under no condition shall the power supply exceed 80 percent of its rated amperage output.
3. Class 2 power supplies shall be sized such that under no condition shall the power supply exceed 80 percent of its rated amperage output. Output shall be regulated to within +- 1 percent of the rating.
4. Coordinate voltage and noise susceptibility with equipment to be powered.
5. Class 1: Cosel, K150A series; or approved equal.
6. Class 2: Idec PS5R-SE24 series, or approved equal *(Southern Steel or Airtec motorized locks).* Units shall be switching, internally protected against shorts, and the output voltage shall be adjustable. Output shall be regulated to within +- 1 percent of the rating.
7. Class 2: Altronix, ALTV 248 UL or ALTV 2416 ULX; Power One, International Series Linear; Entrelec Systron PS series, Phoenix Contact EG45-PS series, or approved equal.

E. Fuses:

1. Fused terminal blocks for DIN rail mounting or PC-board mounted fuse holders and fuses. Provide with hinged fuse holder and fusion indicator light.
2. Acceptable products: Phoenix Contact UK5-HESI, Entrelec M4/8 SD, or approved equal acceptable to the Engineer.

F. Snubbers:

1. RC-type transient voltage suppressor shall be used in all 120 VAC door lock or operator circuits to reduce switching transient to below 250 VAC.
2. Acceptable products: Square-D GT6, Rifa, or approved equal acceptable to the Engineer.

G. Surge Protectors:

1. Fused terminal blocks for DIN rail mounting or PC-board mounted fuse holders and fuses. Provide with hinged fuse holder and fusion indicator light.
2. Acceptable products: Phoenix Contact UK5-HESI, Entrelec M4/8 SD, or approved equal acceptable to the Owner.

H. Cable:

1. As shown on the Drawings and recommended by the manufacturer.

2.4 ACCESSORIES

A. Provide rack-mounting hardware for all rack mount equipment.

B. Software: Low Voltage System Specialty Contractor is responsible for providing, installing and modifying all software required for the system to meet the performance and operational specification of this Section and Related Sections.

PART 3- EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions

1. Low Voltage System Specialty Contractor shall visit the site and inspect the existing conditions. Verify existing rack and cabinet dimensions, accessibility, existing infrastructure, and all other aspects requiring Work or coordination by the Low Voltage System Specialty Contractor.
2. Review the existing wiring installation techniques to identify remedial actions necessary for reuse of field equipment and existing cabling. All field wiring shall be un-terminated from the existing system headend equipment and re-connected to the new system as required for operation.
3. Low Voltage System Specialty Contractor shall visit the site prior to bid to thoroughly familiarize itself with the existing conditions of the existing systems and space availability.

3.2 PROGRAMMING

A. Program using relay logic symbology.

1. Each rung shall have its own specific REM statement.
2. Each external wire shall be labeled in the program as to its color and number.
3. Each input and output shall be labeled as to its type and number.
4. Door control output shall be programmed to allow 1 second delay between door output energization for all group release functions. This group release shall be user definable. Refer to the Touch Screen Section for additional requirements.
5. Provide a 3 second (programmable) delay for all half cycle door locks when programmed for full cycle operation.
6. Upon a loss of power, faults or communication failures with Smart PLC input and output modules or PLC CPUs, all electric locks shall de-energize (fail-secure). Sliding and overhead doors shall remain in their present state.

3.3 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION

A. Special Techniques

1. Locate all control electronics Smart PLC's and I/O in wall cabinets.
2. All interlock logic shall be programmed. Do not use relays for this function. Include a 100ms delay in each interlock program line between the time when an associated door closes and other doors are enabled for control.
3. Confirm that door and gate motor controllers have protection that removes power after 2 times the period normally used to open or close the door or gate. If none exists, provide programming to automatically remove power and initiate a maintenance alarm.
4. Where motor controllers do not come equipped with a time-out function for the controls, provide PLC programming to automatically shut the motor off after 2 times the period by which the door or gate should have fully closed. All alarms shall then be indicated at the HMI.
5. Provide individual relays for each door control circuit. Each shall indicate status by a LED, flag, or other readily visible means.
6. Provide individual fuse(s) or circuit breaker(s) for each door Smart PLC output exceeding 60% of the output ampacity rating of the point. Each shall indicate status by a LED, flag, or other readily visible means. Each fuse shall be rated at 150% of the door locking mechanism inrush rating.
7. All terminal strips, circuit breakers, fuses, steering diodes, over-current protection diodes, and relays shall be DIN rail mounted.
8. Maintain signal separation in all racks.

    a. 2-inch separation between: Video, microphone level, line level audio, 25V audio, and all control cable.
    b. 6-inch separation between: 120 VAC cable an all Class 2 cable. Exception: Maintain 12-inch separation between 120VAC power cable and all microphone level or line level cable.

9. All desk mounted duress switches shall be equipped with a 12' cord.

    a. Each cord shall be equipped with a locking plug/jack.
    b. Each faceplate shall be located adjacent to the nearest telephone outlet in the space (equal in height and not more than 6" horizontal distance away).
    c. Each jack shall be mounted on to a faceplate. The color, material, and thickness of faceplates shall match the nearest telephone outlet faceplate.

B. Interface with Other Work

1. Interface with the Work of other Sections and Divisions as required.
2. Interface with the:

a. Touch Screen system.
b. Intercom and paging systems.
c. CCTV switching system.
d. CCTV quad multiplexing system.
e. CATV system.
f. Elevator system.
g. HVAC system.
h. Domestic water system.
i. Power distribution system.
j. Lighting distribution system.
k. Telephone distribution system.
l. Data distribution system.

C. Sequences of Operations

1. As required by related Sections.
2. Refer to the Basic Requirements and Touch Screen System Sections.

3.4 FIELD QUALITY CONTROL

A. Site Tests, Inspection:

1. After installation of the Door Control and Alarm Monitoring Equipment, and prior to point-by-point performance testing, functionally test all door monitoring switches, electric door locks/operators, and other hardware interconnections, and all interfaces to other systems, including intercommunication, control panels, video surveillance alarm functions. Fully coordinate with Door Hardware and Detention Equipment Contractors to adjust all magnetic switches, limit switches and other door hardware components – not Work of this Section, for proper operation.
2. Point-by-Point Performance Testing:

   a. Perform a thorough, device-by-device, operational test for all monitored and all controlled devices and discrete I/O.
   b. Provide system integration testing to confirm communications with Touch Screen system, CCTV switching system, CCTV quad multiplexing system, video archival system, access control system, and other interfaces. Demonstrate system operations and performance in accordance with Owner requirements and all previous Owner review comments.

3. If test results are not in compliance with requirements, make necessary changes, corrections, repairs or adjustments at no additional cost and arrange for another point-by-point performance test. This process shall continue until the systems are acceptable to the Owner.

3.5 DEMONSTRATION

A. Provide 4 hours of maintenance instruction. Seminars to be “hands on” held at the facility.

3.6 SCHEDULES

A. Refer to Schedules for Electronic Monitoring and Control and the drawings for schedules.

END OF SECTION 28